

5<sup>th</sup> July 2013

The General Manager  
Penrith City Council  
601 High Street  
PENRITH NSW 2760

**Attention:** Gavin Cherry

Dear Gavin,

**DEVELOPMENT APPLICATION (DA)  
PROPOSED VILLAGE CENTRE BULK EARTHWORKS, STORMWATER MANAGEMENT  
WORKS AND ASSOCIATED TREE REMOVAL, JORDAN SPRINGS, WESTERN PRECINCT,  
ST MARYS**

**1.0 INTRODUCTION**

This Statement of Environmental Effects (SEE) is submitted to Penrith City Council (PCC) in support of a Development Application (DA) for the proposed bulk earthworks, stormwater management works and associated tree removal on lot 3138 DP1168995 and lot 11 DP1176163 within Jordan Springs, Western Precinct, St. Marys.

This report has been prepared by the Applicant, Lend Lease (LL) as agent for Maryland Development Company.

This report should be read in conjunction with the following:

- DA form and application fees;
- Location Plan, prepared by Lend Lease (**Appendix A**);
- Existing Conditions Plan, prepared by Lend Lease (**Appendix B**);
- Tree Plan and Existing Tree Schedule, prepared by Lend Lease (**Appendix C**);
- Bulk Earthworks Plans for lot 3138 (future Residential / Education site), prepared by J. Wyndham Prince (**Appendix D**);
- Bulk Earthworks Plans for lot 3138 (future village oval site), prepared by J. Wyndham Prince (**Appendix E**);
- Bulk Earthworks Plans for lot 11 (future V12 residential site), prepared by J. Wyndham Prince (**Appendix F**);
- Waste Management Plan, prepared by Lend Lease (**Appendix G**); and
- Species Impact Statement (SIS), prepared by Cumberland Ecology (**Appendix H**).

This report describes the site and its environs, the proposed development and includes an assessment of the proposal in terms of the matters for consideration as listed under Section 79C(1) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Within this report, references to the 'subject site' mean the land to which this DA relates.



## 2.0 SITE LOCATION AND DESCRIPTION

### 2.1 Background

The St Marys site was endorsed by the NSW Government for inclusion on the Urban Development Program (UDP) in 1993. The St Marys site is located approximately 45km west of the Sydney CBD, 5km north-east of the Penrith City Centre and 12km west of the Blacktown City Centre.

The St Marys site has an area of approximately 1,545ha and is approximately 7km east to west and 2km north to south. The site is bounded by Forrester Road and Palmyra Avenue in the east, The Northern Road in the west, Ninth Avenue and Palmyra Avenue in the north and the Dunheved Industrial Area, Dunheved Golf Club and Cambridge Gardens, Werrington Gardens and Werrington County residential estates in the south.

The St Marys site, which has been rezoned for a variety of uses, comprises 6 development precincts – Western, Central, North and South Dunheved, Ropes Creek and Eastern Precincts. Developable areas within these Precincts are shown on Figure 1.



Figure 1 – St Marys Development Precincts



On 16 June 2003 the Minister for Infrastructure, Planning and Natural Resources announced the “release” of the Eastern, North and South Dunheved Precincts. Subsequently, on 29 September 2006, the Minister released the remaining precincts, allowing “Precinct Plans” to be released for each area.

A Precinct Plan for the Western Precinct (the WPP) and accompanying Development Control Strategy (DCS) were adopted by Penrith City Council on 23<sup>rd</sup> March 2009. Construction of roads, services, landscaping and housing has been undertaken. The WPP required the preparation and adoption by Council of a Concept Plan prior to the approval of any subdivision proposal within the Western Precinct. The Concept Plan provides the next level of specificity of detail in relation to the matters addressed in the WPP and is intended for use by Council as an assessment tool for the consideration of future DAs.

## **2.2 Site Description and Ownership**

The land to which this DA refers is the suburb of Jordan Springs which comprises the Western Precinct of the St Mary’s development. The site is owned by St Marys Land Limited and is being developed by Lend Lease under the name of Maryland Development Company.

The subject land of this DA is located on the following allotments:

- lot 3138 in DP1168995 (proposed future Residential / Education site);
- lot 3138 in DP1168995 (proposed future Village Oval site); and
- lot 11 in DP1176163 (proposed future Village 12 site).

For site context, refer to **Appendix A** for the Site Location Plan.

## **2.3 Relevant Western Precinct Subdivision DAs**

This DA will require consideration within the context of previous DAs lodged adjacent to the subject site (refer **Table 1**). The scope of each DA and its status is provided.

**Table 1- Associated Western Precinct subdivision DAs**

<b>Development Application</b>	<b>Proposal</b>	<b>Status</b>
Stage 3A subdivision application (DA11/0511)	139 Residential lots, 7 residue lots and public roads	Approved 15th August 2011
Stage 3B subdivision application (DA11/0512)	138 Residential lots, 1 public reserve, 3 residue lots and public roads	Approved 15th August 2011
Retail Site subdivision application (DA11/1047)	3 residue lots	Approved 19th December 2011
Childcare Centre and CRH subdivision application (DA11/1360)	1 Childcare Centre site, 1 Community Resource Hub site and 1 residue allotment	Approved 2nd March 2012
Stage 1H subdivision application (DA11/1333)	29 residential lots	Approved 3rd April 2012
Mixed Use site 4-lot subdivision application (DA12/0101)	1 Mixed Use Development site, 1 future road reserve and 2 residue allotments	Approved 15th May 2012
Temporary Builders Display Village Car Park (DA12/0291)	1 temporary car park for the Builders Display Village	Approved 26th June 2012
Living Street subdivision application (DA11/1094)	22 residential lots and public roads	Approved 10th October 2012
Riparian Corridor subdivision application (DA11/1088)	5 residue lots	Approved 13th November 2012
Trunk Sewer EIS (DA12/0910)	Construction of permanent sewer main	Approved 10th December 2012
Village 4 subdivision application (DA12/0897)	292 residential lots and public road	Approved 1st March 2013
Northern Road Oval landscape application (DA12/1363)	Landscape embellishment works	Approved 30th May 2013
Riparian Corridor Construction (DA13/0065)	Construction of Riparian Channel	Lodged 25th January 2013



### **3.0 DESCRIPTION OF PROPOSAL**

This section of the report provides a detailed description of the proposed development. Specifically, the proposed works include the following:

- Bulk earthworks and earth grading;
- Stormwater management works; and
- Tree removal.

#### **3.1 Location of subject site**

The subject site is located centrally in the Western Precinct. The proposed earthworks are to occur on the large and currently undeveloped allotments in an area to the North East of the Village Centre, which are proposed for a future residential / education site, a Village Oval and Village 12 future residential site. The individual sites are separated from each other by existing roads and a proposed Riparian Corridor.

The locality containing the three sites is bound on the Northern side by Greenwood Parkway, Village 2 to the East, and Lakeside Parade to the South, and the future Riparian Corridor and Lakeside Parade to the West.

Refer to the Site Location Plan at **Appendix A**.

#### **3.2 Existing site conditions**

The Existing Site Conditions plan is included at **Appendix B**.

There are existing trees on the site, some of which will require removal. All trees on site have been identified and are specified on the Tree Plan and Existing Tree Schedule in **Appendix C**.

#### **4.0 ASSESSMENT OF PLANNING ISSUES**

Section 79C(1) of the Environmental Planning and Assessment Act 1979 declares that the Consent Authority, in assessing a DA, must take into account a range of issues relevant to the proposal, including the suitability of the site, and the impacts of the site and surrounds imposed by the proposal.

The following matters are reviewed in accordance with the proposed subdivision.

#### **4.1 Flooding and Stormwater Drainage**

The Water, Soils and Infrastructure Report that forms part of the WPP and prepared by SKM contains an analysis of the existing water, drainage and soil characteristics of the Western Precinct. The report establishes that the site is not affected by the Probably Maximum Flood level from the Hawkesbury Nepean River system, or the 100 year ARI level in South Creek, located to the west of the subject site.

Temporary sedimentation basins are proposed to capture and treat stormwater runoff from each site. These are shown on the civil plans prepared by J. Wyndham Prince in the Appendices, including stormwater runoff calculations to demonstrate that the capacity of the basins is sufficient to cater for a 1 in 100 year rainfall event.

#### **4.2 Earthworks and Ground Contouring**

The bulk earthworks plans prepared by J. Wyndham Prince for each site are included in the Appendices. These plans demonstrate the extent of cut and fill on the site, the proposed surface levels and both the existing and ultimate proposed contours across the sites.

Each site is bound on three sides by existing roads, which provide the ultimate surface levels. The land will be graded to follow the natural slope of the land, taking into account the constructed road levels on the boundaries of these sites, and the top of bank levels for the Riparian Corridor, which accommodate the 1 in 100 year flood levels.

The fill will be sourced both from internal and external sites, however no fill material will be imported from outside of Jordan Springs without prior consultation with Council.

#### **4.3 Erosion and Sediment Control**

Erosion and sediment control measures are proposed in the bulk earthworks plans included in the Appendices. The proposed measures comprise:

- A sediment fence located around the sites as required;
- Geotextile filters and mesh and gravel filters at kerb inlet pits; and
- Temporary sediment ponds.

The proposed earthworks will include compaction of the soil to Council specifications to remove the risk of erosion.

#### **4.4 Soil Salinity**

The Soil and Water Management Plan contained within the Western Precinct Plan includes possible measures to address potential soil salinity issues, should they occur.

A salinity review has previously been undertaken for the entire Western Precinct by Geotech Testing Pty Ltd. This has been endorsed by Penrith City Council as part of previous DAs.

#### **4.5 Bushfire Management**

The subject site is identified as bushfire prone land. However, the subject application does not include subdivision of the land for residential purposes, and therefore is not considered integrated development requiring referral to NSW Rural Fire Service under Section 91 of the Environmental Planning and Assessment Act 1979.

#### **4.6 Explosive Ordnance Material**

In accordance with the Contamination Management Plan (CMP), processes are in place for when potential ordnance material is uncovered. These processes have previously been approved as part of the Western Precinct Plan by Penrith City Council.

#### **4.7 Noise and Operation**

Plant machinery required to undertake the proposed bulk earthworks will be the same as those used to undertake earthworks proposed in Subdivision DAs. Operation restrictions will be enforced in line with the *Interim Construction Noise Guidelines*, Australian Standards and Penrith City Council requirements, which includes the monitoring of noise levels and restriction of work hours.

Wide buffers generally exist between the proposed sites and existing residential areas. Where the subject sites adjoin Greenwood Parkway, approximately 20-25 existing dwellings front the road on the opposite side. The other areas which directly adjoin the subject sites are future residential areas, with dwellings yet to be constructed.

In accordance with the *Protection of the Environment Operations Act 1997*, the operating noise level of plant and equipment shall not exceed 5dB(A) above the background noise. Additionally, operations will be restricted to:

- Mondays to Fridays, 7am to 6pm; and
- Saturdays, 7am to 1pm (if inaudible on neighbouring residential properties, otherwise from 8am).

The noise and operation of the bulk earthworks is expected to occur on a sporadic basis, and for short periods of time.



#### **4.8 Access and Traffic**

Truck movements will be occurring on existing roads in the subdivision, which have existing capacity for a high number of truck movements per day. There will be no fixed route to and from the sites, as a result of the various source locations of the fill material, however the sites will not be accessed using the local residential streets.

It is anticipated that the transportation of fill will occur only sporadically and for short periods, and that the impact to the existing development will be minimal as a result.

#### **4.9 Tree Removal**

The proposal includes tree removal as part of the associated civil works to be undertaken on the developable land. The Tree Plan and Existing Tree Schedule are included at **Appendix C**, which identify the trees to be removed and the reasons for removal.

A number of trees located on the Village Oval site are identified for retention to allow for their utilisation as part of the design. The earthworks on the site also take into account the locations of trees to ensure that any alteration of the surrounding surface level is minimal to prevent the loss of these trees.

Trees to be removed are predominantly affected by fill levels depicted by the constructed roads surrounding the site, and the proposed Riparian Corridor design to mitigate the 1 in 100 year flood events.

#### **4.10 Ecology**

A Species Impact Statement (SIS) has been prepared by Cumberland Ecology and is included at **Appendix H**.

In summary, the SIS states that the proposed development will not have a significant adverse impact on the relevant threatened species and ecological communities. The subject site is vegetated by poor quality, exotic dominated derived native grassland which lacks habitat for most threatened native species, and, as a result of significant historic disturbance, is unlikely to naturally regenerate into woodland.

In addition, it is predicted in the SIS that the known occurrences of threatened flora and fauna on the site will be secure in the long term as a result of the dedication of the 900ha Regional Park.

#### **4.11 Heritage**

There are no identified European Heritage items located within the Western Precinct, as listed under SREP30.

An Aboriginal Heritage Assessment has previously been undertaken by Jo McDonald Cultural Heritage Management Pty Ltd, and an associated report produced in 2008 titled *Archaeological assessment of Indigenous Heritage values in the Western Precinct of the St. Marys Site, St*

*Marys*. Subsequently, an Aboriginal Heritage Impact Permit (AHIP) has been granted for the whole of the Western Precinct. The AHIP includes the subject development site. Regardless, there are no identified salvage sites located within the subject site.

#### **4.12 Contamination**

The St Marys Precinct has been subject to extensive investigation and remediation to ensure that the land is suitable for development. The Environmental Protection Agency (EPA), now DECCW, has been involved in the process of preparing the Site Audit Statements (SAS) for the Precinct. The specific SAS which encompasses the subject site is CHK001/1. A copy of this SAS has been submitted to Penrith City Council previously.

#### **4.13 Waste Management**

The Waste Management Plan (WMP) included at **Appendix G** will ensure that reuse and recycling of construction materials is maximised both on and off the site and that waste is minimised as far as practicable.

#### **4.14 Social and Economic Impacts**

The proposed bulk earthworks are undertaken as part of the process of developing urban land for residential purposes, as established under SREP30. The development framework established under SREP 30 is delivering economic development employment opportunities, provides further housing choice within the region that is well connected to education and community services, public transport, parks and open spaces.

Further, the proposed development will continue the utilisation of construction jobs as well as longer term economic benefits associated with flow on effects from establishing a new residential community.

#### **4.19 The public interest**

The proposed development is consistent with the Development Control Strategy and Western Precinct Plan. These documents have been subject to public exhibition and assessment by Penrith City Council, leading to its subsequent adoption. The proposal represents Council's planning objectives for the Western Precinct.

## **5.0 DEVELOPMENT ASSESSMENT UNDER RELEVANT PLANNING INSTRUMENTS AND CONTROLS**

Section 79C(1) of the Environmental Planning and Assessment Act states that the consent authority must take into account a range of matters relevant to the development in determining an application, and specifically the provisions of environmental planning instruments.

The following planning instruments and documents are relevant to the proposed development:

- St Marys Development Agreement and St Marys Penrith Planning Agreement (The Deed);
- Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30);
- St Marys Environmental Planning Strategy (St Marys EPS);
- Western Precinct Plan (including Development Control Strategy and Concept Plan); and
- Penrith Development Control Plan 2006 (DCP).

The following assessment of these instruments only includes those matters under Section 79C(1) that are relevant to the proposal. These planning instruments have been used to determine the social, economic and natural and built environmental impacts.

### **5.1 St. Marys Development Agreement and St Marys Penrith Planning Agreement**

The proposed development is consistent with, and facilitates the implementation of the local and regional services defined in the Agreements. There are no specific requirements which relate to bulk earthworks. Additionally, there are no thresholds which are achieved subsequent to the approval of the subject DA that trigger any obligations in the Agreements.

### **5.2 Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30)**

SREP 30 contains planning objectives, principles and provisions to control development within the Precincts shown in figure 1. Overall, the proposed subdivision is not inconsistent with the achievement of the performance or zone objectives, and reflects the aims of the development control strategies of SREP 30.

Clause 50 in Part 7 allows Council to grant consent to the filling of land where Council is satisfied that:

- The proposed development will not be inconsistent with the principles set out in the manual entitled *Floodplain Development Manual: the management of flood liable land* published by the New South Wales Government;
- In the case of land identified on the Structure Plan as “potential fill area”, the proposed development will not be inconsistent with the performance objectives of this plan; and
- In the case of land not identified on the Structure Plan as “potential fill area” but within the Regional Open Space zone or the Road and Road Widening Zone, the proposed development is necessary as part of development to be carried out on the land.





The proposal is consistent with the principles in Clause 50 because:

- The subject site is not located on land defined as “floodplain”, and therefore the *Floodplain Development Manual* does not apply;
- The subject site is not located in an area identified as a “potential fill area” on the SREP30 Structure Plan; and
- The subject site is not located within the Regional Open Space Zone or the Road and Road Widening Zones.

The proposal is consistent with the remaining clauses in SREP30, and does not prevent the future achievement of these clauses as part of future development applications, particularly the performance objectives in Part 5.

Additionally, the proposed development is consistent with the objectives of the Urban zone specified in Clause 40, as the works on the site will enable the future development of the land for purposes which are consistent with the Urban Zone.

### **5.3 St Marys Environmental Planning Strategy (St Marys EPS)**

The St Marys EPS establishes guidelines and strategies for the future development of land under SREP 30, specifically in relation to matters of conservation, cultural heritage, water cycle and soils, transport, urban form, energy and waste, human services, employment and contamination.

These guidelines and objectives reflect those included within SREP 30, of which the proposed development is generally compliant. Additionally, the proposal facilitates the implementation of the strategies which have been put in place to achieve the performance objectives for the site.

The proposal will not prevent the future achievement of the objectives in the St. Marys EPS.

### **5.4 St Marys Western Precinct Plan (WPP) and Development Control Strategy (DCS)**

The Western Precinct Plan (WPP) identifies the distribution of major land uses including the location and function of open space and public facilities within the Western Precinct.

The DCS contains specific development standards for urban design, built form and environmental management to ensure the implementation of the development principles as specified in the WPP.

The proposal is consistent with the aims and objectives of the WPP and DCS. Additionally, the proposed bulk earthworks will not impact the development of land for residential purposes, or affect the achievement of the vision for the City of Penrith and Western Precinct Development.

Specifically, the proposal complies with the WPP and DCS by achieving the objectives as follows:

- Implementation of soil and water management measures to prevent erosion;
- Retention of trees on the site where practical; and
- Facilitates further development on these allotments in accordance with the WPP and DCS by creating an adequate building foundation and platform on each site.

#### **5.5 Penrith Development Control Plan 2006 (DCP)**

The 2006 DCP was amended in 2010, however the subject site is located on land which was excluded from the Penrith Development Control Plan 2010. Where the Precinct Plan does not specify development objectives, the DCP will provide guiding principles.

A review of the relevant criteria of the Penrith Development Control Plan 2006 confirms that the proposed development is consistent with the relevant controls and objectives of all Parts in the 2006 DCP, particularly as follows:

- The erosion and sediment control measures detailed in the civil plans included in the Appendices, which addresses the controls in the City Wide Controls in Part 2; and
- An approval for tree removal is sought as part of the subject development application.

## **6.0 Conclusion**

The proposed development is consistent with the objectives and controls within the planning instruments relevant to this site.

The proposal is in accordance with the Development Control Strategy and Western Precinct Plan, and supports Council's planning objectives for the Western Precinct. Under SREP 30 objectives, the proposal is permissible with consent according to clause 50.

In light of the merits of the proposal, and in absence of any significant adverse environmental, social or economic impacts, we request that the application be approved, subject to appropriate conditions of consent.

Should you require further clarification on any of the above items or require additional plans or documentation, please do not hesitate to contact me on 0439 094 730.

Yours faithfully,



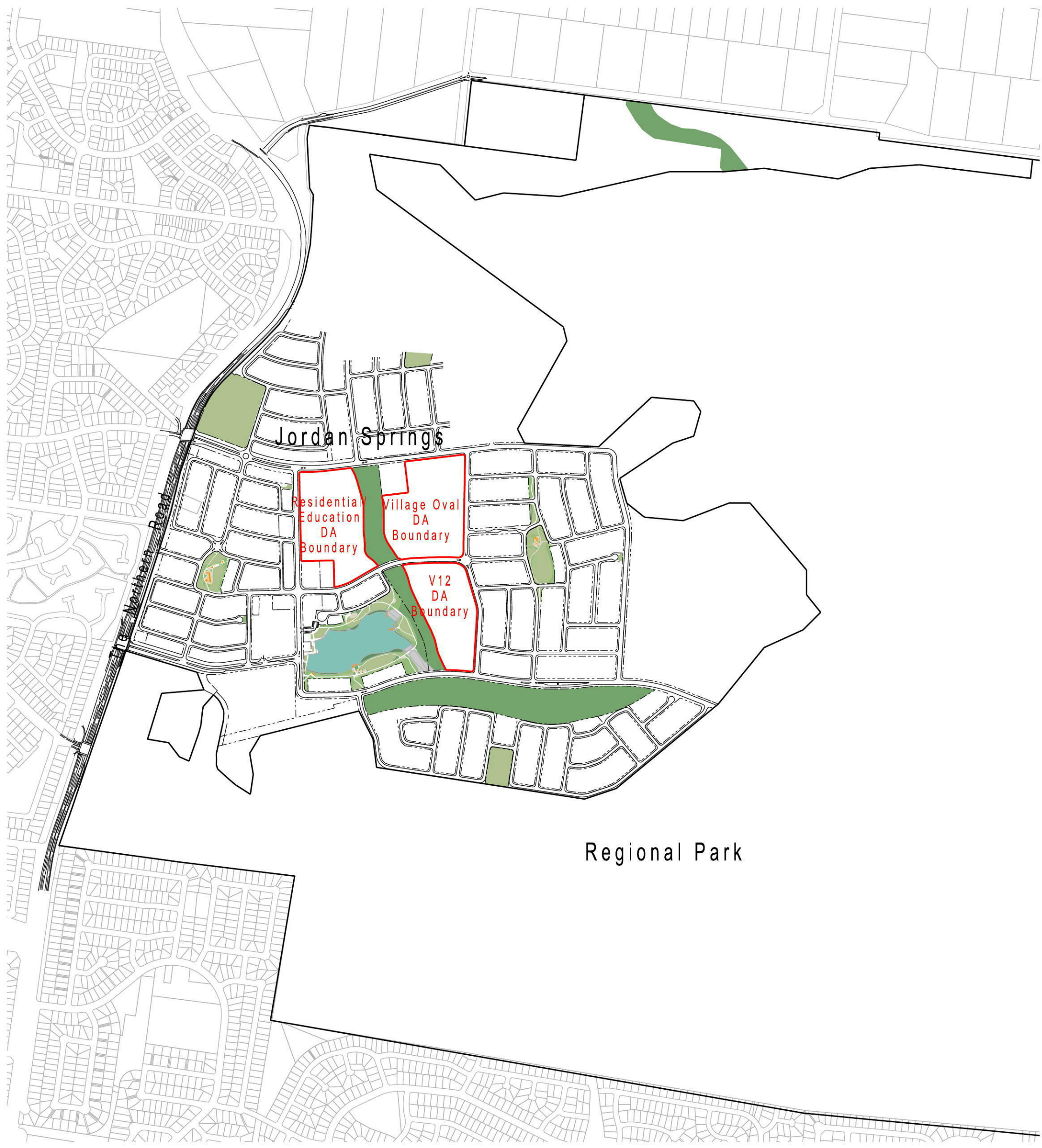
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**Angus Fulton**  
**Statutory Planner NSW / ACT**  
**COMMUNITIES**

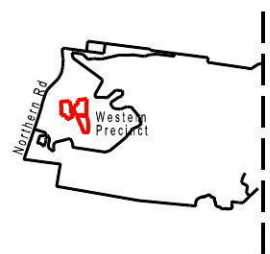




**Appendix A**  
Location Plan, prepared by Lend Lease




KEY PLAN



NOTES

Issue	Amendment	Date
A	Council Submission Issue	20.06.13

NOTES

 Indicative Village Boundary

Developer



Development Manager: Lend Lease Development Pty Ltd

Project



Drawing Title

Village Centre  
 Bulk Earthworks DA  
 Location Plan

Scale AT A3 1:10000  
 Drawn by RS/LM  
 Drawing No. WP VCBE Loc



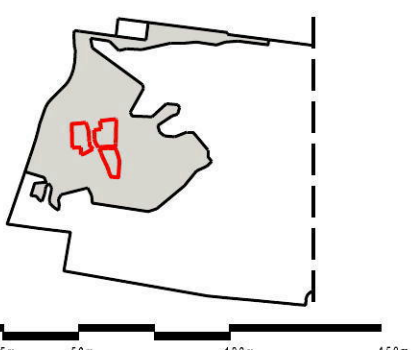


**Appendix B**  
Existing Conditions Plan, prepared by Lend Lease





KEY PLAN



NOTES

Issue	Amendment	Date
A	Council Lodgement Issue	20.06.13

LEGEND

- DA Boundary
- Existing contour
- Top of bank
- Bottom of bank
- Existing tree
- Existing road

Developer

**Lend Lease**  
 Ropes Crossing Boulevard,  
 Ropes Crossing NSW 2760  
 p.02 9673 8800 f.02 9673 8888  
 ABN 88 000 966 085 ©

Development Manager: Lend Lease Development Pty Ltd

Project

**JORDANSPRINGS**

Drawing Title  
**Village Centre  
 Bulk Earthworks DA**

**Existing Conditions Plan**

Scale AT A3 1:2500  
 Drawn by RAS  
 Drawing Number WP VCBE EC



Issue A










**Appendix C**  
Tree Plan and Existing Tree Schedule, prepared by Lend Lease



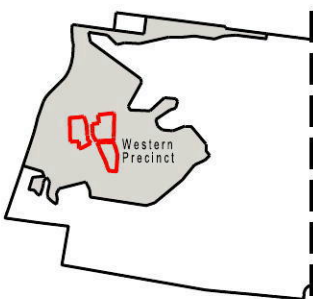
-  Tree to be Retained
-  Tree to be Removed

All Trees to be Removed unless otherwise shown

Tree Significance

-  AA - high ecological/high landscape
-  AB - high ecological/moderate landscape
-  BB - moderate ecological/moderate landscape
-  BC - moderate ecological/low landscape
-  CC - low ecological/low landscape

KEY PLAN



NOTES

Issue	Amendment	Date
A	Council Lodgement Issue	20.06.13

LEGEND

-  DA Boundary

Developer

**Lend Lease**

Ropes Crossing Boulevard,  
Ropes Crossing NSW 2760  
p.02 9673 8600 f.02 9673 8888  
ABN 88 000 966 085 ©

Development Manager: Lend Lease Development Pty Ltd

Project



Drawing Title  
Village Centre  
Bulk Earthworks DA

Tree Plan

Scale AT A3 1:2500  
Drawn by RAS  
Drawing Number WP VCBE TP



Issue A



Jordans Springs Village Centre  
Bulk Earthworks DA

TREE TAG NO.	SPECIES	TO BE RETAINED	TRUNK DIA.	CANOPY SPREAD	TREE HEIGHT	NO OF TRUNKS	A. High	B. Mod.	C. Low	A. High	B. Mod.	C. Low	3. Comments
							1. Ecological Significance			2. Landscape Significance			
1672	Eucalyptus tereticornis	YES	0.90	18	21			Y				Y	
1675	Eucalyptus molucanna	YES	0.80	16	23		Y			Y			
1676	Eucalyptus tereticornis	YES	0.70	14	21				Y			Y	
1678	Eucalyptus molucanna	YES	0.80	16	22		Y			Y			
1679	Eucalyptus tereticornis	YES	0.90	18	19		Y			Y			
1696	Eucalyptus molucanna	YES	0.80	22	24		Y			Y			
1697	Eucalyptus molucanna	YES	0.80	16	23			Y			Y		
1698	Eucalyptus molucanna	NO	0.40	6	23				Y			Y	Within future playing field, impacts from earthworks levels.
1699	Eucalyptus tereticornis	NO	0.70	14	25				Y			Y	Within future playing field, impacts from earthworks levels.
1700	Eucalyptus tereticornis	NO	1.10	22	26			Y			Y		Within future playing field, impacts from earthworks levels.
1701	Eucalyptus tereticornis	NO	0.90	20	24			Y			Y		Within future playing field, impacts from earthworks levels.
1763	Eucalyptus tereticornis	NO	0.90	18	25			Y			Y		Within future playing field, impacts from earthworks levels.
1764	DEAD	NO	1.00	14	26								Within future playing field, impacts from earthworks levels.
1795	Eucalyptus molucanna	NO	0.40	10	19		Y				Y		Impacts from earthworks levels.
1796	Eucalyptus molucanna	NO	0.40	8	19		Y				Y		Impacts from earthworks levels.
1797	Eucalyptus molucanna	NO	0.40	6	22		Y				Y		Impacts from earthworks levels.
1798	Eucalyptus molucanna	NO	0.4 & 0.4	10	19		Y				Y		Impacts from earthworks levels.
1799	Eucalyptus molucanna	NO	0.50	8	20		Y			Y			Impacts from earthworks levels.
1800	Eucalyptus molucanna	NO	0.80	12	23		Y			Y			Impacts from earthworks levels.
1801	DEAD	NO	0.70	14	19								Impacts from earthworks levels.
1814	Eucalyptus molucanna	NO	0.40	8	15				Y			Y	Impacts from earthworks levels.
1975	Eucalyptus crebra	NO	0.60	8	21		Y			Y			Impacts from earthworks levels.
1979	Eucalyptus tereticornis	NO	0.70	6	9		Y			Y			Impacts from earthworks levels.
1980	Eucalyptus molucanna	NO	0.40	8	9			Y				Y	Impacts from earthworks levels.
3663	Eucalyptus molucanna	YES	0.70	15	15		Y				Y		
4376	Eucalyptus tereticornis	NO	0.60	12	22		Y			Y			Impacts from earthworks levels.
10569	Eucalyptus tereticornis	NO	0.25	4	9			Y			Y		Within future playing field, impacts from earthworks levels.
10570	Eucalyptus tereticornis	NO	0.25	7	10				Y			Y	Within future playing field, impacts from earthworks levels.
10571	Eucalyptus tereticornis	NO	0.20	5	10				Y			Y	Within future playing field, impacts from earthworks levels.
10572	Eucalyptus tereticornis	NO	0.20	6	10				Y			Y	Within future playing field, impacts from earthworks levels.
10573	Eucalyptus molucanna	NO	0.20	5	9				Y			Y	Within future playing field, impacts from earthworks levels.
10574	Eucalyptus tereticornis	NO	0.25	7	12				Y			Y	Within future playing field, impacts from earthworks levels.
10575	Eucalyptus molucanna	NO	0.25	7	13	4			Y			Y	Within future playing field, impacts from earthworks levels.
<b>SUMMARY OF EXISTING TREES WITHIN VILLAGE CENTRE BULK EARTHWORKS DA</b>													
NO. OF EXISTING TREES (Excluding Dead)		31	100%										
NO. OF EXISTING TREES TO BE RETAINED		8	26%										
NO. OF EXISTING TREES TO BE REMOVED		23	74%										



**Appendix D**

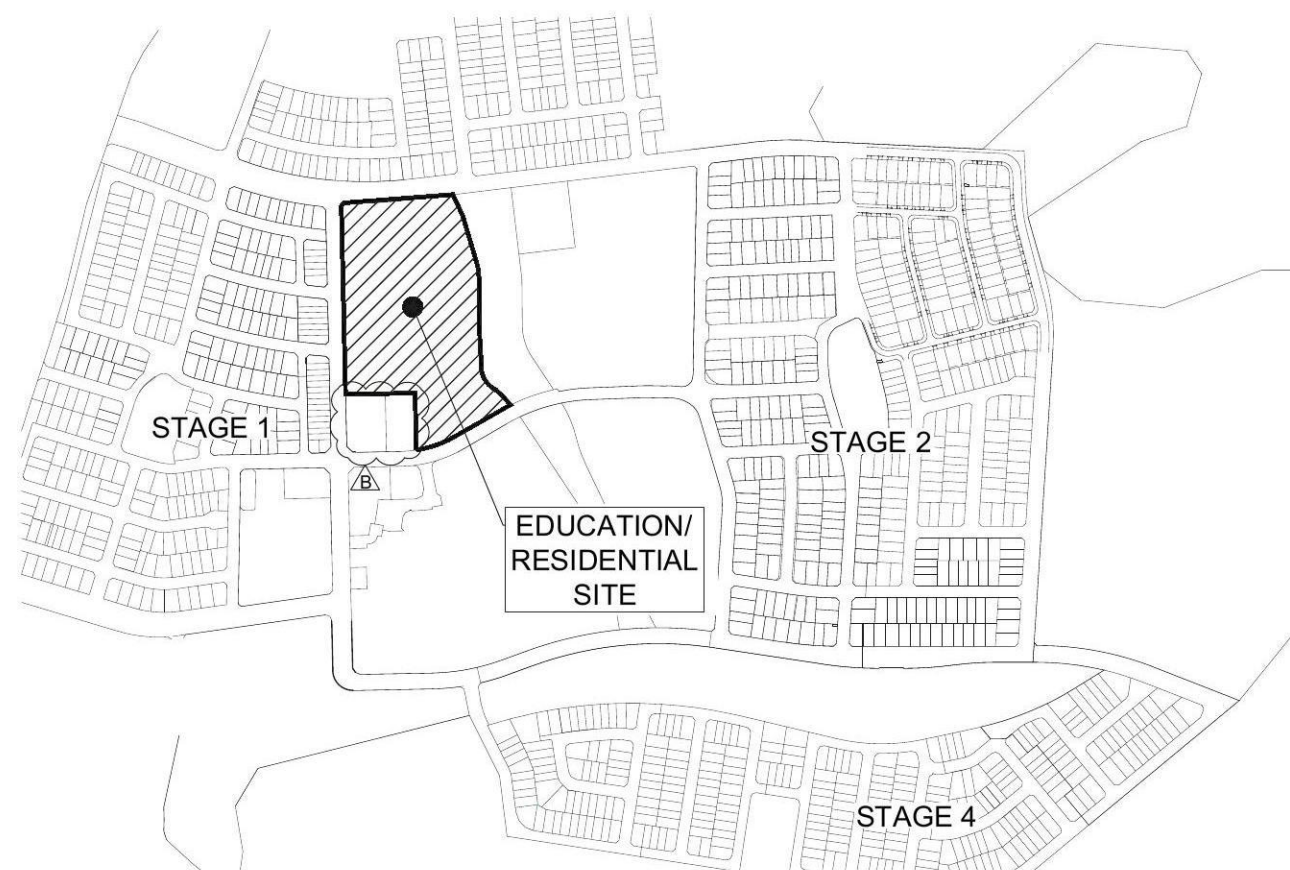
Bulk Earthworks Plans for lot 3138 (future Residential / Education site), prepared by J. Wyndham Prince



PENRITH CITY COUNCIL



JORDAN SPRINGS - EDUCATION/RESIDENTIAL SITE  
DEVELOPMENT APPLICATION/CONSTRUCTION CERTIFICATE  
PROPOSED BULK EARTHWORKS



LOCALITY SKETCH

Prepared By:

**J. WYNDHAM PRINCE**

CONSULTING CIVIL INFRASTRUCTURE ENGINEERS  
& PROJECT MANAGERS

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ISSUED FOR CONSTRUCTION APPROVAL

PLAN No. 9343/06DA01 B

FILE No. 934306DA01

Plotfile: 25 June, 2013 4:09:20 PM File Name: J:\9343\EDUCATION SITE\IDA - Development Application Approval Plans\934306DA02.dwg

LEGEND			
DESCRIPTION	PROPOSED	EXISTING	FUTURE
EXTENT OF WORKS			
KERB & GUTTER			
MOUNTABLE KERB			
INTEGRAL KERB / DISH CROSSING			
LOT BOUNDARY			
PRAM RAMP			
FOOTPATH			
CYCLEWAY			
DRAINAGE LINE, PIT & EASEMENT			
DRAINAGE LINE & PIT			
HEADWALL			
EXTENT OF CUT			
EXTENT OF FILL			
CONTOURS			
CATCH DRAIN			
ELECTRICITY, POWER POLE			
TELECOM, BOX			
WATER, STOP VALVE, HYDRANT			
SEWER, MANHOLE			
GAS			
TREES TO BE RETAINED			
TREES TO BE REMOVED			
SURVEY MARKS - BENCH MARKS			
STATE SURVEY MARKS			
ROAD NAMES	ROAD 18	ROAD 18	ROAD 18
STAGE LABELS	STAGE 3B	STAGE 3B	STAGE 3B
STAGE BOUNDARY			
SUBSOIL DRAINAGE			
BATTER TICKS			
BATTER EXTENTS			
STABILISED SITE ACCESS			
SEDIMENT FENCE			
STRAW BALE BARRIER			
PROTECTIVE FENCING			
MESH AND GRAVEL INLET FILTER			
GEOTEXTILE INLET FILTER			
STREET SIGNS			

### GENERAL NOTES:

- ALL WORKS ARE TO BE IN ACCORDANCE WITH PENRITH COUNCIL'S "STANDARD SPECIFICATION FOR ENGINEERING WORKS".
- SURVEY MARKS:-
  - STATE SURVEY MARKS SHOWN THUS SHALL BE SET IN TOP OF THE KERB AS IT IS BEING LAID, BY THE CONTRACTOR, IN THE INDICATED LOCATIONS. MARKS SHALL BE SUPPLIED BY THE PROJECT SURVEYOR.
  - SURVEY MARKS SHOWN THUS SHALL BE RETAINED AT ALL TIMES. WHERE RETENTION IS NOT POSSIBLE THE SUPERINTENDENT MUST BE NOTIFIED AND CONSENT RECEIVED PRIOR TO THEIR REMOVAL.
- THE CONTRACTOR SHALL LOCATE AND LEVEL ALL EXISTING SERVICES PRIOR TO COMMENCING CONSTRUCTION AND MAKE ARRANGEMENTS WITH THE RELEVANT AUTHORITY TO RELOCATE OR ADJUST IF NECESSARY.
- THE CONTRACTOR SHALL NOT ENTER UPON NOR DO ANY WORK WITHIN ADJACENT LANDS WITHOUT THE WRITTEN PERMISSION OF THE OWNERS. TO BE PROVIDED PRIOR TO THE APPROVAL OF THE PLANS.
- THE CONTRACTOR SHALL MAINTAIN SERVICES AND ALL WEATHER ACCESS AT ALL TIMES TO ADJOINING PROPERTIES.
- COUNCIL'S TREE PRESERVATION ORDER MUST BE OBSERVED AND NO TREE SHALL BE FELLED, LOPPED OR REMOVED WITHOUT THE PRIOR APPROVAL OF COUNCIL'S ENGINEER.
- TREES TO BE RETAINED ON SITE SHALL BE PROTECTED BY SUITABLE STURDY APPROVED PROTECTIVE FENCING PRIOR TO COMMENCEMENT OF SITE WORKS.
- THE CONTRACTOR SHALL CLEAR THE SITE BY REMOVING ALL RUBBISH, FENCES OUT-HOUSES, CAR BODIES AND DEBRIS ETC.
- PUBLIC RESERVE AREAS SHALL BE CLEARED OF UNDERGROWTH, IMPROVEMENTS AND FENCES AS DIRECTED BY THE ENGINEER.
- FILLING IS TO BE FROM A NOMINATED SOURCE, OF SOUND CLEAN MATERIAL, FREE FROM LARGE ROCK, STUMPS, CONTAMINATED MATTER, INDUSTRIAL AND BUILDING WASTE, ORGANIC MATTER AND OTHER DEBRIS. PLACING OF FILLING ON THE PREPARED AREAS SHALL NOT COMMENCE UNTIL THE AUTHORITY TO DO SO HAS BEEN OBTAINED FROM THE COUNCIL.
- SITE FILL AREAS:- THE CONTRACTOR SHALL TAKE LEVELS OF EXISTING SURFACE AFTER STRIPPING TOPSOIL AND PRIOR TO COMMENCING FILL OPERATIONS.
- ALL SITE FILLING TO BE COMPACTED TO 95% STANDARD COMPACTION AND SHALL BE CONTROLLED BY A REGISTERED SOIL LABORATORY IN ACCORDANCE WITH COUNCIL'S "WORKS SPECIFICATION".
- ALL SITE REGRADING AREAS SHALL BE GRADED AT A MINIMUM 1% TO THE ENGINEERS REQUIREMENTS
- SURPLUS EXCAVATED MATERIAL SHALL BE PLACED WHERE DIRECTED BY THE SUPERINTENDENT.
- ALL NEW WORKS SHALL MAKE A SMOOTH JUNCTION WITH EXISTING CONDITIONS.
- DIMENSIONS OF ANY DETAIL SHALL NOT BE SCALED - DIMENSIONS, IF IN DOUBT, SHALL BE VERIFIED BY THE SUPERINTENDENT.
- ALL CONSTRUCTION AND RESTORATION WORK ON COUNCIL'S ROAD AND FOOTPATH AREA ARE TO BE CARRIED OUT IN ACCORDANCE WITH THE APPROVED DRAWINGS AND COUNCIL'S STANDARD SPECIFICATIONS.
- FOR SETOUT PURPOSES CONTACT J. WYNDHAM PRINCE FOR ELECTRONIC DATA FILE.

### SURVEY SET OUT INFORMATION NOTES:

- ALL SITE SET OUT AND CONTROL POINTS ARE TO MGA COORDINATES AND AHD.
- THE INFORMATION DETAILED ON THE CERTIFIED CONSTRUCTION CERTIFICATE PLANS TAKES PRECEDENCE OVER ALL ASSOCIATED ELECTRONIC FILES PROVIDED. THE ORDER OF PRIORITY FOR USE OF CONSTRUCTION CERTIFICATE PLANS & ASSOCIATED ELECTRONIC FILES PROVIDED IS AS FOLLOWS:
  - CERTIFIED CONSTRUCTION CERTIFICATE DRAWINGS
  - 2D DRAFTING BASE (ELECTRONIC FILE)
  - 3D DTM (ELECTRONIC FILE) IF PROVIDED
- ANY DISCREPANCY BETWEEN ANY OF THE INFORMATION CONTAINED WITHIN THESE FILES IS TO BE BROUGHT TO THE ATTENTION OF THE SUPERINTENDENT WHO WILL SEEK CLARIFICATION AND ISSUE INSTRUCTIONS ON THE APPROPRIATE COURSE OF ACTION.

SURVEYED BY:  
WHELANS INSITES PTY LTD  
CAD REFERENCE: D646-DET-001.DWG  
DATE FEB 2010



UTILITIES SHOWN ARE DIAGRAMMATIC ONLY. CONTRACTORS ARE RESPONSIBLE TO LOCATE AND AVOID DAMAGE TO THEM AS SPECIFIED BY EACH UTILITIES EXCAVATION GUIDE LINES & STANDARDS. NOTE: UTILITIES SHOWN MAY NOT INCLUDE ALL SERVICES AFFECTED AREAS

### CIVIL PLAN INDEX

PLAN NO.	PLAN NAME	REV
9343/06DA01	COVER SHEET	B
9343/06DA02	NOTES AND LEGEND	A
9343/06DA03	BULK EARTHWORKS PLAN	B
9343/06DA04	SITE SECTIONS	A
9343/06DA05	SOIL AND WATER MANAGEMENT PLAN	B
9343/06DA06	SLOPE ANALYSIS PLAN	B

### EXISTING SURFACE NOTES:

WORK AS EXECUTED SURVEY WAS NOT AVAILABLE AT THE TIME OF DESIGN. THE CONTRACTOR IS TO VERIFY SITE LEVELS AND EARTHWORKS VOLUMES PRIOR TO CONSTRUCTION.

ISSUED FOR COUNCIL APPROVAL	PAS	PAS	DJH	SA	06/06/13
AMENDMENT	DES	DRN	CKD	APR	DATE

**J. WYNDHAM PRINCE** CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

PO Box 4366 PENRITH WESTFIELD NSW 2750  
P 02 4720 3300 F 02 4721 7638 W www.jwprince.com.au E jwp@jwprince.com.au

AZIMUTH: MGA  
DATUM: AHD  
ORIGIN:

CLIENT:

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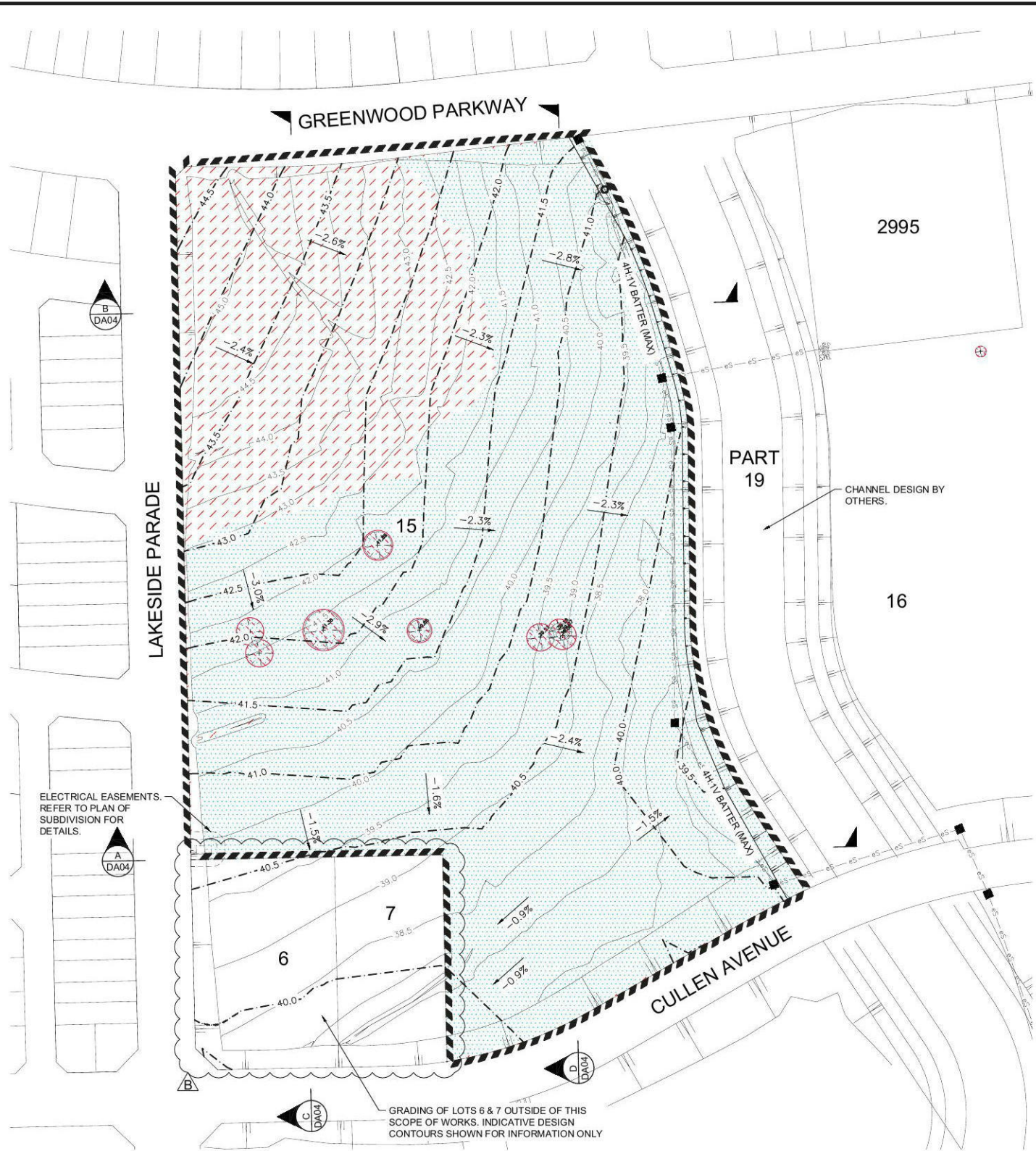
**ISSUED FOR CONSTRUCTION APPROVAL**

JORDAN SPRINGS EDUCATION SITE  
BULK EARTHWORKS  
NOTES AND LEGEND

PLAN No:	9343/06DA02	A
FILE No:	934306DA02	
SHEET SIZE:	A1 ORIGINAL	

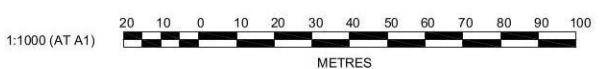


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**WARNING!**  
 UNDERGROUND SERVICE CABLES IN VICINITY. EXERCISE EXTREME CAUTION DURING EXCAVATION. CONTACT "DIAL BEFORE YOU DIG" PRIOR TO ANY CONSTRUCTION WORK.

- NOTES:**
1. NO GEOTECHNICAL REPORT WAS AVAILABLE AT THE TIME OF DESIGN.
  2. CONTRACTOR IS TO ALLOW FOR STRIPPING OF TOPSOIL IN ACCORDANCE WITH THE GEOTECHNICAL REPORT.
  3. DESIGN CONTOURS SHOWN ARE FINISHED SURFACE LEVELS. THE CONTRACTOR IS TO ALLOW FOR TOPSOIL RE-SPREAD IN ACCORDANCE WITH COUNCIL'S CONSTRUCTION SPECIFICATION AND THE GEOTECHNICAL REPORT.
  4. NO WAE SURVEY WAS AVAILABLE AT THE TIME OF DESIGN. THE CONTRACTOR IS TO VERIFY ALL LEVELS AND EARTHWORKS QUANTITIES PRIOR TO CONSTRUCTION.
  5. SEWER MANHOLE ADJUSTMENTS BY OTHERS AS REQUIRED.



AMENDMENT	DES	DRN	CKD	APR	DATE
B	PAS	TG	DJH	SA	25/08/13
A	PAS	PAS	DJH	SA	06/06/13

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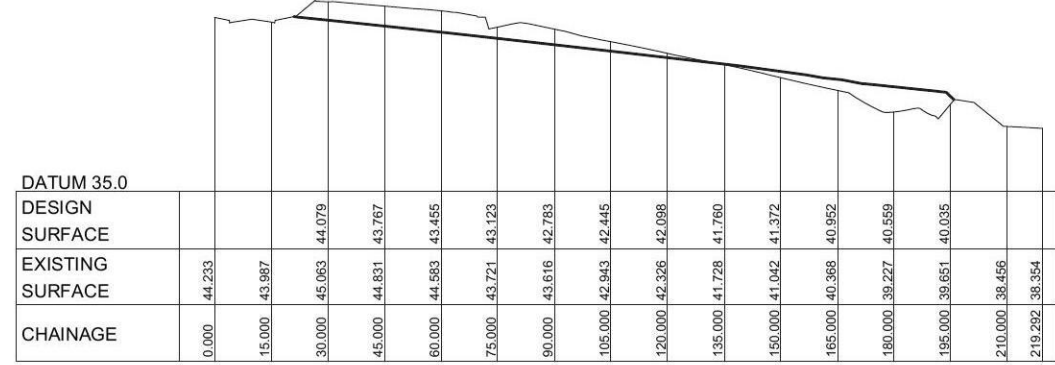
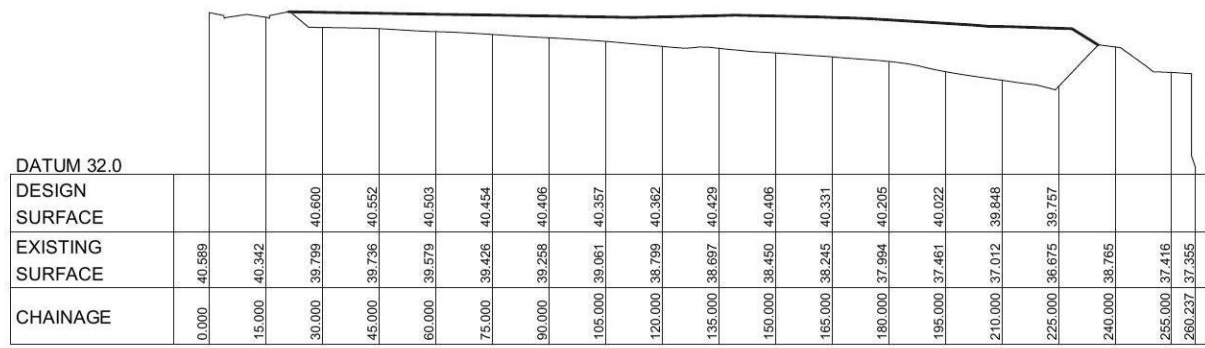
**ISSUED FOR CONSTRUCTION APPROVAL**

JORDAN SPRINGS EDUCATION SITE  
 BULK EARTHWORKS  
 BULK EARTHWORKS PLAN

PLAN No: 9343/06DA03 **B**  
 FILE No: 934306DA03  
 SHEET SIZE: A1 ORIGINAL

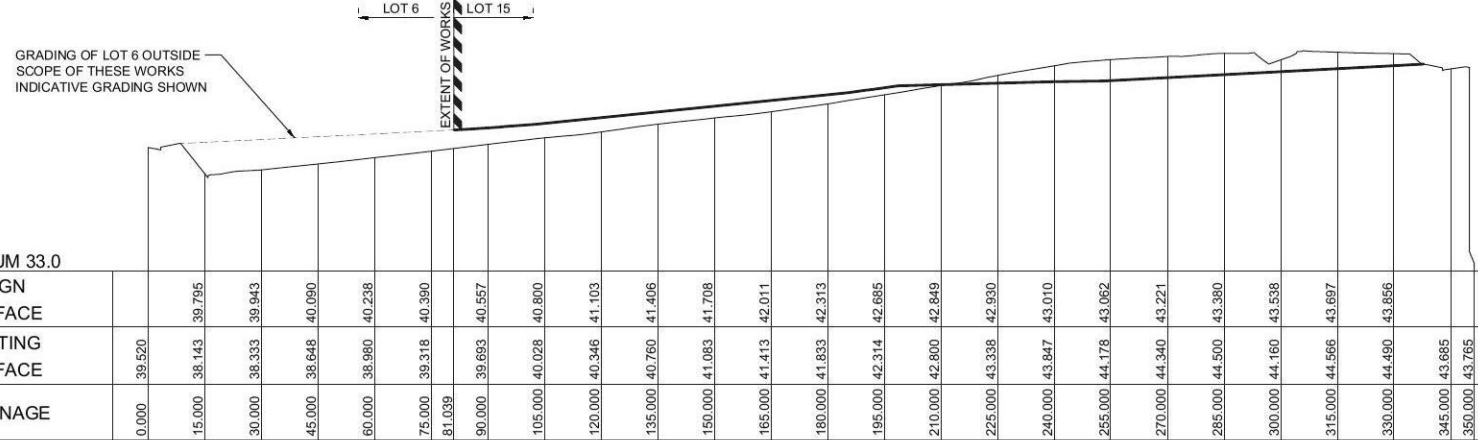


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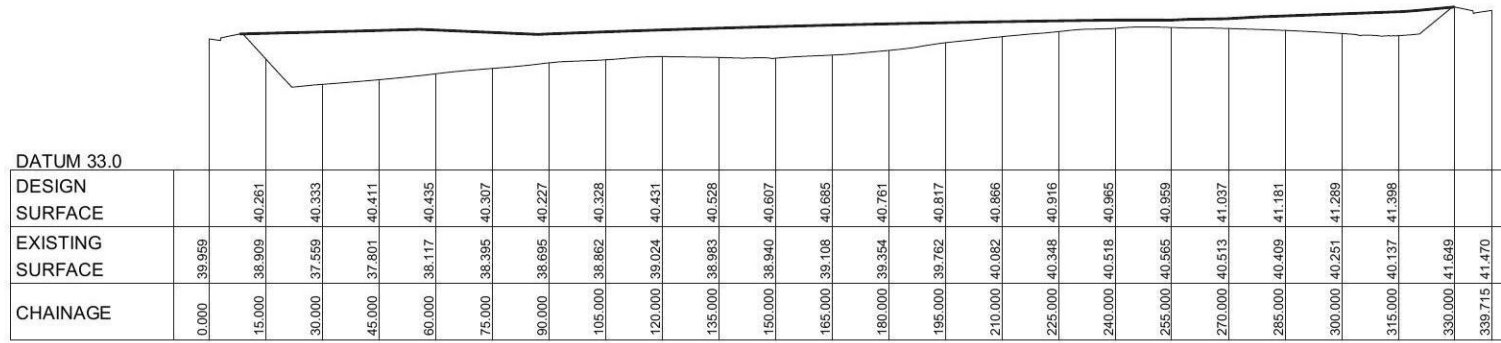


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V 1:200  
DA03

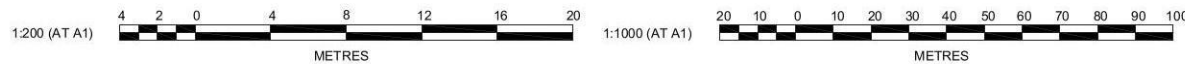
**SECTION B**  
SCALE H 1:1000  
V 1:200  
DA03



**SECTION C**  
SCALE H 1:1000  
V 1:200  
DA03



**SECTION D**  
SCALE H 1:1000  
V 1:200  
DA03



A	ISSUED FOR COUNCIL APPROVAL	PAS	PAS	DJH	SA
	AMENDMENT	DES	DRN	CKD	APR
					DATE
					06/06/13

**J. WYNDHAM PRINCE** CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

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AZIMUTH: MGA  
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ORIGIN:

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**ISSUED FOR CONSTRUCTION APPROVAL**

JORDAN SPRINGS EDUCATION SITE  
BULK EARTHWORKS  
SITE SECTIONS

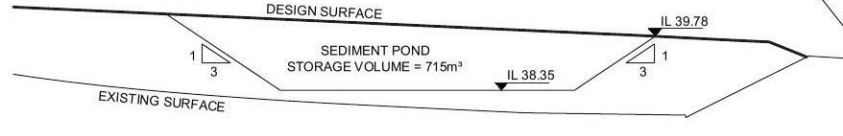
PLAN No: 9343/06DA04 **A**  
FILE No: 934306DA04  
SHEET SIZE: A1 ORIGINAL





**LEGEND**

- SEDIMENT FENCE
- GEOTEXTILE INLET FILTER
- MESH & GRAVEL INLET FILTER
- S.P. STOCKPILE



B	CLIENT AMENDMENTS	PAS	TG	DJH	SA	25/06/13
A	ISSUED FOR COUNCIL APPROVAL	PAS	PAS	DJH	SA	08/08/13
	AMENDMENT	DES	DRN	CKD	APR	DATE

**J. WYNDHAM PRINCE** CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

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**1. Site Data Sheet**

Site Name: Jordan Springs  
 Site Location: Education Site  
 Precinct:  
 Description of Site: Temporary Basin for Bulk Earthworks

Site area	Site	Remarks
Total catchment area (ha)	6	
Disturbed catchment area (ha)	6	

**Soil analysis**

% sand (fraction > 0.075 mm)	50	Soil texture should be assessed through mechanical dispersion only. Dispersing agents (e.g. CaCl <sub>2</sub> ) should not be used.
% silt (fraction 0.002 to 0.075 mm)	50	
% clay (fraction finer than 0.002 mm)	100.0	Clay content is not to be used.
Dispersion percentage	75	Clay content is not to be used.
% of silt and clay dispersible	75	See Section 6.3.3(a)
Soil Texture Group	D	See Section 6.3.3(c), (d) and (e)

**Rainfall data**

Design rainfall depth (days)	5	See Sections 6.3.4 (d) and (e)
Design rainfall depth (percentile)	75	See Sections 6.3.4 (f) and (g)
x-day, y percentile rainfall event	21.8	See Section 6.3.4 (h)
Rainfall intensity: 2 year, 6 hour storm	10.3	See IFO chart for the rate

**RUSLE Factors**

Rainfall erosivity (R-factor)	2300	Automatic calculation from above data
Soil erodibility (K-factor)	0.038	
Slope length (m)	240	
Slope gradient (%)	2	RUSLE data can be obtained from Appendix A, B and C
Length/gradient (L.S-factor)	0.84	
Erosion control practice (P-factor)	1.3	1.3 1.3 1.3 1.3 1.3 1.3
Groundcover (C-factor)	1	1 1 1 1 1 1 1

**Calculations**

Soil loss (t/ha/yr)	74	
Soil Loss Class	1	See Section 4.4.2(b)
Soil loss (m <sup>3</sup> /ha/yr)	57	
Sediment basin storage volume, m <sup>3</sup>	58	See Sections 6.3.4(d) and 6.3.5 (a)

**2. Storm Flow Calculations**

Peak flow is given by the Rational Formula:

$$Q_p = 0.00278 \times C_{10} \times F_y \times I_{y,tc} \times A$$

where:

- $Q_p$  is peak flow rate (m<sup>3</sup>/sec) of average recurrence interval (ARI) of "Y" year
- $C_{10}$  is the runoff coefficient (dimensionless) for ARI of 10 years. Rural runoff coefficients are given in Volume 2, figure 5 of Pilgrim (1998), while urban runoff coefficients are given in Volume 1, Book VIII, figure 1.13 of Pilgrim (1998) and construction r
- $F_y$  is a frequency factor for "Y" years. Rural values are given in Volume 1, Book IV, Table 1.1 of Pilgrim (1998) while urban coefficients are given in Volume 1, Book VIII, Table 1.6 of Pilgrim (1998)
- $A$  is the catchment area in hectares (ha)
- $I_{y,tc}$  is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration ( $t_c$ ) =  $0.76 \times (A/100)^{0.38}$  hrs (Volume 1, Book IV of Pilgrim, 1998)

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 60 per cent.

**Peak flow calculations, 1**

Site	A (ha)	tc (min)	Rainfall intensity, I, mm/hr						C <sub>10</sub>
			1 <sub>yr</sub>	5 <sub>yr</sub>	10 <sub>yr</sub>	20 <sub>yr</sub>	50 <sub>yr</sub>	100 <sub>yr</sub>	
6	6	15	40.3	63	95	110	130	145	0.78

**Peak flow calculations, 2**

ARI (yr)	Frequency (f <sub>y</sub> )	Peak flows					Comment
		6 (m <sup>3</sup> /s)	5 (m <sup>3</sup> /s)	10 (m <sup>3</sup> /s)	20 (m <sup>3</sup> /s)	50 (m <sup>3</sup> /s)	
1 yr	0.8	0.500					
5 yr	0.95	1.000					
10 yr	1	1.204					
20 yr	1.05	1.454					
50 yr	1.15	1.695					
100 yr	1.2	2.208					

**4. Volume of Sediment Basins, Type D and Type F Soils**

Basin volume = settling zone volume + sediment storage zone volume

**Settling Zone Volume**

The settling zone volume for Type F and Type D soils is calculated to provide capacity to contain all runoff expected from up to the y percentile rainfall event. The volume of the basin's settling zone (V) can be determined as a function of the basin's:

$$V = 10 \times C_s \times A \times R_{x,se,y,ns} \times 10^{-6} \text{ (m}^3\text{)}$$

where:

- 10 = a unit conversion factor
- $C_s$  = the volumetric runoff coefficient defined as the portion of rainfall that runs off as stormwater over the x-day period
- $R_{x,se,y,ns}$  = the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events (See Sections 6.3.4(d), (e), (f), (g) and (h))
- A = total catchment area (ha)

**Sediment Storage Zone Volume**

In the detailed calculation on Soil Loss Classes 1 to 4 lands, the sediment storage zone can be taken as 50 percent of the settling zone capacity. Alternatively designers can design the zone to store the 2 month soil loss as calculated by the RUSLE (Section 6.3.5)

Place an "X" in the box below to show the sediment storage zone design parameters used here:

50% of settling zone capacity.  
 2 months soil loss calculated by RUSLE

**Total Basin Volume**

Site	C <sub>s</sub>	R <sub>x,se,y,ns</sub>	Total catchment area (ha)	Settling zone volume (m <sup>3</sup> )	Sediment storage volume (m <sup>3</sup> )	Total basin volume (m <sup>3</sup> )
6	0.50	21.8	6	64	58	712

**GENERAL NOTES:**

- ALL EROSION AND SEDIMENT CONTROL MEASURES, INCLUDING REVEGETATION AND STORAGE OF SOIL AND TOPSOIL, SHALL BE IMPLEMENTED TO THE REQUIREMENTS OF THE "ENVIRONMENT PROTECTION AUTHORITY" AND "DEPT OF LAND AND WATER CONSERVATION". MEASURES OUTLINED IN THE SOIL & WATER MANAGEMENT PLAN MUST BE IMPLEMENTED PRIOR TO AND MAINTAINED DURING AND AFTER THE CONSTRUCTION WORKS.
- TOPSOIL FROM ALL AREAS TO BE DISTURBED SHALL BE STOCKPILED AND LATER RESPREAD TO AID REVEGETATION IN THOSE AREAS. ALL DRAINAGE WORKS SHALL BE CONSTRUCTED AND STABILIZED AS EARLY AS POSSIBLE DURING DEVELOPMENT.
- ALL TAIL-OUT DRAINS SHALL BE GRASSED AND TRAPEZOIDAL IN SECTION. STRAW BALES SHALL BE PLACED AS A SEDIMENT CONTROL DEVICE WHERE REQUIRED.
- VEHICULAR TRAFFIC SHALL BE CONTROLLED DURING DEVELOPMENT CONFINING ACCESS WHERE POSSIBLE TO PROPOSED OR EXISTING ROAD ALIGNMENTS. AREAS TO BE LEFT UNDISTURBED SHALL BE MARKED OFF.
- DISTURBANCE OF VEGETATION SHALL BE LIMITED TO FILL AREAS, ROADWAYS AND DRAINAGE LINES. NO LOT GRADING SHALL BE CARRIED OUT IN UNDISTURBED AREAS WITHOUT CONSULTATION WITH COUNCIL'S ENGINEER.
- ALL DISTURBED AREAS SHALL BE RE-VEGETATED WITHIN 14 WORKING DAYS FROM THE CONCLUSION OF LAND SHAPING.
- MINIMISE DUST BY WATERING WHEN REQUIRED.

**STOCKPILE NOTES:**

- SPOIL AND TOPSOIL STOCKPILES SHALL BE LOCATED AWAY FROM DRAINAGE LINES AND AREAS WHERE WATER MAY CONCENTRATE.
- IF STOCKPILES ARE TO BE IN PLACE FOR LONGER THAN 14 DAYS THEN THEY SHALL BE STABILIZED BY COVERING WITH A MULCH OR WITH TEMPORARY VEGETATION.
- FOLLOWING CONSTRUCTION, TOPSOIL SHALL BE RESPREAD TO A MINIMUM DEPTH OF 100mm ON THE BARE SOIL SURFACES AND REVEGETATE.
- ALL STOCKPILES TO BE (MAX) 2m HIGH AND PROTECTED WITH SILT FENCE.

**SPECIAL NOTES:**

- LOCATION AND EXTENT OF SOIL AND WATER MANAGEMENT DEVICES IS DIAGRAMMATIC ONLY AND THE ACTUAL REQUIREMENTS SHALL BE CONFIRMED ON SITE.
- REFER TO "MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION" -4TH EDITION FOR TYPICAL DETAILS OF STANDARD SEDIMENT AND EROSION CONTROL DEVICES.
- THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE GUIDELINES SET OUT IN "MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION" -4TH EDITION AND THE ACCOMPANYING ROAD AND DRAINAGE PLANS.
- CONFORMITY WITH THIS PLAN SHALL IN NO WAY REDUCE THE RESPONSIBILITY OF THE CONTRACTOR TO PROTECT AGAINST WATER DAMAGE DURING THE COURSE OF THE CONTRACT.
- MANAGEMENT DEVICES SHALL BE MAINTAINED ON A REGULAR BASIS. WHERE CLEANING IS REQUIRED, THE SEDIMENT SHALL BE REMOVED TO A POINT NOMINATED BY THE ENGINEER.
- PRIOR TO THE COMMENCEMENT OF ANY EARTHWORKS, AND AFTER THE ROAD CENTRELINES HAVE BEEN PEGGED AND/OR PERMANENTLY MARKED, THE SITE MUST BE INSPECTED BY COUNCIL'S REPRESENTATIVE AND THE APPLICANT'S REPRESENTATIVE TO IDENTIFY AND APPROPRIATELY MARK:-  
 a) THE TREES TO BE RETAINED.  
 b) ALL TREES TO BE LEFT UNDISTURBED AND TO BE CORDONED OFF.
- NO TREES SHALL BE REMOVED WITHOUT COUNCIL'S CLEARANCE.
- MANAGEMENT DEVICES TO REMAIN UNTIL THE END OF THE MAINTENANCE PERIOD.
- THE TEMPORARY BASIN IS TO REMAIN BE DECOMMISSIONED ONCE THE SITE IS RE-VEGETATED AND ESTABLISHED.

**SEDIMENTATION CONTROL DEVICES:**

ALL STRAW BALES SHALL BE BOUND WITH WIRE. STRAW BALES SHALL BE PLACED END TO END IN A SINGLE ROW AND EMBEDDED INTO THE SOIL TO A DEPTH OF 100mm. EACH BALE SHALL BE SECURELY ANCHORED WITH TWO STEEL STAKES DRIVEN 450mm INTO THE GROUND AND LOCATED ON THE BALE CENTRE LINE. SILT FENCES SHALL BE CONSTRUCTED BY STRETCHING A FILTER FABRIC (PROPEX OR SIMILAR) BETWEEN POSTS AT 2m (3m MAX) CENTRES. FABRIC SHALL BE BURIED 150mm ALONG ITS LOWER EDGE.

CLIENT:

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**ISSUED FOR CONSTRUCTION APPROVAL**

JORDAN SPRINGS EDUCATION SITE  
 BULK EARTHWORKS  
 SOIL AND WATER MANAGEMENT PLAN

PLAN No: 9343/06DA05 **B**  
 FILE No: 934306DA05  
 SHEET SIZE: A1 ORIGINAL



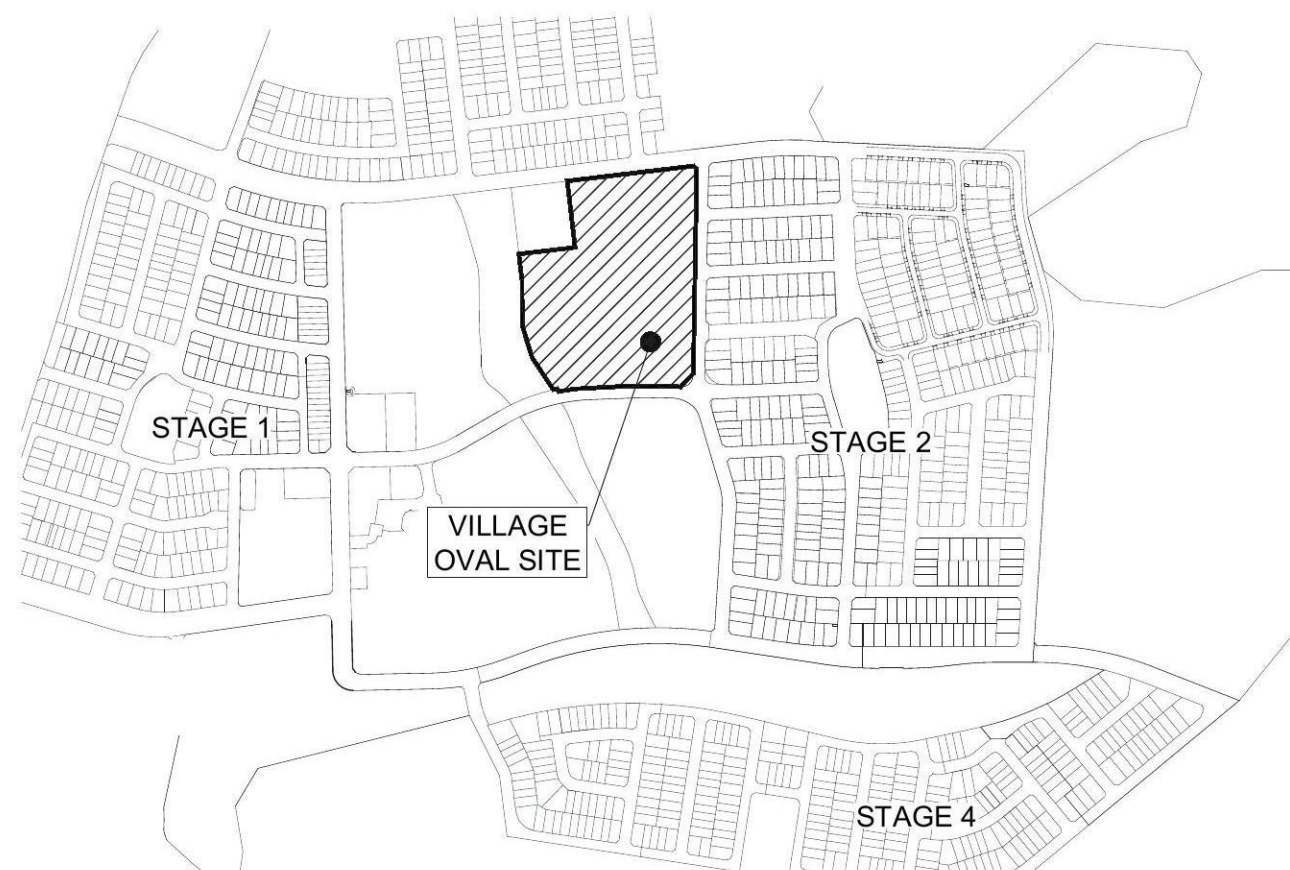


**Appendix E**  
Bulk Earthworks Plans for lot 3138 (future village oval site), prepared by J. Wyndham Prince

PENRITH CITY COUNCIL



JORDAN SPRINGS - VILLAGE OVAL SITE  
DEVELOPMENT APPLICATION/CONSTRUCTION CERTIFICATE  
PROPOSED BULK EARTHWORKS



LOCALITY SKETCH

Prepared By:

**J. WYNDHAM PRINCE**

CONSULTING CIVIL INFRASTRUCTURE ENGINEERS  
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PLAN No.  
9343/07DA01 A  
FILE No. 934307DA01

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- SURVEY MARKS:-
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- TREES TO BE RETAINED ON SITE SHALL BE PROTECTED BY SUITABLE STURDY APPROVED PROTECTIVE FENCING PRIOR TO COMMENCEMENT OF SITE WORKS.
- THE CONTRACTOR SHALL CLEAR THE SITE BY REMOVING ALL RUBBISH, FENCES OUT-HOUSES, CAR BODIES AND DEBRIS ETC.
- PUBLIC RESERVE AREAS SHALL BE CLEARED OF UNDERGROWTH, IMPROVEMENTS AND FENCES AS DIRECTED BY THE ENGINEER.
- FILLING IS TO BE FROM A NOMINATED SOURCE, OF SOUND CLEAN MATERIAL, FREE FROM LARGE ROCK, STUMPS, CONTAMINATED MATTER, INDUSTRIAL AND BUILDING WASTE, ORGANIC MATTER AND OTHER DEBRIS. PLACING OF FILLING ON THE PREPARED AREAS SHALL NOT COMMENCE UNTIL THE AUTHORITY TO DO SO HAS BEEN OBTAINED FROM THE COUNCIL.
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- ALL SITE FILLING TO BE COMPACTED TO 95% STANDARD COMPACTION AND SHALL BE CONTROLLED BY A REGISTERED SOIL LABORATORY IN ACCORDANCE WITH COUNCIL'S "WORKS SPECIFICATION".
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- FOR SETOUT PURPOSES CONTACT J. WYNDHAM PRINCE FOR ELECTRONIC DATA FILE.

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SURVEYED BY:  
WHELANS INSITES PTY LTD  
CAD REFERENCE: D646-DET-001.DWG  
DATE FEB 2010



UTILITIES SHOWN ARE DIAGRAMMATIC ONLY. CONTRACTORS ARE RESPONSIBLE TO LOCATE AND AVOID DAMAGE TO THEM AS SPECIFIED BY EACH UTILITIES EXCAVATION GUIDE LINES & STANDARDS. NOTE: UTILITIES SHOWN MAY NOT INCLUDE ALL SERVICES AFFECTED AREAS

### CIVIL PLAN INDEX

PLAN NO.	PLAN NAME	REV
9343/07DA01	COVER SHEET	A
9343/07DA02	NOTES AND LEGEND	A
9343/07DA03	BULK EARTHWORKS PLAN	A
9343/07DA04	SITE SECTIONS	A
9343/07DA05	SOIL AND WATER MANAGEMENT PLAN	A

### EXISTING SURFACE NOTES:

WORK AS EXECUTED SURVEY WAS NOT AVAILABLE AT THE TIME OF DESIGN. THE CONTRACTOR IS TO VERIFY SITE LEVELS AND EARTHWORKS VOLUMES PRIOR TO CONSTRUCTION.

NO.	DESCRIPTION	PAS	PAS	MS	SA	17/06/13
		DES	DRN	CKD	APR	DATE
A	ISSUED FOR COUNCIL APPROVAL					
	AMENDMENT					

**J. WYNDHAM PRINCE** CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

PO Box 4366 PENRITH WESTFIELD NSW 2750  
P 02 4720 3300 F 02 4721 7638 W www.jwprince.com.au E jwp@jwprince.com.au

AZIMUTH: MGA  
DATUM: AHD  
ORIGIN:

CLIENT:

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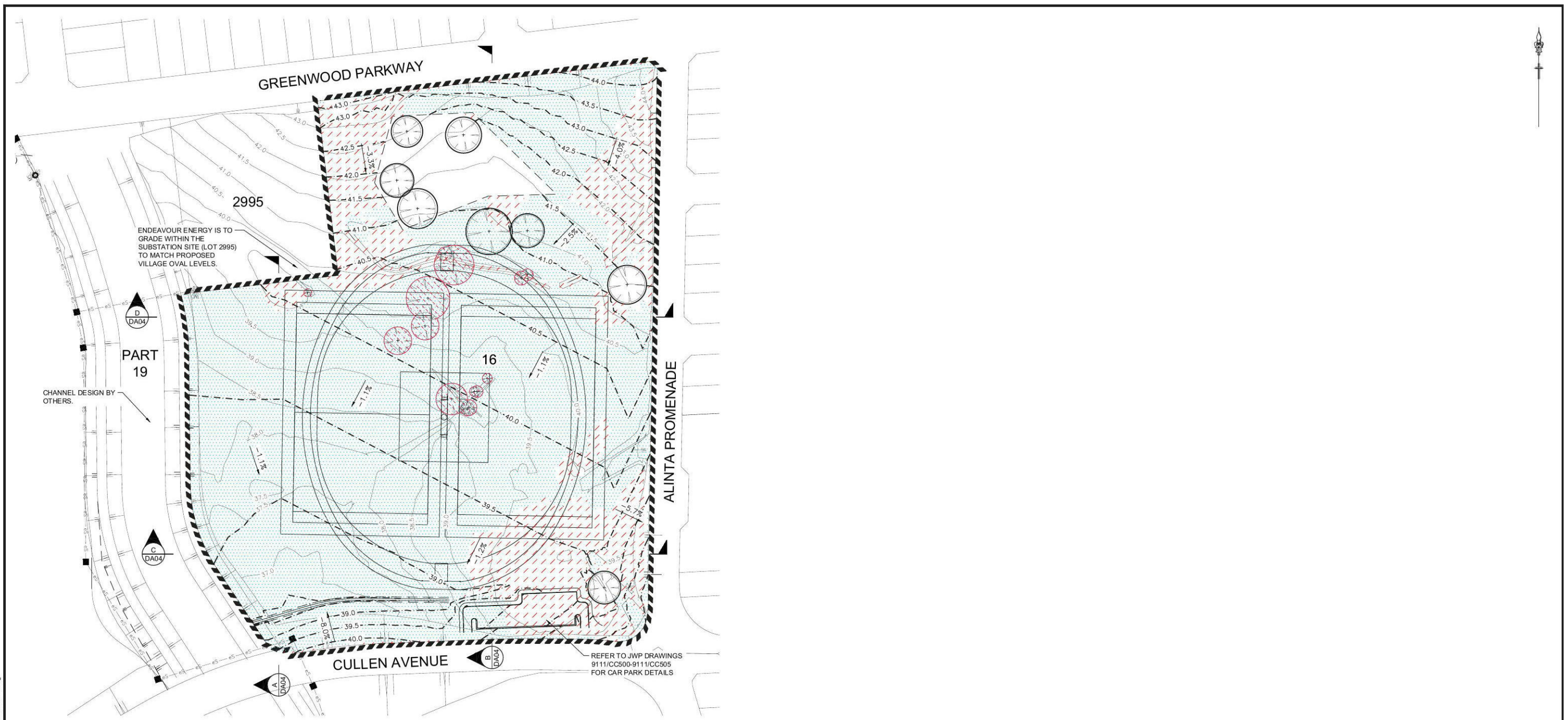
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JORDAN SPRINGS EDUCATION SITE  
BULK EARTHWORKS  
NOTES AND LEGEND

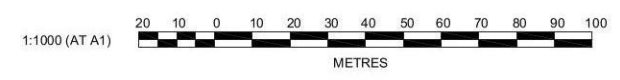
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SHEET SIZE:	A1 ORIGINAL	



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- NOTES:**
1. NO GEOTECHNICAL REPORT WAS AVAILABLE AT THE TIME OF DESIGN.
  2. CONTRACTOR IS TO ALLOW FOR STRIPPING OF TOPSOIL IN ACCORDANCE WITH THE GEOTECHNICAL REPORT.
  3. DESIGN CONTOURS SHOWN ARE FINISHED SURFACE LEVELS. THE CONTRACTOR IS TO ALLOW FOR TOPSOIL RE-SPREAD IN ACCORDANCE WITH COUNCIL'S CONSTRUCTION SPECIFICATION AND THE GEOTECHNICAL REPORT.
  4. NO WAE SURVEY WAS AVAILABLE AT THE TIME OF DESIGN. THE CONTRACTOR IS TO VERIFY ALL LEVELS AND EARTHWORKS QUANTITIES PRIOR TO CONSTRUCTION.
  5. SEWER MANHOLE ADJUSTMENTS BY OTHERS AS REQUIRED.



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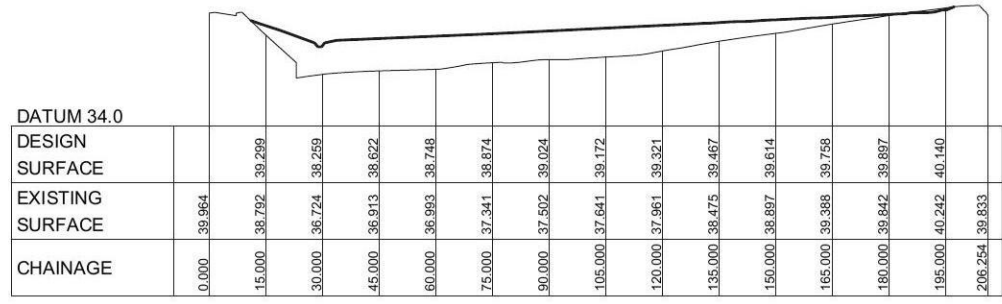
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 BULK EARTHWORKS  
 BULK EARTHWORKS PLAN

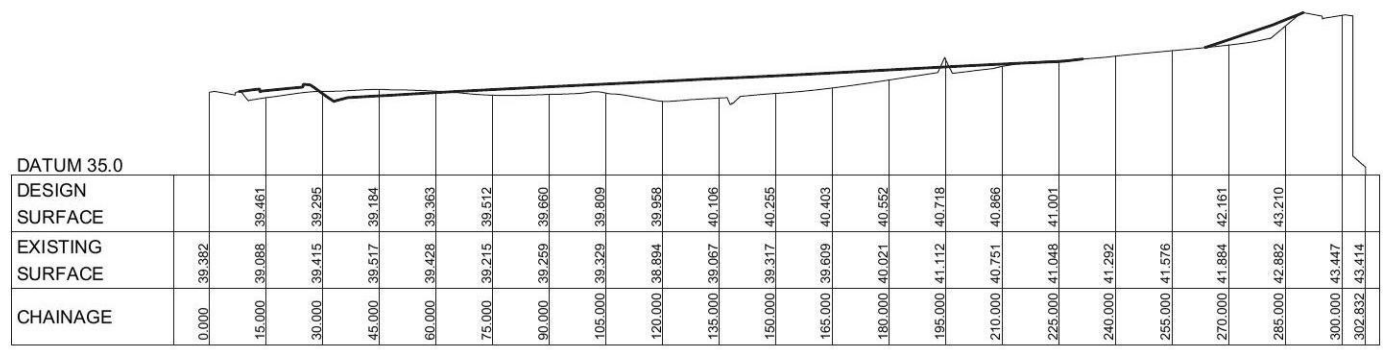
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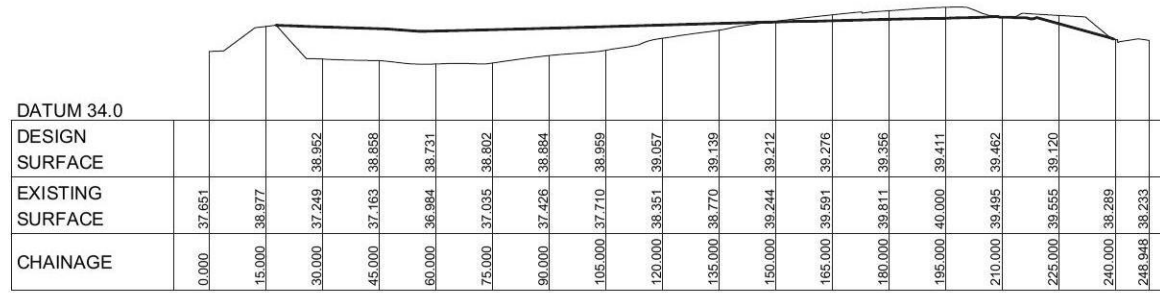
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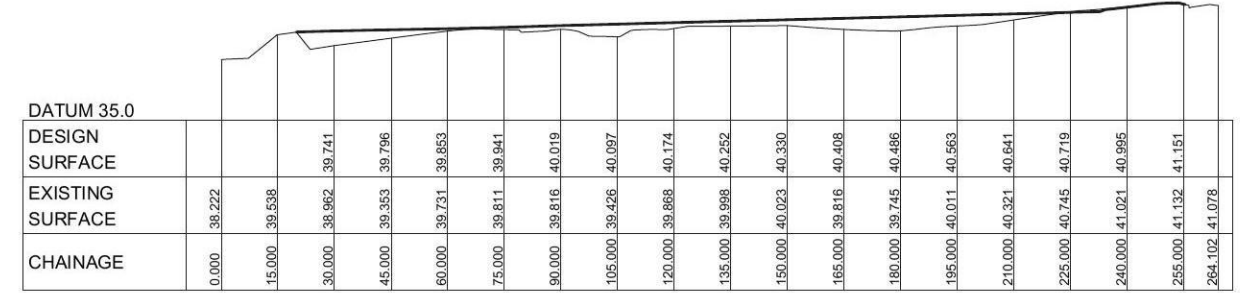
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V 1:200



**SECTION B**  
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V 1:200



**SECTION C**  
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V 1:200



**SECTION D**  
SCALE H 1:1000  
V 1:200



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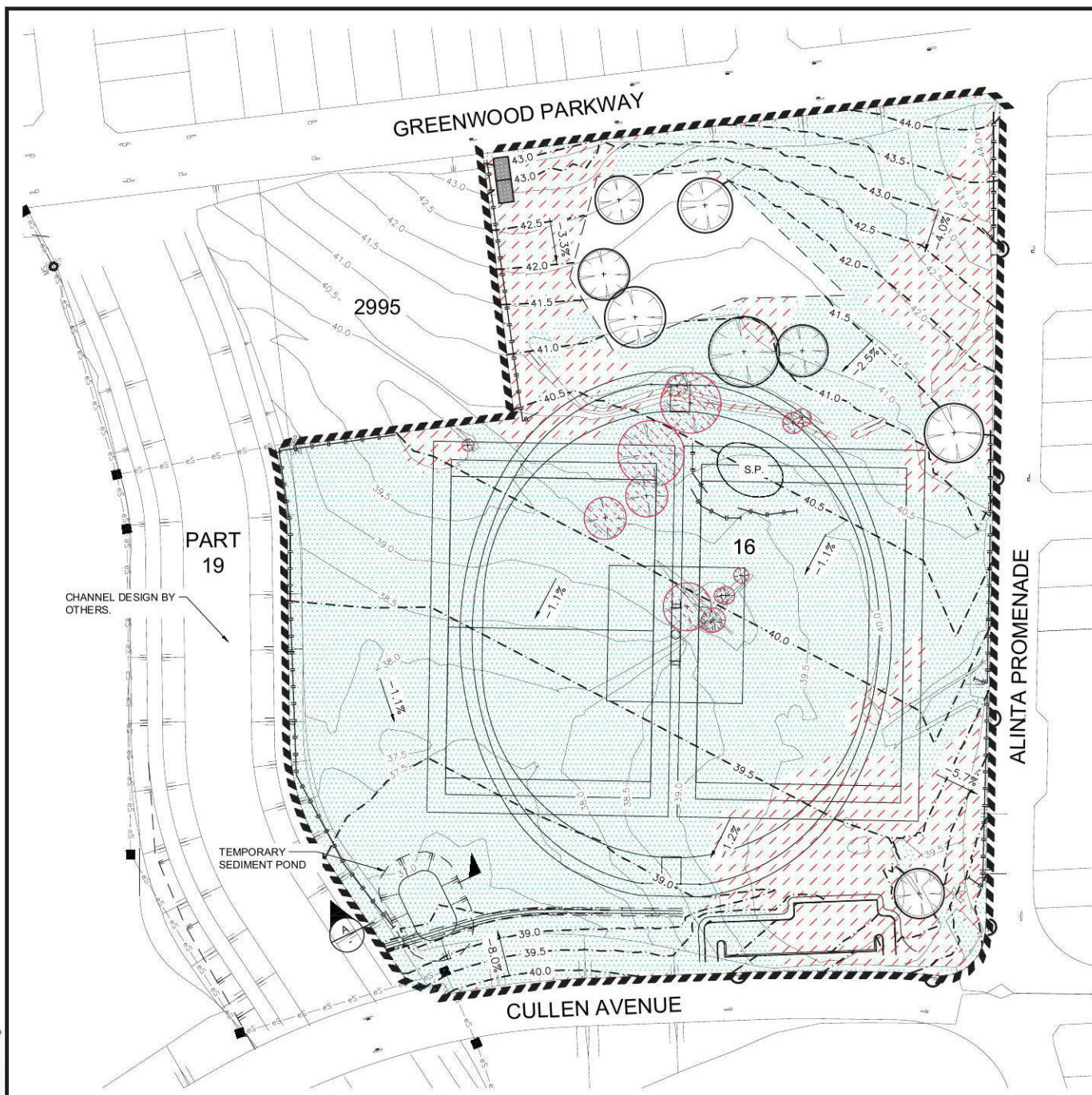
**ISSUED FOR CONSTRUCTION APPROVAL**

JORDAN SPRINGS EDUCATION SITE  
BULK EARTHWORKS  
SITE SECTIONS

PLAN No: 9343/07DA04 **A**  
FILE No: 934307DA04  
SHEET SIZE: A1 ORIGINAL



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Note: These "Detailed Calculation" spreadsheets relate only to high erosion hazard lands as identified in figure 4.6 or where the designer chooses to use the RUSLE to size sediment basins. The "Standard Calculation" spreadsheets should be used on low er

### 1. Site Data Sheet

Site Name: Jordan Springs  
 Site Location: Oval Site  
 Precinct:  
 Description of Site: Temporary Basin for Bulk Earthworks

Site area	Site	Remarks
Total catchment area (ha)	0.75	
Disturbed catchment area (ha)	0.75	

#### Soil analysis

% clay fraction < 0.002 mm	50	Soil texture should be assessed through mechanical dispersion only. Dispersion agents (e.g. Calgon) should not be used.
% clay fraction between 0.002 mm and 0.075 mm	50	
Dispersion percentage	100.0	E.g. enter 10 for dispersion of 10%.
% of hole soil dispersible	75	See Section 3.3.2(a)
Soil texture group	0	See Section 3.3.2(c), (d) and (e)

#### Rainfall data

Design rainfall depth (days)	5	See Section 3.3.4 (f) and (g)
Design rainfall depth (mm)	75	See Section 3.3.4 (f) and (g)
1-day, 1% percentile rainfall event	21.9	See Section 3.3.4 (h)
Rainfall intensity (mm/hr storm)	15.3	See (f), (g) and (h)

#### RUSLE Factors

Rainfall erosivity (P-factor)	2320	Automatic calculation from above data
Soil erodibility (K-factor)	0.028	
Slope length (L-factor)	390	
Slope gradient (S-factor)	2	RUSLE data can be obtained from Appendix A, B and C
Length of protection (P-factor)	0.68	
Erosion control practice (P-factor)	1.3	
Ground cover (C-factor)	1	

#### Calculations

Soil loss (t/ha/yr)	0.9	
Soil Loss Class	1	See Section 4.4.2(a)
Soil loss (t/ha/yr)	0.9	
Sediment basin storage volume (m³)	690	See Section 3.3.4(i) and 3.3.5 (a)

### 2. Storm Flow Calculations

Peak flow is given by the Rational Formula

$$Q_p = 0.00278 \times C_{10} \times C_{12} \times F_p \times I_p \times A$$

where:

- $Q_p$  is peak flow rate (m³/sec) of average recurrence interval (ARI) of "Y" years
- $C_{10}$  is the runoff coefficient (dimensionless) for ARI of 10 years. Rural runoff coefficients are given in Volume 2, figure 5 of Pfigram (1998), while urban runoff coefficients are given in Volume 1, Book VIII, figure 1.13 of Pfigram (1998) and construction  $t$
- $F_p$  is a frequency factor for "Y" years. Rural values are given in Volume 1, Book IV, Table 1.1 of Pfigram (1998) while urban coefficients are given in Volume 1, Book VII, Table 1.6 of Pfigram (1998)
- $A$  is the catchment area in hectares (ha)
- $I_p$  is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "Tc" (minutes or hours)

Time of concentration ( $T_c$ ) =  $0.76 \times (A/100)^{0.38}$  hrs (Volume 1, Book IV of Pfigram, 1998)

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent.

#### Peak flow calculations, 1

Site	A (ha)	I (mm/hr)	1 yr	5 yr	10 yr	20 yr	50 yr	100 yr	$C_{10}$
7	0.75	15	40.5	50	55	100	145	145	0.76

#### Peak flow calculations, 2

ARI (yr)	Frequency factor (F <sub>p</sub> )	7	5	10	20	50	100	Comment
1 yr	0.7	0.462						
5 yr	0.95	0.925						
10 yr	1	1.00						
20 yr	1.05	1.45						
50 yr	1.15	1.68						
100 yr	1.2	2.05						

### 4. Volume of Sediment Basins, Type D and Type F Soils

Basin volume = settling zone volume + sediment storage zone volume

#### Settling Zone Volume

The settling zone volume for Type F and Type D soils is calculated to provide capacity to contain all runoff expected from up to the y-percentile rainfall event. The volume of the basin's settling zone (V<sub>s</sub>) can be determined as a function of the basin's s

$$V_s = 10 \times C_s \times A \times R_{max,y} \times t_{set} \quad (m^3)$$

where:

- $10$  = unit conversion factor
- $C_s$  = the volumetric runoff coefficient defined as that portion of rainfall that runs off as stormwater over the x-day period
- $R_{max,y}$  = the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events. (See Sections 3.3.4(g), (h), (i), (j) and (k))
- $A$  = total catchment area (ha)

#### Sediment Storage Zone Volume

In the detailed calculation on Soil Loss Classes 1 to 4 lands, the sediment storage zone can be taken as 50 percent of the settling zone capacity. Alternatively designers can design the zone to store the 2-month soil loss as calculated by the RUSLE (Section 3.3.5)

Place an "X" in the box below to show the sediment storage zone design parameters used here:

50% of settling zone capacity	<input type="checkbox"/>
2 months soil loss calculated by RUSLE	<input type="checkbox"/>

#### Total Basin Volume

Site	C <sub>s</sub>	R <sub>max,y</sub> (mm)	Total catchment area (ha)	Settling zone volume (m³)	Sediment storage volume (m³)	Total basin volume (m³)
7	0.50	21.8	0.75	620.00	50	670.00

### GENERAL NOTES:

- ALL EROSION AND SEDIMENT CONTROL MEASURES, INCLUDING VEGETATION AND STORAGE OF SOIL AND TOPSOIL, SHALL BE IMPLEMENTED TO THE REQUIREMENTS OF THE "ENVIRONMENT PROTECTION AUTHORITY" AND "DEPT OF LAND AND WATER CONSERVATION". MEASURES OUTLINED IN THE SOIL & WATER MANAGEMENT PLAN MUST BE IMPLEMENTED PRIOR TO AND MAINTAINED DURING AND AFTER THE CONSTRUCTION WORKS.
- TOPSOIL FROM ALL AREAS TO BE DISTURBED SHALL BE STOCKPILED AND LATER RESPREAD TO AID REVEGETATION IN THOSE AREAS. ALL DRAINAGE WORKS SHALL BE CONSTRUCTED AND STABILIZED AS EARLY AS POSSIBLE DURING DEVELOPMENT.
- ALL TAIL-OUT DRAINS SHALL BE GRASSED AND TRAPEZOIDAL IN SECTION. STRAW BALES SHALL BE PLACED AS A SEDIMENT CONTROL DEVICE WHERE REQUIRED.
- VEHICULAR TRAFFIC SHALL BE CONTROLLED DURING DEVELOPMENT CONFINING ACCESS WHERE POSSIBLE TO PROPOSED OR EXISTING ROAD ALIGNMENTS. AREAS TO BE LEFT UNDISTURBED SHALL BE MARKED OFF.
- DISTURBANCE OF VEGETATION SHALL BE LIMITED TO FILL AREAS, ROADWAYS AND DRAINAGE LINES. NO LOT GRADING SHALL BE CARRIED OUT IN UNDISTURBED AREAS WITHOUT CONSULTATION WITH COUNCIL'S ENGINEER.
- ALL DISTURBED AREAS SHALL BE RE-VEGETATED WITHIN 14 WORKING DAYS FROM THE CONCLUSION OF LAND SHAPING.
- MINIMISE DUST BY WATERING WHEN REQUIRED.

### STOCKPILE NOTES:

- SPOIL AND TOPSOIL STOCKPILES SHALL BE LOCATED AWAY FROM DRAINAGE LINES AND AREAS WHERE WATER MAY CONCENTRATE.
- IF STOCKPILES ARE TO BE IN PLACE FOR LONGER THAN 14 DAYS THEN THEY SHALL BE STABILIZED BY COVERING WITH A MULCH OR WITH TEMPORARY VEGETATION.
- FOLLOWING CONSTRUCTION, TOPSOIL SHALL BE RESPREAD TO A MINIMUM DEPTH OF 100mm ON THE BARE SOIL SURFACES AND REVEGETATE.
- ALL STOCKPILES TO BE (MAX) 2m HIGH AND PROTECTED WITH SILT FENCE.

### SPECIAL NOTES:

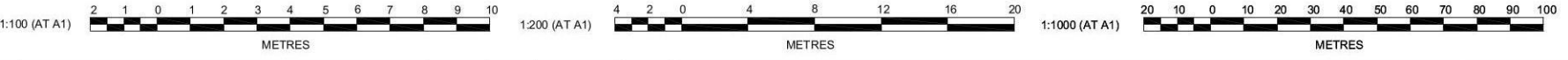
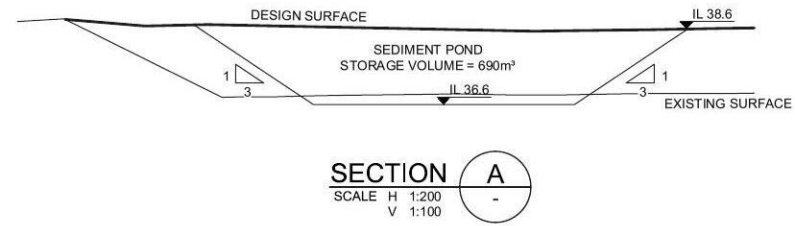
- LOCATION AND EXTENT OF SOIL AND WATER MANAGEMENT DEVICES IS DIAGRAMMATIC ONLY AND THE ACTUAL REQUIREMENTS SHALL BE CONFIRMED ON SITE.
- REFER TO "MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION" - 4TH EDITION FOR TYPICAL DETAILS OF STANDARD SEDIMENT AND EROSION CONTROL DEVICES.
- THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE GUIDELINES SET OUT IN "MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION" - 4TH EDITION AND THE ACCOMPANYING ROAD AND DRAINAGE PLANS.
- CONFORMITY WITH THIS PLAN SHALL IN NO WAY REDUCE THE RESPONSIBILITY OF THE CONTRACTOR TO PROTECT AGAINST WATER DAMAGE DURING THE COURSE OF THE CONTRACT.
- MANAGEMENT DEVICES SHALL BE MAINTAINED ON A REGULAR BASIS. WHERE CLEANING IS REQUIRED, THE SEDIMENT SHALL BE REMOVED TO A POINT NOMINATED BY THE ENGINEER.
- PRIOR TO THE COMMENCEMENT OF ANY EARTHWORKS, AND AFTER THE ROAD CENTRELINES HAVE BEEN PEGGED AND/OR PERMANENTLY MARKED, THE SITE MUST BE INSPECTED BY COUNCIL'S REPRESENTATIVE AND THE APPLICANT'S REPRESENTATIVE TO IDENTIFY AND APPROPRIATELY MARK:-
  - THE TREES TO BE RETAINED.
  - ALL TREES TO BE LEFT UNDISTURBED AND TO BE CORDONED OFF.
- NO TREES SHALL BE REMOVED WITHOUT COUNCIL'S CLEARANCE.
- MANAGEMENT DEVICES TO REMAIN UNTIL THE END OF THE MAINTENANCE PERIOD.
- THE TEMPORARY BASIN IS TO REMAIN BE DECOMMISSIONED ONCE THE SITE IS RE-VEGETATED AND ESTABLISHED.

### SEDIMENTATION CONTROL DEVICES:

ALL STRAW BALES SHALL BE BOUND WITH WIRE. STRAW BALES SHALL BE PLACED END TO END IN A SINGLE ROW AND EMBEDDED INTO THE SOIL TO A DEPTH OF 100mm. EACH BALE SHALL BE SECURELY ANCHORED WITH TWO STEEL STAKES DRIVEN 450mm INTO THE GROUND AND LOCATED ON THE BALE CENTRE LINE. SILT FENCES SHALL BE CONSTRUCTED BY STRETCHING A FILTER FABRIC (PROPEX OR SIMILAR) BETWEEN POSTS AT 2m (3m MAX) CENTRES. FABRIC SHALL BE BURIED 150mm ALONG ITS LOWER EDGE.

### LEGEND

	SEDIMENT FENCE
	GEOTEXTILE INLET FILTER
	MESH & GRAVEL INLET FILTER
	STOCKPILE



NO.	DESCRIPTION	PAS	PAS	MS	SA	DATE
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JORDAN SPRINGS EDUCATION SITE  
 BULK EARTHWORKS  
 SOIL AND WATER MANAGEMENT PLAN

PLAN No: 9343/07DA05 **A**  
 FILE No: 934307DA05  
 SHEET SIZE: A1 ORIGINAL





**Appendix F**

Bulk Earthworks Plans for lot 11 (future V12 residential site), prepared by J. Wyndham Prince

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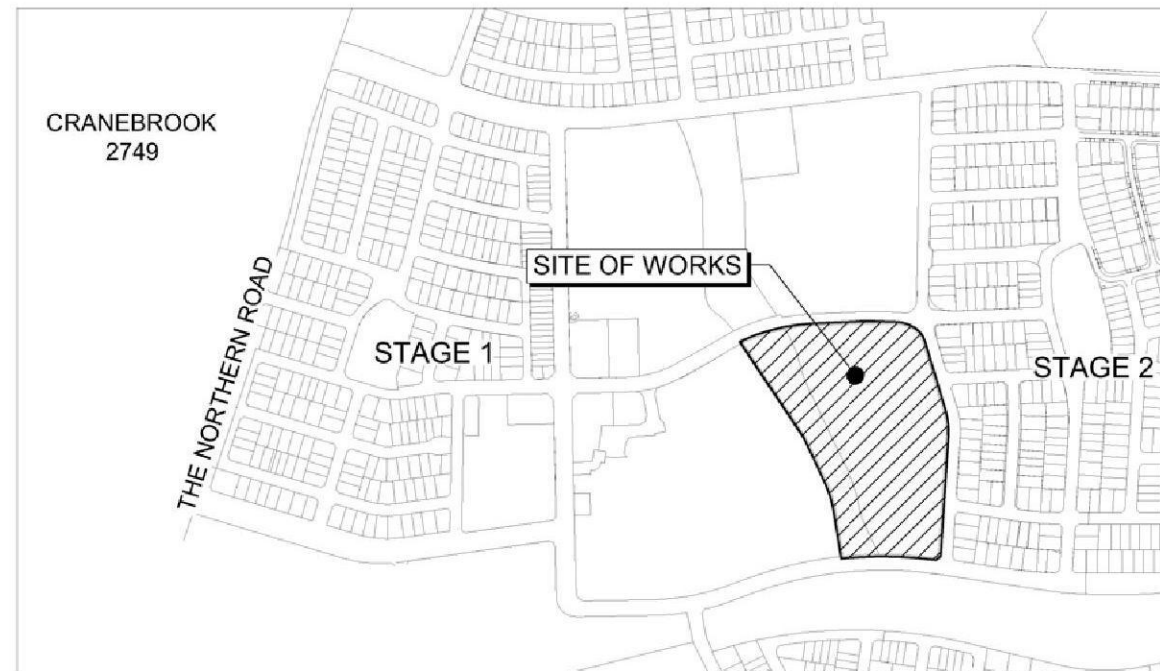
PENRITH CITY COUNCIL



**JORDAN SPRINGS - VILLAGE 12  
 DA & CC APPLICATION  
 PROPOSED BULK EARTHWORKS**

COUNCIL REF:

INDEX		
PLAN NO.	DESCRIPTION	REV
934305/DA01	COVER SHEET, INDEX & GENERAL NOTES	A
934305/DA02	BULK EARTHWORKS PLAN SHEET 1 of 2	A
934305/DA03	BULK EARTHWORKS PLAN SHEET 2 of 2	A
934305/DA04	SITE SECTIONS	A
934305/DA05	SOIL & WATER MANAGEMENT PLAN, NOTES & DETAILS	A



LOCALITY SKETCH

Prepared By:

**J. WYNDHAM PRINCE**  
 CONSULTING CIVIL INFRASTRUCTURE ENGINEERS  
 & PROJECT MANAGERS

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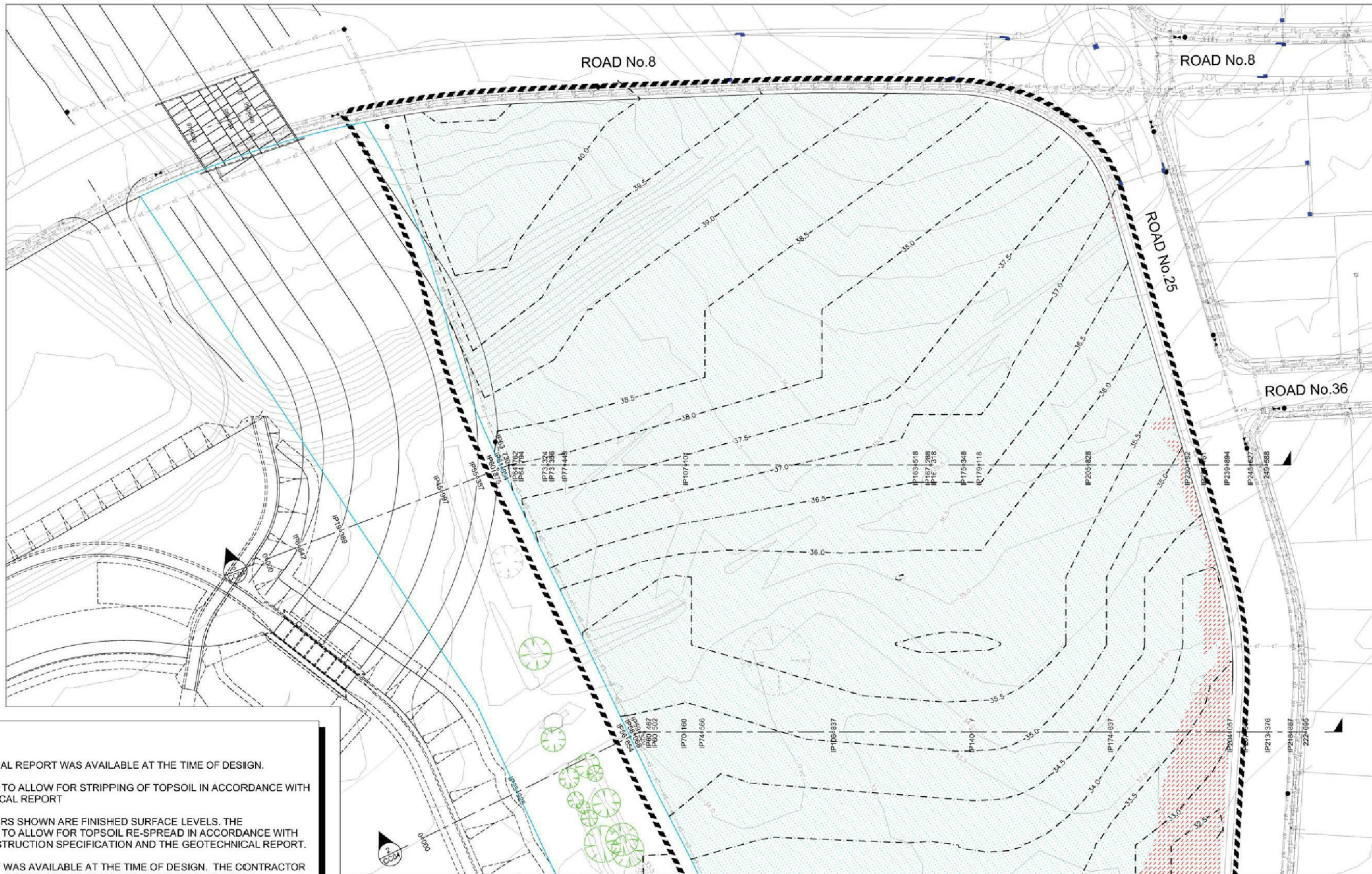
W [www.jwprince.com.au](http://www.jwprince.com.au)

E [jwp@jwprince.com.au](mailto:jwp@jwprince.com.au)

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PLAN No.	9343/05CC01	B
FILE No.	934305CC01	





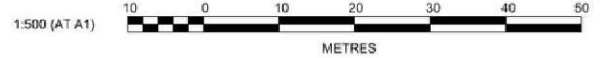
**NOTES:**

1. NO GEOTECHNICAL REPORT WAS AVAILABLE AT THE TIME OF DESIGN.
2. CONTRACTOR IS TO ALLOW FOR STRIPPING OF TOPSOIL IN ACCORDANCE WITH THE GEOTECHNICAL REPORT
3. DESIGN CONTOURS SHOWN ARE FINISHED SURFACE LEVELS. THE CONTRACTOR IS TO ALLOW FOR TOPSOIL RE-SPREAD IN ACCORDANCE WITH COUNCIL'S CONSTRUCTION SPECIFICATION AND THE GEOTECHNICAL REPORT.
4. NO WAE SURVEY WAS AVAILABLE AT THE TIME OF DESIGN. THE CONTRACTOR IS TO VERIFY ALL LEVELS AND EARTHWORKS QUANTITIES PRIOR TO CONSTRUCTION.

REFER TO DRAWING 934305DA03 FOR CONTINUATION

LEGEND	
	EXTENTS OF CUT
	EXTENTS OF FILL

- LEGEND**
- DENOTES TREE TO BE RETAINED
  - DENOTES TREE TO BE REMOVED



PLAN  
SCALE 1:500



**WARNING!**  
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AMENDMENT	DES	DRN	CKD	APR	DATE
B CLIENT REVIEW AMENDMENTS	JM	LVD	AM	SA	22/05/13
A FIRST ISSUE	JM	MR	AM	SA	14/05/13

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AZIMUTH:  
DATUM:  
ORIGIN:

CLIENT:

**Lend Lease**

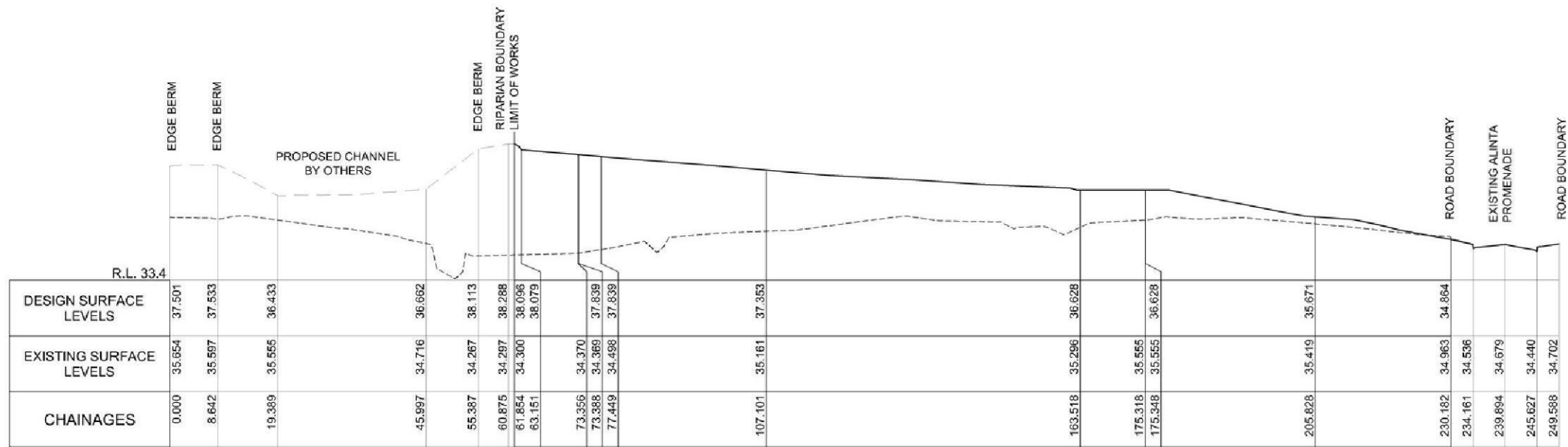
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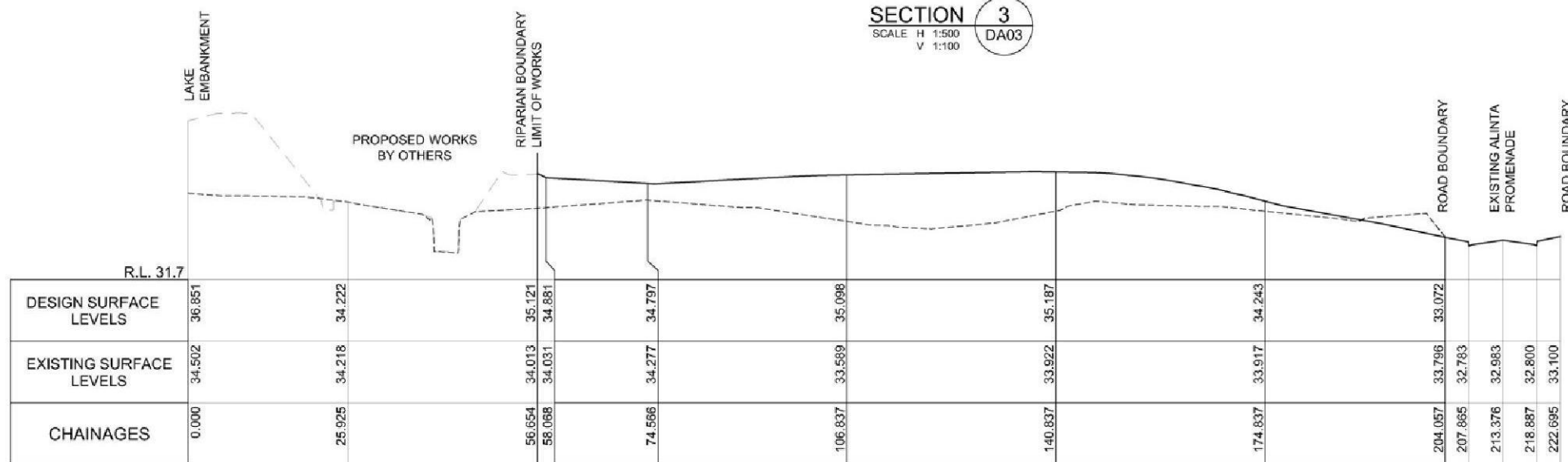
JORDAN SPRINGS VILLAGE 12  
BULK EARTHWORKS  
BULK EARTHWORKS PLAN  
SHEET 2 of 2

PLAN No: 9343/05CC03 **B**  
FILE No: 934305CC03  
SHEET SIZE: A1 ORIGINAL

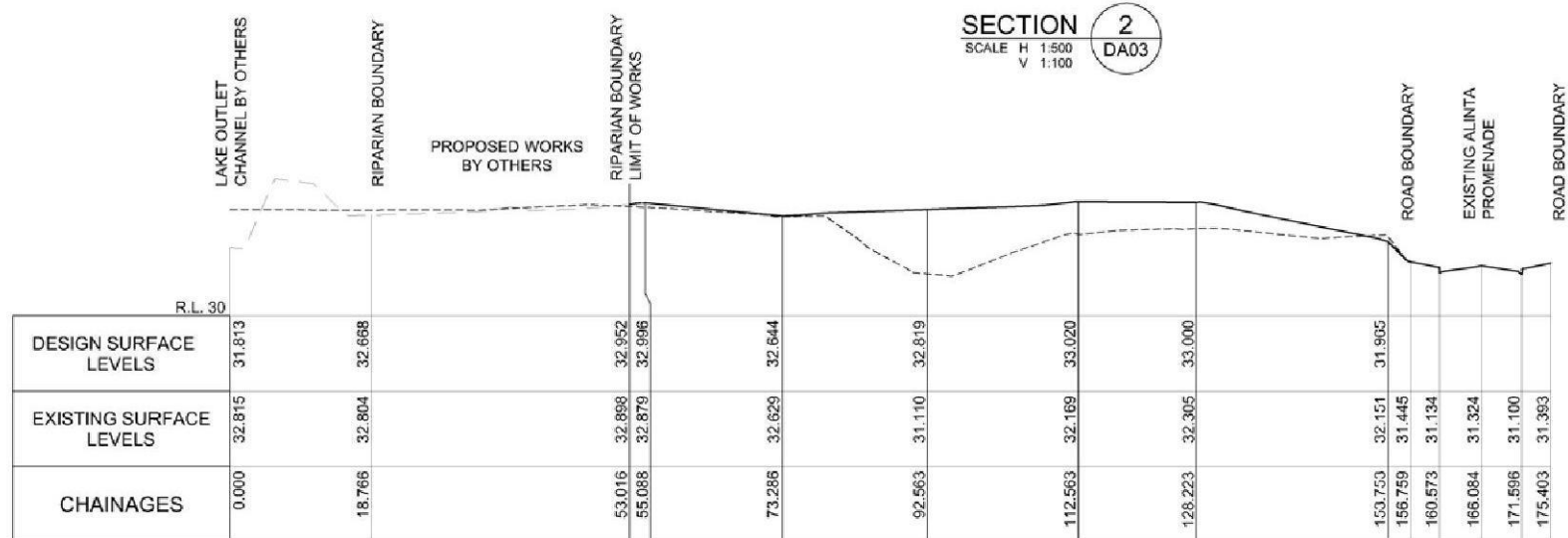




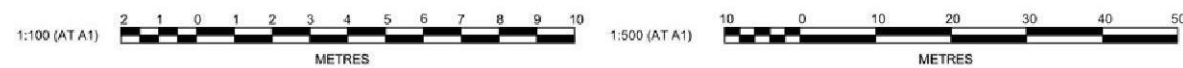
SECTION 3  
SCALE H 1:500  
V 1:100  
DA03



SECTION 2  
SCALE H 1:500  
V 1:100  
DA03



SECTION 1  
SCALE H 1:500  
V 1:100  
DA03



AMENDMENT	DES	DRN	CKD	APR	DATE
B	JM	LVD	AM	SA	22/05/13
A	JM	MR	AM	SA	14/05/13

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JORDAN SPRINGS VILLAGE 12  
BULK EARTHWORKS  
SITE SECTIONS

PLAN No: 9343/05CC04 **B**  
FILE No: 934305CC04  
SHEET SIZE: A1 ORIGINAL

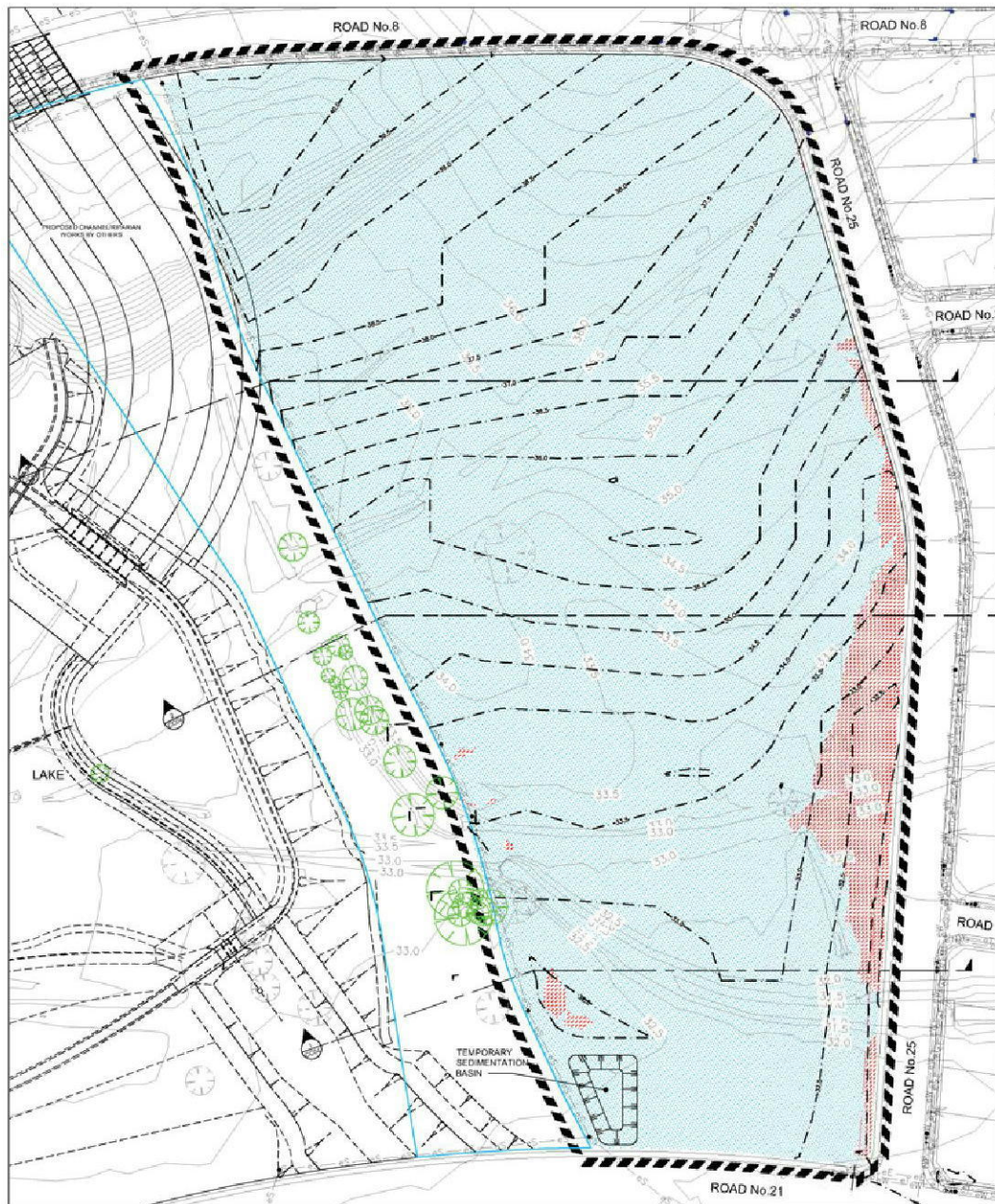


LEGEND	
	EXTENTS OF CUT
	EXTENTS OF FILL

**NOTES:**

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REFER TO DRAWING 934305DA02 FOR CONTINUATION

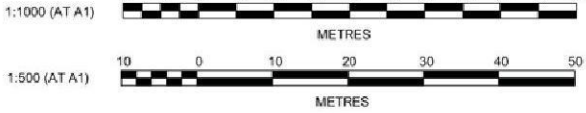


LAYOUT PLAN  
SCALE 1:1000



PLAN  
SCALE 1:500

- LEGEND
- DENOTES TREE TO BE RETAINED
  - DENOTES TREE TO BE REMOVED



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DATUM:  
ORIGIN:

CLIENT:  
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JORDAN SPRINGS VILLAGE 12  
BULK EARTHWORKS  
BULK EARTHWORKS PLAN  
SHEET 1 of 2

PLAN No: 9343/05CC02 **B**  
FILE No: 934305CC02  
SHEET SIZE: A1 ORIGINAL



**GENERAL NOTES:**

- ALL EROSION AND SEDIMENT CONTROL MEASURES, INCLUDING REVEGETATION AND STORAGE OF SOIL AND TOPSOIL, SHALL BE IMPLEMENTED TO THE REQUIREMENTS OF THE "ENVIRONMENT PROTECTION AUTHORITY" AND "DEPT OF LAND AND WATER CONSERVATION". MEASURES OUTLINED IN THE SOIL & WATER MANAGEMENT PLAN MUST BE IMPLEMENTED PRIOR TO AND MAINTAINED DURING AND AFTER THE CONSTRUCTION WORKS.
- TOPSOIL FROM ALL AREAS TO BE DISTURBED SHALL BE STOCKPILED AND LATER RESPREAD TO AID REVEGETATION IN THOSE AREAS. ALL DRAINAGE WORKS SHALL BE CONSTRUCTED AND STABILIZED AS EARLY AS POSSIBLE DURING DEVELOPMENT.
- ALL TAIL-OUT DRAINS SHALL BE GRASSED AND TRAPEZOIDAL IN SECTION. STRAW BALES SHALL BE PLACED AS A SEDIMENT CONTROL DEVICE WHERE REQUIRED.
- VEHICULAR TRAFFIC SHALL BE CONTROLLED DURING DEVELOPMENT CONFINING ACCESS WHERE POSSIBLE TO PROPOSED OR EXISTING ROAD ALIGNMENTS. AREAS TO BE LEFT UNDISTURBED SHALL BE MARKED OFF.
- DISTURBANCE OF VEGETATION SHALL BE LIMITED TO FILL AREAS, ROADWAYS AND DRAINAGE LINES. NO LOT GRADING SHALL BE CARRIED OUT IN UNDISTURBED AREAS WITHOUT CONSULTATION WITH COUNCIL'S ENGINEER.
- ALL DISTURBED AREAS SHALL BE REVEGETATED WITHIN 14 WORKING DAYS FROM THE CONCLUSION OF LAND SHAPING.
- MINIMISE DUST BY WATERING WHEN REQUIRED.

**STOCKPILE NOTES:**

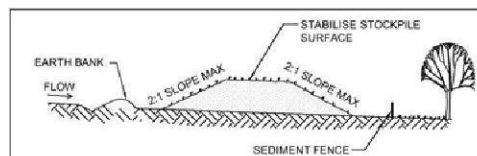
- SPOIL AND TOPSOIL STOCKPILES SHALL BE LOCATED AWAY FROM DRAINAGE LINES AND AREAS WHERE WATER MAY CONCENTRATE.
- IF STOCKPILES ARE TO BE IN PLACE FOR LONGER THAN 14 DAYS THEN THEY SHALL BE STABILIZED BY COVERING WITH A MULCH OR WITH TEMPORARY VEGETATION.
- FOLLOWING CONSTRUCTION, TOPSOIL SHALL BE RESPREAD TO A MINIMUM DEPTH OF 100mm ON THE BARE SOIL SURFACES AND REVEGETATE.
- ALL STOCKPILES TO BE (MAX) 2m HIGH AND PROTECTED WITH SILT FENCE.

**SPECIAL NOTES:**

- LOCATION AND EXTENT OF SOIL AND WATER MANAGEMENT DEVICES IS DIAGRAMMATIC ONLY AND THE ACTUAL REQUIREMENTS SHALL BE CONFIRMED ON SITE.
- REFER TO "MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION" -4TH EDITION FOR TYPICAL DETAILS OF STANDARD SEDIMENT AND EROSION CONTROL DEVICES.
- THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE GUIDELINES SET OUT IN "MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION" -4TH EDITION AND THE ACCOMPANYING ROAD AND DRAINAGE PLANS.
- CONFORMITY WITH THIS PLAN SHALL IN NO WAY REDUCE THE RESPONSIBILITY OF THE CONTRACTOR TO PROTECT AGAINST WATER DAMAGE DURING THE COURSE OF THE CONTRACT.
- MANAGEMENT DEVICES SHALL BE MAINTAINED ON A REGULAR BASIS. WHERE CLEANING IS REQUIRED, THE SEDIMENT SHALL BE REMOVED TO A POINT NOMINATED BY THE ENGINEER.
- PRIOR TO THE COMMENCEMENT OF ANY EARTHWORKS, AND AFTER THE ROAD CENTRELINES HAVE BEEN PEGGED AND/OR PERMANENTLY MARKED, THE SITE MUST BE INSPECTED BY COUNCIL'S REPRESENTATIVE AND THE APPLICANT'S REPRESENTATIVE TO IDENTIFY AND APPROPRIATELY MARK:
  - THE TREES TO BE RETAINED.
  - ALL TREES TO BE LEFT UNDISTURBED AND TO BE CORDONED OFF.
- NO TREES SHALL BE REMOVED WITHOUT COUNCIL'S CLEARANCE.
- MANAGEMENT DEVICES TO REMAIN UNTIL THE END OF THE MAINTENANCE PERIOD.

**SEDIMENTATION CONTROL DEVICES:**

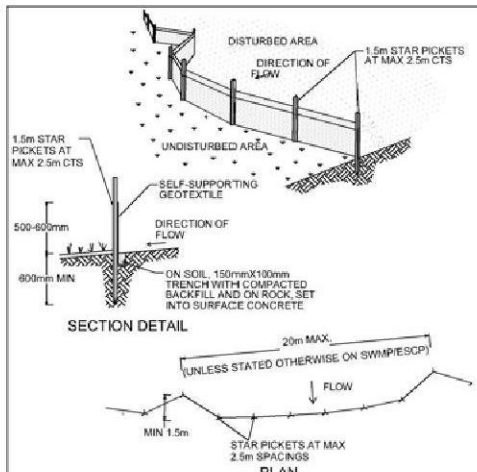
- ALL STRAW BALES SHALL BE BOUND WITH WIRE. STRAW BALES SHALL BE PLACED END TO END IN A SINGLE ROW AND EMBEDDED INTO THE SOIL TO A DEPTH OF 100mm. EACH BALE SHALL BE SECURELY ANCHORED WITH TWO STEEL STAKES DRIVEN 150mm INTO THE GROUND AND LOCATED ON THE BALE CENTRE LINE. SILT FENCES SHALL BE CONSTRUCTED BY STRETCHING A FILTER FABRIC (PROPEX OR SIMILAR) BETWEEN POSTS AT 2m (3m MAX) CENTRES. FABRIC SHALL BE BURIED 150mm ALONG ITS LOWER EDGE.



**CONSTRUCTION NOTES**

- PLACE STOCKPILES MORE THAN 2 (PREFERABLY 5) METRES FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW AND HAZARDOUS AREAS.
- CONSTRUCT ON THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS.
- WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2 METRES IN HEIGHT.
- WHERE THEY ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP OR SWAMP TO REDUCE THE C FACTOR TO LESS THAN 10.
- CONSTRUCT EARTH BANKS (STANDARD DRAWING 5-5) ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES (STANDARD DRAWING 6-6) 1 TO 2 METRES DOWNSLOPE.

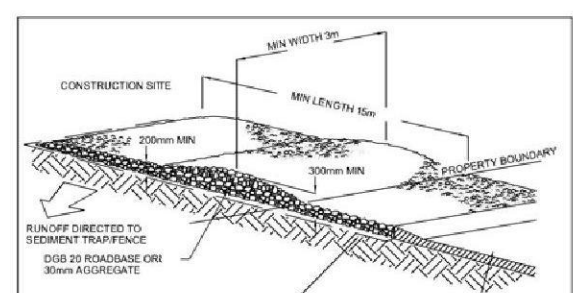
**STOCKPILE SD4-1**  
N.T.S.



**CONSTRUCTION NOTES**

- CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE STORM EVENT, USUALLY THE 10-YEAR EVENT.
- CUT A 150-MM DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
- DRIVE 1.5m LONG STAR PICKETS INTO GROUND AT 2.5m INTERVALS (MAX) AT THE DOWN SLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
- CUT A SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
- JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
- BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.

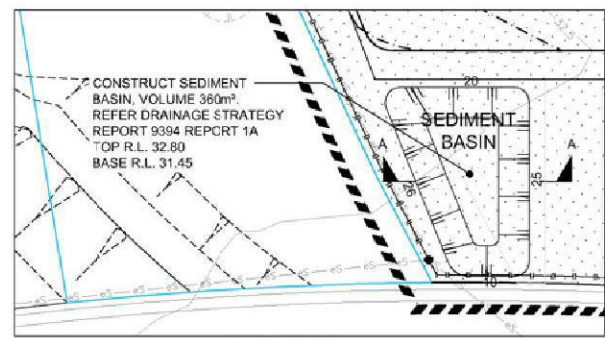
**SEDIMENT FENCE SD6-8**  
N.T.S.



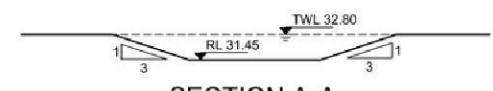
**CONSTRUCTION NOTES**

- STRIP THE TOPSOIL, LEVEL THE SITE AND COMPACT THE SUBGRADE.
- COVER THE AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
- CONSTRUCT A 200mm THICK PAD OVER THE GEOTEXTILE USING ROAD BASE OR 30mm AGGREGATE.
- ENSURE THE STRUCTURE IS AT LEAST 15m LONG OR TO BUILDING ALIGNMENT AND AT LEAST 30m WIDE.
- WHERE A SEDIMENT FENCE JOINS ONTO THE STABILISED ACCESS, CONSTRUCT A HUMP IN THE STABILISED ACCESS TO DIVERT WATER TO THE SEDIMENT FENCE.

**STABILISED SITE ACCESS SD6-14**  
N.T.S.



**INSET 'A'**  
SCALE 1:500



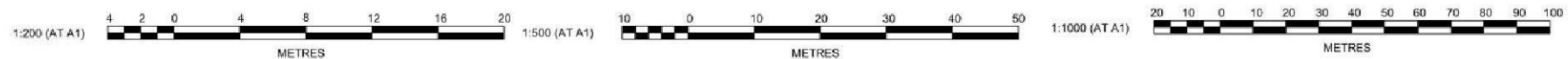
**SECTION A-A**  
SCALE 1:200  
**ROAD NO.8**



**PLAN**  
SCALE 1:1000

**LEGEND**

- 101.0' --- DESIGN CONTOURS
- SEDIMENT FENCE
- S.P. --- TOPSOIL STOCKPILE / BUND.
- SITE REGRADE AREA
- STABILISED SITE ACCESS
- TREES TO BE RETAINED
- TREES TO BE REMOVED



B	CLIENT REVIEW AMENDMENTS	JM	LVD	AM	SA	22/05/13
A	FIRST ISSUE	JM	MR	AM	SA	14/05/13
	AMENDMENT	DES	DRN	CKD	APR	DATE

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CLIENT: **Lend Lease**

AZIMUTH:  
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ORIGIN:

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JORDAN SPRINGS VILLAGE 12  
BULK EARTHWORKS  
SOIL & WATER MANAGEMENT PLAN, NOTES & DETAILS

PLAN No: 9343/05CC05 **B**  
FILE No: 934305CC05  
SHEET SIZE: A1 ORIGINAL





**Appendix G**  
Waste Management Plan, prepared by Lend Lease



# WASTE MANAGEMENT PLAN



**Proposed Development:** Village Centre Bulk Earthworks DA Application  
**Site Address:** Lakeside Parade, Jordan Springs NSW 2747

**Date:** 28/06/2013

**Applicants Name:** Maryland Development Company Pty Ltd

**Applicants Address:** PO Box 1870 Penrith NSW 2751

**Buildings and Other Structures on Site:** Nil

**Brief Description of Proposal:** Bulk Earthworks of Village Centre Sites and ancillary works

**Applicants Representative:** Ahmad Ali

**Telephone:** 8016 6500

**Mobile:** 0447 776 411

**Facsimile:**

MATERIALS ON SITE		DESTINATION		
		Reuse and Recycling		Disposal
Type of Materials	Estimated	ON-SITE	OFF-SITE	OFF-SITE
	Vol. (m <sup>3</sup> )	Specify proposed reuse or on-site recycling methods	Specify contractor and recycling outlet	Specify contractor and landfill site
Excavation Material - Cut	10,775	Cut to Fill requirements		
Excavation Material - Fill				
Imported Material - Fill	124,125	Fill to be extracted from within the Jordan Springs site otherwise, imported fill to be sourced		
Top Soil	18769.25	Reuse as Topsoil within Stage		
Bricks	N/A	N/A		
Concrete	N/A	N/A		
Timber (Trees)	5	Stockpile for future use as Mulch		
Rubbish Generated from Construction	15			Council Approved Landfill Site



**Appendix H**  
Species Impact Statement (SIS), prepared by Cumberland Ecology



**VILLAGE 12 SITE, EDUCATION/RESIDENTIAL  
PRECINCT AND PROPOSED VILLAGE OVAL OF  
JORDAN SPRINGS IN THE WESTERN PRECINCT, ST  
MARY'S PROPERTY**

**Species Impact Statement**

For:

**Lend Lease**

December 2012

**Final**



PO Box 2474, Carlingford Court 2118  
[www.cumberlandecology.com.au](http://www.cumberlandecology.com.au)

**Report No. 8143RP21**

---

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

---

Revision	Date Issued	Reviewed by	Approved by	Date Approved	Revision Type
1	8/10/12	SH	VO	8/10/12	Draft
2	21/12/12	VO	DR	21/12/12	Final

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Approved by: David Robertson

Position: Director

Signed: 

Date: 21 December, 2012

---

I, Arthur Ilias, Attorney, Maryland Development Company Pty Ltd of Level 4, 30 The Bond 30 Hickson Road Sydney NSW 2000, being the applicant for the development consents for proposed development of lot 8 in DP 1176874 and lot 11 in DP 1176163, The Northern Road, Llandilo Penrith LGA have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the proposal.



# Table of Contents

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## EXECUTIVE SUMMARY

### 1 INTRODUCTION

1.1	Purpose	1.1
1.2	Approvals and Licences	1.2
1.2.1	State Government Instruments	1.2
1.2.2	Local Government Policies	1.3
1.2.3	Australian Heritage Commission Register of National Estate	1.3
1.3	DGR Matters Which Have Been Limited or Modified	1.4
1.4	Terminology	1.5

### 2 CONTEXTUAL INFORMATION

2.1	Background	2.1
2.1.1	St Marys Property	2.1
2.1.2	Western Precinct	2.5
2.2	Description of the Current Proposal	2.7
2.2.1	Nature	2.7
2.2.2	Extent	2.8
2.2.3	Location	2.9
2.2.4	Timing	2.9
2.2.5	Layout	2.9
2.2.6	Future Development of the Western Precinct	2.9
2.3	Land Tenure Information	2.10
2.4	Vegetation	2.10
2.4.1	Cumberland Plain Woodland - Shale Hills Woodland	2.10
2.4.2	Cumberland Plain Woodland - Shale Plain Woodland	2.11
2.4.3	Shale Gravel Transition Forest	2.11
2.4.4	Cooks River/Castlereagh Ironbark Forest	2.12
2.4.5	Alluvial Woodland	2.12

---

## Table of Contents *(Cont'd)*

---

2.4.6	Freshwater Wetlands on Coastal Floodplains	2.13
2.4.7	Sandstone Ridgetop Woodland	2.13
2.4.8	Upper Georges River Sandstone Woodland	2.13
2.4.9	Western Sandstone Gully Forest	2.14
2.4.10	Blue Gum High Forest	2.14
2.4.11	Shale Sandstone Transition Forest	2.14
2.5	Plans and Maps	2.15
<b>3</b>	<b>INITIAL ASSESSMENT</b>	
3.1	Endangered and Critically Endangered Ecological Communities	3.1
3.2	Threatened Species and Populations Records	3.1
3.2.1	Database Records	3.1
3.2.2	Literature Review	3.2
3.2.3	Habitat Assessment	3.2
<b>4</b>	<b>SURVEY</b>	
4.1	Survey Background	4.1
4.1.1	Historical Surveys	4.1
4.1.2	Recent Surveys	4.2
4.2	Survey Methods	4.3
4.2.1	Terrestrial Survey	4.3
4.2.2	Statistical Analyses	4.12
4.2.3	Weather Conditions for Surveys by Cumberland Ecology	4.12
4.2.4	Survey Limitations	4.13
4.3	Survey Results	4.14
4.3.1	Vegetation Communities of the Study Area	4.14
4.3.2	Statistical outcomes of vegetation composition comparisons	4.26
4.3.3	Threatened Flora Species	4.28
4.3.4	Fauna Habitats within Study Area	4.1
4.3.5	Fauna Species within the Subject Land	4.2

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## Table of Contents *(Cont'd)*

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	4.3.6 Fauna Species	4.4
4.4	Habitat Corridors	4.11
4.5	Determining Affected (C)EECs/Species	4.11
	4.5.1 Major Affected (C)EECs/species	4.12
	4.5.2 Minor Affected (C)EECs/species	4.13
<b>5</b>	<b>IMPACT ASSESSMENT</b>	
5.1	Assessment of Likely Impacts	5.1
	5.1.1 Direct Impacts of Development	5.1
	5.1.2 Indirect Impacts	5.2
	5.1.3 Cumulative Impact of Development in the Western Precinct	5.3
5.2	Assessment of Critically Endangered and Endangered Ecological Communities and Species Likely to be Affected	5.4
	5.2.1 Major affected (C)EECs/species	5.5
	5.2.2 Minor affected EECs	5.6
5.3	Description of Habitat	5.6
	5.3.1 Cumberland Plain Woodland	5.6
	5.3.2 River-flat Eucalypt Forest	5.10
	5.3.3 Freshwater Wetlands	5.12
5.4	Past Disturbance History of the Western Precinct	5.14
	5.4.1 Assessment of Ability of Affected (C)EECs/Species to Recover to Pre-Disturbance Condition	5.14
5.5	Description of Conservation Status	5.15
	5.5.1 Cumberland Plain Woodland	5.15
	5.5.2 River-flat Eucalypt Forest	5.15
	5.5.3 Freshwater Wetlands	5.16
5.6	Discussion of Likely Effects of the Proposal	5.16
	5.6.1 Extent of Habitat Removal	5.16
	5.6.2 Significance within the Local Context	5.18
	5.6.3 Discussion of Connectivity	5.22

---

## Table of Contents *(Cont'd)*

---

	5.6.4 Consideration of Threatening Processes	5.22
5.7	Description of Feasible Alternatives	5.24
<b>6</b>	<b>CONSISTENCY OF THE PROPOSAL WITH THE OBJECTIVES OF THE CUMBERLAND PLAIN RECOVERY PLAN</b>	
6.1	Introduction	6.1
6.2	Species, Populations and Ecological Communities	6.1
6.3	Compliance of the Proposed Development with the Objectives and Actions of the Final Recovery Plan for the Cumberland Plain	6.4
	6.3.1 Objectives	6.5
	6.3.2 Actions	6.5
	6.3.3 Guidelines	6.6
	6.3.4 Management Plans Regulating Development of the SMP	6.8
	6.3.5 Assessment of Threatened Species, Populations and Ecological Communities within this SIS	6.9
6.4	Application of Recovery Plan to Proposal	6.11
<b>7</b>	<b>AMELIORATIVE MEASURES</b>	
7.1	Introduction	7.1
	7.1.1 SMP/Regional Park	7.1
	7.1.2 Western Precinct	7.2
7.2	Long Term Management Strategies	7.2
	7.2.1 The Landscape Masterplan	7.2
	7.2.2 Weed Management Plan	7.4
	7.2.3 Feral and Domestic Animal Management Strategy	7.4
	7.2.4 Bushfire Management Plan	7.5
	7.2.5 Macrofauna Management Plan	7.5
	7.2.6 Habitat Enhancement within Subject Land	7.5
7.3	Compensatory Measures	7.6
	7.3.1 Regional Park Plan of Management	7.6
	7.3.2 Macrofauna Management Plan	7.7
	7.3.3 Principles for Offsetting	7.7

---



## Table of Contents *(Cont'd)*

---

7.3.4	Alternative Compensatory Measures	7.8
7.4	Monitoring	7.8
7.4.1	Weed Management Plan	7.9
7.4.2	The St Marys Macrofauna Management Plan	7.9
<b>8</b>	<b>ASSESSMENTS OF SIGNIFICANCE</b>	
8.1	Critically Endangered Ecological Community	8.1
8.1.1	Cumberland Plain Woodland	8.1
8.1.2	River-flat Eucalypt Forest	8.5
8.1.3	Freshwater Wetlands	8.7
8.2	Flora	8.10
8.2.1	Pultenaea parviflora	8.10
8.3	Fauna	8.13
8.3.1	Woodland Birds	8.13
8.3.2	Cumberland Plain Land Snail	8.15
8.3.3	Microchiropteran Bats	8.18
8.3.4	Grey-headed Flying-fox	8.21
<b>9</b>	<b>ADDITIONAL INFORMATION</b>	
9.1	Qualifications and Experience	9.1
9.1.1	Other Approvals Required for the Development or Activity	9.1
9.1.2	Licence Matters	9.1
9.1.3	Section 110 (5) Reports	9.1
<b>10</b>	<b>CONCLUSION</b>	
	<b>REFERENCES</b>	

---

## Table of Appendices

---

- A. DIRECTOR GENERAL'S REQUIREMENTS**
  - B. SURVEY EFFORT**
  - C. FLORA AND FAUNA SPECIES LISTS**
  - D. FLORA AND FAUNA DATA ANALYSES**
  - E. ACTIONS PRESCRIBED BY THE FINAL RECOVERY PLAN FOR THE CUMBERLAND PLAIN**
  - F. STAFF CVs**
- 

## List of Tables

---

S.1.1	VEGETATION COMMUNITIES REMOVED FROM THE SUBJECT SITE AND CUMMULATIVE IMPACTS OF VEGETATION REMOVAL FROM THE SUBJECT LAND	10
3.1	THREATENED FLORA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE	3.5
3.2	THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE	3.10
4.1	DATES OF FIELD SURVEYS	4.3
4.2	MODIFIED BRAUN-BLANQUET SCORES USED IN QUADRAT SURVEYS	4.5
4.3	FAUNA SURVEY METHODS AND EFFORT (CUMBERLAND ECOLOGY 2011)	4.7
4.4	TREE HOLLOW CLASS SIZE	4.11
4.5	SUMMARY OF WEATHER CONDITIONS DURING SURVEY	4.12
4.6	LOCATIONS OF GREVILLEA JUNIPERINA SSP JUNIPERINA	

---



## List of Tables

	POPULATIONS IN THE STUDY AREA	4.29
4.7	LOCATIONS OF PULETNAEA PARVIFLORA ON THE SUBJECT SITE	4.30
4.8	POPULATION ESTIMATES FOR PARVIFLORA AND GREVILLEA JUNIPERINA SUBS. JUNIPERINA WITHIN THE WIANAMATTA REGIONAL PARK	4.31
4.9	BAT SURVEY RESULTS	4.6
4.10	BAT SURVEY DEFINITIONS	4.7
5.1	VEGETATION COMMUNITIES REMOVED FROM THE SUBJECT SITE AND CUMMULATIVE IMPACTS OF VEGETATION REMOVAL FROM THE SUBJECT LAND	5.1
5.2	VEGETATION COMMUNITIES CONSERVED IN THE STUDY AREA AND REGIONAL PARK	5.4
6.1	THREATENED BIODIVERSITY ADDRESSED IN THE RECOVERY PLAN	6.1
6.2	THREATENED BIODIVERSITY IDENTIFIED IN THE RECOVERY PLAN THAT HAVE BEEN ADDRESSED IN THIS SIS	6.10
A.1	DGR COMPLIANCE TABLE	A.1
B.1	HISTORY OF SURVEY EFFORT ON THE SMP RELEVANT TO THE WESTERN PRECINCT	B.2
B.2	DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP	B.8
B.3	DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FAUNA SPECIES OF RELEVANCE ON THE SMP	B.33
C.1	FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP	C.1
C.2	FLORA SPECIES RECORDED IN THE STUDY AREA	C.14
D.1	SNAIL SURVEY RECORDS FOR THE STUDY AREA – CE 2011	D.1
D.2	HABITAT ASSESSMENT RESULTS IN THE STUDY AREA	D.2
D.3	RESULTS OF GROUP SIMILARITY ANALYSES (SIMPER) OF FLORA DATA BY HABITAT AND PRIMARY SPECIES CONTRIBUTING TO THE	

## List of Tables

	GROUP SIMILARITY.	D.4
D.4	RESULTS OF GROUP SIMILARITY ANALYSES (SIMPER) OF FLORA DATA BY AREA AND PRIMARY SPECIES CONTRIBUTING TO THE GROUP SIMILARITY.	D.6
D.5	RESULTS OF GROUP SIMILARITY ANALYSES (SIMPER) OF FLORA DATA IN GRASSLAND QUADRATS BY AREA AND PRIMARY SPECIES CONTRIBUTING TO THE GROUP SIMILARITY.	D.8
D.6	STATISTICAL COMPARISON OF CUMBERLAND LAND SNAIL NUMBERS BETWEEN DIFFERENT SECTIONS OF THE STUDY AREA	D.9
D.7	CLUSTER WITH >75% SIMILARITY (SIMPER) IN EXOTIC VEGETATION COMPOSITION IN GRASSLAND QUADRATS	D.11
E.1	COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN	E.2

## List of Figures

1.1	AERIAL PHOTOGRAPH OF THE ST MARYS PROPERTY	1.7
1.2	ZONING OF THE ST MARYS PROPERTY (SREP 30 AMENDMENT 2)	1.8
2.1	PLAN OF THE SUBJECT SITE IDENTIFYING THE PROPOSAL	2.17
2.2	AERIAL VIEW OF THE SUBJECT SITE, SUBJECT LAND AND STUDY AREA	2.18
2.3	VEGETATION COMMUNITIES IN THE LOCALITY	2.19
2.4	TOPOGRAPHY OF THE LOCALITY IDENTIFYING LAND USES	2.20
2.5	AERIAL PHOTOGRAPH OF THE LOCALITY IDENTIFYING AREAS OF NATIVE VEGETATION	2.21
3.1	OEH THREATENED FLORA RECORDS WITHIN THE LOCALITY	3.3
3.2	OEH THREATENED FAUNA RECORDS WITHIN THE LOCALITY	3.4



## List of Figures

---

4.1	FLORA SURVEY LOCATIONS (CUMBERLAND ECOLOGY, 2011)	4.6
4.2	FAUNA SURVEY LOCATIONS (CUMBERLAND ECOLOGY, 2011)	4.9
4.3	COMPARISON OF EXOTIC AND NATIVE PLANT COMPOSITION IN THE SUBJECT SITES (AREA A), REGENERATING REGIONAL PARK WOODLAND (AREA B) AND MATURE REGIONAL PARK WOODLAND (AREA C).	4.26
4.4	SIMILARITY DENDROGRAM OF ALL FLORA SPECIES AMONG QUADRATS	4.27
4.5	COMPARITIVE ABUNDANCE OF CUMBERLAND LAND SNAIL WITHIN THE SUBJECT SITES (AREA A), REGENERATING REGIONAL PARK WOODLAND (AREA B) AND MATURE REGIONAL REGIONAL PARK WOODLAND.	4.10
4.6	THREATENED FLORA AND FAUNA RECORDED IN THE STUDY AREA	4.14
4.7	VEGETATION OF THE STUDY AREA	4.15
D.1	SIMILARITY DENDROGRAM OF EXOTIC SPECIES AMONG GRASSLAND QUADRATS. SLICE INDICATES 75% SIMILARITY LEVEL.	D.10

---

## List of Photographs

---

2.1	Aerial photograph of St Marys Property, 1947	2.2
2.2	Aerial photograph of St Marys Property, 1955	2.2
2.3	Aerial photograph of St Marys Property, 1965	2.3
2.4	Aerial photograph of St Marys Property, 1978	2.3
4.1	Mature CPW in the Regional Park	4.16
4.2	Regenerating CPW in the study area	4.17
4.3	Native dominated Derived Native Grassland, north of the Western	

---

## List of Photographs

---

	Precinct	4.19
4.4	Low diversity Derived Native Grassland on the subject land	4.19
4.5	River-flat Eucalypt Forest in the south-eastern part of the study area	4.22
4.6	Sedgeland on the subject land	4.23
4.7	Freshwater Wetland in the study area	4.25

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# Executive Summary

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## S1 PURPOSE

This document is a Species Impact Statement (SIS) that has been prepared to assess the impacts of a proposed residential subdivision and site works for a village oval, education/residential precinct: lot 8 in DP 1176874 and village 12 site: lot 11 in DP 1176163, within the Western Precinct of the St Marys Property (SMP) in western Sydney. The current proposal involves the development application (DA) for the implementation of a village oval, education/residential precinct and the village 12 site of Jordan Springs (refer Section 2.2.1 for details).

The purpose of the SIS is to:

- Identify threatened species issues and identify and provide appropriate amelioration strategies to minimise adverse impacts resulting from the proposal;
- Assist consent and determining authorities in the assessment of the development applications under Part 4 or request for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- Assist the Director-General of the Office of Environment and Heritage (OEH, formerly DECCW) in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act;
- Assist the Director-General of the OEH when consulted for the purposes of Parts 4 or 5 of the EP&A Act; and
- Assist the Director-General of the OEH in the assessment of Section 91 License applications lodged under the *Threatened Species Conservation Act 1995* (TSC Act).

As described in the Precinct Plan for the Western Precinct (JBA Urban Planning Consultants 2009), approval under Commonwealth environmental law was granted to the development of the SMP (in accordance with the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30)) under the *Environment Protection (Impact of Proposals) Act 1974* (EPIP Act) prior to the gazettal of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Clarification of all related actions necessary for the carrying out of the approved development was thereafter granted by the Commonwealth under the Environmental Reform (Consequential Provisions) Act 1999 (ERCP Act). As such, following the commencement of the EPBC Act, the Commonwealth confirmed that the EPIP Act approval and ERCP Act

certification completed the Commonwealth environmental assessment and held that “**no further approvals**” [our emphasis] were required provided development was consistent with the established planning framework provided by the SREP 30. This SIS therefore does not address species, populations and communities listed under the EPBC Act, except where those species of relevance are also listed under the TSC Act.

This SIS is a detailed assessment of the proposed DAs for a village oval, education/residential precinct: lot 8 in DP 1176874 and village 12 site: lot 11 in DP 1176163 of the Western Precinct of the SMP (also known as the subject site). However, it also assesses the impacts of future development across the Western Precinct as a whole, as detailed in the approved Precinct Plan. It contains specific assessment of threatened species, populations and ecological communities listed in the schedules of the TSC Act.

## S2 BACKGROUND

The former Australian Defence Industries (ADI) site at St Marys was endorsed by the NSW Government for inclusion on the Urban Development Program (UDP) in 1993. The site presented an opportunity to provide housing for Sydney’s growing population within an environmentally sustainable framework.

Given that the site straddles the boundary between two local government areas (Blacktown and Penrith) the NSW Government decided that a regional environmental plan should be prepared for the site. Technical investigations into the environmental values and development capability of the land were commenced in 1994, and the Regional Environmental Plan for St Marys (SREP 30) was gazetted in January, 2001. It zoned the land into “urban”, “employment”, “regional open space”, and “Regional Park” uses (Refer to Figure 1.2).

In view of the original scale of the residential and employment uses, a package of documents was prepared to guide and control development. These comprised SREP 30 (maps and written instrument) (DUAP, 2001b), and an Environmental Planning Strategy (EPS) which sets out performance objectives and strategies to address key aspects associated with the site, including: conservation, cultural heritage, water and soils, transport, urban form, energy and waste, human services, employment, and land contamination.

In addition, a State Development Agreement (State Deed) was entered into between the landowner and developers of the land (a Joint Venture comprising ComLand and Lend Lease Development), and the NSW Government. The State Deed specifies a series of obligations to be provided during development of the SMP. These obligations include, amongst other things, the following relevant contributions:

- the staged transfer and dedication 900ha of land to the NPWS as a Regional Park for the sum of \$3 (three dollars);
- staged monetary contributions (c\$6m) towards capital improvements within the 900ha Regional Park;



- monetary contributions towards a Plan of Management for the 900ha Regional Park; and
- the erection of stock proof fencing in stages along the boundaries of the 900ha Regional Park.

The State Deed was executed in December 2002. It provides legal certainty for the delivery of obligations at specific milestones. Together with the SREP 30 and the EPS, the State Deed provides the broader framework for the facilitation of future development of SMP on an agreed basis.

Under SREP 30 development areas are referred to as “precincts” and the SMP is subdivided into Eastern Precinct, Ropes Creek Precinct, Central Precinct, Western Precinct, Dunheved Precinct and Regional Park, Regional Open Space, Drainage Land and Roads. A Precinct Plan was prepared for the each development precinct.

To date the Precinct Plans for the Eastern Precinct, Ropes Creek Precinct, Dunheved Precincts, Central Precinct, Western Precinct have been prepared, exhibited and adopted by the relevant Councils and development is being progressed on a staged basis. As a result, the SMP is one of the largest single Greenfield Release Areas in the Metropolitan Development Program and critical to the delivery of housing numbers for Metropolitan Sydney.

#### *Western Precinct Plan*

A Precinct Plan was prepared for the Western Precinct and was approved by Penrith City Council in 2009. The Precinct Plan contained assessments of biodiversity, a plan for the management of weeds, and a strategy for management of domestic and feral animals. The Biodiversity Assessment for the Western Precinct predicted that development of the Precinct was not likely to have a significant negative impact upon threatened flora and fauna within the SMP in the long-term due to the major conservation outcome provided by the creation of the 900ha Regional Park in the SMP.

The development applications for Stage 1 of the Western Precinct development, referred to as the future suburb of Jordan Springs, were submitted to Penrith City Council in August 2009. Subsequent DA's for Stages 2 & 3 were submitted in May 2011 and for Stage 4 in September 2012. All applications were in accordance with the Precinct Plan and the broader statutory framework provided by the SREP 30, EPS and the State Deed..

#### *Village Oval, Education/Residential Precinct and Village 12 Site Development Application*

Lend Lease is preparing a DA for submission to Penrith Council for the proposed village oval, education/residential precinct and the village 12 site of Jordan Springs. As part of the Council's and the Joint Regional Planning Panel's consideration of the subject development applications, further clarification has been sought on the assessment of Cumberland Plain Woodland (CPW) since its listing as a Critically Endangered Ecologically Community (CEEC) under the TSC Act (and as Cumberland Plain Woodland and Shale Gravel Transition Forest Critically Endangered Ecological Community under the EPBC Act).

The vegetation present in the subject site is young and degraded and occurs in various stages of regeneration. Although the development of this stage will further fragment representatives of this community and will remove an area of CEEC, the removal of the small area of CPW proposed, is not considered to constitute a significant impact within the meaning of Section 5A of the EP&A Act (the 7 Part Test). A large area of high quality CPW will still be conserved in the Regional Park, regardless of the current DA.

However, on a precautionary basis, it has been agreed with Penrith City Council that all DAs for the Jordan Springs development area, that will involve the removal of TSC Act listed species and communities, will be accompanied by a SIS. For this reason, although the impacts of the current DA are not generally considered to be significant, a SIS has nonetheless been prepared.

### **S3 PROPOSAL**

The proposal that is the focus of this SIS is for the construction of the village oval, education/residential precinct: lot 8 in DP 1176874 and village 12 site: lot 11 in DP 1176163. The proposal includes creation of residue lots. The future subdivision of these residue lots will be subject to future DAs.

Physical works proposed for the subject site will ultimately include:

- Construction of roads,
- Bulk earthworks in grading of the lot and road;
- Provision of associated infrastructure;
- Provision of landscaping; and
- Associated tree removal.

The developments of the village oval, education/residential precinct and the village 12 site of Jordan Springs are to be implemented via a single DA. The location of this DA is mapped in the SIS (refer to Figure 2.1) and set out in detail in the relevant SEEs. Additional ancillary works will be located within the area shown as the subject site and may include the creation of interim sediment and detention basins.

It is anticipated that the development applications for the bulk earthworks on these sites will be lodged in December 2012. This will prepare the sites for future construction and building works and assist in finalising the earthwork levels for the adjacent sites to the proposed Riparian Corridor.

### **S4 VEGETATION OF THE STUDY AREA**

Historically, the Western Precinct was used for ammunition storage bunkers and large numbers of concrete bunkers existed across the area until the 1990s. The Western Precinct was intensively mown and heavily grazed by kangaroos while it was used as a Defence site.



However, with a change of ownership the storage bunkers were removed and mowing has been reduced to areas of the perimeter of the Regional Park and the boundaries of the SMP. Under the provisions of SREP 30 the kangaroos have been subject to management and progressively reduced in numbers via implementation of a Macrofauna Management Plan (Cumberland Ecology 2005a). These land management changes since the late 1990s have allowed for regeneration of CPW across various parts of the SMP. Whereas large areas were mown and heavily grazed and open in the early 1990s, there has been a greater level of regeneration in recent times: by way of example, within the Regional Park there are broad areas of young sapling regrowth of CPW trees and shrubs, creating additional habitat on site for various plants and animals. Such regrowth of habitat has only occurred due to land management practices prescribed and implemented by the proponent since the gazettal of SREP 30.

Consequently, the vegetation of the study area can now be separated into various sub-units of the following vegetation types:

### **Cumberland Plain Woodland**

The vegetation of the Western Precinct contains Cumberland Plain Woodland (CPW) and grassland derived from the clearing of CPW (“derived native grassland”). CPW in the study area is described in various conditions / forms below:

#### *Mature CPW*

The CPW in the central portions of the Regional Park (which have been included in the eastern extent of the study area for the purposes of this SIS) generally contains mature CPW and other woodland types (Refer to Figure 4.4). The mature CPW contains a higher diversity of native species and is generally more structurally intact than the CPW within the rest of the Western Precinct. The mature areas of CPW contain a shrub layer, mostly of *Bursaria spinosa* (Blackthorn) and *Dillwynia sieberi* (Parrot-pea), characteristic species of CPW.

#### *Regenerating CPW*

The CPW present in the Western Precinct is considered to be occurring in a more simplified regenerating form of the community, compared with the regeneration taking place in the Regional Park, possibly because of the historically higher levels of disturbance. There is a visually obvious and statistical difference between the condition (measured by abundance cover of exotic species in each stratum) and the diversity of species present in the CPW of the Western Precinct and that of the Regional Park. This includes woodland of a similar age of regeneration (the sampling area referred to as Area B in this SIS) as shown in the statistical analysis provided in Section 4.3.2. This observation is further supported by previous resilience assessment data collected by Ian Perkins in 1999 that resulted in modifications to the Regional Park boundary (as at the time of the surveys) to include Area B, which was historically cleared (prior to 1940) and maintained as open grassland with scattered mature trees through heavy kangaroo grazing and slashing until 2000 as with the land within the approved Western Precinct limits (the subject land) (Refer to Figure 4.4).

#### *Derived Native Grassland*

The vegetation of the Western Precinct contains grassland derived from the clearing of CPW (“derived native grassland”). This grassland has been extensively surveyed, and can be further characterised by a large zone dominated by exotic grasses (predominately *Axonopus fissifolius*) and few native herbs and shrubs, and a smaller zone in the north of the Precinct dominated by native grasses and the inclusion of a higher diversity of native herbs and shrubs. Although both forms of grassland are considered to be derived from the past clearing of CPW, the latter category is likely to have a higher resilience and is associated with the historically less disturbed portions of the SMP.

### **Shale Gravel Transition Forest**

As its name suggests, Shale Gravel Transition Forest (SGTF) is a transitional plant community which grades into CPW where the influence of gravel soil declines, and grades into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thicker. There is a natural continuum of soil in this spectrum, and it can be difficult to separate out these communities, at the middle of the shale-gravel spectrum. In a new CEEC listing under the EPBC Act, a single community called *Cumberland Plain Woodland and Shale-gravel Transition Forest* is described.

The NSW Scientific Committee description for SGTF includes a slightly different species composition to CPW, based on the local presence of lateritic gravel in the soil. The community is dominated by *Eucalyptus fibrosa* with *E. moluccana* also occurring less frequently. Shrub species are similar to those found in CPW but more commonly include shrubs from the pea family, including threatened species such as Parrot pea, and has also been observed to contain high numbers of *Grevillea juniperina* subsp. *Juniperina*.

Large areas of SGTF occur in the eastern portions of the SMP, mostly to the east of the current study area extent. This community is considered to be a minor affected EEC, but is not likely to experience significant habitat loss and therefore is not considered as a major affected EEC.

This community has been previously mapped in the Western Precinct. The floristics surveyed during the preparation of this SIS suggest that the vegetation patches are not substantially different across the subject land, and therefore it has all been considered to be CPW in this SIS, which is of higher conservation status under the TSC Act.

### **River-flat Eucalypt Forest**

River-flat Eucalypt Forest (RFEF) has a limited occurrence in the Western Precinct, in simplified regenerating form in the south east of the Precinct as a 10m wide band either side of the drainage line. Although it has a limited distribution within the precinct (only 0.7ha), it adjoins more extensive areas of Alluvial Woodland in the Regional Park along the tributary to South Creek.

The vegetation is patchy, with the eastern extent being more intact and exhibiting more of the indicative species of this community, while the western extent is more closely related to CPW. The canopy is mostly dominated by *Eucalyptus tereticornis* (Forest Red Gum) but also includes *Angophora floribunda* (Rough-barked Apple), *Casuarina glauca* (Swamp Oak) and



*Eucalyptus amplifolia* (Cabbage Gum). In the more intact sections, a small tree layer occurs with *Melaleuca linariifolia* and *Acacia floribunda* being present.

This community will experience some habitat loss, and could be indirectly affected by downstream impacts. It is therefore considered as a minor affected EEC.

### **Freshwater Wetlands**

Sedgeland, a form of Freshwater Wetlands, occurs in very small local patches throughout the precinct, generally artificially created by a small scraping of the soil that results in a small depression. These areas usually are too small to warrant mapping, being only a few square metres in area and have therefore been included in the grassland mosaic. Three larger areas of Freshwater Wetlands have been mapped: the area surrounding the dam in the south western corner of the precinct, largely included in the Regional Park, a small soak in the centre of the subject site, and also an area along a drainage line in the eastern section of the precinct.

### **Planted Trees**

There are also areas of planted, non-indigenous trees. These mainly consist of rows of *Corymbia maculata* (Spotted Gum) on the western boundary, along the Northern Road. A patch of *C. maculata* was planted (in approximately 1990) as a scientific trial (pers comm. Ian Doyle, Lend Lease). This patch occurs in the south east of the subject land. These planted canopy trees have an understorey that is consistent with CPW, and therefore have been included in the area of CEEC, despite the non-indigenous canopy cover.

This community is not listed under the TSC Act (or EPBC Act).

## **S5 SUBJECT SITE AND LAND AND AFFECTED FLORA AND FAUNA**

For the purposes of the SIS, the land directly affected by the proposal is defined as the “**subject site**”. The subject site comprises a single DA for the implementation of the village oval, education/residential precinct and the village 12 site within the Western Precinct (Refer to Figure 2.1).

The subject site sits wholly within the “**subject land**”, which corresponds to the area covered by the Western Precinct (Refer to Figures 2.1, and 2.2).

The “**study area**” comprises the subject site, the subject land and adjacent areas that could be directly or indirectly impacted by the proposed development. This includes proximate areas of the Western Precinct, the Regional Park, and land adjoining the SMP (Refer to Figure 2.2).

The “**locality**” is defined as the area within a 10km radius of the centre of the subject site, as determined by the DGRs (Refer to Figure 2.3).

This SIS evaluates subject flora and fauna, known or considered likely to occur in the locality (“subject (C)EECs/species”), and then determines those which are most likely to be affected by the proposed development (“affected (C)EECs/species”). Affected (C)EECs/species means those threatened species, populations and ecological communities that are likely to experience impacts from the proposal.

The SIS distinguishes between “major” and “minor” affected (C)EECs/species (this includes populations and communities). Major affected (C)EECs/species are those that will definitely experience a measureable loss of habitat. Minor affected (C)EECs/species are those species that occur (or are considered likely to occur) in the study area and which may experience small or very minor impacts to habitat, either directly or indirectly.

### **S5.1 Major Affected (C)EECs/species**

The major affected (C)EECs/species include those known from the subject land that will experience a loss of individuals from the population on the SMP. The major affected (C)EECs/species that are considered in detail in the SIS are:

- Cumberland Plain Woodland: occurs predominantly in the form of a variant known as low diversity Derived Native Grassland across most of the subject site, with scattered patches of regenerating CPW predominantly in the northern parts of the subject site;
- Freshwater Wetlands: occurs as sedgeland in a shallow ephemeral wetland created by past soil scraping within the western part of the subject site;
- *Pultenaea parviflora* (Bush Pea): a single individual plant recorded on the subject site, within an area assessed as part of the approved Village 2 and Village 3 DAs; and
- Cumberland Land Snail (*Meridolum carneovirens*): recorded within mature and regenerating CPW across the entire study area and there is a high likelihood of occurrence given the presence of CPW habitat within the subject site.

### **S5.2 Minor Affected (C)EECs/species**

The minor affected (C)EECs/species include:

#### **Endangered ecological communities**

River-flat Eucalypt Forest and Shale Gravel Transition Forest: These EECs occur in the study area but will not be removed on the subject site.

#### **Flora population**

- *Marsdenia viridiflora* subsp. *viridiflora*: This species has been recorded in low numbers in the Regional Park and study area, within fairly close proximity to the subject land, but has not been recorded on the subject site.



### **Flora species**

- *Grevillea juniperina* subsp *juniperina*; and
- *Pimelea spicata* (Spiked Rice-flower)

These flora species have been recorded in the study area and the subject land, but not from within or adjoining the subject site.

### **Fauna species**

Microchiropteran Bats: East-coast Freetail Bat (*Mormopterus norfolkensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Eastern Bentwing Bat (*Miniopterus orianae oceanensis* (formerly *M. schreibersii oceanensis*)), Southern Myotis (*Myotis macropus*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*): These microbats have all been recorded on the SMP, and mostly within the study area. The habitats present on the subject land do not provide significant habitat for these species due to a lack of roosting habitat. However, they will experience a loss of foraging habitat to a relatively minor degree. For this reason, these microbats are considered to be minor affected (C)EECs/species.

Flying Fox: Grey-headed Flying-fox (*Pteropus poliocephalus*): As with the microbats, the subject land provides a relatively small area of foraging habitat for this species, No flying-fox camps are known to occur on or adjoining the study area.

Birds: Speckled Warbler (*Pyrrholaemus sagittata*), Varied Sittella (*Daphoenositta chrysoptera*), Diamond Firetail (*Emblema guttata*), Hooded Robin (*Melanodryas cucullata*). These small woodland birds have been recorded on the SMP and within the study area, although all within the Regional Park.

## **S6 IMPACTS OF THE PROPOSED DEVELOPMENT**

The proposal will result in direct impacts, indirect impacts and will contribute to cumulative impacts of development of the Western Precinct. As described below:

### **S6.1 Direct Impacts**

#### **S6.1.1 Vegetation communities**

The proposed development will occur within a landscape that has been extensively altered since European settlement. The subject site is vegetated by patches of regenerating CPW and low diversity Derived Native Grassland which conforms to the critically endangered listing of CPW under the TSC Act (and EPBC Act). A small area of Freshwater Wetlands, which is listed under the TSC Act will also be removed as shown in Table S.1.1.

**Table S.1.1 VEGETATION COMMUNITIES REMOVED FROM THE SUBJECT SITE AND CUMMULATIVE IMPACTS OF VEGETATION REMOVAL FROM THE SUBJECT LAND**

<b>Vegetation Communities Occurring within the Subject Land</b>	<b>Vegetation within the Subject Land (including Subject Site) (ha)</b>	<b>Vegetation to be removed within the Subject Site (ha)</b>
River-flat Eucalypt Forest (EEC)	0.9	0
Regenerating River-flat Eucalypt Forest (EEC)	7	0
Cumberland Plain Woodland (CEEC)	8	0
Regenerating CPW (CEEC)	47	3.87
Derived Native Grassland (CEEC)	9.2	0
Low diversity Derived Native Grassland (CEEC)	62	11.69
Freshwater Wetland (EEC)	0.8	0.06
Plantings	1	0
<b>TOTAL VEGETATION</b>	<b>136</b>	<b>15.62</b>
Non-vegetation (eg existing roads and cleared vegetation from approved DAs)	93.06	0.82
<b>TOTAL AREA</b>	<b>229.06</b>	<b>16.44</b>

## S6.2 Threatened species

The clearing of vegetation within the subject site will directly remove habitat for threatened species such as *Pultenaea parviflora* (Bush Pea) and the Cumberland Land Snail (*Meridolum corneovirens*), which have been recorded within or immediately adjacent to the subject site.

A single *P. parviflora* plant was recorded within the subject site, in an area that overlaps with an approved DA application and has been removed. No Cumberland land snails were recorded within the subject site but several individuals are likely to be removed given that CPW habitat is to be cleared. No other threatened flora or fauna species have been recorded within or immediately adjacent to the subject site and none are expected to be impacted by the proposed DA.

Some highly mobile fauna species such as microbats, and some small woodland birds that are known from the study area may experience minor habitat loss. However, the subject site, and Western Precinct as a whole, generally lack important habitat features, such as hollow-bearing trees. This paucity of habitat features suggests that it would be unlikely for these



species to be dependent on the habitats present. The Regional Park provides substantial habitat for these species.

Extensive mitigation measures will be implemented across the Western Precinct to minimise the impacts from development. Foremost amongst these is the 900 hectare Regional Park, which will conserve substantial habitat for all known species of threatened flora and fauna that have been recorded previously on the SMP.

### **S6.3 Indirect Impacts**

The subject site includes additional areas for works outside of the DA boundaries. This includes areas for ancillary works and other disturbance such as battering. There is also the chance of indirect effects, such as the spread of weeds, to impact on native vegetation in this area.

Most of the CPW on the subject site occurs as scattered patches of regenerating woodland, largely on the southern side. As these patches do not extend into the Regional Park, where the vegetation is of much higher quality, there is little potential for indirect impacts on the higher quality vegetation in the Regional Park via increases in edge effects and sedimentation or increases in number of feral species within the subject site.

However as further areas of CPW will be cleared from adjacent areas in the subject land which do extend into the Regional Park and, thus, could potentially have indirect impacts via edge effects, increased sedimentation or increase in feral animals, comprehensive mitigation measures, as described in Section 4.5 and detailed in the Western Precinct Biodiversity Assessment (Cumberland Ecology, 2009c), will be implemented to minimise potential impacts.

### **S6.4 Cumulative Impact of Development in the Western Precinct**

As detailed in the approved Western Precinct Plan (JBA 2009), the remainder of the Western Precinct is zoned “Urban” and is proposed for development as residential and commercial land. This will result in the removal of habitat for C/EECs and threatened species of relevance to the current proposal, consistent with the “balanced” outcome for the SMP site as a whole completed under SREP 30. This indirect impact will further fragment habitats in the study area to some degree, although the vegetation patches are already fragmented and the Western Precinct is at the western edge of the SMP and already bounded by residential and rural-residential land holdings. A summary of the maximum area of vegetation estimated to be removed is also presented in Table 5.1 and is referred to further in the detailed impact assessments presented below.

## **S7 MITIGATION MEASURES**

The foremost mitigation measure associated with the proposed development instituted under the established statutory planning framework provided by SREP 30, the EPS and the State Deed is the dedication of land for the creation of the 900 hectare Regional Park. This is supplemented by the provision of funding under the State Deed for the ongoing conservation, enhancement, management and rehabilitation of this land, which, together

with proposed open space areas, will total over 900 hectares of retained and improved habitat. As described within the approved Western Precinct Plan, this area will contain representative and viable occurrences of all known threatened species that occur in the SMP.

This is further supported by the following three documents prepared by the NSW Government:

- Cumberland Plain Recovery Plan (DECCW 2011);
- Draft EPBC Act Strategic Assessment Report for the Sydney Growth Centres Program (DECCW and DoP 2010); and
- Report on the methodology for identifying priority conservation lands on the Cumberland Plain (DECCW July 2010)

Importantly, the latter two of the listed studies above identify the SMP Regional Park as a Priority Area/Priority Conservation Lands for the management and recovery of the Cumberland Plain.

As described within the Western Precinct Plan, there are a suite of management plans currently being implemented for weeds, domestic and feral animals, and macrofauna. Each of these plans contains multiple measures aimed at safeguarding the areas proposed for conservation within the 900ha Regional Park and open space areas of the SMP.

Such mitigation measures are also considered as part of the offset package for the Western Precinct development. Such measures go beyond those generally provided by traditional offsets, which usually require a more simplified level of contribution, dedication or management. The additional measures at SMP include significant financial investment measures, including the funding of the Macrofauna Management Plan (MMP). The MMP manages the kangaroo and emu population through fertility control measures. This has greatly reduced the severity of grazing impacts on the regeneration of CPW and other (C)EECs within the SMP. Trials for kangaroo exclusion and grassy woodland recovery have also been funded by the proponent prior to the transfer of ownership to OEH.

The above mitigation measures are explained in further detail within this SIS.

## **S8 CONCLUSION**

The proposed development of the subject site and subject land will remove a relatively small area of habitat for CPW (primarily 'low diversity Derived Native Grassland'). However, and with due consideration of the restricted distribution of this CEEC in the region, the proposed development is not likely to have a significant impact on CPW such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected and enhanced through a range of mitigation measures identified and retained in perpetuity in public ownership.



The major affected (C)EECs/species impacted by the proposed development are *P. parviflora* and the Cumberland Land Snail. The young regenerating CPW on the subject site provides an area of habitat for *P. parviflora*, the Cumberland Land Snail as well as other potentially occurring threatened plants as well as some potential foraging habitat for wide ranging threatend fauna species. However, when directly compared with the habitats of the Regional Park, these areas of habitat are considered to be degraded and of a lesser significance due to the increased level of disturbance, sparse nature and comparatively small size. Therefore, the loss of this habitat on the subject site is not considered to be significant.

The impact of the proposal will be more than balanced by the major conservation outcome resulting from of the creation of the 900ha Regional Park. The Regional Park comprises CPW of quality and scale in a consolidated land holding, to be transferred into public ownership and subject to a fully funded Plan of Management.

When weighed against the conservation benefits, both direct and indirect, that will be derived from the 900ha Regional Park, together with the various mitigation measures afforded by the management strategies for weeds, feral and domestic animals and macrofauna, the relatively small areas of natural and semi-natural vegetation to be cleared as a result of the proposal are considered to be of minor consequence. This SIS concludes that the proposal will not result in any local populations of threatened species or occurrences of ecological communities becoming extinct. Known occurrences of threatened flora and fauna within the SMP are predicted to be secure in the long term as a result of the creation of the 900ha Regional Park and numerous supporting mitigation measures that are enshrined in a legal, statutory planning framework.

# Introduction

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## 1.1 Purpose

This document is a Species Impact Statement (SIS) that has been prepared to assess the impacts of a proposed residential subdivision and site works for a village oval, education/residential precinct: lot 8 in DP 1176874 and village 12 site: lot 11 in DP 1176163, within the Western Precinct of the St Marys Property (SMP) in western Sydney. The SIS has been prepared in accordance with Section 109 and 110 of the *Threatened Species Conservation Act 1995* (TSC Act) and with the requirements of the Director General of the Office of Environment and Heritage (OEH), copies of which are provided in Appendix A.

The main objectives of this SIS are to:

- Identify threatened species issues and provide appropriate amelioration strategies to minimise adverse impacts resulting from the proposal;
- Provide an appropriate level of background information and assessment to facilitate determinations and licensing processes;
- Assist consent and determining authorities in the assessment of the development application under Part 4 or request for Part 5 approval under the Environmental Planning and Assessment Act 1979 (EP&A Act);
- Assist the Director-General of the OEH in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act;
- Assist the Director-General of the OEH or the Minister for the Environment when consulted for the purposes of Parts 4 or 5 of the EP&A Act;
- Assist the Director-General of the OEH in the assessment of Section 91 Licence applications lodged under the TSC Act; and
- Provide preliminary information if needed to the Department of Sustainability, Environment, Water Population and Communities (SEWPaC) to assist the assessment of a Referral if the proposal is referred to SEWPaC.



Throughout the SIS the section order and heading titles are replicated from the DGRs. In order to demonstrate how each SIS section complies with statutory requirements a comprehensive compliance table is included in Appendix A.

## 1.2 Approvals and Licences

This SIS has been prepared in accordance with Sections 109 and 110 of the TSC Act, which describes the form and content of a SIS, with the exception of those matters limited or modified in the DGRs as listed in Section 1.4 below. The requirements of the Director-General of the OEH were sought pursuant to Section 111 of the TSC Act.

### 1.2.1 State Government Instruments

Planning instruments that relate to the development of the Western Precinct include:

- Sydney Regional Environmental Plan 30 (SREP 30) (DUAP, 2001b); and
- St Marys Environmental Planning Strategy 2000 (EPS 2000) (DUAP, 2001a); and
- St Marys State Development Agreement December 2002.

#### i. SREP 30

*Sydney Regional Environmental Plan No. 30 – St Marys* provides a framework for sustainable development and management of land to which SREP 30 applies, including the Western Precinct. SREP 30 addresses proposals for a Regional Park, regional open space, urban and employment lands and establishes town planning, urban design and environmental conservation principles to guide the long-term development and conservation of the SMP.

Under SREP 30, a draft Precinct Plan is to include proposals for and information about:

*“management of the potential impacts of development on the existing physical and environmental characteristics of the land, including significant native flora and fauna habitat and soil characteristics. The information is to include specific details of those characteristics and to explain how development should be planned and configured to minimise adverse impacts on areas of significance for biodiversity.”*

Part 5 of SREP 30 outlines performance objectives for the development of the SMP. Those outlined for conservation are:

- (1) *A representative and significant proportion of the natural values of the land are to be conserved within a regional park in order to protect the variety of Western Sydney vegetation communities, native flora and fauna species and fauna habitat;*
- (2) *Urban design and site planning in the Employment and Urban zones are to have regard to significant stands of trees and, where practicable, retain those trees;*

- (3) *Adverse impacts on the vegetation and fauna habitats within the Regional Park and Regional Open Space zones resulting from the development of areas zoned Employment or Urban are to be minimised;*
- (4) *Infrastructure is to be designed and located to minimise potential adverse impacts on the conservation values of the land; and*
- (5) *Infrastructure and recreational facilities within the regional park are to be sited and constructed to minimise adverse impacts on the park's natural values.*

ii. *EPS 2000*

The EPS 2000 (DUAP, 2001a) supports SREP 30 and outlines the strategies required to achieve the objectives outlined in SREP 30.

iii *State Deed*

The State Deed requires the delivery of a series of obligations during implementation of the SMP. These obligations include the staged transfer and dedication of 900ha of land to the NPWS as a Regional Park, monetary contributions towards capital improvements and a Plan of Management and the erection of stock proof fencing.

The State Deed provides legal certainty for the delivery of obligations at specific milestones. Together with the SREP 30 and the EPS, the State Deed provides the broader statutory framework for the facilitation of future development of SMP on an agreed basis.

At this point in time – partway through the development - the first element of the Regional Park has already been dedicated (Wianamatta Regional Park), relevant monetary contributions made, Plan of Management adopted and initial stock proof fencing erected.

### **1.2.2 *Local Government Policies***

The Western Precinct is located within the Penrith LGA. However, under the terms of the SREP 30, the no Penrith LEP or DCP apply to the SMP. Penrith City Council (PCC) has produced a document entitled *Sustainability Blueprint for Urban Release Areas* (PCC, 2005). Whilst not an environmental planning instrument, this document outlines the key aims of PCC in relation to ensuring the sustainability of future urban development. The objective of this document, as it relates to biodiversity, is “*to retain and conserve indigenous vegetation and wildlife habitat and corridors*” (PCC, 2005). This requires areas of high conservation value to be identified within urban development areas and to be excluded from development; biodiversity corridors to be established that link corridors of regional significance; and requires the submission of a Flora and Fauna Strategy which outlines how indigenous vegetation and wildlife habitat will be retained and conserved. The objectives of the PCC document are addressed in the Western Precinct Plan and achieved across the SMP site as a whole.

### **1.2.3 *Australian Heritage Commission Register of National Estate***

The majority of the 900ha Regional Park is listed on the Australian Heritage Commission Register of National Estate. The vegetation within this area is referred to in the National



Estate as an important remnant of the vegetation communities that were once widespread on the Cumberland Plain and include Cumberland Plain Woodland and Castlereagh Woodland. The Register of National Estate place description also makes reference to significant flora and fauna, including threatened plants and examples of the Cumberland Plain Woodland bird assemblage. The developments proposed for the Western Precinct will adjoin Regional Park land along the eastern boundary.

### 1.3 DGR Matters Which Have Been Limited or Modified

The following Section 110 Matters need not be addressed by this SIS

- Section 110(2)(g) and 110(3)(d). The matters raised in this section of the TSC Act have been clarified by the requirements below.

The following Section 110 matters need only be addressed where relevant:

- Threat abatement plans

At this time, no threat abatement plans have been approved that are relevant to this proposal.

- Recovery plans:
  - Bush Stone Curlew Recovery Plan
  - Cumberland Plain Recovery Plan
  - *Persoonia nutans* Recovery Plan
  - *Pimelea spicata* Recovery Plan

Of these recovery plans, only the Cumberland Plain Recovery Plan and the *Pimelea spicata* recovery plan are of relevance to the current proposal, due the presence, or potential presence of the species/communities on the subject site. Although *Pimelea spicata* has not been recorded on, or adjoining the subject site, there is potential for this species to occur, given the marginally suitable habitat present within the subject land, and the difficulty in detecting this cryptic herb, therefore consideration of the recovery plan has been included in this SIS.

- Key Threatening Processes:
  - Clearing of native vegetation
  - High frequency fire
  - Loss of vegetation structure and composition
  - Loss of hollow-bearing trees

➤ Critical habitat

At this time, no areas of declared critical habitat are relevant to this proposal.

## 1.4 Terminology

**Abundance:** means a quantification of the population of the species or community.

**Affected (C)EECs/species:** means subject species, populations and communities likely to be affected by the approved components of the project.

**Conservation status:** is an indicator of how likely it is to remain alive at present or in the near future. Many factors are used to assess a species' conservation status, including: the number remaining, the overall increase or decrease in the population over time, breeding success rates and known threats.

**Development:** as defined in the EP&A Act means:

- (a) the use of land, and
- (b) the subdivision of land, and
- (c) the erection of a building, and
- (d) the carrying out of a work, and
- (e) the demolition of a building or work, and
- (f) any other matter or thing referred to in section 26 that is controlled by an environmental planning instrument, but does not include any development of a class or description prescribed by the regulations for the purposes of this definition.

**Director-General:** means the Director-General of the Department of Premier and Cabinet.

**Locality:** means the area within a 10km<sup>2</sup> radius of the centre of the subject site.

**OEH:** means the NSW Office of Environment and Heritage (formerly the NSW Department of Environment, Climate Change and Water). The OEH is a division of the NSW Department of Premier and Cabinet

**Proposal:** is the development, activity or action proposed.

**PLGA:** Penrith Local Government Area;

**Region:** as defined in the TSC Act, means for the purposes of the provision in which it is used, a bioregion defined in a national system of bioregionalisation that is determined (by the



Director-General under subsection (4)) to be appropriate for those purposes. In this case, the Bioregion refers to the Sydney Basin Bioregion.

**Significant species:** means species not listed in the TSC Act but considered to be of regional or local significance.

**Study area:** means the subject site, subject land and any additional areas that are likely to be affected by the proposal, either directly or indirectly. For the purposes of this SIS, the study area includes proximate areas of the proposed St Marys Regional Park

**Subject land:** means the entire Western Precinct, as defined under the Regional Environmental Plan for St Marys (SREP 30).

**Subject site:** means the area directly affected by the proposal, specifically the village oval, education/residential precinct: lot 8 in DP 1176874 and village 12 site: lot 11 in DP 1176163.

**Subject species:** means those threatened species that are known or considered likely to occur in the study area.

**SREP 30:** Sydney Regional Environment Plan 30, Amendment No. 2, as shown in Figure 1.2;

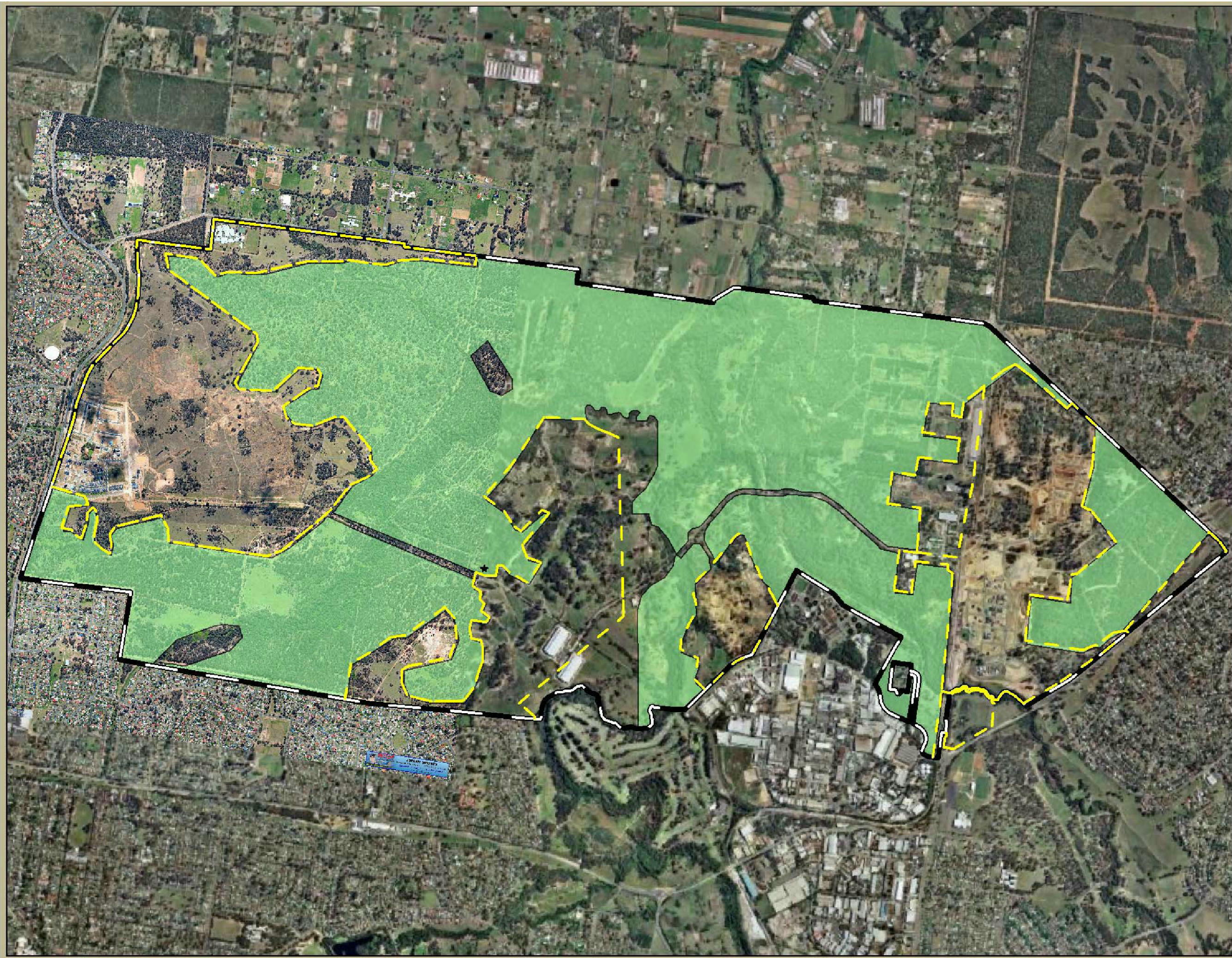
**State Deed:** The St Marys State Development Agreement

**St Marys EPS:** St Marys Environmental Planning Strategy 2000;

**St Marys Property (SMP):** encompassing land marked in Figures 1.1 and 1.2;

**Western Precinct:** encompassing the land identified as such in Figure 1.2.





**Legend**



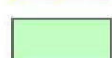
-  St Marys Property Boundary
-  Precinct Boundary
-  Regional Park

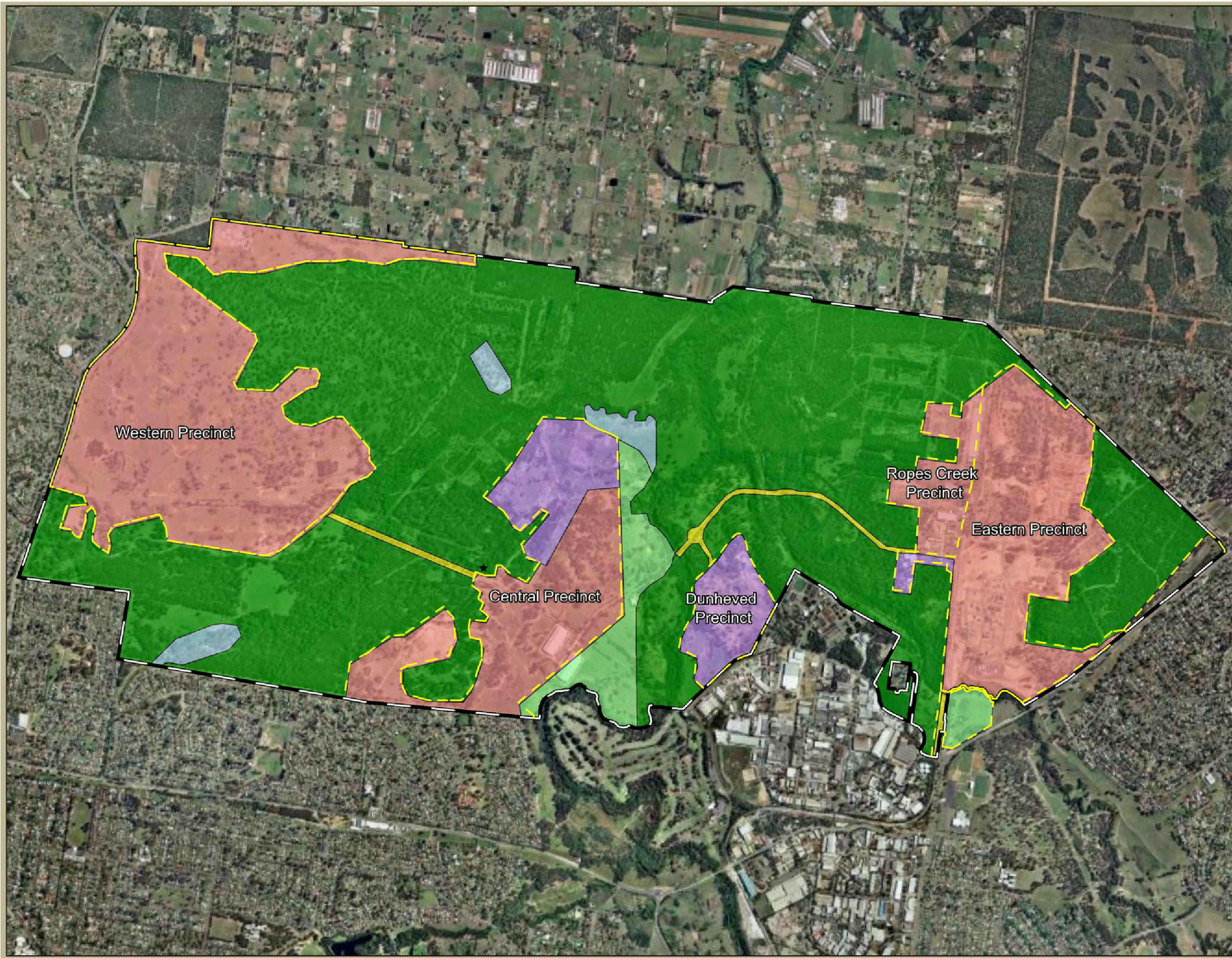
Image Source:  
©2011 Sinclair Knight Merz & Fugro  
©2011 Skycam Australia



Figure 1.1. Aerial photograph of the St Marys Property







**Legend**

- St Marys Property Boundary
- Western Precinct Boundary

**Zone**

- Employment
- Road and Road Widening
- Drainage
- Regional Park
- Urban
- Regional Open Space

Image: ©2011 Sinclair Knight Merz & Fugro



Figure 1.2. Zoning of the St Marys Property (SREP 30 Ammendment 2)





## Contextual Information

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### 2.1 Background

#### 2.1.1 *St Marys Property*

The SMP comprises 1,545 ha of land which is situated north of St Marys and north-east of Penrith on the Cumberland Plain in Western Sydney. The SMP incorporates areas of cleared agricultural land, developed areas and areas of regenerating Western Sydney Woodland vegetation (ERM, 2000). The site is adjoined on three sides by urban development and to the north by lands used for agricultural purposes.

Historically, there is evidence that the site was occupied continuously by Aborigines prior to European settlement. From 1803 the site was surveyed, settled, cleared and used for farming purposes by Governor King's family.

Generally, farming in the St Marys area centred on cattle with the nearby St Marys saleyards being the second largest in rural New South Wales during the 60 years of its operation from the 1880s. Within the SMP, the ruins of the former Beacroft Butchery and slaughter yard are to be found.

In 1924, the lands generally comprising the SMP were consolidated into one parcel by a grazier, Mr JW Fisher. Following the outbreak of World War II, the Australian Government established an explosives and munitions filling factory on these lands, which had by then been resumed from various farmers, including JW Fisher. These manufacturing operations were established in two major waves during World War II and later during the 1950's. Extensive works were undertaken on the site involving the construction of more than 800 buildings, a transport network including roads and railway lines, as well as major services infrastructure and telecommunications facilities. The site was segregated into small areas by security fencing for both safety and security reasons. This complex of munitions factories operated until production ceased in 1994. The site has subsequently been decontaminated, and the great majority of the buildings and other infrastructure demolished and removed.

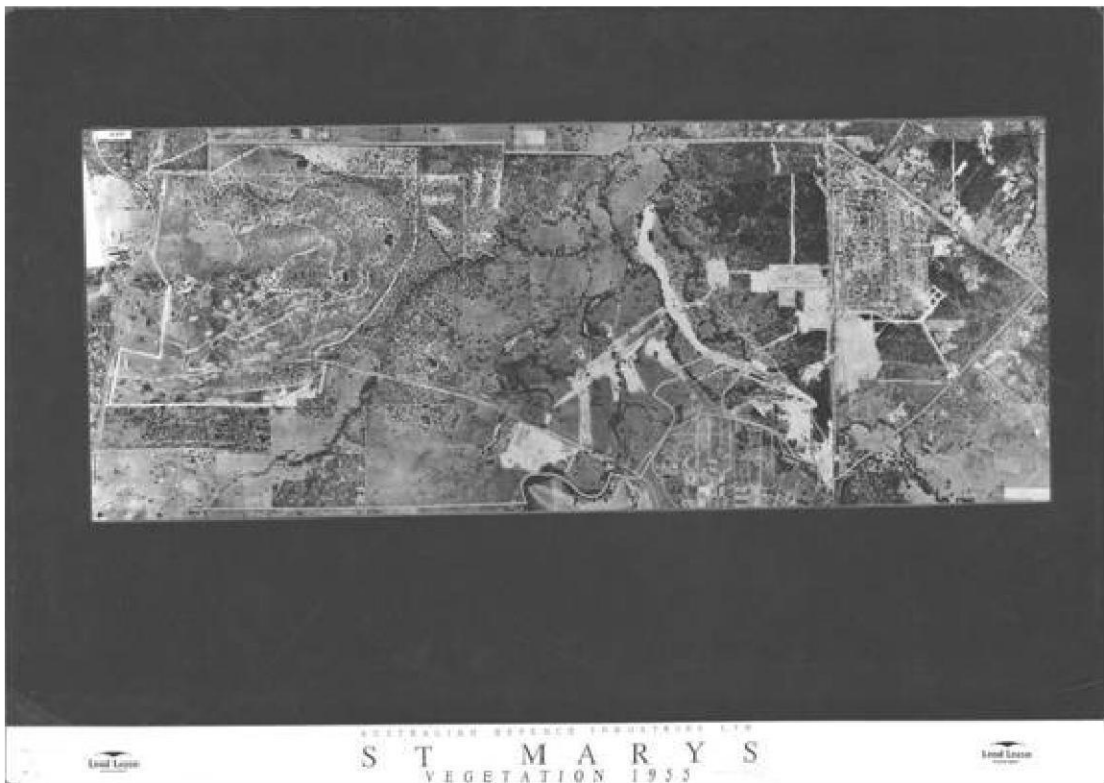
The flora and fauna of the SMP have been extensively surveyed and analysed over the last 28 years (Gunninah, 1991, Gunninah, 1995, Gunninah, 1997, ERM, 1997, ERM, 1998, ERM, 2000, Kinhill, 1995, Cumberland Ecology, 2004a, Cumberland Ecology, 2004c, Cumberland Ecology, 2005). The native vegetation within the St Marys Property has survived decades of use and clearing since European settlement. The entire property experienced tree clearance and pastoral activities prior to the 1940s (ERM, 2000). Most of



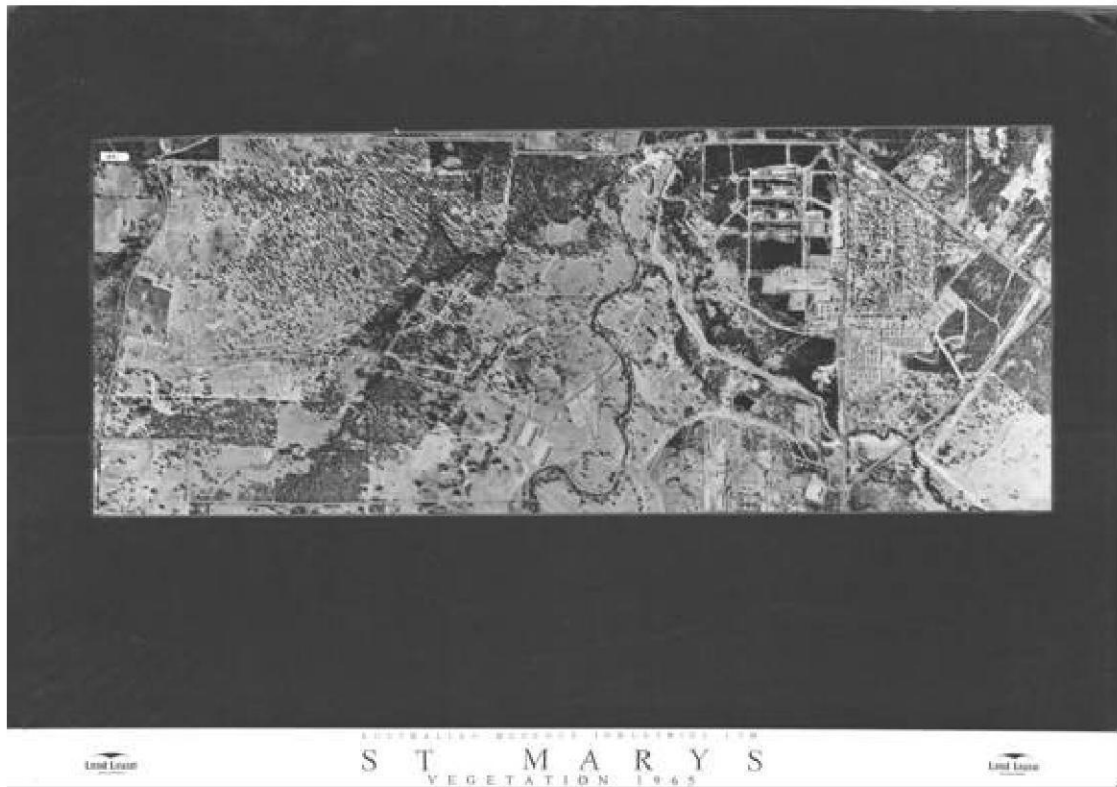
the native vegetation is regenerating from earlier episodes of clearing (NSW NPWS, 2000a, Gunninah, 1995, Gunninah, 1997). Photographs 1.1 – 1.4 depict these transitions. Despite being shaped by these previous management actions, the remnant Cumberland Plain Woodland and other vegetation communities present on the site support flora and fauna species of acknowledged significant conservation value.



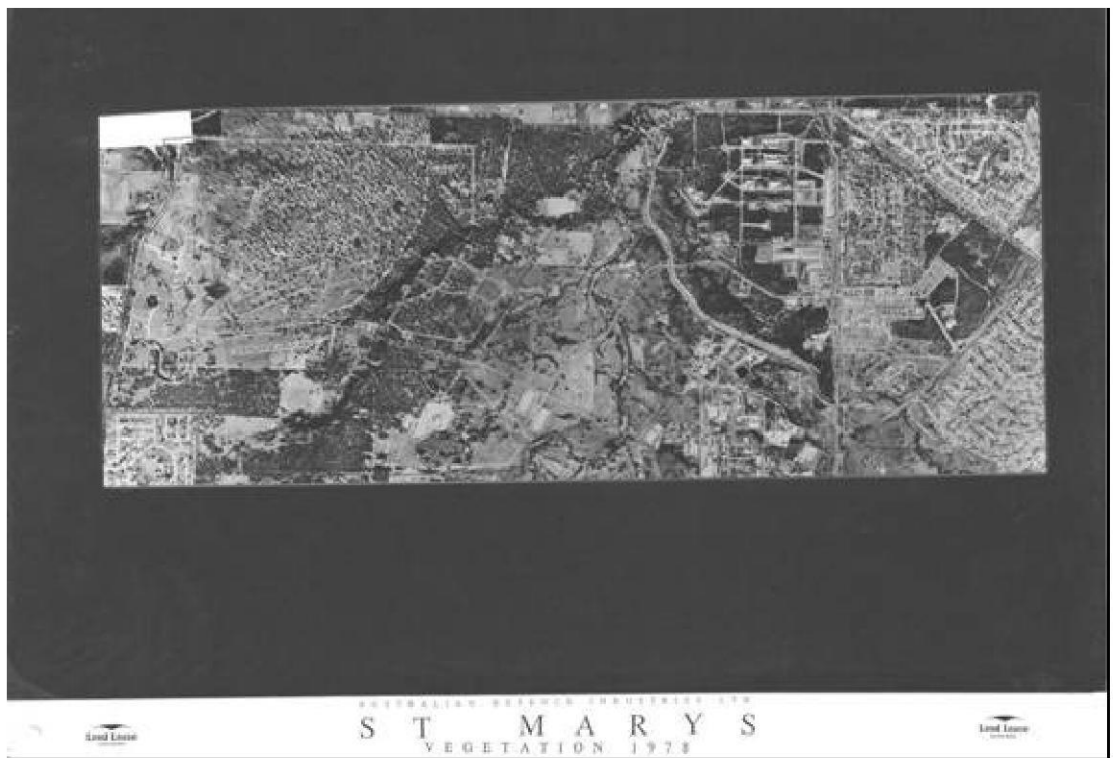
**Photograph 2.1 Aerial photograph of St Marys Property, 1947**



**Photograph 2.2 Aerial photograph of St Marys Property, 1955**



**Photograph 2.3 Aerial photograph of St Marys Property, 1965**



**Photograph 2.4 Aerial photograph of St Marys Property, 1978**



The former Australian Defence Industries (ADI) site at St Marys was endorsed by the NSW Government for inclusion on the Urban Development Program (UDP) in 1993. The site was seen to present an opportunity to provide housing for Sydney's growing population within an environmentally sustainable framework.

Given that the site straddles the boundary between two local government areas (Blacktown and Penrith); the Government decided that a regional environmental plan should be prepared for the site. Technical investigations into the environmental values and development capability of the land were commenced in 1994, and the Regional Environmental Plan for St Marys (SREP 30) (DUAP, 2001b) was gazetted in January, 2001. It zoned the land into "urban", "employment", "regional open space", and "regional park" uses (Refer to Figure 1.2). Appendix F includes a flowchart (JBA Planning 2011) of the chronology of the statutory process.

In view of the original scale of the residential and employment uses, a package of documents was prepared to guide and control development. It comprised SREP 30 (maps and written instrument) (DUAP, 2001b), and an Environmental Planning Strategy (EPS) (DUAP, 2001a) which sets out performance objectives and strategies to address key aspects associated with the site, including: conservation, cultural heritage, water and soils, transport, urban form, energy and waste, human services, employment, and land contamination.

The State Development Agreement (State Deed) was entered into between the landowner and developers of the land (a Joint Venture comprising ComLand and Lend Lease Development), and the NSW Government in December 2001. The State Deed sets out the specific obligations and responsibilities in providing, amongst other things, services, infrastructure, monetary contributions and land in support of the SMP. These obligations include, amongst other things, the following relevant contributions:

- The staged transfer and dedication 900ha of land to the NPWS as a Regional Park for the sum of \$3 (three dollars);
- Staged monetary contributions (c\$6m) towards capital improvements within the 900ha Regional Park;
- Monetary contributions towards a Plan of Management for the 900ha Regional Park; and
- The erection of stock proof fencing in stages along the boundaries of the 900ha Regional Park.

The State Deed provides legal certainty for the delivery of obligations at specific milestones. Together with the SREP 30 and the EPS, the State Deed provides the broader framework for the facilitation of future development of SMP on an agreed basis.

SREP 30 (DUAP, 2001b) identified 6 development "precincts" (known as the Western Precinct, Central Precinct, North and South Dunheved Precincts, Ropes Creek Precinct and Eastern Precinct) and requires a precinct plan be adopted by the relevant council prior to any development taking place.

To date the Precinct Plans for the Eastern Precinct, Ropes Creek Precinct, Dunheved Precincts, Central Precinct, Western Precinct have been prepared, exhibited and adopted by the relevant Councils and development is being progressed on a staged basis. As a result, the SMP is one of the largest single Greenfield Release Area in the Metropolitan Development Program and critical to the delivery of housing numbers for Metropolitan Sydney.

Planning for any precinct is to address all of the issues in SREP 30 and the EPS, including preparation of management plans for a range of key issues such as weed management, feral and domestic animal management and bushfire management.

A Macrofauna Management Plan for the entire site needed to be submitted before or at the same time as lodgement of the first Precinct Plan (Eastern Precinct), under section 4.4 (15) of the EPS. The plan is required to account for displacement of macrofauna through the loss of habitat that would occur as a result of development of the SMP.

In March 2002, the Commonwealth Government advised that those areas of the site listed on the Register of the National Estate should be excluded from urban development. This had the effect of changing the boundaries of the areas to be set aside for conservation. The precincts for development are shown in Figure 1.1.

The Minister for Planning has declared the Eastern Precinct, North and South Dunheved Precincts, Ropes Creek, Central and Western Precinct as Release Areas for development. All Precinct Plans have been prepared, exhibited and adopted by the relevant Council. Development is currently underway in the Eastern Precinct and Ropes Creek Precinct and has recently commenced in the Western Precinct, Since the endorsement of the Macrofauna Management Plan in 2004, 27 permanent kangaroo grazing monitoring plots have been surveyed annually in the Regional Park. These include grazing-excluded and open plots in CPW. The plots have been surveyed five times by Cumberland Ecology, resulting in a comprehensive species list for the community on the SMP, as well as an indication of the condition of CPW in the Regional Park. Four out of the six locations of plots are in sections of the Regional Park surrounding the Western Precinct.

A compilation of survey methods and results from the reports available to Cumberland Ecology is found in Chapter 4.

### **2.1.2 Western Precinct**

Following surveys completed for the EPS Environmental Planning Strategy and SREP 30 that covered the entire SMP, the key surveys in the Western Precinct include those completed for the additions to the land on the Register of National Estate:

- ERM (1998) Addendum to Objection to Interim Listing of ADI St Marys Site in the Register of the National Estate Submission to the Australian Heritage Commission. Environmental Resources Management Australia, Sydney (ERM, 1998).
- Perkins, I. (1999) Flora Assessment of the Disputed Areas of Western Sydney Shale Woodlands Ian Perkins Consultancy Services, Sydney (Perkins, 1999).



The main purpose of these assessments was to determine if any land in the western portion of the SMP should be included in the listing of National Estate. The land on the Register of National Estate on the SMP has formed the land zoned as Regional Park.

Perkins completed a resilience survey over the SMP that included analysis of canopy regeneration, proportion of native ground cover species and soil disturbance to determine viability of land that had been used for grazing. The majority of the western portion of the SMP had been cleared and grazed by sheep and kangaroos. Some areas at the time of assessment contained a scattering of large, old trees and the area of the denser coverage of trees was included on the Register of National Estate. This area was included as one large patch and did not include smaller scattered, isolated patches containing only a few trees.

The land on the Register of National Estate at SMP lies wholly within the land zoned “Regional Park” in the SREP 30 (confirmed via SREP 30 Amendment 1). The remaining area not included on the Register of National Estate formed the Western Precinct (zoned “Urban” in the SREP 30).

ERM commenced surveys for the development of the Western Precinct in 2000 with Dr David Robertson as Senior Ecologist. Original plans for the development of the SMP were focussed on developing the Western Precinct first but then the focus was changed to development of the Eastern Precinct first. Meanwhile, the surveys conducted by ERM were never published in a report but Dr Robertson retains a general knowledge of the findings of the surveys.

Since sheep grazing was removed approximately 10 years ago from the Western Precinct and the western portion of the Regional Park, listed on the Register of National Estate, there has been prolific eucalypt regeneration surrounding the old remnant trees, filling in the spaces between the older trees. However, much of the Western Precinct is still heavily influenced by the history of sheep grazing, including a high proportion of exotic pasture grass coverage and evidence of sheep camps where herbaceous weeds form thick coverage around the bases of large, old trees.

*i. Western Precinct Plan*

Further to the surveys undertaken from 1995 to 2001, Cumberland Ecology undertook vegetation surveys in 2007 and a condition assessment in 2008 as part of the Biodiversity Assessment prepared as part of the Western Precinct Plan (Cumberland Ecology, 2009c). It should be noted that the Biodiversity Assessment took into account transect and condition assessment data to 2008. The final modifications to the Biodiversity Assessment were made in 2009 to take into account the preliminary determination of CPW as a critically endangered ecological community.

The Western Precinct Plan was adopted in March 2009. This relates to a total of approximately 200ha of land, zoned “Urban” in SREP 30 (Amendment No. 2).

*ii. Stage 1, 2, 3 and 4 Development Applications*

The development applications for Stage 1 of the Western Precinct development, referred to as the future suburb of Jordan Springs, were submitted to Penrith City Council in August 2009. Subsequent DA's for Stages 2 & 3 were submitted in May 2011 and for Stage 4 in September 2012.. All submitted stages were approved under Part 4 of the EP&A Act, in accordance with the Western Precinct Plan.

*iii. Village Oval, Education/Residential Precinct and the Village 12 Site Development Application*

A DA is being prepared for submission for the proposed village oval, education/residential precinct and the village 12 site development of Jordan Springs.

The areas subject to the current DA are bounded by areas that are the subjects of other DAs. While some mature trees are present, the vegetation present in the subject site is dominated by grassland with scattered patches of young and degraded woodland in various stages of regeneration. Although, the development of the village oval, education/residential precinct and the village 12 site will further fragment representatives of the CPW community from the Regional Park and will remove an area of CEEC, the small area of CPW to be removed is not considered to constitute a significant impact in terms of Section 5A of the EP&A Act (the 7 Part Test) because of the large area and high quality of the CPW conserved in the Regional Park. However, on a precautionary basis, it has been agreed with Penrith City Council that all DA's for the Jordan Springs development area, that will involve the removal of TSC Act listed species and communities, will be accompanied by a SIS. For this reason, although the impacts of the current DA are not generally considered to be significant, a SIS has nonetheless been prepared.

## **2.2 Description of the Current Proposal**

### **2.2.1 Nature**

The current proposal involves the development of the village oval, education/residential precinct and the village 12 site (the "subject site") within the Western Precinct, the future residential suburb of Jordan Springs. The subject site is located within the central part of the Western Precinct and is bounded to the north by Village 3, to the east by Village 2, to the south by the proposed Village 4 and to the west by Village 1.

The locations of the subject land and subject site DA are shown in Figure 2.1. Additional ancillary works will be located within the area shown as the subject site and include the creation of an interim sediment and detention basin and culverts with relation to road infrastructure works.

*i. Buildings and other structures*

The proposal includes land subdivision and the ancillary works described above . All buildings and structures will be subject to future development applications.



*ii. Installation and maintenance of utilities*

All necessary utilities required to service a residential subdivision will be installed and maintained in the appropriate manner, in accordance with accepted standards.

*iii. Waste and Water Management*

Specific waste and water management requirements, including the establishment of interim stormwater and sediment detention basin will be detailed in engineering plans for future Development Applications. Waste management during construction would be in accordance with all relevant Council regulations.

*iv. Changes in surface water flows*

As a result of the transformation of the site from former defence uses / redundant land into a master planned residential community there will be changes to surface water flows across the site. These changes are set out in detail in the approved Western Precinct Plan - Water, Soils and Infrastructure report.

*v. Fire protection zones*

Asset Protection Zones (APZs) are required for all urban areas within 100 metres of a high or medium bushfire hazard and 30 metres of a low bushfire hazard. In accordance with the "Planning for Bushfire Protection 2006" guidelines and in agreement with the NSW Rural Fire Services (RFS), it is proposed to construct temporary APZs between the areas of proposed works and the areas of hazard. The temporary APZs will be managed by the landowner, in accordance with the NSW RFS guidelines until such time as permanent APZs have been put in place. The permanent APZs will be established through future stages of subdivision in accordance with the provisions of the RFS.

The details of the specific APZ requirements will be detailed in the future.

*vi. Landscaping*

Landscaping will include street tree planting and the creation of a village oval, as detailed in the approved Western Precinct Plan. All species used in planting are selected in accordance with Council requirements and avoid the use of species that may invade bushland. Please refer to the approved Western Precinct Plan.

### **2.2.2 Extent**

As described above, for the purposes of this SIS, the current proposal includes the village oval, education/residential precinct and the village 12 site of the Jordan Springs development. The total area of the proposed works within the DA comprises approximately 16.44 ha. Further details will be provided within the future DAs.

### **2.2.3 Location**

The DA is located within Jordan Springs of the St Marys Development project, Western Precinct, located on the Northern Road, St Marys NSW 2760

### **2.2.4 Timing**

Anticipated start- of- works to implement the proposed development are forecast for early – mid 2013. This timing is subject to planning consent being issued.

### **2.2.5 Layout**

The layout of the DA, identifying the subject site, is set out in the SEE and the extent of works is shown on the attached plan (refer to Figure 2.1). The layout conforms to the objectives, principles, and requirements of the strategic statutory framework (as set out in SREP 30 Sydney Regional Environmental Plan No.30, the EPS and the State Deed) - St Marys, the St Marys Environmental Planning Strategy 2000 and the local environmental planning instrument for the site (as set out in the, the Western Precinct Plan and Development Control Strategy (JBA 2009)) submitted to Penrith City Council in 2009.

### **2.2.6 Future Development of the Western Precinct**

Upon gazettal of SREP 30 Amendment No. 2 of State Regional Environmental Plan No. 30 – St Marys (SREP 30) in February 2009, the Western Precinct was wholly zoned Urban. Land zoned Urban is intended to primarily accommodate residential uses, with some limited non-residential development, such as local retail and commercial uses. The Western Precinct Plan (WPP) and accompanying Development Control Strategy (DCS) have been prepared and were adopted by Penrith City the Council at its ordinary meeting on 23 March 2009. These documents are to guide the future development of Jordan Springs.

The approved WPP illustrates the manner in which the Western Precinct (Jordan Springs) is to be developed. A copy of the overall Framework Plan which sets the direction for the development of the precinct is provided in the Precinct Plan (JBA 2009).

As illustrated in the Framework Plan, the proposed development of Jordan Springs entails:

- A Village Centre, comprising a mix of retail, commercial, community, open space and residential uses, in the southern part of the precinct;
- Predominantly residential development in the remainder of the precinct;
- Construction of roads, including external connections to The Northern Road and Ninth Avenue and east to the Central Precinct; and
- Provision of local open space, riparian corridors and stormwater basins.

It is anticipated that once fully developed Jordan Springs will accommodate approximately 2,450 dwellings with a residential population in the order of 6,400.



## 2.3 Land Tenure Information

The registered proprietor of the subject land is St Marys Land Limited. The 900ha Regional Park will be owned by the NSW Government and managed by the Office of Environment and Heritage, National Parks Division (formerly NPWS). Initial transfer has already taken place (Wianamatta Regional Park)

## 2.4 Vegetation

The vegetation communities of the Cumberland Plain have been mapped by the Office of Environment and Heritage (OEH) (then the Department of Environment, Climate Change and Water (DECCW) (Tozer 2003, DECCW 2007), including several updated versions based on more recent aerial photography, showing types and extent of canopy disturbance of vegetation communities, as shown in Figure 2.3. The DECCW map units have been verified and refined in parts of the study area by ground-truthing vegetation communities in the SMP (refer to Figure 4.7).

The following endangered ecological communities (referred to collectively as (C)EEC's) are known to occur within the study area:

- Cumberland Plain Woodland (in the form of Shale Plains Woodland, as mapped by DECCW 2007);
- River-flat Eucalypt Forest (in the form of Alluvial Woodland, as mapped by DECCW 2007);
- Shale-Gravel Transition Forest;
- Freshwater Wetlands on Coastal Floodplains

Within the locality, a much broader range of communities are known to occur. The distribution of these communities in the locality is shown in Figure 2.3.

As specified in the DGRs, the Biometric tool (Gibbons et al. 2008) was used to describe vegetation communities known or likely to be present in the locality. All vegetation communities mapped by NPWS (2002) were described by Tozer (2003), which has also been consulted during the preparation of the relevant ecological community descriptions, below.

### 2.4.1 *Cumberland Plain Woodland - Shale Hills Woodland*

The CEEC listing for Cumberland Plain Woodland corresponds closely to the Tozer (2006) description of: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin. The community occurs on clay/loam soils derived from Wianamatta Shale ridges in the area of north-east Sydney and is described as woodland with an open shrub layer and a grassy groundcover.

The canopy is dominated by Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*Eucalyptus tereticornis*) and is associated with Narrow-leaved Ironbark (*Eucalyptus crebra*) and Thin-leaved Stringybark (*Eucalyptus eugenioides*). The mid-storey is dominated by Blackthorn (*Bursaria spinosa*). The groundcover dominants are Kidney Weed (*Dichondra repens*), Poison Rock Fern (*Cheilanthes sieberi*), Threeawned Speargrass (*Aristida vagans*), Weeping Meadow Grass (*Microlaena stipoides*), Kangaroo Grass (*Themeda australis*), Blue Trumpet (*Brunoniella australis*), Slender Tick-trefoil (*Desmodium gunnii*), *Opercularia diphylla*, Sprawling Bluebell (*Wahlenbergia gracilis*), Shorthair Plumegrass (*Dichelachne micrantha*), *Paspalidium distans*, Paddock Lovegrass (*Eragrostis leptostachya*) and Wattle Mat-rush (*Lomandra filiformis*) (Tozer et al. 2006).

It is estimated that 95% of the original extent of this community has been cleared since European settlement.

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002), and descriptions by Tozer (2003) for Map Unit 10: Shale Plains Woodland is consistent with the Tozer (2006) description and also correspond to the mapping of Cumberland Plain Woodland.

#### **2.4.2 Cumberland Plain Woodland - Shale Plain Woodland**

The CEEC listing for Cumberland Plain Woodland corresponds closely to the Tozer (2006) description of: Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin. This community occurs on undulating terrain on shale hills of the southern Cumberland Plain at altitudes from 50-300m and is described as woodland with an open shrub layer and grassy groundcover.

The dominant canopy species are; Grey Box and Forest Red Gum, in association with Narrow-leaved Ironbark and Hickory Wattle (*Acacia implexa*). Mid-storey dominants include; Blackthorn, Native Raspberry (*Rubus parvifolius*) and Headache Vine (*Clematis glycinoides*). The groundcover is dominated by Kidney Weed, Blue Trumpet, Slender tick trefoil, Purple Wiregrass (*Aristida ramosa*) Weeping Meadow Grass, *Carex inversa*, Kangaroo Grass, Slender Flat-sedge (*Cyperus gracilis*), Shorthair Plumegrass (*Dichelachne micrantha*), Common Woodruff (*Asperula conferta*), *Oxalis perennans*, Poison Rock Fern, and Large Tick-trefoil (*Desmodium brachypodium*).

It is estimated that 90% of the original extent of this community has been cleared since European settlement.

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002), and descriptions by Tozer (2003) for Map Unit 9: Shale Plains Woodland are consistent with the Tozer (2006) description and also correspond to the mapping of Cumberland Plain Woodland.

#### **2.4.3 Shale Gravel Transition Forest**

The EEC listing for Shale Gravel Transition Forest (NSW Scientific Committee, 2002b) corresponds closely to the Tozer (2006) description of Shale-gravel Transition Forest (SGTF). It has a dominant canopy species of Broad-leaved Ironbark (*Eucalyptus fibrosa*) but Grey Box (*E. moluccana*) and Forest Red Gum (*E. tereticornis*) may also occur. Paperbark



(*Melaleuca decora*) dominates the understorey, with *Bursaria spinosa*, *Daviesia ulicifolia* and *Lissanthe strigosa* occurring in the shrub layer. Grasses and herbs occur in the ground layer. SGTF occurs mainly in the north of the Cumberland Plain, on gravel deposits over shale soils. Threats to SGTF include clearing, mining for gravel and weed invasion.

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002), and descriptions by Tozer (2003) for Map Unit 103: Shale Gravel Transition Forest are consistent with the Tozer (2006) description.

#### **2.4.4 Cooks River/Castlereagh Ironbark Forest**

The EEC listing for Cooks River/Castlereagh Ironbark Forest (NSW Scientific Committee, 2002a) corresponds closely to the Tozer (2006) description. Cooks River/Castlereagh Ironbark Forest (CRCIF) occurs in the Holsworthy and Castlereagh areas, and in the eastern section of the Cumberland Plain. The dominant canopy species are Broad-leaved Ironbark (*Eucalyptus fibrosa*) and Paperbark (*Melaleuca decora*). The understorey is typically dense and contains *M. nodosa*, *Lissanthe strigosa*, *Dillwynia tenuifolia*, *Pultenaea villosa* and *Daviesia ulicifolia*. The ground layer consists of grasses and herbs.

The community occurs on alluvial soils and can intergrade with Shale-Gravel Transition Forest. It is under threat from weed invasion, clearing, rubbish dumping and damage by vehicle access.

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002), and descriptions by Tozer (2003) for Map Unit 3: Cooks River/Castlereagh Ironbark Forest are consistent with the Tozer (2006) description.

#### **2.4.5 Alluvial Woodland**

The EEC listing for River-flat Eucalypt Forest corresponds closely with the Tindall et al (2004) description of: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin. This community occurs on stream banks and alluvial flats on the Cumberland Plain and is restricted to the Hawkesbury-Nepean and Georges River systems on alluvial soils derived from Wianamatta Shale. The community occurs as woodland with an open shrub layer and a continuous groundcover of grasses and forbs.

The dominant canopy species are; Forest Red Gum, Rough-barked Apple (*Angophora floribunda*), Cabbage Gum (*Eucalyptus amplifolia* subsp. *amplifolia*), associated with; Thin-leaved Stringybark and River Peppermint (*Eucalyptus elata*). Dominant mid-storey species include; Parramatta Wattle (*Acacia parramattensis*), Blackthorn and *Sigesbeckia orientalis*. Dominant groundcover species are; Weeping Meadow Grass, Basket Grass (*Oplismenus aemulus*), Kidney Weed, Bordered Panic (*Entolasia marginata*), Forest Nightshade (*Solanum prinophyllum*), Whiteroot, Forest Hedgehog Grass (*Echinopogon ovatus*), Slender Tick trefoil, Native Wandering Jew (*Commelina cyanea*) and Trailing Speedwell, (*Veronica plebeian*) (Tindall et al. 2004).

It is estimated that 95% of the original extent of this community has been cleared since European settlement.

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002), and descriptions by Tozer (2003) for Map Unit 11: Alluvial Woodland are consistent with the Tindall et al (2004).

#### **2.4.6 Freshwater Wetlands on Coastal Floodplains**

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee, 2004e)

This community is not described by any mapping projects of the Cumberland Plain.

#### **2.4.7 Sandstone Ridgetop Woodland**

Map Unit 31: Sandstone Ridgetop Woodland has been described by Tozer (2003) as occurring predominantly on sandstone ridgetops and plateaux, but may extend into shallow gullies. This community does not correspond to a State or Commonwealth listed threatened ecological community and is common in the locality.

Sandstone Ridgetop Woodland is dominated by Red Bloodwood (*Corymbia gummifera*) and Hard-leaved Scribbly Gum (*Eucalyptus sclerophylla*) with Saw Banksia (*Banksia serrata*) frequently present in lower abundance. A variety of other tree species occur more sporadically, including Grey Gum, Narrow-leaved Stringybark and Smooth-barked Apple. A diverse shrub layer commonly includes; Hairpin Banksia (*Banksia spinulosa* var. *spinulosa*), Broad-leaf Drumsticks (*Isopogon anemonifolius*), Slender Tea-tree (*Leptospermum trinervium*), Thyme Spurge (*Phyllanthus hirtellus*), *Dillwynia retorta* and *Eriostemon australasius* subsp. *australasius*. The ground stratum features species such as *Lomandra obliqua*, Wiry Panic, *Cyathochaeta diandra*, *Dampiera stricta* and *Austrostipa pubescens*.

#### **2.4.8 Upper Georges River Sandstone Woodland**

Map Unit 32: Upper Georges River Sandstone Woodland has been described by Tozer (2003) as occurring predominantly on the Mittagong Formations and typically found on upper slopes and ridges. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The canopy is dominated by Grey Gum and Red Bloodwood, with Narrow-leaved Stringybark and Black She-oak (*Allocasuarina littoralis*). Shrub species include Prickly Moses (*Acacia ulicifolia*), Sunshine Wattle (*Acacia Terminalis*), Narrow-leaved Wattle (*Acacia linifolia*), Narrow-leaved Geebung (*Persoonia linearis*), Slender Teatree and Dwarf Cherry (*Exocarpos strictus*). The ground stratum is often dominated by grass species such as Wiry Panic, Kangaroo Grass, *Austrostipa pubescens*, Threawn Speargrass and *Austrodanthonia fluva*.



#### **2.4.9 Western Sandstone Gully Forest**

Map Unit 33: Western Sandstone Gully Forest has been described by Tozer (2003) as occurring on the lower slopes of sandstone gullies on Hawkesbury Sandstone and Mittagong Formations. This community does not correspond to a State or Commonwealth listed threatened ecological community and is common in the locality.

The canopy is dominated by Smooth-barked Apple, Red Bloodwood and Blackbutt, with Grey Gum. A sparse layer of smaller trees is dominated by Christmas Bush (*Ceratopetalum gummiferum*) and Black She-oak. Shrub species include *Sunshine Wattle*, *Slender Teatree*, Narrow-leaved Geebung and Hairpin Banksia. In the ground stratum, the fern species Bracken (*Pteridium esculentum*) is invariably present, along with the climber Sweet Sarsaparilla (*Smilax glycyphylla*).

#### **2.4.10 Blue Gum High Forest**

The CEEC listing for Blue Gum High Forest corresponds closely with the Tozer et al (2006) description of: Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin. The community occurs on Wianamatta Shale ridges in the Hornsby area of north-east Sydney and exists as a tall open forest with a moist open shrubby understorey.

The canopy is dominated by Sydney Blue Gum (*Eucalyptus saligna*), Blackbutt and Smooth-barked Apple and in association with Forest Oak, Blueberry Ash (*Elaeocarpus reticulatus*) and Sweet Pittosporum. The shrub stratum is dominated by Coffee Bush, Prickly Beard-heath (*Leucopogon juniperinus*), Wild Yellow Jasmine, Orange Bark (*Maytenus silvestris*), Hairy Clerodendrum (*Clerodendrum tomentosum*), Handsome Flat Pea (*Platylobium formosum*), Elderberry Panax (*Polyscias sambucifolia*), Muttonwood (*Myrsine variabilis*), Bearded Tylophora (*Tylophora barbata*), Wombat Berry (*Eustrephus latifolius*) and Wonga Wonga Vine. The groundcover dominants are Spiny-headed Matt-rush, Common Maidenhair (*Adiantum aethiopicum*), Bordered Panic, Pastel Flower (*Pseuderanthemum variabile*), Blue Flax-lily, Rainbow Fern (*Calochlaena dubia*), *Oplismenus imbecillis* and *Poa affinis* (Tozer et al. 2006).

It is estimated that 90% of the original extent of this community has been cleared since European settlement.

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002) and descriptions by Tozer (2003) for Map Unit 152: Blue Gum High Forest are consistent with the Tozer et al (2006).

#### **2.4.11 Shale Sandstone Transition Forest**

The EEC listing for Shale Sandstone Transition Forest corresponds most closely to the Tozer (Tozer et al., 2006) description for: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin. This community occurs on transitional shale-sandstone soils around the edge of the Cumberland Plain at

altitudes up to 350m and is described as woodland with an open shrub layer and a grassy groundcover.

The dominant canopy species are; Narrow-leaved Ironbark (*Eucalyptus crebra*), Broad-leaved Ironbark (*Eucalyptus fibrosa*) and Grey Gum (*Eucalyptus punctata*), generally also in association with; White Stringybark (*Eucalyptus globoidea*) and Thin-leaved Stringybark (*Eucalyptus eugenioides*).

Dominant understorey species include; Black She-oak (*Allocasuarina littoralis*), *Persoonia linearis*, Blackthorn (*Bursaria spinosa* subsp. *spinosa*), White Dogwood (*Ozothamnus diosmifolius*) and Rough Guinea Flower (*Hibbertia aspera*). Dominant groundcover species include; *Lepidosperma laterale*, Poison Rock Fern (*Cheilanthes sieberi* subsp. *Sieberi*), Threeawned Speargrass (*Aristida vagans*), Whiteroot (*Pratia purpurascens*), Weeping Meadow Grass (*Microlaena stipoides* var. *stipoides*), Wiry Panic (*Entolasia stricta*), Many-flowered Mat-rush (*Lomandra multiflora*), Kangaroo Grass (*Themeda australis*), Two-colour Panic (*Panicum simile*), Hedgehog Grass (*Echinopogon caespitosus*), *Pomax umbellata*, Kidney Weed (*Dichondra repens*), *Glycine clandestina*, Hairy Apple Berry (*Billardiera scandens*) and *Opercularia diphylla* (Tozer et al. 2006).

An estimate of the area of this vegetation type which has been cleared from its original extent is 80% since European settlement.

Tozer (2003) described the corresponding community as Map Unit 1: Shale Sandstone Transition Forest (Low sandstone influence) and Map Unit 2: (High sandstone influence). The low sandstone influence variant is described as typically occurring on the middle or upper slopes of gently undulating land, whilst the high sandstone influence variant occurs on the higher slopes, further from soils with shale influence.

## 2.5 Plans and Maps

The following maps are provided at the end of each chapter:

Chapter 1:

- Aerial photograph of the St Marys Property (Figure 1.1);
- Zoning of the St Marys Property (SREP 30 Amendment 2) (Figure 1.2).

Chapter 2:

- Plan of the subject site identifying the proposal (Figure 2.1);
- Aerial view of the subject site, subject land and study area (Figure 2.2);
- Vegetation communities in the locality (NPWS 2002) (Figure 2.3);
- Topography of the locality identifying land uses (Figure 2.4); and



- Aerial photograph of the locality identifying areas of native vegetation (Figure 2.5).

Chapter 3:

- OEH (2012) threatened flora species records (Figure 3.1); and
- OEH (2012) threatened fauna species records (Figure 3.2).

Chapter 4;

- Flora survey locations (Figure 4.1);
- Fauna survey locations (Figure 4.2);
- Threatened flora and fauna recorded in the study area (Figure 4.6); and
- Vegetation of the study area (Figure 4.7).





**Legend**

- Subject Site
- Subject Land

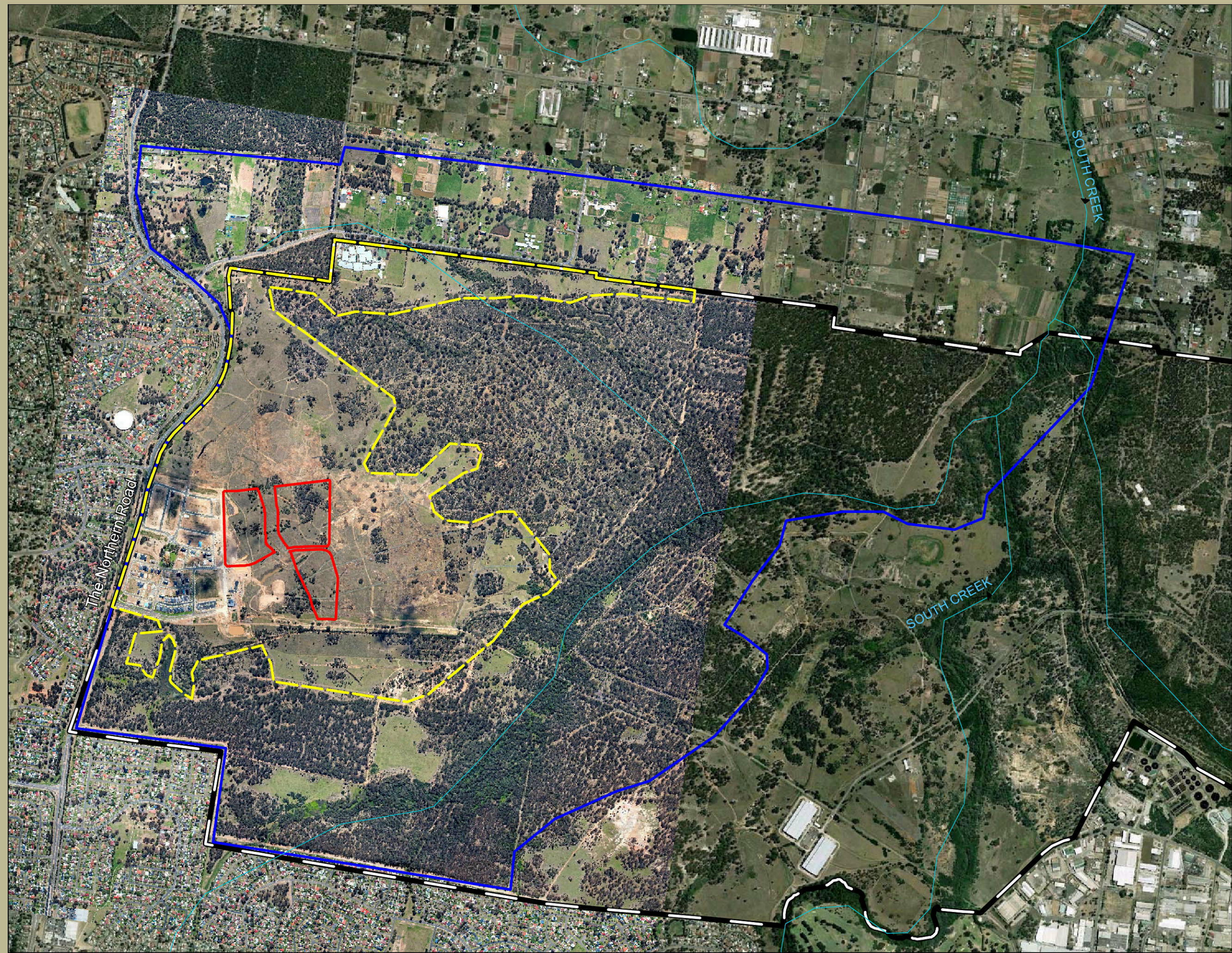
Image Source: © 2011 Skycam Australia  
 © 2011 Sinclair Knight Merz & Fugro



Figure 2.1. Plan of the Subject Site identifying the proposal







**Legend**






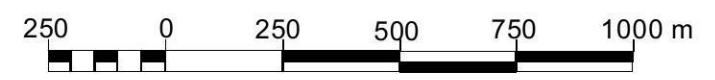
-  St Marys Property Boundary
-  Subject Site
-  Subject Land (Western Precinct)
-  Study Area
-  Waterway

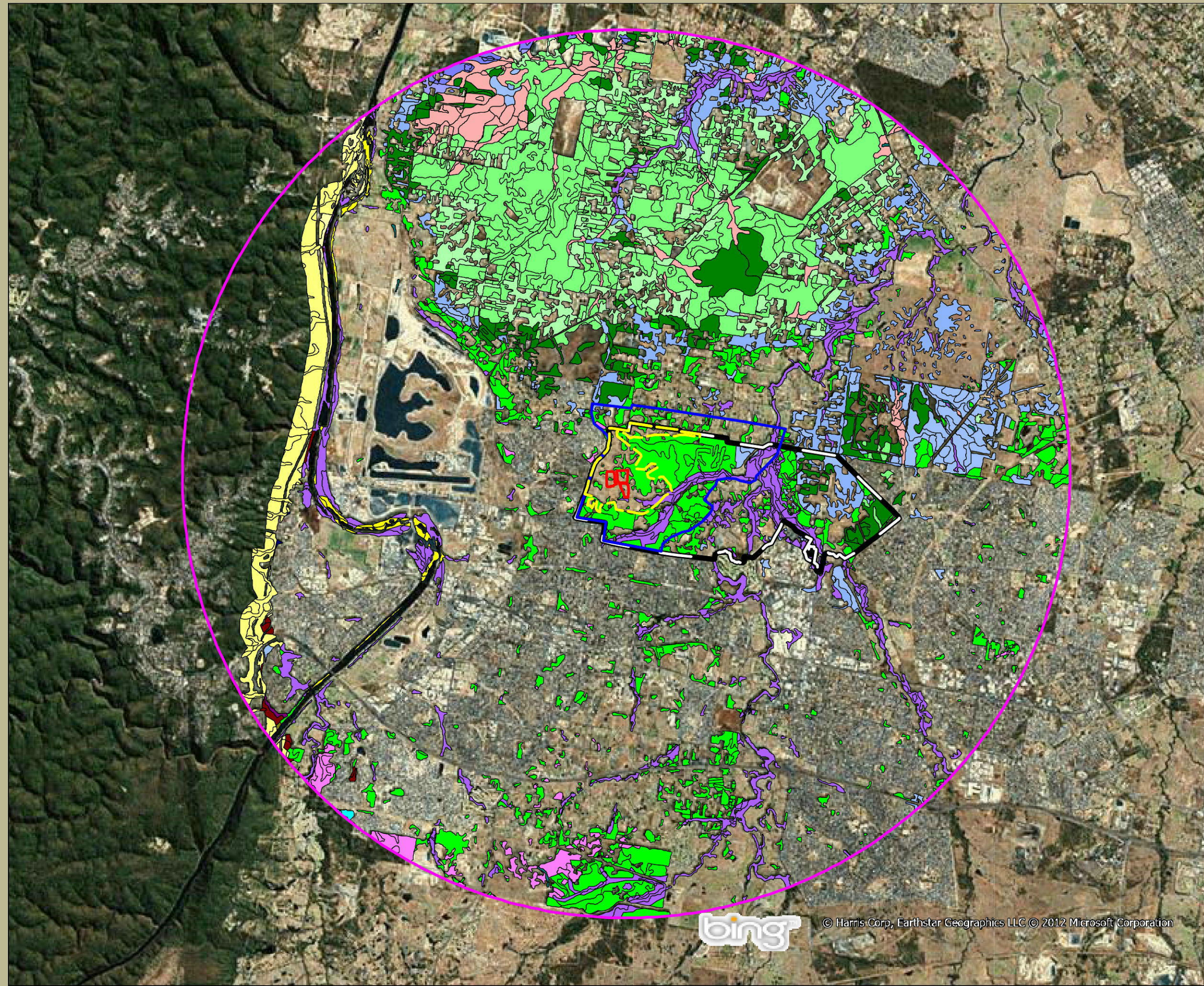
Image Source: © 2011 Skycam Australia  
 © 2011 Sinclair Knight Merz & Fugro
























Figure 2.2. Aerial view of the Subject Site, Subject Land and Study Area







- Legend**
-  St Marys Property Boundary
  -  Subject Site
  -  Subject Land
  -  Study Area
  -  Locality

- Vegetation Community**
-  Shale Plains Woodland (CPW) (CEEC)
  -  Shale Hills Woodland (CPW) (CEEC)
  -  Alluvial Woodland (RFEF) (EEC)
  -  Riparian Forest (RFEF) (EEC)
  -  Shale/Gravel Transition Forest (EEC)
  -  Shale Sandstone Transition Forest (Low Influence) (EEC)
  -  Shale Sandstone Transition Forest (High Influence) (EEC)
  -  Freshwater Wetlands (EEC)
  -  Moist Shale Woodland (EEC)
  -  Cooks River Castlereagh Ironbark Forest (EEC)
  -  Castlereagh Swamp Woodland (EEC)
  -  Agnes Banks Woodland (EEC)
  -  Castlereagh Scribbly Gum Woodland (VEC)
  -  Upper Georges River Sandstone Woodland
  -  Western Sandstone Gully Forest
  -  Riparian Scrub
  -  Unclassified Vegetation

Data Source: Change in the distribution of  
Cumberland Plain Woodland 2007  
(DECCW, 2007)

bing © Harris Corp, Earthstar Geographics LLC © 2012 Microsoft Corporation

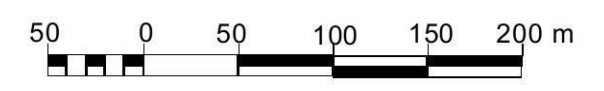
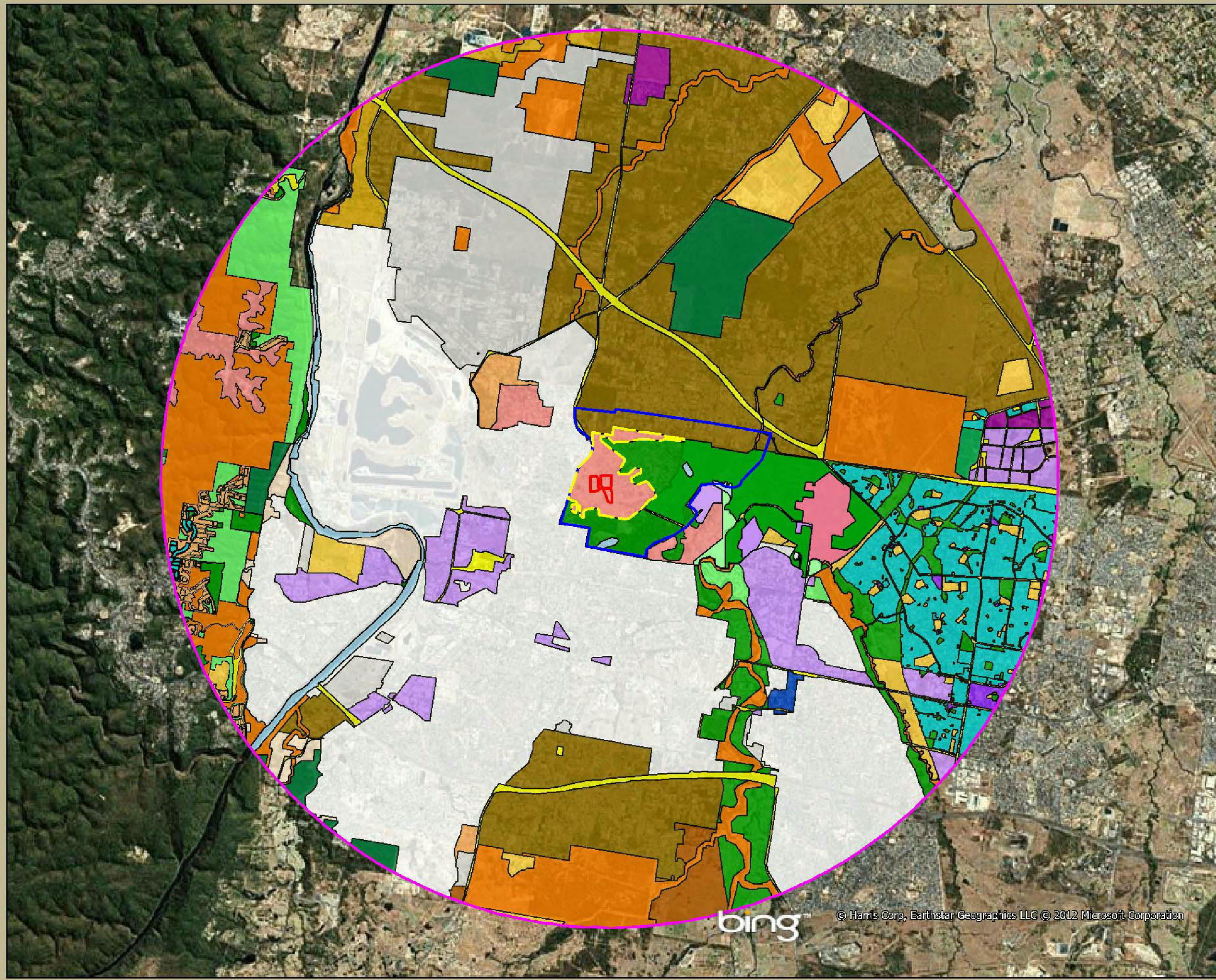


Figure 2.3. Vegetation communities in the Locality (DECCW, 2007)





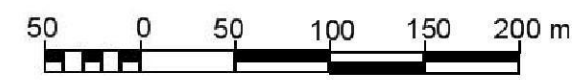
- Legend**
- Subject Site
  - Subject Land
  - Study Area
  - Locality
- Land Use Zone**
- Mixed Use
  - Private Recreation
  - Business
  - Primary Production
  - Rural Small Holdings
  - Infrastructure
  - Environmental Conservation
  - Industrial
  - Environmental Living
  - Rural Landscape
  - Special Activities
  - No Zone
  - Public Recreation
  - Village
  - National Parks and Nature Reserves
  - Waterway
  - Deferred Matter
  - Residential
  - Large Lot Residential
  - Environmental Management

Data Source: Blacktown City Council, 2011;  
 Blue Mountains City Council, 2011;  
 Penrith City Council, 2010

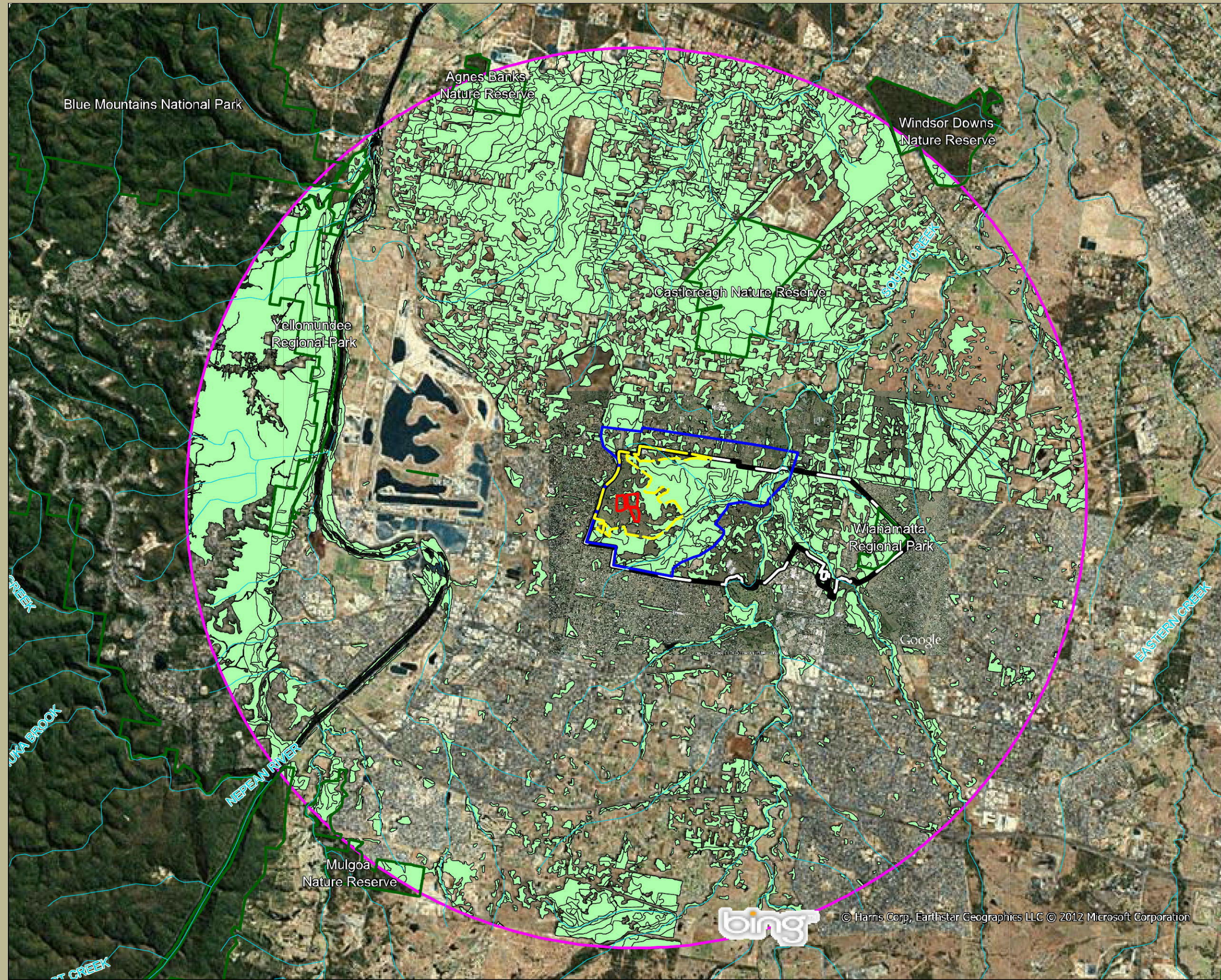
Image Source: © 2011 Skycam Australia  
 © 2011 Sinclair Knight Merz & Fugro



Figure 2.4. Topography of the locality identifying land uses







- Legend**
-  St Marys Property Boundary
  -  Subject Site
  -  Subject Land (Western Precinct)
  -  Study Area
  -  Locality
  -  Native Vegetation
  -  National Parks and Reserves



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Figure 2.5. Aerial photograph of the Locality identifying areas of Native vegetation





## Initial Assessment

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This initial assessment provides a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action. Based on habitat assessment and records from the locality and study area within the south eastern portion of the SMP, this chapter determines the “subject species” and those species likely to be affected by the proposal (“affected (C)EECs/species”). Affected (C)EECs/species defines those threatened species, populations and ecological communities that are likely to experience impacts from the proposal.

### 3.1 Endangered and Critically Endangered Ecological Communities

The following endangered and critically endangered ecological communities (referred to collectively as (C)EEC’s) are known to occur within the subject land:

- Cumberland Plain Woodland (CPW);
- River –flat Eucalypt Forest (RFEF);
- Shale-Gravel Transition Forest (SGTF); and
- Freshwater Wetlands on Coastal Floodplains (FWCF). ()

This SIS considers these (C)EEC’s as subject communities. Only CPW is considered to occur within the subject site. The floristics of SGTF surveyed during the preparation of this SIS suggests that the vegetation patches are not substantially different from those of CPW across the subject land. This vegetation community is therefore considered to be CPW in this SIS, which is of higher conservation status under the TSC Act

### 3.2 Threatened Species and Populations Records

#### 3.2.1 Database Records

Threatened species, populations and ecological community records from within the locality were obtained from databases, including the Atlas of NSW Wildlife (OEH 2012a) , Bird Data (Birds Australia, 2005-2007) and the Biobanking Credit Calculator Tool (DECC, 2009). The

search area was defined as within a 10km radius of the subject site. A 10 km radius search area was adopted for the Birds Australia database. These records are shown in Figure 3.1 and Figure 3.2.

The number and age of records of threatened species recorded within a 10 km radius of the Western Precinct provided a picture of the distribution for relevant species within the locality and was useful supplementary information when assessing the likelihood of occurrence of threatened species within the Western Precinct.

### **3.2.2 Literature Review**

The Western Precinct, including the current study area, has been subject to a series of flora and fauna investigations from the early 1990s until the present date. These have involved literature reviews, database assessments, vegetation mapping, a general census of flora and fauna and targeted surveys for threatened species. A synthesis of the information from the relevant reports has been carried out as part of the Western Precinct Biodiversity Assessment (Cumberland Ecology, 2009c) to determine the flora and fauna species which may be affected by any activity within the Western Precinct. A summary of the results of these surveys is shown in Chapter 4. Further details are provided in the Supplementary Report prepared by Cumberland Ecology for the Western Precinct Stage 1 DAs (Cumberland Ecology, 2009a).

A summary of more recent surveys conducted specifically for the Western Precinct Biodiversity Assessment and Flora and Fauna Assessments for development applications in the Western Precinct and this SIS is provided in Chapter 4.

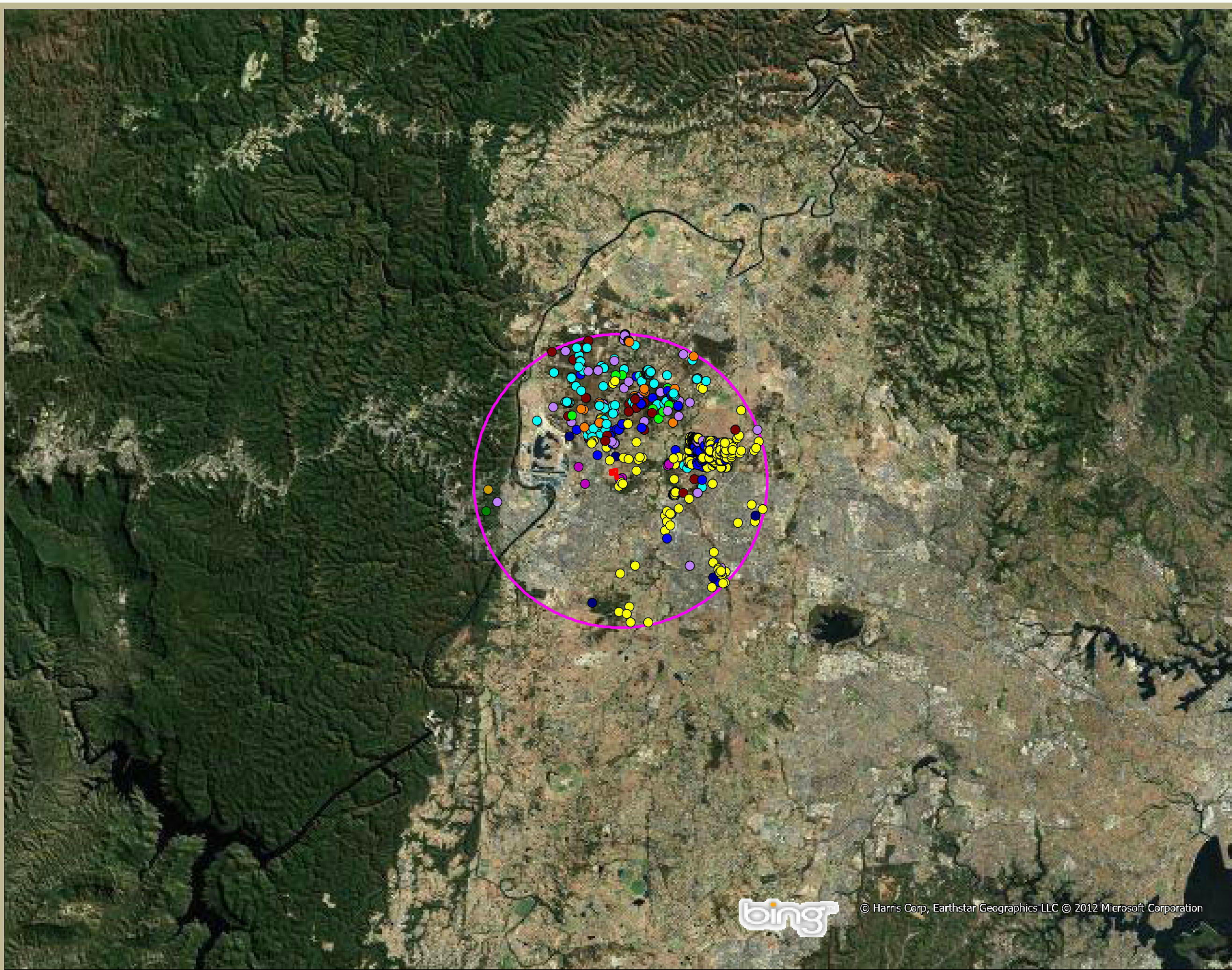
Table 3.1 provides an initial assessment of the exhaustive list provided by the databases and literature review process. Table 3.1 also identifies the “subject species”, as described below.

### **3.2.3 Habitat Assessment**

Habitat assessment and field surveys of the study area were used to determine the threatened species likely to occur, or occurring on the subject site. The results of this assessment are found in Chapter 4.

Based on this habitat assessment, and consideration of the species records for the study area, the threatened species or populations that occur or have potential to occur in the study area were identified (the “subject species”).





**Legend**

- Subject Site
- Locality

**Threatened Flora**

- *Acacia bynoeana*
- *Allocasuarina glareicola*
- *Callistemon linearifolius*
- *Dillwynia tenuifolia*
- *Grevillea juniperina* subsp. *juniperina*
- *Marsdenia viridiflora* subsp. *viridiflora*
- *Micromyrtus minutiflora*
- *Persoonia hirsuta*
- *Persoonia nutans*
- *Pimelea spicata*
- *Pultenaea parviflora*

Data Source: OEH 17/01/2012  
Map Scale: 1:250,000



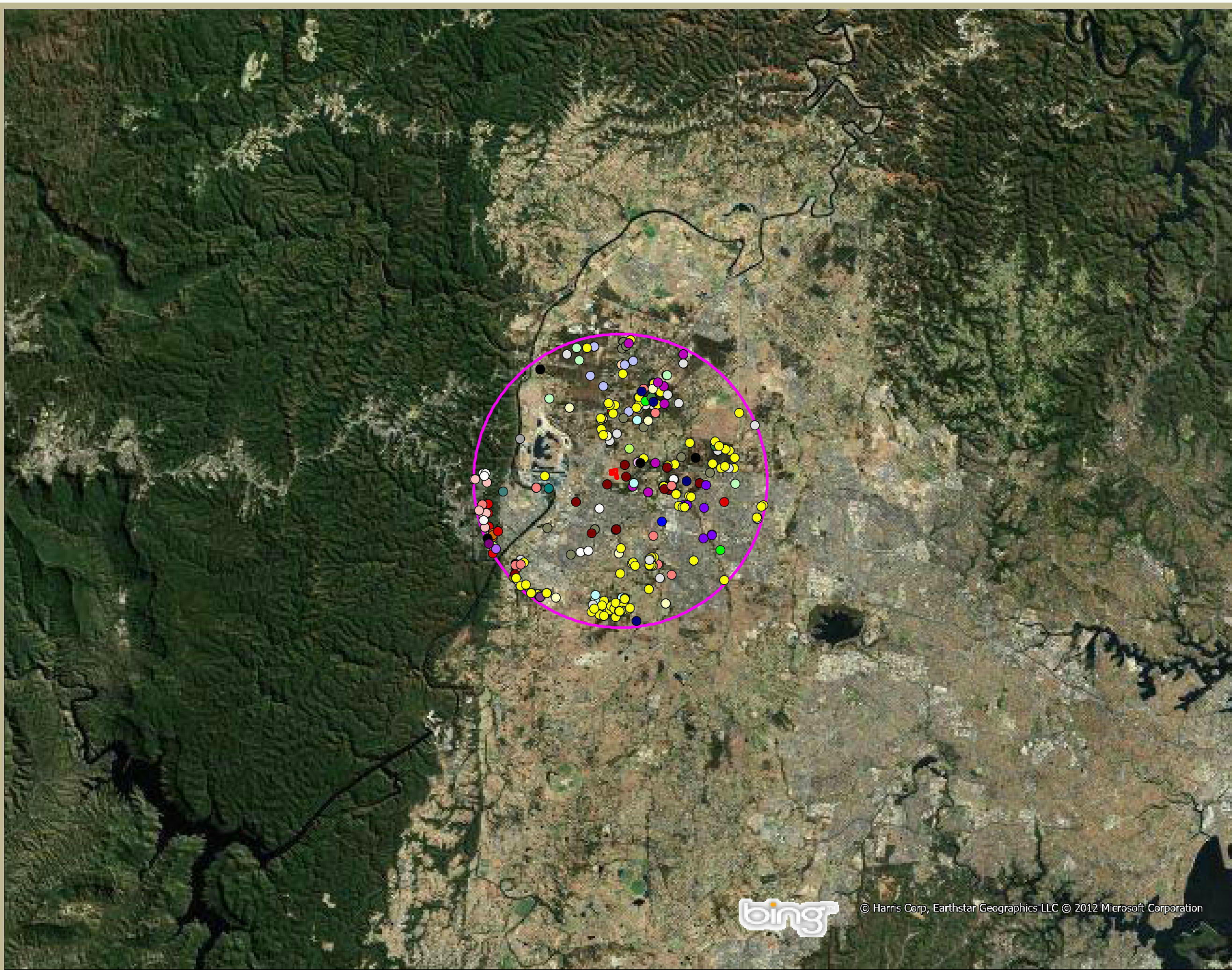
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Figure 3.1. OEH Threatened Flora records within the Locality







- Legend**
- Subject Site
  - Locality
- Threatened Fauna**
- Australasian Bittern
  - Black-chinned Honeyeater (eastern subspecies)
  - Black-necked Stork
  - Bush Stone-curlew
  - Cumberland Plain Land Snail
  - Diamond Firetail
  - Eastern Bentwing-bat
  - Eastern False Pipistrelle
  - Eastern Freetail-bat
  - Eastern Pygmy-possum
  - Flame Robin
  - Freckled Duck
  - Gang-gang Cockatoo
  - Glossy Black-Cockatoo
  - Greater Broad-nosed Bat
  - Green and Golden Bell Frog
  - Grey-headed Flying-fox
  - Koala
  - Large-eared Pied Bat
  - Little Eagle
  - Little Lorikeet
  - Masked Owl
  - Painted Honeyeater
  - Powerful Owl
  - Red-crowned Toadlet
  - Regent Honeyeater
  - Scarlet Robin
  - Sooty Owl
  - Southern Myotis
  - Speckled Warbler
  - Spotted Harrier
  - Spotted-tailed Quoll
  - Square-tailed Kite
  - Squirrel Glider
  - Swift Parrot
  - Varied Sittella
  - Yellow-bellied Glider

Data Source: OEH 17/01/2012  
Map Scale 1:250,000



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Figure 3.2. OEH Threatened Fauna records within the Locality





**Table 3.1 THREATENED FLORA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Acacia bynoeana</i>	Bynoe's Wattle	E1	V	Found in heath and woodland on sandy soils. Scattered from coast to mountains, uncommon. Associated overstorey species include <i>Corymbia gummifera</i> (Red Bloodwood), Scribbly Gum ( <i>Eucalyptus haemastoma</i> ), Parramatta Red Gum ( <i>Eucalyptus parramattensis</i> ), <i>Banksia serrata</i> and <i>Angophora bakeri</i> .	Unlikely to occur. The study area does not contain sandy soils and the typical overstorey species are absent.	No
<i>Acacia pubescens</i>	Downy Wattle	V	V	Occur in open woodland and forest, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland.	Potential to occur. Suitable habitat is present in study area.	Yes
<i>Allocasuarina glareicola</i>		E1	E	Castlereagh Woodlands on lateritic soils. Found in open woodland with <i>Eucalyptus parramattensis</i> , <i>Eucalyptus fibrosa</i> , <i>Angophora bakeri</i> , <i>Eucalyptus sclerophylla</i> and <i>Melaleuca decora</i> . Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool.	Unlikely to occur. Open woodland habitat does not occur and the characteristic overstorey associated with this species are absent.	No
<i>Asterolasia elegans</i>			E	Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest.	Unlikely to occur. Suitable habitat does not occur in study area.	No
<i>Cynanchum elegans</i>			E	Climber or twiner found on the edge of dry rainforest communities. Also associated with littoral rainforest and Coastal Tea-tree - Coastal Banksia scrub.	Unlikely to occur. No suitable habitat present in study area.	No
<i>Dillwynia tenuifolia</i>		V	V	It has a core distribution within the Cumberland Plain, where it may be locally abundant within scrubby, dry heath areas within	Likely to occur. This species has not been recorded on the subject site or	Yes



**Table 3.1 THREATENED FLORA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
				Castlereagh Ironbark Forest and Shale/Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in the ecotone between these areas and Castlereagh Scribbly Gum Woodland.	subject land. This species has been widely recorded on the SMP and suitable habitat is present in the study area.	
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V	Occurs in open forest and requires a combination of deep alluvial and a flooding regime that permits seedling establishment.	Unlikely to occur. Lack of necessary flooding regime.	No
<i>Grevillea juniperina subsp. juniperina</i>	Juniper-leaved Grevillea	V		Restricted to red sandy to clay soils – often lateritic on Wianamatta Shale and Tertiary alluvium in Cumberland Plain Woodland and Castlereagh Woodland.	This species has been recorded from the study area and subject land in moderately high numbers. Tens of thousands of this species are estimated to occur in the Regional Park.	Yes
<i>Grevillea parviflora subsp. parviflora</i>	Small Flower Grevillea	V	V	Occurs on sandy clay loam soils, often with lateritic ironstone gravels. Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones. Soil landscapes include Lucas Heights and Berkshire Park. Often occurs in open, slightly disturbed sites such as along tracks	Potential to occur. Suitable habitat for this species is present in the study area.	Yes
<i>Hypsela sessiliflora</i>		E1	X	Known to grow in damp places on Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain woodland.	Suitable habitat available but Unlikely to occur due to rarity of species.	No



**Table 3.1 THREATENED FLORA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Marsdenia viridiflora subsp. viridiflora</i>		E2		Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. Grows in vine thickets and open shale woodland.	Potential to occur. This species has not been recorded on the subject land, although it is known from the study area.	Yes
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	Grows in heath on sandstone.	Unlikely to occur. The study area is not located on sandstone geology and therefore does not provide suitable habitat.	No
<i>Micromyrtus minutiflora</i>		E1	V	Restricted to the general area between Richmond and Penrith, western Sydney. Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments.	Potential to occur. This species has not been recorded on the subject land although it has been widely recorded on the SMP and suitable habitat is present in the study area.	Yes
<i>Persoonia nutans</i>	Nodding Geebung	E1	E	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained. Also occurs in Shale Gravel Transition Forest and Castlereagh Ironbark Forest. Endemic to Western Sydney.	Potential to occur. This species has not been recorded on the subject land, although it is known from the study area.	Yes
<i>Pimelea curviflora var. curviflora</i>		V	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	Unlikely to occur. The study area is not located on sandstone geology and therefore does not provide suitable	No



**Table 3.1 THREATENED FLORA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
					habitat.	
<i>Pimelea spicata</i>	Spiked Rice-flower	E1	E	In western Sydney, it occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale. It is associated with Cumberland Plain Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines. Has been located in disturbed areas that would have previously supported CPW.	Potential to occur. This species has been recorded from the study area and subject land in very small numbers. The study area provides suitable habitat for this species.	Yes
<i>Pomaderris brunnea</i>			V	Shrub that grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines in association with <i>Eucalyptus amplifolia</i> , <i>Angophora floribunda</i> , <i>Acacia parramattensis</i> , <i>Bursaria spinosa</i> and <i>Kunzea ambigua</i> . Flowers Sept-Oct.	Unlikely to occur due to restricted distribution within NSW.	No
<i>Pterostylis gibbosa</i>			E	Found in open forest or woodland, on flat or gently sloping land with poor drainage.	Unlikely to occur due to lack of suitable habitat and restricted distribution within NSW.	No
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E1		Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where it occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	Unlikely to occur. No suitable habitat components such as sandstone rock shelves occur in the study area.	No
<i>Pultenaea parviflora</i>		E1	V	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel	Potential to occur. This species has been recorded from the study area,	Yes



**Table 3.1 THREATENED FLORA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
				Transition Forest on tertiary alluvium or laterised clays. May also be common in ecotone between these communities and Castlereagh Scribbly Gum Woodland.	subject land and also widely throughout the SMP.	
<i>Rhizanthella slateri</i>			E	The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available.	Unlikely to occur due to limited distribution within NSW.	No
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1	V	Occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforests or on gravels, sands, silts and clays in riverside gallery rainforests.	Unlikely to occur. Habitat requirements such as sandstone and rainforest not present in study area.	No

Key: E/E1 = Endangered, E2 = Endangered population, V = Vulnerable, X – Extinct



**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
Invertebrates						
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E1		Primarily inhabits Cumberland Plain Woodland. This community is a grassy, open woodland with occasional dense patches of shrubs.	Potential to occur. This species has been recorded from the SMP and potential habitat is present in the study area.	Yes
Amphibians						
<i>Litoria aurea</i>	Green and Golden Bell Frog	E1	V	Large permanent freshwater wetlands, with dense stands of reeds.	Potential suitable habitat including permanent freshwater wetlands are present in the study area. However, this species is thought to be extinct in Western Sydney and is therefore highly unlikely to occur.	No
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	E1	V	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Breeding habitat is generally soaks or pools within first or second order streams. During non-breeding periods, it burrows below the soil surface or in the leaf litter.	Unlikely to occur. Some potential habitat occurs in the study area, only 1 record exists for this species.	No
Aves						



**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Actitis hypoleucos</i>	Common Sandpiper		C, J, K	Abundant in mangrove inlets but also present in rocky shores and margins of coastal and inland wetlands.	Unlikely to occur. Suitable habitat not present in study area.	No
<i>Apus pacificus</i>	Fork-tailed Swift		C, J, K	Highly mobile whilst in Australia and almost exclusively aerial to 300m. Mostly found over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh of inland plains.	Unlikely to occur. Individuals may fly over area while migrating to more suitable habitats.	No
<i>Ardea ibis</i>	Cattle Egret		C, J	Inhabit shallow water and wetland habitats (such as inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial.	Unlikely to occur. Favours marine/estuarine habitats which do not occur within the study area.	No
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E1		Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes ( <i>Typha</i> spp.) and spikerushes.	Potential suitable habitat including permanent freshwater wetlands are present in the study area. Only 1 record for the area so Unlikely to occur.	No
<i>Burhinus grallarius</i>	Bush Stone-curler	E1		Well wooded floodplain forests, amongst fallen timber.	Unlikely to occur. No suitable floodplain forest habitat for this species is present in the study area.	No



**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V		Wetter forests, and woodlands, from sea level to 2000m on divide. From timbered foothills and valleys to suburban gardens. Nests in large tree hollows.	Unlikely to occur. Potential foraging habitat for this species is present in the study area, although limited nesting habitat is present due to the lack of large hollow bearing trees.	No
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V		Eucalypt forests and woodlands and forage in Allocasuarina. Nest in large tree hollows.	Unlikely to occur. This species has been recorded from near the SMP according to the Atlas of NSW Wildlife (DECCW 2010). However, the SMP lacks suitable foraging habitat and large tall hollow-bearing trees for nesting, therefore is not likely to be a significant area of habitat.	No
<i>Circus assimilis</i>	Spotted Harrier	V		Grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Potential to occur. Suitable foraging habitat is present in the study area.	Yes



**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		Eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Potential to occur. Eucalypt woodland habitat is present in the study area.	Yes
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E1		Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands, floodplains. Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains.	Unlikely to occur. Some wetland habitat is present in the study area, although not on the subject site.	No
<i>Gallinago hardwickii</i>	Latham's Snipe		C, J, K	In Australia, inhabit permanent and ephemeral open, freshwater wetlands with low, dense vegetation up to 2000 m above sea-level. Forage in areas of mud (either exposed or beneath a very shallow covering of water) and some form of cover (e.g. low, dense vegetation).	Unlikely to occur. Potential suitable habitat including permanent freshwater wetlands are present in the study area, although not on the subject site.	No



**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Glossopsitta pusilla</i>	Little Lorikeet	V		Mostly occurs in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees are also used.	Potential to occur. Potential woodland habitat is present in the study area.	Yes
<i>Grantiella picta</i>	Painted Honeyeater	V		A nomadic species that typically inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests with abundant mistletoe. It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias, preferring <i>Amyema</i> sp (mistletoe).	Potential to occur. Eucalypt woodland habitat is present in the study area.	Yes
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle		C	Australian distribution along the coastline and some larger inland waterways. Generally forage over large expanses of open water, in-shore waters and open terrestrial habitats.	Unlikely to occur. Favoured habitats not present in study area	No

**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Hieraaetus morphnoides</i>	Little Eagle	V		The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch.	Potential to occur. Eucalypt woodland habitat is present in the study area.	Yes
<i>Hirundapus caudacutus</i>	White-throated Needletail		C, J, K	Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Occur over most types of habitat, particularly above wooded areas including open forest and rainforest, between trees or in clearings and below the canopy.	Unlikely to occur. Favoured habitats are not present in study area.	No
<i>Ixobrychus flavicollis</i>	Black Bittern	V		Boggy marsh, wetland margins.	Unlikely to occur. Wetland habitat is present in the study area, although not on the subject site.	No
<i>Lathamus discolor</i>	Swift Parrot	E1	E	Forests, woodlands, plantations, banksias, street trees and gardens.	Potential to occur. Woodland habitat is present in the study area.	Yes
<i>Limosa limosa</i>	Black-tailed Godwit	V	C, J,K,	Primarily a coastal species, found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats.	Unlikely to occur. No suitable mudflat/sandflat habitat present.	No



**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Lophoictinia isura</i>	Square-tailed Kite	V		Diverse habitats from dry woodlands and open forests. Shows a particular preference to timbered watercourses.	Potential to occur. Woodland foraging habitat is present in the study area and it may forage over the study area as part of a larger range.	Yes
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V		Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	Potential to occur. Suitable habitat such as native grassland and woodland is present in the study area.	Yes
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V		Drier eucalypt forests, woodlands, timber on water courses, often no understorey, scrubs. Favours ironbark woodlands on western slopes.	Potential to occur. Woodland habitat is present in the study area.	Yes
<i>Merops ornatus</i>	Rainbow Bee-eater		J	Inhabit healthland, open forests and woodlands, shrublands, and various cleared or semi-cleared habitats, including farmland and areas of human habitation. Often occur in open, cleared or lightly-timbered areas located in close proximity to permanent water.	Potential to occur. This species occurs in a wide range of habitats and suitable habitat such as open areas, woodland and permanent water is present in the study area.	Yes

**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Neophema pulchella</i>	Turquoise Parrot	V		Steep rocky ridges and gullies, rolling hills, valleys and river flats and the plains of the Great Dividing Range. It is associated with coastal scrubland, open forest and timbered grassland, especially low shrub ecotones between dry hardwood forests and grasslands with high proportion of native grasses and forbs.	Potential to occur. This species occurs in a wide range of habitats and suitable habitat such as native grassland and woodland is present in the study area.	Yes
<i>Ninox connivens</i>	Barking Owl	V		Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Is flexible in its habitat use and hunting can extend in to closed forest and more open areas. Requires very large permanent territories.	Unlikely to occur. Habitat and prey species present but territorial requirements may exceed availability, especially as potential breeding habitat (large tree hollows) is minimal.	No
<i>Ninox strenua</i>	Powerful Owl	V		Habitat for this species is widespread and is primarily tall moist eucalypt forest of the eastern tableland edge and the mosaic of wet and dry sclerophyll forests occurring on undulating gentle terrain nearer the coast. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal marsupials.  Pairs occupy large, probably permanent home and nest in large hollows.	Unlikely to occur. Moist tall eucalypt forest is not present in the study area. Potential breeding habitat is minimal as no large tree hollows are present.	No



**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Oxyura australis</i>	Blue-billed Duck	V		Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached.	Unlikely to occur. Wetland habitat is present in the study area, although not on the subject site.	No
<i>Petroica boodang</i>	Scarlet Robin	V		The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris.	Potential to occur. Woodland habitat is present in the study area and logs and woody debris are present.	Yes
<i>Petroica phoenicea</i>	Flame Robin	V		In NSW it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains.	Potential to occur, particularly in winter when the species migrates to more open habitats	Yes

**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Pyrrholaemus sagittatus</i> ( <i>Chthonicola sagittata</i> )	Speckled Warbler	V		Lives in a wide range of eucalypt dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	Potential to occur. This species has been recorded from the SMP and suitable habitat occurs in the study area	Yes
<i>Rostruatula australis</i>	Australian Painted Snipe	E1	V	Inhabits fringes of shallow inland wetlands, swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Unlikely to occur. Wetland habitat is present in study area, although not on the subject site.	No
<i>Stagonopleura guttata</i>	Diamond Firetail	V		Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum <i>Eucalyptus pauciflora</i> Woodlands.	Potential to occur. Suitable habitat is present in the study area.	Yes
<i>Stictonetta naevosa</i>	Freckled Duck	V		Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters.	Unlikely to occur. Wetland habitat is present in the study area, although not on the subject site.	No
<i>Tringa glareola</i>	Wood Sandpiper		C, J, K	Uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes	Unlikely to occur. Potential habitat does occur in study area, although this species favours Western Australia.	No



**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Tringa nebularia</i>	Common Greenshank		C, J, K	Occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass	Unlikely to occur. Favoured habitat is not present in study area.	No
<i>Tyto novaehollandiae</i>	Masked Owl	V		Occurs mainly in large areas of forests. Roosts in large hollow	Unlikely to occur. Dense forest habitat is not readily available in Western Sydney and there is a lack of records in the locality. Very limited breeding habitat is available due to the lack of large trees with hollows.	No
<i>Tyto tenebricosa</i>	Sooty Owl	V		Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species. Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. Typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows	Unlikely to occur. No suitable habitat such as wet old growth forest is present in the study area, and no large trees with hollows are present.	No
<i>Xanthomyza phrygia</i> ( <i>Anthochaera phrygia</i> )	Regent Honeyeater	E4A	E, M	Dry open forests, woodlands, especially red ironbark, yellow box, yellow gum	Potential to occur. Woodland habitat is present in the study area.	Yes
Mammals						

**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Frequents low to mid-elevation dry open forest and woodland close to caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin ( <i>Hirundo ariel</i> ). Probably forages for small, flying insects below the forest canopy	Potential to occur. May forage over the study area however no suitable roosting habitat such as caves, cliffs or mines are present in the study area.	Yes
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Occurs in wide variety of habitats in large remnants. Dens in tree hollows, hollow logs or rock crevices	Potential to occur. Woodland habitat is present in the study area as are habitat resources such as hollow logs.	Yes
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		Usually roosts in tree hollows in the higher rainfall forests within its range.	Potential to occur. May forage over the study area however no suitable roosting habitat is present in the study area.	Yes
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V		Forages above the canopy and eats mostly moths. Roosts in caves, old mines, road culverts	Potential to occur. May forage over the study area however no suitable roosting habitat such as caves or mines are present in the study area.	Yes
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V		Inhabits dry and wet sclerophyll forests, coastal woodland. Roosts in tree hollows and buildings. Have been found roosting under the bark of trees.	Potential to occur. May forage over the study area and suitable roosting habitat is present in the study area.	Yes



**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Myotis macropus</i>	Southern Myotis	V		Known from a range of habitats close to water from lakes, small creeks to large lakes and mangrove lined estuaries	Potential to occur. Aquatic foraging habitat is present in the study area.	Yes
<i>Petaurus australis</i>	Yellow-bellied Glider	V		Patchily distributed in wet sclerophyll forest	Unlikely to occur. No wet sclerophyll forest is present in the study area.	No
<i>Petaurus norfolcensis</i>	Squirrel Glider	V		Associated with dry hardwood forest and woodlands. Habitats typically include gum barked and high nectar producing species, including winter flower species. The presence of hollow bearing eucalypts is a critical habitat value	Potential to occur. Woodland habitat is present in the study area.	Yes
<i>Petrogale penicillata</i>	Brush-tailed Rock-Wallaby	E1	V	Inhabit rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north.	Unlikely to occur. No suitable habitat present on site.	No
<i>Phascolarctos cinereus</i>	Koala	V		Widespread in sclerophyll forest and woodlands. Requires relatively large home ranges.	Potential to occur. Potential habitat occurs in the study area however this species has not been recorded. The habitat on the study area is relatively isolated and it is not likely to form part of a home range of a koala.	Yes

**Table 3.2 THREATENED FAUNA RECORDED IN THE LOCALITY AND ASSESSMENT OF THE LIKELIHOOD OF OCCURRENCE**

Scientific Name	Common Name	Status		Habitat Requirements	Likelihood of occurrence	Subject Species?
		TSC Act	EPBC Act			
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo	V	V	Inhabits dry/wet sclerophyll forests or coastal heaths with dense understorey and occasional open areas	Unlikely to occur. No wet sclerophyll forest or coastal heath present in the study area.	No
<i>Pseudomys novaehollandiae</i>	New Holland Mouse		V	Inhabit open heathland, open woodland and vegetated sand dunes in coastal areas and up to 100 km inland on sandstone country up to 900m altitude.	Unlikely to occur. Has very specific habitat requirements that do not occur in the study area.	No
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Roosts in large camps and disperses nightly up to 20km to feed in flowering eucalypts	Potential to occur. No roosting camps are present in the study area however potential foraging habitat is present in the study area.	Yes
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V		Roosts in tree hollows and buildings; utilises mammal burrows in treeless areas. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory	Potential to occur. May forage over the study area and some roosting habitat is available.	Yes
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		Usually in tall wet forest, extending into drier forest along gullies. Forages along forest edges. Roosts in tree hollows	Has been recorded, despite the lack of optimal wet forest habitat present in the study area.	Yes

Key: E/E1 = Endangered, E4A = Critically Endangered, V = Vulnerable, M = Migratory species, C - China-Australia Migratory Bird Agreement (CAMBA), J - Japan-Australia Migratory Bird Agreement (JAMBA), K - Republic of Korea - Australia Migratory Bird Agreement (ROKAMBA).





## Survey

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This chapter presents the background of ecological studies in the subject area, details of the procedures for the current surveys undertaken for the purposes of this SIS and the results of past and current surveys in relation to flora and fauna, vegetation communities and mapping and the occurrence of any threatened species, in accordance with DGRs 4.1; *Requirement to Survey* and 4.2; *Documentation*.

### 4.1 Survey Background

#### 4.1.1 Historical Surveys

The Former ADI Site and its surrounds have been subject to detailed flora and fauna studies since the area was rezoned in 1993. There has been considerable ecological survey effort within the locality of the Western Precinct in recent times for baseline data by Government and Industry. The contemporary studies completed within the Western Precinct and within the locality were reviewed, including unpublished reports prepared for OEH on the flora and fauna of both the Western Precinct and adjacent Regional Park. The reports utilised to inform this SIS include:

- 1 ERM (2000) *Assessment of the Implications of Development for Land Registered on the National Estate at St Marys NSW* Report to ComLand Limited Environmental Resources Management Australia, Sydney.
2. Gunninah (1991) **Australian Defence Industries (ADI) Site, St Marys, Fauna Survey** Gunninah Environmental Consultants, Sydney.
3. Gunninah (1995) **Australian Defence Industries St Marys Planning Study: Flora and Fauna Issues** Gunninah Environmental Consultants, Sydney.
4. Cumberland Ecology (2004) **St Mary's Eastern Precinct: Fauna and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications** Cumberland Ecology, Sydney.
5. Cumberland Ecology (2004) **Stage 1 Subdivision, St Mary's Eastern Precinct: Part Lot 2 DP 1038166 Species Impact Statement** Cumberland Ecology, Sydney.
6. Cumberland Ecology (2005) **St Marys North and South Dunheved Precincts Plan: Biodiversity Assessment** Cumberland Ecology, Epping.



7. NSW NPWS (2000) **The Native Vegetation of the Cumberland Plain, Western Sydney: Technical Report** NSW National Parks and Wildlife Service, Hurstville.
8. DUAP (2001) **Sydney Regional Environmental Plan No. 30: St Marys** Department of Urban Affairs and Planning, Sydney.
9. DUAP (2001) **St Marys Environmental Planning Strategy 2000** Department of Urban Affairs and Planning, Sydney.
10. Perkins, I. (1999) **Flora Assessment of the Disputed Areas of Western Sydney Shale Woodlands** Ian Perkins Consultancy Services, Sydney.
11. Cumberland Ecology (2009) **St Marys Property - Western Precinct: Biodiversity Assessment** Cumberland Ecology, Epping.

#### **4.1.2 Recent Surveys**

The contemporary ecological study was initially intended to update existing knowledge of the biodiversity values within the Western Precinct in line with legislative changes, current survey guidelines and new protected species listings. Detailed surveys were completed in 2011 to provide baseline flora and fauna data for the Western Precinct in compliance with the OEH guidelines for flora and fauna survey (DEC (NSW), 2004). Additional flora surveys were conducted in 2012 to supplement data collected in the previous year.

##### *i. Vegetation Surveys*

Vegetation mapping has previously occurred within the Western Precinct and across the whole St Mary's Property. However the increasing importance placed by government agencies on the conservation of CEECs and in particular the up-listing of Cumberland Plain Woodland from endangered to critically endangered under the TSC Act and EPBC Act (although the EPBC Act status is not applicable for the SMP) directed the need for current floristic surveys.

##### *ii. Targeted threatened species surveys*

Based on the identification of subject species from assessment of species records and the habitats present (Chapter 3), targeted surveys were conducted for the following threatened species groups:

- Shrubs and herbs associated with Cumberland Plain Woodland (in particular *Pimelea spicata* and *Grevillea juniperina subsp juniperina*);
- Cumberland Land Snail;
- Microchiropteran bats; and
- Diurnal birds.

## 4.2 Survey Methods

### 4.2.1 Terrestrial Survey

#### i. Dates of Survey

The most recent surveys built upon an existing database of flora and fauna information that included data from the 1990s and 2000s. Recent surveys are also available from nearby areas of the Western Precinct, being those undertaken to inform flora and fauna assessments in the Eastern Precinct. A summary of earlier surveys is provided within Appendix B.

The detailed field surveys within the SMP took place over the 2011 Autumn period and are summarised in Table 4.1. Both floristic and faunal surveys were conducted throughout this survey period. Additional flora surveys and threatened species searches were conducted within the study area between 22 – 23 February and 15 March 2012 to supplement data collected in the previous year. Further targeted flora surveys and fauna habitat assessments were conducted along a road easement within the Regional Park, between the Central and Western Precincts on 2 August 2012.

<b>Dates of Survey</b>	<b>Tasks completed</b>
April 14, 2011	Flora Quadrats, targeted threatened flora searches.
April 22, 2011	Flora Quadrats, targeted threatened flora searches.
April 27-29, 2011	Diurnal bird surveys, snail searches, targeted threatened flora searches.
May 2, 2011	Flora Quadrats, targeted threatened flora searches.
February 22-23, 2012	Flora Quadrats, targeted threatened flora searches.
March 15, 2012	Flora Quadrats, targeted threatened flora searches.
August 2, 2012	Targeted threatened flora searches, fauna habitat assessment

#### ii. Flora Survey

##### a. Vegetation Mapping of the Western Precinct

Vegetation maps provided by DECC in the Mapping of the Cumberland Plain (2007) and ground-truthing that was undertaken by Cumberland Ecology in 2007-2008 to inform the



Western Precinct Biodiversity Assessment (Cumberland Ecology, 2009) were used in the first instance to map the vegetation of the St Marys Property. This survey data formed a basis of the current investigation, although the survey methods used varied from those used in previous and current surveys.

Additional flora surveys were conducted specifically for the purposes of this SIS report through Quadrat sampling (20m x 20m) conducted between 27 April and 2 May 2011. Additional sampling was conducted using the same methods, in close proximity to the newly proposed development area and also other parts of the subject land on 22 – 23 February and 15 March 2012. The quadrats were located within all classes of the vegetation communities present in the study area both to supplement previous survey data and to compare data collected in the same survey season and using the same methodology. Analysis of the data was used to characterise vegetation map units by their species composition and community structure.

The resultant information was synthesised using Geographical Information Systems (GIS) to create a spatial database that was used to interpret and interpolate the data to produce a vegetation map of the Western Precinct. Mapping was completed using MapInfo Version 11.0.4 (Pitney Bowes Software Inc., 2010) on a Windows XP platform.

#### b. Floristic Census and Targeted Surveys

The flora assemblage within the Western Precinct was recorded by quadrat sampling and through targeted searches for threatened species. The Subject Site and adjacent areas were traversed extensively during the 2011 and 2012 surveys (see Figure 4.1). The locations of all threatened species detected within the traverses were recorded, with estimates of the population size made. All vascular plants recorded or collected were identified using keys and nomenclature provided in Harden (1990-1993). Additionally, Richardson *et al* (2006) was used to assist identification of selected plant taxa. Where known, taxonomic and nomenclatural changes have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust, 2010). Any specimens that were not readily identifiable were lodged for identification with the National Herbarium of NSW at the Royal Botanic Gardens, Sydney.

#### c. Quadrat Sampling

A total of 76 quadrats were sampled across the 2011, February 2012 and March 2012 survey periods in 20 x 20 metre plots. The locations of these quadrats were chosen so that sampling was conducted in areas most representative of the condition and composition of the vegetation patch. The quadrat locations are shown in Figure 4.1. Flora quadrat data is provided in Appendix C. In each quadrat, the following information was recorded as a minimum:

- All vascular flora species present within the plot or directly adjacent to the plot;
- The stratum in which each species occurred;
- The relative frequency of occurrence of each plant species;

- Vegetation structural data (i.e. height and percentage cover of each stratum);
- A waypoint to mark the location of the quadrat, using a handheld GPS; and
- Photographs of the quadrat.

The relative abundance and cover of each species within the quadrat was approximated using a scoring system based on the Braun-Blanquet scoring system (Braun-Blanquet, 1927). The scores used are provided in Table 4.2.

<b>Table 4.2 MODIFIED BRAUN-BLANQUET SCORES USED IN QUADRAT SURVEYS</b>		
<b>Class</b>	<b>Cover-abundance</b>	<b>Notes</b>
+	Rare (less than 1 % cover)	Herbs, sedges and grasses: within 4 m <sup>2</sup> Shrubs and small trees: less than 5 individuals.
1	Few Individuals (less than 5 % cover)	Herbs, sedges and grasses: within 20 m <sup>2</sup> Shrubs and small trees: 5 or more individuals Medium - large overhanging tree.
2	5 - less than 25 % cover	-
3	25 - less than 50 % cover	-
4	50 - less than 75 % cover	-
5	75 - 100 % cover	-



Legend

- Subject Site
- Subject Land
- Study Area
- Quadrat Location

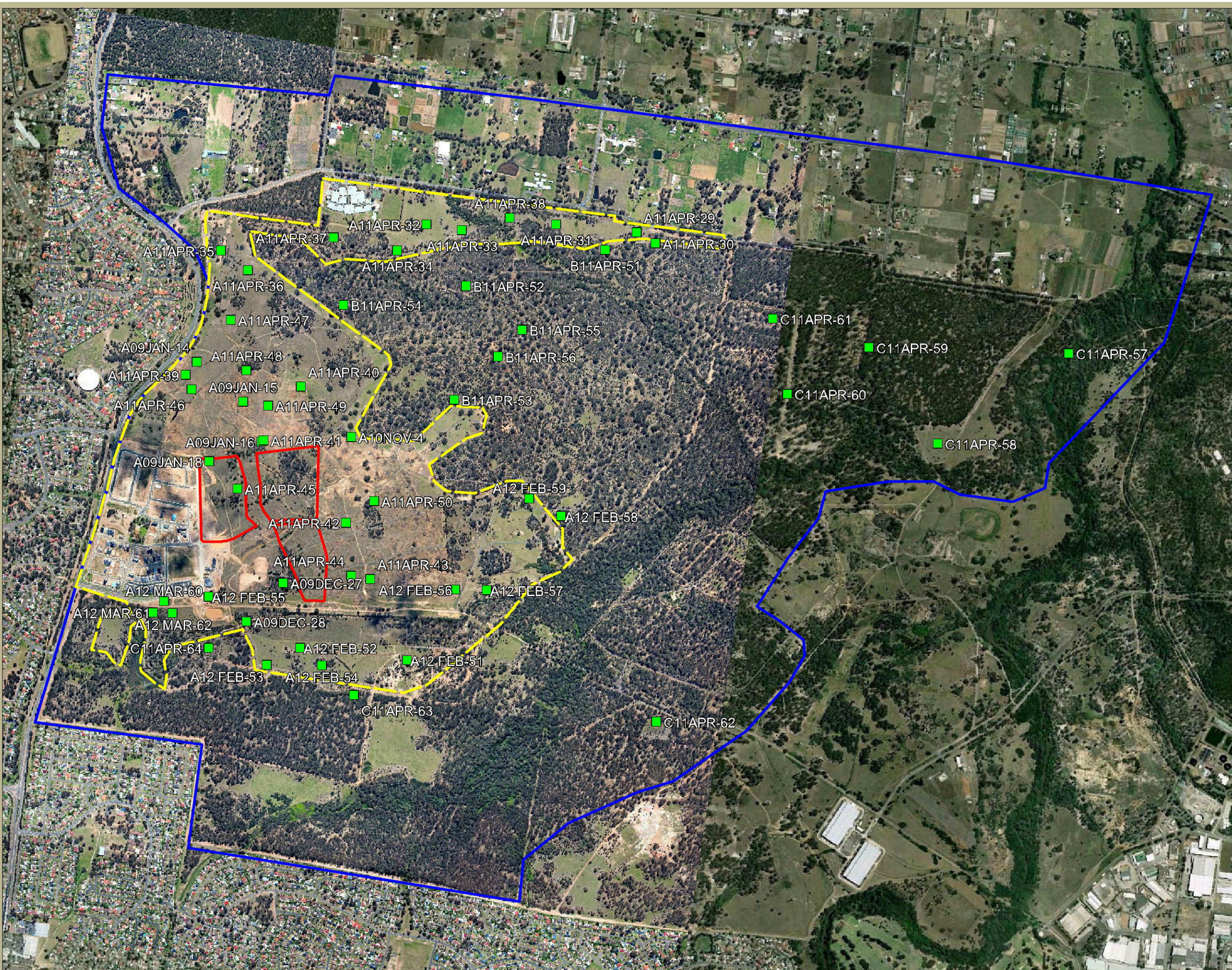


Image Source:  
 Image © 2011 Sinclair Knight Merz & Fugro  
 © 2011 Skycam Australia



Figure 4.1. Flora survey locations





iii. *Fauna survey*

Fauna surveys were conducted during the 2011 survey period, where possible, in accordance with OEH guidelines for ecological assessment (DEC (NSW), 2004). Due to the extensive nature of these surveys, further surveys in 2012 were deemed unnecessary.

As OEH survey guidelines are based upon stratification units, the Western Precinct was stratified using vegetation units as a surrogate for fauna habitat and survey effort was allocated accordingly. This was determined to constitute the following units:

- Sparse regenerating woodland and grassland (referred to as area A, being the subject land);
- Regenerating woodland (continuous) (referred to as area B, being the regrowth woodland added to the Regional Park since 1990); and
- Mature Woodland (referred to area C, being the established mature woodland of the Regional Park).

A summary of sampling method and effort used are provided in **Table 4.3**. Fauna survey locations are shown in **Figure 4.2**.

<b>Table 4.3 FAUNA SURVEY METHODS AND EFFORT (CUMBERLAND ECOLOGY 2011)</b>	
<b>Survey Method</b>	<b>CE Survey Effort in Western Precinct</b>
<i>Amphibians</i>	
Opportunistic call detection	Throughout survey period
<i>Reptiles</i>	
Opportunistic sightings	Throughout survey period
<i>Diurnal Birds</i>	
Walking transects	9 Hours (3 hours at 3 sites)
Opportunistic sightings	Throughout survey period
<i>Nocturnal Birds</i>	
Day habitat search	Throughout survey period
<i>Non-flying Mammals</i>	
Search for scats and signs	5 hours
<i>Bats</i>	



<b>Table 4.3 FAUNA SURVEY METHODS AND EFFORT (CUMBERLAND ECOLOGY 2011)</b>	
<b>Survey Method</b>	<b>CE Survey Effort in Western Precinct</b>
Ultrasonic call recording	6 nights
<i>Snails</i>	
Active habitat searches (spot assessment method)	300 sites



- Legend**
- Subject Site
  - Subject Land
  - Study Area
- Survey Locations**
- Cumberland Plain Land Snail Search Centre Point
  - Anabat
  - Bird Transect

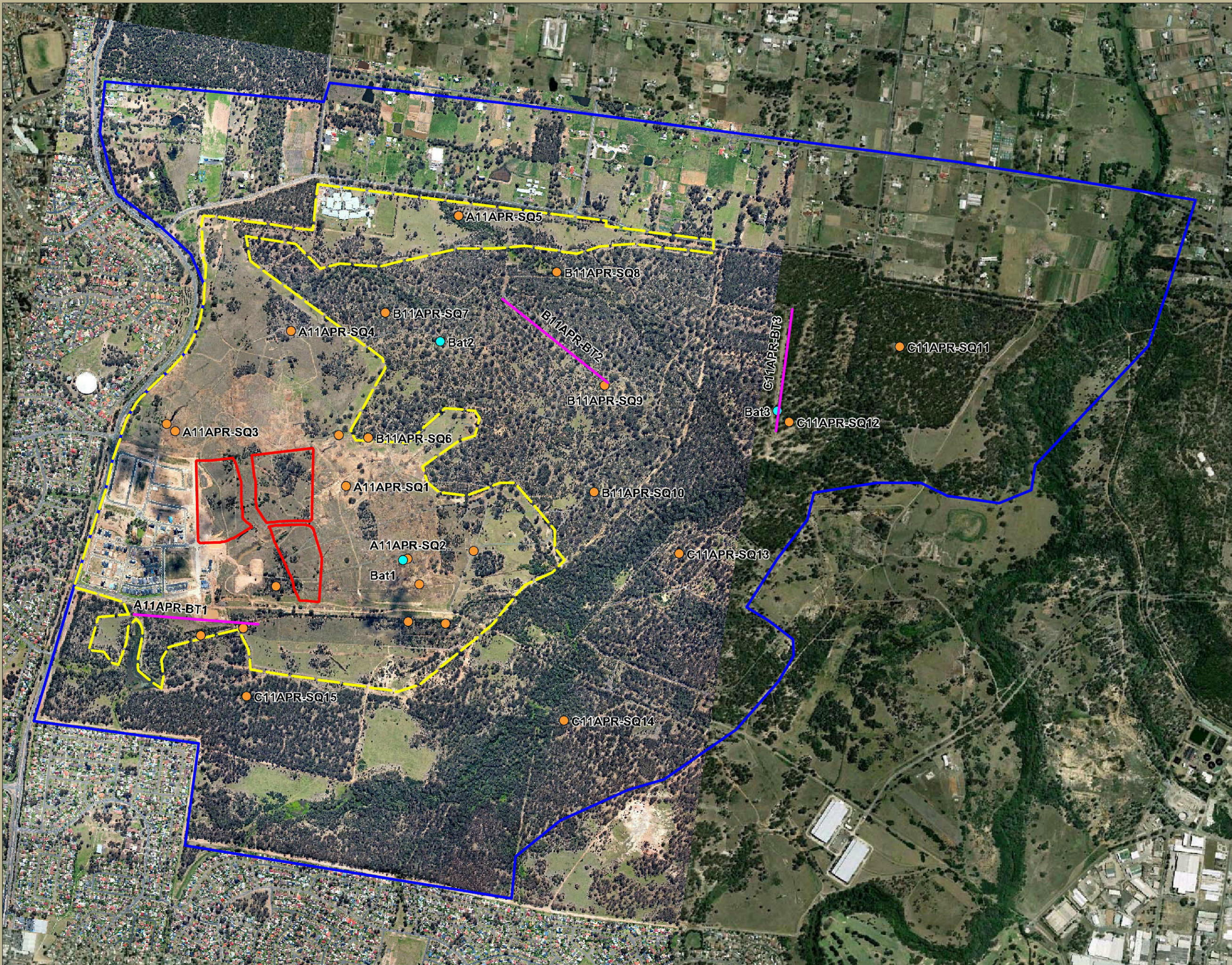


Figure 4.2. Fauna Survey Locations





a. Bat Surveys

Microchiropteran bats (microbats) were surveyed through the use of Anabat Z-caim units to record ultrasonic bat recordings.

Anabat Z-caim units were employed during the survey to record calls of microbats and were left at each survey location for two nights. Anabats were set before dusk each evening and set to automatically switch off after dawn. Calls recorded on each anabat were analysed to determine which species were present within the Study area.

b. Diurnal Bird Surveys

Visual observation and call identification of diurnal birds was carried out during each survey period. Dawn surveys were conducted at several points throughout the Western Precinct, and in the adjacent Regional Park, through the use of 500m walking transects over a 1 hour time period. Stops were made throughout the transects to positively identify birds, and detect cryptic species in the vegetation adjacent to the transect. Diurnal birds were also identified and recorded as they were encountered throughout the Western Precinct during the survey periods. GPS readings were taken near sightings of any threatened bird species.

c. Incidental Observations

Any incidental vertebrate fauna species that were heard calling, observed or otherwise detected on the basis of tracks or signs during 2011 fauna surveys and the August 2012 traverses were recorded and listed in the total species list for the Study Area. Incidental records of threatened flora and fauna from areas adjacent to the study area have also been included.

d. Cumberland Plain Land Snail Assessment –Spot Assessment Technique

A survey of Cumberland Plain Land Snail activity was conducted based on an adaption of the methodology known as the Regularised Grid-Based Spot Assessment Technique (RGB-SAT) protocol developed by Biolink (Biolink , 2008), generally used to detect Koala scats. The spot assessment technique did not adhere strictly to a grid based protocol, but rather sampled five representative sites within each zone, at approximately equal spacing from each site.

A total of 15 sampling points were taken, with five occurring in the Western Precinct, five occurring within the 'Perkins Peninsula' and five occurring within the Regional Park. Searches of five minutes in duration were made within the one metre of each of 20 trees for either live snails, or snail shells. Where there was no suitable habitat present, an appropriate habitat tree within a 100m radius of the sampling point was chosen. Trees that were targeted were those which provided suitable habitat for the species, predominantly those with a DBH of over 10cm and having a layer of bark around their base. Typical species included Grey Box (*Eucalyptus moluccana*) and to a lesser extent Forest Red Gum (*E. teretecornis*).

iv. *Habitat Assessment*

The characteristic attributes of different types of fauna habitat generally influences the assemblage of fauna species that can be found within each habitat and also affects the general value of the habitat for fauna. The Western Precinct contains three broad habitat types that vary in their value for fauna. These are:

- Remnant woodland and open forest;
- Riparian vegetation associated with minor tributaries and drainage lines;
- Young regenerating woodland; and
- Grassland.

Habitat condition was assessed during the 2011 surveys and the August 2012 surveys by noting ground and canopy cover, number and size of hollows present, habitat features such as bush rock and fallen trees, and signs of fauna usage such as scats and scratches.

Fauna habitat assessments also included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, bush rock and wetland areas such as creeks and soaks. An assessment of the structural complexity of vegetation, the age structure of the forest and the nature and extent of human disturbance throughout the Western Precinct was undertaken and considered.

a. *Hollow Assessment*

Hollows are used as a general indication of habitat quality for arboreal fauna, and hollow-dependent birds and bats. Hollows observed during surveys were recorded and the general vegetation condition and tree maturity were used to predict whether trees on site are likely to contain hollows. Indirect indicators of fauna use of the site such as droppings, diggings, footprints, scratches, nests, burrows, paths and runways were also noted.

A regularised hollow assessment was also conducted at each of the 15 sampling points used for the above Cumberland Plain Land Snail assessment described above. At each sampling point, searches for hollow-bearing trees were made within a 20m x 20m quadrat. For each quadrat the number of hollows and size class of hollows were recorded. Hollow size classes are defined in Table 2.5 below. Data obtained was used to give an indication of the availability of habitat for arboreal fauna, and hollow-dependent birds and bats.

<b>Table 4.4 TREE HOLLOW CLASS SIZE</b>	
<b>Class</b>	<b>Diameter (cm)</b>
Small	<10
Medium	10>-<30
Large	>30



#### 4.2.2 *Statistical Analyses*

Percentage composition of native and exotic flora species in the different study areas from current and previous surveys were calculated and plotted in Microsoft Excel. Flora data was further analysed using the statistical program PRIMER (Version 6). Similarity matrix dendrograms were produced (CLUSTER) and analysed using SIMPER (Similarity percentages) tests to determine levels of similarity between different groups of quadrats. Separate CLUSTER and SIMPER analyses were conducted for the native and exotic species data sets in addition to the analyses for the complete set of flora data. This information was used as part of the analysis to separate out various condition classes of vegetation.

Differences in Cumberland Plain Land Snail numbers between the different areas were analysed using the Statistical software package, MyStat. Data was tested for normality and homogeneity of variance and then analysed using either Analysis of Variance (ANOVA) or Kruskal-Wallis (K-W) tests in the event that ANOVA requirements were not met even after data transformations. Mann-Whitney U-tests were used for post-hoc pair wise comparisons between areas for the K-W tests. As U-tests are not typical post-hoc tests, a Bonferroni adjustment was applied to the level of significance to avoid Type I errors. As three comparisons were run, this reduced the standard 0.05 level of significance to 0.017 (0.05/3).

#### 4.2.3 *Weather Conditions for Surveys by Cumberland Ecology*

This report draws upon information collected by numerous ecologists over many years, including studies done across the 900ha Regional Park and both the Western and other Precincts. Surveys have therefore been conducted in all seasons and in a wide variety of weather conditions. This means that the resultant database of ecological information is detailed and reliable.

Weather conditions during surveys by Cumberland Ecology were generally appropriate for detection of a wide variety of flora and fauna, and due to high rainfall in Autumn 2011, were generally very good for flora survey.

A summary of weather conditions in the locality of the Western Precinct during the 2011 surveys is provided in Table 4.5. Weather conditions during the survey period stayed predominantly cool to mild, with the daily maximum temperature varying from 18.3°C to 25.7°C. Two days saw rainfall, with most other days being overcast but remaining dry.

Conditions leading up to and during the survey period (14 April- 2 May, 2011) were generally warm, with some isolated rainfall. This rainfall created boggy conditions within the drainage lines across the Western Precinct.

<b>Table 4.5      SUMMARY OF WEATHER CONDITIONS DURING SURVEY</b>			
<b>Date</b>	<b>°C min</b>	<b>°C max</b>	<b>Rain (mm)</b>
14/04/2011	9.9	24.1	0

**Table 4.5 SUMMARY OF WEATHER CONDITIONS DURING SURVEY**

Date	°C min	°C max	Rain (mm)
22/04/2011	12	25.7	0
27/04/2011	14.5	18.9	5.4
28/04/2011	14.1	20.1	0.4
29/04/2011	13.9	20.8	2.8
02/05/2011	9.9	18.3	0

#### **4.2.4 Survey Limitations**

Adequate ecological data exists for the assessment of the ecological impacts for the Project. There are no significant limitations to the data available.

The flora and fauna of the study area, the SMP and immediate surrounds have been subject to a series of surveys over many years. Consequently, the ecology of the Western Precinct and indeed the flora and fauna of the locality is well known. There is an excellent baseline of flora and fauna data, including vegetation mapping, and information about individual species.

The SMP and its surrounds have been subject to detailed flora and fauna studies since the area was rezoned in 1993. There has been considerable ecological survey effort within the locality of the Western Precinct in recent times for baseline data by Government and Industry. The contemporary studies completed within the Western Precinct and within the locality were reviewed, including unpublished reports prepared for OEHL on the flora and fauna of both the Western Precinct and adjacent Regional Park. These included vegetation community mapping, targeted threatened species surveys listed in Section 4.1.1 above.

At the time of both the 2011 and 2012 surveys by Cumberland Ecology, and in the months before, the weather conditions had been favourable for plant growth and reproduction. Features such as flowers and fruits required for identification of most plants to species level was available. Grasses, herbs and creepers were readily identifiable in most instances.

A range of threatened flora is known to occur in the locality, and the SMP. The majority of these threatened flora were not detected in the subject land or study area during the surveys to date however, the habitats that are present in the subject land and study area have the potential to support the species. For this reason, where potential habitats were present, it was assumed that minor or negligible impacts to the species could occur, despite negative survey results. Species that have been recorded on the subject site, are considered as major affected species in this SIS, and are assessed as such.

The comprehensive fauna surveys previously conducted on the SMP were generally undertaken according to OEHL guidelines (DEC (NSW), 2004) (despite a number of the historic surveys being prior to this publication date). Targeted fauna surveys conducted for this SIS were not intended as baseline fauna surveys, due to this extensive prior survey data, but were conducted to supplement previous surveys and provide updated data for



specific threatened species. The data produced by the surveys is intended to be indicative of the types of species that could occur and not an absolute census of all flora and fauna species of the study area.

### 4.3 Survey Results

This section presents the results of recent surveys and describes the flora and fauna of the study area of the Western Precinct, taking into account information obtained from previous surveys and surveys undertaken specifically for this Western Precinct Biodiversity Assessment. Particular emphasis has been placed on threatened flora and vegetation communities that have been recorded from the SMP or that could potentially occur.

This addresses the DGRs 4.2; *Documentation* and subsections 4.2.3 *Description and mapping of results of vegetation, flora and fauna surveys*.

Detailed descriptions of each of the communities listed above are provided in the following sections.

#### 4.3.1 *Vegetation Communities of the Study Area*

Cumberland Plain Woodland (CPW) is the dominant vegetation community occurring in the study area. Across much of the study area its occurrence ranges from sparse open woodland interspersed with large patches of grassland to more intact, large areas of woodland.

The CPW present in the subject site is dominated by a low quality variant of the community, low diversity Derived Native Grassland. Other variants of CPW within the subject site include some regenerating CPW and very small patches of mature woodland. The other communities present within the subject land are a regenerating form of RFEF, a riparian community and also small areas of Freshwater Wetlands. Detailed descriptions of each of the communities listed above are provided in the following sections.

For the purposes of this SIS, three sampling areas were identified:

- Area A: The subject land, including the more sparse occurrences of CPW present in the study area;
- Area B: The Regional Park; including areas of regenerating CPW that are of a similar age to Area A. This area was identified during very early surveys by Perkins as being of higher quality than CPW in Area A, and consequently the woodland was added to the larger 900ha Regional Park; and
- Area C: The Regional Park; including predominantly mature CPW and also RFEF and some patches of grassland that historically experienced higher levels of disturbance than other parts of the Regional Park.

i. *Cumberland Plain Woodland*

a. Mature CPW in the Regional Park

The CPW in the central portions of the Regional Park, which has been included in the eastern extent of the study area for the purposes of this SIS, generally contained mature CPW and other woodland types. Quadrats conducted within this variation of CPW in the Regional Park were located within the mature and structurally complex woodland shown as Area C (or Quadrats labelled with C). However, not all quadrats in area C conformed to this definition, as open-structured regenerating plots and some grassland plots were also surveyed for comparison with the subject land. A small number of plots within Area B also conformed to this mature class of CPW.

The canopy of the CPW was open and almost exclusively dominated by *E. moluccana* with some areas also containing *E. fibrosa* (Broad-leaved Ironbark) and *E. tereticornis* with an average Projective Foliage Cover (PFC) of 10-40%. The Midstorey was also dominated by sparse small trees of *E. moluccana*, *Acacia parramattensis* (Parramatta Wattle) with some areas including *E. tereticornis* with a slightly variable PFC of between 1-5% and occasionally up to 20%. A very sparse to moderate shrub layer was present in most quadrats, dominated by *Bursaria spinosa* (Blackthorn) and *Dillwynia sieberi* (Parrot-pea). The groundcover was dominated by native herbs and twiners typical of CPW; *Brunoniella australis* (Blue Trumpet), *Glossocardia bidens* (Cobbler's Tick), *Phyllanthus virgatus* (a spurge), *Hypochaeris radicata* (Flatweed), *Oxalis perennans*, *Dichondra repens* (Kidney Weed) and *Glycine tabacina* (Love Creeper) and a few exotic herbs also dominant; *Sida rhombifolia* (Paddy's Lucerne) and *Richardia stellaris*. Native grasses were abundant and included: *Aristida vagans* (Three-awned Spear Grass), *Bothriochloa decipiens/macra* (Pitted Bluegrass/Red Leg Grass), *Chloris ventricosa* (Windmill Grass), *Sporobolus creber* (Slender Rat's Tail Grass) and *Paspalidium distans*.

Exotic groundcover abundance within quadrats was estimated to be approximately 1-20%. Mature CPW with a shrub layer of *Bursaria spinosa* is shown in Photograph 4.1.





**Photograph 4.1**      **Mature CPW in the Regional Park**

b.      Regenerating CPW

Regenerating CPW occurs throughout a large portion of the study area. This variation of the community refers to both the regeneration (often prolific) of sapling and juvenile Grey Box and also the generally reduced diversity of native ground cover species that typify CPW, being a grassy open woodland community, as shown in Photograph 4.2.





**Photograph 4.2      Regenerating CPW in the study area**

*Area B – Regional Park*

Quadrats conducted within this variation of CPW that occurs in the Regional Park were located within the dense regenerating woodland shown as Area B (or Quadrats labelled with B) in Figure 4.2. The canopy was very sparse and almost exclusively dominated by *E. moluccana* with an overall Projective Foliage Cover (PFC) of 5-10%. The Midstorey was also dominated by *E. moluccana* with some areas including *E. tereticornis* with a highly variable PFC of between 5-50%. A very sparse shrub layer was present in most quadrats, dominated by *E. moluccana* saplings and occasionally *B. spinosa*. The groundcover was similar to that of mature CPW, described above, although the diversity of native groundcover species was slightly reduced, with several native herbs absent, including; *P. virgatus* and *O. perennans*.

Several of the herbs and grasses that were recorded to be present, but not dominant, in the Mature CPW were not present in this variation, including the characteristic species; *Lomandra filiformis* ssp. *filiformis* (Wattle Mat-rush), *Plantago debilis* and *Hypochaeris radicata* and some native grasses such as *Sporobolus creber* (Slender Rat's Tail Grass).

This variant of regenerating CPW was estimated to have an exotic ground cover of mostly between 5-10%.

*Area A – Subject land*

Quadrats conducted within this variation of CPW in the Western Precinct were located within the sparse regenerating woodland shown as Area A (or Quadrats labelled with A) in Figure



4.2. This variant is similar to that described above, although the canopy is generally more open, with a PFC of 5-10% and a native shrub layer is often absent. The species were as above, although the diversity of native groundcover species was reduced, with several of the dominant native herbs absent, including; *P. virgatus*, *O. perennans*. Several of the herbs and grasses that were recorded to be present, but not dominant, in the Mature CPW were not present in this variation, including characteristic species; *Lomandra filiformis* ssp. *filiformis* (Wattle Mat-rush), *Plantago debilis* and *Hypochaeris radicata* and some native grasses such as *Sporobolus creber* (Slender Rat's Tail Grass).

c. Derived Native Grasslands

Two main forms of grassland are recognised: areas supporting native herbs and some native grasses and areas supporting a far higher concentration of exotic species. Although both forms of grassland are considered to be derived from the past clearing of CPW, the former category is likely to have a higher resilience and is associated with the historically less disturbed portions of the SMP. Photographs below indicate the two categories of derived native grassland.

*Native dominated DNG*

The canopy, midstorey and shrub layers were absent. The native herb layer was similar to that of CPW, although native herbs were less frequent. Dominant native species included herbs and grasses such as *Gnaphalium* sp., *Wahlenbergia gracilis* (Native Bluebell), *Fimbristylis dichotoma* (Common Fringe-sedge), *Bothriochloa decipens/macra*, *Sporobolus creber*, *Eragrostis brownii*, *Cymbopogon refractus*, *Aristida ramosa* and *Aristida vagans*. Other dominant species included exotic grasses such as *Setaria parviflora*, *Eragrostis curvula* (African Lovegrass), and *Axonopus fissifolius* (Carpet Grass), as well as exotic herbs such as *Senecio madagascariensis* (Fireweed) and *Conyza bonariensis* (Flaxleaf Fleabane)

*Low diversity DNG*

The majority of this grassland is within Area A and supports a far higher concentration of weeds than the native dominated sub-category, being dominated by few species of exotic grasses; mainly *Axonopus fissifolius*, *Paspalum dilatatum*, *Setaria parviflora* and *Eragrostis curvula* and also *Cynodon dactylon* (Couch Grass). Exotic herbs were also common and included; *Senecio madagascariensis*, and *Hypochaeris radicata*. Native species present include *Fimbristylis dichotoma*, *Eragrostis brownii*, *Themeda australis* (Kangaroo grass) and *Wahlenbergia gracilis*.

Drainage depressions, formed from historic soil scraping and the creation of contour banks within the subject land, are generally considered to be part of the grassland category. Due to the high concentration of exotic species, these areas were not considered separately from the more exotic, low diversity variant of CPW derived native grassland described above.





**Photograph 4.3** Native dominated Derived Native Grassland, north of the Western Precinct



**Photograph 4.4** Low diversity Derived Native Grassland on the subject land



ii. *Shale Gravel Transition Forest*

This community occurs predominantly in Area C in the Regional Park, but fragmented patches were found in the subject land.

As the name suggests, this is a transitional plant community which grades into Cumberland Plain Woodland where the influence of gravel soil declines, and grades into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thick. There is a natural continuum of soil in this spectrum, and it can be difficult to distinguish these communities, towards the centre of the shale-gravel spectrum. In a new critically endangered listing under the EPBC Act, a single community called *Cumberland Plain Woodland and Shale-gravel Transition Forest* is described.

The NSW Scientific Committee description for SGTF includes a slightly different species composition from CPW, based on the local presence of lateritic gravel in the soil. The community is dominated by *Eucalyptus fibrosa* with *E. moluccana* also occurring less frequently. Shrub species are similar to those found in CPW but more commonly include shrubs from the pea family, including threatened species such as Parrot pea, and has also been observed to contain high numbers of *Grevillea juniperina* subsp. *juniperina*.

Large areas of SGTF occur in the eastern portions of the SMP, mostly to the east of the current study area extent. This community has previously been mapped in the Western Precinct. While floristic data from one quadrat, collated for the preparation of this SIS was strongly consistent with this community, most vegetation patches in the current study site are considered to conform more to the definition of CPW. For the purposes of this SIS, the few patches of SGTF occurring within the subject site have therefore been incorporated within CPW, which is also of higher conservation status under the TSC Act.

The SGTF community is therefore considered unlikely to experience significant habitat loss.

iii. *River-flat Eucalypt Forest*

River-flat Eucalypt Forest (RFEF) has a limited occurrence in the Western Precinct, occurring in a simplified regenerating form in the south of the Precinct as a 10m wide band either side of a drainage line. Although RFEF has a limited distribution within the precinct, it adjoins more extensive areas of Alluvial Woodland in the Regional Park along the tributary to South Creek.

The subject site and Western Precinct generally does not form part of a natural floodplain, as indicated by ground levels present and the soil scrapes and dug out channels that have been historically formed to direct water flow. Although vegetation in the subject land exhibits some riparian characteristics, the majority of this vegetation is unvaried in composition from the surrounding woodland. Within the study area as a whole, most of the limited native vegetation associated with any drainage channels is more indicative of CPW than a riparian community.

The occurrence of RFEF vegetation is somewhat fragmented, with the eastern extent being more intact and exhibiting more of the species indicative of this community. The western extent however, is more closely related to CPW.

Previous quadrat and transect data was used to describe this community in the Western Precinct. The data indicated that the canopy was mostly dominated by either *Eucalyptus tereticornis* (Forest Red Gum) or *Angophora floribunda* (Rough-barked Apple), but also included *Casuarina glauca* (Swamp Oak) and *E. amplifolia* (Cabbage Gum). In the more intact sections, a small tree layer occurs with *Melaleuca linariifolia* and *Acacia floribunda* being present.

The midcanopy was sparse and absent in some areas, but dominated by juvenile *E. moluccana* and *E. tereticornis* trees, *Allocasuarina littoralis* (Black She-oak), *Casuarina glauca* and *Acacia parramattensis*.

The shrub layer was dense in parts and dominated by saplings of the canopy and midcanopy species including *Bursaria spinosa*, *Daviesia ulicifolia* and *Grevillea juniperina* spp *juniperina* and exotic species such as *Phoenix canariensis* (Canary Island Date Palm) and *Ligustrum lucidum* (Large-leaved Privet).

The groundcover was dominated by native grasses, mainly *Aristida ramosa*, *Chloris ventricosa*, *Bothriochloa decipiens*, *Cymbopogon refracta* and *Themeda australis* with exotics *Axonopus affinis*, *Cynodon dactylon*, and *Chloris gayana* (Rhodes Grass). Herbs were infrequent, but dominated by *Pratia purpurascens* (White Root), *Asperula conferta* (Common Woodruff), *Cyperus gracilis*, *L. filiformis* ssp *filiformis* (Wattle Mat-rush) and the vine *Desmodium varians* (Tick-trefoil) and exotics *Richardia stellaria*, *Sida rhombifolia* (Paddys Lucerne) and *Verbena officinalis* (Small-flowered Purpletop).





**Photograph 4.5 River-flat Eucalypt Forest in the south-eastern part of the study area**

As identified by the final determination (NSW Scientific Committee, 2004j), this community typically tends to form mosaics with other floodplain forest communities and treeless wetlands. River-flat Eucalypt Forest, in the form of Alluvial Woodland, is present on the SMP, in association with South Creek and Ropes Creek. The drainage channels present in the study area are currently in a modified and degraded condition, but in the future, their connection with tributaries of South Creek will be enhanced. The regeneration of River-flat Eucalypt Forest and wetland habitats will form part of the Riparian Corridor development, and will therefore increase the current extent of this EEC.

*iv. Freshwater Wetlands*

*a. Sedgeland*

Sedgeland, a form of Freshwater Wetlands, occurs in very small localised patches throughout the precinct, generally artificially created by a small scraping of the soil that has resulted in a small depression. These areas usually are too small to warrant mapping, being only a few square metres in area and have been included in the grassland mosaic.

These areas of sedgeland have been created by ponding next to a contour bank, which was similar to the other areas of ephemeral ponding, aside from the dominance of native rather than exotic species. The man-made landform is not likely to exist on a natural floodplain and is not mapped as being within the 1:100 year flood zone.



The identification guidelines for Freshwater Wetlands on Coastal Floodplains, an EEC listed under the TSC Act state that the wetland must be on a natural coastal floodplain that is inundated at least every 100 years (DECC (NSW), 2008). The majority of the subject land is not within the 100 year flood extent. However, based on the species present, it is considered that the EEC is present in a degraded / simplistic form.

The sedgeland within the study area is mostly dominated by *Carex appressa*, *Juncus* sp. and *Pericaria decipiens*. *Triglochin procera* and *Ludwigia peploides* ssp. *montevidensis* occurred within the water. Occasional *Ranunculus inundatus*, *Philydrum lanuginosum*, *Ottelia ovalifolia*, *Paspalum distichum*, *Cyperus eragrostis*, *Centella asiatica*, *Typha orientalis* and *Alternanthera denticulata* also occur. The vegetation within the wetland in the subject land was dominated by *Cyperus* sp., *Axonopus fissifolius* and *Eragrostis brownii*. *Goodenia paniculata*, *Alternanthera denticulata* and *Juncus* sp. occurred occasionally along with rare occurrences of *Melaleuca stypheloides* and *Potamogeton* sp. This can be seen in Photograph 4.6.



**Photograph 4.6 Sedgeland on the subject land**

The smaller areas of sedgeland in the Western Precinct formed in scrapes in the soil have minimal conservation value. They provide small areas of habitat to common frog species and water resources for other animals, as well as local provenance plants. The larger area of wetland towards the eastern side of the Western Precinct has a slightly higher conservation value, based on its connectivity with larger areas of habitat within the Regional Park.



b. Wetland/dam

A large dam occurs in the study area, just to the south of Western Precinct boundary. The dam comprises an arc shaped body of water that follows the local contours and a series of borrow pits from which soil was taken to construct the dam wall. Wetland species occur in the dam as well as the low lying borrow pits but would have only colonised the area since the dam was flooded. The area covered by the current extent of Freshwater Wetlands would have comprised Cumberland Plain Woodland and River-flat Eucalypt Forest prior to construction of the dam. An area at the north-eastern extent of the wetland contained vegetation that could be described as wet meadow.

This Freshwater Wetland can be seen in Photograph 4.7

Wetland vegetation in the dam was concentrated at the northern end and mainly comprised *Elaeocharis sphacelata* and *Marsilea hirsuta* (Nardoo). *Philydrum lanuginosum* (Frogsmouth) was common, and *Juncus* sp formed a band around the margin and on the dam wall at the overflow zone.

The borrow pit vegetation varied from a small pond with dense *Elaeocharis sphacelata* and sparse *Philydrum lanuginosum* and *Potamogeton tricarinarus*, to seepage zones with *Juncus* sp, *Ranunculus inundatus*, *Ludwigia peploides* and *Lythrum hyssopifolia*. Seepage zone vegetation occurred in many of the borrow pits and the south eastern end of the dam wall, that acted as a spillway.

Remnants of the original vegetation communities had regenerated on the slightly higher ground between borrow pit wetland zones. This was largely composed of large *Eucalyptus tereticornis* with *Angophora floribunda* and *Allocasuarina littoralis* (Black She-oak) understorey, and *Bursaria spinosa* shrub stratum with native grass ground cover.

The wet meadow zone was a low lying area that received periodic inundation, but apparently at a frequency less than required for most wetland plant species. It comprised *Microlaena stipoides* grassland with *Juncus* sp., *Persicaria decipiens*, *Centella asiatica* and *Lythrum hyssopifolia* being co-dominant. Common species included: *Ranunculus inundatus*, *Eclipta platyglossa* and exotic Asteraceae. Juveniles of the noxious *Xanthium* sp were recorded in significant numbers in this area. *Cynodon dactylon* was locally dominant, especially at the dry margins except along the northern side. Overall, exotic species ranged from 5-70% of the projective foliage cover of the ground cover in the wet meadow and borrow pit zones.



**Photograph 4.7**      **Freshwater Wetland in the study area**

Large wetlands are uncommon in and around the SMP and are considered to have moderate to high conservation significance. Where wetland species have colonised artificially created habitats, the area is still considered to be a degraded variant of the EEC.

Wetlands have conservation value if they form part of a habitat corridor, provide habitat for aquatic species and resources for birds and mammals, provide habitat for threatened aquatic plants or maintain a seed bank of local provenance plants.

The larger dam and wetland habitat is of high conservation value as it provides habitat for migratory species including Latham's Snipe, covers a relatively large area compared with sedgeland formed in scrapes and is connected to other types of habitat through the Regional Park. Some sedgelands and wet meadows that occur around the dam near the precinct also have high conservation value because of the connectivity to the Regional Park habitats.

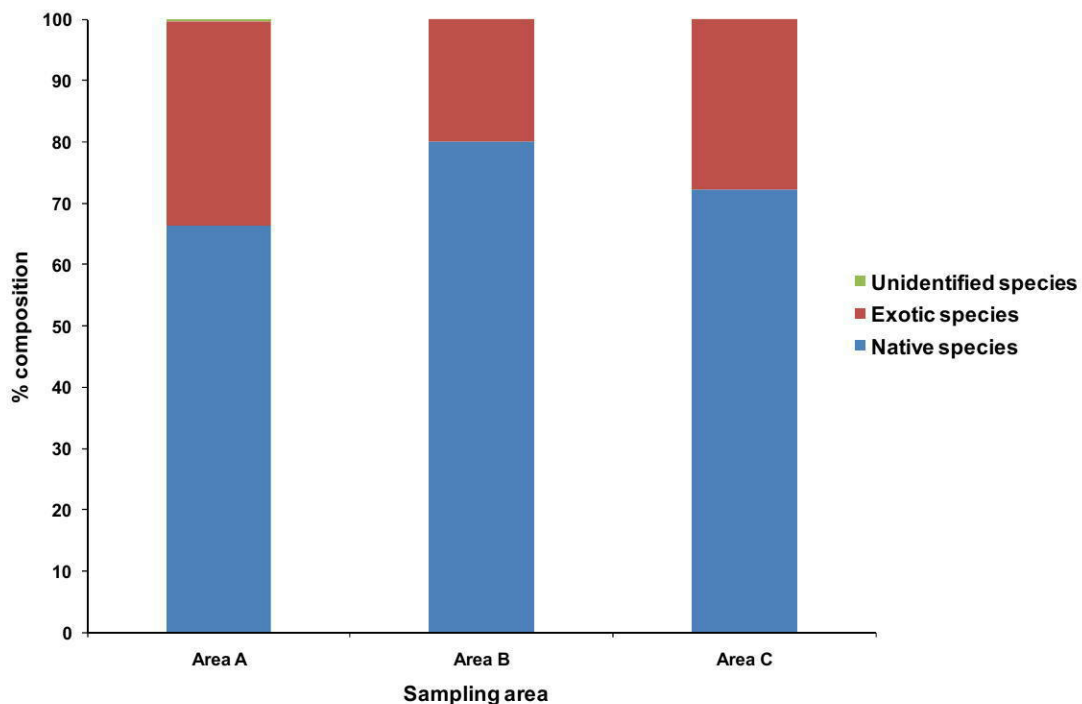
v.      *Planted Trees*

Areas of planted, non-indigenous trees also occur within the subject land. These mainly consist of rows of Spotted Gums (*Corymbia maculata*) on the western boundary, along the Northern Road. A patch of Spotted Gums was also planted (in approximately 1990) in the south east of the subject land as a scientific trial (pers comm. Ian Doyle, 2011). These planted tree areas support an understorey that is consistent with CPW, and therefore have been included in the area of EEC, despite the non-indigenous canopy cover.



### 4.3.2 Statistical outcomes of vegetation composition comparisons

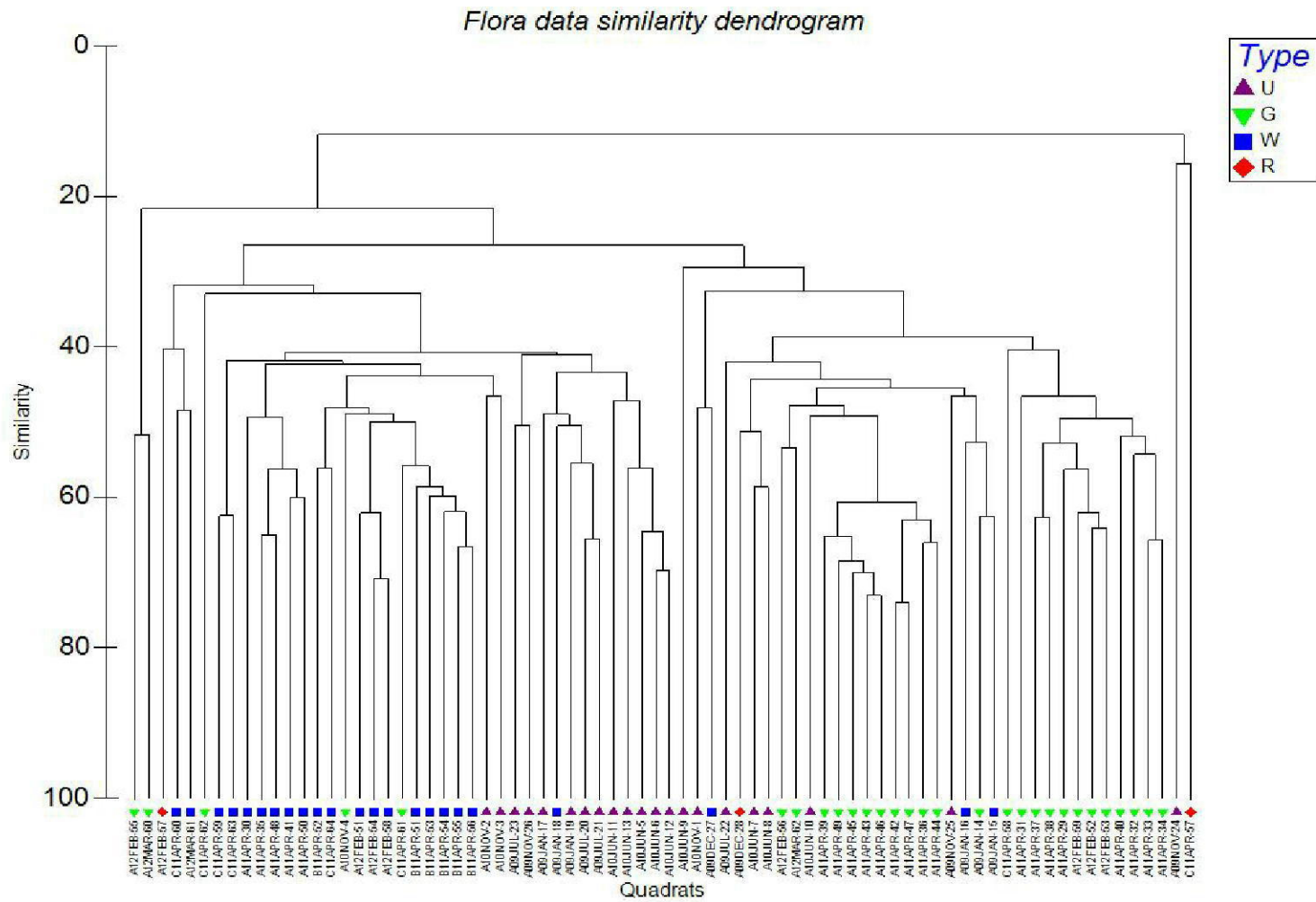
Statistical analyses of the data found that the subject land (Area A) had a higher exotic species composition (33.8%) than the Regenerating woodland (Area B: 19.9%) or Mature woodland (Area C: 27.9%) areas. These figures provide support to the decision to include the regenerating woodland (Area B) into the Regional Park as the lower exotic species composition is indicative of its higher conservation value. The following figure (Fig 4.3) shows the relative proportions of native and exotic plant species in the different sampling areas.



**Figure 4.3 COMPARISON OF EXOTIC AND NATIVE PLANT COMPOSITION IN THE SUBJECT SITES (AREA A), REGENERATING REGIONAL PARK WOODLAND (AREA B) AND MATURE REGIONAL PARK WOODLAND (AREA C).**

The following similarity dendrogram (Figure 4.4) shows that the different quadrats start segregating into groups or clusters at similarity levels of ~10-15%, indicating that plant composition differs between quadrats/habitats. Although all three sampling areas recorded a higher percentage of native than exotic flora species, SIMPER (Similarity Percentage) analyses found that species contribution to the vegetation composition differed between the different sampling areas and between habitat types. Details of similarity levels among similarly classified quadrats and the three primary species contributing to this similarity is provided in Appendix D.

Overall Areas A and B showed a 66.50% dissimilarity in their species composition, Areas A and C had a dissimilarity of 74.08% while Areas B and C differed by 60.81%. Grassland and Woodland habitats across the entire study area had a dissimilarity of 70.40%. Riparian habitats had a dissimilarity of 75.78% and 77.81% with grassland and woodland habitats respectively.



Key: R = Riparian Vegetation, W = Woodlands, G = Grasslands, U = Unidentified areas

**Figure 4.4 SIMILARITY DENDROGRAM OF ALL FLORA SPECIES AMONG QUADRATS**



### 4.3.3 Threatened Flora Species

Numerous flora surveys have recorded a wide diversity of plants from the SMP, including several threatened species. These are *Grevillea juniperina* ssp *juniperina*, *Pultenaea parviflora*, *Pimelea spicata*, *Dillwynia tenuifolia*, *Micromyrtus minutiflora*, *Marsdenia viridiflora* ssp *viridiflora* (endangered population), and *Persoonia nutans*. The majority of these species are found in Shale-gravel Transition Forest (SGTF) and Cooks River/Castlereagh Ironbark Forest (CRCIF) in the east of the current study area, where the soil is characterised by large amounts of lateritic gravel. *Pimelea spicata*, *Marsdenia viridiflora* ssp *viridiflora* are also found in Cumberland Plain Woodland and *Grevillea juniperina* ssp *juniperina* can be found in Cumberland Plain Woodland or grassland areas where there is a gravel influence. The soil type in the Western Precinct is different however, and contains less lateritic gravel, although localised areas contain high proportions of gravel also. Consequently, there is limited habitat for most of the threatened species recorded from the east, except in pockets of similar soil type.

#### i. Recent surveys of the study area

Two threatened plant species; *Grevillea juniperina* ssp *juniperina*, and *Pultenaea parviflora* have been recorded during the 2011 and 2012 surveys of the Western Precinct. Additionally, several individuals of *Pimelea spicata* have been detected in the past, however the species was not detected within the 2011 and 2012 surveys despite searches in the locations of previous records.

These records are summarised below.

#### a. *Grevillea juniperina* subsp *juniperina*

*Grevillea juniperina* subsp. *juniperina* is listed as Vulnerable under the TSC Act. It is a dense shrub, 0.5-1.5m tall, found only in Western Sydney, between St Mary's, Londonderry and Prospect (Robinson, 1991).

Occurrences of *Grevillea juniperina* subsp. *juniperina* were recorded from the northern and southern margins of the precinct, and it is estimated that approximately 700 individuals occur within the precinct although none occur within the subject site. Local population sizes varied from individuals to an estimated 410 plants (Table 4.6). Large areas of habitat for this species are contained within the Regional Park, where over 250,000 *Grevillea juniperina* subsp *juniperina* specimens are estimated to be located (Cumberland Ecology, 2004c) with numerous sub-populations and individuals of the species being detected in the 2011 period.

<b>Table 4.6 LOCATIONS OF GREVILLEA JUNIPERINA SSP JUNIPERINA POPULATIONS IN THE STUDY AREA</b>	
<b>Location – AGD 66</b>	<b>Number of plants (estimated)</b>
56 290647 6267154	Over 30
56 289573 6267156	Over 30
56 289340 6266924	Approximately 20
56 290357 6265591	single plant
56 290389 6265714	single plant
56 290388 6265684	approximately 55
56 290276 6267251	less than 10 plants
56 290147 6265572 (and immediate surrounds)	42 (within or directly adjoining the subject site)
56 290344 6265574 (and immediate surrounds)	125 (within or directly adjoining the subject site)
56 289909 6265136	60
56 290064 6265381	40
56 290165 6265290	410
56 289234 6266875	23
56 290181 6267063	50
56 290553 6266991	120
56 290118 6265420	Single plant
56 290435 6265697	Single plant
<b>Total estimated to occur</b>	<b>1017</b>

Previous surveys have indicated medium-high densities of this species found in the Regional Park (averaging up to 1300 plants/ha in less fragmented areas, and 750 plants/ha in



fragmented areas, and lower densities (200 plants/ha) in development area, as discussed further below and shown in Appendix B.

b. *Pultenaea parviflora*

Only one occurrence of *Pultenaea parviflora* has been recorded within the Western Precinct, and specifically within the subject site. The individual plant was identified in the 2011 surveys, and occurs in an area of grassland at the northern edge of the subject site. Due to overlapping site areas, the subject site for the approved Village 2 and Village 3 DA's also included the location of this individual. Large areas of habitat for this species are contained within the Regional Park, with numerous populations and individuals of the species being detected in the 2011 survey period.

<b>Table 4.7 LOCATIONS OF PULETNAEA PARVIFLORA ON THE SUBJECT SITE</b>	
<b>Location – AGD 66</b>	<b>Number of plants (estimated)</b>
56 289601 6266220	single plant

ii. *Historic surveys of the study area and SMP*

Gunninah Consultants (Gunninah, 1995) and ERM (ERM, 2003) have previously counted threatened plants within quadrats of various sizes that have allowed for extrapolations or counts of threatened plants within the SMP. This has been possible for *Pultenaea parviflora*, and *Grevillea juniperina* subspecies *juniperina*. The Biodiversity Assessment of the Eastern Precinct (ERM, 2003) of the SMP provided estimates of populations of these species based upon such counts. For the purposes of this SIS, Cumberland Ecology also counted plants on the subject site and within the eastern tip of the Regional Park.

The various counts of threatened plants were done at different times under differing seasonal conditions by different people. The densities of plants counted by Gunninah Consultants were generally the highest (although they did not count *Grevillea*) and it is possible that additional seedlings were present during these counts to inflate the population estimates.

Due to the variation in numbers of plants between the different estimates, this SIS relies upon the lowest most conservative estimates of plant numbers within the Regional Park. The numbers should be interpreted as indicative only and reflect the scale and variability of the populations.

The table below shows the assumed areas of habitat and habitat types for each of the threatened plants in the Regional Park. The table on the following page shows the various population estimates for each of the threatened plants.

**Table 4.8 POPULATION ESTIMATES FOR PARVIFLORA AND GREVILLEA JUNIPERINA SUBS.JUNIPERINA WITHIN THE WIANAMATTA REGIONAL PARK**

Estimated Numbers of <i>P. parviflora</i> and <i>G. juniperina</i> in Regional Park	Surveyors:	Gunninah 1995	ERM 2001/02	ERM 2003	Cumberland Ecology 2004	Max Pop in Reg Pk	Min Pop in Reg Pk
	<b>Plot size in metres square:</b>	200	1000	10	10		
	<b>Plot number:</b>	32	4	91	35		
<i>Pultenaea parviflora</i>	Mean per hectare	436	1,162	1,933	1,371	260,955	58,860
	Standard Error	106	770	325	296	43,875	14,310
<i>Grevillea juniperina subspecies juniperina</i>	Mean per hectare	not counted	467	2,822	714	987,700	249,900
	Standard Error		401	361	156	126,350	214,582

Gunninah 1995 = Gunninah Environmental Consultants report for Pyro Park; ERM 2001/02 = Biodiversity Assessment for Eastern Precinct; ERM 2003 = estimates from Remediation Works Assessment; Cumberland Ecology 2004 = surveys for the Eastern Precinct SIS



iii. *Pimelea spicata*

*Pimelea spicata* is listed as Endangered under both the TSC Act and the EPBC Act. It is a summer flowering shrub that grows to 50 cm tall, is erect or somewhat prostrate in habit (NSW NPWS, 2004). *Pimelea spicata* has white, pink-tinged tubular flowers to 10mm long, with four spreading petals (DEC (NSW), 2005I). The leaves are opposite and elliptical to 20mm long by 8mm wide (DEC (NSW), 2005I). This species was once widespread on the Cumberland Plain, however now it only occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Threats to this species include: loss of habitat to urban development; high frequency fire; and habitat modification such as mowing, grazing and weed invasion. A draft recovery plan has been prepared for this species which identifies the following objectives (DEC (NSW), 2006):

- Conserve *P. spicata* using land use and conservation planning mechanisms;
- Identify and minimise the operation of threats at sites where *P. spicata* occurs;
- Implement a survey and monitoring program that will provide information on the extent and viability of *P. spicata*;
- Provide the community with information that assists in conserving the species;
- Raise awareness of the species and involve the community in the recovery program; and
- Promote research questions that will assist future management decisions.

One population consisting of two individuals of *Pimelea spicata* was historically recorded south of the main east-west road within the Western Precinct. These individuals were not detected during the recent 2012 surveys. Another population has been historically recorded in the Regional Park, although this population was also not confirmed during the 2011 field surveys.

#### **4.3.4 Fauna Habitats within Study Area**

i. *Woodland Habitat*

The dominant fauna habitat in the Study area is woodland, and this occurs throughout the southern and eastern portions of the Study area. The woodland falls within the Regional Park, and occurs in two distinct growth forms.

- Mature woodland; and
- Regenerating woodland.

All vegetation on the SMP is regenerated vegetation, however the core area of the Regional Park is considered to be mature (regenerated) woodland. The core area has not been cleared within the last 50 years, and therefore has a higher degree of structural complexity than areas of woodland found within the younger regenerating woodland within the Regional

Park, or that found within the subject land (refer to Section 4.3.3). The stands of mature trees provide sheltering, foraging, nesting and breeding habitat for most fauna that may occur within the SMP.

The remainder of the Regional Park consists of regenerating woodland. This area occurs to the west of the central portion of the Regional Park, and is sometimes referred to as the “Perkins Peninsula”, due to the fact that the area was identified as regenerating Cumberland Plain Woodland by Ian Perkins in his submission to the Australian Heritage Commission (Perkins, I 1999). This area has been cleared more recently than other parts of the Regional Park, and therefore consists of less mature woodland, with a greater number of eucalypt saplings occurring within the mid stratum than in the Mature Woodland. This woodland currently provides some feed and shelter habitat, and will, in the future, form a large area of mature woodland.

*ii. Grassland Habitats*

Grassland areas occur within the study area but represent little value to native fauna, as there is little structural complexity that is necessary to provide roosting or nesting habitat for most species. The grassland areas within the study area may, in the future, regenerate to form additional woodland. Species that commonly occur in the grassland habitats are those that are generally abundant in agricultural areas where the native vegetation has been significantly modified or removed, or they are species that typically favour foraging in grassland. Such species include birds such as the Australian Raven (*Corvus coronoides*), Crested Pigeon (*Geophaps lophotes*), Galah (*Cacatua roseicapilla*), and mammals such as the Eastern Grey Kangaroo (*Macropus giganteus*).

*iii. Riparian and Aquatic Habitats*

Significant riparian habitat occurs within the wider study area and Regional Park. A tributary of South Creek runs from west to east through the southern end of the subject land and drains into South Creek within the Regional Park. As discussed previously, this drainage line contains some water at most times of the year and therefore provides a water source for native fauna. However, this ephemeral watercourse is not likely to provide connective aquatic habitat for fish species. The wetland in the Regional Park is likely to provide a significant amount of habitat for native species as it is a permanent source of water and supports significant amounts of fringing vegetation that provides habitat for wading birds and amphibians.

Smaller areas of ephemeral wetlands occur throughout the Regional Park in low depressions often resulting from a scrape formed in the topsoil. These support common frog species including the Common Eastern Froglet (*Crinia signifera*) and Striped Marsh Frog (*Limnodynastes peroni*).

### **4.3.5 Fauna Species within the Subject Land**

Habitats of value to native fauna in the Western Precinct are generally associated with the largely regrowth woodland that occurs in the east along the border with the Regional Park and as isolated groups of trees across the precinct. However, the value of this vegetation to



hollow-dwelling native fauna is limited as the trees are mostly immature and offer limited roosting or nesting habitat. The majority of the woodland habitat that occurs on the SMP will be conserved within the Regional Park.

The extent of disturbance and land management activities has significantly limited the suitability of the Western Precinct to provide habitat for native species. Disturbed habitats generally support populations of native and exotic species that are common in urban/rural environments. Therefore the patches of remnant vegetation in the Western Precinct are not likely to support a wide range of species compared with the Regional Park which contains larger areas not subject to ongoing disturbance.

*i. Grassland Habitats*

The dominant fauna habitat in the Western Precinct is grassland, and this occurs throughout most of the Western Precinct. Grassland areas are of little value to native fauna, as there is little structural complexity that would provide roosting or nesting habitat for most species. Species that commonly occur in these habitats are those that are generally abundant in agricultural areas where the native vegetation has been significantly modified or removed, or they are species that typically favour foraging in grassland. Such species include birds such as the Australian Raven (*Corvus coronoides*), Crested Pigeon (*Geophaps lophotes*), Galah (*Cacatua roseicapilla*), and mammals such as the Eastern Grey Kangaroo (*Macropus giganteus*).

*ii. Woodland Habitats*

The woodland communities in the Western Precinct are very limited, and are restricted to remnants occurring along the common border with the Regional Park and patches of regrowth in the middle of the precinct. These areas typically have very little understorey vegetation remaining, and consist mostly of juvenile canopy species. Despite this, flowering eucalypts, paperbarks and smaller shrubs on the subject site are likely to provide some foraging resources for nectivorous mammals and birds. The Sugar Glider (*Petaurus breviceps*) will feed on nectar and pollen when available (Suckling, 1995) and the Common Ring-tail Possum (*Pseudocheirus peregrinus*) will also feed on flowers (McKay and Ong, 1995). Birds such as honeyeaters, would also feed on the nectar resources and several bat species may also forage over or through the canopy (Churchill, 1998).

The woodlands within the Western Precinct consist of predominantly regrowth vegetation and therefore are relatively immature. Few trees are older than approximately 50 years, and as such, show little signs of senescence and generally lack hollows. This significantly limits the nesting habitat available for hollow-dependent fauna such as Sulphur-crested Cockatoos, Galahs and Brushtail Possums. The majority of trees with potential to support hollows are located external to the Western Precinct within the Regional Park.

Extensive areas of woodland habitat occur throughout most of the Regional Park and provide sheltering, foraging, nesting and breeding habitat for most fauna that may occur within the Western Precinct. These habitats are extensive within the SMP and facilitate

fauna movement within the property and between external areas of habitat. These habitats will be protected in the long term within the Regional Park.

*iii. Riparian Habitats*

Riparian habitats are limited in the Western Precinct; however a man-made drainage line runs from west to east through the southern end of the precinct and drains into a tributary of South Creek in the Regional Park. This drainage line contains some water at most times of the year and therefore provides a water source for native fauna. It provides only limited direct habitat for aquatic species however, as it is lined with concrete and has steep sides. Furthermore it lacks aquatic and fringing vegetation that is a prerequisite for most aquatic species' occurrence. The wetland in the Regional Park on the other hand is likely to provide a significant amount of habitat for native species as it is a permanent source of water and contains significant amounts of vegetation on the edges that provides habitat for wading birds and amphibians.

As described for the Study Area, smaller areas of ephemeral wetlands occur in low depressions often resulting from a scrape formed in the topsoil. These support common frog species including the Common Eastern Froglet (*Crinia signifera*) and Striped Marsh Frog (*Limnodynastes peroni*) and have limited connectivity of habitat to the Regional Park.

**4.3.6 Fauna Species**

A wide variety of fauna species have been recorded from the SMP, and the Western Precinct, including several threatened species. A complete fauna species list for the study area is provided in Appendix C.

*i. Non-Flying Mammals*

The most common and conspicuous mammals across the SMP, are the Eastern Grey Kangaroo (*Macropus giganteus*) and Red Kangaroo (*Macropus rufus*). The animals within the SMP are not a naturally occurring population as they were introduced into the area by humans. Population numbers are dynamic but were estimated to be 2,185 animals in May 2007 across the entire SMP (Cumberland Ecology, 2007b). A large number of kangaroos occur in the Western Precinct as it provides ideal habitat. These animals are subject to a Macrofauna Management Plan (Cumberland Ecology, 2004b), which is currently being implemented across the SMP and the population has been substantially reduced or retained in particular areas since implementation of the Plan in 2005.

Three arboreal mammals have been recorded within the SMP; the Common Brush-tail Possum (*Trichosurus vulpecula*), the Common Ring-tail Possum (*Pseudocheirus peregrinus*), and the Sugar Glider (*Petaurus breviceps*). The Common Brush-tail Possum and Sugar Glider generally occur in low numbers on the SMP which is likely to be a reflection of the lack of hollow-bearing trees. The Common Ring-tail Possum is more abundant, which is most likely due to its ability to build nests in tree foliage. One native terrestrial mammal has been recorded from the SMP; the Echidna (*Tachyglossus aculeatus*). These species are likely to be found predominantly in the Regional Park where large areas of intact woodland are present.



Several threatened mammals have been recorded within the locality (see Figure 4.2) or have potential habitat within the locality including the Spotted-tailed Quoll (*Dasyurus maculatus maculatus*), Koala (*Phascolarctos cinereus*) and Squirrel Glider (*Petaurus norfolcensis*). No recent, confirmed records for these species have been obtained for the SMP, and it is unlikely that these species occur in the Western Precinct due to the limited availability of habitat.

No koalas were detected in the Western Precinct during recent field investigations, nor were any traces of Koalas found such as scats or scratches on trees. According to members of staff who have worked on the site for many years, including Senior Development Managers Graham Duncan and Bill Mitchell of Delfin Lend Lease, there have been no formal or verified reports of Koalas made within the site. This is consistent with the findings of earlier fauna surveys by Gunninah Consultants and ERM (Gunninah, 1991, ERM, 2003).

Several introduced species have been recorded from the SMP including the European fox (*Vulpes vulpes*), cat (*Felis catus*), dog (*Canis familiaris*), rabbit (*Oryctolagus cuniculus*), Brown hare (*Lepus capensis*), Black rat (*Rattus rattus*) and House mouse (*Mus musculus*). The introduced species are the subject of a Feral and Domestic Animal Management Strategy for the Western Precinct, which includes recommendations for their control.

#### ii. Bats

Numerous bat surveys have been conducted on the SMP and the species detected during these surveys are indicated in Table 4.10 below. Of the species recorded, several are listed as threatened under the TSC Act and/or the EPBC Act including; the Grey-headed Flying-fox (*Pteropus poliocephalus*), Large Footed Myotis (*Myotis adversus*), Eastern Bentwing Bat (*Miniopterus orianae oceanensis* (formerly *M. schreibersii oceanensis*)), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and East-coast Freetail Bat (*Mormopterus norfolkensis*).

The Western Precinct does not provide suitable habitat for the Large Footed Myotis, as this species forages over open water for fish and insects, using its feet (DEC (NSW), 2005i). However, the dam and wetland area in the south western section of the Regional Park may provide suitable habitat for this species as it contains a relatively large area of open water where it may forage. This area will be protected for conservation in the long term as it is located in the Regional Park, although some impacts to it may occur due to its close proximity to the Western Precinct.

The Greater Broad-nosed Bat, Eastern False Pipistrelle and East-coast Freetail Bat may have some limited potential roosting habitat on the Western Precinct as they are known to roost in tree hollows (DEC (NSW), 2005f, DEC (NSW), 2005e). This kind of habitat is limited in the Western Precinct however, as the vegetation is predominantly immature regrowth. A greater number of mature trees are conserved within adjacent areas of the Regional Park. The Greater Broad-nosed Bat has also been known to roost in buildings, and there are several derelict buildings within the study area that may provide habitat for this species.

The Greater Broad-nosed Bat has only had a possible detection within the regional park, and the East-coast Freetail Bat has been detected within the regional park, but not within the subject land during current surveys. In addition, the Eastern False Pipistrelle has only had a single possible detection within the subject land within the current surveys. These species may forage across the Western Precinct but are not expected to rely upon the vegetation in the precinct. The Eastern Bentwing Bat has been detected during current surveys, and occurs both within the subject land and the study area. The species utilises caves as its primary roost habitat, and has occasionally been known to utilise man-made structures. Within the subject land, all historical man-made structures have been removed, therefore there is no suitable roost habitat within the subject land, however the species may still utilise the area as a foraging resource.

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is listed as Vulnerable under both the TSC Act and the EPBC Act. This species is the largest Australian bat, and forages on the nectar, fruits and pollen of native trees, and roosts in large aggregations. The Grey-headed Flying-fox has been recorded from the locality and has the potential to forage on the SMP; however no roosting camps are present on the site. There is limited habitat present in the Western Precinct for this species due to the relatively low amounts of native vegetation that is present. The species was not recorded during the current survey period.

Unit	Date	T. au	M. no	M. sp	C. go	C. mo	F. ta	M. sc	N. sp.	S. ru	S. or	V. re	V. vu	Total Passes
1	27-Apr	C			C	C	Po	C	Po		Po		C	130
2	27-Apr	C	C	Po		C		C	P				C	46
2	28-Apr	P	C	Po	C	Po		C						62
3	27-Apr	C	C	Po	C			C				P		143
3	28-Apr	C	P	Po	C			C		Po	Po			124

*Note* Bat Specialist; Glenn Hoye, who has identified the calls recorded on Anabat by Cumberland Ecology, has assigned a confidence level to each species record, depending on call quality and the ease of recognition between subspecies etc. As such, **C = Confident**, **P = Probable** and **Po = Possible**. Abbreviations of species names are defined in Table 4.10.

Unit locations are shown in Figure 4.1.



<b>Abbreviation</b>	<b>Common</b>	<b>Scientific</b>	<b>Status</b>
T. au	White-striped Mastiff Bat	<i>Austronomus australis</i> (formerly <i>Tadarida australis</i> )	P
M. no	East-coast Freetail Bat	<i>Mormopterus norfolkensis</i>	V
M. sp	Eastern Freetail Bat	<i>Mormopterus ridei</i> (formerly sp. 2)	P
C. go	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	P
C. mo	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	P
F. ta	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V
M. sc	Eastern Bent-wing Bat	<i>Miniopterus oriana oceanensis</i> (formerly <i>M. schreibersii oceanensis</i> )	V
N. sp.	Unidentified Long-eared Bat	<i>Nyctophilus sp.</i>	P
S. ru	Greater Broad-nosed Bat	<i>Scoteanax rueppelli</i>	V
S. or	Eastern Broad-nosed Bat	<i>Scotorepens orion</i>	P
V. re	Southern Forest Bat	<i>Vespadelus regulus</i>	P
V. vu	Little Forest Bat	<i>Vespadelus vulturnus</i>	P

As indicated by the results in Table 4.10 above, the entire study area is likely to provide habitat for the majority of bat species, including the subject site.

### *iii. Birds*

Within the Western Precinct, the main habitats most suitable for birds are those associated with remnant and regrowth vegetation. However, these areas of regrowth are generally immature and structural diversity is low, thereby limiting the diversity of birds. These kinds of habitats are also rare in the Western Precinct, the main habitat type being open grassland which supports a low diversity of bird species. Within the disturbed grasslands and open woodland, common bird species include the Australian Magpie-lark (*Grallina cyanoleuca*), Australian Raven (*Corvus coronoides*), Eastern Rosella (*Platycercus eximius*), Rainbow Lorikeet (*Trichoglossus haematodus*) and the Noisy Miner (*Manorina melanocephala*). These species are common in urban and rural environments and often out-compete smaller

forest birds at the interface with woodland habitats. Emus (*Dromaius novaehollandiae*) are also present in the precinct within the grassland and open woodland areas. Although there are limited habitat areas for small birds, several common birds were recorded in woodland areas including the Weebill (*Smicromnis brevirostris*), Superb Fairy Wren (*Malurus cyaneus*), and the Spotted Pardalote (*Pardalotus punctatus*).

A number of bird species listed under the TSC Act and/or the EPBC Act, including migratory and non-migratory species, have been recorded from the SMP and may utilise habitats within the Western Precinct.

Migratory species that may visit the site to forage include the Lathams Snipe (*Gallinago hardwickii*), and Swift Parrot (*Lathamus discolor*). The Swift Parrot is listed under both the TSC Act and the EPBC Act as Endangered and has been recorded from within the locality, although it has not been recorded from the SMP or the Western Precinct. This species may visit the locality as part of a broad foraging area during some years of migration, however, it is far more likely to utilise the Regional Park, which includes a greater diversity of blossoming species.

Lathams Snipe is listed as Migratory under the EPBC Act and was recorded during the 2007 field survey (Cumberland Ecology, 2007) in the dam wetland area, directly adjacent to the Western Precinct in the Regional Park.

The Speckled Warbler (*Pyrrholaemus sagittata*) is listed as Vulnerable under the TSC Act and has been recorded at the SMP in 1991 (Gunninah, 1991), and most recently in 2006 by Cumberland Ecology when it was recorded in the western area of the Regional Park. This species forages on the ground in grassy woodlands, and requires large undisturbed remnants in order to persist (DEC (NSW), 2005k). The Western Precinct consists predominantly of degraded regrowth woodland that has been highly disturbed. The precinct may constitute some limited potential habitat for this species, although this species is most likely to occur within parts of the Regional Park where there is sufficient shelter in the grass and shrub layers.

The Varied Sittella (*Daphoenositta chrysoptera*) is listed as Vulnerable under the TSC Act and has been recorded at the SMP, specifically in the Regional Park, in August 2012 by Cumberland Ecology. This species inhabits Eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland (OEH 2012b). The Western Precinct consists predominantly of degraded regrowth woodland that has been highly disturbed. The precinct may constitute some limited potential habitat for this species. However, this species is sedentary and is most likely to occur within parts of the Regional Park where there are sufficient mature trees and mallee habitat.

The Diamond Firetail (*Emblema guttata*) is listed as Vulnerable under the TSC Act and was recorded on the SMP in 1991 (Gunninah, 1991), however no subsequent records have been documented. The Diamond Firetail inhabits grassy eucalypt-dominated woodlands, nests in trees and bushes, and forages on the ground (Department of Sustainability, 2011). The Western Precinct consists predominantly of degraded regrowth woodland with few areas of



shrubs and provides little habitat for this species. Consequently it is considered unlikely that the Diamond Firetail is present in the Western Precinct.

The Black Bittern is listed as Vulnerable under the TSC Act and may have been recorded close to the SMP in 1985 in South Creek near the southern boundary of the SMP (pers comm. Bill Mitchell of Delfin Lend Lease). The Black Bittern is found in wetland areas with permanent water and dense vegetation. There is no suitable habitat for this species within the Western Precinct, although it could potentially occur in permanently wet areas in the adjacent Regional Park including areas of South Creek and Ropes Creek.

Other threatened aquatic birds including the endangered Black-necked Stork (*Ephippiorhynchus asiaticus*), which has been recorded in the locality (see Figure 3.2) but not on the SMP, could potentially use the wetland associated with the dam in the south of the study area as it holds permanent water. This area will be protected for conservation in the long-term as it is located within the Regional Park.

Threatened forest and woodland bird species recorded from the locality but not the SMP include: the Regent Honeyeater (*Xanthomyza phrygia*), listed as Endangered under both the EPBC Act and the TSC Act; Painted Honeyeater (*Grantiella picta*), Square-tailed Kite (*Lophoictinia isura*) and the Glossy Black Cockatoo (*Calyptorhynchus lathami*), all listed as Vulnerable under the TSC Act. These species may forage in the study area from time to time, although this would be likely part of a much bigger foraging range, including the large reserves to the north of the study area. The SMP generally does not contain *Allocasaurina* tree species, and therefore is not likely to be suitable habitat for the Glossy Black Cockatoo.

These species are considered potentially to occur in the Western Precinct on the basis of either previous records in the locality or the occurrence of suitable habitat. If these species do occur on the SMP however, they are considered unlikely to utilise the poor quality habitats of the subject land and would be more likely to occur within the Regional Park which supports large areas of intact native vegetation. This vegetation is to be preserved.

#### iv. Reptiles and Amphibians

Reptiles that have been recorded at the SMP and that may occur within the Western Precinct include the Red-bellied Black-snake (*Pseudechis porphyriacus*), Eastern Brown Snake (*Pseudonaja textilis*), Bearded Dragon (*Amphibolurus barbatus*) and the Delicate Garden Skink (*Lampropholis delicata*). These species are generally common in open grassland/open woodland habitats.

No threatened reptiles have been recorded on the SMP. The Broad-headed Snake (*Hoplocephalus bungaroides*), listed as Endangered under the TSC Act and Vulnerable under the EPBC Act has been recorded from the locality, however it has not been recorded on the SMP, and is unlikely to occur due to lack of suitable habitat. This species inhabits sandstone escarpments and none are present on the SMP.

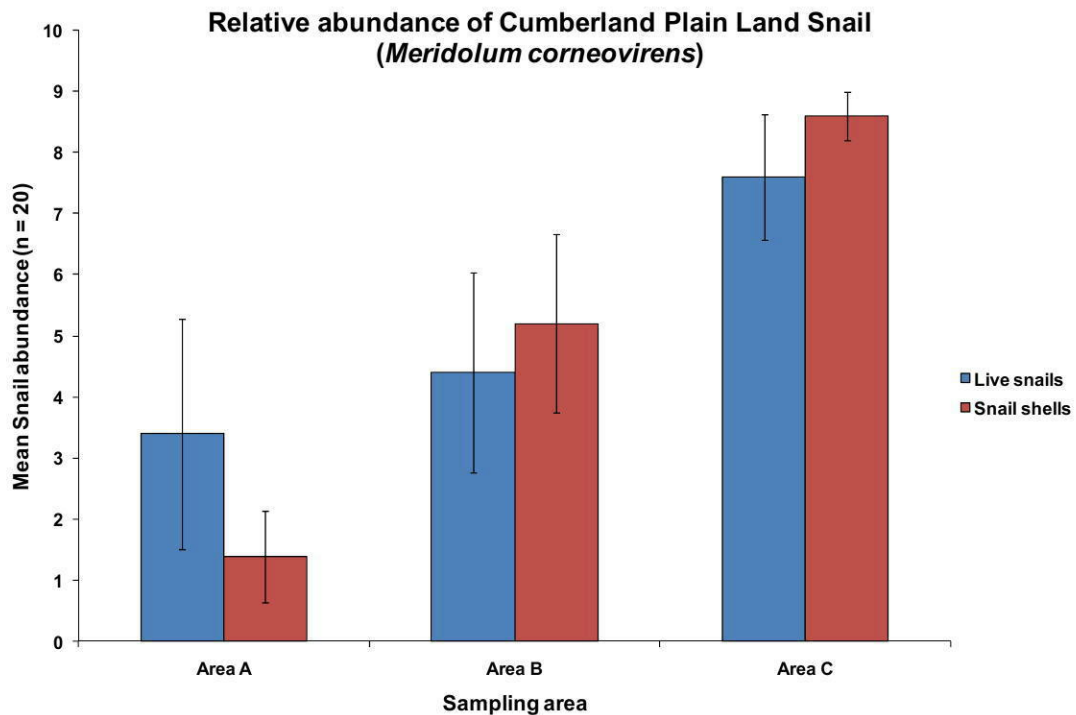
One amphibian listed as Endangered under the TSC Act and Vulnerable under the EPBC Act that has been recorded in the locality more than 20 years ago is the Green and Golden Bell Frog (*Litoria aurea*). However, the Western Precinct contains limited areas of wetland

that do not contain permanent water and this species is therefore not expected to occur in this precinct.

An area of wetland occurs in the south west of the Regional Park, directly adjacent to the Western Precinct and provides potential habitat for the Green and Golden Bell Frog. However, established populations of Mosquito Fish (*Gambusia holbrooki*) are also present in this wetland, which are a known predator of Green and Golden Bell Frog eggs and tadpoles (DEC (NSW), 2005b). Mosquito Fish have been linked to declines in Green and Golden Bell Frog distribution and are likely to limit the suitability of the wetlands to provide habitat for this species. Furthermore, extensive past targeted surveys for this species have failed to detect it, and no recent records occur in the locality. The Green and Golden Bell Frog is therefore not expected to occur on the SMP.

v. *Invertebrates*

One invertebrate species listed as Endangered under the TSC Act has been recorded on the SMP, the Cumberland Land Snail (*Meridolum corneovirens*). The Cumberland Land Snail has been found in many areas of Cumberland Plain Woodland on the SMP and many records of the species exist in the surrounding locality. The Cumberland Land Snail was recorded in the Western Precinct during targeted surveys to inform this Species Impact Statement. The following figure shows the relative abundance of the Cumberland Plain Land Snail within the Subject Land and the broader Study Area.



Data = Means, Error bars = Std. error

**Figure 4.5** COMPARITIVE ABUNDANCE OF CUMBERLAND LAND SNAIL WITHIN THE SUBJECT SITES (AREA A), REGENERATING REGIONAL PARK WOODLAND (AREA B) AND MATURE REGIONAL REGIONAL PARK WOODLAND.



The graph shows that there is a relatively lower abundance of the Cumberland Plain Land Snail within the Subject Land (Area A) than the other parts of the broader Study Area (Areas B and C). Statistical analyses confirmed that these differences in total snail numbers (live snails and snail shells) were significant (Kruskal Wallis:  $H = 6.517$ ,  $p = 0.012$ ). The Mature woodland area (Area C) had significantly higher numbers of snails than the subject land (Area A) ( $p = 0.008$ ). No significant differences in snail numbers were found between the Regenerating Woodland area (Area B) and either of the other two areas. Details of the statistical tests conducted are provided in Appendix D.

The significantly higher snail numbers in Area C shows that the species is well conserved within the mature core of the Regional Park, with strong supporting numbers in the adjoining regenerating portion of the Regional Park. The habitat occurring within the Subject Land is highly fragmented, and consists predominantly of few large remnant trees surrounded by new re-growth, and therefore it is felt that the habitat within the Subject Land does not constitute core or high value habitat for the species.

Threatened species recorded in the locality are listed in Table 3.1. Records of recent surveys are shown in Figures 4.6 and 4.7.

#### **4.4 Habitat Corridors**

The study area forms part of a broad local corridor that extends to the north of the site, and to a lesser extent to the south via South Creek riparian corridor, as shown in Figure 2.5. The vegetation on the subject land is connected to vegetation in the Regional Park to the east, but to the west beyond the Northern Road is urban development. Development of the subject land will not sever connectivity between areas of existing native vegetation. To the north of the study area beyond Ninth Avenue, there are rural residential blocks and several patches of remnant vegetation.

#### **4.5 Determining Affected (C)EECs/Species**

Affected (C)EECs/species means those threatened species, populations and ecological communities that are likely to experience impacts from the proposal.

The SIS distinguishes between “major” and “minor” affected (C)EECs/species. Major affected (C)EECs/species are those that will definitely experience a measureable loss of habitat. Minor affected (C)EECs/species are those species that occur (or are considered likely to occur) in the study area and which may experience small or very minor impacts to habitat, either directly or indirectly.

The primary impact of the proposal in terms of flora and fauna is the reduction in potential habitat in the study area from native vegetation clearance. The following threatened species includes those that may be affected by the proposal and are therefore assessed in subsequent sections of this chapter.

This list of species has been refined from the list of subject species (see Chapter 3) based on their listing in the DGRs, their known occurrence in the study area or their likelihood of occurrence. The remaining subject species listed in Chapter 3 are not analysed further as they are not considered likely to occur in the study area (based on general species distribution information) and/or are not known to utilise the habitat types of the subject area.

Habitat analysis and targeted surveys have indicated that several of these species do not appear to occur in the study area. The plants Parrot Pea (*Dillwynia tenuifolia*), Nodding Geebung (*Persoonia nutans*) and *Micromyrtus minutiflora* have not been located in the study area. For this reason, these plant species are not considered as affected (C)EECs/species.

Very few of the birds listed as the subject species have ever been detected on the SMP, and none were detected on the site during the current surveys of the study area. The majority of birds are therefore not considered as affected (C)EECs/species, however, small grassy woodland associated species that are known from the SMP are included as affected (C)EECs/species.

Additionally, Koalas, Spotted-tailed Quolls, Squirrel Gliders and Green and Golden Bell Frogs have not been found on the SMP, though some marginal potential habitat occurs, and are not considered as affected (C)EECs/species. Furthermore, Green and Golden Bell Frog is considered likely to be extinct in this part of Western Sydney (DEC (NSW), 2005b).

The threatened bat species are considered likely to forage on the site but have limited habitat present. They are also highly mobile and so are not predicted to have habitat significantly fragmented as a result of the proposed development.

#### **4.5.1 Major Affected (C)EECs/species**

The major affected (C)EECs/species include those known from the subject land that will experience a loss of individuals from the population on the SMP. The major affected (C)EECs/species that are considered in detail in the SIS are:

- Cumberland Plain Woodland: occurs predominantly in the form of a variant known as low diversity Derived Native Grassland across most of the subject site, with scattered patches of regenerating CPW predominantly in the northern parts of the subject site;
- Freshwater Wetlands: occurs as sedge land in a shallow ephemeral wetland created by past soil scraping within the western part of the subject site;
- *Pultenaea parviflora* (Bush Pea): a single individual plant recorded on the subject site, within an area assessed as part of the approved Village 2 and Village 3 DAs; and
- Cumberland Land Snail (*Meridolum corneovirens*): recorded within mature and regenerating CPW across the entire study area and there is a high likelihood of occurrence given the presence of CPW habitat within the subject site.



#### 4.5.2 Minor Affected (C)EECs/species

The minor affected (C)EECs/species include:

Endangered ecological communities

River-flat Eucalypt Forest and Shale Gravel Transition Forest: These EECs occur in the study area but will not be removed on the subject site.

Flora population

- *Marsdenia viridiflora* subsp. *viridiflora*: This species has been recorded in low numbers in the Regional Park and study area, within fairly close proximity to the subject land, but has not been recorded on the subject site.

#### Flora species

- *Grevillea juniperina* subsp. *juniperina*; and
- *Pimelea spicata* (Spiked Rice-flower)

These flora species have been recorded in the study area and the subject land, but not from within or adjoining the subject site.

#### Fauna species

Microchiropteran Bats: East-coast Freetail Bat (*Mormopterus norfolkensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Eastern Bentwing Bat (*Miniopterus orianae oceanensis* (formerly *M. schreibersii oceanensis*)), Southern Myotis (*Myotis macropus*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*): These microbats have all been recorded on the SMP, and mostly within the study area. The habitats present on the subject land do not provide significant habitat for these species due to a lack of roosting habitat. However, they will experience a loss of foraging habitat to a relatively minor degree. For this reason, these microbats are considered to be minor affected (C)EECs/species.

Flying Fox: Grey-headed Flying-fox (*Pteropus poliocephalus*): As with the microbats, the subject land provides a relatively small area of foraging habitat for this species, No flying-fox camps are known to occur on or adjoining the study area.

Birds: Speckled Warbler (*Pyrrholaemus sagittata*), Varied Sittella (*Daphoenositta chrysoptera*), Diamond Firetail (*Emblema guttata*), Hooded Robin (*Melanodryas cucullata*). These small woodland birds have been recorded on the SMP and within the study area, although all within the Regional Park.



- Legend**
- Subject Site
  - Western Precinct
  - Study Area
- Threatened Flora**
- 2012 Records**
- ★ *Grevillea juniperina* subsp. *juniperina*
  - Grevillea juniperina* subsp. *juniperina*
  - Pultenea parviflora*
- 2011 Records**
- Grevillea juniperina* subsp. *juniperina*
  - Pultenea parviflora*
- 2010 records**
- ◆ *Grevillea juniperina* subsp. *juniperina*
- 2009 Records**
- ▲ *Grevillea juniperina* subsp. *juniperina*
- 2005 Incidental Records**
- Marsdenia viridifolia*
- 2004 Incidental Records**
- Pimelea spicata*
- Threatened Fauna**
- 2012 Records**
- ◆ Cumberland Plain Land Snail Shell
  - Varied Sitella
- 2011 records**
- Cumberland Plain Land Snail
  - Eastern Bent-wing Bat
  - Eastern Freetail-Bat
- 2010 records**
- ▼ Cumberland Plain Land Snail
- 2005 Indicative record**
- Speckled Warbler

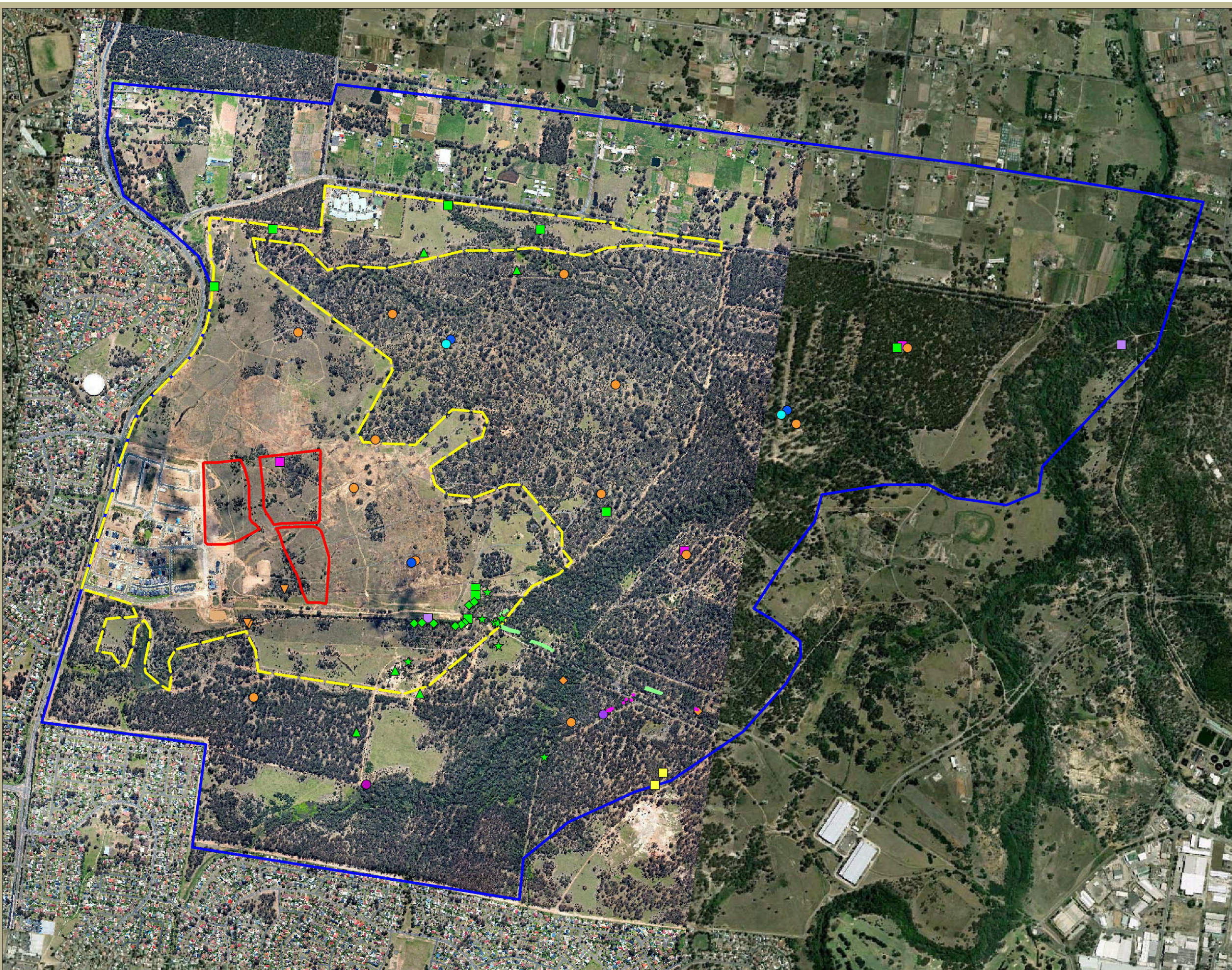
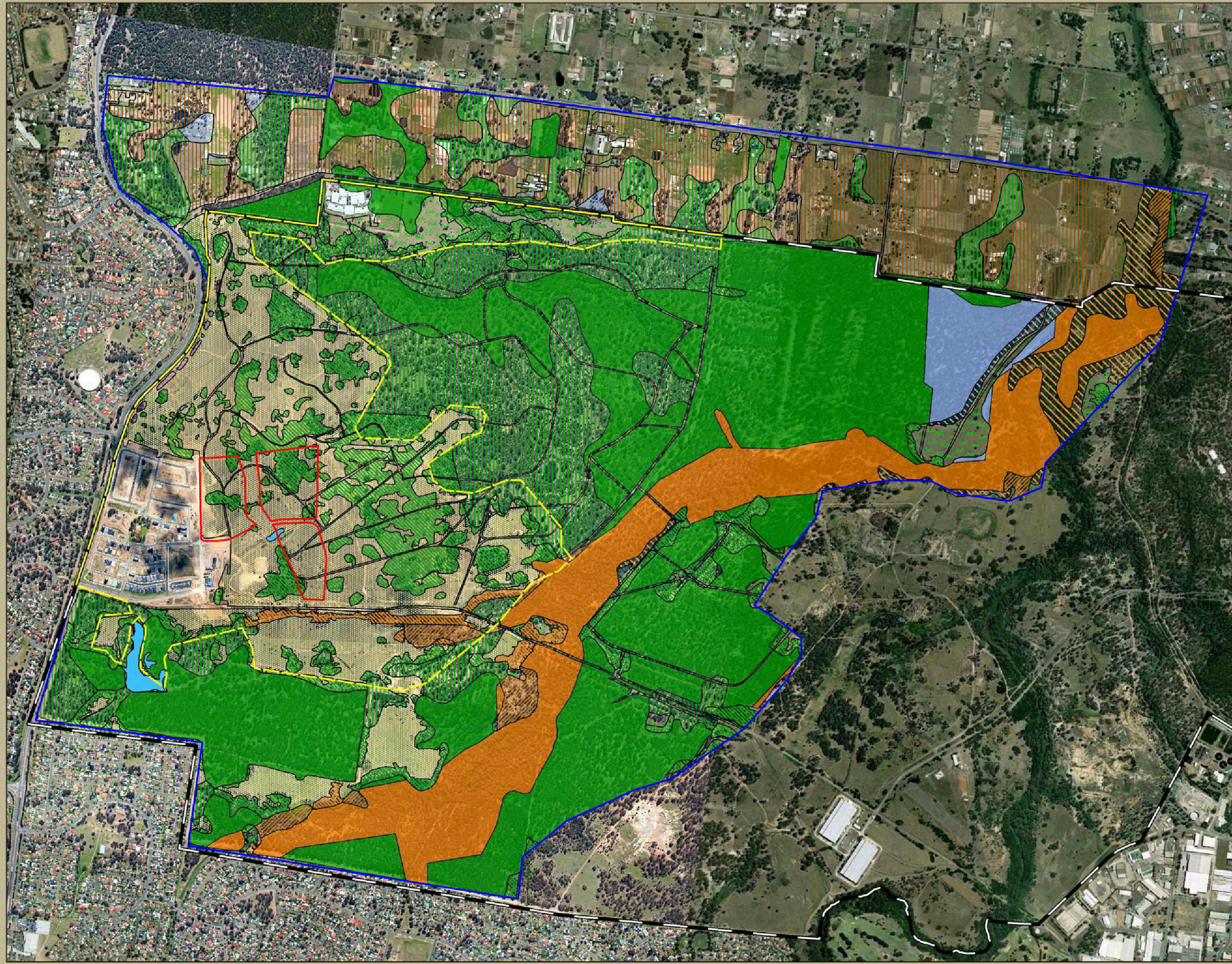


Figure 4.6. Threatened Flora and Fauna records







**Legend**

- St Marys Property Boundary
- Subject Site
- Subject Land
- Study Area

**Vegetation Community (CE, 2011)**

- Cumberland Plain Woodland (CEEC)
- Regenerating Cumberland Plain Woodland (CEEC)
- Derived Native Grassland (CEEC)
- Low Diversity Derived Native Grassland (CEEC)
- River Flat Eucalypt Forest (EEC)
- Regenerating River-flat Eucalypt Forest (EEC)
- Shale Gravel Transition Forest (>10% canopy cover) (EEC)
- Freshwater Wetlands (EEC)
- Rural / Undetermined
- Plantings

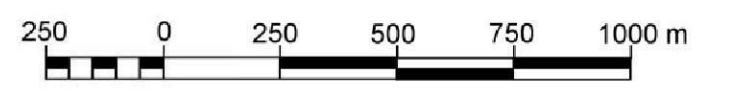
**Vegetation Communities (DECCW, 2007)**

- Shale Plains Woodland (CEEC) (Cumberland Plain Woodland) (>10% canopy cover)
- Shale Plains Woodland (CEEC) (Cumberland Plain Woodland) (5-10% canopy cover)
- Alluvial Woodland (EEC) (River-flat Eucalypt Forest) (>10% canopy cover)
- Alluvial Woodland (EEC) (River-flat Eucalypt Forest) (5-10% canopy cover)
- Shale Gravel Transition Forest (EEC) (>10% canopy cover)
- Shale Gravel Transition Forest (EEC) (5-10% canopy cover)

Image Source: © 2011 Skycam Australia  
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Figure 4.7. Vegetation of the Study Area







**Legend**

- St Marys Property Boundary
- Subject Site
- Subject Land
- Study Area

**Vegetation Community (CE, 2011)**

- Regenerating Cumberland Plain Woodland (CEEC)
- Low Diversity Derived Native Grassland (CEEC)
- Freshwater Wetland

Image Source: © 2011 Skycam Australia



Figure 4.8. Vegetation of the Subject Site





## Impact Assessment

This chapter addresses the impacts to species, populations and C/EECs in order to address DGR Sections 5 and Section 6. The following summary of impact provides an indication of general impacts of the proposal and future proposals within the subject site and Western Precinct development area.

### 5.1 Assessment of Likely Impacts

#### 5.1.1 Direct Impacts of Development

##### i. Vegetation communities

The proposed development will occur within a landscape that has been extensively altered since European settlement took place. The subject site is predominantly vegetated by patches of regenerating CPW and low diversity Derived Native Grassland which collectively conforms to the critically endangered listing under the TSC Act.

The development of the subject site and the future development of the Western Precinct will result in the clearance of this vegetation, as shown in Table 5.1.

<b>Table 5.1 VEGETATION COMMUNITIES REMOVED FROM THE SUBJECT SITE AND CUMMULATIVE IMPACTS OF VEGETATION REMOVAL FROM THE SUBJECT LAND</b>		
<b>Vegetation Communities Occurring within the Subject Land</b>	<b>Vegetation within the Subject Land (including Subject Site) (ha)</b>	<b>Vegetation to be removed within the Subject Site (ha)</b>
River-flat Eucalypt Forest (EEC)	0.9	0
Regenerating River-flat Eucalypt Forest (EEC)	7	0
Cumberland Plain Woodland (CEEC)	8	0
Regenerating CPW (CEEC)	47	3.87
Derived Native Grassland (CEEC)	9.2	0
Low diversity Derived Native Grassland (CEEC)	62	11.69

**Table 5.1 VEGETATION COMMUNITIES REMOVED FROM THE SUBJECT SITE AND CUMMULATIVE IMPACTS OF VEGETATION REMOVAL FROM THE SUBJECT LAND**

Vegetation Communities Occurring within the Subject Land	Vegetation within the Subject Land (including Subject Site) (ha)	Vegetation to be removed within the Subject Site (ha)
Freshwater Wetland (EEC)	0.8	0.06
Plantings	1	0
<b>TOTAL VEGETATION</b>	<b>136</b>	<b>15.62</b>
Non-vegetation (eg existing roads and cleared vegetation from approved DAs)	1.93	0.82
<b>TOTAL AREA</b>	<b>229.06</b>	<b>16.44</b>

ii. *Threatened species*

The clearing of vegetation within the subject site will directly remove habitat for threatened species such as *Pultenaea parviflora* and the Cumberland Land Snail (*Meridolum corneovirens*). A single *P. parviflora* plant was recorded within the subject site, in an area that overlaps with an approved DA application and has been removed. No Cumberland land snails were recorded within the subject site but several individuals are likely to be removed given that CPW habitat is to be cleared.

Some highly mobile fauna species such as microbats, and some small woodland birds that are known from the study area may experience minor habitat loss, however, the subject site, and Western Precinct as a whole, generally lack important habitat features, such as hollow-bearing trees. This paucity of habitat features suggests that it would be unlikely for these species to be dependent on the habitats present. The Regional Park also provides substantial habitat for these species.

Extensive mitigation measures will be implemented across the Western Precinct to minimise the impacts from development. Foremost amongst these is the 900 hectare Regional Park, which will conserve substantial habitat for all known species of threatened flora and fauna that have been recorded previously on the SMP. Such mitigation measures are discussed further in Chapter 6.

### 5.1.2 Indirect Impacts

i. *Subject site*

The subject site includes additional areas for works outside of the DA boundaries. This includes areas for ancillary works and other disturbance such as battering. There is also the



chance of indirect effects, such as the spread of weeds, to impact on native vegetation in this area.

Most of the CPW on the subject site occurs as scattered patches, largely on the southern side. As these patches do not extend into the Regional Park, where the vegetation is of much higher quality, there is little potential for indirect impacts on the higher quality vegetation in the Regional Park via increases in edge effects and sedimentation or increases in number of feral species within the subject site.

However as further areas of CPW will be cleared from adjacent areas in the subject land which do extend into the Regional Park and, thus, could potentially have indirect impacts via edge effects, increased sedimentation or increase in feral animals, the clearing of these areas are considered within the cumulative impacts of development within the subject land. Comprehensive mitigation measures, as described in Section 4.5 and detailed in the Western Precinct Biodiversity Assessment (Cumberland Ecology, 2009c), will be implemented to minimise potential impacts.

Site specific mitigation measures for the protection of (C)EEC vegetation should include the continued mowing of a buffered edge between the residential development area and the Regional Park. The mowing itself appears to favour the establishment of native grass and herb species (as was found on the northern boundary, where native grassland occurs in the mown APZ) and removes woody weeds. Trees should be retained wherever possible and fertilisers avoided at the perimeter of the Regional Park. In combination with the comprehensive mitigation measures for the SMP, minimal indirect impacts are likely to occur as a result of the proposed development.

### ***5.1.3 Cumulative Impact of Development in the Western Precinct***

As detailed in the approved Precinct Plan (JBA 2009), the remainder of the Western Precinct is zoned “Urban” and is proposed for residential and commercial development. This will result in the removal of a large area of habitat for C/EECs and threatened species of relevance to the current proposal. This indirect impact will further fragment habitats in the study area to some degree, although the vegetation patches are already fragmented and the Western Precinct is at the western edge of the SMP, which is bounded by existing residential and rural-residential land holdings. A summary of the maximum area of vegetation estimated to be removed is also presented in Table 5.1 and is referred to further in the detailed impact assessments presented below.

The total area of vegetation conserved outside the subject land is also present in Table 5.2.

<b>Table 5.2 VEGETATION COMMUNITIES CONSERVED IN THE STUDY AREA AND REGIONAL PARK</b>		
<b>Vegetation Community</b>	<b>Study Area (Ha)</b>	<b>Regional Park (Ha)</b>
Cumberland Plain Woodland	252	408
Regenerating Cumberland Plain Woodland	158	27
Derived Native Grassland	11	23
Shale Gravel Transition Forest (>10% canopy cover)	17	55.8
Shale/Gravel Transition Forest (5-10% cc)	2	
River Flat Eucalypt Forest	105	217
Regenerating River-flat Eucalypt Forest	10	265
Freshwater Wetland	2	2
Rural / Undetermined	118	
<b>TOTAL</b>	<b>691</b>	<b>998</b>

## 5.2 Assessment of Critically Endangered and Endangered Ecological Communities and Species Likely to be Affected

Major affected (C)EECs/species are those that will experience a measureable loss of habitat as a result of the development. Relatively few of the subject (C)EECs/species are considered likely to be affected by the proposed development. The major affected (C)EECs/species include those known from the subject site that will experience a loss of individuals from the population on the SMP and are assessed in detail in the sections below. These are:

- Cumberland Plain Woodland;
- Freshwater Wetlands;
- *Pultenaea parviflora*; and
- Cumberland Land Snail.

Minor affected EECs/species are those that occur (or are considered likely to occur) in the study area and which may experience small or very minor impacts to habitat, as identified in Chapter 5. The minor affected EECs, Freshwater Wetlands and River-flat Eucalypt Forest, are considered in more detail in the following sections, due to the potential for indirect effects, despite the small area of habitat present on the subject land.

Minor affected species are not considered in detail in the following sections. Habitat descriptions are provided for these species in Table 3.1 and impacts to these species are



considered more in terms of impacts to their habitats/potential habitats in Sections 5.3 and 5.6.

### **5.2.1 Major affected (C)EECs/species**

#### *i. Cumberland Plain Woodland*

The NSW Scientific Committee made a final determination on the 18<sup>th</sup> December 2009 to list Cumberland Plain Woodland as 'critically endangered' under the TSC Act. The state listing includes derived native grasslands where they contain characteristic native non-woody species (NSW Scientific Committee, 2009). It does not state minimum condition thresholds, patch size or project foliage cover requirements for Cumberland Plain Woodland or derived native grasslands.

Most of this community had been heavily cleared on the SMP and is in various stages of regeneration in the study area. Cumberland Plain Woodland would have covered the study area prior to historical clearing for grazing, based on the soils and ground cover species present.

Although no strict definition of derived native grasslands is provided in the final determination, generally this term refers to areas of native vegetation where the tree and shrub layers have been removed, leaving a herbaceous ground cover layer.

#### *ii. Freshwater Wetlands*

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is an EEC listed under the TSC Act. In the Western Precinct, it is predominately known from the southern extent and a small area will be removed as part of works on the subject site.

#### *iii. Pultenaea parviflora*

This plant is a small erect shrub reaching up to 1.8 meters in height. The leaves are alternate, are 2 - 6 mm long and 1 – 1.5 mm wide. It has typical pea flowers which are yellow in colour with reddish markings. Flowers are about 5 – 7 mm long with flowers occurring at the end of branchlets. Flowering generally occurs between August and November. A single *Pultenaea parviflora* plant was recorded within the subject site during the 2011 surveys in an area that overlaps with an approved DA and has been cleared. This plant had not been recorded previously in the Western Precinct.

#### *iv. Cumberland Plain Land Snail*

The Cumberland Plain Land Snail is superficially similar to the exotic Garden Snail. The shell is between 25 mm and 30 mm in size and while it may be almost any shade of brown, it is always uniform in colour. The Cumberland Land Snail has a more flattened shell that is very thin and fragile, compared with the thick shell of the Garden Snail. It primarily occurs in Cumberland Plain Woodland, which is a grassy open woodland with occasional dense patches of shrubs (DEC (NSW), 2005a).

This species has been recorded on the subject site and is estimated to occur in a low density in the Western Precinct, likely due to the regenerating form of CPW present which generally lacks significant leaf litter and debris due to the young age of most trees present.

### **5.2.2 Minor affected EECs**

#### *i. River-flat Eucalypt Forest*

River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is an EEC listed under the TSC Act. In the Sydney Basin bioregion this community replaces the former EEC Sydney Coastal River-flat Forest.

The patch of this community in the Western Precinct is regenerating after previous disturbances and although dominated by native species in each stratum and in viable condition, it contains some significant weed development.

#### *ii. Shale-gravel Transition Forest*

Shale-gravel Transition Forest is listed as an EEC under the TSC Act and a CEEC under the EPBC Act, where it is described as part of the Cumberland Plain Woodland Community.

An area of Shale-gravel Transition Forest occurs in the study area, but not within the subject land, where the majority of woodland present is considered to be more closely related to CPW.

## **5.3 Description of Habitat**

### **5.3.1 Cumberland Plain Woodland**

#### *i. The assessment of habitat for Cumberland Plain Woodland (CPW) also provides an assessment for affected (C)EECs/species occurring within CPW on the subject site, which includes the Cumberland Land Snail.*

Threatened birds known from the study area, in particular small woodland birds including Speckled Warbler, Diamond Firetail, Hooded Robin, Varied Sittella and Scarlet Robin utilise this open woodland habitat type, are known from the SMP and are likely to occur in the study area. However, these species generally require large undisturbed remnants in order to persist. Therefore the sparse and fragmented woodland patches present in the Western Precinct are not likely to represent highly suitable habitat and these species are more likely to be associated with the intact CPW in the Regional Park, where the records are from.

Likewise with microbats and the Grey-headed Flying-fox, the CPW present on the subject land provides some foraging resources, although only as part of a larger habitat matrix including the Regional Park. Roosting habitat is not readily available for microbats in the study area, as hollow-bearing trees are very uncommon and few buildings remain for cave/building roosting bats. No Flying-fox camps are known from the study area, with the closest being at Cabramatta Creek.



The Cumberland Plain Land Snail has been recorded near the margins of the subject site and is estimated to occur in a low density in the Western Precinct, likely due to the regenerating form of CPW present which generally lacks significant leaf litter and debris due to the young age of most trees present.

The CPW present on the subject land provides habitat for the threatened flora species; *P. parviflora*.

ii. *Habitat in the study area*

a. Type

In the study area CPW occurs in the Shale Plains Woodland (SPW) form, as referred to in Chapter 2. Its habitat is in gently undulating areas of the Cumberland Plain, in the driest areas of Sydney, receiving less than 800mm of rain a year (Benson and Howell, 1990). It occurs on Wianamatta shales, some Holocene alluvium and occasionally Mittagong formation, Tertiary alluvium, Hawkesbury sandstone and Aeolian deposits (Tozer, 2003).

Within the study area, the habitat for CPW and associated fauna species exists as larger tracts of mature woodland, which provides more connective habitat and structured woodland.

b. Size

The total area of CPW within the subject site includes 3.87 ha of regenerating CPW and 11.69 ha of low diversity derived native grassland with approximately 109 ha of these two CPW variants in the undeveloped portions of the Western Precinct. This compares with a total of 756.24ha of core and support for core habitat throughout the SMP, including CPW in the Regional Park, within areas listed on the Register of the National Estate (Australian Heritage Commission, 1999) and in open space areas. Throughout Western Sydney, 6745 (±968)ha of CPW in the form of Shale Plains Woodland existed in 1997 (Tozer, 2003).

The study area was determined as including the adjoining areas of the Regional Park and connective woodland beyond the SMP to the north in order to comprehensively address any potential indirect impacts to proximate habitat. This includes a large portion of the Regional Park and surrounds included in the study area and totals approximately 410ha of CPW.

c. Condition

Previous assessments of the Western Precinct have classified grasslands with greater than 50% native groundcover abundance as being CPW derived native grassland and areas with less than 50% native cover abundance (or greater than 50% exotic cover abundance) were not classified as being part of the CEEC. The survey and detailed assessment of floristic data prepared specifically for this SIS has involved the comparison of quadrats at both ends of the spectrum of native and low diversity (exotic dominated) grassland using statistical analysis.

The analysis indicates that although the low diversity grasslands of the Western Precinct are unlikely to regenerate to woodland naturally, due to the historical disturbance experienced,

they exhibit many of the native herb and grass species characteristic of CPW. Areas supporting grasslands in the north of the Western Precinct, close to the Regional Park boundary, were observed to contain a higher diversity of native herbs and grasses, which correlated with the area of the Precinct where disturbance was historically less. These areas would be more likely to regenerate to woodland over time. This can be seen in the lower dissimilarity levels between Areas B & C which supports the fact that Area B has the potential to regenerate to a condition similar to that of Area C. In contrast, this is not observed in the statistical analysis for grasslands of Area A.

Visual observations further support this, as very limited areas of woodland have regenerated throughout much of the Western Precinct, despite the removal of grazing and several years of high rainfall, and generally good conditions for plant growth.

Mature CPW within the Regional Park was identified as being in much better condition than the CPW in the Western Precinct and on the subject site. Despite the presence of some dominant weeds, namely Paddys Lucerne and Fireweed, a higher diversity of native groundcover species, particularly herbs and grasses were consistently recorded within the Regional Park. The overall condition of CPW in the study area was determined to be high.

*iii. Habitat in the locality*

Mature and regenerating CPW occurs throughout much of the locality as the SMP is well within the natural extent of this community, and not at the edge of its distribution. The majority of habitat is sparsely distributed and dissected by rural/residential developed across western, south western and parts of northern Sydney. In the study area, similar regenerating CPW occurs between rural lands to the north and links with a very large block of habitat in the Air Services Australian Defence land. The Air Services site exists as a very large block of high quality mature CPW and forms part of a major corridor of CPW habitat to the north linking with several National Parks and Nature Reserves.

*iv. Distribution of similar habitats in the region*

Known areas of CPW within the region occur at Scheyville National Park, Windsor Downs Nature Reserve, Leacock Regional Park and Mulgoa Nature Reserve (NSW NPWS, 2001a) and also at Nelsons Ridge and Prospect Reservoir. In proximate sites to the study area, it is represented in Shanes Park and in other bushland remnants of Penrith and adjoining Blacktown Local Government Area, such as Prospect Reservoir, Nurragingy Reserve and intergrading with Sydney Coastal River Flat Forest at Bells and Eastern Creek (NSW NPWS, 1997a).

The Cumberland Land Snail has been found within the region at Scheyville National Park, Agnes Banks Nature Reserve, Castlereagh Nature Reserve, Windsor Downs Nature Reserve and in Gulguer Nature Reserve. Most occurrences, however, are not from conserved areas (NSW NPWS, 2000b). The species occurs in CPW and in Castlereagh Woodlands in Western Sydney and therefore is likely to occur at Shanes Park, to the north east of the SMP, Prospect Reservoir, Marsden Park, Nurragingy Reserve, the Regional Park



on the SMP and in other smaller bushland remnants throughout the region (NSW NPWS, 1997a).

This is further supported by the following three documents prepared by the NSW Government:

- Cumberland Plain Recovery Plan (DECCW 2011);
- Draft EPBC Act Strategic Assessment Report for the Sydney Growth Centres Program (NSW Department of Planning, 2010); and
- Report on the methodology for identifying priority conservation lands on the Cumberland Plain (DECCW, 2010).

Importantly, the latter two of the studies listed above identify the SMP Regional Park as a Priority Area/Priority Conservation Lands for the management and recovery of the Cumberland Plain.

v. *Condition of similar habitat in the region*

Condition of similar habitat within the region is likely to vary with disturbance history and human accessibility.

Castlereagh Nature Reserve, Windsor Downs Nature Reserve and Scheyville National Park all contain CPW and are assumed to be managed to provide good condition habitat for CPW and for the Cumberland Land Snail.

Prospect Reservoir contains a large area of regrowth CPW. The area was grazed prior to becoming a reservoir and grazing was continued but increasingly restricted until the 1970s. Much of the vegetation has only regenerated since grazing ceased (NSW NPWS, 1997a).

Shanes Park, adjacent to the corner of the north and north eastern boundaries of the SMP, contains the second largest intact remnant of CPW (NSW NPWS, 1997a). This remnant is a central area of core habitat in Blacktown LGA, with the potential to form corridors to other bushland remnants throughout the LGA.

Nurrangy Reserve contains some CPW of varying condition. Better condition CPW is contained in areas of the reserve only used for passive recreation (NSW NPWS, 1997a).

vi. *National distribution*

Cumberland Plain Woodland is only found on the Cumberland Plain of Western Sydney, in the LGAs of Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly (NSW Scientific Committee, 1997b).

### 5.3.2 River-flat Eucalypt Forest

Part of a patch of RFEF that surrounds an existing drainage channel occurs close to the southern end of the study area. The vegetation is in moderate condition and continues to the east through the Regional Park.

This riparian community represents foraging habitat for microbats, particularly for the fishing bat; Large-footed Myotis. This community may also provide habitat for Black Bittern, although this is likely to be restricted to the dense and connective riparian habitats of the study area. Small woodland birds may use this woodland for shelter as part of a matrix of woodland and forest habitats in the study area.

#### i. Habitat in the study area

##### a. Type

River-flat Eucalypt Forest (RFEF) is found on coastal floodplains and has a tall canopy of eucalypts. The most widespread canopy trees include *Eucalyptus tereticornis*, *E. amplifolia*, *Angophora floribunda* and *A. subvelutina*. It may have a layer of small trees and a scattering of shrubs. The ground cover consists of abundant forbs, scramblers and grasses. RFEF occurs on alluvial soils on river-flats of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Within the study area, the habitat for RFEF and associated fauna species exists as larger tracts of mature woodland, which provides more connective habitat and structured woodland.

##### b. Size

A very small area, totalling approximately 0.9 ha of regenerating RFEF occurs on the subject land as a narrow strip along a drainage channel in the south of the subject land, which is a man-made tributary of South Creek. This compares with a total of 265.3ha of core and support for core habitat throughout the SMP, including 217.7ha of RFEF included in the Regional Park, within areas listed on the Register of the National Estate (Australian Heritage Commission, 1999) and in open space areas. Throughout Western Sydney, 4698 ( $\pm 903$ )ha of Alluvial Woodland existed in 1997 (Tozer, 2003).

The study area was determined as including the adjoining areas of the Regional Park and connective woodland beyond the SMP to the north in order to comprehensively address any potential indirect impacts to proximate habitat. This includes a large portion of the Regional Park and totals approximately 215ha of RFEF.

##### c. Condition

The narrow band of RFEF in the study area is highly degraded due to severe stream erosion which has incised the banks of the channel in the south of the subject site. The canopy exhibits past disturbance and although it is currently dominated by *Angophora floribunda*, it also contains *Casuarina glauca* and may have once fitted into the definition of the Swamp Oak Floodplain Forest EEC. One *E. amplifolia* (Cabbage Gum) specimen adjoins the



community in cleared grassland, an indicator that the community is more similar to RFEF. The canopy height is 15-20m and projective foliage cover (PFC) 50% which is very open for this forest community.

Weeds are present, including *Ligustrum sinense* (Small-leaved Privet) and thickets of *Rubus fruticosus* (Blackberry) although they do not dominate the understorey.

ii. *Habitat in the locality*

Major watercourses in the study area and locality contain RFEF, including Ropes Creek and South Creek as shown in Figure 5.1. These first order streams are well vegetated in parts of their range, although significant weed invasion is present throughout. This community grades into several floodplain EECs including Swamp Oak Floodplain Forest, which is known to be present in the locality.

iii. *Distribution of similar habitats in the region*

Larger corridors of Alluvial Woodland occur within the study area and the SMP. Most of these areas will be conserved within the Regional Park. Small areas of RFEF occur at Cattai National Park, Dharug National Park, Georges River National Park, Scheyville National Park, Gulguer Nature Reserve, Mulgoa Nature Reserve and Marramarra National Park (NSW Scientific Committee, 2004I). In proximate sites to the study area, it is represented in the SMP Regional Park, RAAF land at Orchard Hills, Rickabys Creek, Mulgoa Creek, South Creek, Prospect Reservoir, Nurragingy Reserve and at Bells Creek, near Townson Rd (NSW NPWS, 1997a, NSW NPWS, 1997b).

iv. *Condition of similar habitat in the region*

Condition of similar habitat within the region is likely to vary with disturbance history and human accessibility.

Cattai National Park, Dharug National Park, Georges River National Park, Scheyville National Park, Gulguer Nature Reserve, Mulgoa Nature Reserve and Marramarra National Park all contain RFEF (NSW Scientific Committee, 2004I). It is assumed that these Nature Reserves and National Parks are managed to provide and maintain RFEF in good condition.

Prospect Reservoir contains an area of regrowth RFEF. The area was grazed prior to becoming a reservoir and grazing was continued but increasingly restricted until the 1970s. Much of the vegetation has only regenerated since grazing ceased. Riparian habitats for RFEF are degraded due to weed invasion (NSW NPWS, 1997a).

Nurragingy Reserve contains some RFEF of varying condition. RFEF is degraded in areas of unlimited pedestrian access. Weed invasion has also led to the degradation of this RFEF (NSW NPWS, 1997a).

RAAF land at Orchard Hills contains good condition riparian areas of RFEF but this is under Defence ownership (NSW NPWS, 1997b).

RFEF along Rickabys Creek has been impacted by clearing for development and has been degraded by rubbish dumping and use of trail bikes in the area. Road construction has also damaged this bushland remnant (NSW NPWS, 1997b).

RFEF along Mulgoa Creek has been subject to poor land management and the negative effects of agriculture in the area. It has also been degraded by weed invasion (NSW NPWS, 1997b).

The corridor of RFEF along South Creek varies in condition; with good condition RFEF occurring in the central section of the Regional Park. Southern sections of this creek have been affected by clearing for agriculture and weed invasion (NSW NPWS, 1997b).

An area of RFEF along Bells Creek, near Townson Rd is currently threatened by grazing and has been subject to weed invasion (NSW NPWS, 1997a).

v. *National distribution*

RFEF is known from parts of the Local Government Areas of Port Stephens, Maitland, Singleton, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Parramatta, Penrith, Blue Mountains, Fairfield, Holroyd, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Palerang, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions (DEC (NSW), 2005j).

### **5.3.3 Freshwater Wetlands**

Small areas of Freshwater Wetland are present on the subject land as small depressions with a low diversity of native and exotic wetland species. A larger area of this habitat is present to the south of the subject land, contained mostly within the Regional Park.

This wetland community represents foraging habitat for microbats, particularly for the fishing bat; Large-footed Myotis.

i. *Habitat in the study area*

a. Type

Sedgeland, a form of Freshwater Wetlands, occurs in very small local patches throughout the precinct, generally artificially created by a small scraping of the soil that results in a small depression. These areas usually are too small to warrant mapping, being only a few square metres in area and have been included in the grassland mosaic. Two larger areas of Freshwater Wetlands have been mapped within the study area: an area surrounding the dam in the south western corner of the precinct, largely included in the Regional Park and an area along a drainage line near the central section of the subject land within the proposed north-south riparian corridor.

This kind of wetland is uncommon in and around the SMP and is considered to have moderate to high conservation significance. Where wetland species have colonised



artificially created habitats, the area is still considered to be a degraded variant of the EEC. Degraded wetlands have conservation value if they form part of a habitat corridor, provide habitat for aquatic species and resources for birds and mammals, provide habitat for threatened aquatic plants or maintain a seed bank of local provenance plants.

The smaller areas of sedgeland in the Western Precinct formed in scrapes in the soil have minimal conservation value. They provide small areas of habitat to common frog species and water resources for other animals, as well as local provenance plants. The larger area of wetland towards the eastern side of the Western Precinct has a slightly higher conservation value as it connects to larger areas of habitat in the Regional Park. The wetland associated with the dam in the south west of the Regional Park near the south-western corner of the Western Precinct is of high conservation value as it provides habitat for migratory species including Latham's Snipe (listed under the EPBC Act), covers a relatively large area compared with sedgeland formed in scrapes and is connected to other types of habitat through the Regional Park. Some sedgelands and wet meadows that occur around the dam near the precinct also have high conservation value because of the connectivity to the Regional Park habitats.

b. Size

A very small area, totalling approximately 0.06 ha, of Freshwater Wetlands occurs on the subject site as sedgeland in an artificial scrape. The far larger wetland in the south of the precinct will not be removed, and totals approximately 2ha.

c. Condition

Overall, exotic species ranged from 5-70% of the projective foliage cover of the ground cover in the wet meadow and borrow pit zones.

ii. *Habitat in the locality*

No significant occurrences of this EEC are known to occur in the locality. However, farm dams and other similar man-made wetlands are frequent throughout the locality, and are also likely to conform to a variant of Freshwater Wetlands, if only in a very simplified form, as with the study area.

iii. *Distribution of similar habitats in the region*

Few good examples of this community are reserved in the region. This community is known to occur in Hexham Swamp and Pitt Town Nature Reserves and Scheyville National Park in the Region.

iv. *Condition of similar habitat in the region*

Condition of similar habitat within the region is likely to vary with disturbance history and human accessibility. There is likely to be other similar man-made habitats for this EEC in the locality and region that occur in a similar state to the study area habitat.

v. *National distribution*

Although Freshwater Wetland is known from along the majority of the NSW coast, it is distinct in the Sydney Basin where it is associated with sandplains. As a habitat, it has been extensively cleared and modified. In the 1990s the extent remaining was: 3% in the NSW North Coast bioregion, 66% in the lower Hunter – Central coast region, 40% on the Cumberland Plain, 70% in the Sydney – South Coast region, and 30% in the Eden region.

## 5.4 Past Disturbance History of the Western Precinct

Land parcels were granted for pastoralism on the Cumberland Plain in the early 1800s. Parts of the SMP were included in these grants. Timber-getting took place in the South Creek area of the SMP, in the 1860s, for sleepers and general construction associated with the extension of the western railway line (Kinhill, 1995).

The SMP was acquired by the Commonwealth in the 1940s for the manufacture and storage of munitions. Grazing continued on much of the SMP in order to keep ground layer fuel levels low (Kinhill, 1995).

The SMP underwent demolition of most buildings and decontamination, including soil remediation works, in the 1990s (Kinhill, 1995).

Much of the vegetation currently on the property has regenerated since the cessation of grazing and clearing from the mid 1940s onwards (ERM, 2003). Such vegetation is now predominantly within the Regional Park.

Most of the subject site was subject to remediation works in the mid 1990s with the result that much of the soils have either been removed or highly disturbed. This has greatly degraded the condition of any native vegetation remaining in the area.

### 5.4.1 *Assessment of Ability of Affected (C)EECs/Species to Recover to Pre-Disturbance Condition*

Resilience, or the ability of native vegetation to recover to a pre-disturbance condition is assessed using the *In Situ Resilience and Anticipated Recovery Capacity Assessment* (Perkins, 2002). Refer to Figure 4.4 mapping of vegetation communities for an indication of canopy cover and regeneration age of the forest, woodland and grassland in the study area.

All woodland and forest habitat types exhibit high resilience, evident from the regeneration of all community types. However, in the Western Precinct, where past disturbance was significant, all communities were recorded to contain a lower diversity of native species than in the Regional Park. The woodland cover is more sparse and has less structure than the representatives in the Regional Park, however, it is likely that over time, these communities could have the potential to regenerate to a state similar to pre-disturbance.

The grasslands are however considered to be a more degraded form of the community from which they are derived, as no regeneration of midstorey and canopy layers are evident. This



is not to say that areas of grassland are not in reasonable condition, as they contain a number of native groundcover species indicative of the original woodland. Overall, a reduced abundance of native species occurs in the Western Precinct, which is likely as a result of the past disturbance.

The consistency of the Proposal with the objectives of the Recovery Plan for the Cumberland Plain (DECCW 2011) is discussed in detail in Chapter 6.

## **5.5 Description of Conservation Status**

### **5.5.1 Cumberland Plain Woodland**

Cumberland Plain Woodland has recently been up-listed to critically endangered on both the TSC Act and EPBC Act and is therefore not considered likely to be well reserved. As previously discussed however, CPW may be comparatively well reserved in the locality, as demonstrated by the high proportion of the study area that includes CPW. Further discussion of the state and regional conservation of this community is provided in Section 6.3. This CEEC is not at the limit of its known distribution in the study area.

The principal threat to the biodiversity of the Cumberland Plain is the further loss and fragmentation of habitat and the resulting indirect impacts (such as weed invasion) that occur as a result of this. The proposal will contribute to this threat, however, the retention of expansive areas of the high quality habitat in the Regional Park and the management of this vegetation are likely to significantly reduce the effect of the threat to this community in the locality.

Cumberland Land Snail is at threat from the modification to CPW. The bulk of the known populations are small, isolated and vulnerable to impacts from clearing and habitat modification such as weed invasion, inappropriate fire management and removal of ground cover, as this removes shelter, breeding habitat and sources of food (DEC (NSW), 2005a).

### **5.5.2 River-flat Eucalypt Forest**

RFEF is listed as endangered under the TSC Act. It is likely to be well represented in the locality and is distributed throughout the region, and other parts of NSW. Further discussion of the state and regional conservation of this community is provided in Section 6.3.

The community has experienced a reduction in the area of habitat and the remaining area is likely to represent much less than 30% of its original range. Recently recorded, major occurrences include: about 2,000 ha in the lower Hunter region; less than 10,000 ha on the NSW south coast from Sydney to Moruya, of which up to about three-quarters occurred on the Cumberland Plain in 1998 (DEC (NSW), 2005j).

The principles threats to this EEC of relevance to the study area include:

- Flood mitigation and drainage works;

- Landfilling and earthworks associated with urban and industrial development;
- Changes in water quality, particularly increased nutrients and sedimentation; and
- Weed invasion.

The proposed development of the Western Precinct has the potential to exacerbate the impact of threats to this community due to proposed drainage upgrade works. However, the occurrence of such works is only of relevance to the sparse areas of RFEF that occur in association with the artificial drainage channel in the south of the precinct. Mature trees will be retained wherever possible on the banks of the channel and regeneration of the riparian corridor after structural works are completed will include extensive planting of native and RFEF representative species, as per the VMP for the Riparian Corridor developments (under a separate DA).

### **5.5.3 Freshwater Wetlands**

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee, 2004e).

The community is threatened by land clearing, fragmentation, flood mitigation, land-filling, pollution from runoff, weed invasion, damage from livestock and feral animals, acid sulphate soils, rubbish dumping and climate change (NSW Scientific Committee, 2004e).

The development of the subject site and continued development of the Western Precinct will not greatly exacerbate the effects of this threat to the larger examples of this EEC. The small localised depressions with characteristics of Freshwater Wetlands that will be removed on the subject site are not likely to constitute significant habitat as they are already subject to substantial weed invasion and are isolated from the natural floodplain.

## **5.6 Discussion of Likely Effects of the Proposal**

### **5.6.1 Extent of Habitat Removal**

The subject site is proposed for development via a single development application (DA). Table 5.1 outlines the extent of the developable area for this DA within the subject site, and cumulative impacts of the development of the Western Precinct subject land. Other precincts will be progressively developed within the SMP as outlined within SREP 30.

Most of these areas are currently cleared, although more vegetation will be modified or removed as a result of this proposal and subsequent developments. Although there is scope for retention of canopy species and some under storey species in open space areas, the open space areas will be highly modified as a result of the proposal and subsequent DAs. The vegetation community lining South Creek and tributaries in the study area will not be



cleared. In fact, a significant riparian zone along the southern edge of precinct will be established, allowing the area to regenerate.

As detailed in Table 5.1, the proposed development of the subject site and Western Precinct will remove habitat for the C/EECs and species described in this chapter. Of greatest significance is the direct removal of CPW which is described further below. Other species and EEC will experience habitat loss or modification to a lesser extent.

*i. CPW*

The proposal for the subject site will clear a total of 15.56 ha of CPW consisting of 3.87 ha of regenerating CPW and 11.69 ha of low diversity DNG.

This represents a small area of habitat for the Cumberland Land Snail. However, a significantly greater density of snails is known to occur in the Regional Park, particularly within the mature woodland in the central sections park. The discrete subpopulations of this species present in the Western Precinct are likely to be permanently removed by the removal and modification of CPW proposed. However, the extent of such habitat removal for this species in the Western Precinct is not considered likely to cause the extinction of the local population centred on the Regional Park as sizable numbers occur within a secure and connective tract of woodland habitat.

The removal of this woodland type also represents foraging habitat for threatened bats and birds, although as previously discussed, such habitat is likely to form marginal support areas as part of a large habitat matrix centred on the Regional Park and proximate reserves. It is therefore expected that this habitat removal is a minor area of habitat for these highly mobile species.

*ii. RFEF*

The RFEF to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the community within the locality. River-flat Eucalypt Forest of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Western Precinct as it is in better condition and is more intact.

As with CPW, this community provides some habitat for threatened bats and birds known to occur in the study area. This habitat will not be greatly modified for these species.

*iii. Freshwater Wetlands*

The Freshwater Wetlands to be removed totals 0.06 ha, and is not likely to be important to the long-term survival of the community within the locality. Freshwater Wetlands of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Western Precinct as it is in better condition and is more intact.

As with CPW, this community provides some habitat for threatened bats and birds known to occur in the study area. This habitat will not be greatly modified for these species.

*iv. Plant species*

A single *Pultenaea parviflora* plant was recorded in the subject site during the 2011 surveys in an area that overlaps with an approved DA and has been cleared. This plant had not been previously recorded in the Western Precinct, and no other specimens were found. This is not considered to be a significant part of the population which is centred on the Regional Park, where it is estimated that at least 50,000 of this species occur.

Approximately 700 specimens of *Grevillea juniperina* spp. *juniperina* were recorded in the Western Precinct during the field surveys. These are located at the northern and southern margins of the precinct. However, none were recorded in the subject site.

This is a small number of specimens relative to the numbers within the Regional Park and is not considered to represent an important number of specimens for the persistence of the local occurrence of this species. It has been estimated that at least 249,000 (minimum) specimens of *Grevillea juniperina* subsp. *juniperina* occur within the Regional Park, where extensive habitat has been conserved (ERM, 2003). These specimens will not be affected by development within the Western Precinct and will be protected in perpetuity.

A single *Pultenaea parviflora* plant was recorded in the subject land, to the east of the subject site, during the 2011 surveys. This plant had not been previously recorded in the Western Precinct, and no other specimens were found. This is not considered to be a significant part of the population which is centred on the Regional Park, where it is estimated that at least 50,000 of this species occur.

Approximately 2 specimens of *Pimelea spicata* have previously been recorded from the Western Precinct but were not detected during 2011 or 2012 surveys. These specimens are located in the south eastern portion of the precinct, in a drainage depression. A larger patch with more specimens is located within the Regional Park (although outside of the current study area) and the development is not considered likely to threaten the survival of this species in the locality.

The table provided in Section 4.3.2 provides an estimate of the approximate number of the affected plant species to be removed from the subject site and the Western Precinct as a whole and those conserved in the Regional Park study area.

### **5.6.2 Significance within the Local Context**

*i. Cumberland Plain Woodland*

The geography, soils, topography and associated species of CPW are specific to Western Sydney, although dominant canopy species are found elsewhere in NSW and Australia. Remnants are often small (<10ha) and vulnerable to disturbance and degeneration by humans (NSW NPWS, 1997c). According to the JANIS report (Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee, 1997), 15% of the pre-



1750 distribution of any vegetation community should be conserved within the Comprehensive, Adequate and Representative (CAR) reserve system. As such, only 7.7( $\pm$ 1.1)% of the Pre-European extent of Shale Plains Woodland existed in 2003 (Tozer, 2003). Of this, significant areas are conserved within Windsor Downs Nature Reserve (NSW NPWS, 1997c), Scheyville National Park, Leacock Regional Park and Mulgoa Nature Reserve (NSW NPWS, 2001a).

Within the Region, there are core CPW remnants at Kemps Creek, Prospect Reservoir, Shanes Park, Orchard Hills RAAF base, the 900ha Regional Park on the SMP, Hawkesbury Reserve, Lansdowne Park, Boral-Lower Canal (Prospect) and on the Wonderland site at Eastern Creek (NSW NPWS, 1997c).

The long-term security of CPW in the SMP, within the study area, will be assured with its inclusion in the Regional Park. The area of CPW to be included within the Regional Park is 531.8ha of core and support for core habitat. This includes core habitat CPW within the study area. The 900ha Regional Park will be transferred to State Government ownership and managed by the NSW National Parks and Wildlife Service (ERM, 2003).

CPW occurring on the subject site occurs as sparse regenerating woodland patches and is moderately disturbed. Many small patches of CPW, such as those on the subject site, occur throughout the Cumberland Plain. The area of CPW to be conserved within the Regional Park is of much greater size and quality and is one of the largest areas of CPW remaining.

There is no long-term security for patches of CPW in the Western Precinct, as they occur in the area of the future development. There is scope for the retention of individual trees within open space areas, although the viability of the under storey and shrub layer is dependent on landscaping plans and management.

#### *ii. River-flat Eucalypt Forest*

The geography, soils, topography and associated species of RFEF are specific to Western Sydney, although dominant canopy species are found elsewhere in NSW and Australia. Much of the pre-European distribution of this community has been cleared for agriculture, as it occurs on fertile alluvial soils. According to the JANIS report (Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee, 1997), 15% of the pre-1750 distribution of any vegetation community should be conserved within the Comprehensive, Adequate and Representative (CAR) reserve system. As such, only 13( $\pm$ 2.5)% of the Pre-European extent of Alluvial Woodland existed in 2003 (Tozer, 2003). Of this, good representations of RFEF are conserved within Bents Basin State Recreation Area, Mulgoa Nature Reserve and Western Sydney Regional Park (NSW NPWS, 2001b), and small areas are conserved within Cattai National Park, Dharug National Park, Georges River National Park, Scheyville National Park, Gulguer Nature Reserve and Marramarra National Park (NSW Scientific Committee, 2004I).

Within the region, there are core RFEF remnants at Prospect Reservoir, Orchard Hills RAAF base, the SMP Regional Park, Rickabys Creek, Mulgoa Creek, South Creek, Nurragingy

Reserve and along Bells Creek near Townson Road (NSW NPWS, 1997a, NSW NPWS, 1997b).

The long-term security of RFEF in the SMP, within the study area, will be assured with its inclusion in the Regional Park. The area of RFEF to be included within the Regional Park is 217.7ha of core and support for core habitat. This includes core habitat RFEF within the study area. The Regional Park will be transferred to State Government ownership and managed by the NSW National Parks and Wildlife Service (ERM, 2003).

The area of RFEF within the edge of the subject site and adjacent to the subject site is of little local significance. This representative occurs as a very simplified form of the community and is very sparse in a narrow band surrounding an incised drainage channel. Larger areas of much higher quality exist in the locality and a large area will be conserved within the Regional Park. Notwithstanding this, the RFEF will not be significantly cleared but will be conserved and rehabilitated as part of the future riparian corridor for the Western Precinct.

Although the proposed Riparian Corridor construction will involve some vegetation removal for the creation of the new channel and other bank stabilisation works, the landscaping of the entire Riparian Corridor will include the retention of the majority of the trees and also the larger patches of woodland, particularly in areas of higher sensitivity, such as the locations containing *Grevillea juniperina* ssp *juniperina*. Significant areas of future plantings will include CPW, RFEF, wetland and other riparian associated species.

There is long-term security for the corridor of RFEF adjacent to the subject site, as it occurs in the riparian zone adjacent to the proposal. The corridor will be rehabilitated and widened as a result of management requirements for the riparian zone.

### *iii. Freshwater Wetlands*

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee, 2004e).

The community is threatened by land clearing, fragmentation, flood mitigation, land-filling, pollution from runoff, weed invasion, damage from livestock and feral animals, acid sulphate soils, rubbish dumping and climate change (NSW Scientific Committee, 2004e).

There is long-term security for the large wetland in the south of the study area as it occurs in the riparian zone adjacent to the proposal. The wetland and riparian corridor will be rehabilitated and widened as a result of management requirements for the riparian zone.

### *iv. Plant species*

The three subject plant species are all shrubs endemic to the Cumberland Plain. *Pultenaea parviflora* and *Pimelea spicata* are TSC listed as endangered plants, *G. juniperina* subsp.



*juniperina* are vulnerable plants, with relatively narrow total ranges. The Regional Park contains some of the largest known populations of these species, if not the largest known population of *P. parviflora* in existence.

The long-term security of these shrubs in the study area is assured with the dedication of large areas of habitat to the Regional Park, in particular, the eastern section of the Regional Park. The conservation of these shrubs within the Regional Park is important for its long-term security because of the large size of the populations of the species.

Within the region, *P. parviflora* is also conserved within Scheyville National Park, Windsor Downs Nature Reserve and Castlereagh Nature Reserve (NSW NPWS, 2002). *G. juniperina* subsp. *juniperina* is conserved within Castlereagh Nature Reserve (NSW Scientific Committee, 2000). *Pimelea spicata* is not known to have secure habitat in the region, although suitable secure habitat occurs in the nearby Regional Park as well as the Castlereagh Nature Reserve, the Agnes Bank Nature Reserve, and the Windsor Downs Nature Reserve. Although other bushland remnants contain populations of these affected (C)EECs/species, the gazetted National Parks and Nature Reserves referred to provide a higher level of protection as they are dedicated to the long-term security of the species.

v. *Cumberland Land Snail*

The Cumberland Land Snail only occurs on the Cumberland Plain. It is known from over 100 locations in Western Sydney. The area of habitat for the Cumberland Land Snail coincides with occurrences of CPW on the subject site. As referred to above, the area of CPW on the subject site is very small and not high quality habitat, compared with CPW occurrences in the Regional Park and other parks and reserves within the locality. This area of habitat within the subject site is not ensured of long-term security, as the activity of vegetation clearance has been proposed for the subject site.

The subject site contains a large area of habitat for these species. However, this is an artificial habitat created by past activities and disturbance due to demolition and decontamination of facilities on the subject site. Therefore the subject site represents a highly modified area of habitat.

vi. *Bats and birds*

Woodland habitat on the subject land is fragmented for the wide ranging, minor affected fauna species. In the context of the locality, and the Regional Park, it is not considered likely that the subject site on subject land would form a significant area of habitat for local populations of these species.

As the potential habitat on the subject site and subject land represents only a small portion of the area available to the species in the locality and the species are highly mobile, the proposal is not likely that the habitat present is critical to their survival, and hence is not significant in the local context.

### **5.6.3 Discussion of Connectivity**

#### *i. C/EECs and flora species*

The study area forms part of a broad local corridor that extends to the north of the site, and to a lesser extent to the south via South Creek riparian corridor. The vegetation on the subject land is connected to vegetation in the Regional Park to the east, but to the west beyond the Northern Road is urban development. Development of the subject land will not sever connectivity between areas of existing native vegetation. To the north of the study area beyond Ninth Avenue, there are rural residential blocks and several patches of remnant vegetation.

The cumulative impacts of the development of the Western Precinct is not expected to greatly limit gene flow of plant species between the north western parts of the Regional Park and the proximate areas of CPW to the north and north west. These areas of habitat are already fragmented and pollination between these areas of habitat is therefore slightly reduced from that of continuous woodland. Further fragmentation is not likely to reduce the viability of CPW, RFEF and Freshwater Wetlands and the subject plant species in the locality.

#### *ii. Bats and birds*

Woodland habitat on the subject land is already fragmented for the affected fauna species. The sparse patches do however provide additional connection to the intact habitats in the Regional Park. The development of the Western Precinct is not likely to greatly reduce this connection, as it occurs at the western extent of the core area of habitat for these species and will not sever a significant connection that exists in the Regional Park.


As the potential habitat on the subject site and subject land represents only a small portion of the area available to the species in the locality and the species are highly mobile, the proposal is not likely to decrease the movement of individuals and gene flow between areas of potential habitat throughout the locality or within or between local populations.

#### *iii. Cumberland Plain Land Snail*

The Cumberland Plain Land Snail is not a highly mobile species and therefore does not depend on extensive movement of individuals to maintain a viable population. The species occurs in isolated populations throughout its highly restricted distribution. Therefore the lack of connectivity present on the study area is not expected to affect the survival potential of the species, and the proposal is not expected to decrease the connectivity relative to existing levels. A viable local population is expected to persist in the Regional Park.

### **5.6.4 Consideration of Threatening Processes**

The following Key Threatening Processes, listed under the TSC Act have been considered with respect to C/EECs and the affected (C)EECs/species:

-  Clearing of native vegetation;



- Native vegetation will definitely be cleared (see above section) and the most significant impacts on CPW and the affected (C)EECs/species will arise from vegetation clearance.
- Invasion of native plant communities by exotic perennial grasses;
  - There is potential for exotic perennial grasses to invade bushland in the Regional Park, particularly if there is runoff from the subject site to the Regional Park, or dumping of grass propagules in the Regional Park, from residential areas, on completion of the proposal. Exotic grasses are currently in existence on the subject site, particularly dominating the grassland, and invading other habitats. Active management of the Regional Park will reduce the effect of exotic grasses and minimise invasion into the Regional Park.
- Competition from Feral Honeybees;
  - Honeybees are established in the vegetation of the SMP at present and are an ongoing threat. Honeybees can compete with native arboreal fauna and native bees for tree hollows. They can also compete with native pollinators for floral resources (NSW Scientific Committee, 2004a).
- Infection of native plants by *Phytophthora cinnamomi*;
  - There is a potential threat to the vegetation to be conserved within the Regional Park. However, no dieback of the type caused by this plant pathogen has been observed within the SMP and it is not generally regarded as a threat within Western Sydney vegetation (NSW Scientific Committee, 2004h).
- Importation of red imported fire ants into NSW;
  - Fire ants, if established would be a major threat to terrestrial ecosystems. The proposal is not likely to increase the risk of establishment of these ants.
- Introduction of the large earth bumblebee *Bombus terrestris*;
  - The large earth bumblebee, if established would be a major threat to terrestrial ecosystems. The proposal is not likely to significantly increase the establishment of this species.
- Removal of dead wood and dead trees;
  - The proposed development will remove some dead wood and a small number of dead trees. However, most of the vegetation in the subject site is regrowth and so contains little dead wood. There is also potential for new human residents of the subject site to gather wood from the Regional Park. This threat must be managed by the OEH via the management plan for the Regional Park.

- Competition and grazing by the feral European rabbit;
  - Rabbits are established across the SMP. The proposal will not increase the threat from rabbits. Moreover, the Western Precinct Plan has a Domestic and Feral Animal Management Strategy (Cumberland Ecology, 2008b) that includes rabbit control measures. Such measures are currently being implemented in the SMP.
- Ecological consequences of high frequency fires;
  - The SMP has had a relatively high fire frequency in the past due to arson. This will need to be managed via the Regional Park Plan of Management. The proposed development of the Western Precinct is unlikely to significantly increase the frequency of fire, but fire frequencies will need to be monitored.
- Predation by Plague Minnow (*Gambusia holbrooki*)
  - The Plague Minnow preys upon tadpoles and is a threat to a number of frog species. It occurs within South Creek and the smaller drainage-lines in the study area. The proposal entails construction of biofiltration and wetland detention basins. The permanent wetland detention basins have potential to be colonised by the Plague Minnow, but the ephemeral biofiltration areas have potential to create additional habitat for frogs that is free of Plague Minnow. Such artificial wetlands will provide additional foraging areas for bats, frogs and birds within the study area.

Measures to minimise the impacts of the proposed development on threatened species and communities are discussed further in Chapter 7.

## 5.7 Description of Feasible Alternatives

The proposed residential subdivision and subsequent development of the SMP Western Precinct complies with the land use zoning as set out in Sydney Regional Environmental Plan No. 30 - St Marys (DUAP, 2001b) (SREP30). SREP30 was prepared, and land use zones identified, following significant investigations over many years into the biophysical, economic, social and ESD considerations of development via Section 22 and Joint Steering Committee processes. Alternatives to the proposal were considered in the Section 22 Advisory Committee Report (Department of Urban Affairs and Planning, 1997). A conservation outcome was determined, and conservation areas to be included in the Regional Park (now 900ha in area) and Regional open space areas were determined before the developable area was defined.

The following points were considered in order to determine the area for conservation:

- The relative size or area of habitat patches;



- Representation of a vegetation community on a regional scale;
- The presence of threatened flora and fauna species;
- Species diversity in habitat patches;
- The relative naturalness of the habitat patch;
- Connectivity of habitat patches;
- Fragmentation of habitat patches;
- The ease of management of habitat patches, including amount of active management, feasibility and cost; and
- The strategic importance of the SMP for biodiversity management within the locality.

# Consistency of the Proposal with the Objectives of the Cumberland Plain Recovery Plan

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## 6.1 Introduction

A Final Recovery Plan (the Recovery Plan) for the communities and associated threatened species and populations of the Cumberland Plain has been prepared and adopted by the OEH in January 2011 (DECCW 2011). The Draft Recovery Plan (DECCW (NSW) 2009) was in force between 2009 and 2011. The purpose of this chapter is to examine the consistency of the Proposal with the objectives and actions of the Recovery Plan for the purpose of considering whether there is likely to be a significant impact on threatened species. This analysis is undertaken under section 5A of the EP&A Act.

When considering whether to approve the Proposal under section 79C of the *Environmental Planning and Assessment Act 1979* Council is not required to act in a manner consistent with the objectives and actions in the Recovery Plan, but should take those objectives and actions into account when determining the development applications.

## 6.2 Species, Populations and Ecological Communities

The Recovery Plan (DECCW 2011) addresses the following threatened species, populations and ecological communities that are found on the Cumberland Plain, as shown in **Table A.1**.

**Table 6.1 THREATENED BIODIVERSITY ADDRESSED IN THE RECOVERY PLAN**

Threatened Biodiversity	TSC Act Status	EPBC Act Status
<b>Flora Species</b>		
<i>Allocasuarina glareicola</i>	Endangered	Endangered
<i>Dillwynia tenuifolia</i>	Vulnerable	Vulnerable
Juniper-leaved Grevillea ( <i>Grevillea juniperina</i> subsp. <i>juniperina</i> )	Vulnerable	-
<i>Micromyrtus minutiflora</i>	Endangered	Vulnerable
Sydney Plains Greenhood ( <i>Pterostylis saxicola</i> )	Endangered	Endangered
<i>Pultenaea parviflora</i>	Endangered	Vulnerable



**Table 6.1 THREATENED BIODIVERSITY ADDRESSED IN THE RECOVERY PLAN**

Threatened Biodiversity	TSC Act Status	EPBC Act Status
<b>Fauna Species</b>		
Cumberland Land Snail ( <i>Meridolum corneovirens</i> )	Endangered	-
<b>Populations</b>		
<i>Dillwynia tenuifolia</i> population in the Baulkham Hills LGA	Endangered	-
<i>Dillwynia tenuifolia</i> population at Kemps Creek	Endangered	-
<i>Marsdenia viridiflora</i> R. Br subsp. <i>viridiflora</i> population in the Bankstown, Blacktown, Camden, Fairfield, Holroyd, Liverpool and Penrith LGAs	Endangered	-
<i>Pomaderris prunifolia</i> (a shrub) population in the Parramatta, Auburn, Strathfield and Bankstown LGAs	Endangered	-
<b>Ecological Communities</b>		
Agnes Banks Woodland	Endangered	-
Castlereagh Swamp Woodland	Endangered	-
Cooks River/Castlereagh Ironbark Forest	Endangered	-
Cumberland Plain Woodland (listed on EPBC Act as Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest)	Critically Endangered	Critically Endangered
Moist Shale Woodland	Endangered	-
Shale Gravel Transition Forest (listed on EPBC Act as Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest)	Endangered	Critically Endangered
Shale Sandstone Transition Forest	Endangered	Endangered
River-flat Eucalypt Forest (previously Sydney Coastal River Flat Forest)	Endangered	-
Western Sydney Dry Rainforest	Endangered	-

The management and recovery objectives for the flora and fauna species, populations and ecological communities listed above are addressed as part of the overall objectives for the communities of the Cumberland Plain as it is recognised that the recovery of the vegetation will facilitate the recovery of the associated flora and fauna species.

In addition to those listed above, the following threatened species and populations are found on the Cumberland Plain but are not specifically addressed in the Recovery Plan, as only a small proportion of their distribution occurs within the Cumberland Plain or a recovery plan already exists:

- Downy Wattle (*Acacia pubescens*);

- *Hibbertia superans*;
- Matted Bush-pea (*Pultenaea pedunculata*);
- Nodding Geebung (*Persoonia nutans*);
- *Pimelea curviflora* var. *curviflora*; and
- Spiked Rice-flower (*Pimelea spicata*).

Of the species listed above, only one; *Pimelea spicata* occurs on the subject land. Although not covered by the Recovery Plan, this species is addressed in a species specific recovery plan (DEC (NSW) 2006). This species is dealt with at Section 4.3.2iii of this SIS.

The Recovery Plan also identifies a number of additional fauna species, including threatened microbats and birds that are likely to benefit from the implementation of the prescribed management actions. The SIS has dealt with these in Section 4.3.5ii.

The subject land, including the development of the subject site at Jordan Springs, contains some ecological communities and threatened species, or habitat for such species, of relevance to the plan, including;

- Cumberland Plain Woodland;
- River-flat Eucalypt Forest;
- *Grevillea juniperina* subsp *juniperina*;
- *Pultenaea parviflora*; and
- Cumberland Plain Land Snail.

The primary focus of the Recovery Plan is the preservation of threatened species, populations and communities in priority conservation lands. Priority conservation lands are identified in Figure 1 of the Recovery Plan and are said to represent the best remaining opportunities in the region to maximise biodiversity benefits. OEH considers these lands to be the highest priority for future efforts to conserve the threatened biodiversity in the region. The 900 ha proposed Regional Park is identified in the Recovery Plan as priority conservation land.

While the subject site is not priority conservation lands, the Recovery Plan nevertheless identifies as a responsibility of, in this case, Council, the promotion and adoption of best practice standards for bushland management on private land outside the identified priority conservation lands. These best practices standards are set out in Appendix 2 to the Recovery Plan and are considered in Section 6.3 below and Appendix E. In relation to private land, the Recovery Plan contemplates the preparation of site action or management plans which address the management of threatened biodiversity in accordance with the Recovery Plan. The action and management plans addressing the management of threatened biodiversity for the subject land are also discussed in Section 6.3 below.



Chapter 5 considers the impacts of the proposed development on threatened species, populations and ecological communities, including those listed in the Recovery Plan. The clearing of vegetation within the subject site will directly remove habitat for a small number of threatened species including; *Pultenaea parviflora* and Cumberland Plain Land Snail. *Marsdenia viridiflora* has been recorded in the study area, but not within the subject land or subject site. Notwithstanding this, the potential impacts of the proposed development on this species have been considered.

Further to this, 3.87 ha of regenerating CPW and 11.69 ha of low diversity Derived Native Grassland of CPW along with 0.06 ha of Freshwater Wetlands will be removed as part of the current proposal. The removal of this vegetation will remove the habitat of the Cumberland Land Snail on the subject site. Significant and higher quality habitat for the threatened species will remain in the proposed Regional Park. Such impacts have been assessed in detail in Chapter 5 and Chapter 8 of this SIS.

The Recovery Plan identifies the proposed Regional Park; now named the Wianamatta Regional Park, as priority conservation lands. The Regional Park adjoins the subject site to the east. Partial transfer of Wianamatta Regional Park ownership to the National Parks and Wildlife Division of the OEH has been gazetted. This being the Eastern portion, fronting Forrester Road and Palmyra Avenue. The balance of the land zoned Regional Park is still owned by St Marys Land Limited a Lend Lease Company. The Wianamatta Regional Park Plan of Management was adopted by the Minister for Climate Change and the Environment on 15<sup>th</sup> February 2011. The Regional Park forms the primary mitigation measure for the development of the SMP and the subject site, consistently with the planning framework which has regulated the development of the SMP for over two decades.

### **6.3 Compliance of the Proposed Development with the Objectives and Actions of the Final Recovery Plan for the Cumberland Plain**

The Recovery Plan identifies the principal threat to the biodiversity of the Cumberland Plain as being the further loss and fragmentation of habitat. Clearing for rural and residential developments, industry, and agricultural land uses has led to increasingly isolated small remnants which are more susceptible to degradation, provide less habitat values and support fewer species.

The Recovery Plan makes clear that there are other areas of local conservation significance, including areas which provide buffers, corridors and ecological linkages for the priority conservation lands, which must be the subject of best practice management (p11). Likewise, (p12) the Recovery Plan notes that the significance of remnant vegetation outside the priority conservation lands should not be underrated, and that best practice management should be implemented on other areas of local conservation significance. It is clear, therefore, that actions to be taken do not relate exclusively to priority conservation lands.

### **6.3.1 Objectives**

The objectives of the Final Recovery Plan are to improve the conservation of the communities of the Cumberland Plain and protect significant remnants in the long-term. The objectives are as follows:

- Recovery Objective 1: To build a protected area network, comprising public and private lands focused on the priority conservation lands (PCL);
- Recovery Objective 2: To deliver best practice management for threatened biodiversity across Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation;
- Recovery Objective 3: To develop an understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management, and the recovery program; and
- Recovery Objective 4: To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner.

The responsibility for the implementation of these objectives is with OEH (Formerly DECCW). However, the proposed development of the subject site and the Western Precinct in general is consistent with these objectives. The proposed Wianamatta Regional Park has been designated as priority conservation lands and will therefore address Objectives 1 and 2.

The community awareness of the Cumberland Plain's threatened biodiversity is enhanced through the creation of the Regional Park. This will assist in achieving Recovery Objective 3.

The Regional Park also allows for the continued increase of knowledge of threats to the threatened biodiversity of the Cumberland Plain, and therefore assists in the implementation of Recovery Objective 4.

### **6.3.2 Actions**

The responsibilities imposed upon the Council in the implementation of the Recovery Plan require the following:

- Action 1.4 requires the Council to have regard to Priority Conservation Lands in identifying areas for inclusion into environment protection and regional open space zones. This has been achieved by Council through the making of SREP 30 by the Minister for Planning and the reservation of the proposed Regional Park, as discussed above and in Chapter 7;
- Action 1.5 is directed to "*circumstances where impacts on the threatened biodiversity listed in Table 1 (of the Recovery Plan) are unavoidable, as part of any*



*consent, approval or license that is issued, ensure that offset measures are undertaken within the priority conservation lands where practicable ...*” It is noted that Council is not listed as a responsible authority for this action. However, the above action has been included for completeness. In any event, any loss of ecological communities on the subject site is overcome by the offset measures proposed by the proposed Regional Park, as discussed in detail in Chapter 7 of this SIS;

- Action 2.2 requires that Council support and promote the adoption of best practice standards for bushland management and restoration (as specified in Appendix 2) on public and private lands within the Cumberland Plain. The best practice standards are set out in Appendix 2 of the Recovery Plan.

### **6.3.3 Guidelines**

Appendix 2 of the Recovery Plan includes guidelines for the best practice standards for bushland management. The guidelines relate to 3 types of bushland reserved within the Cumberland Plain:

- Bushland on public lands within or outside of priority conservation lands which have conservation as a primary management objective;
- Bushland on public lands outside the priority conservation lands where conservation is not a primary management objective but is compatible with the primary objective; and
- Bushland on private lands

The Wianamatta Regional Park falls under both the categories of “bushland on public lands within priority conservation lands where conservation is the primary management objective” and “bushland on private lands within priority conservation lands where conservation is the primary management objective”. The management of this land is governed by the Wianamatta Plan of Management (DEC (NSW) 2007), the implementation of which is the responsibility of OEHL and Lend Lease. Regional Park ownership will be transferred to OEHL progressively through the life of the development of the SMP.

Only small areas of land within the subject site or Western Precinct will conform to the description of the second point: “bushland on public lands outside of the priority conservation lands”, where parklands are created and bushland retained in the development areas. However, presently, any bushland retained in the Western Precinct conforms to “bushland on private lands”.

Within the subject site and Western Precinct as a whole, some areas of bushland will be retained after residential development is complete. These areas will predominantly include Asset Protection Zones (APZ), riparian corridors and open space, including some pocket parks. Open Space & pocket parks will be dedicated to Penrith Council as Public Reserve.

According to Appendix 2, bushland on public lands outside the priority conservation lands where conservation is not a primary management objective but is compatible with the primary management objective requires an adopted management system or policy (or similar planning document) which addresses:

- *management of threatened biodiversity and is consistent with the recovery plan;*
- *the land to be managed such that the objectives of the management system or policy are met;*
- *monitoring to be undertaken periodically to determine the status of threatened entities, or to assess the effectiveness of threat abatement measures being implemented (for guidance see the Monitoring manual for bitou bush control and native plant recovery (Hughes et al. 2009) at [www.environment.nsw.gov.au/bitouTAP/monitoring.htm](http://www.environment.nsw.gov.au/bitouTAP/monitoring.htm)); and*
- *management is consistent with the following documents, and any additional best practice documents that DECCW may promote at a later date:*
  - *Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland (DEC 2005a);*
  - *the recommended fire regimes in the Appendix 3; and*
  - *a landscape-scale response to African Olive invasion on the Cumberland Plain (as per completion of action 2.6).*

For bushland on private lands to meet best practice standards for management, Appendix 2 indicates the following measures:

- *a site action or management plan to be prepared which addresses the management of threatened biodiversity and is consistent with the recovery plan;*
- *the land to be managed in accordance with the site action or management plan; and*
- *management to be consistent with the following documents, and any other best practice documents that DECCW may promote at a later date:*
  - *Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland; and*
  - *The recommended fire regimes in Appendix 3.*

The document *Recovering Bushland on the Cumberland Plain - Best Practice Guidelines for the Management and Restoration of Bushland* (DEC 2005a) ("the DEC Guidelines") is referred to in Appendix 2, which requires management to be consistent with the DEC Guidelines in order to reach "best practice standards for management" of bushland on private lands. Relevantly, the DEC guidelines include the following provisions:



- " ... protect any retained native vegetation from further degradation by fencing it so it can be managed as a separate unit..." (p 16);
- "...actively manage all retained and protected native vegetation ..." (p 16); and
- "It is extremely important that [remnants of native vegetation] are retained and effort is made to link them across the landscape" (p 17) (emphasis in original).

Page 24 of the DEC Guidelines is headed "Checklist: Ten simple guidelines for making your land fauna friendly". It relevantly includes the following principles:

- Local native vegetation should cover at least 30 per cent of the total area;
- Exclude high impact land uses from at least 30 per cent of the area;
- Maintain native grasses... for grassy woodland areas, it has been recommended that at least half the area contain native grass and herb species ...;
- Native vegetation cover ideally should be in patches of at least 5 to 10 hectares and linked by strips at least 25-50 metres wide;
- Manage at least 10 per cent of the area for wildlife. Of the 30 per cent of the area that is local native vegetation, one third (10 per cent) should be managed primarily for wildlife; and
- Maintain understorey cover over at least a third of the area within a patch of trees. Ensure that approximately one-third of the area managed for wildlife has a high diversity of locally occurring understorey species (herbs, grasses and shrubs) (emphasis in original).

These provisions have been collectively satisfied by the management plans described in the following section, 6.3.4.

### **6.3.4 Management Plans Regulating Development of the SMP**

Several management plans have been approved and adopted for the bushland across the SMP and of specific relevance to this SIS, within the Western Precinct. These areas are already being managed in accordance with these management plans to the extent required. These management plans are consistent with the objectives and requirements of the Recovery Plan, as outlined above.

In addition to the Wianamatta Regional Park Plan of Management, the management plans include the following which have been approved and adopted by Council as part of the statutory planning framework:

- Weed Management Plan (WMP) (Cumberland Ecology 2008b);
- Feral and Domestic Animal Management Strategy (FDAMS) (Cumberland Ecology 2008a);

- Bushfire Hazard Reduction Plan (BES 2008);
- Landscape Management Plan (Riparian Restoration) (Environmental Partnership 2008); and
- A Plan of Management for Eastern Grey Kangaroos, Red Kangaroos and Emus (Referred to as a Macrofauna Management Plan - *MMP*) (Cumberland Ecology 2005).

The MMP relates to the entire SMP, including the proposed Wianamatta Regional Park, and was approved by DEC (2005) and stipulates the humane management of macrofauna across the SMP.

The other management plans listed above were prepared as part of the Western Precinct Plan and were adopted by Council in April 2009. The plans are consistent with relevant best practice guidelines for the management of bushland and were prepared in consultation with relevant government departments. Despite the differing publication dates, a review of the purpose and objectives of these guidelines demonstrates that the principles established are collectively satisfied by the management plans.

The recommended fire regimes in Appendix 3 of the Recovery Plan are not considered relevant to bushland in the Western Precinct, as the remnants of bushland are not suitable for this kind of management.

Table **E.1** in **Appendix E** provides a summary of the best practice standards for bushland management, as stated in Appendix 2 of the Recovery Plan and indicates the applicable management plan and section that addresses each point.

### ***6.3.5 Assessment of Threatened Species, Populations and Ecological Communities within this SIS***

Several threatened species, populations and ecological communities recorded from the subject land are covered in the Recovery Plan. These species and populations have been considered in the SIS, and impacts from the proposed development on these species and populations have been assessed. **Table 6.2** indicates the relevant sections in the SIS where these species have been addressed.

The management and recovery objectives for the flora and fauna species, populations and ecological communities listed in **Table 6.2** are addressed as part of the overall objectives for the ecological communities of the Cumberland Plain as it is recognised that the recovery of the vegetation will facilitate the recovery of the associated flora and fauna species.



**Table 6.2 THREATENED BIODIVERSITY IDENTIFIED IN THE RECOVERY PLAN THAT HAVE BEEN ADDRESSED IN THIS SIS**

Threatened Biodiversity listed in the Recovery Plan	Addressed in SIS
Cumberland Plain Woodland	Identified as a Subject and Affected Community in Section 4.5 of the SIS. Impacts to this community are assessed in Section 5.2.1.
River-flat Eucalypt Forest	Identified as a Subject Community in Section 4.5 of the SIS. Impacts to this species are assessed in Section 5.2.2.
<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Identified as a Subject Species in Section 4.5 of the SIS. Impacts to this species are assessed in Section 5.2.4.
<i>Pultenaea parviflora</i>	Identified as a Subject and Affected Species in Section 4.5 of the SIS. Impacts to this species are assessed in Section 5.2.5.
<i>Marsdenia viridiflora</i> R. Br subsp. <i>viridiflora</i> population in the Bankstown, Blacktown, Camden, Fairfield, Holroyd, Liverpool and Penrith LGAs	Identified as a Subject Species in Section 4.5 of the SIS. Impacts to this species are not assessed in detail, due to the lack of records in the subject site.
Cumberland Plain Land Snail ( <i>Meridolum corneovirens</i> )	Identified as a Subject and Affected Species in Section 4.5 of the SIS. Impacts to this species are assessed in Section 5.2.7.

As discussed in detail within Chapter 8 of this SIS, the proposed Regional Park. The main actions proposed in the Recovery Plan include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best areas of high quality biodiversity in the SMP will be conserved within the proposed Regional Park, adding to the protected area network with opportunity to deliver best practice management. The area of habitat for threatened biodiversity proposed to be cleared is comparatively small and is of lower biodiversity value compared to that of the Regional Park.

## 6.4 Application of Recovery Plan to Proposal

As discussed briefly above, when considering whether to grant development consent to the Proposal, Council is not required to act in a manner consistent with the objectives and actions in the Recovery Plan. Those objectives and actions should however be taken into account, as follows:

- Under sections 5A and 79C of the Environmental Planning and Assessment Act 1979, Council is required to take into account whether the Proposal is consistent with the objectives and aims of the Recovery Plan. Under section 79C Council retains the discretion to approve or refuse the Proposal so long as mandatory matters have been taken into account. Under section 69 of the Threatened Species Conservation Act 1995 Council is not required to strictly apply each action for which it is said to be responsible in the Recovery Plan when determining a development application.
- The main actions proposed in the Recovery Plan include:
  - Building the protected area network;
  - Delivering best practice management;
  - Promoting awareness, education and engagement; and
  - Enhancing information, monitoring and enforcement.

The Proposal is consistent with these actions because:

1. The largest and best areas of high quality biodiversity in the SMP will be conserved within the proposed Regional Park, adding to the protected area network with opportunity to deliver best practice management;
2. The area of habitat for threatened biodiversity proposed to be cleared is comparatively small and is of lower biodiversity value compared to that of the Regional Park; and
3. Management plans regulating the development of the SMP have been approved and adopted that are consistent with the objectives and requirements of the Recovery Plan.



## Ameliorative Measures

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### 7.1 Introduction

Measures have been put in place to mitigate adverse affects on the species, populations and ecological communities that exist or may occur in the study area during and after the construction of the Western Precinct. Long term management strategies, compensatory management strategies and monitoring plans have been developed in order to minimise the impacts of the proposal on the flora and fauna of the subject site, including affected (C)EECs/species and ecological communities. These management strategies and plans will minimise and control the key threatening processes outlined in Chapter 5.

This chapter provides a summary of the mitigation measures proposed and the extent of implementation that has occurred to date.

The mitigation measures will cover the SMP including the Western Precinct and the Regional Park. Long term management strategies and plans include:

#### 7.1.1 *SMP/Regional Park*

- The statutory planning framework established for the SMP provides the foundation for the sustainable development and management of the SMP :
  - The SREP30 (DUAP, 2001b) zones 900ha of land for the purpose of a Regional Park to conserve a representative and significant proportion of the natural values of the SMP in order to protect the variety of Western Sydney vegetation communities, native flora and fauna species and fauna habitat. Clause 37(1)(b) of SREP 30 provides a relevant objective of this zoning is to “conserve and enhance the range and variety of ecological communities...within the area”. Development for the purpose of any land use authorised under the National Parks and Wildlife Act (NPW Act) is permissible without consent, and any other land use is prohibited: cl 37(2) ;
  - The EPS2000 establishes amongst other things the environmental conservation principles to guide the long term development and conservation of the SMP. Section 4.2 provides that the Regional Park will provide for the conservation of EECs including CPW. Section 4.3 provides performance objectives amongst which is the objective of minimising

adverse impacts on the vegetation habitats within the Regional Park resulting from the development of areas zoned “Urban”;

- The State Deed provides for the transfer of land to NPWS, provision of funding and the obligation to gazette land as Regional Park under the NPW Act;
- The Regional Park Plan of Management, adopted under S.75A of the NPW Act; and
- The approved St Marys Macrofauna Management Plan (Cumberland Ecology, 2004b).

### **7.1.2 Western Precinct**

- The Western Precinct Weed Management Plan (Cumberland Ecology, 2008a);
- The Western Precinct Feral and Domestic Animal Management Strategy (Cumberland Ecology, 2008b);
- The Western Precinct Landscape Concept Plan; and
- Vegetation Management Plan for Riparian Corridors (Environmental Partnership, 2008).

## **7.2 Long Term Management Strategies**

Long-term management strategies to protect the high quality habitats of the study area from impacts prior to, during and post construction of developments in the Western Precinct, as detailed in the Precinct Plan (JBA 2009). Such measures include the implementation of the following plans:

### **7.2.1 The Landscape Masterplan**

A number of principles have been adopted in relation to the Landscape Masterplan for the Western Precinct (Environmental Partnership, 2009) including;

- Maximising natural functioning of the watercourses, incorporating bed and bank stability;
- Maximising corridor functions for native fauna and flora of the riparian areas;
- Maximise water quality functions;
- Maximising biological functions within riparian areas;
- Minimising movement of undesirable flora within the riparian areas; and



- Minimising future salinity impacts for the whole site.

*i. Seed collection*

The seed from local native plants will be collected for use in the revegetation plans for riparian zone and open space areas. This will ensure preservation of the local genetic material of the flora.

*ii. Retention of significant trees*

Street trees are an important element of the streetscape and open space system. Street trees assist in reinforcing the biodiversity values of the St Marys Development. The following strategies are to be used wherever possible in the subsequent planning phases to respond to retain individual trees and stands of existing trees through the site.

- Existing significant trees shall be incorporated into the planting design at key locations within parks and streetscapes; and
- Street trees are predominantly native trees indigenous to Western Sydney.

*iii. Environmental Considerations*

The environmental values of both the subject site and the Western Precinct will be reinforced through appropriate revegetation from local seed stock and protection of natural features. The natural features that will be protected in the Western Precinct include watercourses, mature trees, fire cycle maintenance, and the soil seed bank.

The revegetation of the riparian zone will incorporate indigenous plant species predominantly propagated from seed stock collected from the site and from local seed stock collected by other organisations. This will ensure that the creek and environmental corridors are revegetated with genetically appropriate plant species to maintain genetic integrity of the local biodiversity. The maintenance of naturally functioning watercourses increases the environmental value of the site by increasing creek bank stability and water quality. Moreover, naturally functioning watercourses protects from future degradation of the site from invasive weeds and high salinity.

All open spaces will be designed to ensure that the maintenance of local flora is sustainable. The design and maintenance standards will be defined by the quality, size, location and use of each individual open space area. Existing significant trees shall be incorporated into the planting design at key locations within parks and streetscapes. These mature trees will strengthen the biodiversity values of the subject site by providing shelter, habitat and corridors for native fauna. Moreover, the mature trees will provide shade and aesthetic values for the residents of SMP. Any trees that are removed will be harvested for landscape mulch and furniture items to minimise wastage and in up keeping with sustainability values. Furthermore the onsite topsoil will be stripped, stored, ameliorated and reused within streetscape and parks. This will ensure that local seed bank in the soil is preserved for the biodiversity value of the Western Precinct.

A well-defined asset protection zone and appropriate interface and edge treatments along the Regional Park boundary will assist in the ongoing management of the park. The maintenance of the natural fire cycles in the Regional Park is important for the preservation of floral diversity in the Regional Park, however regular burn offs of ground litter in the Regional Park will safeguard the residents of SMP from the threat of bush fire. The asset protection zone will enhance this safeguard.

### **7.2.2 Weed Management Plan**

A Weed Management Plan has been developed and adopted by Penrith City for the Western Precinct in order to provide for the following objectives:

- Identification and management of weeds during and after construction on the Western Precinct to prevent the spread of weeds into the Regional Park;
- Specify control measures for noxious weeds of significance in the SMP specifically identified in the EPS, Noxious Weeds Act 1993 and Weeds of National Significance;
- Set out requirements for revegetation after disturbance or construction to reduce the potential spread and establishment of weeds;
- Prepare prescriptions for the control of significant weed species within the Western Precinct development area during and after construction;
- Detail a weed control program for the Western Precinct development area;
- Make provision for weed control guidelines for building and landscaping and education material for future residents;
- Outline strategies to ensure that the relevant objectives outlined in SREP 30 and St Marys EPS Environmental Planning Strategy and State Deed are met; and
- The WMP will be implemented and enforced via conditions of consent on DAs.

### **7.2.3 Feral and Domestic Animal Management Strategy**

A Feral and Domestic Animal Management Strategy has been developed and adopted by PCC for the Western Precinct in order to provide for the following objectives:

- To ensure that development of the Western Precinct does not directly increase populations of, or improve habitats for, feral/exotic pest animals and over-abundant native species;
- To ensure that development of Western Precinct does not indirectly increase populations of feral animals such as European Red Foxes and Feral Cats by creating abundant prey;



- To ensure that development of Western Precinct does not exacerbate any Key Threatening Process;
- To minimise the potential for domestic animals within Western Precinct to impact on native flora and fauna values at the SMP;
- To minimise the potential for feral/exotic pests, over-abundant native and domestic animals to impinge on the conservation values of the adjoining Regional Park; and
- This strategy will be implemented and enforced via conditions of consent on DAs.

#### **7.2.4 Bushfire Management Plan**

The Bushfire Management Plan is being implemented progressively in the Western Precinct to reduce the bushfire hazard to life and property within the precinct and reduce the adverse effects of frequent bushfires on the Regional Park.

#### **7.2.5 Macrofauna Management Plan**

The St Marys Macrofauna Management Plan (for kangaroos and emus) for the entire SMP has been endorsed by NPWS and is now being implemented, which will ultimately result in a decrease in grazing pressure in the Regional Park and exclusion of macrofauna from the Western Precinct.

The key objectives of the MMP include:

- Minimisation of risks to macrofauna from human activities and from macrofauna to humans on the SMP;
- Provision of a protocol for the treatment of sick or injured macrofauna on the SMP;
- Justification of management options for the macrofauna population;
- Provision of short term prescriptions for management of macrofauna in relation to proposed developments within the development precincts of the SMP;
- Provision of medium term and long term prescriptions for management of macrofauna within the Regional Park and open space areas of the SMP; and
- Provision of appropriate mechanisms for monitoring, review and revision of the MMP as required for adaptive management of the macrofauna populations.

#### **7.2.6 Habitat Enhancement within Subject Land**

Some existing trees and understorey within the Western Precinct will be retained and incorporated into the landscape design of the precinct plan. These may be retained around future dwellings or in proposed riparian corridors and areas of open space where possible.

Planting of riparian corridors as part of water management will also form part of onsite mitigation.

### **7.3 Compensatory Measures**

Compensatory strategies have been put in place to minimise impacts on threatened species and (C)EECs.

The foremost mitigation measure for threatened species and ecological communities is the establishment of the 900ha Regional Park, to be managed by OEH. The Regional Park will conserve extensive, viable tracts of forest and woodland, and habitats of threatened and regionally significant species. The Regional Park comprises the best representative parts of the (C)EECs in the SMP.

In addition to the reservation of this land, regeneration (assisted if required) of endangered ecological communities and threatened flora will occur within degraded parts of the Regional Park using local seed stock (this has been addressed within the Regional Park Plan of Management). The establishment of the Regional Park is further supported by the extensive plans of management of relevance to the long-term management of this large conservation area. The following plans have been implemented for the Regional Park:

#### **7.3.1 Regional Park Plan of Management**

- A Plan of Management for the 900ha Regional Park (DEC (NSW), 2007) has been prepared and recently endorsed by OEH. The Regional Park will be managed to maintain the remnant vegetation communities and associated biodiversity and will include the protection of significant cultural and scenic values. Visitor and research opportunities will be provided that are consistent with the conservation values of the Park. The key objectives of this plan include:
- Protection and enhancement of the natural heritage of the Park, particularly the endangered ecological communities and the threatened flora and fauna species through the management of fire, disturbed areas, drainage, introduced species, access and visitor use;
- Protection of the catchment values of South and Ropes Creeks through managing any disturbances, particularly those associated with fire, access and drainage;
- Provision of recreational facilities that are appropriate in a regional context and are designed, located and managed to protect the natural and cultural heritage and visual values of the Park;
- Provision of interpretive and educational opportunities through signage, park brochures and activities to assist visitor understanding and enjoyment of the Park; and



- Improving knowledge of natural and cultural heritage, corresponding threats and the evaluation of management programs through research and monitoring. Working with local government, other agencies and authorities, the community and commercial interests to maximise community interest and involvement in the conservation of the Park, and the implementation of sympathetic conservation measures in the neighbouring environment.

### **7.3.2 Macrofauna Management Plan**

Significant financial investment has been made by the proponent to contribute to the overall compensatory “package”. The population management of kangaroo and emu populations in the 900ha Regional Park (and other areas of the SMP) has allowed for the regeneration of CPW and other woodland types due to the significant reduction in grazing animals present. There has also been investment in the monitoring of impacts from grazing over a number of years, as described in Section 7.4 below.

### **7.3.3 Principles for Offsetting**

The compensatory measures against current state-wide standards in offsetting is specified by OEH in ‘*Guidelines for Biodiversity Certification of Environmental Planning Instruments Working Draft – Department of Environment and Climate Change, October 2007*’. (DECC, 2007). The Principles for offsetting (DECC 2007) require that offsets be underpinned by sound ecological principles and must:

- Include the consideration of structure, function and compositional elements of biodiversity, including threatened species;
- Enhance biodiversity at a range of scales;
- Consider the conservation status of ecological communities; and
- Ensure the long-term viability and functionality of biodiversity.

Offsets should be targeted according to biodiversity priorities in the area, based on the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats. Only ecological communities that are equal or greater in conservation status to the type of ecological community lost can be used for offsets. One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity but these benefits do not reduce the biodiversity offset requirements.

The dedication of 900ha of land to create Regional Park, monetary contributions towards capital costs of the Regional Park, fencing and additional measures, such as the implementation of management plans described above, satisfies these principles.

### **7.3.4 Alternative Compensatory Measures**

The options for the SMP have been considered over many years and they range from the “complete conservation option”, which would involve designating the entire SMP as a conservation reserve, through to options that would see the majority of the site developed and used for urban development.

The “complete conservation option” has not been considered feasible due to the extensive disturbance of the former industrial portions of the subject site and the high costs (and impracticalities) of restoration of such land. More extensive development of the SMP is also not warranted as this would likely require clearing of at least some relatively undisturbed woodland and forest and impact upon areas listed on the Register of National Estate.

The conservation outcome for the SMP provided for under SREP 30 was determined by the detailed deliberations of a statutory committee convened by the NSW Minister for Planning under Section 22 of the NSW EP&A Act (1979) (Department of Urban Affairs and Planning, 1997). This outcome was added to in more recent years by the inclusion of all areas of National Estate into an expanded Regional Park. Due to the high conservation values of portions of the site, conservation outcomes were considered in detail and provided for as the first priority for planning the future of the property.

The major alternatives to the development of the property would be more conservation/less development or more development/less conservation. However, currently SREP 30 and the subsequent amendments to expand the Regional Park provide for conservation of approximately 900 hectares of the 1545 hectare site and include the vast majority of the high and medium conservation value lands.

In the context of the SMP, and the study area, the subject site is a highly disturbed area. While the subject site could in theory be added to the conservation reserve for the SMP, this is not a practical alternative to the current proposal owing to the high level of disturbance to the site. Such an alternative would also substantially reduce the developable area of the subject site without adding substantially to the conservation of threatened flora and fauna.

## **7.4 Monitoring**

The effectiveness of the mitigation measures is determined by ongoing monitoring. The objective of the ongoing monitoring of the affected (C)EECs/species will be to ascertain whether the predicted impacts on the species occur. Monitoring will also detect other unexpected impacts and where necessary, measures to prevent further impacts can be implemented. The method of monitoring, reporting framework, duration and frequency is outlined in detail. The effectiveness of mitigation measures is generally proven by experimental design allowing adaptive management and appropriate monitoring. Details of the monitoring for all flora and fauna within the SMP, including macrofauna, weeds, feral animals and threatened species, will be provided within a Monitoring Plan prepared in conjunction with the Regional Park Plan of Management.



#### **7.4.1 Weed Management Plan**

A vital component of weed control strategy is follow-up work and monitoring. The review and monitoring of weed control is outlined in this plan. Short term monitoring will be undertaken as a follow-up to weed control operations, ensuring that weed control has been successful. The long-term monitoring program is to provide sufficient feedback on the success of the overall weed control strategies including suppression and prevention of weed spread and establishment. Detailed short-term and long-term monitoring objectives and methods are outlined in the plan. An annual review of the plan will be undertaken to assess the effectiveness of the plan, during the first three years. The detailed reporting framework is also outlined in the plan.

#### **7.4.2 The St Marys Macrofauna Management Plan**

The Macrofauna Management Plan (MMP) is based upon an adaptive management approach and regular monitoring and review. This will ensure that the kangaroo and emu populations are managed in an optimal way that ensures animals are removed from development areas and where retained, they are maintained in a healthy humane condition at densities that do not unsustainably impact upon the condition and use of the Regional Park. Kangaroos and emus will be counted on a quarterly basis for the first five years of the MMP. The counts of kangaroos and emus will, where possible, be related to data from fox baiting programs conducted on the SMP. Detailed short-term and long-term monitoring objectives and methods are outlined in the MMP. The findings of monitoring work for the MMP and results of various adaptive management procedures will be summarised within an annual report, submitted to NPWS. This annual report will be used as the basis for the annual revision of the MMP.

It is a condition of the MMP that vegetation will be monitored in these plots annually in autumn for the life of the MMP. Baseline flora surveys of these plots were completed between March and July 2005. Vegetation within the plots was then re-surveyed between March and May 2006, April and June 2007, between April and July 2008 in August 2009 and between June and July 2010. Reports have been completed, analysing the floristic and structural changes within the first (Cumberland Ecology, 2006), second (Cumberland Ecology, 2007a), third (Cumberland Ecology, 2008c) and fourth (Cumberland Ecology, 2009b) year after grazing exclosure. This research is considered to assist in the conservation efforts for CPW by OEH.

## Assessments of Significance

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### 8.1 Critically Endangered Ecological Community

#### 8.1.1 Cumberland Plain Woodland

Cumberland Plain Woodland (CPW) occurs in two forms; Shale Hills Woodland and Shale Plains Woodland. Shale Hills Woodland occurs in the south of the Cumberland Plain in more elevated areas. Shale Plains Woodland (SPW) is more widely distributed, occurring throughout the drier areas of the Cumberland Plain (NSW NPWS, 2001a). Dominant canopy species include Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*E. tereticornis*), Narrow-leaved Ironbark (*E. crebra*), Spotted Gum (*Corymbia maculata*) and Thin-leaved Stringybark (*E. eugenoides*). The shrub layer is dominated by Blackthorn (*Bursaria spinosa*). Grasses dominate the ground layer (Benson and Howell, 1990).

The community is well adapted to fire and drought but is now under threat from disturbance triggering weed invasion, increased soil nutrients, rubbish dumping and altered fire regimes (NSW NPWS, 2001a).

In December 2009, the NSW Scientific Committee released a final determination for the listing of Cumberland Plain Woodland as a critically endangered ecological community. The definition of the community in this final determination includes areas of derived native grasslands, referring to areas where trees and shrubs have been cleared but a native understorey typical of Cumberland Plain Woodland still exists.

CPW within the subject site exists predominantly in the form of low diversity Derived Native Grassland although sparse patches of regenerating CPW in the form of few canopy trees surrounded by juvenile eucalypts and native groundcover species also occur. CPW within the subject site totals an area of 15.56 ha of vegetation and is similar to other representatives in the study area and locality. Larger patches and more intact tracts of CPW occur on the SMP, with the largest and best quality areas conserved within the Regional Park.

- a) *in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*

Not applicable.



- b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction*

Not applicable.

- c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
- (i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

The proposed development of the subject site will remove an area of approximately 15.56 ha of CPW consisting of 3.87 ha of regenerating CPW and 11.69 ha of low diversity Derived Native Grasslands.

Additionally, cumulative impacts of the Western Precinct development (currently undeveloped portions, including the subject site) are likely to remove or modify a further 47 ha of regenerating CPW and 62 ha of low diversity Derived Native Grassland. This is not likely to have an adverse effect on the extent of the community such that its local occurrence is likely to be placed at risk of extinction because the community is well-represented within the adjacent Regional Park where it has a higher conservation value and is in better condition.

There is a possibility that the composition of CPW may be modified in the adjoining areas of the Regional Park due to an increase in edge effects from the future residential areas. However, a suite of mitigation measures will be implemented to reduce impacts from the proposed development within the Western Precinct and adjoining Regional Park including fencing and comprehensive drainage and waste management strategies. Any edge-effects that may occur are expected to be localised, and would not be expected to adversely modify composition to place the local occurrence at risk of extinction.

- d) *in relation to the habitat of a threatened species, population or ecological community:*
- (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
  - (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
  - (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

It is assumed that all CPW within the subject site will be removed or substantially modified for the proposed development. The proposed development of the subject site will collectively remove an area of approximately 3.87 ha of regenerating CPW and 11.69 ha of low diversity Derived Native Grasslands.

Additionally, cumulative impacts of the Western Precinct development (currently undeveloped portions only) are likely to remove or modify a further 47 ha of regenerating CPW and 62 ha of low diversity Derived Native Grassland. This is compared with the large areas of intact CPW/Cumberland Plain Vegetation Communities totalling more than 411ha/746ha respectively (DEC (NSW), 2007) conserved in perpetuity in the 900ha Regional Park as an offset to development of the SMP development precincts.

The CPW of the study area occurs at the eastern edge of the Western Precinct development area and will not isolate any patches of woodland that occur outside of the development areas. The sparse regenerating woodland on the subject land occurs at the outer edge of a continuous patch that extends into the Regional Park. The proposed development of the Western Precinct will however contribute to the increasing fragmentation of habitat within the Western Precinct and links to the Regional Park.

The CPW to be removed or modified as a result of the proposed development is not likely to be of great importance to the long-term survival of the community within the locality. Cumberland Plain Woodland of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the subject site as it has higher resilience, is more structurally intact and has higher species diversity.

e) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)*

No critical habitat for this endangered ecological community has currently been identified by the Director-General of the OEH.

f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

The Recovery Plan for the Cumberland Plain states that the main actions required for the recovery of this community include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best quality areas of CPW in the SMP will be conserved within the Regional Park, adding to the



protected area network with opportunity to deliver best practice management. The patches and sparse patches of CPW in the study area are comparatively small and degraded compared to the representation in the Regional Park and will not greatly add to the viability of the community if retained, once the study area is developed for urban purposes. The consistency of the proposal with the Recovery Plan for the Cumberland Plain is discussed in detail in Chapter 6.

There are no threat abatement plans relevant to CPW.

- g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The proposed development will result in the threatening process 'Clearing of native vegetation'. However, the vegetation to be cleared consists predominantly of degraded and sparsely regenerating CPW and higher quality examples of the community will be conserved within the Regional Park.

Other key threatening processes that may be increased as a result of the proposed development include:

- Competition and grazing by the Feral European Rabbit;
- Ecological consequence of high frequency fires; and
- Invasion of native plant communities by exotic perennial grasses.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct to ensure that the effects of rabbits are not exacerbated by the proposed development and to decrease the impacts from rabbits as they currently exist on the SMP.

The Bushfire Management Plan has been designed to mitigate factors that could lead to high frequency fires. The plan of management for the Regional Park will also ensure that this process is not exacerbated.

The Weed Management Plan will be implemented to reduce the impacts of exotic perennial grasses.

### *Conclusion*

The development of the subject site and subject land will remove a relatively small area of habitat for this community based and recent assessments of derived native grassland on the subject land and with due consideration of the restricted distribution of this CEEC in the region..

However, the proposed development is not likely to have a significant impact on Cumberland Plain Woodland such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park

will be protected through a range of mitigation measures and retained in perpetuity in public ownership.

### **8.1.2 River-flat Eucalypt Forest**

River-flat Eucalypt Forest (RFEF) is found on coastal floodplains and has a tall canopy of eucalypts. The most widespread canopy trees include *Eucalyptus tereticornis*, *E. amplifolia*, *Angophora floribunda* and *A. subvelutina*. It may have a layer of small trees and a scattering of shrubs. The ground cover consists of abundant forbs, scramblers and grasses. RFEF occurs on alluvial soils on river-flats of the NSW North Coast, Sydney Basin and South East Corner bioregions.

No RFEF is present on the subject site. A small patch of RFEF in moderate condition occurs in the south east of the subject land. It is connected to a larger area of RFEF (a form of Alluvial Woodland) in the Regional Park.

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

- b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

(ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

The RFEF in the Western Precinct occurs in a small area connected to a larger section of RFEF in the Regional Park. while the proposed development will not remove any RFEF from the subject site, 7.9 ha may be removed from the subject land. This will not have an adverse effect on the extent of the community such that its local occurrence is likely to be placed at risk of extinction because the community is well-represented within the adjacent Regional Park where it has a higher conservation value and is in better condition than the areas present on the subject land.



The composition may be modified in parts of the Western Precinct where representations of the community are retained such as significant trees or patches of understorey. Although patches of vegetation are not likely to be retained with structural complexity or composition resembling RFEF, this will not adversely modify composition to place the local occurrence at risk of extinction because of the retention of RFEF in the Regional Park.

- d) *In relation to the habitat of a threatened species, population or ecological community:*
- (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
  - (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
  - (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

No area of RFEF will be removed on the subject site although 7.9 ha may be modified as part of future works on the subject land. However, such works will occur in the future riparian corridor, which will include regeneration of this community.

Intact RFEF will remain connected to other areas of native vegetation through the Regional Park around the southern and eastern sides of the precinct. Any significant trees or patches of understorey that are retained within the precinct will become isolated as a result of the proposed development.

The RFEF to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the community within the locality. River-flat Eucalypt Forest of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Western Precinct as it is in better condition and is more intact.

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

No critical habitat for this endangered ecological community has currently been identified by the Director-General of the OEH.

- f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,*

The Recovery Plan for the Cumberland Plain states that the main actions required for the recovery of this community include:

- Building the protected area network;

- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best quality areas of RFEF in the SMP will be conserved within the Regional Park, adding to the protected area network with opportunity to deliver best practice management. The consistency of the proposal with the Recovery Plan for the Cumberland Plain is discussed in detail in Chapter 6.

There are no threat abatement plans relevant to RFEF.

- g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The proposed development will result in Clearing of native vegetation. However, the vegetation to be cleared consists of degraded RFEF and higher quality examples of the community will be conserved within the Regional Park. Other key threatening processes that may be increased as a result of the proposed development include:

- Competition and grazing by the feral European rabbit;
- Ecological consequence of high frequency fires; and
- Invasion of native plant communities by exotic perennial grasses.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct to ensure that the effects of rabbits are not exacerbated by the proposed development and to decrease the impacts from rabbits as they currently exist on the SMP.

The Bushfire Management Plan has been designed to mitigate factors that could lead to high frequency fires. The Plan of Management for the Regional Park will also ensure that this process is not exacerbated.

The Weed Management Plan will be implemented to reduce the impacts of exotic perennial grasses.

#### *Conclusion*

The proposed development is not likely to have a significant impact on River-flat Eucalypt Forest.

### **8.1.3 Freshwater Wetlands**

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats,



depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee, 2004e).

The community is threatened by land clearing, fragmentation, flood mitigation, land-filling, pollution from runoff, weed invasion, damage from livestock and feral animals, acid sulphate soils, rubbish dumping and climate change (NSW Scientific Committee, 2004e).

A small patch of Freshwater Wetlands occurs on the subject site, with others occurring in nearby parts of the subject land in low-lying areas. Other areas of Freshwater Wetlands are conserved within the Regional Park.

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

- b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
- (i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

The Freshwater Wetlands in the Western Precinct and surrounding areas of the Regional Park occur in very small localised depressions. The proposed development will remove 0.06 ha of Freshwater Wetlands through earthworks and vegetation clearance. This will not have an adverse effect on the extent of the community such that its local occurrence is likely to be placed at risk of extinction because the community is well-represented within the adjacent Regional Park where it has a higher conservation value and is in better condition.

The composition may be modified in parts of the Western Precinct where representations of the community are retained such as within riparian corridors. This will not adversely modify composition to place the local occurrence at risk of extinction because of the retention of Freshwater Wetlands in the Regional Park.

- d) *In relation to the habitat of a threatened species, population or ecological community:*
- (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
  - (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
  - (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

It is assumed that some of the Freshwater Wetlands within the precinct will be removed or substantially modified for the proposed development while some areas may be retained within riparian corridors.

Intact Freshwater Wetlands will remain connected to other areas of native vegetation as the community intergrades with RFEF, through the Regional Park around the southern and eastern sides of the precinct. Any areas that are retained within riparian corridors in the precinct are likely to be connected to the Regional Park.

The Freshwater Wetlands to be removed, modified or isolated as a result of the proposed development are not important to the long-term survival of the community within the locality. Freshwater Wetlands of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Western Precinct as it is in better condition and is more intact.

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

No critical habitat for this endangered ecological community has currently been identified by the Director-General of the OEH.

- f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,*

No recovery plan is of relevance to this community.

There are no threat abatement plans relevant to Freshwater Wetlands.

- g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The proposed development will result in Clearing of native vegetation. However, the vegetation to be cleared consists of degraded Freshwater Wetlands and higher quality



examples of the community will be conserved within the Regional Park. Other key threatening processes that may be increased as a result of the proposed development include:

- Competition and grazing by the feral European rabbit;
- Ecological consequence of high frequency fires; and
- Invasion of native plant communities by exotic perennial grasses.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct to ensure that the effects of rabbits are not exacerbated by the proposed development and to decrease the impacts from rabbits as they currently exist on the SMP.

The Bushfire Management Plan has been designed to mitigate factors that could lead to high frequency fires. The plan of management for the Regional Park will also ensure that this process is not exacerbated.

The Weed Management Plan will be implemented to reduce the impacts of exotic perennial grasses.

### *Conclusion*

The proposed development will not have a significant impact on Freshwater Wetlands.

## **8.2 Flora**

### **8.2.1 *Pultenaea parviflora***

- a) *In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.*

*Pultenaea parviflora* is a small shrub to 1m which is endemic to the Cumberland Plain. It occurs in the Windsor – Penrith – Dean Park area, with outlying populations at Kemps Creek and Wilberforce. It is conserved within Scheyville National Park, Windsor Downs Nature Reserve and Castlereagh Nature Reserve. It occurs in dry heath areas within Castlereagh Ironbark Forest on Tertiary alluvium and laterised clays. The abundance of the species depends on past disturbance. Clearing, altered fire regime, vehicle access, rubbish dumping and weed invasion threaten *P. parviflora*. Disturbance that leads to competition with taller colonising species also threatens this species. In summary:

- Thousands of individuals of this plant and many hectares of habitat are conserved within the Regional Park adjacent to the subject site; and
- A single specimen of this species has been recorded on the subject site and similar habitat occurs within the study area.

- b) *In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,*

There are no populations of this species listed as endangered under the TSC Act.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

- (i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

- d) *In relation to the habitat of a threatened species, population or ecological community:*

- (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

All of the known and potential habitat for this species in the subject site and Western Precinct will be removed or substantially modified as a result of the proposed development.

No areas of known or potential habitat for this species will become isolated by the proposed development. Connectivity will be maintained in the short term around the eastern side of the study area, and in the long term through the Regional Park, which will connect plants that occur to the north and south of the study area.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the species within the locality. Areas of high quality habitat and large numbers of the species occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*



No critical habitat for this species has currently been identified by the Director-General of the OEH.

f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

The Recovery Plan for the Cumberland Plain states that the main actions required for the recovery of the associated species include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best quality areas of habitat in the SMP will be conserved within the Regional Park, adding to the protected area network with opportunity to deliver best practice management. The consistency of the proposal with the Recovery Plan for the Cumberland Plain is discussed in detail in Chapter 6.

No threat abatement plans are relevant to this species.

g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.*

Clearing of native vegetation resulting in the loss of habitat is a listed threatening process under the TSC Act. A small area of habitat for this species will be cleared for the proposed development. However, potential habitat for the species and large numbers of the species will be contained within the Regional Park, which will be managed to improve habitat on the SMP.

No other key threatening process that may be exacerbated by the proposed action will affect this species.

#### *Conclusion*

When compared with the extensive area of habitat and known population of this species in the Regional Park, the proposed development will not have a significant impact on *P. parviflora*.

## 8.3 Fauna

### 8.3.1 Woodland Birds

The following vulnerable listed woodland bird species have been recorded in the study area, and have similar habitat requirements, are assessed in the Assessment of Significance below:

- Speckled Warbler;
- Diamond Firetail;
- Varied Sittella; and
- Hooded Robin

The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. The Speckled Warbler lives in a wide range of *Eucalyptus* dominated communities that have a grassy understorey, often on rocky ridges or in gullies (DEC (NSW), 2005k). The Speckled Warbler is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee, 2004k).

The Diamond Firetail occurs in Eucalypt woodlands including Box-Gum and Snow Gum woodlands. It also occurs in open forest, mallee, natural temperate grasslands and derived grasslands, often in riparian areas. It is widely distributed across NSW. The Diamond Firetail is threatened by habitat loss through clearing, invasion of weeds and firewood collection, and predation of eggs and nestlings by the Pied Currawong (Department of Sustainability, 2011). The Diamond Firetail is listed as Vulnerable on Schedule 2 of the TSC Act (Department of Sustainability, 2011).

The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Its distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades.

The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter.

- (a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*



Development of the subject site may impact on some potential habitat for these small woodland bird species that have been recorded in the study area (or similar habitats on the SMP) during past surveys. Although none have been recorded in the Western Precinct and areas of better quality habitat occur within the Regional Park. The proposed development is not likely to place a local population of the species at risk of extinction.

- (b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

There are no populations of the species that are listed as endangered under the TSC Act.

- (c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

*(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

*(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

Not applicable.

- (d) *In relation to the habitat of a threatened species, population or ecological community:*

*(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

*(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

*(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

All of the known and potential habitat for the species on the subject site, and consequently across the subject land, will be removed or substantially modified as a result of the proposed development. This is a small area in comparison to that of the adjoining Regional Park.

The potential habitat for the species in the study area occurs in sparse patches that are fragmented from larger occurrences in the Regional Park. The proposed development will however increase the effects of existing fragmentation. Any significant trees or patches of understorey that are retained within the subject land will remain isolated from the Regional Park.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the species within the locality. Areas of high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

- (e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

No critical habitat for this species has currently been identified by the Director-General of the OEH.

- (f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

The Red Fox threat abatement plan is relevant to this species, although the birds are not a priority species listed in the plan. The proposed development is consistent with the objectives of the plan.

No recovery plan has been prepared for the species..

- (g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The proposed development will result in Clearing of native vegetation. However, the vegetation to be cleared consists of degraded habitat for the species. Larger areas of better quality habitat will be conserved within the Regional Park.

Other key threatening processes that may be increased as a result of the proposed development include:

- Predation by the European Red Fox; and
- Predation by the Feral Cat.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct to ensure that the effects of foxes and cats are not exacerbated by the proposed development.

#### *Conclusion*

The proposed development will not have significant impact on the woodland bird species such that a local population would be placed at risk of extinction.

### **8.3.2 Cumberland Plain Land Snail**

The Cumberland Plain Land Snail inhabits a very small area on the Cumberland Plain west of Sydney from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains (DEC (NSW), 2005a). It



primarily occurs in Cumberland Plain Woodland, which is a grassy open woodland with occasional dense patches of shrubs (DEC (NSW), 2005a). It lives under litter or bark, leaves and logs or shelters in loose soil around grass clumps (DEC (NSW), 2005a). The Cumberland Land Snail is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee, 1997a).

- a) *In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.*

Little is known about the range of the Cumberland Land Snail and the area required for a viable population, but it is thought that the remaining total population on the Cumberland Plain consists of several disjunct populations (NSW Scientific Committee, 1997a). The SMP is likely to support one large population or subpopulation of this species. The Cumberland Land Snail is present within most or all of the larger patches of CPW on the SMP and is represented within the Regional Park which contains more than 400ha of potential habitat.

Cumberland Land Snail's were recorded on the subject land, although not from within the subject site. As an indication of relative abundance, surveys of comparative CPW in the Regional Park indicate a significantly higher number of snails in mature CPW. The habitat on the subject land is sparse and suitable CPW patches are small and infrequent. Based on the assessments in the Regional Park, it can be assumed that approximately 400ha of habitat occurs, which would suggest potentially hundreds of thousands of snails.

Because the CPW on the subject site is isolated from other patches, it is questionable as to whether the subpopulation would be viable in the long term as it may not survive stochastic events such as a long drought period or disease. The conservation of large, intact areas of habitat for the species in the Regional Park is considered an adequate conservation measure for the long term viability of the species on the SMP.

- b) *In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,*

There are no populations of this species listed as endangered under the TSC Act.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(iii) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

(iv) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

- d) *In relation to the habitat of a threatened species, population or ecological community:*
- (iv) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
  - (v) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
  - (vi) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

A total of 15.56 ha of marginal potential habitat will be removed on the subject site. Additionally, the development of the subject land will remove up to 31ha of potential habitat. It can therefore be assumed that all of the potential habitat for this species on the subject site will be removed or substantially modified as a result of the proposed development.

The potential habitat for this species occurs in patches fragmented from larger occurrences in the Regional Park. Any significant trees or patches of understorey that are retained within the subject site will remain isolated from the Regional Park.

The habitat to be removed, modified or isolated as a result of the proposed development may be important to the long-term survival of the species within the locality. However, areas of known high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

No critical habitat for this species has currently been identified by the Director-General of the OEH.

- f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

The Recovery Plan for the Cumberland Plain states that the main actions required for the recovery of the associated species include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best quality areas of habitat in the SMP will be conserved within the Regional Park, adding to the



protected area network with opportunity to deliver best practice management. The consistency of the proposal with the Recovery Plan for the Cumberland Plain is discussed in detail in Chapter 6.

The Cumberland Plain Recovery Plan (DECCW 2011) focuses primarily on vegetation

g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.*

Clearing of native vegetation resulting in the loss of habitat is a listed threatening process under the TSC Act. Small, degraded patches of potential habitat will be cleared for the proposed development. However, over 400ha of known habitat for the species will be contained within the Regional Park, which will be managed to improve fauna habitat on the SMP.

No other key threatening process that may be exacerbated by the proposed action will affect this species.

#### *Conclusion*

The proposed development is not likely to have a significant impact on the Cumberland Land Snail. The development of the subject site and the subject land will remove an area of habitat for this species. However, the proposed development is not likely to have a significant impact on Cumberland Land Snail such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected through a range of mitigation measures and retained in perpetuity.

### **8.3.3 *Microchiropteran Bats***

The following Assessments of Significance demonstrates apply to the following species of microchiropteran bats known to occur in the locality:

- Eastern Bentwing-bat (*Miniopterus orianae oceanensis* (formerly *schreibersii oceanensis*));
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- East-coast Freetail-bat (*Mormopterus norfolkensis*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Large-footed Myotis (*Myotis macropus*); and
- Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*).

The Eastern Bentwing Bat occurs along the east and north-west coasts of Australia. It roosts in caves, derelict mines, stormwater tunnels, buildings and other man-made structures. It forages above the canopy in forested areas. The Eastern Bentwing Bat forms maternity colonies in caves and populations usually centre on such caves (DEC (NSW), 2005c). The Eastern Bentwing Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee, 2004b).

The Eastern False Pipistrelle is found on the south eastern coast and ranges of Australia from southern Queensland to Victoria and Tasmania (DEC (NSW), 2005d). It prefers moist habitats and generally roosts in eucalypt hollows, but has been found under loose bark on trees or in buildings (DEC (NSW), 2005d). The Eastern False Pipistrelle is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee, 2004c).

The East-coast Freetail Bat occurs from southern Queensland to southern NSW, in dry sclerophyll forest and woodland. It roosts in tree hollows and sometimes under bark or in man-made structures (DEC (NSW), 2005e). The East-coast Freetail Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee, 2004d).

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW (DEC (NSW), 2005h). This species roosts in caves, crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features (DEC (NSW), 2005h). This species is found in well-timbered areas containing gullies. The Large-eared Pied Bat is listed as Vulnerable on Schedule 2 of the TSC Act and Vulnerable under the EPBC Act.

The Large-footed Myotis occurs in coastal areas from north western Australia to south western Victoria (DEC (NSW), 2005i). It roosts close to water in caves, mine shafts, tree hollows, stormwater channels, buildings, under bridges and in dense foliage. It forages over streams and pools by raking its feet across the surface for insects and small fish (DEC (NSW), 2005i). The Large-footed Myotis is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee, 2004i).

The Greater Broad-nosed Bat occurs from the Atherton Tableland to north eastern Victoria in gullies and river systems that drain the Great Dividing Range. It roosts in tree hollows and sometimes in buildings. It occurs in woodland to moist and dry eucalypt forest and rainforest but is most common in tall wet forest (DEC (NSW), 2005f). The Greater Broad-nosed Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee, 2004f).

The Yellow-bellied Sheathtail Bat is a large species of microchiropteran bat that is characterised by rich shiny black fur on the back and contrasting bright white or yellow fur on the belly (Churchill, 1998). It occurs across northern and eastern Australia but it is a rare visitor in the southern parts of this range, including Victoria, south western NSW and eastern South Australia. It roosts in tree hollows and buildings and forages in most habitats (DEC (NSW), 2005m). The Yellow-bellied Sheathtail Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee, 2004m).



- a) *In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.*

There is very limited potential roosting habitat for the hollow-dwelling species of these microchiropteran bats in the study area and no potential roosting habitat for cave-dwelling species. These species are likely to primarily utilise the study area as foraging habitat as part of a larger range. Potential habitat will be retained in the Regional Park, where extensive areas of roosting and foraging habitat are located. As 900ha of potential roosting and foraging habitat will be conserved within the Regional Park, it is not likely that the proposal will affect the life cycle of these species such that a viable local population is placed at risk of extinction.

- b) *In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,*

There are no populations of these species listed as endangered under the TSC Act.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

- (i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

- d) *In relation to the habitat of a threatened species, population or ecological community:*

- (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

All of the known and potential habitat for these species on the subject site will be removed or substantially modified as a result of the proposed development.

The potential habitat for these species in the study area occurs in patches isolated from larger occurrences in the Regional Park. Any significant trees or patches of understorey that are retained within the subject site will remain isolated from the Regional Park.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of these species within the locality. Areas of high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

No critical habitat for these species has currently been identified by the Director-General of the OEH.

- f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

No recovery plan has been prepared for these species.

No threat abatement plans are relevant to these species.

- g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.*

Clearing of native vegetation and Loss of hollow-bearing trees are listed key threatening processes under the TSC Act. No old-growth trees with hollows were recorded and limited mature trees occur on the subject site, which would provide foraging and potential roosting habitat, may be removed for the proposed development. However 900 ha of vegetation, including hollow bearing trees, will be conserved within the Regional Park. Future management of the Regional Park will also be designed to protect fauna habitats. The extent of clearing proposed is therefore not considered to be a threat to microchiropteran bat species in the precinct.

No other key threatening process that may be exacerbated by the proposed action will affect these species.

#### *Conclusion*

The proposed development will not have a significant impact on threatened microchiropteran bats.

### **8.3.4 Grey-headed Flying-fox**

The Grey-headed Flying-fox is found along the east coast of Australia from Bundaberg to Melbourne. It occurs in subtropical and temperate rainforests, tall sclerophyll forest and woodlands, heaths, swamps, gardens and orchards. The species roosts in camps with high site fidelity. The Grey-headed Flying-fox is threatened by loss of foraging habitat,



disturbance to camps, unregulated shooting and electrocution on power lines (DEC (NSW), 2005g). It is listed as vulnerable under the TSC Act and the EPBC Act (NSW Scientific Committee, 2004g).

- a) *In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.*

The study area consists only of potential foraging habitat for the Grey-headed Flying-fox as this species roosts in camps, the locations of which are well-known in the Sydney region. No camps occur on the SMP. The proposed development is unlikely to place a local population of the species at risk of extinction as it will result in the removal of a small area of low quality foraging habitat.

- b) *In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,*

There are no populations of this species listed as endangered under the TSC Act.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

- (i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

- d) *In relation to the habitat of a threatened species, population or ecological community:*

- (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

All of the known and potential habitat for this species on the subject site will be removed or substantially modified as a result of the proposed development.

The potential habitat for this species in the study area occurs in patches isolated from larger occurrences in the Regional Park. Any significant trees or patches of understorey that are retained within the subject site will remain isolated from the Regional Park.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the species within the locality. Areas of high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

No critical habitat for this species has currently been identified by the Director-General of the OEH.

f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

No recovery plan has been prepared for this species. No threat abatement plans are relevant to the species.

g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.*

Clearing of native vegetation is a listed key threatening process under the TSC Act. A relatively small number of mature eucalypt trees occur on the subject site, which provide potential foraging habitat, will be removed for the proposed. However 900 ha of vegetation, will be conserved within the Regional Park. Future management of the Regional Park will also be designed to protect fauna habitats. The extent of clearing proposed is therefore not considered to be a threat to the Grey-headed Flying-fox in the precinct.

No other key threatening process that may be exacerbated by the proposed action will affect this species.

#### *Conclusion*

The proposed development will not have a significant impact on the Grey-headed Flying-fox.



## Additional Information

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### 9.1 Qualifications and Experience

The Cumberland Ecology staff involved with the compilation of this SIS have many years of experience in ecology, flora and fauna assessments and threatened species legislation. The sub-consultants are specialist in their area of expertise. The details of the qualifications of key Cumberland Ecology staff involved in the preparation of this SIS, and relevant sub-consultants, are provided in Appendix F.

#### ***9.1.1 Other Approvals Required for the Development or Activity***

The proposal will be assessed under Part 4 of the Environmental Planning and Assessment Act 1979. Penrith City Council will be the consent authority for the proposal. The development application will be lodged concurrently with this SIS.

The development of the SMP has been assessed by the Commonwealth under the provisions of the Environment Protection (Impacts of Proposals) Act 1974. Associated certification of related actions under the Environmental Reform (Consequential Provisions) Act 1999 has also been granted.

#### ***9.1.2 Licence Matters***

The actions necessitate the clearing of land and the removal of threatened plant species. These actions are permitted with the approval of licence applications under State and Commonwealth legislation. The following licence applications are to be submitted concurrently with this SIS:

- EPBC Permit (Section 201) – Licence to kill, injure, take, trade, keep or move a listed threatened species or ecological community.

Cumberland Ecology currently holds the following licences:

- Scientific licence (Section 132 C) (National Parks and Wildlife Act 1974)

#### ***9.1.3 Section 110 (5) Reports***

Impact assessment was conducted after due consideration for the Environmental Impact Assessment Guidelines for relevant threatened species and the condition of potential habitats in the study area. Section 110 (5) reports utilised in preparation of this SIS are included in the References section below.

## Conclusion

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The proposed development of the subject site will remove a small area of habitat for CPW, predominantly in the form of low diversity Derived Native Grassland, totalling an area of 11.69 ha of vegetation, along with some patches of regenerating CPW totalling an area of 3.87 ha and Freshwater Wetlands, totalling an area of 0.06 ha. However, and with due consideration of the restricted distribution of this CEEC in the region, the proposed development is not likely to have a significant impact on CPW such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected and enhanced through a range of mitigation measures identified and retained in perpetuity.

The major affected (C)EECs/species impacted by the proposed development includes *P. parviflora*, and the Cumberland Land Snail. The low diversity Derived Native Grassland on the subject land provides an area of marginal habitat for these threatened species. However, when directly compared with the habitats of the Regional Park, this area of habitat is considered to be degraded and of a lesser importance due to the increased level of disturbance, sparse nature and is comparatively small in size. Therefore, the loss of this habitat in the subject site and subject land is not considered to be significant.

The impact of the proposal will be more than balanced by the major conservation outcome resulting from the creation of the 900ha Regional Park. The Regional Park comprises CPW of quality and scale in a consolidated land holding, to be transferred into public ownership and subject to a Plan of Management.

When weighed against the conservation benefits, both direct and indirect, that will be derived from the 900ha Regional Park, together with the various mitigation measures afforded by the management strategies for weeds, feral and domestic animals and macrofauna, the relatively small areas of natural and semi-natural vegetation to be cleared as a result of the proposal are considered to be of minor consequence. The proposal is unlikely to result in any threatened species or ecological community becoming extinct. Known occurrences of threatened flora and fauna within the SMP are predicted to be secure in the long term as a result of the creation of the 900ha Regional Park and numerous supporting mitigation measures that are enshrined in the legal, statutory planning framework.



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*Appendix A*

# Director General's Requirements

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**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
1 FORM OF THE SPECIES IMPACT STATEMENT		
	1.1 A species impact statement must be in writing (Section 109 (1))	The SIS is written
	1.2 A species impact statement must be signed by the principal author of the statement and by:	Refer to page i
	a. the applicant for the licence, or	
	b. if the species impact statement is prepared for the purposes of the Environmental Planning and Assessment Act 1979, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires) Section 109(2)).	
	The applicant or proponent must sign the following declaration: "I...[insert name], of ..[address], being the applicant for the development consent...[insert DA number, Lot & DP numbers, street, suburb and LGA names] have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the proposal."	
2. CONTEXTUAL INFORMATION		
The description must include information of the following forms or types:	2.1 Description of proposal, subject site and study area  The following are further requirements related to your obligation under Section 110(1) to address the following:	Ref to Section 2.2.



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout</p> <p>A comprehensive description of the nature, extent and timing of all components and associated or consequent actions of the proposal must be provided, including actions that have effects both on and off the subject land as a result of the proposal. These actions detailed must include, but are not to be restricted to construction or ongoing use and maintenance of proposed:</p> <ul style="list-style-type: none"> <li>• buildings or other structures</li> <li>• utilities such as for sewage, electricity, gas or water</li> <li>• access routes;</li> <li>• dams/ponds, pipes/channels or other infrastructure for drainage, waste water/effluent management or erosion control</li> <li>• any structure or activity that may change surface or subterranean water movements</li> <li>• wastewater disposal</li> <li>• bush fire hazard reduction and protection measures, such inner and outer protection areas of asset protection zones (APZs), etc.</li> <li>• landscaping.</li> </ul>	
	<p>2.2 Land tenure information</p> <p>A legal description of the land (lot and deposited plan numbers) and information about the land tenure across the study area must be provided.</p>	Ref to Section 2.3.
	<p>2.3 Vegetation</p> <p>Vegetation present within the locality must be mapped and described. The descriptions</p>	Ref to Section 2.4.

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>should refer to:</p> <ul style="list-style-type: none"> <li>• Scientific Committee determinations (<a href="http://www.environment.nsw.gov.au/committee/ListOfScientificCommitteeDeterminations.htm">http://www.environment.nsw.gov.au/committee/ListOfScientificCommitteeDeterminations.htm</a>;</li> <li>• The OEH Vegetation Types Database (<a href="http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm">http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm</a>); and.</li> <li>• The Cumberland Plain vegetation mapping. (<a href="http://www.environment.nsw.gov.au/surveys/CumberlandPlainVegetationMappingProject.htm">http://www.environment.nsw.gov.au/surveys/CumberlandPlainVegetationMappingProject.htm</a>;</li> </ul>	
	<p>2.4 Plans and maps</p> <p>An aerial photograph or reproduction of such a photograph (preferably colour), of the locality, indicating scale and clearly delineating the subject site must be provided.</p> <p>A map or maps must be provided, showing:</p>	<p>Ref to page 2.16 for a list of Figures in each chapter of this SIS.</p>
	<p>i. in the locality,</p> <ul style="list-style-type: none"> <li>• any locally significant areas for threatened biodiversity.</li> <li>• the locations and types of vegetation and cleared areas (with reference to the description required in section 2.3).</li> </ul>	
	<p>ii. in the study area,</p> <ul style="list-style-type: none"> <li>• the location, size and dimensions of the study area.</li> <li>• the full extent of the proposed works as described in section 2.1 at a scale of not less than 1:1000.</li> <li>• the locations and types of vegetation and cleared areas (with reference to the description required in section 2.3).</li> </ul>	



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<ul style="list-style-type: none"> <li>• the current activities/usage of this land.</li> </ul>	
	All maps must indicate scale and have an explanatory legend of any symbols used.	
	<p>2.5 Threatened Species</p> <p>A list of all the threatened species or populations found in the database searches referred to in Section 3.1.1.</p>	Refer to table 3.1 and Figures 3.1 and 3.2.
3 INITIAL ASSESSMENT	<p>The following are further requirements related to your obligation under Section 110(2)(a) to address the following:</p> <p>a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action.</p> <p>and the requirements under Section 110(3)(a) to address the following:</p> <p>a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action</p>	
	3.1 Identifying subject threatened species, populations and ecological communities ('subject species')	Refer to Chapter 3.
	<p>3.1.1 Assessment of available information</p> <p>In determining the species, populations and ecological communities likely to be present (the subject species) consideration must be given to the records and known distribution of species and to habitat types present within the study area. OEH recommends that a comprehensive habitat assessment across the whole site, identifying key habitat features for both flora and fauna, should first be conducted, following the guidelines at <a href="http://www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm">www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm</a> be used.</p>	Ref to Chapter 3.

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>Additionally, the OEH threatened species profiles, any available recovery plans and or draft recovery plans, and vegetation assessment and mapping by State or local government agencies must be consulted. Specific fauna information regarding bushland that encompasses the site may be found in OEH's Rapid Fauna Habitat Assessment of the Sydney Metropolitan CMA Area (DECC 2008, <a href="http://www.sydney.cma.nsw.gov.au/component/option,com_repository/Itemid,116/func,select/id,40">www.sydney.cma.nsw.gov.au/component/option,com_repository/Itemid,116/func,select/id,40</a>). For obtaining known records flora and fauna databases such as the OEH Atlas of NSW Wildlife, as well as those held by local governments, the Australian Museum, CSIRO, Forests NSW and the Botanic Gardens Trust Sydney should be consulted to assist in compiling the list. Note that the OEH Atlas only holds records for which OEH is the custodian and does not include records held in other databases, and the conditions of data licences or data exchange agreements prevent OEH from distributing such information. In many cases, OEH Atlas may only contain a small subset of available data. Hence, other databases must also be consulted to make an adequate determination of subject species. Additionally, the OEH web site version of the Atlas does not provide all held records and does not provide all records with accurate location information.</p> <p>Use of the BioBanking Credit Calculator (<a href="http://www.environment.nsw.gov.au/biobanking/calculator.htm">www.environment.nsw.gov.au/biobanking/calculator.htm</a>) is also recommended to supplement the list of threatened species that possibly occur on the site (see guidelines at <a href="http://www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm#4">www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm#4</a>).</p> <p>In determining the subject species, any available recovery plans or draft recovery plans, and vegetation assessment and mapping by State or local government agencies must be consulted.</p> <p>The following vulnerable, endangered or critically endangered species should be</p>	



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	considered as a subject species:	
Species Lists		
	<p>These lists are not exhaustive. One of the roles of the SIS is to determine which species may be utilising the study area given the limitations of existing databases. Also be aware that additional species, populations, and ecological communities could be added to the schedules of the TSC Act between the issue of these requirements and the granting of consent. If this occurs, these additional entities will need to be addressed in the SIS and considered by the consent, determining, or concurrence authority. This requirement does not apply to the listing of a vulnerable ecological community (s5D EP&amp;A Act). This requirement does not apply to the new listing of a vulnerable species unless the development application has not been determined by the consent authority within the period of 12 months after the date the application was made (s.105A EP&amp;A Act).</p>	
4 SURVEY		
	<p>4.1 Requirement to survey</p> <p>Targeted surveys for subject species and their habitats must be undertaken</p> <ul style="list-style-type: none"> <li>• within the study area to provide information on distribution, population/sub-population sizes and density, and area of habitat (known and potential), noting variations across the study area.</li> <li>• within the locality to provide information on distribution, population/sub-population sizes, and area of habitat (known and potential).</li> </ul> <p>This data is necessary to support the impact assessment requirements of section 5 and factors (a) and (d) of the assessment of significance.</p> <p>The techniques and timing of these surveys should be commensurate with the</p>	<p>Ref to Chapter 4, Sections 4.1 – 4.2.</p>

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>biology/ecology of these species and ecological communities in order to maximise the likelihood and accuracy of detection. Survey requirements for certain species are identified in section 4.3. Guidance on appropriate methodologies and level and timing of survey efforts for some other species can be obtained from OEH's Threatened Species Survey and Assessment Guidelines (<a href="http://www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm">www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm</a>), environmental impact assessment guidelines (see section 9.4), draft or approved recovery plans (see section 9.4), scientific or environmental management journals, biodiversity surveys and other sources. The information required to identify the type of impacts and assess their significance on threatened species is the key determinant for the level of survey effort required.</p> <p>Specific survey requirements for certain species, populations and ecological communities are identified in section 4.3.</p> <p>Any modifications to the recommended or required survey methods or levels of survey effort require justification of their adequacy. This justification should be scientifically valid and refer to relevant scientific literature. Previous surveys (yours or others) can contribute to fulfilling the requirements of section 4, but only if they have been conducted and documented in accordance with the provisions specified in that section, e.g. with respect to the type, location, duration, spacing/density, appropriate season and weather conditions, etc. of the surveys. Documentation and mapping of these attributes, as required by section 4.2, applies equally to any previous surveys used. The currency of any previous surveys used to fulfill these requirements is a matter that will need to be considered by the consent authority in determining the adequacy of the SIS.</p> <p>Species of taxonomic uncertainty must have their identification confirmed by a recognised</p>	



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	authority such as the Australian Museum or National Herbarium at the Royal Botanic Gardens, Sydney.	
	4.2 Documentation	
	<p>4.2.1 Description of survey techniques and survey locations</p> <p>Survey technique(s) must be described and, where possible, a reference supporting the survey technique employed is to be provided.</p> <p>The size, orientation and dimensions of plots, transects or other sampling units should be clearly documented for each type of survey technique undertaken. Full AMG grid references for the survey site(s) should be noted. Survey site(s) should be shown on a map or maps, at a scale of not less than 1:2000, which indicate scale and have an explanatory legend of all information shown and symbols used.</p>	Refer to Section 4.2.
	<p>4.2.2 Documenting survey effort and results</p> <p>Each and every survey must be documented.</p> <p>Name(s) of surveyor(s) and other personnel must be recorded. Other persons who identified records (e.g., by analysis of Anabat recordings, hair tubes, scats) should also be named.</p> <p>The date and time and environmental conditions experienced during each survey must be documented.</p> <p>Survey proformas for a range of standard fauna survey techniques can be provided separately by email from the nominated contact officer upon request. These forms have provision for the types of information required to be documented. These or equivalent forms must be used by field staff when undertaking fauna surveys. Completed data sheets are to be included as an appendix to the SIS.</p>	Ref to Section 4.3-4.5.

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>Additionally, the time invested in applying each different survey technique – e.g. number of person hours/transect, duration of call playback, number of nights traps set – must be summarised in the SIS. It is not sufficient to document only the aggregate time spent on all survey techniques combined.</p> <p>Any limitations (e.g. denied access to private land) to sampling across the study area are to be documented.</p>	
	<p>4.2.3 Description and mapping of results of vegetation, flora and fauna surveys</p> <p>The locations of any newly recorded threatened species or endangered populations resulting from additional surveys must be mapped and described. The mapping of vegetation required under section 2.3 must reflect any new information resulting from additional surveys.</p>	<p>Refer to Section 4.3 and Figures 4.3 and 4.4.</p>
<p>5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES AND POPULATIONS</p>	<p>Assessment of impacts must consider the nature, extent and timing of the proposal and all associated actions, including but not restricted to construction, provision and ongoing maintenance of approved or proposed:</p> <ul style="list-style-type: none"> <li>buildings or other structures;</li> <li>utilities such as for sewage, electricity, gas or water;</li> <li>routes for access and egress; dams and associated infrastructure;</li> <li>pipelines;</li> <li>drainage infrastructure and changes made to surface water flows;</li> <li>bush fire hazard reduction and protection measures;</li> <li>landscaping; and</li> <li>ongoing maintenance</li> </ul>	<p>Refer to Chapter 5.</p>



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>Assessment must include the direct and indirect impacts of these activities which may occur both on or off the subject land.</p> <p>To assess the impacts from the provision bushfire protection (e.g. if there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland), proponents should consider recommendations in 'Planning for Bushfire Protection' (NSW Rural Fire Service 2006) and consider the use of siting required access roads around the roads as an option to meet those requirements but reduce impacts on retained bushland.</p>	
	<p>5.1 Assessment of species likely to be affected</p> <p>The following are further requirements related to your obligation under Section 110(2)(b) to address the following:</p> <p>an assessment of which threatened species or population known or likely to be present in the area are likely to be affected by the action.</p> <p>This requires you to refine the list of subject threatened species and populations (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or endangered populations may be affected directly or indirectly (including cumulatively), by the proposal. This is to be done taking account of the requirements outlined previously in section 4 of these requirements and information in any relevant Scientific Committee determinations, OEH threatened species profiles, recovery plans or draft recovery plans, and vegetation assessment and mapping. Detailed rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the species does not occur in the study area, or if not resident, will not utilise habitats on site on occasion, or if off-site, be</p>	<p>Refer to Sections 4.5 and 5.2.</p>

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>influenced by off-site impacts of the activity, that species does not have to be considered further. Otherwise all species/populations likely to occur in the study area (based on general species distribution information), and known to utilise those habitat types, should be assessed as if they are present.</p> <p>The requirements in the remainder of this section need only be addressed for those species that are likely to be affected by the proposal. Subsequently this information should be used in an Assessment of Significance (as required in section 8) for each of those species or populations.</p>	
	<p>5.2 Discussion of local and regional abundance and distribution</p> <p>The following are further requirements related to your obligation under Section 110(2)(d) to address the following:</p> <p>an estimate for the local and regional abundance of those species or populations</p>	Refer to Section 5.3.
	<p>5.2.1 Discussion of other known local populations</p> <p>A discussion of other known populations in the locality must be provided. An estimate of the numbers of individuals of each threatened species or population utilising the area and the relative significance of the population(s) in the study area to the populations in the locality must be included.</p>	Refer to Section 5.3.
	<p>5.3 Assessment of habitat</p> <p>The following are further requirements related to your obligation under Section 110(2)(f) to address the following:</p> <p>a full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region (Section 110 (2)(f)).</p>	Refer to Section 5.3.



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>5.3.1 Description of habitat values</p> <p>Specific habitat features must be described (e.g. frequency and location of stags, hollow bearing trees, culverts, rock shelters, rock outcrops, crevices, caves, drainage lines, soaks etc) and the density of understorey vegetation and groundcover.</p> <p>The condition of the habitat within the study area must be discussed, including the prevalence of introduced species, species of weeds present and an estimate of the total weed cover as a percentage of each vegetation community, whether trampling or grazing is apparent, effects of erosion, prevalence of rubbish dumping, history of resource extraction or logging and proximity to roads.</p> <p>Details of the subject site's fire history (eg frequency, time since last fire, intensity) and the source of fire history (eg observation, local records), must be provided.</p> <p>OEH's Rapid Fauna Habitat Assessment of the Sydney Metropolitan CMA Area (DECC 2008, <a href="http://www.sydney.cma.nsw.gov.au/component/option,com_remository/Itemid,116/func,select/id,40">www.sydney.cma.nsw.gov.au/component/option,com_remository/Itemid,116/func,select/id,40</a>) is a source of information that should be referred to in meeting this requirement.</p>	<p>Refer to Sections 4.3 and 5.3.</p>
	<p>5.3.2 Discussion of habitat utilisation</p> <p>A discussion of how individuals use the area (eg residents, transients, adults, juveniles, nesting, foraging) and discussion of the significance of the habitat of the study area to the viability of the threatened species or endangered population in the locality must be included.</p>	
	<p>5.4 Discussion of conservation status</p> <p>The following are further requirements related to your obligation under Section 110(2)(c) to address the following:</p>	<p>Refer to Section 5.5.</p>

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>for each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it</p> <p>and to your obligation under Section 110(2)(e) to address the following:</p> <p>an assessment of whether those species or populations are adequately represented in conservation reserves (or other similar protected areas) in the region</p> <p>and to your obligation under Section 110(2)(e1) to address the following:</p> <p>an assessment of whether any of those species or populations is at the limit of its known distribution</p> <p>The relative significance of the subject site for threatened species or endangered populations in the locality must be discussed. In particular, discussion of other known populations must be provided. Such an assessment must consider and compare the differences in the type, condition, and tenure and long-term security of other areas of known habitats in the locality with those in the study area.</p> <p>The discussion must also relate to the threatening processes (see section 6.4.4) that affect the conservation status of the ecological community.</p> <p>Known occurrences in the locality and region of the extinction or degradation of local populations of each affected threatened species or population and of fragmentation, decrease in extent or degradation of its habitat should be documented.</p>	
	5.5 Discussion of the likely effect of the proposal at local and regional scales	Refer to Section 5.6.
	5.5.1 Significance within a local context The significance of impacts in the study area for conservation of affected threatened	Refer to Section 5.6.2.



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>species or endangered populations in the locality must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in the type, condition, and the tenure and long-term security, of other areas of known habitats in the locality with those in the study area.</p>	
	<p>5.5.2 Discussion of connectivity</p> <p>The potential of the proposal to increase fragmentation of the habitat or decrease the ability for movement of individuals and/or gene flow between habitats or populations of a threatened species or population must be appraised.</p>	<p>Refer to Section 5.6.</p>
	<p>5.5.3 Consideration of threatening processes</p> <p>Assessment of effects must not be limited only to threats that are recognised as key threatening processes, but must include other threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or exacerbated by the proposal. Assessment should also include consideration of information in the Priorities Action Statement and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.</p>	<p>Refer to Section 5.6.4.</p>
	<p>Description of feasible alternatives</p> <p>The following are further requirements related to your obligation under Section 110(2)(h) to address the following:</p> <p>a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development.</p> <p>Where a Statement of Environmental Effects, Environmental Impact Statement or Review</p>	

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF as long as the document referred to is provided with the SIS.</p> <p>The SIS must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.</p>	
<p>6 ASSESSMENT OF LIKELY IMPACTS ON THREATENED ECOLOGICAL COMMUNITIES</p>	<p>Assessment of impacts must consider the nature, extent and timing of the proposal and all associated actions, including but not restricted to construction, provision and ongoing maintenance of approved or proposed:</p> <ul style="list-style-type: none"> <li>buildings or other structures;</li> <li>utilities such as for sewage, electricity, gas or water;</li> <li>routes for access and egress;</li> <li>dams and associated infrastructure;</li> <li>pipelines;</li> <li>drainage infrastructure and changes made to surface water flows;</li> <li>bush fire hazard reduction and protection measures;</li> <li>landscaping; and</li> <li>ongoing maintenance</li> </ul> <p>Assessment must include the direct and indirect impacts of these activities which may occur both on or off the subject land.</p> <p>To assess the impacts from the provision bushfire protection (e.g. if there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland), proponents should consider recommendations in 'Planning for Bushfire Protection' (NSW</p>	<p>Refer to Section 5.1.</p>



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>Rural Fire Service 2006) and consider the use of siting required access roads around the roads as an option to meet those requirements but reduce impacts on retained bushland.</p>	
	<p>6.1 Assessment of critically endangered or endangered ecological communities likely to be affected</p> <p>The following are further requirements related to your obligation under Section 110(3)(a) to address the following:</p> <p>a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action.</p> <p>This requires you to refine the list of subject ecological communities (given the outcome of survey and analysis of likely impacts) in order to identify which critically endangered or endangered ecological communities (C/EECs) may be affected, directly or indirectly (including cumulatively), by the proposal. This must include reference to the ecological community as described by the NSW Scientific Committee, and to the requirements outlined previously in section 4 of these requirements, and take into account information any relevant C/EEC profile, recovery plan or draft recovery plan, and vegetation assessment and mapping. Adequate rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the C/EEC does not occur in the study area, or will not utilise habitats on site, or if off-site, be influenced by off-site impacts of the activity, that C/EEC does not have to be considered further. Otherwise all C/EECs likely to occur in the study area (based on general distribution information), and known to occupy those habitat types, should be assessed as if present.</p> <p>The requirements in the remainder of this section need only be addressed for those</p>	<p>Refer to Section 5.2.</p>

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	C/EECs that are likely to be affected by the proposal.	
	<p>6.2 Description of habitat</p> <p>The following are further requirements related to your obligation under Section 110(3)(c) to address the following:</p> <p>a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region.</p>	Refer to Section 5.3.
	<p>6.2.1 Study area</p> <p>An assessment of habitat the study area is required to include:</p> <p>a description of each C/EEC, including:</p> <ul style="list-style-type: none"> <li>• a description those areas where the community may only be represented by soil stored seed with no or few above-ground components, and</li> <li>• description of disturbance history and recovery capacity. If the site shows signs of disturbance, details should be provided of the site's disturbance history. An assessment should be made of the ability of the ecological community to recover to a state representative of its pre-disturbance condition. This assessment will include consideration of the site's in-situ and migratory resilience and will be accompanied by a map of the recovery capacity of the ecological community across the site. Consideration should be given to the results (preliminary or otherwise) of restoration projects being undertaken at other sites that contain the ecological community when assessing its recovery capacity.</li> </ul> <p>comparison of the affected community with the C/EEC as determined by the NSW Scientific Committee.</p> <p>reference to any relevant available recovery plans or draft recovery plans and vegetation</p>	Refer to Section 5.4.



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>assessment and mapping.</p> <p>maps, consistent with the descriptions provided, showing of the extent and condition of the C/EEC.</p>	
	<p>6.2.2 Locality</p> <p>A discussion of other occurrences of each C/EEC populations in the locality must be provided. This must include:</p> <p>a comparison of other known occurrences and their habitats with those of the study area in terms of remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances).</p> <p>the tenure and long-term security of other occurrences and its habitat.</p> <p>the relative significance of the subject site for each C/EEC in the locality and region.</p>	<p>Refer to Section 5.3.</p>
	<p>6.3 Discussion of conservation status</p> <p>The following are further requirements related to your obligation under Section 110(3)(b) to address the following:</p> <p>for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or any threat abatement plan applying to it</p> <p>The following are further requirements related to your obligation under Section 110(3)(b1) to address the following:</p> <p>an assessment of whether those ecological communities are adequately represented in conservation reserves (or other similar protected areas) in the region</p> <p>The following are further requirements related to your obligation under Section 110(3)(b2)</p>	<p>Refer to Section 5.5.</p>

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>to address the following:</p> <p>an assessment of whether any of those ecological communities is at the limit of its known distribution</p> <p>The relative significance of the subject site for each C/EEC in the locality must be discussed. In particular, discussion of other known occurrences of each affected C/EEC must be provided. Such an assessment must consider and compare the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the locality with those in the study area.</p> <p>The discussion must also relate to the threatening processes (see section 6.4.4) that affect the conservation status of the ecological community.</p> <p>Known occurrences in the locality and region of fragmentation, decrease in extent or degradation of each C/EEC or its habitat should be documented.</p>	
	6.4 Discussion of the likely effect of the proposal at local and regional scales	Refer to Section 5.3.
	<p>6.4.1 Significance within a local context</p> <p>The significance of impacts in the study area for conservation of affected C/EEC in the locality must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the locality with those in the study area.</p>	Refer to Section 5.3.
	6.4.2 Extent of habitat removal or modification	Refer to Section 5.6.



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>The location, nature and extent of habitat removal or modification which may result from the proposed action including the cumulative loss of habitat from the study area (including all proposed DAs and those areas in the subject area already with development consent or identified for development) and the impacts of this on the viability of the C/EEC in the locality.</p> <p>This must include an assessment of the proportion of the C/EEC to be affected by the proposal, in relation to the total extent of the C/EEC, and the impact of this on the viability of the endangered ecological community at the local level.</p>	
	<p>6.4.3 Discussion of connectivity</p> <p>The potential of the proposal to increase fragmentation of each C/EEC, its relation to adjoining vegetation and to exacerbate edge effects or to decrease the ability for movement of individuals and/or gene flow between habitats must be discussed. The impact on habitats in the proximate reserved lands, must be discussed.</p> <p>If connectivity between adjacent remnants of C/EECs is likely to be affected, the impact of the proposal on connectivity must also be discussed.</p>	Refer to Section 5.6.
	<p>6.4.4 Consideration of threatening processes</p> <p>Assessment of effects must not be limited to threats that are determined to be key threatening processes', but must also include threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or exacerbated by the proposal. Assessment should also include consideration of information in the Priorities Action Statement and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.</p>	Refer to Section 5.6.
	6.4 Description of feasible alternatives	Refer to Section 5.7.

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>The following are further requirements related to your obligation under Section 110(3)(e) to address the following:</p> <p>a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development.</p> <p>Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF.</p> <p>The SIS must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.</p>	
<p>7 AMELIORATIVE AND COMPENSATORY MEASURES</p>		
	<p>7.1 Description of ameliorative measures</p> <p>The following are further requirements related to your obligation under Sections 110(2)(i) and 110(3)(f) to address the following:</p> <p>a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations [s.110(2)(i)] [or] ecological community [s.110(3)(f)] including a compilation (in a single section of the statement) of those measures.</p> <p>OEH strongly supports the view that development proposals should, in order of preference:</p>	<p>Refer to Chapter 6.</p>



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>i. Avoid any impacts;</p> <p>ii. Minimise on- and off-site impacts such that a significant impact is not likely.</p> <p>Measures proposed to avoid, reduce or ameliorate impacts should only be proposed where it can be clearly demonstrated that they have been successfully applied elsewhere. The likely efficacy of such measures with respect to the current proposal should be assessed in detail.</p>	
	<p>7.1.1 Long term management strategies</p> <p>Consideration must be given to developing long term management strategies to protect areas within the study area which are of particular importance for the threatened species or endangered populations likely to be affected. This may include proposals to restore or improve habitat on site where possible.</p>	Refer to Section 6.3.
	<p>7.1.2 Compensatory strategies</p> <p>Where the proposal will still result in loss to threatened species or habitats, strategies to compensate (offset) for the loss(es) should be considered. These may include other off-site or local area proposals that contribute to long term conservation of the threatened species.</p> <p>Any offsetting measures should be developed in accordance and be consistent with the "Principles for the Use of Biodiversity Offsets in NSW" (<a href="http://www.environment.nsw.gov.au/biocertification/offsets.htm">www.environment.nsw.gov.au/biocertification/offsets.htm</a>). OEH advocates use of the Biobanking Assessment Method (<a href="http://www.environment.nsw.gov.au/biobanking/assessmethodology.htm">www.environment.nsw.gov.au/biobanking/assessmethodology.htm</a>) which affords a transparent, consistent and scientifically-based method to inform the calculation of sufficient offset areas and appropriate management actions to ensure maintenance or</p>	Refer to Section 6.3.

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>improvement of threatened biota.</p> <p>Where such proposals involve other lands, or where the involvement of community groups is envisaged in such proposals, such groups are to be consulted and proposals should contain evidence of support from these stakeholders and from relevant land managers.</p> <p>Compensatory benefits likely to result from such measures proposed for alternative sites are to be discussed and evaluated along with a discussion of mechanisms of how they might best occur.</p>	
	<p>7.1.3 Translocation</p> <p>OEH does not consider the translocation of threatened species, populations or ecological communities to be an ameliorative measure for the purposes of considering impacts of a particular development/activity and translocation is usually only supported by OEH in specific conservation programs (e.g. recovery planning), but only as a last resort after in-situ conservation options have been exhausted.</p> <p>Translocation should only be considered following extensive investigation of alternative options to avoid and mitigate the impacts of the development and a demonstrated long term financial commitment by the applicant.</p>	<p>Translocation is not considered in this SIS or as part of the proposal.</p>
	<p>7.1.4 Ongoing monitoring</p> <p>Any proposed pre- or post-development monitoring plans of the effectiveness of the mitigation or compensatory measures must be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies which have not been proved effective should be undertaken under experimental design conditions and appropriately monitored.</p>	<p>Refer to Section 6.4.</p>



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
8. ASSESSMENT OF SIGNIFICANCE OF LIKELY EFFECT OF PROPOSED ACTION	Based on the detailed assessment and consideration of alternatives and/or ameliorative measures proposed in the SIS, a re-assessment of the significance of impact (section 5A EP&A Act) is to be carried out for each of the entities (threatened species, population or ecological community) identified in the SIS as being likely to be affected. This assessment must be carried out in accordance with the Threatened species assessment of significance guidelines (DECC 2007) ( <a href="http://www.environment.nsw.gov.au/threatenedspecies/tsaguide.htm">www.environment.nsw.gov.au/threatenedspecies/tsaguide.htm</a> ) and must incorporate the relevant information from sections 5.1 to 7 of these SIS requirements. For each entity an overall conclusion must be drawn as to whether the proposal is still considered likely to have a significant effect.	Refer to Chapter 7.
9 ADDITIONAL INFORMATION		
	<p>9.1 Qualifications and experience</p> <p>The following is your obligation under Sections 110(4) to address the following: a species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement</p>	Refer to Chapter 8, Section 8.1
	<p>9.2 Other approvals required for the development or activity</p> <p>The following are further requirements related to your obligation under Sections 110(2)(j) and 110(3)(g)) to address the following: a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population or ecological community</p>	Refer to Section 8.1
	Other approvals under NSW law	

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>In providing a list of other approvals the following must be included:</p> <ul style="list-style-type: none"> <li>• Where a consent is required under Part 4 of the Environmental Planning and Assessment Act 1979, the name of the consent authority and the timing of the development application should be included; or</li> <li>• Where an approval(s) is required under Part 5 of the Environmental Planning and Assessment Act 1979, the name of the determining authority(ies), the basis for the approval and when these approvals are proposed to be obtained should be included.</li> </ul>	
	<p>Approval under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)</p> <p>A development or action will require referral to, and may require the approval of, the Federal Minister for the Environment (in addition to any local or state government consent or approval) if that action will have, or is likely to have, a significant impact on the environment or on a matter of national environmental significance (NES matter). Threatened species and communities listed in the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) are considered to be matters of national environmental significance, as are migratory species and a number of other matters.</p> <p>It is the responsibility of the proponent to assess whether the development is likely to have a significant impact on an NES matter. Information regarding matters of national environmental significance and guidelines to assist whether to refer the action can be obtained from the Commonwealth Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) at <a href="http://www.environment.gov.au/epbc/protect/index.html">www.environment.gov.au/epbc/protect/index.html</a> or by contacting DSEWPC on (02) 6274 1111. A proponent can also make a referral if they are unsure whether approval is</p>	



**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<p>needed under the Act or if it needs certainty. To minimise delays in getting approvals under the Commonwealth and State processes, it is best, and in the interest of the proponent, if the development is referred early to DSEWPC's Environment Assessment Branch to obtain a decision on whether it is a controlled action before the SIS is exhibited under the EP&amp;A Act.</p>	
	<p>Further information regarding the operation of the EPBC Act in NSW can be found in the NSW Department of Planning and Infrastructure's website at <a href="http://www.planning.nsw.gov.au/SettingtheDirection/GovernmentAgreementsandForums/BilateralAgreementwiththeCommonwealth/tabid/283/language/en-AU/Default.aspx">www.planning.nsw.gov.au/SettingtheDirection/GovernmentAgreementsandForums/BilateralAgreementwiththeCommonwealth/tabid/283/language/en-AU/Default.aspx</a> and on the DEWHA website at <a href="http://www.environment.gov.au/epbc/assessments/bilateral/nsw.html">www.environment.gov.au/epbc/assessments/bilateral/nsw.html</a>.</p> <p>Further information regarding the operation of the EPBC Act in NSW can be found in the NSW Dept of Planning and Infrastructure's website at EPBC Act Guide to Implementation in NSW (available at <a href="http://www.planning.nsw.gov.au/environmentalassessment/comm.asp">www.planning.nsw.gov.au/environmentalassessment/comm.asp</a>) and on the DSEWPC website at <a href="http://www.environment.gov.au/epbc/assessments/bilateral/index.html">www.environment.gov.au/epbc/assessments/bilateral/index.html</a>.</p>	
	<p>9.3 Licensing matters relating to conducting surveys</p> <p>Persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. The relevant legislation and associated licences and approvals that may be required are listed below:</p> <p>National Parks and Wildlife Act 1974:</p> <ul style="list-style-type: none"> <li>• General Licence (Section 120) to harm or obtain protected fauna (this may include threatened fauna).</li> <li>• Licence to pick protected native plants (Section 131).</li> </ul>	<p>Refer to Section 8.1.2.</p>

**Table A.1 DGR COMPLIANCE TABLE**

Main Heading	Subsections	Our Response
	<ul style="list-style-type: none"> <li>• Scientific Licence (Section 132C) to authorise the carrying out of actions for scientific, educational or conservation purposes.</li> </ul> <p>Threatened Species Conservation Act 1995:</p> <ul style="list-style-type: none"> <li>• Licence to harm threatened animal species, and/or pick threatened plants and/or damage the habitat of a threatened species (Section 91).</li> </ul> <p>Animal Research Act 1985:</p> <ul style="list-style-type: none"> <li>• Animal Research Authority to undertake fauna surveys.</li> </ul>	
	<p>9.4 Section 110 (5) reports</p> <p>Section 110(5) of the Threatened Species Conservation Act 1995 has the effect of requiring OEH to provide that information it has regarding the State-wide conservation status of the subject species is made available, in order to satisfy ss.110(2) &amp; (3) of the Act. To this end, OEH provide this information via <a href="http://www.threatenedspecies.environment.nsw.gov.au">www.threatenedspecies.environment.nsw.gov.au</a>). Detailed species profiles and environmental impact assessment guidelines for threatened species, populations and ecological communities are available via this website.</p> <p>Proponents and consultants should note that OEH has no further published information available to satisfy s.110(5) of the Act and that purchase or receipt and use of the above profiles can be taken to have satisfied the requirements of ss.110(2) &amp; (3) in relation to the State-wide conservation status of the listed species, populations and ecological communities.</p>	<p>Refer to Section 8.1.3 and References Section.</p>



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*Appendix B*

Survey Effort

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**Table B.1 HISTORY OF SURVEY EFFORT ON THE SMP RELEVANT TO THE WESTERN PRECINCT**

Date	Author	Report	Location*	Flora Methods	Flora Effort	Fauna Methods	Fauna Effort
Oct-93	James, T.A.	Vegetation Survey - Australian Defence Industries St Mary's Facility	Regional Park (eastern section)	Inspected to identify plant communities and to compile a plant species list. Both native and the more significant exotic plant species were recorded.	Inspected on 3 occasions during August and September.	n/a	n/a
Jun-91	Gunninah Consultants	Fauna Survey - Australian Defence Industries (ADI) Site, St Mary's	Across the SMP (including Regional Park and Western Precinct)	n/a	n/a	Daytime searches for native animals in all vegetation communities. Record kept of all native bird species sighted, searches for cryptic species such as frogs and reptiles, and for indirect evidence of all native animals (diggings, footprints, burrows, scats, bones, scratchings etc) and recording sightings of	200 person hours of field survey over 8 days. Elliotts: 1200 trap nights, Harps: 26 trap nights, Pitfalls: 60 trap nights



**Table B.1 HISTORY OF SURVEY EFFORT ON THE SMP RELEVANT TO THE WESTERN PRECINCT**

Date	Author	Report	Location*	Flora Methods	Flora Effort	Fauna Methods	Fauna Effort
						animals. Elliott A trapping, live pitfall traps, harp-type bat traps, spotlight surveys.	
Aug-94	Gunninah Consultants	Environmental Review - Australian Defence Industries (ADI) Site, St Mary's					
Apr-95	Gunninah Consultants	Distribution of Endangered Flora: Pyro Park - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (eastern section)	A fixed, marked grid based on transect lines placed at 50m centres were surveyed for threatened flora species. Tagging was conducted until it was deemed not to be feasible. Transect surveys undertaken after this point.		n/a	n/a
Apr-95	Gunninah Consultants	Flora Survey: Bomb and North Bomb Sectors - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (central section)	Detailed walked surveys throughout the Bomb and North Bomb sites, describing and mapping the vegetation communities present,	Over a period of three days.	n/a	n/a

**Table B.1 HISTORY OF SURVEY EFFORT ON THE SMP RELEVANT TO THE WESTERN PRECINCT**

Date	Author	Report	Location*	Flora Methods	Flora Effort	Fauna Methods	Fauna Effort
				establishing a flora species inventory, and identifying plant species of conservation concern or interest.			
Aug-95	Gunninah Consultants	Fauna and Flora Issues - Australian Defence Industries (ADI) Site, St Mary's - Planning Study	Across the SMP (including Regional Park and Western Precinct)	Supplementary flora field surveys to provide more detailed vegetation community descriptions, to locate endangered plant species, and confirm the accuracy and consistency of available information. Quadrats surveyed.		n/a	n/a
Jan-96	Gunninah Environmental Consultants	Flora Survey: Ropes Creek Area - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (Ropes Creek Area)	Detailed walked surveys throughout the Ropes Creek Area, describing and mapping the vegetation communities present, establishing a flora species inventory, searching for and identifying plant species of conservation interest.		n/a	n/a



**Table B.1 HISTORY OF SURVEY EFFORT ON THE SMP RELEVANT TO THE WESTERN PRECINCT**

Date	Author	Report	Location*	Flora Methods	Flora Effort	Fauna Methods	Fauna Effort
Nov-96	Gunninah Environmental Consultants	Vegetation Communities - Australian Defence Industries (ADI) Site, St Mary's Facility	Across the SMP (including Regional Park and Western Precinct)	Quadrats (20m x 20m) were defined within each study area and were placed at 1ha intervals, except from those areas in which the community/floristic group varied within the range of 1ha. Dominant species from each stratum were recorded. Species of conservation significance recorded		n/a	n/a
Jan-97	Gunninah Environmental Consultants	Flora Survey: Northern Sector - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (Northern Sector)	Walked surveys throughout the Northern Sector describing and mapping the vegetation communities present. A flora species inventory was also established and plant species of conservation concern or interest were identified and located.	Surveyed for one day to compile a flora inventory identifying endangered plant species, native and exotic species.		

**Table B.1 HISTORY OF SURVEY EFFORT ON THE SMP RELEVANT TO THE WESTERN PRECINCT**

Date	Author	Report	Location*	Flora Methods	Flora Effort	Fauna Methods	Fauna Effort
Feb-99	Ian Perkins	Flora Assessment of the Disputed Areas of the Western Sydney Shale Woodlands	Regional Park (North western section and Western Precinct)	15 Quadrats (20x20m) in the north western section and western sections of the Regional Park, and in the Western Precinct. A flora species list was made for each quadrat.	15 quadrats surveyed over 5 days.	n/a	n/a
May-09	Cumberland Ecology	St Marys Property Western Precinct Stage 1A Development Application Flora and Fauna Assessment	Western Precinct	Transects with spot assessments to determine vegetation community type and vegetation condition	83 5x5m quadrats between 2007 and 2008	Bird transects, fauna habitat assessments, incidental fauna records throughout site	16 person hours targeted bird surveys
Apr-11	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct and Regional Park	Quadrats (20m x 20m) placed within the subject site, subject land and study area. Targeted searches throughout subject site, subject land and study area.	35 Quadrats, more than 200 ha of targeted threatened species searches	Daytime searches for native animals in all vegetation communities. Record kept of all native bird species sighted and for indirect evidence of all native animals (diggings, footprints, burrows, scats,	9 Person Hours Targeted Bird Transects, 6 nights Anabat survey, 300 trees with potential snail habitat.



**Table B.1 HISTORY OF SURVEY EFFORT ON THE SMP RELEVANT TO THE WESTERN PRECINCT**

Date	Author	Report	Location*	Flora Methods	Flora Effort	Fauna Methods	Fauna Effort
						bones, scratchings etc) and recording sightings of animals. 500m Bird transects within subject site, subject land and study area. Targeted snail searches at 15 sites, 5 within the Subject Land, each containing 20 sample trees. Anabat detectors within subject site, subject land and study area.	
Feb- 12	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct - Village 4	Quadrats (20m x 20m) and Targeted searches across subject site (Village 4).	4 Quadrats, approx 20 ha of targeted threatened flora searches	n/a	n/a

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	<i>Dillwynia tenuifolia</i>	Eastern section of RP. Common throughout eastern end of the ADI site, particularly in open sites within the Ironbark forest communities and along tracks.	Common	Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	<i>Dillwynia tenuifolia</i>	Eastern section of RP. Was found more widely over the eastern RP study area, and its occurrence appears to be highly correlated with sites of disturbance.	249 in 0.64ha of Section 3. Across all Pyro Park: approx range 1803 - 6075.	Two approaches. The first was to tag each individual specimen, however this approach was abandoned. The second approach was a transect-based survey of the specimens using the grid lines to be surveyed through the Pyro Park area. This involved botanists surveying transects and recording the densities of the



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						specimens. Four transects (100m long, spaced 25m apart-later to 50m). Plants were surveys at specified survey points (10m diameter: 78.5m <sup>2</sup> area) at 10m intervals along each transect, and the density of specimens was noted at a scale of 1-6 (1: 91-100, 2 = 50-90, 3=21-50, 4=5-20, 5=5-3, 6=2-1 plants per survey point).
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	<i>Dillwynia tenuifolia</i>	Northern Sector of RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Eastern section RP		Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Flora Survey Bomb & North Bomb Sectors	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Central section RP		Walked surveys throughout the Bomb and North Bomb sites establishing a flora species inventory and identifying plant species of conservation concern or interest. The study



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						sites were surveyed over a period of three days.
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - Flora Survey Ropes Creek Area	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Ropes Creek	Infrequent in area B. Commonly represented in area E (eastern portion)	Detailed walked surveys throughout the Ropes Creek study area. Involved establishing a flora species inventory and searching for and identifying plant species of conservation concern or interest.
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Northern Sector, western section, eastern section, central section RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon threatened flora and fauna	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Fenceline between Eastern and Ropes Creek Precincts, and Regional Park		The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2005	Cumberland Ecology	Eastern Precinct, St Marys Property - Flora and Fauna Assessment for a	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Eastern Precinct	In CRCIF: 83/ha (SE 64.55), estimated 747. In Remediated Areas: 308/ha (SE	Quadrats were placed to sample the vegetation communities present. Three 20 m x 20 m



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Residential Subdivision within Lot 4 in DP107944 (in DA 04-1669)			169.12), estimated 4928. Abundance in each quadrat - Q2:1; Q4:4.	quadrats were randomly placed in woodland and three quadrats were placed in disturbed/open areas and traversed.
2005	Cumberland Ecology	Letter: Eastern Precinct - Proposed subdivision DA - Stage 1(E) - Flora and fauna assessment. 9/6/05. To Rob Bennett.	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Located in Stage 1(e), Eastern Precinct.		Inspected the area covered by Stage 1(e) identifying any additional threatened species issues.
2005	Cumberland Ecology	Letter: Eastern Precinct - Proposed subdivision DA - Stage 1(F) - Flora and fauna assessment. 9/6/05. To Rob	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Located in Stage 1(f), Eastern Precinct.		Inspected the area covered by Stage 1(f) identifying any additional threatened species issues.

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Bennett.				
2005	Cumberland Ecology	Letter: Zone Substation Flora and Fauna Assessment; Ropes Creek Precinct, SMP.	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Zone Substation, Ropes Creek.	Less than 10 plants.	Inspected the area covered by the Zone Substation, Ropes Creek, identifying any additional threatened species issues.
2006	Cumberland Ecology	Flora and fauna assessment for future learning and community uses in the Eastern Precinct	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Eastern Precinct, proposed residual lots 17, 18, 20 and 21.	Exotic grassland = 57, Woodland = 78. Total = 135.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for a Private School in the Eastern	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Village North development area Eastern Precinct.	Approximately 100 to be removed.	A threatened species search was made concurrently with the general flora survey.



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Precinct				
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for Level 1 Park Earthworks in the Eastern Precinct.	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Eastern Precinct.	Approximately 200 on subject site.	A botanist surveyed Residue Lots 19, 20 and 21 and the surrounding Learning and Community sites, for the presence of threatened shrub species which are known to occur in large numbers in the Eastern Precinct and throughout the Regional Park
2006	Cumberland Ecology	Proposed Concrete Recycling Facility - Flora and Fauna Assessment	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Central Precinct stockpile.	Several specimens.	A threatened species search was made concurrently with the general flora survey.
2006	Cumberland Ecology	Ropes Creek Precinct - Biodiversity	<i>Grevillea juniperina</i> subsp	Ropes Creek Precinct.	Estimated that no more than 500 individuals	A targeted threatened flora survey was conducted within the

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Assessment	<i>juniperina</i>			precinct.
2006	Cumberland Ecology	St Marys Property - Penrith Local Government Area - Assessments of Significance of the impacts of long term macrofauna fencing upon threatened flora and fauna	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Fenceline between Central and Western Precinct, and Regional Park	34	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2008	Cumberland Ecology	St Mary Property - Western Precinct Biodiversity Assessment	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Western Precinct. Northern and southern margins of the Precinct. (See report for GPS locations)	Approximately 700. Populations of 60, 40, 410, 23, 50 and 120.	A targeted threatened flora survey was conducted within the precinct during the flora survey.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park	<i>Grevillea juniperina</i> subsp	Western Precinct northern section	Approximately 150.	A field survey of each area.



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	<i>juniperina</i>			
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Western Precinct northern section	Rarely in this section.	A field survey of each area.

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Environment Protection and Biodiversity Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Western Precinct northern section	Approximately 50.	A field survey of each area.
2008	Cumberland Ecology	St Marys Property	<i>Grevillea juniperina</i>	Central Precinct.	Approximately 1000.	A field survey of each area.



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	subsp <i>juniperina</i>			
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Regional Park (near Ropes Creek Precinct).	Approximately 1000.	A field survey of each area.

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999				
2003	ERM	Remediation Action Plan for the Eastern Sector of the St Marys Property - Flora & Fauna Assessment	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Eastern section RP		
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	cluster along north-western boundary of SMP	Over 30	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp	cluster along north-western boundary of SMP	Over 30	Targeted survey for threatened species that were known to be



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
			<i>juniperina</i>			present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	along fence line on western side of Western Precinct	Approximately 20	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Adjacent to creekline in Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Adjacent to creekline and enclosure fencing in Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Adjacent to creekline and enclosure fencing in Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Adjacent to creekline and enclosure fencing in Western Precinct	approximately 55	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Directly to the East of the drainage line, in the north west of the western precinct	Less than 10 plants	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Within regional park, adjacent to track	25 Pultenaea, 44 Grevillea	Targeted survey for threatened species that were known to be present or considered a possibility to be present.



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Grevillea juniperina</i> subsp <i>juniperina</i>	Within regional park	approximately 10 plants	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2006	Cumberland Ecology	St Marys Property - Penrith Local Government Area - Assessments of Significance of the impacts of long term macrofauna fencing upon threatened flora and fauna	<i>Marsdenia viridiflora</i> subsp <i>viridiflora</i>	Fenceline between Central and Western Precinct, and Regional Park	<30 on fenceline, >100 in Regional Park in immediate vicinity of fence.	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2007	Cumberland Ecology	Analysis of the responses of Cumberland Plain	<i>Marsdenia viridiflora</i> subsp	Exclosure plot 6Do and 6Eo.	Approximately 5 plants	Exclosure plot methodology.

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Woodland to grazing by macrofauna at St Marys - 2006-2007 Floristic and structural changes two years after grazing enclosure	<i>viridiflora</i>			
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	<i>Micromyrtus minutiflora</i>	Eastern section RP		Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	<i>Micromyrtus minutiflora</i>	Eastern section RP	265 in 0.64ha of Section 3. Across all Pyro Park: approx range 604-1810.	Two approaches. The first was to tag each individual specimen, however this approach was abandoned. The second approach was a transect-based



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						<p>survey of the specimens using the grid lines to be surveyed through the Pyro Park area. This involved botanists surveying transects and recording the densities of the specimens. Four transects (100m long, spaced 25m apart-later to 50m). Plants were surveys at specified survey points (10m diameter: 78.5m<sup>2</sup> area) at 10m intervals along each transect, and the density of specimens was noted at a scale of 1-6 (1: 91-100, 2 = 50-90, 3=21-50, 4=5-20, 5=5-3, 6=2-1</p>

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						plants per survey point).
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	<i>Micromyrtus minutiflora</i>	Northern Sector RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of	<i>Micromyrtus minutiflora</i>	Fenceline between Central and Western Precinct, and Regional Park	4	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		long term macrofauna fencing upon threatened flora and fauna				
2006	Cumberland Ecology	Flora and fauna assessment for future learning and community uses in the Eastern Precinct	<i>Micromyrtus minutiflora</i>	Eastern Precinct, proposed residual lots 17, 18, 20 and 21.	Exotic grassland = 5, Woodland = 48. Total = 53.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.
2008	Cumberland Ecology	Eastern Precinct Development Application - Flora and Fauna Assessment	<i>Micromyrtus minutiflora</i>	Eastern Precinct northern section.	A single localised population was recorded near the western end of the subject site, and the population was estimated to comprise approximately 200	During the field survey an estimate made of the numbers of threatened flora recorded from the SMP occurring within the subject site.

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
					plants.	
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility - Western Sydney - Environmental Review	<i>Persoonia nutans</i>	Eastern section RP	2 specimens	Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	<i>Persoonia nutans</i>	Eastern section RP	2	Not available
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	<i>Persoonia nutans</i>	Northern Sector RP	Not available	Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	<i>Persoonia nutans</i>	Eastern section RP	<i>Persoonia nutans</i> has been recorded at 3 locations in the study area.	
2012	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Pimelea spicata</i>	Along slope adjacent to creek towards Southern edge of proposed Village 4.	None recorded	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
1994	Gunninah Consultants	Australian Defence Industries St	<i>Pultenaea parviflora</i>	Eastern section RP	Common	Wide-ranging walked inspections of the Pyro Park area recording all

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
		Marys Facility Western Sydney - Environmental Review				species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	<i>Pultenaea parviflora</i>	Eastern section RP	284 in 0.64ha of Section 3. Across all Pyro Park: approx range 3370 - 11080.	Two approaches. The first was to tag each individual specimen, however this approach was abandoned. The second approach was a transect-based survey of the specimens using the grid lines to be surveyed through the Pyro Park area. This involved botanists surveying transects and recording the densities of the specimens. Four transects (100m long, spaced 25m apart-



**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						later to 50m). Plants were surveys at specified survey points (10m diameter: 78.5m <sup>2</sup> area) at 10m intervals along each transect, and the density of specimens was noted at a scale of 1-6 (1: 91-100, 2 = 50-90, 3=21-50, 4=5-20, 5=5-3, 6=2-1 plants per survey point).
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	<i>Pultenaea parviflora</i>	Northern Sector RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study

**Table B.2 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FLORA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Location*	Numbers	Method
						sites were surveyed on one day. Survey quadrats were 20m in diameter.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Pultenaea parviflora</i>	Located in grassland in centre of Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Pultenaea parviflora</i> / <i>Grevillea juniperina</i> subsp <i>juniperina</i>	Located in regional park in an area surrounded by large earth mounds, adjacent to road	>100 individuals of both species present	Targeted survey for threatened species that were known to be present or considered a possibility to be present.



**Table B.3 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FAUNA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Common name	Location	Numbers	Method
1991	Gunninah Consultants	Australian Defence Industries (ADI) site, St Marys - Fauna Survey	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat			Harp-type bat traps (approximately 2m x 2m), ranging from 0-3 nights of survey for 16 survey sites.
1991	Gunninah Consultants	Australian Defence Industries (ADI) site, St Marys - Fauna Survey	<i>Sericornis sagittatus</i>	Speckled Warbler	Site 10 (Woodland - vegetation community 2A). Site 15 (Woodland - vegetation community 2A)		Daytime searches for native animals were conducted in all vegetation communities. A record of all bird species sited was kept.
1991	Gunninah Consultants	Australian Defence Industries (ADI) site, St Marys - Fauna Survey		Diamond Firetail	During investigation on SMP, or incidental by staff.		Daytime searches for native animals were conducted in all vegetation communities. A record of all bird species sited was kept.
2001	ERM	?	<i>Miniopterus shreibersii oceanensis</i>	Eastern Bentwing-bat	Western Precinct (Regional Park - riparian habitats; Western Village - dam/riparian habitats)	RP riparian habitats - 9 calls. WV dam/riparian habitats - 6 calls	Anabat surveys.
2001	ERM	?	<i>Mormopterus</i>	Eastern	Western Precinct	RP riparian habitats - 2	Anabat surveys.

**Table B.3 DETAILED METHODS AND RECORDS OF SURVEY FOR THREATENED FAUNA SPECIES OF RELEVANCE ON THE SMP**

Year	Author	Title	Scientific name	Common name	Location	Numbers	Method
			<i>norfolkensis</i>	Freetail-bat	(Regional Park - riparian habitats and woodland/forest habitats; Western Village - dam/riparian habitats and grassland/woodland habitats)	calls, woodland/forest habitats - 1 call. WV dam/riparian habitats - 13 calls, grassland/woodland habitats 12 calls.	
2001	ERM	?	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	Western Precinct (Western Village - dam/riparian habitats)	WV dam/riparian habitats - 2 calls.	Anabat surveys.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	<i>Meridolum comeovirens</i>	Cumberland Land Snail	3 sites within the Western Precinct, 9 sites within the Regional Park.	17 live snails and 7 snail shells within Western Precinct, 60 live snails and 69 snail shells within the Regional Park	Surveys were conducted at 5 locations within the Western Precinct, and 10 locations within the Regional Park. 20 trees per site with suitable snail habitat (fallen bark around base) were searched for 5 minutes per tree, or until a live snail or shell was detected.



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*Appendix C*

**Flora and Fauna Species Lists**

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**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Acanthizidae	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	P	X		X	X				
Acanthizidae	<i>Acanthiza lineata</i>	Striated Thornbill	P	X		X					
Acanthizidae	<i>Acanthiza nana</i>	Yellow Thornbill	P	X	X	X	X		X	X	X
Acanthizidae	<i>Acanthiza pusilla</i>	Brown Thornbill	P	X	X					X	
Acanthizidae	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill	P			X					
Acanthizidae	<i>Gerygone olivacea</i>	White-throated Gerygone	P				X				
Acanthizidae	<i>Pyrrholaemus saggitatus</i>	Speckled Warbler	V	X							
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren	P			X					
Acanthizidae	<i>Smicromnis brevirostris</i>	Weebill	P			X	X		X	X	X
Accipitridae	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	P	X		X					
Accipitridae	<i>Accipiter fasciatus</i>	Brown Goshawk	P			X					X
Accipitridae	<i>Accipiter novaehollandiae</i>	Grey Goshawk	P					X			
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle	P		X		X				
Accipitridae	<i>Aviceda subcristata</i>	Pacific Baza	P							X	



**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite	P	X	X						
Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite	P	X							
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	P	X							
Agamidae	<i>Pogona barbata</i>	Bearded Dragon	P	X	X						
Alcedinidae	<i>Ceyx azureus</i>	Azure Kingfisher	P	X							
Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	P	X	X	X	X			X	
Anatidae	<i>Anas castanea</i>	Chestnut Teal	P			X					
Anatidae	<i>Anas gracilis</i>	Grey Teal	P			X	X				
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck	P	X		X	X				
Anatidae	<i>Aythya australis</i>	Hardhead	P				X				
Anatidae	<i>Biziura lobata</i>	Musk Duck	P	X							
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck	P	X		X	X				
Anatidae	<i>Cygnus atratus</i>	Black Swan	P	X							
Ardeidae	<i>Ardea alba</i>	Great Egret	P	X							
Ardeidae	<i>Ardea intermedia</i>	Intermediate Egret	P	X							

**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Ardeidae	<i>Bubulcus ibis</i>	Cattle Egret	P	X							
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron	P	X		X	X				
Artamidae	<i>Artamus cyanopterus</i>	Dusky Woodswallow	P			X					X
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird	P	X	X	X			X	X	X
Artamidae	<i>Gymnorhina tibicen</i>	Australian Magpie	P	X	X	X	X	X		X	X
Artamidae	<i>Strepera graculina</i>	Pied Currawong	P	X	X	X	X				
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	P	X	X	X	X				
Cacatuidae	<i>Cacatua sanguinea</i>	Little Corella	P	X		X					
Cacatuidae	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	P	X	X	X					
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah	P	X	X	X	X				
Camaenidae	<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E1			X			X	X	X
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	P	X	X	X	X		X		
Campephagidae	<i>Lalage tricolor</i>	White-winged Triller	P				X				
Canidae	<i>Canis lupus familiaris*</i>	Dog	U		X				X		



**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Canidae	<i>Vulpes vulpes*</i>	Fox	U	X	X				X		
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu	P	X	X	X	X	X		X	
Charadriidae	<i>Euseyornis melanops</i>	Black-fronted Dotterel	P	X							
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing	P	X	X	X		X			
Climacteridae	<i>Cormobates leucophaea</i>	White-throated Treecreeper	P			X					
Columbidae	<i>Columba livia*</i>	Rock Dove	U	X	X						
Columbidae	<i>Geopelia placida</i>	Peaceful Dove	P	X							
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon	P	X		X	X				
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing	P			X	X			X	
Columbidae	<i>Streptopelia chinensis*</i>	Spotted Turtle-Dove	U	X	X	X	X	X		X	
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird	P	X							
Corcoracidae	<i>Corcorax melanorhamphos</i>	White-winged Chough	P	X	X	X	X			X	
Corcoracidae	<i>Struthidea cinerea</i>	Apostlebird	P				X				

**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Corvidae	<i>Corvus coronoides</i>	Australian Raven	P	X	X	X	X	X	X	X	X
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	P	X	X						
Cuculidae	<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo	P	X		X					
Cuculidae	<i>Cuculus pallidus</i>	Pallid Cuckoo	P				X				
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	P			X					
Dicruridae	<i>Grallina cyanoleuca</i>	Magpie-lark	P	X	X	X	X		X	X	X
Dicruridae	<i>Myiagra inquieta</i>	Restless Flycatcher	P			X					
Dicruridae	<i>Rhipidura albiscapa</i>	Grey Fantail	P	X	X	X	X		X	X	X
Dicruridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	P	X	X	X	X		X		X
Dicruridae	<i>Rhipidura rufifrons</i>	Rufous Fantail	P	X							
Elapidae	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	P	X	X				X		
Elapidae	<i>Pseudonaja textilis</i>	Eastern Brown Snake	P	X	X						
Estrildidae	<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin	P	X							
Estrildidae	<i>Neochmia temporalis</i>	Red-browed Finch	P	X	X	X	X				
Estrildidae	<i>Stagonopleura guttata</i>	Diamond Firetail	V	X							



**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Estrildidae	<i>Taeniopygia bichenovii</i>	Double-barred Finch	P	X		X	X		X		
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch	P	X							
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel	P	X							
Falconidae	<i>Falco longipennis</i>	Australian Hobby	P			X					
Felidae	<i>Felis catus*</i>	Cat	U	X		X					
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	P	X		X	X		X		X
Hirundinidae	<i>Petrochelidon ariel</i>	Fairy Martin	P	X							
Hirundinidae	<i>Petrochelidon nigricans</i>	Tree Martin	P	X							
Hylidae	<i>Litoria dentata</i>	Bleating Tree Frog	P			X					
Hylidae	<i>Litoria peronii</i>	Peron's Tree Frog	P		X						
Hylidae	<i>Litoria verreauxii</i>	Verreaux's Frog	P		X						
Leporidae	<i>Lepus capensis*</i>	Brown Hare	U	X	X	X					
Leporidae	<i>Oryctolagus cuniculus*</i>	Rabbit	U	X	X	X			X		
Macropodidae	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	P	X	X	X		X		X	X
Macropodidae	<i>Macropus robustus</i>	Common Wallaroo	P								X

**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Macropodidae	<i>Macropus rufus</i>	Red Kangaroo	P	X	X	X					
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren	P	X	X	X	X		X	X	X
Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	P	X	X	X					
Meliphagidae	<i>Anthochaera carunculata</i>	Red Wattlebird	P			X	X				
Meliphagidae	<i>Anthochaera chrysoptera</i>	Little Wattlebird	P		X						
Meliphagidae	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	P	X	X	X				X	X
Meliphagidae	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater	P	X		X					
Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner	P	X	X	X	X	X	X	X	
Meliphagidae	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	P			X	X				
Meliphagidae	<i>Melithreptus lunatus</i>	White-naped Honeyeater	P	X		X					
Meliphagidae	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	P	X		X					
Meliphagidae	<i>Philemon corniculatus</i>	Noisy Friarbird	P	X		X	X				
Molossidae	<i>Mormopterus "Species 2"</i>	Undescribed Freetail Bat	P			X					



**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Molossidae	<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V		X						
Molossidae	<i>Mormopterus planiceps</i>	Little Mastiff-bat	P		X						
Molossidae	<i>Tadarida australis</i>	White-striped Freetail-bat	P		X						
Motacillidae	<i>Anthus australis</i>	Australian Pipit	P	X							
Muridae	<i>Mus musculus*</i>	House Mouse	U	X							
Muridae	<i>Rattus rattus*</i>	Black Rat	U	X							
Myobatrachidae	<i>Crinia signifera</i>	Common Eastern Froglet	P		X	X			X		X
Myobatrachidae	<i>Limnodynastes ornatus</i>	Ornate Burrowing Frog	P	X							
Myobatrachidae	<i>Limnodynastes peronii</i>	Brown-striped Frog	P			X					
Myobatrachidae	<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog	P			X					
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	X	X	X					
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole	P	X		X					
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	P	X	X	X				X	

**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Pachycephalidae	<i>Falcunculus frontatus</i>	Eastern Shrike-tit	P	X	X	X					
Pachycephalidae	<i>Monarcha melanopsis</i>	Black-faced Monarch	P	X							
Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden Whistler	P	X	X	X	X		X	X	X
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	P				X				
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote	P	X	X	X	X		X		
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote	P			X	X				
Petauridae	<i>Petaurus breviceps</i>	Sugar Glider	P	X							
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin	P	X	X	X					
Petroicidae	<i>Melanodryas cucullata</i>	Hooded Robin	V		X	X	X				
Petroicidae	<i>Microeca fascinans</i>	Jacky Winter	P			X					X
Petroicidae	<i>Petroica rosea</i>	Rose Robin	P	X		X				X	X
Phalacrocoracidae	<i>Phalacrocorax</i>	Little Pied Cormorant	P	X		X	X				



**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
ae	<i>melanoleucos</i>										
Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	P	X		X		X			
Phasianidae	<i>Coturnix ypsilophora</i>	Brown Quail	P	X							
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth	P	X							
Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	P	X		X	X				
Pseudocheiridae	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	P	X	X						
Psittacidae	<i>Glossopsitta concinna</i>	Musk Lorikeet	P							X	
Psittacidae	<i>Platycercus adscitus eximius</i>	Eastern Rosella	P	X	X	X	X	X		X	
Psittacidae	<i>Platycercus elegans</i>	Crimson Rosella	P	X	X	X					
Psittacidae	<i>Psephotus haematonotus</i>	Red-rumped Parrot	P	X		X	X				
Psittacidae	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	P	X							
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	P	X		X	X	X			

**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird	P				X				
Pycnonotidae	<i>Pycnonotus jocosus</i> *	Red-whiskered Bulbul	U	X		X					
Rallidae	<i>Fulica atra</i>	Eurasian Coot	P	X		X	X				
Rallidae	<i>Gallinula tenebrosa</i>	Dusky Moorhen	P	X		X	X				
Rallidae	<i>Porphyrio porphyrio</i>	Purple Swamphen	P	X		X	X				
Scincidae	<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink	P	X	X						
Scincidae	<i>Tiliqua scincoides</i>	Eastern Blue-tongue	P	X					X		
Scolopacidae	<i>Gallinago hardwickii</i>	Latham's Snipe	P				X				
Strigidae	<i>Ninox boobook</i>	Southern Boobook	P	X							
Sturnidae	<i>Acridotheres tristis</i> *	Common Myna	U	X		X	X	X			
Sturnidae	<i>Sturnus vulgaris</i> *	Common Starling	U	X		X	X				
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	P	X							
Threskiornithidae	<i>Platalea flavipes</i>	Yellow-billed Spoonbill	P	X		X					



**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Threskiornithidae	<i>Platalea regia</i>	Royal Spoonbill	P	X							
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	P	X							
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	P		X	X		X			
Vespertilionidae	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	P	X	X						
Vespertilionidae	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	X	X	X		X			
Vespertilionidae	<i>Myotis macropus</i>	Large-footed Myotis	V			X					
Vespertilionidae	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	P	X	X						
Vespertilionidae	<i>Nyctophilus sp.</i>	long-eared bat	P		X	X					
Vespertilionidae	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	X	X						
Vespertilionidae	<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	P		X						
Vespertilionidae	<i>Vespadelus darlingtoni</i>	Large Forest Bat	P		X						
Vespertilionidae	<i>Vespadelus regulus</i>	Southern Forest Bat	P		X	X					
Vespertilionidae	<i>Vespadelus vulturinus</i>	Little Forest Bat	P	X	X						



**Table C.1 FAUNA SPECIES RECORDED IN THE STUDY AREA AND SMP**

Family	Scientific Name	Common Name	Legal Status	Gunninah 1991	ERM 2003	CE 2004-2006	CE 2007-2008	CE 2009	Cumberland Ecology 2011		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Zosteropidae	<i>Zosterops lateralis</i>	Silvereye	P	X	X	X			X		



**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Fabaceae (Mimosoideae)	n	<i>Acacia parramattensis</i> (small tree)	Parramatta Wattle (small tree)	-	-	+	+	-	-	+	-
Myrtaceae	n	<i>Angophora floribunda</i>	Rough-barked Apple	-	-	-	-	-	-	+	-
Myrtaceae	n	<i>Angophora floribunda</i> (small tree)	Rough-barked Apple (small tree)	-	-	-	-	+	-	+	-
Cupressaceae	e	<i>Cupressus sp.</i>	a Cypress Pine	-	-	-	-	-	-	+	-
Myrtaceae	n	<i>Eucalyptus amplifolia</i>	Cabbage Gum	-	-	-	-	-	-	+	-
Myrtaceae	n	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	+	-	-	-	-	-	-	-
Myrtaceae	n	<i>Eucalyptus crebra</i> (small tree)	Narrow-leaved Ironbark (small tree)	+	-	+	-	-	-	+	-
Myrtaceae	n	<i>Eucalyptus fibrosa</i>	Red Ironbark	-	+	+	-	-	-	-	-
Myrtaceae	n	<i>Eucalyptus moluccana</i>	Grey Box	-	+	+	-	-	-	-	-
Myrtaceae	n	<i>Eucalyptus moluccana</i> (small tree)	Grey Box (small tree)	+	+	+	-	-	+	+	-
Myrtaceae	n	<i>Eucalyptus tereticornis</i>	Forest Red Gum	+	+	+	-	-	-	+	-
Myrtaceae	n	<i>Eucalyptus tereticornis</i> (small tree)	Forest Red Gum (small tree)	+	+	+	+	-	+	+	-

**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Moraceae	e	<i>Maclura pomifera</i> (small tree)	Osage Orange (small tree)	-	-	-	-	-	-	+	-
Fabaceae (Mimosoideae)	n	<i>Acacia parramattensis</i> (juvenile)	Parramatta Wattle (juvenile)	+	-	+	-	+	+	+	-
Myrtaceae	n	<i>Angophora floribunda</i> (juvenile)	Rough-barked Apple (juvenile)	-	-	-	-	+	-	+	-
Ericaceae (Styphelioideae)	n	<i>Astroloma humifusum</i>	Native Cranberry	+	-	+	-	+	-	+	-
Fabaceae (Faboideae)	n	<i>Bossiaea buxifolia</i>		-	-	+	-	-	-	-	-
Pittosporaceae	n	<i>Bursaria spinosa</i>	Blackthorn	+	-	-	-	+	-	-	-
Pittosporaceae	n	<i>Bursaria spinosa</i> ssp. <i>spinosa</i>	Blackthorn	+	-	+	+	+	-	-	-
Casuarinaceae	n	<i>Casuarina glauca</i>	Swamp Oak	-	-	-	+	-	-	-	-
Fabaceae (Faboideae)	n	<i>Chorizema parviflorum</i>	Eastern Flame Pea	-	-	+	-	-	-	-	-
Fabaceae (Faboideae)	n	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	-	-	+	-	-	-	+	-



**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Fabaceae (Faboideae)	n	<i>Dillwynia sieberi</i>	a Parrot-pea	+	+	+	-	+	-	+	-
Sapindaceae	n	<i>Dodonaea viscosa subsp. cuneata</i>		-	-	-	-	+	-	-	-
Myrtaceae	n	<i>Eucalyptus crebra (juvenile)</i>	Narrow-leaved Ironbark (juvenile)	+	-	+	+	-	-	-	-
Myrtaceae	n	<i>Eucalyptus eugenioides (juvenile)</i>	Thin-leaved Stringybark (juvenile)	-	-	-	-	-	-	+	-
Myrtaceae	n	<i>Eucalyptus molucanna (juvenile)</i>	Grey Box (juvenile)	+	+	+	+	+	-	-	-
Myrtaceae	n	<i>Eucalyptus tereticornis (juvenile)</i>	Forest Red Gum (juvenile)	+	+	+	+	+	-	+	-
Proteaceae	n	<i>Grevillea juniperina ssp juniperina</i>		+	-	-	-	-	-	+	-
Proteaceae	e	<i>Grevillea robusta (juvenile)</i>	Silky Oak (juvenile)	+	-	-	-	-	-	-	-
Dilleniaceae	n	<i>Hibbertia diffusa</i>	Wedge Guinea Flower	+	-	+	-	-	-	+	-
Myrtaceae	n	<i>Kunzea ambigua</i>	Tick Bush	-	-	-	-	-	-	+	-

**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Verbenaceae	e	<i>Lantana camara</i>	Lantana	+	-	-	-	-	-	-	-
Oleaceae	e	<i>Ligustrum lucidum (juvenile)</i>	Large-leaved Privett (juvenile)	-	-	+	-	-	-	+	-
Oleaceae	e	<i>Ligustrum sinense</i>	Small-leaved Privett	-	-	-	-	-	-	+	-
Solanaceae	e	<i>Lycium ferocissimum</i>	African Boxthorn	+	-	-	-	-	-	-	-
Myrtaceae	n	<i>Melaleuca styphelioides</i>	Prickly-leaved Paperbark	-	+	-	-	-	-	-	+
Meliaceae	n	<i>Melia azedarach</i>	White Cedar	-	-	+	-	-	-	-	-
Oleaceae	e	<i>Olea europaea ssp. cuspidata</i>	African Olive	+	-	+	-	-	-	-	-
Asteraceae	n	<i>Ozothamnus diosmifolius</i>	White Dogwood	-	-	+	-	+	-	-	-
Solanaceae	n	<i>Solanum prinophyllum</i>	Forest Nightshade	+	-	-	-	-	-	-	-
Solanaceae	e	<i>Solanum pseudocapsicum</i>	Jerusalem Cherry	+	-	-	-	-	-	-	-
Ulmaceae	n	<i>Trema tomentosa var. aspera</i>	Native Peach	-	-	+	-	-	-	-	-
Asteraceae	e	<i>Xanthium occidentale</i>	Noogoora Burr	-	-	-	+	-	-	-	-



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Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Asteraceae	n	? <i>Lagenophora</i> sp.		-	-	+	-	-	-	-	-
Fabaceae (Mimosoideae)	n	<i>Acacia decurrens</i> (seedling)	Black Wattle (seedling)	+	-	-	-	-	-	-	-
Lamiaceae	n	<i>Ajuga australis</i>	Austral Bugle	-	+	+	-	-	-	-	-
Amaranthaceae	n	<i>Alternanthera denticulata</i>	Lesser Joyweed	+	-	+	-	-	+	-	+
Amaranthaceae	n	<i>Alternanthera nana</i>	Hairy Joyweed	-	+	+	-	-	-	-	-
Amaranthaceae	n	<i>Alternanthera nodiflora</i>	Common Joyweed	+	+	+	-	+	-	-	-
Amaranthaceae	e	<i>Amaranthus viridus</i>		-	-	-	-	-	+	-	-
Amaranthaceae	e	<i>Amaranthus</i> sp.		-	-	-	-	-	+	-	-
Myrsinaceae	e	<i>Anagallis arvensis</i>	Scarlet Pimpernel	+	-	+	-	+	+	-	-
Myrtaceae	n	<i>Angophora floribunda</i> (seedling)	Rough-barked Apple (seedling)	-	-	-	-	-	-	+	-
Rubiaceae	n	<i>Asperula conferta</i>	Common Woodruff	+	+	+	+	+	-	-	-
Asteraceae	e	<i>Aster subulatus</i>	Wild Aster	-	-	+	-	-	+	-	-
Ericaceae (Styphelioideae)	n	<i>Astroloma humifusum</i> (juvenile)	Native Cranberry (juvenile)	-	-	+	-	-	-	-	-

**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Asteraceae	e	<i>Bidens pilosa</i>	Farmer's Friend	+	+	+	+	+	+	+	-
Asteraceae	e	<i>Bidens subalternans</i>	Greater Beggar's Ticks	+	-	+	+	+	-	+	-
Brassicaceae	e	<i>Brassica fruticulosa</i>	Twiggy Turnip	-	-	-	-	-	+	-	-
Brassicaceae	e	<i>Brassica sp.</i>		+	-	-	-	-	-	+	-
Acanthaceae	n	<i>Brunoniella australis</i>	Blue Trumpet	+	+	+	-	-	-	-	-
Pittosporaceae	n	<i>Bursaria spinosa (seedling)</i>	Blackthorn (seedling)	-	-	-	-	-	-	+	-
Pittosporaceae	n	<i>Bursaria spinosa ssp. spinosa (seedling)</i>	Blackthorn (seedling)	+	-	+	-	-	-	-	-
Asteraceae	n	<i>Calotis cuneifolia</i>	Blue Burr-daisy	+	+	+	+	+	+	+	-
Asteraceae	n	<i>Calotis lappulacea</i>	Yellow Burr-daisy	+	+	+	+	+	-	-	-
Asteraceae	n	<i>Cassinia sp.</i>		+	-	-	-	-	-	-	-
Gentianaceae	e	<i>Centaurium erythraea</i>	Common Century	+	-	-	-	+	+	-	-
Gentianaceae	e	<i>Centaurium sp.</i>		+	-	-	+	+	+	-	-
Apiaceae	n	<i>Centella asiatica</i>	Pennywort	+	+	+	+	+	+	+	+
Solanaceae	e	<i>Cestrum parqui</i>	Green Cestrum	-	-	-	-	-	-	+	-



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Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
		(juvenile)	(juvenile)								
Euphorbiaceae	n	<i>Chamaesyce drummondii</i>	Caustic Weed	+	-	-	-	+	-	-	-
Euphorbiaceae	n	<i>Chamaesyce sp.</i>		-	+	+	-	-	+	-	-
Chenopodiaceae	e	<i>Chenopodium album</i>	Fat Hen	-	-	-	-	-	+	-	-
Fabaceae (Faboideae)	n	<i>Chorizema parviflorum (juvenile)</i>	Eastern Flame Pea (juvenile)	-	-	-	-	-	-	+	-
Asteraceae	e	<i>Cirsium vulgare</i>	Spear Thistle	+	+	+	-	+	+	-	-
Asteraceae	e	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	+	+	+	+	+	+	+	-
Asteraceae	e	<i>Conyza sp.</i>	Fleabane	-	-	-	-	+	-	-	-
Apiaceae	e	<i>Cyclospermum leptophyllum</i>	Slender Celery	+	-	-	-	+	-	-	-
Asteraceae	n	<i>Cymbonotus lawsonianus</i>	Bear's Ears	-	+	+	-	-	-	-	-
Apiaceae	n	<i>Daucus glochidiatus</i>	Native Carrot	+	-	-	-	-	-	-	-
Fabaceae (Faboideae)	n	<i>Desmodium varians</i>	Tick Trefoil	+	+	+	+	+	-	+	-
Convolvulaceae	n	<i>Dichondra repens</i>	Kidney Weed	-	+	+	+	-	-	+	-

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Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Fabaceae (Faboideae)	n	<i>Dillwynia sieberi</i> (juvenile)	a Parrot-pea (juvenile)	-	-	-	+	-	-	-	-
Droseraceae	n	<i>Drosera peltata</i>		-	-	-	-	-	-	+	-
Droseraceae	n	<i>Drosera sp.</i>	a Sundew	-	-	-	+	-	-	-	-
Asteraceae	n	<i>Eclipta platyglossa</i>									+
Chenopodiaceae	n	<i>Einadia hastata</i>	Berry Saltbush	+	-	-	-	-	-	-	-
Chenopodiaceae	n	<i>Einadia nutans</i>	Climbing Saltbush	+	-	-	-	-	-	-	-
Chenopodiaceae	n	<i>Einadia polygonoides</i>		+	+	+	-	+	+	-	-
Chenopodiaceae	n	<i>Einadia trigonos</i>	Fishweed	+	-	-	-	-	-	-	-
Chenopodiaceae	n	<i>Enchylaena tomentosa</i>	Ruby Saltbush	+	-	-	-	-	-	-	-
Asteraceae	n	<i>Epaltes australis</i>	Spreading Nut-heads	-	-	+	-	-	-	-	-
Asteraceae	e	<i>Epaltes minor</i>		-	-	-	-	-	+	+	-
Myoporaceae	n	<i>Eremophila debilis</i>	Winter Apple	+	+	+	-	-	-	-	-
Myrtaceae	n	<i>Eucalyptus crebra</i> (seedling)	Narrow-leaved Ironbark (seedling)	-	-	-	+	-	-	-	-
Myrtaceae	n	<i>Eucalyptus moluccana</i> (seedling)	Grey Box (seedling)	+	+	+	+	+	-	-	-



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Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Myrtaceae	n	<i>Eucalyptus tereticornis</i> (seedling)	Forest Red Gum (seedling)	+	-	+	+	-	-	-	-
Asteraceae	n	<i>Euchiton sphaericus</i>		-	+	-	-	+	-	-	-
Asteraceae	e	<i>Gamochaeta americana</i>	Cudweed	-	-	-	-	+	+	-	-
Geraniaceae	n	<i>Geranium ?solanderi</i>	Native Geranium	+	+	-	-	-	-	-	-
Asteraceae	n	<i>Glossocardia bidens</i>	Cobbler's Tick	+	+	+	+	+	-	-	-
Asteraceae	e	<i>Gnaphalium sp.</i>		+	+	+	+	+	-	+	-
Apocynaceae	e	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	+	-	+	-	-	-	-	-
Amaranthaceae	e	<i>Gomphrena celosioides</i>	Gomphrena Weed	+	-	-	-	-	-	-	-
Goodeniaceae	n	<i>Goodenia ?gracilis</i>		+	-	+	-	-	-	-	-
Goodeniaceae	n	<i>Goodenia bellidifolia</i>		+	-	-	-	-	-	-	-
Goodeniaceae	n	<i>Goodenia hederacea</i>	Forest Goodenia	+	+	+	-	-	-	-	-
Goodeniaceae	n	<i>Goodenia paniculata</i>	Branched Goodenia	+	-	-	-	-	-	-	+
Haloragaceae	n	<i>Haloragis heterophylla</i>	Rough Raspwort	-	-	-	-	+	-	-	-
Boraginaceae	e	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	+	+	+	-	+	-	-	-

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Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Apiaceae	n	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort	-	-	-	+	-	-	-	-
Clusiaceae	n	<i>Hypericum gramineum</i>	Small St. John's Wort	+	+	+	+	+	+	+	-
Clusiaceae	e	<i>Hypericum perforatum</i>	St. John's Wort	-	-	+	+	+	-	+	-
Asteraceae	e	<i>Hypochaeris microcephala</i>	White Flatweed	+	-	-	-	-	-	-	-
Asteraceae	e	<i>Hypochaeris microcephala</i> var. <i>albiflora</i>	White Flatweed	+	-	+	-	-	+	-	-
Asteraceae	e	<i>Hypochaeris radicata</i>	Flatweed	+	+	+	+	+	-	+	-
Asteraceae	e	<i>Lactuca saligna</i>	Willow-leaved Lettuce	-	-	-	-	+	-	-	-
Linaceae	n	<i>Linum marginale</i>	Native Flax	-	-	-	+	-	-	-	-
Linaceae	e	<i>Linum trigynum</i>	French Flax	+	-	-	-	+	+	-	-
Onagraceae	n	<i>Ludwigia peploides</i> ssp. <i>montevidensis</i>	Water Primrose								+
Lythraceae	n	<i>Lythrum hyssopifolia</i>	Hyssop Loosestrife	-	-	+	-	-	-	-	+
Fabaceae (Faboideae)	e	<i>Medicago polymorpha</i>	Burr Medic	-	+	-	-	-	-	-	-
Lamiaceae	n	<i>Mentha saturoides</i>	Creeping Mint	-	+	+	+	-	-	-	-



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Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Malvaceae	e	<i>Modiola caroliniana</i>	Red-flowered Mallow	-	+	+	-	+	+	-	-
Rubiaceae	n	<i>Opercularia diphylla</i>	Stinkweed	-	+	+	-	-	-	-	-
Rubiaceae	n	<i>Opercularia varia</i>	Variable Stinkweed	-	-	-	+	-	-	-	-
Cactaceae	e	<i>Opuntia aurantiaca</i>	Tiger Pear	-	-	+	-	-	-	-	-
Oxalidaceae	n	<i>Oxalis exilis</i>	a Wood Sorrel	+	-	-	+	+	-	-	-
Oxalidaceae	n	<i>Oxalis perennans</i>		+	+	+	+	+	-	-	-
Oxalidaceae	n	<i>Oxalis perennans?</i>		+	-	-	-	+	-	-	-
Oxalidaceae	e	<i>Oxalis sp.</i>		-	-	-	-	+	-	-	-
Polygonaceae	n	<i>Persicaria decipiens</i>	Slender Knotweed	-	-	-	-	-	+	-	+
Polygonaceae	n	<i>Persicaria sp.</i>		-	-	-	-	-	-	+	-
Euphorbiaceae	n	<i>Phyllanthus virgatus</i>	a spurge	+	+	+	+	+	-	+	-
Phyllanthaceae	n	<i>Phyllanthus virgatus</i>		+	-	+	-	+	-	-	-
Thymeliaceae	n	<i>Pimelea curviflora var. subglabrata</i>		-	+	-	-	-	-	-	-
Thymeliaceae	n	<i>Pimelea sp.</i>		-	-	+	-	-	-	-	-
Thymeliaceae	n	<i>Pimelea sp. 1 (unknown - collected)</i>		-	-	-	-	+	-	-	-

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Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Plantaginaceae	n	<i>Plantago debilis</i>		+	+	+	-	-	-	-	-
Plantaginaceae	n	<i>Plantago gaudichaudii</i>	Narrow Plantain	-	+	-	-	-	-	-	-
Plantaginaceae	e	<i>Plantago lanceolata</i>	Lamb's Tongues	-	-	-	-	+	-	-	-
Rubiaceae	n	<i>Pomax umbellata</i>		-	-	+	-	-	-	-	-
Portulacaceae	n	<i>Portulaca oleracea</i>	Pigweed	-	-	+	-	-	+	-	-
Lobeliaceae	n	<i>Pratia purpurascens</i>	Whiteroot	+	+	+	+	+	-	-	-
Ranunculaceae		<i>Ranunculus inundatus</i>	River Buttercup								+
Ranunculaceae	n	<i>Ranunculus lappaceus</i>	Common Buttercup	-	-	-	-	-	-	+	-
Rubiaceae	e	<i>Richardia stellaris</i>		+	+	+	+	+	+	+	-
Polygonaceae	n	<i>Rumex brownii</i>	Swamp Dock	-	-	-	-	-	-	+	-
Polygonaceae	e	<i>Rumex crispus</i>	Curled Dock	-	-	-	-	+	-	-	-
Lamiaceae	?	<i>Salvia sp.</i>		-	-	-	-	-	+	-	-
Asteraceae	n	<i>Senecio diaschides</i>		+	-	-	-	-	-	-	-
Asteraceae	e	<i>Senecio madagascariensis</i>	Fireweed	-	+	+	+	+	+	+	-
Malvaceae	n	<i>Sida corrugata</i>	Corrugated Sida	+	-	+	-	-	-	-	-
Malvaceae	e	<i>Sida rhombifolia</i>	Paddy's Lucerne	+	+	+	+	+	+	+	-



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Asteraceae	e	<i>Sigesbeckia orientalis</i>		-	+	-	-	-	-	-	-
Solanaceae	e	<i>Solanum nigrum</i>	Blackberry Nightshade	-	-	-	-	-	+	-	-
Solanaceae	n	<i>Solanum prinophyllum</i> (juvenile)	Forest Nightshade (juvenile)	+	+	+	-	-	-	-	-
Solanaceae	e	<i>Solanum pseudocapsicum</i> (juvenile)	Jerusalem Cherry (juvenile)	+	+	+	-	-	-	+	-
Asteraceae	n	<i>Solenogyne bellioides</i>		-	+	+	+	+	-	-	-
Asteraceae	e	<i>Sonchus oleraceus</i>	Sow Thistle	+	-	+	-	-	+	-	-
Caryophyllaceae	n	<i>Spergularia sp.</i>		-	+	+	-	-	-	-	-
Stackhousiaceae	n	<i>Stackhousia viminea</i>	Slender Stackhousia	+	+	-	-	+	-	-	-
Asteraceae	e	<i>Tagetes minuta</i>	Stinking Roger	-	-	+	-	-	-	-	-
Asteraceae	e	<i>Taraxacum officianale</i>	Dandelion	+	-	-	-	-	-	-	-
Fabaceae (Faboideae)	e	<i>Trifolium dubium</i>	Yellow Suckling Clover	-	+	+	-	+	+	-	-
Fabaceae (Faboideae)	e	<i>Trifolium repens</i>	White Clover	-	-	-	-	-	+	-	-

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Fabaceae (Faboideae)	e	<i>Trifolium sp.</i>	Clover	-	-	-	-	-	+	-	-
Unknown	?	<i>Unknown sp. 1</i>	Persecaria like	-	-	-	-	+	-	-	-
Unknown	?	<i>Unknown sp. 4</i>		-	-	-	-	+	-	-	-
Verbenaceae	e	<i>Verbena bonariensis</i>	Purpletop	-	-	-	+	+	-	-	-
Verbenaceae	e	<i>Verbena brasiliensis</i>		+	-	-	-	-	-	-	-
Verbenaceae	e	<i>Verbena officinalis</i>	Common Verbena	-	+	+	+	+	+	-	-
Verbenaceae	e	<i>Verbena rigida</i>	Veined Verbena	-	-	-	+	+	-	-	-
Asteraceae	n	<i>Vernonia cinerea</i>		-	+	+	-	-	-	-	-
Scrophulariaceae	n	<i>Veronica ?calycina</i>	Hairy Speedwell	-	+	-	-	-	-	-	-
Scrophulariaceae	n	<i>Veronica plebia</i>	Trailing Speedwell	+	-	-	-	-	-	-	-
Asteraceae	n	<i>Vittadinia cuneata</i>	Fuzzweed	+	-	-	-	-	-	-	-
Asteraceae	n	<i>Vittadinia hispidula</i>		+	-	-	-	+	-	-	-
Asteraceae	n	<i>Vittadinia spp.</i>		+	+	+	+	-	-	-	-
Campanulaceae	n	<i>Wahlenbergia communis</i>	Tufted Bluebell	+	+	+	-	+	-	-	-
Campanulaceae	n	<i>Wahlenbergia gracilis</i>	Native Bluebell	+	+	+	+	+	-	-	-



**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Asteraceae	e	<i>Xanthium sp.</i>		+	-	+	-	-	-	-	+
Fabaceae (Faboideae)	n	<i>Zornia dictiocarpa</i>	Zornia	+	+	+	+	+	-	+	-
Anthericaceae	n	<i>Arthropodium milleflorum</i>	Pale Vanilla-lily	-	+	+	-	-	-	-	-
Anthericaceae	n	<i>Arthropodium sp.</i>		+	-	-	+	-	-	-	-
Asparagaceae	e	<i>Asparagus asparagoides</i>	Bridal Creeper	-	-	+	-	-	-	-	-
Cyperaceae	n	<i>Carex breviculmis</i>		+	-	-	-	+	-	-	-
Cyperaceae	n	<i>Carex inversa</i>		+	-	-	-	+	-	-	-
Commelinaceae	n	<i>Commelina cyanea</i>	Blue Wandering Jew	+	+	+	-	+	-	+	-
		CYPERACEAE		-	-	-	-	-	-	+	-
Cyperaceae	n	<i>Carex appressa</i>	Tall Sedge								+
Cyperaceae	e	<i>Cyperus brevifolius</i>	Mullumbimbi Couch	+	-	-	+	+	+	-	-
Cyperaceae	n	<i>Cyperus difformis</i>		+	-	-	-	+	-	-	-
Cyperaceae	e	<i>Cyperus eragrostis</i>		-	-	+	-	+	+	+	+
Cyperaceae	n	<i>Cyperus gracilis</i>	Slender Flat-sedge	+	+	-	-	+	-	-	-

**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Cyperaceae	n	<i>Cyperus laevis</i>		-	-	-	+	-	-	-	-
Cyperaceae	n	<i>Cyperus sp.</i>	a Sedge	-	-	-	-	+	-	-	+
Phormiaceae	n	<i>Dianella longifolia</i>	Blue Flax Lily	+	-	+	-	-	-	-	-
Anthericaceae	n	<i>Dichopogon fimbriatus</i>	Nodding Chocolate Lily	-	-	-	-	+	-	-	-
Cyperaceae	n	<i>Eleocharis sphacelata</i>									+
Cyperaceae	n	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge	+	+	+	+	+	+	+	-
Hypoxidaceae	n	<i>Hypoxis hygrometrica hygrometrica</i>	Golden Weather-grass	+	-	-	-	-	-	-	-
Hypoxidaceae	n	<i>Hypoxis sp.</i>		-	-	-	+	+	-	-	-
Juncaceae	n	<i>Juncus sp.</i>									+
Juncaceae	e	<i>Juncus sp.</i>		-	-	+	-	+	-	-	-
Juncaceae	n	<i>Juncus usitatus</i>		-	-	-	-	+	-	+	-
Anthericaceae	n	<i>Laxmannia gracilis</i>	Slender Wire Lily	-	+	-	-	-	-	-	-
Lomandraceae	n	<i>Lomandra filiformis ssp. filiformis</i>	Wattle Mat-rush	+	+	+	-	-	-	-	-



**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Lomandraceae	n	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	-	-	-	-	-	-	+	-
Hydrocharitaceae	n	<i>Ottelia ovalifolia</i>	Swamp Lily								+
Philydraceae		<i>Philydrum lanuginosum</i>	Frogsmouth								+
Potamogetonaceae	n	<i>Potamogeton tricarinatus</i>									+
Potamogetonaceae	n	<i>Potamogeton sp.</i>									+
Iridaceae	e	<i>Romulea rosea</i>	Onion Grass	-	-	-	-	+	-	-	-
Cyperaceae	n	<i>Schoenus apogon</i>	Common Bog-rush	-	-	-	-	+	-	-	-
Cyperaceae	n	<i>Scleria mackaviensis</i>		+	-	-	-	-	-	-	-
Commelinaceae	e	<i>Tradescantia fluminensis</i>	Wandering Jew	-	-	-	-	-	-	+	-
Anthericaceae	n	<i>Tricoryne elatior</i>	Yellow Autumn-lily	-	-	-	-	+	-	-	-
Anthericaceae	n	<i>Tricoryne simplex</i>		+	-	-	-	+	-	+	-
Anthericaceae	n	<i>Tricoryne sp.</i>		-	-	-	-	+	-	-	-
Juncaginaceae	n	<i>Triglochin procera</i>	Water Ribbons								+

**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Typhaceae	n	<i>Typha orientalis</i>	Broadleaf Cumbungi								+
Unknown	?	<i>Unknown sp. 2</i>	rush	-	-	-	-	+	-	-	-
Poaceae	n	<i>Aristida ramosa</i>	a Three-awned Grass	+	-	-	+	+	-	+	-
Poaceae	n	<i>Aristida vagans</i>	Three-awned Spear Grass	+	+	+	+	+	-	+	-
Poaceae	n	<i>Aristida warburgii</i>		-	-	+	-	-	-	+	-
Poaceae	n	<i>Austrodanthonia fulva</i>	Wallaby Grass	+	-	-	-	-	-	-	-
Poaceae	n	<i>Austrodanthonia sp.</i>	a Wallaby Grass	+	-	+	-	-	-	-	-
Poaceae	n	<i>Austrodanthonia tenuior</i>		+	-	-	-	-	-	-	-
Poaceae	e	<i>Axonopus fissifolius</i>	Carpet Grass	+	+	+	+	+	+	+	+
Poaceae	n	<i>Bothriochloa decipiens/macra</i>	Pitted Bluegrass/Red Leg Grass	+	+	+	+	+	-	+	-
Poaceae	e	<i>Briza minor</i>	Shivery Grass	-	-	-	-	+	-	-	-
Poaceae	e	<i>Briza subaristata</i>		-	-	-	-	+	+	+	-
Poaceae	n	<i>Chloris divaricata</i>	Slender Chloris	-	-	-	+	-	-	-	-
Poaceae	n	<i>Chloris truncata</i>	Windmill Grass	+	+	-	-	-	-	-	-
Poaceae	n	<i>Chloris ventricosa</i>	Windmill Grass	+	+	+	-	-	-	-	-



**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Poaceae	n	<i>Cymbopogon refractus</i>	Barbed Wire Grass	-	+	+	+	+	-	+	-
Poaceae	n	<i>Cynodon dactylon</i>	Couch Grass	+	-	+	+	+	+	+	+
Poaceae	n	<i>Dichanthium sericeum</i>	Queensland Bluegrass	-	+	+	-	-	-	-	-
Poaceae	n	<i>Dichelachne micrantha</i>	Short-haired Plume Grass	+	+	-	-	+	+	+	-
Poaceae	n	<i>Dichelachne parva</i>		-	-	-	-	+	-	-	-
Poaceae	n	<i>Dichelachne rara</i>		-	-	-	-	+	-	-	-
Poaceae	?	<i>Digitaria sp.</i>		-	-	-	-	-	+	-	-
Poaceae	e	<i>Echinochloa crus-galli</i>	Barnyard Grass	-	-	-	-	-	+	-	-
Poaceae	?	<i>Echinochloa sp.</i>		-	-	-	-	-	+	-	-
Poaceae	n	<i>Echinopogon caespitosus</i>	Hedgehog Grass	+	+	+	-	+	-	+	-
Poaceae	n	<i>Echinopogon ovatus</i>	Tufted Hedgehog Grass	+	-	+	-	-	-	-	-
Poaceae	e	<i>Eleusine indica</i>	Crowsfoot Grass	-	-	-	-	-	+	-	-
Poaceae	n	<i>Enteropogon acicularis</i>		+	-	-	-	-	-	-	-

**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Poaceae	n	<i>Entolasia stricta</i>	Wiry Panic	-	-	-	-	-	-	+	-
Poaceae	n	<i>Eragrostis brownii</i>	Brown's Love-grass	+	+	+	+	+	+	+	+
Poaceae	e	<i>Eragrostis curvula</i>	African Love-grass	+	-	+	+	+	+	+	-
Poaceae	n	<i>Eragrostis leptostachya</i>	Paddock Love-grass	+	+	+	+	+	-	+	-
Poaceae	n	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass	+	+	+	-	+	-	+	-
Poaceae	n	<i>Lachnagrostis filliformis</i>	Blown Grass	-	-	-	-	+	-	-	-
Poaceae	n	<i>Lachnagrostis sp</i>		-	-	-	-	-	+	-	-
Poaceae	e	<i>Melinis repens</i>	Red Natal Grass	-	-	-	-	+	-	-	-
Poaceae	n	<i>Microlaena stipoides</i>	Weeping Meadow Grass	+	-	-	-	-	-	+	+
Poaceae	n	<i>Microlaena stipoides var. stipoides</i>	Weeping Meadow Grass	+	+	+	+	+	-	+	-
Poaceae	n	<i>Oplismenus aemulus</i>	Basket Grass	-	-	+	-	-	-	+	-
Poaceae	n	<i>Panicum effusum</i>	Hairy Panic	-	-	-	-	-	-	+	-
Poaceae	n	<i>Paspalidium distans</i>		-	+	+	+	+	+	+	-
Poaceae	e	<i>Paspalum dilatatum</i>	Paspalum	+	+	-	-	+	+	+	-



**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Poaceae	n	<i>Paspalum distichum</i>	Water Couch	-	-	-	-	-	+	-	+
Poaceae	e	<i>Pennisetum clandestinum</i>	Kikuyu	-	-	-	-	-	+	-	-
Poaceae	n	<i>Poa labillardieri</i>	Tussock Grass	+	-	-	-	-	-	-	-
Poaceae	e	<i>Setaria parviflora</i>	Slender Pigeon Grass	+	+	+	+	+	+	+	-
Poaceae	n	<i>Sorghum leiocladum</i>	Wild Sorghum	-	-	-	-	+	-	-	-
Poaceae	e	<i>Sporobolus africanus</i>	Parramatta Grass	-	-	-	-	+	-	-	-
Poaceae	n	<i>Sporobolus creber</i>	Slender Rat's Tail Grass	+	+	+	+	+	-	+	-
Poaceae	n	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	-	-	+	+	+	-	+	-
Poaceae	e	<i>Stenotaphrum secundatum</i>	Buffalo Grass	-	-	-	-	+	-	-	-
Poaceae	n	<i>Themeda australis</i>	Kangaroo Grass	+	+	-	+	+	-	+	-
Apocynaceae	e	<i>Araujia sericifera</i>	Moth Vine	+	-	+	-	-	-	+	-
Ranunculaceae	n	<i>Clematis glycinoides</i>	Headache Vine	-	-	-	-	-	-	+	-
Fabaceae (Faboideae)	n	<i>Glycine clandestina</i>		-	-	+	-	-	-	+	-

**Table C.2 FLORA SPECIES RECORDED IN THE STUDY AREA**

Family	Status	Scientific Name	Common Name	Regen CPW - Subject land	Regen CPW - Regional Park	Mature CPW - Regional Park	DNG	Low diversity DNG	Exotic Grassland	Riparian	Wetland (Incidental Records)
Fabaceae (Faboideae)	n	<i>Glycine microphylla</i>	Small-leaf Glycine	+	+	+	-	+	-	+	-
Fabaceae (Faboideae)	n	<i>Glycine tabacina</i>	Love Creeper	+	+	+	+	-	+	-	-
Fabaceae (Faboideae)	n	<i>Hardenbergia violacea</i>	False Sasparilla	-	-	+	-	-	-	-	-
Apocynaceae	n	<i>Parsonsia straminea</i>	Common Silkpod	+	-	-	-	-	-	-	-
Passifloraceae	e	<i>Passiflora caerulea</i>	Blue Passionflower	+	-	-	-	-	-	-	-
Adiantaceae	n	<i>Cheilanthes sieberi</i>	Poison Rock Fern	+	+	+	+	+	-	+	-
Blechnaceae	n	<i>Doodia caudata var. caudata</i>	Small Rasp Fern	-	-	-	-	-	-	+	-
Marsileaceae	n	<i>Marsilea hirsuta</i>	Nardoo								+
Santalaceae	n	<i>Amyema miquelii</i>	Mistletoe	-	-	+	-	-	-	-	-



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*Appendix D*

# Flora and Fauna Data Analyses

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**Table D.1 SNAIL SURVEY RECORDS FOR THE STUDY AREA – CE 2011**

	Area A – Regenerating CPW- Subject Land					Area B - Regenerating CPW- Regional Park					Area C-Mature CPW- Regional Park				
	A-SQ1	A-SQ2	A-SQ3	SQ4	SQ5	B-SQ6	B-SQ7	B-SQ8	B-SQ9	B-SQ10	C-SQ11	C-SQ12	C-SQ13	C-SQ14	C-SQ15
Total trees	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Live snails	8	8	0	1	0	4	5	3	0	10	9	11	6	6	6
Snail Shells	2	4	0	1	0	1	9	4	8	4	10	9	8	8	8
Total Snails	10	12	0	2	0	5	14	7	8	14	19	20	14	14	14
Ave for Area	4.8					9.6					16.2				
St Dev	5.76194					4.15933					3.03315				
St Err	2.57682					1.86011					1.35647				



**Table D.2 HABITAT ASSESSMENT RESULTS IN THE STUDY AREA**

	Habitat Features	Area A-Regenerating CPW - study area					Area B - Regenerating CPW- Regional Park					Area C - Mature CPW - Regional Park				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15
Projective Cover (total % cover = 100%)	Vegetation	95	92	80	85	20	95	83	85	80	70	70	40	80	65	70
	Logs	0	0	1	0	1	1	2	0	5	2	1	5	2	0	1
	Rock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Litter	1	5	9	12	55	2	4	10	5	15	15	25	10	15	12
	Soil	2	1	0	0	5	0	4	0	3	3	2	10	0	5	2
	Bark	2	2	10	3	19	2	7	5	7	10	12	20	8	15	15
Hollows	Small	0	4	3	2	1	1	5	3	2	2	1	3	3	2	3
	Medium	1	1	0	0	0	0	1	0	1	1	0	0	1	0	0
	Large	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Main Tree Species	<i>E.molucanna</i>	X	X	X	X		X		X	X	X	X	X	X	X	X
	<i>E. teretecornis</i>		X			X		X	X	X						
	<i>E. fibrosa</i>				X											
Main Understory Species	Native Grasses	X	X	X	X	X		X	X	X	X		X	X		
	Exotic Grasses			X												

**Table D.2 HABITAT ASSESSMENT RESULTS IN THE STUDY AREA**

Habitat Features	Area A-Regenerating CPW - study area					Area B - Regenerating CPW- Regional Park					Area C - Mature CPW - Regional Park				
	SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15
Native Shrubs					X						X			X	X
Native Herbs						X				X	X			X	X
Regenerating Eucalypts															
Exotic Herbs															
Flowering Tree	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Signs of fauna activity	Nil	Macropod scats	Macropod scats	Nil	Macropod scats	Nil	Macropod scats,	Macropod scats	Macropod scats, Emu scats,	Macropod scats	Nil	Macropod scats	Macropod scats	Nil	Macropod scats, Emu scats



**Table D.3 RESULTS OF GROUP SIMILARITY ANALYSES (SIMPER) OF FLORA DATA BY HABITAT AND PRIMARY SPECIES CONTRIBUTING TO THE GROUP SIMILARITY.**

Data type	Habitat	Group similarity (%)	Main contributing species	% contribution to similarity
All Quadrats – flora abundance data	Undetermined	33.04	<i>Senecio madagacariensis</i>	7.59
			<i>Eragrostis curvula</i>	6.31
			<i>Axonopus fissifolius</i>	4.54
	Grassland	41.55	<i>Senecio madagacariensis</i>	8.16
			<i>Axonopus fissifolius</i>	8.00
			<i>Setaria parviflora</i>	7.18
	Woodland	38.63	<i>Aristida vagans</i>	7.14
			<i>Cymbopogon refractus</i>	5.72
			<i>Glycine tabacina</i>	4.81
	Riparian	13.88	<i>Sida rhombifolia</i>	9.62
			<i>Angrophora floribunda</i>	9.18
			<i>Axonopus fissifolius</i>	7.79
All Quadrats – Native flora abundance data	Undetermined	28.99	<i>Cymbopogon refractus</i>	7.99
			<i>Bothriochloa decipiens/macra</i>	6.97
			<i>Microlaena stipoides var. stipoides</i>	5.02
	Grassland	36.59	<i>Fimbristylis dichotoma</i>	13.06
			<i>Cynodon dactylon</i>	12.54
			<i>Cymbopogon refractus</i>	10.45

**Table D.3 RESULTS OF GROUP SIMILARITY ANALYSES (SIMPER) OF FLORA DATA BY HABITAT AND PRIMARY SPECIES CONTRIBUTING TO THE GROUP SIMILARITY.**

Data type	Habitat	Group similarity (%)	Main contributing species	% contribution to similarity
	Woodland	38.09	<i>Aristida vagans</i>	9.08
			<i>Cymbopogon refractus</i>	7.44
			<i>Glycine tabacina</i>	6.22
	Riparian	12.19	<i>Angophora floribunda</i>	14.97
			<i>Microlaena stipoides var. stipoides</i>	13.06
			<i>Dichelachne micrantha</i>	9.57
All Quadrats – Exotic species abundance data	Undetermined	38.11	<i>Senecio madagascariensis</i>	20.08
			<i>Eragrostis curvula</i>	14.88
			<i>Axonopus fissifolius</i>	10.64
	Grassland	48.80	<i>Senecio madagascariensis</i>	17.32
			<i>Axonopus fissifolius</i>	16.29
			<i>Setaria parviflora</i>	14.99
	Woodland	39.30	<i>Sida rhombifolia</i>	26.29
			<i>Senecio madagascariensis</i>	21.01
			<i>Richardia stellaris</i>	16.70
	Riparian	19.85	<i>Axonopus fissifolius</i>	24.65
			<i>Eragrostis curvula</i>	20.13
			<i>Sida rhombifolia</i>	16.54



**Table D.4 RESULTS OF GROUP SIMILARITY ANALYSES (SIMPER) OF FLORA DATA BY AREA AND PRIMARY SPECIES CONTRIBUTING TO THE GROUP SIMILARITY.**

Data type	Area	Group similarity (%)	Main contributing species	% contribution to similarity
All Quadrats – flora abundance data	A	33.15	<i>Senecio madagacariensis</i>	8.17
			<i>Axonopus fissifolius</i>	6.37
			<i>Cymbopogon refractus</i>	6.00
	B	56.43	<i>Aristida vagans</i>	7.19
			<i>Cymbopogon refractus</i>	5.21
			<i>Glossocardia bidens</i>	4.88
	C	30.56	<i>Aristida vagans</i>	6.57
			<i>Sida rhombifolia</i>	5.32
			<i>Glycine tabacina</i>	5.28
All Quadrats – Native flora abundance data	A	29.19	<i>Cymbopogon refractus</i>	10.59
			<i>Fimbristylis dichotoma</i>	8.03
			<i>Bothriochloa decipiens/macra</i>	7.14
	B	56.02	<i>Aristida vagans</i>	8.93
			<i>Cymbopogon refractus</i>	6.46
			<i>Glossocardia bidens</i>	6.07
	C	28.42	<i>Aristida vagans</i>	9.51
			<i>Bothriochloa decipiens/macra</i>	7.85
			<i>Glycine tabacina</i>	7.82
All Quadrats – Exotic flora abundance data	A	38.82	<i>Senecio madagascariensis</i>	20.89

**Table D.4 RESULTS OF GROUP SIMILARITY ANALYSES (SIMPER) OF FLORA DATA BY AREA AND PRIMARY SPECIES CONTRIBUTING TO THE GROUP SIMILARITY.**

Data type	Area	Group similarity (%)	Main contributing species	% contribution to similarity
			<i>Axonopus fissifolius</i>	13.99
			<i>Eragrostis curvula</i>	12.44
	B	57.62	<i>Richardia stellaris</i>	25.94
			<i>Sida rhombifolia</i>	24.85
			<i>Senecio madagascariensis</i>	17.57
	C	34.61	<i>Sida rhombifolia</i>	18.46
			<i>Senecio madagascariensis</i>	15.66
			<i>Richardia stellaris</i>	14.91



**Table D.5 RESULTS OF GROUP SIMILARITY ANALYSES (SIMPER) OF FLORA DATA IN GRASSLAND QUADRATS BY AREA AND PRIMARY SPECIES CONTRIBUTING TO THE GROUP SIMILARITY.**

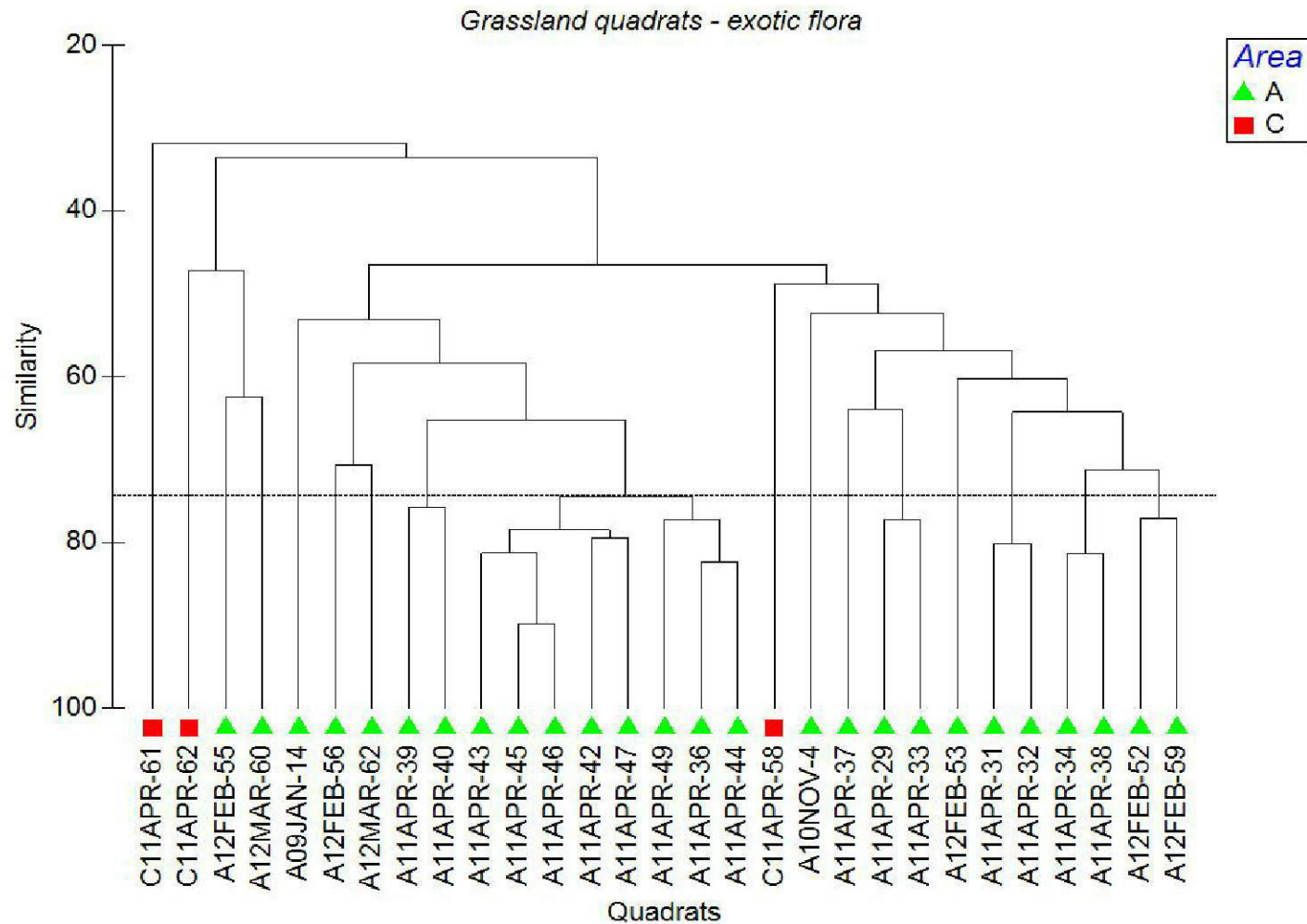
Data type	Area	Group similarity (%)	Main contributing species	% contribution to similarity
Grassland Quadrats – flora abundance data	A	43.71	<i>Axonopus fissifolius</i>	8.61
			<i>Senecio madagascariensis</i>	7.88
			<i>Setaria parviflora</i>	7.62
	C	38.39	<i>Bothriochloa decipiens/macra</i>	8.93
			<i>Hypochaeris radicata</i>	7.91
			<i>Senecio madagascariensis</i>	7.51
Grassland Quadrats – Native flora abundance data	A	38.07	<i>Fimbristylis dichotoma</i>	13.91
			<i>Cynodon dactylon</i>	13.39
			<i>Centella asiatica</i>	10.59
	C	37.20	<i>Bothriochloa decipiens/macra</i>	14.60
			<i>Glycine tabacina</i>	11.28
			<i>Vittadinia spp.</i>	9.55
Grassland Quadrats – Exotic species abundance data	A	52.04	<i>Axonopus fissifolius</i>	17.38
			<i>Senecio madagascariensis</i>	16.29
			<i>Setaria parviflora</i>	15.72
	C	40.19	<i>Hypochaeris radicata</i>	20.60
			<i>Senecio madagascariensis</i>	19.95
			<i>Conyza bonariensis</i>	18.33

**Table D.6 STATISTICAL COMPARISON OF CUMBERLAND LAND SNAIL NUMBERS BETWEEN DIFFERENT SECTIONS OF THE STUDY AREA**

Data type	Normality test (Shapiro – Wilks test)	Homogeneity of Variances test (Levene’s test)	Comparative test utilised	Test statistic	Test statistic p-value	Post Hoc tests					
						A & B		A & C		B & C	
						U	p	U	p	U	p
Live	✓	✓	ANOVA	1.984	0.180	n/a	n/a	n/a	n/a	n/a	n/a
Shells	✓	×	Kruskal – Wallis	8.916	<b>0.012</b>	3.50	0.055	0.00	<b>0.008</b>	5.00	0.104
Totals	✓	×	Kruskal - Wallis	8.873	<b>0.012</b>	6.00	0.172	0.00	<b>0.008</b>	3.00	0.034

**Bold & Italics** = Significant results





**Figure D.1 SIMILARITY DENDROGRAM OF EXOTIC SPECIES AMONG GRASSLAND QUADRATS. SLICE INDICATES 75% SIMILARITY LEVEL.**

Table D.7 CLUSTER WITH >75% SIMILARITY (SIMPER) IN EXOTIC VEGETATION COMPOSITION IN GRASSLAND QUADRATS				
Cluster	Quadrats	Group similarity	Main contributing species	% contribution to similarity
1	A11Apr-39, A11Apr40	75.75	<i>Paspalum dilatatum</i>	15.59
			<i>Axonopus fissifolius</i>	11.02
			<i>Eragrostis curvula</i>	11.02
2	A11Apr-36, A11Apr-42, A11Apr-43, A11Apr-44, A11Apr-45, A11Apr-46, A11Apr-47, A11Apr-49	76.95	<i>Paspalum dilatatum</i>	18.15
			<i>Axonopus fissifolius</i>	17.52
			<i>Eragrostis curvula</i>	17.13
3	A11Apr-29, A11Apr-33	77.15	<i>Senecio madagascariensis</i>	14.80
			<i>Verbena bonariensis</i>	14.80
			<i>Conyza bonariensis</i>	12.08
4	A11Apr-31, A11Apr-32	80.15	<i>Axonopus fissifolius</i>	25.95
			<i>Eragrostis curvula</i>	25.95
			<i>Hypochaeris radicata</i>	20.10
5	A11Apr-34, A11Apr-38	81.32	<i>Setaria parviflora</i>	17.98



Table D.7 CLUSTER WITH >75% SIMILARITY (SIMPER) IN EXOTIC VEGETATION COMPOSITION IN GRASSLAND QUADRATS				
Cluster	Quadrats	Group similarity	Main contributing species	% contribution to similarity
			<i>Hypochaeris radicata</i>	15.57
			<i>Eragrostis curvula</i>	15.57
6	A12Feb-52, A12Feb-59	77.1	<i>Axonopus fissifolius</i>	16.04
			<i>Hypochaeris radicata</i>	12.42
			<i>Senecio madagascariensis</i>	12.42

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*Appendix E*

**Actions Prescribed by the Final Recovery  
Plan for the Cumberland Plain**

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**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
Building the protected area network	Page 14 - Recovery Objective 1: To build a protected area network, comprising public and private lands, focused on the priority conservation lands (PCL)	Recovery objective subdivided into several actions. 1.1, 1.2. 1.3 and 1.6 not applicable to management plan as they are responsibility of OEH (listed as DECCW in CPW plan). Actions 1.4 and 1.5 potentially applicable to management plans as they refer to acquisition of lands for inclusion into protection and assurance of offsets where impacts are unavoidable respectively	Possible statement in management plan acknowledging that appropriate local council/govt dept will be contacted in the event of future rezonation/change of development plans	Feral and Domestic Animal Management Stragety (FDAMS) - No	FDAMS not really applicable as area covered by plan is not a PCL. Only potential relevance may be Action 1.5 - offsets where impacts are unavoidable - which has a note on offsets in Growth Centres. May need to state in sections 3.1.3 (Pg 3.2) and 3.1.6 (Pg 3.4) that planting of native shrubs is in accordance with the Growth Centres Biodiversity Certification Order as well as Asset Protection Zone requirements?
				Weed Management Plan (WMP) - No	WMP not really applicable as area covered by plan is not a PCL. Action 1.5 may have some relevance as clearing for development will remove native vegetation as well as

**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					the weeds. Could make statement in Section 4.2.3 (Pg 4.4) and/or 4.3.1 (pg 4.5) that loss/disturbance of native vegetation within development site does not affect local long-term survival of native species as adjacent Regional Park has sustainable populations (refer to 2009 WP Biodiversity assessment)
				Macrofauna Management Plant (MFMP) - Yes	MFMP indirectly addresses Action 1.4 as Chapter 1, Section 1.3.1 (pg 1.9) states that St Mary's Property has been zoned into urban development and regional park areas, thus lands for inclusion into protection are acquired. Action 1.5 (offsets) not relevant as plan deals



**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					with fauna. Presence of park indicates offset area for flora
Delivery of best practise management strategies	Page 16: Recovery Objective 2: To deliver best practice management for threatened biodiversity across Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation	Recovery objective subdivided into several actions. 2.1, 2.4, 2.6, 2.7 not applicable to management plan as they are govt dept responsibilities or refer to Priority Conservation lands. Actions 2.2, 2.3 and 2.5 all refer to best management practices outlined in Appendix 2 which has relevant sections detailed below. Actions 2.3 and 2.5 not directly relevant as they refer to local, state and Australian government lands. Action 2.2 highly relevant as it refers to public and private lands	Responses to relevant sections of Appendix 2 required. Point 2 is relevant as it refers to public lands compatible with primary management objective. Point 3 also relevant as it deals with private land.	FDAMS - Yes WPS - Yes MFMP - Yes	Detailed in following points
Appendix 2 - Best practice standards for bushland management	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with primary management objective	Requirement 1: a site action or management plan to be prepared which addresses the management of threatened biodiversity and is consistent with the recovery plan	Development of management plan consistent with recovery plan	FDAMS - Yes	FDAMS: Chapter 3, Section 3.1.1 (Pg 3.1) and 3.2 (Pg 3.6) Overall management strategy acknowledges that threatened flora, fauna and EECs have to be protected

**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					from feral/stray and domestic animals
				WMP - Yes	WMP: Chapter 4, Section 4.1 (Pg 4.1) acknowledges the different threats weeds pose to native vegetation and habitats
				MFMP - yes	Chapters 4 and 5 cover issues that necessitate fauna population management. While they deal with macrofauna, these comply with recovery plan as they indirectly aid in protecting/regeneration of the CEEC.
	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with primary management objective	Requirement 2: the land to be managed in accordance with the site action or management plan	Procedures/Strategies to execute management plan	FDAMS - Yes	FDAMS - Chapter 3, Sections 3.1.2 - 3.1.8 and Section 3.2 outline procedures for MP execution to prevent feral/domestic animals effects



**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					on native flora/fauna and prevent/reduce access to adjacent PCL.
				WMP - Yes	WMP - Chapter 4, Sections 4.2, 4.3 and Appendix C provide details on procedures to remove/reduce spread of weeds. Explicit mention of protecting adjacent Regional Park by preventing weed infestations mentioned on pg 4.3.
				MFMP - yes	Chapters 7 - 12 outline various protocols/strategies for implementing management issues identified in Chapters 4-5.
	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with primary management	Requirement 3: Monitoring to be undertaken periodically to determine the status of threatened entities, or to assess the effectiveness of threat	Periodic monitoring using monitoring methods listed in Hughes article	FDAMS - No	No mention of ongoing monitoring of feral population numbers or of corresponding responses of native

**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
	objective	abatement measures being implemented (for guidance see the Monitoring manual for bitou bush control and native plant recovery (Hughes et al. 2009) at <a href="http://www.environment.nsw.gov.au/bitouTAP/monitoring.htm">www.environment.nsw.gov.au/bitouTAP/monitoring.htm</a> )			flora/fauna species. Hughes article not really applicable as it deals with methods for monitoring flora not fauna
				WMP - Yes	Monitoring of weed populations along with ongoing review of strategy outlined in Chapter 5 with timeline for procedures outlined in Appendix E. Methodolgy for Long term Monitoring (Section 5.2) not specifically mentioned but it is stated that methods used in this WMP (transects - which is one of the methods listed in Hughes 2009) be used. No methods/reference link for methods mentioned for Short term monitoring (Section 5.1)
				MFMP - yes	Methods for ongoing



**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					monitoring for macrofauna as well as flora outlined in Sections 13.1.1 - 13.1.4
	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with primary management objective	Requirement 4: Management to be consistent with the following documents (Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland (DEC 2005a); recommended fire regimes in Appendix 3) , and any other best practice documents that OEH (DECCW) may promote at a later date. A landscape-scale response to African Olive invasion on the Cumberland Plain (as per completion of action 2.6)	Appropriate references have to be incorporated/references in management plan	FDAMS - No	FDAMS - N/A as fire regimen not included in MP. May need to reference the DEC document with regard to planting of native shrubs? Action 2.6 is responsibility of OEH (DECCW) and is not applicable to this MP as the focus is on fauna
				WMP - Yes	WMP - Fire regimes N/A as it is not used as a weed control method. Action 2.6 is responsibility of OEH (DECCW) but plan is in compliance as control and removal of African Olive is covered (Appendix C, Section C.3) Recovering Bushland document not

**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					referenced. Important/Relevant sections of Recovering Bushland document are chapter 2 (pg 16, pg 21, pg 25?) and Chapter 4 (pg 38, )
				MFMP - yes	Recovering bushland documents highlights need to reduce overgrazing (and it's side effects like erosion). Reducing of grazing pressure is explicitly stated in Chapter 12, Section 12.3 as an outcome of controlling Macrofauna populations. However previous section does state that some weed species may increase (pg 12.3, dot point 4) which may be contradictory. Fire regimen and African Olive invasion N/A as plan is



<b>Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN</b>					
<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					focussed on macrofauna
Appendix 2 - Best practice standards for bushland management	Page 31: Appendix 2, Point 3: Bushland on private lands	Requirement 1: a site action or management plan to be prepared which addresses the management of threatened biodiversity and is consistent with the recovery plan	Development of management plan consistent with recovery plan	FDAMS - Yes	FDAMS: Chapter 3, Section 3.1.1 (Pg 3.1) and 3.2 (Pg 3.6) Overall management strategy acknowledges that threatened flora, fauna and EECs have to be protected from feral/stray and domestic animals
				WMP - Yes	WMP: Chapter 4, Section 4.1 (Pg 4.1) acknowledges the different threats weeds pose to native vegetation and habitats
				MFMP - yes	Chapters 4 and 5 cover issues that necessitate fauna population management. While they deal with macrofauna, these comply with recovery plan as they indirectly aid in

**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					protecting/regeneration of the CEEC.
	Page 31: Appendix 2, Point 3: Bushland on private lands	Requirement 2: the land to be managed in accordance with the site action or management plan	Procedures/Strategies to execute management plan	FDAMS - Yes	FDAMS - Chapter 3, Sections 3.1.2 - 3.1.8 and Section 3.2 outline procedures for MP execution to prevent feral/domestic animals effects on native flora/fauna and prevent/reduce access to adjacent PCL.
				WMP - Yes	WMP - Chapter 4, Sections 4.2, 4.3 and Appendix C provide details on procedures to remove/reduce spread of weeds. Explicit mention of protecting adjacent Regional Park by preventing weed infestations mentioned on pg 4.3.
				MFMP - yes	Chapters 7 - 12 outline various protocols/strategies



**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					for implementing management issues identified in Chapters 4-5.
	Page 31: Appendix 2, Point 3: Bushland on private lands	Requirement 3: Management to be consistent with the following documents [Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland (DEC 2005a); recommended fire regimes in Appendix 3], and any other best practice documents that OEH (DECCW) may promote at a later date	Appropriate references have to be incorporated/references in management plan	FDAMS - Yes	FDAMS - N/A as fire regimen not included in MP. May need to reference the DEC document with regard to planting of native shrubs?
				WMP - Yes	WMP - Fire regimes N/A as it is not used as a weed control method. Recovering Bushland document not referenced. Important/Relevant sections of Recovering Bushland document are chapter 2 (pg 16, pg 21, pg 25?) and Chapter 4 (pg 38, )
				MFMP - yes	Recovering bushland documents highlights need to reduce overgrazing (and it's

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
					side effects like erosion). Reducing of grazing pressure is explicitly stated in Chapter 12, Section 12.3 as an outcome of controlling Macrofauna populations. However previous section does state that some weed species may increase (pg 12.3, dot point 4) which may be contradictory. Fire regimen N/A as plan is focussed on macrofauna
Community awareness	Page 17: Recovery Objective 3: To develop an understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its	Recovery objective subdivided into several actions. Actions 3.1, 3.2, 3.3, 3.6 and 3.7 not relevant as they are council or OEH responsibilities. Actions 3.4 and 3.5 may have some relevance as they refer to OEH and local councils working collaboratively with landowners and other organisations to increase awareness	Statement in management plan communication section addressing potential methods for raising awareness of issues in recovery plan if necessary	FDAMS - Yes  WMP - Yes	FDAMS: Section 2.2 (Pg 2.8); Section 3.1.1 (pg 3.1); Section 3.2 (Pg 3.6) and Section 3.3 (Pg 3.7)  WMP: Chapter 4, Section 4.2.4 (Pg 4.5). Could potentially be expanded to have more regular updates/awareness programs



**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
	management, and the recovery program	of best practice standards and opportunities for further involvement/participation in the recovery program			on importance of weed control.
				MFMP - yes	Initiation of a environmental education program explicitly mentioned in Chapter 7, section 7.10. However this is not clearly divided into separate programs for the Park area and the development area
Continued research/monitoring and data updates	Page 19: Recovery Objective 4: To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner	Recovery objective subdivided into several actions. Actions 4.1, 4.2 and 4.6 not relevant as they are council or OEH responsibilities. Action 4.4 not directly relevant but deals with compliance and enforcement programs dealing with unauthorised clearing of bushland. Local councils and OEH responsible for carrying out Actions 4.3 and 4.5 respectively, which deal with reviewing biodiversity	Make a statement in management plan that all required permits for clearing were acquired thus removing any potential issues with regard to Action 4.4. Actions 4.3 and 4.5 can be addressed via statements indicating ongoing development of management plans and proper communication within legal channels of any future changes in development plans.	FDAMS - No	FDAMS - N/A as all actions are to be carried out by government bodies. However could add statement in Conclusion that MP strategy will be reviewed and revised according to feral animal responses
				WMP - Yes	WMP - Chapter 5 and Appendix E specify ongoing monitoring, annual reviews

**Table E.1 COMPLIANCE WITH CUMBERLAND PLAIN RECOVERY PLAN**

<i>Topics to address</i>	<i>CPW recovery plan objectives</i>	<i>Relevant sections</i>	<i>Required action</i>	<i>Objective addressed in Cumberland Ecology management plan</i>	<i>Relevant Cumberland Ecology Management plan/section</i>
		strategies and establishing development notification frameworks. But these may be relevant as they include areas around the priority conservation lands			and adaptive management timeframes for weed control which will ultimately aid in protecting adjacent Park
				MFMP - yes	MFMP has been developed as an adaptive management plan and Chapter 13 covers multiple issues that will contribute to ongoing development and improvement of management plan (including liasions and reviews) thus indirectly complying with requirement of improving management capacity/strategy



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*Appendix F*

**Staff CVs**

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# Dr. David Robertson, Director

## Curriculum Vitae

### Summary

Dr David Robertson's ecological career has spanned 27 years since completion of his PhD at Melbourne University in 1985. He is a specialist ecologist with expertise in both botany and zoology and has worked as an ecological consultant since 1993.

During part of his career, David has also been a lecturer in plant taxonomy, plant ecology and freshwater ecology at Charles Sturt University and Australian Catholic University. This has developed his capability to work in both aquatic and terrestrial flora and fauna inventory, management of threatened species, ecological risk assessment, wetland rehabilitation and management, and ecological research for environmental impact assessment.

Throughout his career, David has worked on a wide variety of ecological projects. This includes ecological projects across Australia, including New South Wales, Queensland, ACT, Victoria, Tasmania and Western Australia. He has also gained international experience as the senior ecologist involved with consultancies in Hong Kong, Sri Lanka and the Philippines.

Since the inception of Cumberland Ecology Pty Ltd in 2003, David and his team of ecologists at Cumberland Ecology have worked on ecological investigations throughout NSW, averaging 60-80 projects per year. They have worked extensively within the Hunter Valley, Gunnedah Basin, Sydney Region, on coastal projects and in the Western Blue Mountains.

David has had, and continues to have, direct involvement in many large-scale vegetation mapping and flora and fauna impact assessment projects.

David has worked on many projects that entail the preparation of ecological offsets and Cumberland Ecology has been engaged to monitor such offsets. Cumberland Ecology has helped to formulate offsets for many mining projects in NSW, and also for mines in north Queensland and in Mindanao. Under David's direction, an array of monitoring work has been and is being conducted at sites in the Hunter Valley, Gunnedah, Coffs Harbour and Western Sydney.





## Education

David undertook his tertiary education at Melbourne University, completing a Bachelor of Science majoring in botany and zoology. This included a thesis submitted as part of the requirements for the B.Sc. Honours Degree at The University of Melbourne School of Botany:

**Aspects of the Ecology of *Eucalyptus sideroxylon* (A. Cunn, ex W. Wool) at Point Addis, Victoria (November 1980).**

He completed his Doctor of Philosophy in 1985 at the School of Botany, which was entitled::

**Interrelationships between Kangaroos, Fire and Vegetation Dynamic at Gellibrand Hill Park, Victoria (August 1985).**

## Professional Memberships and Affiliations

Currently David is a member of:

- Ecological Society of Australia
- Ecological Consultants Association of NSW
- He is also an accredited BioBanking Assessor.

## Employment History

David has lectured in ecology and aquatic biology at Charles Sturt University. Consultancy employment includes as a senior ecologist with the Australian Museum, senior ecologist in charge of the Ecological Services Practice for ERM Australia, and Director of Cumberland Ecology (current).

Employer	Position	Date
Cumberland Ecology Pty Ltd	Director	2003 - 2012 (ongoing)
Environmental Resources Management	Senior Ecologist	1997-2003
Australian Catholic University	Lecturer	1998-1999 (part time)
Australian Museum Business Services	Senior Ecological Consultant	1995-1996
Charles Sturt University	Lecturer	1987-1994
University of Melbourne	Research Fellow	1986-1987



## Consultancy Experience

Recent consultancy work has included:

- Participation in numerous large ecological impact assessments and offsetting projects for mining projects in NSW, Queensland and Mindanao;
- Provision of expert testimony, acting as a Court appointed expert for the Land and Environment Court;
- Management of high level flora and fauna investigations for Environmental Impact Assessments;
- Development of ecological management plans;
- Habitat reconstruction;
- Development of offset packages for compensatory habitats; and
- Management of negotiations about the level of mitigation measures required for flora and fauna impacts.

David has worked on many projects that have required the provision of offsets and is currently engaged in monitoring offsets for a suite of projects across NSW. In 2011 he was engaged directly by Department of Planning to prepare a draft methodology for offsetting major projects and to do so he conducted a review of Australian and international literature on the subject. In recent years he has also been engaged by Department of Planning to review proposed mining offset packages for Cleary Brothers Sand Quarry at Gerroa, Ulan Mine Extension, Moolarben Mine Extension, Ravensworth Mine Extension and Anvil Hill Mine. He is also currently working on the development of an offset package for a large copper and gold mine in Mindanao in the Philippines.

In addition to the aforementioned project work, Dr Robertson and five of his staff have been trained in the use of BioBanking assessments and Dr Robertson is an accredited BioBanking practitioner. Biobanking is one means by which offsets can be evaluated using a systematic, landscape scale of assessment. Cumberland Ecology has conducted many such assessments of projects large and small since the inception of this method.

## Consultancy Publications (examples)

### ***Relevant Australian Projects***

Cumberland Ecology (2012). Project Stone: Terrestrial and Aquatic Ecology Assessment Report. Prepared for Hansen Bailey on behalf of Macmines Austasia Pty Ltd. Carlingford Court, NSW.





Cumberland Ecology (2012). Drayton South Ecology Impact Assessment Final Report. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2011). Maules Creek Coal Project: Ecological Assessment. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2011). Drayton South Project: Pre-feasibility Study Ecological Assessment. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2010). Bengalla Mine Development Consent Modification: Ecological Impact Assessment for a Section 75W Application for an Overburden Emplacement Area. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2010). Mount Pleasant Project Modification - Ecological Assessment. Prepared for Coal & Allied Operations Pty Limited. Carlingford Court, NSW.

Cumberland Ecology (2009). St Marys Property Western Precinct Stage 1 Development Applications: Supplementary Flora and Fauna Report. Prepared for Maryland Development Company. Carlingford Court, NSW, Cumberland Ecology.

Cumberland Ecology (2009). Mt Arthur Coal Consolidation Project. Ecological Assessment. Final Report. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2009). Mount Thorley Warkworth Gap Analysis Report. Carlingford Court, NSW.

Cumberland Ecology (2009). Calga Sand Quarry Southern Extension Ecological Assessment. Prepared for R.W. Corkery & Co. on behalf of Rocla Pty Ltd. Carlingford Court, NSW.

Cumberland Ecology (2006). Emirates Wolgan Valley Resort and Spa: Flora and Fauna Assessment for the Upgrade of Power Services. Prepared for HLA-Envirosciences. Carlingford Court, NSW.

### ***Philippines Projects***

Cumberland Ecology (2010). Tampakan Copper - Gold Mine Project - Off-Lease Linear Infrastructure Terrestrial and Freshwater Ecological Assessment. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2010). Tampakan Copper - Gold Mine Project - Tampakan Power Station, Port & Filter Plant ESIA. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2010). Tampakan Copper-Gold Mine Project - Terrestrial Ecological Assessment. Prepared for Hansen Bailey. Carlingford Court, NSW.



### **Monitoring Reports**

Cumberland Ecology (2011). Ecological Monitoring Report: Mt Arthur Coal Flora and Fauna Monitoring Program - Summer 2011. Prepared for BHP Billiton. Carlingford Court, NSW.

Cumberland Ecology (2009). Mt Arthur Coal 2008 Flora and Fauna Monitoring Program - draft Ecological Monitoring Report. Prepared for Mt Arthur Coal. Carlingford Court, NSW, Cumberland Ecology Pty Ltd.

Cumberland Ecology and Greenloaning Biostudies (2007). Vertebrate Pest Management Results Summary,. For: Department of Commerce. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2007). Ecological Monitoring Report for Threatened Species, Weeds and Vertebrate Pests (Autumn 2007),. Prepared for The Clarence Valley and Coffs Harbour Regional Water Supply Project. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2008). Ecological Monitoring Report for Threatened Species, Weeds and Vertebrate Pests (Autumn 2008). Prepared for Clarence Valley Council. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2009). Ecological Monitoring Report for Threatened Species, Weeds and Vertebrate Pests (Autumn/ Winter 2009). Prepared for Clarence Valley Council. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2012). Ecological Monitoring Report for Threatened Species, Weeds and Vertebrate Pests (Autumn 2011). Prepared for Clarence Valley Council. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2012). Ecological Monitoring Report for Threatened Species, Weeds & Vertebrate Pests (Spring/Summer 2011). Prepared for Clarence Valley Council. Carlingford Court, NSW.

### **Peer Reviews**

Cumberland Ecology (2012). Peer Review of State and Commonwealth Ecological Impact Assessment Reports for the Proposed Mount Penny Coal Mine, Bylong. Prepared for Wells Environmental Services. Carlingford Court, NSW.

Cumberland Ecology (2011). Peer Review of Wallarah Underground Coal Project. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2011). Re Peer Review of EcoLogical Report: "Proposed Framework for Assessing the Cumulative Risk of Mining on Natural Resource Assets in the Namoi Catchment". Prepared for Aston Resources. Carlingford Court, NSW.

Cumberland Ecology (2010). Review of Response to Submissions Relating to Continued Operations at Ulan Coal. Prepared for Department of Planning. Carlingford Court, NSW.





Cumberland Ecology (2010). Re: Review of Revised Statement of Commitments and Offset Strategy - Moolarben Coal Project. Prepared for Department of Planning. Carlingford Court, NSW.

## Conference Papers

Robertson, D. J. (2011). Tampakan Copper-Gold Project - Analysis of the Fauna and Vascular Flora of the Tampakan project area, Mindanao, Philippines (110725\_Botanical Congress[final].pptx) International Botanical Congress. Melbourne.

Robertson, D. J. (1983). Vegetation management towards native mammal reintroduction at Gellibrand Hill State Park. Royal Australian Institute of Parks and Recreation 56 th National Conference. Latrobe University.

Robertson, D. J. (1991). Macrobenthic communities in four billabongs of the Murrumbidgee River: seasonal changes versus water quality. Australian Society for Limnology. Lorne.

Murray, P. and D. Robertson (1993). Methods for rapid assessment of macroinvertebrate communities using multivariate analysis. Australian Society for Limnology. Calloundra.

Hardwick, L., D. Robertson, et al. (1995). The relationship between macroinvertebrate communities and riparian vegetation in Tarcutta Creek, a lowland tributary of the Murrumbidgee River, NSW.

## Academic Publications

Robertson, D. J. and C. Nannestad, (eds.). (1994). Proceedings of the forum on European Carp. Wagga Wagga, NSW, Murrumbidgee Catchment Management Committee.

Wark, M. C., M. D. White, D. J. Robertson, and P. F. Marriot. (1987). Regeneration of heath and heath woodland in the North Eastern Otway Ranges following the wildfire of February 1983. Proceedings of the Royal Society of Victoria **99**:51-88.

Wilson, B. A. and D. J. Robertson (1990). "Factors affecting small mammal distribution and abundance in the Eastern Otways." Proceedings from the Ecological Society of Australia, **39**(2): 35-40.

Holdway, D. A., M. J. Barry, D. Logan, and Robertson, D.J (1994). "Acute toxicity of pulse-exposed fenvalerate and esfenvalerate to larval crimson-spotted rainbow fish (*Melanotaenia fluviatilis*)". Aquatic Toxicology.

Robertson, A. I., A. J. King, M. R. Healey, D. J. Robertson, and S. Helliwell (1995). "The Impact of Carp on Billabongs". Prepared for the Environment Protection Authority, NSW, Riverina Region

# Vanessa Orsborn

## *Project Manager / Ecologist*



**Vanessa Orsborn** has worked as a Project Manager and Ecologist for over seven years and has excellent communication skills and relations with clients and government bodies. Vanessa primarily manages flora and fauna assessments and related Section 5A and State Significant Project Assessments under the EP&A Act as well as assessments under the EPBC Act.

### **Fields of Competence**

- Commonwealth and State environmental legislation,
- Ecological survey and monitoring, particularly assessment of threatened species and ecological communities,
- Report writing and liaison with government departments.

### **Key Industry Sectors**

- Urban development
- Natural Resource Management
- Power & Renewable Energies

### **Education**

Bachelor of Environmental Science. Australian Catholic University 2004.

### **Key Projects**

#### **Coal Mine Consent Modification Projects**

Since 2010, Vanessa has managed the ecological assessments for several Major Project applications for various coal mines in the Upper Hunter Valley, including Muswellbrook Coal, Bengalla Mine and Mount Pleasant project. Assessments have included consideration of offset requirements, particularly in relation to Box Gum Woodland and other vegetation communities listed under the TSC Act and EPBC Act.

#### **M2 Upgrade – Leighton Contractors**

Since 2011, Vanessa has managed the ecological approvals and (current) construction phase of the M2 Upgrade project. Vanessa has prepared extensive documentation to satisfy approval conditions including

mitigation and offset strategies. During construction, she has led a team of ecologists to ensure the safe handling of fauna disturbed during clearing.

#### **St Marys Development – Delfin Lend Lease**

Vanessa has been involved with the progression of the former ADI site at St Marys, Western Sydney, mainly in the preparation of impact assessments and also constraints analysis during Precinct Planning. Recent assessments have included the preparation of a large scale Species Impact Assessment for the Western Precinct developments proposals.

#### **Emirates Wolgan Valley Resort & Spa**

In 2006, Vanessa project managed the EPBC Act assessment process for Emirates Wolgan Valley Resort, Lithgow. This involved the production of a Public Environment Report including community and government consultation and associated documentation.

Since construction approval, Vanessa has prepared an Operations Manual which outlines all future environmental works, monitoring and reporting, while demonstrating compliance with Consent Conditions.

#### **Macropod Management – Dept of Defence**

Vanessa has worked on a number of kangaroo management projects for Defence. Her experience with the methods used for kangaroo census have allowed for adaptation to other macropod species in other projects, such as Brush-tailed Rock-wallabies.

#### **Ecological Management - Dept of Defence**

During her time as an ecologist at Sinclair Knight Merz (2007-2009), Vanessa prepared a Pest Animal Management Strategy for Shoalhaven Defence Estate and conducted surveys and monitoring for the preparation of a threatened



species database for Defence Estate Orchard Hills.

#### **Windfarm and Powerline Projects (SKM)**

Vanessa conducted surveys and prepared impact assessment reports for several Wind Farm and 330kV Transmission Line extension projects. These projects involved issues specific to the industry, such as assessing bird and bat strikes and developing mitigation measures for these impacts.

#### **Pacific Highway Upgrade – RTA (SKM)**

Vanessa participated in fauna surveys for the Warrell Creek to Urunga Pacific Highway Upgrade and contributed to the comprehensive Environmental Impact Statement for the total project.

#### **Aquatic and riparian monitoring - Sydney Catchment Authority (SKM)**

Vanessa was involved with riparian vegetation condition monitoring and water quality assessments for the Avon Dam Environmental Flows Study.

# Dr Gitanjali Katrak

## *Project Manager / Ecologist*



**Gitanjali Katrak** is an Ecologist at Cumberland Ecology based in Sydney. She has a Bachelor of Sciences (Biological Sciences) with Honours and a PhD in intertidal wetland ecology.

Gitanjali has been involved in several projects involving development and review of management plans, flora and fauna assessments, mining projects in NSW vegetation mapping, biobanking and Land and Environment court cases. Gitanjali has experience in flora and fauna surveys, fauna population studies, biogeochemistry and statistical analyses.

Gitanjali has completed her PhD, specialising in ecological interactions in mangroves and saltmarshes. Concurrent with her PhD, she was employed as an Associate Lecturer at Flinders University, teaching marine & terrestrial ecology and zoology. She is also an experienced public speaker and has done presentations at national and international conferences.

Recent consultancy work has included:

- Flora and fauna impact assessments for Part 3A and Part 5 Projects
- Commonwealth Referral application for Part 3A Mine Project;
- Statistical analyses for legal court cases and ongoing monitoring programmes; and
- Impact assessment and offsetting for mining projects.

### **Fields of Competence**

- Flora and fauna surveys
- Ecological survey methods
- Invertebrate fauna taxonomy
- Biogeochemistry

- Statistical analyses
- Commonwealth Environment Protection and Biodiversity Conservation Act 1999;
- NSW Threatened Species Conservation Act 1995

### **Education**

Bachelor of Science (Honours) in Biological Sciences, La Trobe University, VIC. 2002

Doctor of Philosophy, Intertidal Wetland Ecology. Flinders University, SA. 2011

### **Key Projects**

#### ***Threatened Species Assessment***

Gitanjali has assisted on projects with threatened species and/or endangered ecological community issues in assessing responses to threatened species legislation, including the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the NSW Threatened Species Conservation Act 1995

#### ***Flora and fauna surveys***

Gitanjali has been involved in ecological assessments including Species Impact Statements and Flora and Fauna Assessments as part of development applications for a variety of projects. These include residential subdivisions in the greater Sydney Metropolitan area and mining projects in the Wyong area.

#### ***Statistical analysis***

Gitanjali has experience conducting statistical analyses, using programmes such as SPSS and PRIMER, to determine biological patterns and community structure.



# Michelle Frolich

## GIS Specialist



**Michelle Frolich** is a Sydney based GIS specialist at Cumberland Ecology. She has a Bachelor of Science (Marine Science) (Honours) degree.

Michelle has detailed technical knowledge and experience in the interpretation and production of mapping products, including topographic modelling as well as classification and feature extraction using aerial photography and satellite imagery. At Cumberland Ecology, Michelle is closely involved in all major projects and responsible for GIS development, mapping and analyses as well as the training of staff in GIS.

Recent consultancy work has included:

- GIS mapping and analysis for various mining projects for Environmental Assessments, Biodiversity Management Plans, NSW Part 3A project applications and Referrals under the Commonwealth EPBC Act.
- Vegetation, threatened flora and fauna mapping for a large-scale project for a NSW government agency.

GIS vegetation mapping and analysis for a large scale project in the Philippines.

### Fields of Competence

- Geographic Information Systems (GIS)
- Image and spatial data analysis
- Completed DECCW BioBanking Assessors Training Course.
- Coastal and estuarine morphodynamics
- Data and project management

### Key Industry Sectors

- Urban Development;
- International Developments;
- Extraction industry; and
- Government Utilities.

### Education

Bachelor of Science (Marine Science) (Honours), University of Sydney (2007)

### Key Projects

#### *NSW Mining Projects*

Michelle has extensive experience working on GIS mapping for Part 3A Major Projects relating to mining in the Central Hunter Valley. She has been involved in the GIS mapping of vegetation communities, threatened flora and fauna species and produced detailed maps for field surveys.

#### *International projects*

Michelle has been working on the vegetation mapping of a mining project in Mindanao, Philippines. She has been involved in the mapping of vegetation communities from field collected data and assisted in the production of detailed vegetation maps for an area of approximately 10,000ha. She has also produced detailed field and topographic maps for field teams to assist with navigation and field surveys.

#### *Western Sydney Government Utilities*

Michelle has been working extensively on a project for Sydney Water in Western Sydney, providing field maps for field surveys to identify vegetation communities. She has then taken field collected data and produced a vegetation map using GIS to assess the extent and condition of vegetation within the area of impact.

#### *Other Projects*

Michelle has also worked on several other small scale projects in Sydney and throughout NSW, using GIS for vegetation mapping, mapping of threatened flora and fauna species, production of field maps and image analysis. She has also assisted in the field and on BioBanking assessments.

**Cecilia Phu** is a project manager and ecologist at Cumberland Ecology based in Sydney. She has a Bachelor of Science (Honours) with a major in Biology.

Cecilia has been involved in a number of projects with threatened species or endangered ecological community issues and assessed projects in response to threatened species legislation.

Specifically, Cecilia has experience in conducting targeted flora surveys and mapping vegetation communities and manages projects in relation to Part 3A and Section 5A assessments as part of development applications for a variety of projects. These include residential subdivisions in the greater Sydney Metropolitan area.

Additionally, Cecilia has recently completed her Biobanking Assessors Training Course and is currently working on projects involving the Biobanking assessment pathway. Cecilia also has experience in community and population data analysis (SPSS and ePRIMER) and is able to collect, store and analyse geospatial data to provide key strategic advice to clients and department agencies (CivilCad, MapInfo).

Recent consultancy work has included:

- Flora and fauna impact assessment;
- Biobanking assessments;
- Vegetation community mapping;
- Development of bushland management plans with focuses on threatened species habitat management, weed control and bush regeneration; and
- Monitoring of impacts from approved activities on ecological issues.

### Fields of Competence

- Commonwealth Environment Protection and Biodiversity Conservation Act 1999;
- NSW Environmental Planning and Assessment Act 1979;
- NSW Threatened Species Conservation Act 1995;

- Completed Biobanking Assessors Training Course at TAFE Ryde;
- Ecological field surveys, biological monitoring and environmental impact assessment; and
- Geospatial Information Systems (GIS).

### Key Industry Sectors

- Urban development; and
- Extraction industry.

### Education

Bachelor of Science, University of Sydney, 2006

Bachelor of Science (Honours) in Biology. The University of Sydney, 2008

### Key Projects

#### *Vegetation Assessments of the Hunter Valley*

Cecilia has extensive experience with the flora issues of the Hunter Region, with a particular focus on threatened flora and threatened vegetation community issues related to various Development Applications including Part 3A Major Projects.

#### *Flora and Fauna Impact Assessments within the Sydney Metropolitan Area*

Cecilia has worked on many projects within the Sydney Metropolitan area. Cecilia has particular experience with Western Sydney and has been involved in a number of Part 3A assessments within the Sydney Growth Centres and the Western Sydney Employment Hub

#### *Threatened Species Assessment*

Cecilia has assisted with a number of projects with threatened species issues and assessed projects in response to threatened species legislation, including the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the NSW Threatened Species Conservation Act 1995.



**Aleksei Atkin** is an Ecologist at Cumberland Ecology based in Sydney. He has a Bachelor of Natural Science, majoring in Nature Conservation..

Aleksei has been involved in a number of projects with threatened species or endangered ecological community issues and assessed projects in response to threatened species legislation.

Specifically, Aleksei has experience in terrestrial restoration ecology, bush regeneration, flora and fauna surveys and mapping vegetation communities as part of development applications for a variety of projects. These include residential subdivisions and mining projects in the regional NSW.

Recent consultancy work has included:

- Flora and fauna impact assessments for Part 3A and Part 5 Projects
- Targeted threatened fauna searches;
- Vegetation community mapping; and
- Monitoring of impacts from approved activities on ecological issues.

### Fields of Competence

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;
- NSW *Threatened Species Conservation Act 1995*
- Bushland Regeneration
- Monitoring environmental restoration performance criteria
- Flora and fauna surveys
- Ecological field surveys, biological monitoring and environmental impact assessment; and

### Key Industry Sectors

- Urban development;
- Mining and Extraction industries
- Government utilities;

### Education

Bachelor of Natural Science majoring in Nature Conservation. University of Western Sydney

### Key Projects

#### ***Threatened Species Assessment***

Aleksei has assisted with a number of projects with threatened species and/or endangered ecological community issues and assessed projects in response to threatened species legislation, including the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the NSW Threatened Species Conservation Act 1995.

#### ***Flora and Fauna Impact Assessment***

Aleksei has been involved in numerous ecological assessments including Species Impact Statements and Flora and Fauna Assessments as part of development applications for a variety of projects. These include linear infrastructure projects in the greater Sydney Metropolitan area

#### ***Other Projects***

Aleksei has been involved in extensive field work and many research projects, including biodiversity surveys, habitat assessments and targeted surveys.

## Curriculum vitae - David Thomas

*Address* 9 Miriam Road, Denistone NSW 2114

*Phone & Fax* (02) 9874 6581

*Email address* thomas\_surveys@optusnet.com.au

Member of Ecological Consultants Association

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### Areas of Expertise

- vegetation survey, assessment & mapping
- preparation of management plans for natural areas
- bushland reconstruction, rehabilitation & regeneration planning

### Employment History

**Environmental Consultant** (1994 to present)

- *Locations of Vegetation Surveys & Assessments* (as at June, 2003):

#### Northern Sydney

Bayview, Beacon Hill, Beecroft, Belrose, Buffalo Creek, Castle Cove, Castle Hill, Cheltenham, Church Point, Cowan, Cromer, Denistone, Duffys Forest, Dural, Eastwood, Epping, Glenorie, Gordon, Hornsby, Killara, North Epping, Palm Beach, Ryde (various), St. Ives, Shrimptons Creek, Brush Farm Park), Sydney Harbour NP, Terrey Hills, The Spit, Turramurra, Warriewood, West Pennant Hills, Willoughby

#### Western Sydney

Agnes Banks, Airids, Auburn LGA, Austral, Badgerys Ck, Berkshire Park, Blacktown, Cattai, Chullora, Doonside, Eastern Creek, Fairfield, Granville, Green Valley, Hoxton Park, Kellyville, Kemps Creek, Kingswood, Kurrajong, Kurmond, Leacock Regional Park, Lidcombe, Marayong, Marsden Park, Milperra, Mt Druitt, Newington, Nth Parramatta, Prestons, Prospect Reservoir, Quakers Hill, Riverstone, Rooty Hill, Rouse Hill development area, Rydalmere, St. Marys, Scheyville NP (part), Schofields, Seven Hills, Villawood, Warragamba, Wedderburn, Werrington



### **Southern & Eastern Sydney**

Alfords Point, Bondi Junction, Calsil Dune (Kurnell), Centennial Park, Coogee, Cronulla, LaPerouse, Matraville, Menai, Menangle, Narellan, Smiths Creek, Voyager Point, Vaucluse, Wedderburn, Woronora

### **Illawarra**

American Creek, Avon Water Catchment Area, Bellambi Colliery (Woronora Water Catchment Area), Berkeley, Blue Angle Creek (Gerroa), Bulli Pass, Cataract Water Catchment Area, Cordeaux Heights, Farmborough Heights, Minnamurra, Royal NP, Mt. Keira, Mt. Kembla, Spring Creek (Kiama), Stanwell Tops, Toolijooa, West Dapto, Wilton

### **Blue Mountains**

Bell, Glenbrook-Blackheath, Lapstone, Lawson-Nth Katoomba, Megalong Valley, Springwood, Wentworth Falls, Woodford

### **Country NSW**

Bargo, Brisbane Water NP, Glen Innes, Gosford-Port Stephens, Green Point (Lake Macquarie), HMAS Albatross (Nowra), Hunter Valley (Pokolbin-Scone), Iluka, Kincumber, Lake Munmorah, Menangle Park, Mt Penang, Nattai, Joorilands, Patonga, Picton, Singleton, Tahmoor, Taree, Tuncurry, Werriberri/The Oaks/Oakdale, Woy Woy, Yuragir NP

#### **• *Vegetation Mapping* (of plant community, &/or bushland condition)**

Prospect	Eastern Creek
Upper sections of creeks in Fairfield LGA	Singleton Army Training Area
Ryde LGA	Newington
Leacock Regional Park, Casula	Green Point, Lake Macquarie
Taree LGA (eastern half)	Sydney Harbour NP
Flat Rock Ck, Willoughby	Woronora (for DCP)
Voyager Point/Pleasure Point, Kemps Ck and Bonds Ck (in Liverpool LGA)	
Nth Katoomba	Carlton Stud, Picton
Wentworth Falls	Werriberri & Nattai Catchments

#### **• *Management Plans* (including site and impact assessment)**

Duffys Forest	Prestons	
Wilton sandstone quarry	Denistone Catchment (Ryde City Council)	
Kemps Ck	Camden Airport	Hoxton Park Airport
In part:	Prospect Reservoir recreational use	
	Flat Rock Ck, Willoughby	Stonequarry Ck, Picton

- ***Bushland Rehabilitation Planning and related work***
  - Eastern Suburbs Banksia Scrub at Bondi Junction
  - Chullora railway yards bushland corridor
  - City of Lithgow
  - Blue Mountains sewage treatment plants rehabilitation
  - Eastwood; planning & supervision of rehabilitation of railway embankment for City-Rail, and worksites in Brush Farm Park
  - Bush regeneration at Royal National Park and Dee Why
  - Leader of LEAP (Land Care & Environmental Action Program) team (bush regeneration training component) at Ryde Hospital bushland & Prospect Reservoir
  - Plant selection for rehabilitation work for M2 motorway, quarry at Cattai, Lambert - Park, Eastwood and part of Olympic site, Homebush Bay
  - Nth Ryde - Epping; identification of soil conditions/types for topsoil storage (for later rehabilitation) during M2 road construction

- ***Other Work:***

Member of Flora Team, Western Sydney Biodiversity Survey, NPWS (1996)

Contract botanical survey for NPWS for: Bargo, Gosford-Port Stephens-Upper Hunter, and Illawarra, Warragamba and Western Sydney mapping surveys

Preparation of Species Impact Statements for sites at Prestons, Bondi Junction, Belrose and Green Valley

Tree surveys for proposed residential developments at Berowra, Carigbar, Coogee, Eastwood, Epping, Nth Epping, Hornsby, Killara, Turramurra, Waitara, West Pennant Hills

Royal National Park - investigation of possible effect of vegetation on road accident

Peer review of vegetation surveys near Murwillumbah and at Darling Mills Ck, Baulkham Hills; Voyager Point, Liverpool; Upper Blue Mountains

**Environmental Officer, Sydney Water (1989-1994)**

Vegetation surveys throughout Board's area of operations

Plant community mapping and description of Katoomba & Blackheath Water Catchment Areas, & Prospect Reservoir

Preparation & supervision of revegetation & landscape plans for Prospect Reservoir



Supervision of field work for 96 students involved in a six month environmental training program (LEAP)

Selection and project management of bushland restoration projects (Sydney, Illawarra, & Blue Mountains)

Environmental assessment of potential impact of proposed construction works on bushland - including preparation of reviews of environmental factors

Advice on construction site management & restoration

Preparation of environmental management plan for Prospect Reservoir (1989) & later update *Prospect Reservoir Landuse & Environmental Management Plan* (1993)

Publication: *Rainforest Conservation Status in the Metropolitan and Woronora Catchment Areas*. 1990. Water Board - Sydney, Blue Mountains, Illawarra.

**Previous work in engineering:**

**Pumping Engineer** (Water Board, 1979-1989)

**Technical Inspector** (Dept. Labour & Industry, 1977-1978)

**Refrigeration/Air Conditioning Mechanic** (Royal North Shore Hospital, 1976)

**Marine Engineer** (Australian & overseas shipping companies, 1969-1976, 1978)

**Qualifications & Training**

Uncompleted BSc. (University of New England)

Biology	Geography
Identification of Australian Plants	Earth Mapping Technology
Aquatic Ecology	Pollination Biology
Ecology of Disturbed Communities	Australian Rainforests
Plant-Microbe Interactions	

Bush Regeneration Certificate TAFE, 1994

First Class Certificate of Competency for Steam & Motor Ships - Ministry of Shipping & Transport, 1974, 1977

Marine Engineering Technology Certificate, TAFE, 1969

Fitting & Machining Apprenticeship, Associated Steamships P/L, 1966-8

NSW Leaving Certificate (Matriculation), 1965

**CURRICULUM VITAE**

GLENN ALEXANDER HOYE

PO Box 271  
BELMONT NSW 2280  
Tel: (02) 49477 794  
Fax: (02) 49477 537

**ACADEMIC  
QUALIFICATIONS**

Bachelor of Science (Hons)  
University of Newcastle, 1993.

Bachelor of Engineering (Mining)  
University of New South Wales, 1981.

**MEMBERSHIP OF SCIENTIFIC SOCIETIES**

Australasian Bat Society (1992-2009)  
Royal Zoological Society of New South Wales (Scientific Member) (1980-2009)  
Australian Mammal Society (1982-2009)

**PROFESSIONAL EXPERIENCE**

Extensive survey and research of bats has been undertaken throughout Australia from 1980 until the present. This has included the survey of bats during private expeditions in Queensland (1982, 1986 & 1988), the Northern Territory (1988), Lord Howe Island (1986, 1997 & 1998) and Tasmania (1992). Bats have also been surveyed during expeditions of the Australian Geographic magazine to the Gulf of Carpentaria in 1990 and the Kings Canyon area of the Northern Territory in 1992. Extensive bat survey of eastern New South Wales and in particular the Hunter Valley has been undertaken from 1980 to the present.

December 1992 to present

BAT SPECIALIST  
FLY BY NIGHT BAT SURVEYS PTY LTD

Bat surveys have been undertaken and reports prepared for environmental impact statements, fauna impact statements and species impact statements.

Over seventy smaller reports have been prepared on bat surveys undertaken for environmental, fauna and species impact statements throughout New South Wales during this period.



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 CONFERENCE PRESENTATIONS

- Hoye, G.A. *Survey of Bats on Norfolk Island*. Spoken Presentation. Joint Symposium of the Royal Zoological Society of NSW and the ABS on the Biology and Conservation of Australasian Bats. Sydney, NSW. April 2007.
- Hoye, G.A. *Wing injury rates in the Eastern Bent-wing Bat (Miniopterus schreibersii oceanensis)*. Spoken Presentation. 12<sup>th</sup> Australasian Bat Conference. Auckland, New Zealand. April 2006.
- Hoye G. A. Fly By Night Bat Surveys Pty Ltd, 2006. *Recovery Plan for the large-eared pied bat Chalinobus dwyeri*. Queensland Parks and Wildlife Service, Brisbane.
- Hoye, G.A. *Bat Survey Methods and Standards – not just a stab in the dark*. Spoken Presentation. *Fauna survey guidelines*. A forum of the ECA of NSW. Sydney, Australia. November 2004.
- Hoye, G.A., Spate, A. & Steed, A. *A census of major maternity roosts of the Eastern Bent-wing Bat Miniopterus schreibersii oceanensis within New South Wales*. Spoken Presentation. 11<sup>th</sup> Australasian Bat Conference. Toowoomba, Queensland. April 2004.
- Hoye, G.A. *The Large Bent-wing Bat in urban environments. A survivor?* Spoken Presentation. *Urban Wildlife: More than meets the eye*. A forum of the RZS of NSW. Sydney, Australia. April 2002.
- Hoye, G.A. *The population dynamics and roosting ecology of Gould's Long-eared Bat (Nyctophilus gouldi) in a coastal urban environment*. Spoken Presentation. 10<sup>th</sup> Australasian Bat Conference. Cairns, Queensland. April 2002.
- Hoye, G.A. *The Large Forest Bat (Vespadelus darlingtoni) on Lord Howe Island*. Spoken Presentation. 9<sup>th</sup> Australasian Bat Conference. Tocal, New South Wales. April 2000.
- Hoye, G.A. *The Discovery of Two and Distinctive Maternity Roosts of the Large Bent-wing Bat in the Hunter Valley, NSW*. Spoken Presentation. 9<sup>th</sup> Australasian Bat Conference. Tocal, New South Wales. April 2000.
- Williams, C.R. & Hoye, G.A. *New Information on the Southern Limit of the Little Bent-wing Bat (Miniopterus australis) in New South Wales*. Poster Paper. 9<sup>th</sup> Australasian Bat Conference. Tocal, New South Wales. April 2000.
- Hoye, G.A. *The Exclusion and Subsequent Re-establishment of a Colony of Fishing Bats (Myotis adversus) from a bridge near Morisset, New South Wales*. Spoken Presentation. 8<sup>th</sup> Australasian Bat Conference. Rockhampton, Queensland. April 1998.
- Hoye, G.A. *Bats of the Sydney Region*. Spoken Presentation. *Urban Wildlife Ecology – the balancing act*. Lane Cove, New South Wales. October 1997.
- Hoye, G.A. *Address to Bat Survey Methods and Standards Workshop*. Spoken Presentation. 7<sup>th</sup> Australasian Bat Conference. Naracoorte, South Australia. April 1996.
- Hoye, G.A. *Wildlife Corridors in Mining Areas*. Spoken Presentation. *Workshop on Biological Diversity and Remnant Vegetation in the Hunter Valley*. Singleton, NSW. June 1995.
- Hoye, G.A. *The Conservation Status of Bats in the Hunter Valley*. Spoken Presentation. Seminar on "Conservation in the Hunter - Identifying the Issues". Environment Week at the University of Newcastle. Newcastle, NSW. September 1993.
- Hoye, G.A. *Habitat and Altitudinal Preferences of Vespadelus in the Hunter Region of NSW*. Spoken Presentation. 4<sup>th</sup> Australasian Bat Research Conference, Brisbane 1991.
- Hoye, G.A. *Bone Fluoride Levels in Bats Around an Aluminium Smelter at Tomago, NSW*. Spoken Presentation. 8<sup>th</sup> International Bat Symposium, Sydney 1989.

## PUBLICATIONS

- Hoye, G.A. and Milne, D.J. (2008) Forest Pipistrelle (*Pipistrellus adamsi*) in Van Dyck, S. & Strahan, R. ed. The Mammals of Australia. Third Edition. *Reed New Holland*, Chatswood. p.546-547.
- Hoye, G.A. and Richards, G.C. (2008) Greater Broad-nosed Bat (*Scoateanax rueppellii*) in Van Dyck, S. & Strahan, R. ed. The Mammals of Australia. Third Edition. *Reed New Holland*, Chatswood. p.551-552.
- Richards, G.C., Hoye, G.A., Lumsden, L.F., Law, B.S. and Milne, D.J. (2008) Large-footed Myotis (*Myotis macropus*) in Van Dyck, S. & Strahan, R. ed. The Mammals of Australia. Third Edition. *Reed New Holland*, Chatswood. p.544-545.
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- Reardon, T.B., Kutt, A.S., Richards, G.C. and Hoye, G.A. (2008) Inland Forest Bat (*Vespadelus baverstocki*) in Van Dyck, S. & Strahan, R. ed. The Mammals of Australia. Third Edition. *Reed New Holland*, Chatswood. p.560-561.
- Hoye, G.A., Herr, A. and Law, B.S. (2008) Large Forest Bat (*Vespadelus darlingtoni*) in Van Dyck, S. & Strahan, R. ed. The Mammals of Australia. Third Edition. *Reed New Holland*, Chatswood. p.562-563.
- Hoye, G.A. and Hall, L.S. (2008) Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) in Van Dyck, S. & Strahan, R. ed. The Mammals of Australia. Third Edition. *Reed New Holland*, Chatswood. p.507-508.
- Hoye, G.A. and Hall, L.S. (2008) Little Bent-wing Bat (*Miniopterus schreibersii oceanensis*) in Van Dyck, S. & Strahan, R. ed. The Mammals of Australia. Third Edition. *Reed New Holland*, Chatswood. p.503-504.
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