

# Environmental field survey of Commonwealth land at Badgerys Creek

Report prepared for Western Sydney Unit  
Department of Infrastructure and Regional Development

October 2014

## IMPORTANT NOTICE

---

This report is confidential and is provided solely for the use of the Western Sydney Unit, Department of Infrastructure and Regional Development ('the Client') in relation to management of the Commonwealth land at Badgerys Creek, Western Sydney. This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited ('SMEC') and the Client under which SMEC undertook to perform a specific and limited task for the Client. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. The executive summary is not a substitute for this. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. Subject to clause 7.3 (Defects Warranty) and clause 7.5 (Warranties Generally) of the Consultancy Agreement, this report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

Except as required under the Consultancy Agreement, SMEC does not accept a duty of care or any other legal responsibility whatsoever in relation to this report, or any related enquiries, advice or other work, nor does SMEC make any representation in connection with this report, to any person other than the Client.



## EXECUTIVE SUMMARY

---

### **Background to the current investigation**

The environmental status of the Commonwealth land at Badgerys Creek has been the subject of a number of past investigations. This includes environmental investigations undertaken for the Draft Environmental Impact Statement (EIS) that was completed in 1997 and the Supplement to the Draft EIS completed in 1999, both under the *Environment Protection (Impact of Proposals) Act 1974*. The purpose of this survey is to build upon the previous work relating to the environmental issues of the land and to bring the knowledge up to date. This current work interprets the findings of the survey in the context of current Commonwealth and NSW legislation and guidance materials.

### **Objectives**

The objectives of the survey are to:

- update existing baseline environmental information for the Commonwealth land at Badgerys Creek and specifically the status and condition of the site's flora, fauna, cultural heritage and hydrological features
- identify the national, state and regional significance of these environmental aspects in the broader environmental context of the area surrounding the site
- analyse any changes in status and condition since the last field surveys undertaken in the late 1990s and particularly in the context of the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- provide baseline data to inform any future environmental assessment(s) provide a benchmark against which past and future surveys can be compared
- make recommendations for possible future site survey program(s).

The environmental survey will be used to assist the Commonwealth to identify, analyse and consider options available for the existing and future management of the site.

### **Biodiversity**

The key findings of the biodiversity investigation noted the following with regard to flora:

- EPBC Act:
  - Two endangered ecological communities occur within the Commonwealth land at Badgerys Creek (Cumberland Plain Shale Woodlands and Shale–Gravel Transition Forest, Western Sydney Dry Rainforest and Moist Woodland on Shale)
  - Four individuals of *Pultenaea parviflora* were recorded on the southern side of Longleys Road between Ferndale and Taylors Road (this is a significant reduction from the 68 individuals previously recorded along both sides of Longleys Road in this location since the 1999 Supplement to the Draft EIS)
  - No other threatened flora species were recorded on site, however, potential habitat exists for a further five threatened flora species listed under the EPBC Act (*Acacia pubescens*, *Cynanchum elegans*, *Grevillea parviflora* subsp. *parviflora*, *Isotoma sessiliflora*, *Pimelea spicata*)
- TSC Act:
  - Four endangered ecological community occur within the Commonwealth land at Badgerys Creek (Cumberland Plain Woodland, Shale Gravel Transition Forest, Moist Shale Woodland, River-flat Eucalypt Forest on Coastal Floodplains)

- One individual of *Marsdenia viridiflora* (within the extent of the endangered population) was recorded along the eastern side of Badgerys Creek, just north of Gardiner Road
- Twelve new individual *Marsdenia viridiflora* were recorded on the southern side of Longleys Road between Ferndale and Taylors Road (refer Figure 2-2)
- Potential habitat exists for an additional two species and one endangered population listed under the TSC Act (respectively *Dillwynia tenuifolia*, *Grevillea juniperina* subsp. *juniperina* and *Dillwynia tenuifolia* (Kemps Creek endangered population)).
- Nine noxious weeds declared in the Liverpool LGA were observed in the study area, six of these are also Weeds of National Significance.
- The NSW Office of Water Risk assessment guidelines for groundwater dependent ecosystems indicate that several vegetation communities that occur within the study area are likely to be ‘high probability groundwater dependent ecosystems’.

The key findings of the biodiversity investigation noted the following with regard to fauna:

- The Commonwealth land contains low to moderate quality habitat, including riparian vegetation and grassy woodland vegetation.
- Badgerys Creek has been identified as a potential wildlife corridor in a number of local and regional planning documents.
- Potential habitat is available for threatened fauna species including the Cumberland Land Snail, woodland birds, microchiropteran bats and the Grey-headed Flying-fox.
- There is potential suitable habitat for seven migratory species: Cattle Egret, Fork-tailed Swift, Great Egret, Latham’s Snipe, Rainbow Bee-eater, Rufous Fantail and White-throated Needletail.

There are a number of information gaps that exist due to:

- lack of detailed knowledge of the distribution and condition of threatened species and ecological communities
- new and improved standards for flora and fauna survey required to satisfy updated environmental assessment techniques
- lack of detail concerning aquatic species and habitats
- changes in legislative status of biodiversity.

Results from the site surveys undertaken in the late 1990s would not be suitable for use as part of any future environmental assessment as they are now outdated. In the intervening period there have been changes to Commonwealth environmental legislation (most notably the introduction of the EPBC Act) and supporting regulation (such as threatened flora and fauna survey and assessment guidelines), and changes to the suite of listed threatened species (both NSW and Commonwealth). There have also been changes in the ecological and physical condition of the land associated with the predominantly agricultural land use. This notwithstanding, previous surveys may still provide useful general background information of site conditions and facilitate understanding of the nature of changes over time.

### **Historic heritage**

There are currently eight historic heritage places within the Commonwealth land at Badgerys Creek, comprising either built heritage or an archaeological site. Specific advice has been provided with regard to future investigation to better characterise the respective heritage values and/or management of each site.

The investigation also identified other heritage items within the vicinity of the Commonwealth land. The majority of these are local heritage items listed under the Liverpool and Penrith LEPs, however two additional items were identified as having potential historic heritage values.

The investigation noted a number of information gaps including a full understanding of the heritage values of the eight historic heritage places with reference to CHL criteria, incomplete understanding of the heritage values of the three identified built heritage places and options for potential retention of buildings, the research potential and heritage values of the three identified archaeological sites, and options for management of heritage values associated with the two former church sites and associated cemeteries.

### ***Aboriginal heritage***

Of the 21 Aboriginal heritage sites within areas of moderate and high archaeological potential, only seven sites could be located and verified during the current survey. These were the two possible scarred tree sites and five stone artefact sites. Impacts recorded during the 1996 survey of the area have continued to affect the condition and visibility of the sites, and the majority of sites are now either being actively impacted by water or stock movements, or are overgrown and obscured by vegetation. These impacts appear to have either obscured the previously recorded artefacts, or to have removed them from the immediate location of the original site recording.

Limited information regarding descriptions and locations of all Aboriginal sites previously identified within the current study area was available due to the assessment documents being made public. As such, all Aboriginal site information recorded during the field investigations for the Draft EIS was obtained from AHIMS site cards held by OEH. However, this information is in many cases limited.

Archaeological investigation of the Aboriginal cultural heritage of the Commonwealth land at Badgerys Creek has not, to date, included archaeological excavations. Surface expressions of Aboriginal heritage sites reviewed during this investigation were entirely exposed through disturbance, and it is likely that substantial archaeological deposits may remain present within the study area within landforms that have not experienced significant disturbance.

### ***Hydrology and water quality***

The Environment Australia assessment report prepared in 1999 recommended collection of time-series information on hydrology, hydrogeology and water quality for the Commonwealth land and adjacent areas as necessary. There is still no time-series information available to inform characterisation of the temporal aspects of the hydrological and water quality regimes.

The current investigation included the collection of water samples from six of the 10 sites used in the previous investigations. Four sites were not able to be sampled due to access being through private properties. Samples were analysed by a NATA-accredited laboratory and the results reviewed with reference to the *Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZECC 2000).

The results of the analyses suggest there have not been any material changes in water quality in the intervening period. Water quality is degraded with elevated levels of nutrients (nitrogen, phosphorus). The results for metals were all below guideline values. Exceedances of investigation values for hydrocarbons were observed for Duncans Creek and Badgerys Creek. Both sample locations are in close proximity to roads and water quality may be influenced by stormwater runoff.

Based on a review of aerial photography recorded between 2002 and 2014, there appears to have been no material changes in land use in this part of the Badgerys Creek subcatchment. As such, it is unlikely that there would have been any material changes to the downstream hydrological regime including flooding behaviour. Given the size of this part of the subcatchment relative to the whole subcatchment, it is anticipated that this area would also have only a limited influence on downstream water quality. There is also a large area of the South Creek catchment upstream of the Badgerys Creek confluence that would exert a greater influence on downstream flooding behaviour.

### ***Contamination***

There is potential for contamination of land and water associated with agricultural and related land use within the Commonwealth land at Badgerys Creek. While there are no National Pollutant Inventory listings within the boundary of the Commonwealth land, there are 17 facilities listed within the wider Liverpool LGA, some in proximity to the Commonwealth land.

During the site investigations, the historic heritage specialist was advised that the site of the former Anchau vineyard (1880 The Northern Road) had been used for the illegal dumping of waste material. This may have resulted in contamination of the land and there may also be hazardous materials present.

### ***Landscape and natural heritage***

The Commonwealth land at Badgerys Creek is in general proximity to the Greater Blue Mountains Area which is included on the World Heritage List. This is not an issue with regard to current management of the land but could be an issue for consideration for any future environmental assessment(s).

### ***Information gaps and recommendations***

As part of the investigation, gaps in existing information were identified with regard to current management of the Commonwealth land, and in relation to informing any future environmental assessment(s) associated with development of the land. Recommendations have been made with regard to these two matters. Those relating to management of the land and protection and enhancement of existing environmental values should be considered in the context of 'reasonable and feasible' to the extent that land use permits.

In developing recommendations with regard to further investigation, consideration has been given to the anticipated value of the information that would be generated, noting relevant factors such as the Commonwealth's obligations under the *Environment Protection and Biodiversity Conservation Act 1999*.

As a general recommendation, future management of the Commonwealth land should consider the 'avoid/mitigate/offset' hierarchy for management of impacts. This should be consistent with current best practice guidance and, where relevant, take account of the outcomes of any further field investigations.

# TABLE OF CONTENTS

---

<b>EXECUTIVE SUMMARY .....</b>	<b>iii</b>
<b>1. INTRODUCTION .....</b>	<b>1</b>
1.1. Background to the investigation.....	1
1.2. Objectives of the investigation .....	1
1.3. Legislative context .....	3
1.4. Previous investigations .....	6
1.5. Study area .....	6
1.6. Structure of the report .....	9
<b>2. BIODIVERSITY .....</b>	<b>11</b>
2.1. Previous investigations .....	11
2.2. Relevant legislation and guidelines .....	13
2.3. Survey methodology.....	20
2.4. Key findings and information gaps .....	24
2.5. Recommendations.....	30
<b>3. HISTORIC HERITAGE .....</b>	<b>33</b>
3.1. Previous investigations .....	33
3.2. Relevant legislation and guidelines .....	35
3.3. Survey methodology.....	37
3.4. Key findings and information gaps .....	39
3.5. Recommendations.....	43
<b>4. ABORIGINAL HERITAGE.....</b>	<b>45</b>
4.1. Previous investigations .....	45
4.2. Relevant legislation and guidelines .....	47
4.3. Survey methodology.....	51
4.4. Key findings and information gaps .....	52
4.5. Recommendations.....	54
<b>5. HYDROLOGY AND WATER QUALITY.....</b>	<b>55</b>
5.1. Previous investigations .....	55
5.2. Relevant legislation and guidelines .....	59
5.3. Survey methodology.....	62
5.4. Key findings and information gaps .....	64
5.5. Recommendations.....	68
<b>6. OTHER MATTERS .....</b>	<b>71</b>
6.1. Contamination .....	71
6.2. Landscape and natural heritage .....	72
<b>7. SUMMARY AND RECOMMENDATIONS .....</b>	<b>75</b>
7.1. Summary.....	75
7.2. Recommendations.....	77
<b>8. REFERENCES .....</b>	<b>83</b>
<b>APPENDIX A      BIODIVERSITY REPORT</b>	
<b>APPENDIX B      HISTORICAL HERITAGE REPORT</b>	



<b>APPENDIX C</b>	<b>ABORIGINAL HERITAGE REPORT</b>
<b>APPENDIX D</b>	<b>RISK ASSESSMENT</b>
<b>APPENDIX E</b>	<b>WATER QUALITY ANALYSIS RESULTS</b>

## LIST OF FIGURES

---

Figure 1.1	Regional context of Commonwealth land at Badgerys Creek .....	2
Figure 1.2	Study area .....	7
Figure 2.1	Existing vegetation.....	21
Figure 2.2	EPBC listed vegetation and field survey locations .....	22
Figure 2.3	Vegetation communities and condition .....	26
Figure 2.4	<i>Pultenaea parviflora</i> and <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> .....	27
Figure 3.1	Listed and potential historic heritage items within and in proximity to the Commonwealth land at Badgerys Creek .....	42
Figure 5.1	Catchments and water quality sampling locations.....	63

## LIST OF TABLES

---

Table 1.1	Likelihood descriptors .....	8
Table 1.2	Consequence descriptors .....	8
Table 2.1	Commonwealth guidelines and strategies related to biodiversity conservation .....	15
Table 2.2	EPIs made under the EP&A Act related to biodiversity conservation.....	17
Table 2.3	Key TSC Act provisions related to biodiversity conservation .....	17
Table 2.4	NSW guidelines and strategies related to biodiversity conservation .....	18
Table 2.5	Condition and extent of vegetation communities within the Commonwealth land .....	25
Table 3.1	Commonwealth guidelines and strategies related to historic heritage.....	36
Table 3.2	EPIs made under the EP&A Act related to historic heritage .....	37
Table 3.3	NSW guidelines and strategies related to historic heritage.....	37
Table 3.4	Heritage items within the Commonwealth land at Badgerys Creek .....	40
Table 3.5	Heritage items within the vicinity of the Commonwealth land at Badgerys Creek.....	41
Table 4.1	Commonwealth guidelines and strategies related to Aboriginal heritage .....	49
Table 4.2	NSW guidelines and strategies related to Aboriginal heritage .....	50
Table 5.1	EPIs made under the EP&A Act related to hydrology and water resources .....	61
Table 5.2	NSW guidelines and strategies related to hydrology and water resources.....	61
Table 5.3	Previous water quality sampling .....	62
Table 6.1	Greater Blue Mountains Area WHL/NHL listing .....	72

## ABBREVIATIONS AND ACRONYMS

Abbreviation/ Acronym	Description
ADWG	Australian Drinking Water Guidelines (2011, updated December 2013)
AHC Act	<i>Australian Heritage Commission Act 1975</i> (Commonwealth, ceased operation 1 January 2004)
AHIMS	Aboriginal Heritage Information Management System (database of recorded Aboriginal heritage sites and places in NSW administered by OEH)
AHIP	Aboriginal Heritage Impact Permit (an authorisation under the NSW NPW Act to impact on Aboriginal heritage)
ANZECC	Australia-New Zealand Environment and Conservation Council
ATSHIP Act	<i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i> (Commonwealth)
CAMBA	China-Australia Migratory Birds Agreement
CHL	Commonwealth Heritage List
CRC	Cooperative Research Centre
DECC	Department of Environment and Climate Change (a precursor agency to the current NSW Office of Environment and Heritage)
DECCW	Department of Environment, Climate Change and Water (a precursor agency to the current NSW Office of Environment and Heritage)
DI&RD	Department of Infrastructure and Regional Development (Commonwealth)
DoE	Department of the Environment (Commonwealth)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (a precursor agency to the current Commonwealth Department of the Environment)
EA	Environment Australia (a precursor agency to the current Commonwealth Department of the Environment)
EIS	Environmental impact statement
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth, commenced operation on 16 July 2000)
EPI	Environmental planning instrument (made under the EP&A Act)
ILUA	Aboriginal Land Use Agreement
JAMBA	Japan-Australia Migratory Birds Agreement
MNES	Matter of national environmental significance (under the EPBC Act)
LEP	Local environmental plan (a type of EPI)
LGA	Local government area
NHL	National Heritage List
NPW Act	<i>National Parks and Wildlife Act 1974</i> (NSW)
NNTT	National Native Title Tribunal
NHMRC	National Health and Medical Research Council
OEH	Office of Environment and Heritage (NSW)

Abbreviation/ Acronym	Description
PCT	Plant community type
ROTAP	Rare or Threatened Australia Plants (a list of rare or threatened Australian plant taxa developed and maintained by the CSIRO)
RNE	Register of the National Estate
SEPP	State Environmental Planning Policy (a type of EPI)
SHR	State Heritage Register (NSW)
SSI	State Significant Infrastructure; a class of major development undertaken by a NSW public authority
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW)</i>
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHL	World Heritage List
WQ	Water quality
WQO	Water Quality Objectives (these represent the community's environmental values for waterways within each catchment in NSW)
WSU	Western Sydney Unit (of DI&RD)

# 1. INTRODUCTION

---

## 1.1. Background to the investigation

This environmental survey of Commonwealth land at Badgerys Creek has been prepared by SMEC Australia Pty Ltd (SMEC) on behalf of the Western Sydney Unit (WSU) of the Department of Infrastructure and Regional Development. The survey builds upon a substantial body of existing information about the site to provide an updated baseline of the status and condition of specific environmental aspects.

In particular, this survey focuses on the following specific environmental aspects:

- flora and fauna, including nationally and state-listed threatened species and ecological communities and listed migratory species potentially on or utilising the site
- hydrological features and water quality
- Aboriginal and historic cultural heritage.

The environmental status of the Commonwealth land at Badgerys Creek (refer Figure 1-1) has been the subject of a number of previous investigations. These include environmental investigations undertaken for the Draft Environmental Impact Statement (EIS) that was completed in 1997 and the Supplement to the Draft EIS completed in 1999, both under the *Environment Protection (Impact of Proposals) Act 1974*.

## 1.2. Objectives of the investigation

The purpose of the current survey is to build upon the previous work relating to the environmental issues of the Commonwealth land at Badgerys Creek and to bring this knowledge up to date. The current work interprets the findings of the survey in the context of current Commonwealth and NSW legislation and guidance materials.

The specific objectives of the investigation are to:

- update existing baseline environmental information for the Commonwealth land at Badgerys Creek and specifically the status and condition of the site's flora, fauna, cultural heritage and hydrological features
- identify the national, state and regional significance of these environmental aspects in the broader environmental context of the area surrounding the land
- analyse any changes in status and condition since the last field surveys undertaken in the late 1990s, particularly in the context of the requirements of the *Environment Protection and Biodiversity Conservation Act 1999*
- provide baseline data to inform any future environmental assessment(s)
- provide a benchmark against which past and future surveys can be compared
- make recommendations for possible future site survey program(s).

The environmental survey will be used to assist the Commonwealth to identify, analyse and consider options available for the existing and future management of the land.

Specialist investigations for biodiversity, historic heritage and Aboriginal heritage were undertaken to support and inform the survey. These are included as Appendices A, B, and C respectively to this report.



Badgerys Creek  
Commonwealth  
Land

Badgerys Creek Studies 3001806

Vector backdrop data © MDS 2014



Location: I:\projects\3001806 - Badgerys Creek Studies\008 DATA\GIS\Maps\1\_1 Study location.mxd

Last updated by RC10721 on 11/11/2014 at 15:17

Figure 1.1 Regional context of Commonwealth land at Badgerys Creek

## 1.3. Legislative context

### 1.3.1. Commonwealth legislation

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central piece of environmental legislation and commenced operation on 16 July 2000. It provides the legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places defined in the Act as matters of national environmental significance. In addition, the EPBC Act confers jurisdiction over actions that have a significant impact on the environment where the actions affect, or are taken on, Commonwealth land or are undertaken by the Commonwealth or a Commonwealth agency. This applies even if that significant impact is not on one of the nine matters of 'national environmental significance'.

The objects of the EPBC Act are:

- (a) *to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and*
- (b) *to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and*
- (c) *to promote the conservation of biodiversity; and*
- (ca) *to provide for the protection and conservation of heritage; and*
- (d) *to promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples; and*
- (e) *to assist in the co-operative implementation of Australia's international environmental responsibilities; and*
- (f) *to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and*
- (g) *to promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.*

Currently, there are nine matters of national environmental significance (MNES) protected under the EPBC Act:

- World Heritage properties
- National Heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)
- a water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act provides for a process that accredits state planning systems under national environmental law, to create a single environmental assessment and approval process, referred to as an 'assessment bilateral agreement' for nationally protected matters. It also contains a range of provisions for enforcement mechanisms to manage suspected or identified instances of non-compliance and for reviewing the compliance of referred projects.

The previous environmental investigations of the Badgerys Creek site were undertaken in accordance with the Commonwealth *Environment Protection (Impact of Proposals) Act 1974*. This Act ceased operation on 16 July 2000 and was replaced by the EPBC Act. One of the objectives of this study is to assess the existing conditions of the study area in the context of the EPBC Act.

The Greater Blue Mountains Area is located to the west of the study area and is listed on the World Heritage List (WHL) and national Heritage List (NHL). Discussion on this issue is provided in Section 6.2.

### **1.3.2. Relevant NSW legislation**

As Commonwealth land, management of the Badgerys Creek site is subject to Commonwealth legislation which generally prevails over NSW legislation.

The following is an overview of NSW legislation that deals with development and environmental management and protection. Comment on specific details of individual legislation on environmental aspects is provided in Sections 2–6 as relevant.

#### ***National Parks and Wildlife Act 1974***

The *National Parks and Wildlife Act 1974* (NPW Act) sets out the requirements for the conservation of nature, ecosystems, biological diversity, landscapes and landforms and objects, places or features of cultural value within the landscape. It includes specific provisions for the conservation and care of Aboriginal objects and Aboriginal places. The NPW Act also sets out the responsibilities for the management of national parks.

#### ***Heritage Act 1977***

The *Heritage Act 1977* provides protection for heritage places, buildings, works, relics, moveable objects, precincts and archaeological sites. The Act sets out the responsibilities and requirements for the management of heritage items and places in NSW. The Act provides for the listing and protection of State significant heritage items in the State Heritage Register (SHR). Under the Act, an excavation permit is required for the disturbance or excavation of any relic. Any deposit, object or material evidence relating to the settlement of NSW, not being Aboriginal settlement, that is over 50 years old is classified as a relic under the Act.

#### ***Environmental Planning and Assessment Act 1979***

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the primary legislation regulating land use in NSW. The EP&A Act provides for environmental planning instruments (EPI) to be made to guide the process of development and to regulate competing land uses. Currently, there are two types of EPIs under the Act:

- Local environmental plans (LEP) that guide planning decisions for a local government area (LGA)
- State environmental planning policies (SEPP) that address planning issues of State or regional significance within NSW.

An EPI specifies what type(s) of development are allowed in an area, whether development consent is required and what type of assessment must be undertaken before consent is granted.

The EP&A Act makes a distinction between development undertaken by public authorities and that by other developers. Generally, public authorities are exempted from the need to obtain development consent. However, for proposals where a significant environmental impact is likely approval from the Minister for Planning is required. The application for approval must be supported by an EIS prepared under either Part 5 (for an activity that is not State Significant Infrastructure, SSI) or Part 5.1 (for an activity that is SSI).

### ***Fisheries Management Act 1994***

The *Fisheries Management Act 1994* protects fishery resources within the State. The objectives of the Act including the conservation of fish stocks and key fish habitats, threatened species, populations and ecological communities of fish and marine vegetation.

### ***Threatened Species Conservation Act 1995***

The *Threatened Species Conservation Act 1995* (TSC Act) aims to conserve biological diversity by protecting and encouraging the conservation of threatened species, populations and ecological communities and their critical habitats.

### ***Protection of the Environment Operations Act 1997***

The *Protection of the Environment Operations Act 1997* (PoEO Act) is administered by the NSW Environment Protection Authority (EPA). It provides the legislative framework for the protection of environmental values in NSW including:

- the making of protection of the environment policies (PEPs)
- an integrated system of licensing for air pollution, water pollution, noise pollution and waste management
- a duty to notify relevant authorities of pollution incidents likely to cause material harm to the environment
- an enforcement framework including powers of investigation, civil enforcement, and sentencing options
- the development and implementation of economic measures for environmental protection.

### ***Water Management Act, 2000***

The *Water Management Act 2000* provides for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. The Act controls the extraction of and use of water, the construction of works such as dams and weirs, and the carrying out of activities in or near water sources in NSW. 'Water sources' are defined broadly and include the whole or any part of a river, lake, estuary, place where water occurs naturally on or below the surface of the ground, and NSW coastal waters.

### ***Native Vegetation Act 2003***

The *Native Vegetation Act 2003* commenced operation on 1 December 2005. It provides the statutory framework for the management and protection of native vegetation in NSW. The Commonwealth land at Badgerys Creek lies wholly within the Liverpool LGA. Schedule 1 to the Act identifies certain land that is excluded from the Act which includes the Liverpool LGA.

At the time of preparation of the Draft EIS and Supplement to the Draft EIS, the prevailing NSW legislation was the *Native Vegetation Conservation Act 1997*. This Act was repealed in 2005, however, it still has effect in relation to:

- clearing living native vegetation on State Protected Land in local government areas specified in Schedule 1 to the *Native Vegetation Conservation Act 1997* (which includes the Sydney metropolitan area)
- clearing exotic and dead trees on State Protected Land (apart from clearing in circumstances set out in guidelines approved and published by the Minister to enable clearing where no minimal environmental harm is likely)
- some private native forestry development consents issued under the *Native Vegetation Conservation Act 1997*.



## 1.4. Previous investigations

The Badgerys Creek site has been the subject of a number of previous investigations including:

- the Draft EIS and Supplement to the Draft EIS prepared in 1985 which examined a number of possible locations that would be suitable for a major airport, including the Badgerys Creek site<sup>1</sup>
- the Draft EIS completed in 1997 which examined the alternatives for an airport at the Badgerys Creek site (Option A in this EIS approximates the current extent of Commonwealth land at Badgerys Creek)
- the Supplement to the Draft EIS prepared in 1999 which summarised the findings of the 1997 Draft EIS and provided additional information in response to issues raised in submissions and the findings of an audit undertaken in 1998 on the Draft EIS
- audit reports prepared by SMEC in 1998 and 1999 which independently evaluated the appropriateness and adequacy of the data and methodologies in the draft and supplementary EIS reports
- the *Joint Study on Aviation Capacity in the Sydney Region* prepared in 2012
- a study of Wilton and RAAF Base Richmond prepared in 2013.

Preparation of this report has also made reference, as appropriate, to the assessment report prepared by Environment Australia in July 1999 with regard to the Draft EIS and Supplement to the Draft EIS.

## 1.5. Study area

The study area for this environmental survey generally comprises the Commonwealth owned land at Badgerys Creek as shown in Figure 1.2. The study area includes the creeks bordering the site and the land immediately adjacent to The Northern Road, within the Commonwealth land, also known as Lot 1 DP838361. The areas adjacent to the Commonwealth-owned land comprising parts of Badgerys Creek, Luddenham and Bringelly are identified in this report as being in the vicinity of the Commonwealth land.

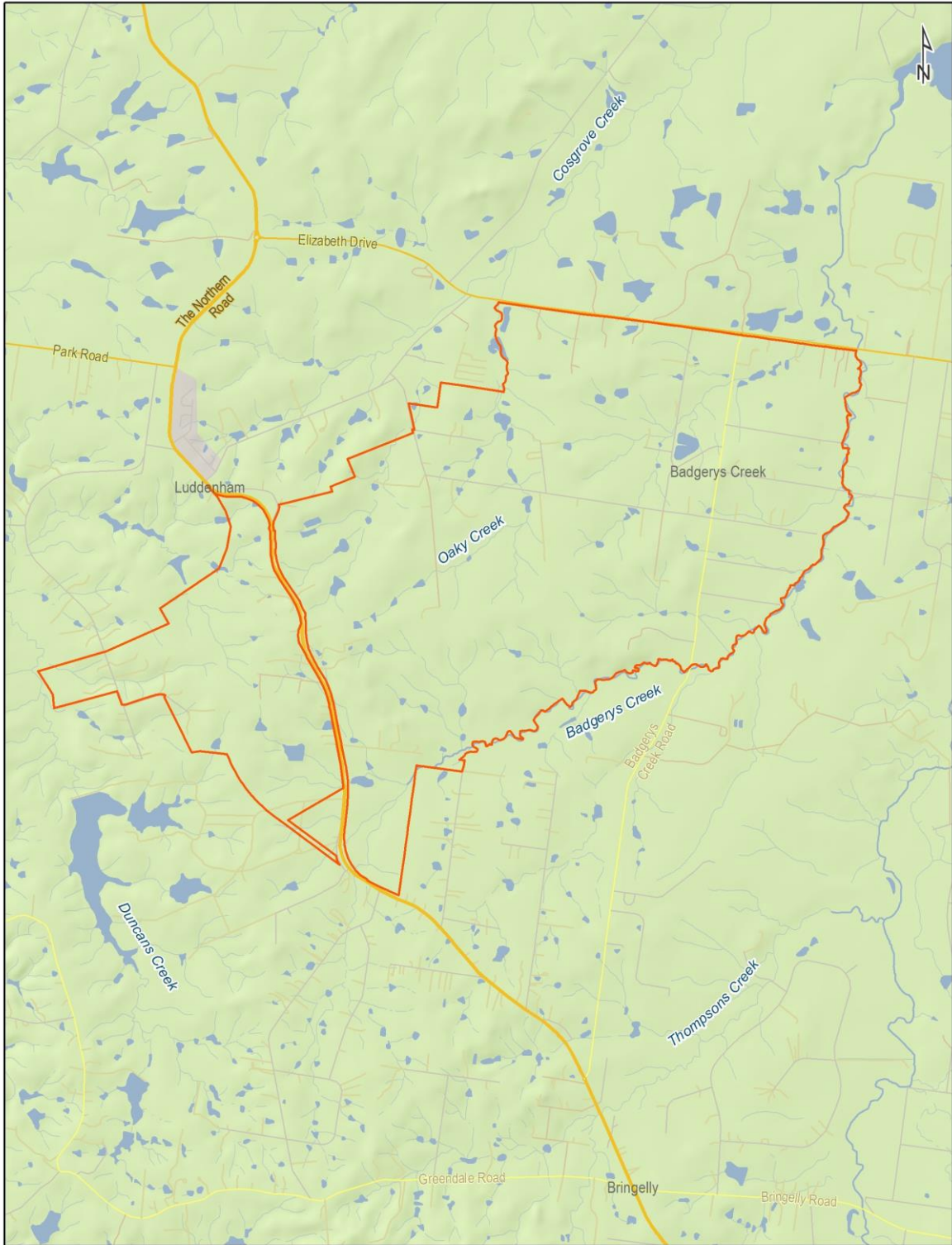
The study area is located within the Liverpool LGA and is about 50 kilometres west of the Sydney CBD, 15 kilometres west of the Liverpool town centre, and about 12 kilometres south of Penrith. To the west of the site lies the Nepean River and the Blue Mountains, including the Greater Blue Mountains World Heritage Area. The site is adjacent to the north-western boundary of the South West Growth Centre and at the far western edge of the Western Sydney Employment Area.

The land is about 1,700 hectares in size and is currently tenanted. There are about 200 short term residential rural and commercial leases. Commercial leases include grazing, horse agistment, a winery, shop, piggery, duck farming, quarrying, irrigation, landfilling and market gardens. The majority of the properties are rural residential of about two hectares or greater.

The general area is undulating, with rolling hills and valleys, large areas of grassland, and some areas of flat land. The main land uses are various agricultural purposes and low density rural residential development. The study area is within the catchment of South Creek which flows generally northward into the Hawkesbury River.

---

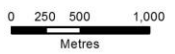
<sup>1</sup> The current (2014) investigation has given limited consideration to the information provided in the 1985 EIS on the presumption that all relevant details would have been considered in the subsequent Draft EIS prepared in 1997 and Supplement to the Draft EIS prepared in 1999.




**Badgerys Creek Commonwealth Land**

Badgerys Creek Studies 3001806

Vector backdrop data © MDS 2014



Location: I:\projects\3001806 - Badgerys Creek Studies\008 DATA\GIS\Maps\1\_2 Investigations area.mxd

Last updated by: RC10721 on 11/11/2014 at 15:17

Figure 1.2 Study area

## 1.6. Risk assessment

An early activity involved developing an understanding of the issues and risks associated with undertaking the project services and achieving the project objectives. This was undertaken by way of a risk assessment that considered the likelihood of events and the consequence of outcomes in line with the accepted methodology of such risk assessments.

Likelihood and consequence descriptors are provided in the following tables.

Table 1.1 Likelihood descriptors

Likelihood	Definition
1 – Rare	Event will not occur or is not expected to occur
2 – Unlikely	Event has a minimal chance of occurring
3 – Possible	Event may occur
4 – Likely	Event has a high chance of occurring
5 – Almost certain	Event will occur or is expected to occur

Table 1.2 Consequence descriptors

Consequence	Definitions			
	Survey program <sup>1</sup>	Environmental management	Environmental assessment	Client reputation
1 – Negligible	No material delay to program	Local negligible or reversible, short term (<1 month) impact	Available information sufficient to inform future EIA	No/negligible impact on WSU/
2 – Minor	Delay <5 days; float available in program	Local minor or reversible, short term (<3 months) impact	Delays to EIA due to field work requirements 1-3 months	Commonwealth reputation
3 – Moderate	Delay 5-10 days; limited float in program	Local moderate or reversible (within 2 years) impact	Delays to EIA due to field work requirements 3-6 months	Potential for reputational harm to WSU/ Commonwealth
4 – Significant	Delay 10-20 days; no float in program	Extensive but reversible (within 2 years) impact or significant irreversible local impact	Delays to EIA due to field work requirements 6-12 months	Major reputational harm to WSU/
5 – Extreme	Delay > 20 days	Widespread irreversible impacts	Delays to EIA due to field work requirements >12 months	Commonwealth

1 Business days

Risk levels were then assigned in accordance with the following matrix.

		Likelihood				
		1	2	3	4	5
Consequence	1	1 LOW	2 LOW	3 LOW	4 LOW	5 LOW
	2	2 LOW	4 LOW	6 LOW	8 MEDIUM	10 MEDIUM
	3	3 LOW	6 LOW	9 MEDIUM	12 MEDIUM	15 HIGH
	4	4 LOW	8 MEDIUM	12 MEDIUM	16 HIGH	20 VERY HIGH
	5	5 LOW	10 MEDIUM	15 HIGH	20 VERY HIGH	25 VERY HIGH

Following assignment of risk levels, potential risk treatments were identified for risks identified as 'high' or 'very high'. The likely effectiveness of these treatments in mitigating risk was then assessed using the same likelihood-consequence methodology and a residual risk level identified.

The resultant risk matrix is provided as Appendix D.

## 1.7. Structure of the report

This report is structured as follows:

Section	Description
1	Outlines the background and purpose of the environmental survey.
2	Summarises the results of the biodiversity investigations, identifies information gaps and makes recommendations for future investigations.
3	Summarises the results of the historic heritage investigations, identifies information gaps and makes recommendations for future investigations.
4	Summarises the results of the Aboriginal heritage investigations, identifies information gaps and makes recommendations for future investigations.
5	Summarises the results of the hydrology and water quality investigations, identifies information gaps and makes recommendations for future investigations.
6	Provides comment on other environmental aspects considered of relevance to management of the Commonwealth land at Badgerys Creek.
7	Provides a synopsis of the results of the survey and consolidates the recommendations made with regard to individual environmental aspects.
8	List of reference documents and other information sources consulted in preparation of the report.



## 2. BIODIVERSITY

---

### 2.1. Previous investigations

#### 2.1.1. 1997 Draft EIS

Chapter 17 of the Draft EIS addressed the flora and fauna impacts of the then proposed Second Sydney Airport. Discussion was based on a separate specialist investigation documented in *Technical Paper 8: Flora and Fauna* (Biosis Research 1997).

Assessment of impacts on flora and fauna drew on a number of other specialist investigations: water quality, bushfire risk, bird and bat strike assessments, and noise assessments. Assessment was limited to the airport options and immediate surrounds; proposed access corridors outside the airport sites were not investigated.

Assessment of impacts on flora and fauna of national significance was based upon listings in Schedules 1 and 2 to the Commonwealth *Endangered Species Protection Act 1992*. Assessment of impacts on State-listed flora and fauna made reference to Schedules 1 and 2 to the NSW TSC Act. Consideration of impacts on flora included reference to the Rare or Threatened Australia Plants (ROTAP) list. Reference was also made to bird species listed under the *Japan-Australia Migratory Birds Agreement* (JAMBA) and the *China-Australia Migratory Birds Agreement* (CAMBA).

The Draft EIS included a range of management measures to mitigate and manage impacts during construction and operation. This included preparation of a monitoring strategy as part of an environmental management plan for the airport.

#### ***Auditor's Report***

The Auditor's Report on the Draft EIS (SMEC 1998) identified three main areas where it was considered a more extensive assessment or clearer statement of potential impacts could have been provided:

- The Draft EIS lacked a clear assessment of the impacts of construction on Cumberland Plain Woodland, a listed endangered ecological community under the TSC Act.
- The assessment of impacts on terrestrial and aquatic environments was not consistent; in particular, the categories used to define spatial and temporal scales of impacts on aquatic habitats were not applied to the terrestrial environment.
- The treatment of cumulative impacts, particularly the cumulative impact of construction of the airport and associated infrastructure, was cursory and qualitative.

The report also noted a number of other general weaknesses of the Draft EIS.

#### 2.1.2. 1999 Supplement to the Draft EIS

Chapter 14 of the Supplement to the Draft EIS summarised the findings of the Draft EIS and issues raised in submissions.

Additional flora and fauna studies were undertaken targeting threatened species and endangered ecological communities that were considered inadequate in the Draft EIS. The chapter also provided a reassessment of the ecological significance of flora and fauna based on the additional field survey results, amendments to the TSC Act and the Western Sydney urban bushland biodiversity survey (National Parks and Wildlife Service 1997), the results of which were not available at the time of the release of the Draft EIS.

The additional targeted flora survey for *Pultenaea parviflora*, a species of national significance identified a population of 68 plants. No additional threatened flora species were observed during the

targeted survey. Approximately 90 Cumberland Plain Land Snails were recorded in remnants of Cumberland Plain Woodland during targeted fauna surveys, representing one of the largest known populations at the time.

The Supplement to the Draft EIS provided additional information on the size and locations of remnant Cumberland Plain Woodland and River-Flat Forest communities within the airport options sites. These sites were subsequently elevated from regional to State significance, primarily as a result of the identification of the Cumberland Plain Land Snail populations.

### **Auditor's Report**

The Auditor's Report on the Supplement to the Draft EIS (SMEC 1999) noted that additional surveys and assessments were undertaken for the Supplement that addressed comments raised in the first audit report and in public submissions. A summary of the key findings of the additional investigations was also provided. Despite the Auditor stating that the concerns regarding the Draft EIS had been addressed, it was noted that the following uncertainties remained:

- 6.2 hectares of the site, including small remnants of Cumberland Plain Woodland, were yet to be surveyed due to access restrictions during the additional surveys.
- Relocation techniques for the Cumberland Plain Land Snail were untested and the survival of the population would be heavily dependent on these techniques.
- The effect of aircraft noise on animal populations in the Blue Mountains National Park, and elsewhere, is uncertain.

### **2.1.3. 1999 Environment Australia Assessment Report**

Environment Australia's report disagreed with the level of significance assessed in the Supplement to the Draft EIS. The report stated that the airport options sites should have been assessed as being of national conservation significance rather than State significance in view of Cumberland Plain Woodland and *Pultenaea parviflora* being listed under the Commonwealth *Endangered Species Protection Act 1992*.

The report made the following recommendations:

- A comprehensive flora and fauna field survey of the airport site and relevant areas adjacent to the site boundary must be completed prior to construction of an airport to complement information already gathered.
- The impacts of an airport on the following species and ecological communities must be kept to a minimum by implementing management, monitoring and reporting measures which include, but are not limited to, those set out in Section 2.7 of Appendix M to the Supplement to the Draft EIS:
  - *Pultenaea parviflora* (shrub)
  - the bat population residing in Badgerys Creek Community Hall
  - *Meridolum corneovirens* (Cumberland Plain Land Snail)
  - Cumberland Plain Woodland and River-flat Forest.
- Cumberland Plain Woodland and River-flat Forest communities must, to the greatest extent that is practicable, be reserved, rehabilitated and revegetated. Areas of these communities suitable for reservation should be identified off the airport site to compensate for losses incurred as a result of the proposal. The areas reserved should be substantially greater in total than the areas destroyed. The objective should be to establish, in consultation with NSW Government authorities, areas of high quality forest that are viable in the long term. Consideration should be given to:

- developing and reserving these communities in buffer areas around the airport site and in noise prone corridors
- preserving and rehabilitating bushland corridors, particularly riparian corridors, in order to maintain a network of habitat refuges for native fauna.
- The potential impacts on the World Heritage values of the Greater Blue Mountains Area must be identified and taken into account in all elements of the planning and operation of an airport at Badgerys Creek. This should be done in collaboration with Environment Australia and with relevant NSW authorities.

#### **2.1.4. Other investigations**

##### ***Western Sydney Urban Bushland Biodiversity Survey***

The *Western Sydney Urban Bushland Biodiversity Survey* (National Parks and Wildlife Service 1997a) outlines the types and status of urban bushland in Western Sydney. The study discusses general trends and changes associated with flora and fauna in the area, with specific reference to historic and ongoing threats and conservation and management measures.

While the survey does not focus on specific areas it does provide an overview of the status of flora, fauna and ecological communities found within and around the Commonwealth land at Badgerys Creek. In particular, the survey notes that Cumberland Plain Woodland (listed as endangered in 1997, now listed as critically endangered) was under particular threat from clearing for agricultural and residential purposes, alongside other threats (e.g. invasive species, declining water quality, etc).

The report briefly discusses the Badgerys Creek Corridor between The Northern Road and Elizabeth Drive. It notes the presence of Swamp Oak Forest dominated by *Casuarina glauca* intergrading with Red Gum-Cabbage Gum Forest and identifies three species considered to be vulnerable in Western Sydney that have been recorded in the area: *Angophora subvelutina*, *Eriochloa pseudoacrotricha* and *Eucalyptus amplifolia*. Recommendations of the survey included protection of vulnerable plant species and protection of the riparian corridor generally.

## **2.2. Relevant legislation and guidelines**

### **2.2.1. Commonwealth**

#### ***Environment Protection and Biodiversity Conservation Act 1999***

In addition to the listing of nationally threatened species and ecological communities, migratory species and marine species, the EPBC Act contains a range of provisions dealing with the conservation of biodiversity including:

- identifying and monitoring biodiversity, and preparing bioregional plans
- preparing conservation advice and/or national recovery plans and wildlife conservation plans for listed species and additional protection for listed species in Commonwealth areas
- identifying key threatening processes and the preparing threat abatement plans for such processes
- access to biological resources in Commonwealth areas
- invasive species
- voluntary conservation agreements which may cover environmentally significant private land, including Aboriginal land
- protection and management of World Heritage properties, National and Commonwealth Heritage places, Ramsar wetlands and Commonwealth reserves.



### **Cumberland Plain Recovery Plan**

The Cumberland Plain Recovery Plan (Dept of Environment, Climate Change & Water (DECCW) 2010a) has been prepared under the EPBC Act and the TSC Act to promote the recovery of threatened species, populations and ecological communities on the Cumberland Plain. The recovery plan aims to guide investment in the recovery of the threatened biodiversity of western Sydney, and to inform future urban planning decisions.

The Cumberland Plain Recovery Plan addresses a number of species that are known or are likely to have habitat within the study area and surrounds.

### **Species recovery plans**

There are species-specific national recovery plans in place for the following EPBC-listed threatened species that have potential habitat in the study area:

- *Persoonia nutans*
- *Pimelea spicata*
- *Acacia pubescens*
- Large-eared Pied Bat
- Swift Parrot
- Glossy Black Cockatoo
- Regent Honeyeater.

### **Key threatening processes**

The EPBC Act provides for the identification and listing of key threatening processes. A threatening process is defined as such if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community

The following key threatening processes listed under the EPBC Act are likely to be relevant to the study area:

- aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)
- competition and land degradation by rabbits
- dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)
- infection of amphibians with chytrid fungus resulting in chytridiomycosis
- land clearance
- loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
- predation by European Red Fox.

### **Threat abatement plans**

Threat abatement plans provide for the research, management, and any other actions necessary to reduce the impact of a listed key threatening process on native species and ecological communities. Those of likely relevance to the study area are:

- threat abatement plan for competition and land degradation by rabbits
- threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi*
- threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis

- threat abatement plan for predation by European Red Fox.

### **Guidelines and strategies**

Commonwealth guidelines and strategies related to biodiversity conservation that are of likely or potential relevance to the study area are listed in the following table with comment provided on the nature of their relevance.

*Table 2.1 Commonwealth guidelines and strategies related to biodiversity conservation*

<b>Guideline/Strategy</b>	<b>Agency</b>	<b>Comment</b>
National Biodiversity Conservation Strategy (2010-2030)	DoE	Identifies three priorities for action to help stop, and then reverse, the current decline in Australia’s biodiversity. <ul style="list-style-type: none"> <li>• Engaging all Australians in biodiversity conservation.</li> <li>• Building ecosystem resilience in a changing climate.</li> <li>• Getting measurable results.</li> </ul>
National Weeds Strategy	DoE	Under the National Weeds Strategy, 32 Weeds of National Significance (WoNS) have been identified by Australian governments based on their invasiveness, potential for spread and environmental, social and economic impacts. Individual landowners and managers are ultimately responsible for managing WoNS.
EPBC Significant Impact Guidelines 1.1 (Matters of NES)	DoE	Provide overarching guidance on determining whether an action is likely to have a significant impact on a matter protected under national environment law, the EPBC Act, and whether a referral to the Australian Department of the Environment is necessary.
EPBC Significant Impact Guidelines 1.2 (Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies)	DoE	Assists in deciding whether or not to submit a referral to the DoE for a decision by the federal environment minister on whether assessment and approval is required under the EPBC Act. This guideline applies to any person who proposes to undertake an action which is either situated on Commonwealth land or which may impact on Commonwealth land, and/or representatives of Commonwealth agencies who propose to undertake an action that may affect the environment anywhere in the world.
Draft EPBC Act Referral Guidelines for the Vulnerable Koala	DoE	Provides guidance to proponents regarding whether an action is likely to require referral to the Commonwealth Department of the Environment due to impacts on the Koala. In doing so the guidelines seek to: <ul style="list-style-type: none"> <li>• Promote avoidance and mitigation of significant impacts on the koala.</li> <li>• Promote and ensure the recovery of the koala through the regulatory requirements of the EPBC Act.</li> <li>• Promote a clear, consistent and transparent approach for proponents deciding whether to refer an action to the Department for approval and assessment of significant impacts on the koala.</li> <li>• Promote streamlined decision-making and approval processes.</li> </ul>
Significant Impact Guidelines for the Green and Golden Bell Frog	DoE	Designed to assist in determining whether a proposed action is likely to have a significant impact on the green and golden bell frog. These guidelines are to be applied over and above the legal obligations as set out in the EPBC Act. The guidelines also include best practice survey methodology and advice on avoidance or mitigation of significant impacts upon populations and individuals.

Guideline/Strategy	Agency	Comment
EPBC Act Administrative Guidelines on Significance - Supplement for the Grey-headed Flying-fox	DoE	Provides general guidance to assist in determining whether a proposed activity is likely to have a significant impact on the grey-headed flying fox and whether a referral to DoE is required. These guidelines are applied over and above the legal obligations as set out in the EPBC Act.
EPBC Species Survey Guidelines	DoE	The Commonwealth Department of the Environment has prepared a range of survey guidelines that provide advice on survey techniques for specific threatened species and give guidance on the Department's expectations with regard to surveys. The following survey guidelines for Australian flora and fauna are currently available: <ul style="list-style-type: none"> <li>• Threatened Bats</li> <li>• Threatened Birds</li> <li>• Threatened Frogs</li> <li>• Threatened Fish</li> <li>• Threatened Mammals</li> <li>• Threatened Reptiles</li> <li>• Draft survey guidelines for Australia's Threatened Orchids.</li> </ul>
EPBC Environmental Offsets Policy (2012) and Offsets Assessment Guide	DoE	Provides guidance on the role of offsets in environmental impact assessments, and how DoE considers the suitability of a proposed offset. It aims to improve environmental outcomes through the consistent application of best practice offset principles, provide more certainty and transparency, and encourage advanced planning of offsets.

## 2.2.2. New South Wales

### ***National Parks and Wildlife Act 1974***

The NPW Act sets out the requirements for the conservation of nature, ecosystems, biological diversity, landscapes and landforms and objects, places or features of cultural value within the landscape. The NPW Act sets out the responsibilities for the management of national parks.

### ***Environmental Planning and Assessment Act 1979***

The EP&A Act is the primary legislation regulating land use in NSW. One of the objects of the Act is to encourage ecologically sustainable development (ESD). Schedule 2 to the *Environmental Planning and Assessment Regulation 2000* sets out the principles of ESD which include the conservation of biological diversity and ecological integrity.

The Act contains certain provisions to facilitate appropriate consideration of biodiversity issues including:

- Section 5A – matters for consideration with regard to a significant effect on threatened species, populations or ecological communities, or their habitats (informally referred to as ‘the seven part test’)
- Section 5B – requirement for planning authorities to have regard of the register of critical habitat (kept and maintained by OEH under the TSC Act) when exercising their functions under

the EP&A Act ( a similar provision exists under Section 110C with regard to determining authorities)

- Section 5C – application of the EP&A Act in relation to critical habitat of fish or marine vegetation, or threatened species, populations or ecological communities of fish or marine vegetation, or their habitats
- Section 112A – requirement for a determining authority when considering an SIS to have regard to any relevant recovery plan or threat abatement plan.

Part 3 of the EP&A Act provides for the making of specific EPIs to regulate land use and development. Table 2.2 identifies two EPIs that specifically address biodiversity.

Table 2.2 EPIs made under the EP&A Act related to biodiversity conservation

EPI	Comment
SEPP 19 – Bushland in Urban Areas	Aims to protect and preserves bushland within certain urban areas (including Liverpool LGA) as part of the natural heritage or for recreational, educational and scientific purposes. The policy is designed to protect bushland in public open space zones and reservations, and to ensure that bush preservation is given a high priority when local environmental plans for urban development are prepared.
SEPP 44—Koala Habitat Protection	The objective of SEPP 44 is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

### **Noxious Weeds Act 1993**

Under the *Noxious Weeds Act 1993*, public authorities are required to control noxious weeds that are likely to spread to adjoining land.

### **Fisheries Management Act 1994**

The *Fisheries Management Act 1994* seeks to protect threatened species, populations and ecological communities of fish and marine vegetation, and other living resources of NSW waters.

### **Threatened Species Conservation Act 1995**

The TSC Act protects threatened flora and fauna species, endangered populations and ecological communities and their habitats within NSW. The Act contains a number of specific provisions aimed at conserving biodiversity as identified in the following table.

Table 2.3 Key TSC Act provisions related to biodiversity conservation

TSC Act provision	Comment
Recovery Plans	In addition to the national recovery plans identified under the EPBC Act, a number of NSW Recovery Plans, prepared under the TSC Act, are in place for the Large Forest Owls Powerful Owl ( <i>Ninox strenua</i> ), Sooty Owl ( <i>Tyto tenebricosa</i> ) and Masked Owl ( <i>Tyto novaehollandiae</i> ).
Threatened Species Priority Action Statement	The NSW Threatened Species Priorities Action Statement (PAS) identifies strategies to help recover threatened plants and animals and establishes priorities to implement these strategies. The PAS identifies actions for all listed species, populations and ecological communities. It also identifies actions to manage listed key threatening processes.

TSC Act provision	Comment
Key Threatening Processes	A threat can be listed under the TSC Act as a 'key threatening process' if it adversely affects threatened species, populations or ecological communities or if it could cause species, populations or ecological communities that are not threatened to become threatened. Key threatening processes are considered in an assessment of significance where a proponent considers whether a development constitutes or exacerbates a key threatening process.
Threat Abatement Plans	A threat abatement plan (TAP) is a statutory document prepared and approved in accordance with the TSC Act. Ministers and public authorities are required to take any appropriate action available to them to implement the measures in the plan. The terms of TAPs are to be taken into account by consent and determining authorities when they are considering development applications under the planning legislation.

### Guidelines and strategies

Several survey guidelines and strategies are relevant to the above legislation. Several of these, including survey and assessment guidelines, are required by the EP&A Act to be taken into account when assessing impact upon threatened species, populations or ecological communities. These and other relevant guidelines and strategies are outlined in Table 2.4.

Table 2.4 NSW guidelines and strategies related to biodiversity conservation

Guideline/Strategy	Agency	Comment
Threatened Species Survey and Assessment Guidelines	OEH	The Guidelines aim to provide a consistent and systematic approach to survey and assessment of threatened biodiversity. In particular, the guidance provides assistance in: <ul style="list-style-type: none"> <li>• setting appropriate aims for survey and assessment of threatened biodiversity;</li> <li>• the planning of suitable survey techniques and the appropriate level of effort;</li> <li>• the provision of adequate reporting;</li> <li>• a justifiable interpretation of results; and</li> <li>• making an informed and justifiable decision.</li> </ul>
Species-specific impact assessment guidelines	OEH	Environmental Impact Assessment (EIA) guidelines have been prepared for the following species, populations and ecological communities that are known or have potential habitat in the study area. The guidelines include species-specific survey requirements for the following flora and fauna: <ul style="list-style-type: none"> <li>• <i>Cynanchum elegans</i></li> <li>• <i>Dillwynia tenuifolia</i></li> <li>• <i>Pultenaea parviflora</i></li> <li>• <i>Acacia pubescens</i></li> <li>• <i>Eucalyptus benthamii</i></li> <li>• <i>Grevillea juniperina</i></li> <li>• <i>Grevillea parviflora</i></li> <li>• <i>Persoonia nutans</i></li> <li>• <i>Pimelea spicata</i></li> <li>• Green and Golden Bell Frog</li> <li>• Cumberland Land Snail</li> </ul>

Guideline/Strategy	Agency	Comment
		<p>The following best practice guidelines are also available for management:</p> <ul style="list-style-type: none"> <li>Recovering Bushland on the Cumberland Plain Best Practice Guidelines.</li> <li>Best Practice Guidelines for the Grey-headed Flying-fox.</li> </ul>
NSW (draft) Biodiversity Strategy (2010-2015)	OEH	<p>Identifies key themes and measurable targets that will contribute to building ecosystems that are healthy and resilient:</p> <ul style="list-style-type: none"> <li>Smarter Biodiversity Investment.</li> <li>Whole of Landscape Planning.</li> <li>Improved Partnerships.</li> <li>Effectively Managing Threats.</li> <li>Sustainable Production Environments.</li> </ul>
NSW Biodiversity Offset Policy for Major Projects (2014)	OEH	<p>The NSW Biodiversity Offset Policy for Major Projects clarifies, standardises and improves biodiversity offsetting for major project approvals. The policy applies to state significant development and state significant infrastructure under the EP&amp;A Act.</p> <p>The policy aims to strike an effective balance between the needs of proponents, communities and the environment by:</p> <ul style="list-style-type: none"> <li>providing clear, efficient and certain guidance for stakeholders</li> <li>improving outcomes for the environment and communities</li> <li>providing a practical and achievable offset scheme for proponents.</li> </ul> <p>The policy is underpinned by the Framework for Biodiversity Assessment. The FBA sets out the process for:</p> <ul style="list-style-type: none"> <li>assessing biodiversity impacts on a proposed development site</li> <li>determining the biodiversity offset requirements for those impacts.</li> </ul>
Draft Metropolitan Strategy (2013)	DP&E	<p>A plan to guide Sydney's growth as well as protect and improve biodiversity as the city grows. Policy objectives include objectives to address biodiversity protection and enhancement.</p>
Liverpool Biodiversity Management Plan (2012)	Liverpool City Council	<p>Provides an implementation framework for the protection and management of biodiversity at the local, and where relevant, regional scale. This Plan is concerned with the conservation and management of native plants and animals, genetic variations, ecosystems and ecological processes which occur within, or are dependent upon, the Liverpool LGA.</p> <p>The BMP discusses the distribution of endangered ecological communities across the LGA and sets targets for their protection. It also maps regional connectivity (or corridors) across the LGA.</p>
Greater Sydney Local Land Services Strategic Plan	Greater Sydney LLS	<p>The <i>Local Land Service Act 2013</i> requires the development of regional strategies to inform the deployment of local land services through resources and creation of partnerships across the regions. The plan sets the vision, priorities and strategy for the delivery of local land services in the Greater Sydney region, with a focus on appropriate economic, social and environmental outcomes.</p>

## 2.3. Survey methodology

Desktop research was undertaken prior to the commencement of field surveys and included database searches and a review of relevant literature to help identify threatened biota known or likely to occur in the study area.

The following databases and resources were investigated:

- NSW OEH Atlas of NSW Wildlife Database within a 10 kilometre buffer of the site (OEH 2014)
- Commonwealth Protected Matters Search to identify all MNES within 10 km of the site. MNES include threatened species, communities and migratory species which are listed under the EPBC Act (Department of Environment 2014)
- NSW Flora Online Search – Rare or Threatened Australian Plants (ROTAP) species (The Royal Botanic Gardens and Domain Trust 2014)
- NSW OEH NSW Native Vegetation Types Database, Vegetation Benchmarks Database, Threatened Species Profile Database (OEH 2012)
- Native Vegetation of the Cumberland Plain, Western Sydney (NPWS 2002)
- Western Sydney Urban Bushland Biodiversity Survey (NPWS 1997)
- Department of Primary Industry – Fishing and Aquaculture: Threatened and Protected Species, Liverpool LGA (DPI 2014)
- NSW Department of Primary Industries records viewer, <http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer>
- NSW Department of Primary Industries Noxious Weeds List (DPI 2014)
- National Groundwater Dependent Ecosystems Atlas (BoM 2014)
- Previous ecological reports prepared as part of the Second Sydney Airport Draft Environmental Impact Statement in 1997 and associated supplementary reports.

Survey methods were developed following a review of *Survey Guidelines for Nationally Threatened Species, Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft)* (DEC 2004) and the *Native Vegetation Interim Type Standard* (DECCW 2010b).

A full description of the methodology is provided in the biodiversity report included as Appendix B to this report.

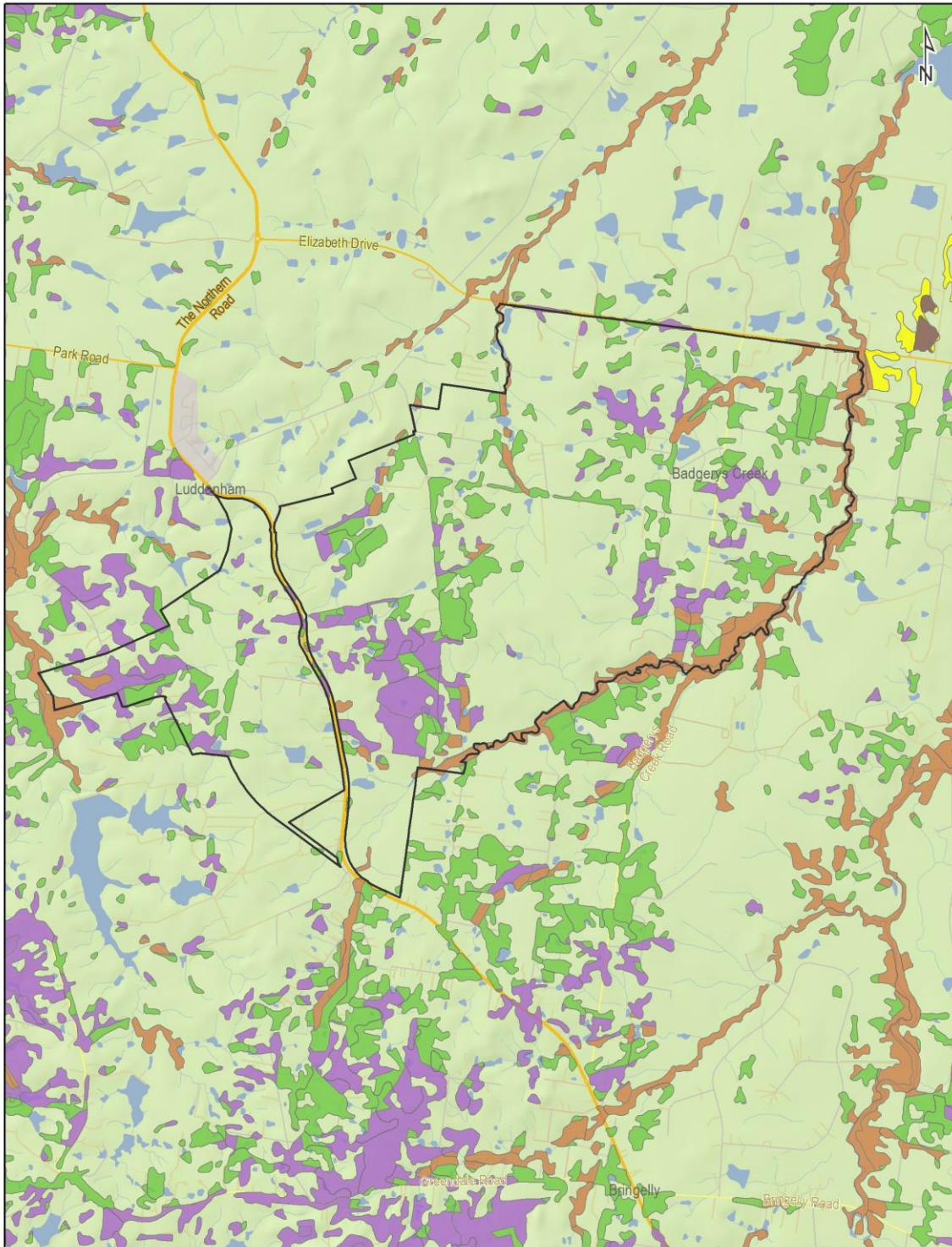
### 2.3.1. Field survey

A terrestrial flora survey and fauna habitat assessment of the study area was conducted on 22, 23 and 25 September 2014. The field survey aimed to ground truth existing vegetation mapping, describe vegetation and habitat type and condition in more detail, and identify any areas of higher quality vegetation habitat that could support threatened species potentially occurring in the study area.

The field surveys undertaken by SMEC in September 2014 added to, and updated, previous flora and fauna surveys undertaken by Biosis in the study area for the Draft EIS.

#### **Flora**

Existing mapping of vegetation communities in the study area (Figure 2.1) undertaken by NPWS (2002) was obtained and reviewed. Sites were selected via desktop to undertake vegetation plot assessments in the field. Sites selected were within patches of vegetation most likely to meet the definition of EPBC listed Cumberland Plain Shale Woodlands and Shale–Gravel Transition Forest (CPW). Two additional sites were selected along Badgerys Creek to sample riparian vegetation. The locations of survey sites are shown in Figure 2.2.

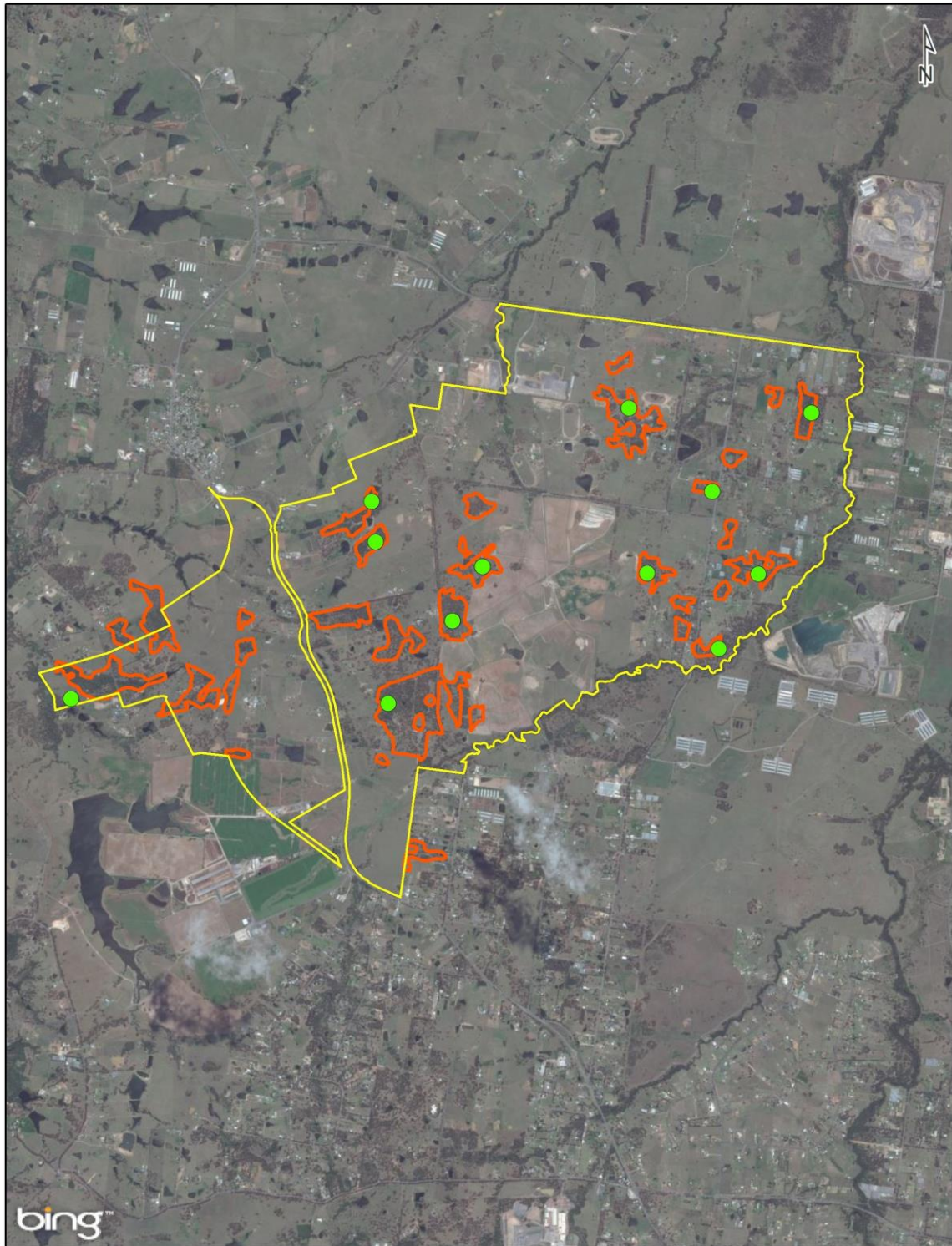


Badgerys Creek Commonwealth Land	<b>Native Vegetation of the Cumberland Plain (NPWS 2002)</b>	Cooks River Castlereagh Ironbark Forest	Badgerys Creek Studies	3001806
Waterbodies	Shale Plains Woodland	Shale Hills Woodland		
Cleared land	Shale-Gravel Transition Forest			
	Alluvial Woodland			

Extant vegetation coverage of the Cumberland Plain, Western Sydney, NPWS Vector backdrop data © MDS 2014  
 0 250 500 1,000 Metres  
 Last updated by RC10721 on 11/11/2014 at 15:17

Figure 2.1 Existing vegetation

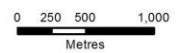




- Field survey locations
- Badgerys Creek Commonwealth Land
- EPBC listed vegetation

Badgerys Creek Studies 3001806

*Extant vegetation coverage of the Cumberland Plain, Western Sydney, NPWS Vector backdrop data © MDS 2014*



Location: I:\projects\3001806 - Badgerys Creek Studies\008 DATA\GIS\Maps\2\_EPBC.mxd

Last updated by: RC10721 on 11/11/2014 at 15:17

Figure 2.2 EPBC listed vegetation and field survey locations

In addition to plot assessments, additional observations of vegetation type and condition were made throughout the study area. These included opportunistic observation of the condition of 'cleared' land to assess whether the remaining grassland contained native vegetation. These observations were used in conjunction with plot data and aerial photography to confirm (ground-truth) existing vegetation mapping and assist in calculating approximate patch sizes of vegetation communities.

The random meander technique (Cropper 1993) was used to target areas in the vicinity of previously known locations of threatened flora species. This focussed specifically on *Pultenaea parviflora* along Longleys Road and Anton Road as well as *Marsdenia viridiflora* along Badgerys Creek Road in the north of the study area.

Searches were also undertaken in suitable habitat near to an old recovery plan record of *Acacia pubescens* on a property on Longleys Road as well as a herbarium record for this species on Elizabeth Drive referred to in the urban bushland biodiversity survey report (National Parks and Wildlife Service 1997).

### **Fauna**

A fauna habitat assessment was conducted to assist in determining the likelihood of presence of threatened fauna species. Habitat assessments focussed on sites where rapid vegetation assessment plots were undertaken.

Habitat characteristics considered include the presence of nectar-producing plants, hollow bearing trees, fallen logs, leaf litter and other ground debris, drainage lines, ponds, the structure of vegetation communities and the presence of fruiting/flowering plant species to assess the habitat suitability for a range of fauna species.

Using the random meander technique, searches were carried out for signs of fauna activity such as tracks, scats, scratches and notches on trees, as well as any opportunistic sightings, to identify the presence of common and threatened fauna species.

### **2.3.2. Limitations**

The limitations of the flora and fauna surveys are as follows:

- The biodiversity report provides an overview of the biodiversity values of the study area to assist in developing an understanding of its biodiversity characteristics. It is not a report of a detailed investigation of all relevant ecological characteristics.
- Access to parts of the study area for field survey was limited due to time constraints and landholder notification requirements.
- Vegetation survey was limited to assessment of 12 vegetation plots at selected locations mainly targeting better condition EPBC-listed CPW. There were no full floristic surveys and vegetation community diagnostic analyses undertaken in relation to plot data.
- The rapid flora surveys conducted in September 2014 allowed considerable validation of the existing Cumberland Plain vegetation mapping (NPWS 2002). This provided a high level of confidence in the plant communities identified and associated threatened species that may occur in the study area.
- Threatened flora surveys were limited to known locations of *Pultenaea parviflora*, *Marsdenia viridiflora* and *Acacia bynoeana*. No seasonal surveys were undertaken for threatened flora across the whole study area.
- While fauna habitat assessments were undertaken, this technique is not a complete substitute for fauna surveys. Fauna are capable of inhabiting sub-optimal habitat. In addition fragmentation, isolation or species density can all influence the presence and distribution of a particular species. Species likelihood of occurrence was informed by habitat characteristics and

opportunistic sightings. For the purposes of this biodiversity assessment, threatened fauna species known to occur in the locality are assumed to use the site if suitable habitat is present. No seasonal fauna survey or trapping was undertaken.

- No aquatic survey was undertaken of Badgerys Creek or other drainage lines in the study area. Species likelihood of occurrence was informed by previous ecological reports, habitat characteristics and opportunistic sightings.

Given the identified limitations, all survey results arising from this investigation should be regarded as providing only a limited picture of the biodiversity assets and values at a point in time. Related to this, these results are unlikely to be able to be solely relied upon as the 'before' element in any BACI (before, after, control, impact) assessment.

The compressed timeframe in which the field assessment was undertaken has meant that a sampling and ground-truthing approach has been taken. As such surveys may not have included all individuals, populations or communities that may be present within the site. Any assessment of the site in support of future development should employ an approach that adequately captures all ecological assets in at an appropriate level of detail.

## 2.4. Key findings and information gaps

### 2.4.1. Flora

#### ***Vegetation communities***

In terms of the existing environment, the *Interpretation Guidelines for Native Vegetation Maps of the Cumberland Plain, Western Sydney* (NPWS 2002) identify the following native plant communities within the study area (refer Figure 2.1):

- Alluvial Woodland
- Shale Plains Woodland
- Shale Hills Woodland
- Shale–Gravel Transition Forest.

The majority of native vegetation in the study area comprises Shale Plains Woodland in varying condition with Alluvial Woodland present along Badgerys Creek and other drainage lines in the study area. The mapping also identifies small areas of Shale–Gravel Transition Forest.

The Shale Plains Woodland and Shale Hills Woodland vegetation communities mapped in the study area meet the definition of Cumberland Plain Shale Woodlands and Shale–Gravel Transition Forest, a Critically Endangered Ecological Community under the EPBC Act. This vegetation is also listed as a Critically Endangered Ecological Community under the NSW TSC Act (listed name: Cumberland Plain Woodland in the Sydney Basin Bioregion).

Shale Plains Woodland is also equivalent to the NSW Plant Community Type 849 Grey Box–Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin in the NSW Vegetation Types Database (OEH 2012). Shale Hills Woodland is equivalent to NSW plant community type (PCT) 850 Grey Box–Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin. Both vegetation types occur across most of the study area.

The Shale–Gravel Transition Forest in the study area also meets the definition of Cumberland Plain Shale Woodlands and Shale–Gravel Transition Forest under the EPBC Act. It is listed under the TSC Act as Shale–Gravel Transition Forest and is equivalent to NSW PCT 724 Broad-leaved Ironbark–Grey Box–*Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin.

The Alluvial Woodland vegetation mapped in the study area is not listed under the EPBC Act, however it is listed at the state level under the TSC Act as River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

### **Survey findings**

Field survey broadly agreed with the 2002 National Parks and Wildlife Service (NPWS) mapping, with most sites being confirmed as Shale Plains Woodland, or Alluvial Woodland along drainage lines. However, for some sites, differences were noted between the mapped vegetation community and what was observed on the ground.

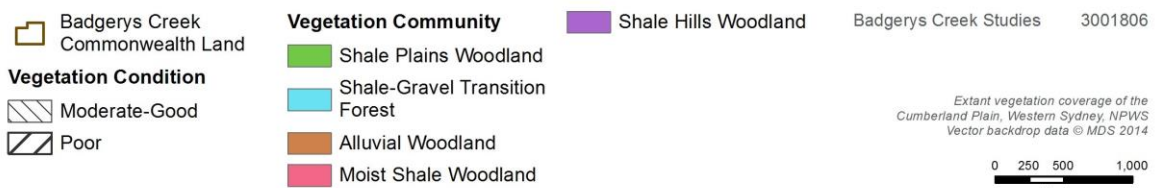
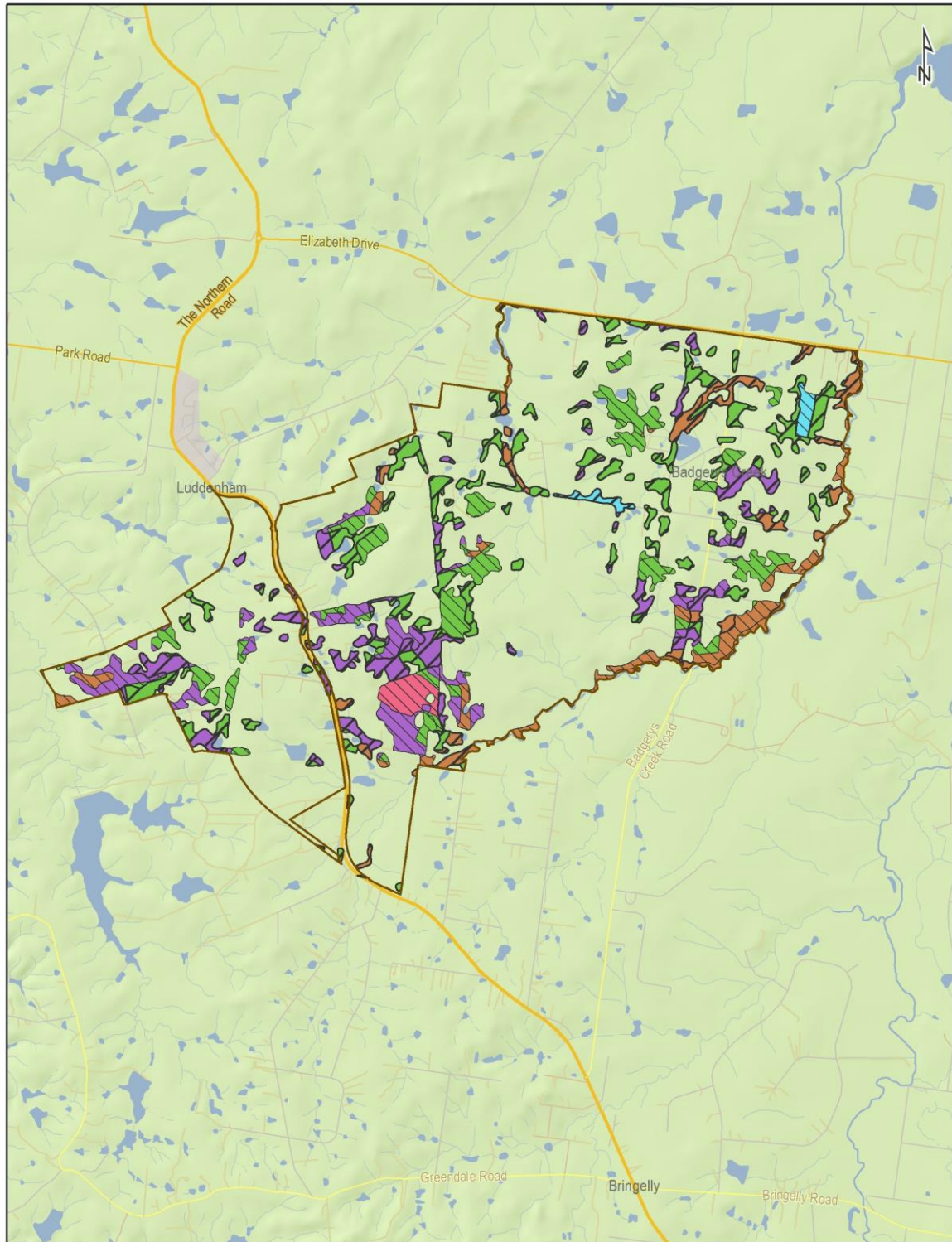
The vegetation type and condition shown in Figure 4 is largely based upon existing vegetation mapping but also incorporates results of the twelve vegetation plot assessments undertaken during field survey in September 2014. Table 2.5 provides a summary of these communities by condition and extent.

Table 2.5 Condition and extent of vegetation communities within the Commonwealth land

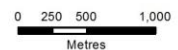
<b>Vegetation community / Condition</b>	<b>Area (ha)</b>
Alluvial Woodland / Moderate-Good	43.0
Alluvial Woodland / Poor	38.7
Moist Shale Woodland / Moderate-Good	13.5
Shale-Gravel Transitional Forest / Moderate-Good	5.2
Shale-Gravel Transitional Forest / Poor	3.9
Shale Hills Woodland / Moderate-Good	54.0
Shale Hills Woodland / Poor	74.3
Shale Plains Woodland / Moderate-Good	88.6
Shale Plains Woodland / Poor	115.5

The findings of the field survey with regard to flora are summarised as follows:

- EPBC Act:
  - two endangered ecological communities occur within the Commonwealth land at Badgerys Creek (Cumberland Plain Shale Woodlands and Shale–Gravel Transition Forest, Western Sydney Dry Rainforest and Moist Woodland on Shale)
  - four individuals of *Pultenaea parviflora* were recorded on the southern side of Longleys Road between Ferndale Roads and Taylors Road (refer Figure 2.4); this is a significant reduction from the 68 individuals previously recorded along both sides of Longleys Road in this location since the 1999 Supplement to the Draft EIS
  - no other threatened flora species were recorded on site, however, potential habitat exists for a further five threatened flora species listed under the EPBC Act (*Acacia pubescens*, *Cynanchum elegans*, *Grevillea parviflora* subsp. *parviflora*, *Isotoma sessiliflora*, *Pimelea spicata*)
- TSC Act:
  - four endangered ecological community occur within the Commonwealth land at Badgerys Creek (Cumberland Plain Woodland, Shale Gravel Transition Forest, Moist Shale Woodland, River-flat Eucalypt Forest on Coastal Floodplains)
  - one individual of *Marsdenia viridiflora* (within the extent of the endangered population) was recorded along the eastern side of Badgerys Creek, just north of Gardiner Road



Extant vegetation coverage of the Cumberland Plain, Western Sydney, NPWS Vector backdrop data © MDS 2014



Location: I:\projects\3001806 - Badgerys Creek Studies\008 DATA\GIS\Maps\2\_Veg comm.mxd

Last updated by RC10721 on 11/11/2014 at 15:17

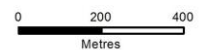
Figure 2.3 Vegetation communities and condition



- ▭ Badgerys Creek Commonwealth Land
- SMEC 2014 threatened flora locations**
- *Marsdenia viridiflora* subsp. *viridiflora*
- *Pultenaea parviflora*
- Existing threatened flora records**
- ▲ *Marsdenia viridiflora* subsp. *viridiflora*
- ▲ *Pultenaea parviflora*

Badgerys Creek Studies 3001806

Threatened species data - Atlas of NSW Wildlife, NSW OEH 2014  
Vector backdrop data © MDS 2014



Location: I:\projects\3001806 - Badgerys Creek Studies\008 DATA\GIS\Maps\2\_Pultenaea and Marsdenia.mxd

Last updated by RC10721 on 11/11/2014 at 15:18

Figure 2.4 *Pultenaea parviflora* and *Marsdenia viridiflora* subsp. *viridiflora*

- 12 new individual *Marsdenia viridiflora* were recorded on the southern side of Longleys Road between Ferndale and Taylors Road (refer Figure 2.4)
- potential habitat exists for an additional two species and one endangered population listed under the TSC Act (respectively *Dillwynia tenuifolia*, *Grevillea juniperina* subsp. *juniperina* and *Dillwynia tenuifolia* (Kemps Creek endangered population)).
- Nine noxious weeds declared in the Liverpool LGA were observed in the study area, six of these are also Weeds of National Significance.
- The NSW Office of Water Risk assessment guidelines for groundwater dependent ecosystems indicate that several vegetation communities that occur within the study area are likely to be ‘high probability groundwater dependent ecosystems’.

### 2.4.2. Fauna

Fauna habitat present within the study area is moderately to highly modified. Much of this disturbance is due to the grazing of livestock. It is likely that much of the original vegetation within the area was directly cleared to facilitate grazing and other agricultural activities, with remaining vegetation clearing and suppression of regeneration accounted for by grazing itself.

Despite this, several native fauna habitats persist within the study area. These can be classified into three broad types: open woodland, grassland, and aquatic habitat. Each exhibits a high degree of variation in its vegetation composition across the study area, however, the structural elements relevant to native fauna are generally consistent.

#### **Open woodland**

Pockets of open woodland habitat are scattered across the study area, separated by large expanses of grassland. These open woodland areas are of varying age; some are likely to be remnant while others have regenerated since clearing. The presence of large tree stumps within remnant patches indicates that within these areas many of the large trees have been selectively removed. The overall result of such clearing is the general scarcity of trees old or large enough to produce usable hollows for arboreal mammals, reptiles and diurnal and nocturnal birds and other native fauna. As such habitat value of this layer is considered to be low.

Within remnant/regenerating patches, mid-storey vegetation varies from non-existent to native shrubs of varying density to dense African Olive infestations. Mid-storey vegetation within the native plant communities types present within the study area is typically sparse and usually dominated by *Bursaria spinosa*.

While the abundant introduced African Olive provides some habitat structure within the mid-storey (e.g. shelter and foraging opportunities for reptiles and small birds), this is at the expense of native mid-storey vegetation which is likely to provide better structure, as well as increased opportunity for hosting food resources for native wildlife. Of the open woodland sites surveyed it was noted that a couple of sites contained mid-storeys dominated by African Olive and African Boxthorn. As such the overall habitat value of this layer within remnant/regenerating patches is generally considered to be moderate to low.

Vegetative ground cover within some remnant/regenerating patches of open woodland is often sparse or less than five centimetres in height as a result of ongoing grazing pressure. Leaf litter is thin, although many sites are littered with debris and fallen/cut logs. Parts of the study area are infested with non-native groundcovers such as African lovegrass. Some areas of remnant vegetation area present where there is good native species diversity and there are some fenced areas with reduced grazing pressure where the native grass cover is also intact. It is likely that populations of the threatened Cumberland Plain Land Snail persist in these areas; however, no targeted searches

were undertaken. The habitat value within this layer across the broader study area is considered to be moderate to low.

### ***Grassland***

The grassland habitat present exhibits a mixture of native and exotic grasses. Occasional emerging eucalypts are present where there is reduced grazing pressure. Isolated mature canopy trees and logs occur sporadically amongst pastures. The overall habitat value of grasslands throughout the site is considered to be low to moderate.

### ***Aquatic habitat***

There are numerous farm dams within the Commonwealth land. These are generally vegetated around the edge except where the banks have been degraded by livestock access.

Badgerys Creek flows through the eastern portion of the area in a northerly direction and has a relatively well vegetated riparian corridor. Large portions of the waterway are infested with weeds and natural water flow is significantly altered in certain locations, particularly through the actions of livestock and other agricultural activities. Despite this highly degraded state the creek is likely to provide suitable habitat for a variety of native fauna species.

Aquatic habitats have the potential to be adversely affected by future development in the area. Additional and ongoing water quality testing would be recommended in order to provide an adequate baseline against which impacts may be measured. It should be noted in this context that no aquatic ecological assessment was undertaken during field investigations for the biodiversity report.

### ***Wildlife connectivity corridors***

Parts of the study area have been identified within the Liverpool City Council Biodiversity Management Plan as 'regionally connected vegetation', and 'riparian corridor' (Liverpool City Council 2012). Badgerys Creek (the waterway) remains largely vegetated throughout the study area. It is likely that the creek forms an important (broadly) north-south corridor for wildlife movement within the Commonwealth land.

There is a high probability that the vegetation surrounding most waterways within the study area would be of a somewhat degraded condition based upon the prevalence of exotic vegetation generally in the area. Limited results from two sites sampled in the SMEC flora survey (away from the riparian zone but still within River-flat Forest) indicates that vegetation was in moderate condition.

### ***Survey findings***

The findings of the field survey with regard to fauna are summarised as follows:

- The study area contains low to moderate quality habitat, including riparian vegetation and grassy woodland vegetation.
- Badgerys Creek is identified as a potential wildlife corridor in a number of local and regional planning documents.
- Potential habitat is available within the study area for threatened fauna species including the Cumberland Land Snail, woodland birds, microchiropteran bats and the Grey-headed Flying-fox.
- There is potential suitable habitat in the study area for seven migratory species (Cattle Egret, Fork-tailed Swift, Great Egret, Latham's Snipe, Rainbow Bee-eater, Rufous Fantail, White-throated Needletail).



### 2.4.3. Information gaps

There are a number of information gaps that exist due to:

- lack of detailed knowledge of the distribution and condition of threatened species and ecological communities
- new and improved standards for flora and fauna survey required to satisfy updated environmental assessment techniques
- lack of detail concerning aquatic species and habitats
- changes in legislative status of biodiversity.

Results from the site surveys undertaken in the late 1990s would not be suitable for use as part of any future environmental assessment as they are now outdated. In the intervening period there have been changes to Commonwealth environmental legislation (most notably the introduction of the EPBC Act) and supporting regulation (such as threatened flora and fauna survey and assessment guidelines), and changes to the suite of listed threatened species (both NSW and Commonwealth). There have also been changes in the ecological and physical condition of the land associated with the predominantly agricultural land use. This notwithstanding, previous surveys may still provide useful general background information of site conditions and facilitate understanding of the nature of changes over time.

## 2.5. Recommendations

### 2.5.1. Information gaps

To the extent that future land use permits, and management measures are practicable and feasible, consideration should be given to implementing the following measures to protect and enhance existing ecological assets and values:

- Undertake further assessment of remnant vegetation to accurately determine the extent of vegetation communities present, particularly the extent of Moist Shale Woodland and Shale–Gravel Transition Forest components of EPBC listed EECs.
- Undertake further field assessment to better detail the extent of EPBC Act listed vegetation as a subset of TSC Act listed vegetation in line with patch size and condition thresholds in the determination. Survey methods will need to be consistent with current accepted standards and guidelines.
- Undertake targeted threatened flora and fauna survey for all species listed in Appendix 4 to the biodiversity report (Appendix A) as having a medium to high risk of occurrence to bring the level of information into line with current accepted standards and guidelines. Requirements for survey for each of the 12 flora and 33 fauna species requiring survey including duration, timing and technique are detailed in Appendix 4 to the biodiversity report.
- For any future development proposal(s), where impacts are unavoidable or cannot otherwise be suitably mitigated through management actions, consideration should be given to potential offsetting arrangements consistent with relevant legislative and policy requirements.

### 2.5.2. Management

Within the context of existing management of the Commonwealth land and any future development proposals, consideration should be given to implementing the following management measures, to the extent that these are practicable and reasonable, to protect and enhance existing ecological assets and values. The recommended measures address protection of relevant MNES and would also address many NSW objectives for threatened species management.

- Protect all moderate to good condition native vegetation in the study area with particular focus upon EPBC listed Cumberland Plain Shale Woodland and Shale–Gravel Transition Forest and Western Sydney Dry Rainforest and Moist Woodland on Shale.
- Protect nectar producing trees and shrubs and revegetate/rehabilitate degraded sites with appropriate species.
- Fence off better condition remnants from grazing and protect areas where *Pultenaea parviflora* and *Marsdenia viridiflora* have been recorded. Consider seed collection/propagation of *P. parviflora* and *M. viridiflora* should these populations be at risk of further clearing.
- Ensure road maintenance and agricultural activities adjacent to Longleys Road and Badgerys Creek Road avoid known *P. parviflora* and *M. viridiflora* populations.
- Retain mature and hollow bearing trees and supplement with nest boxes.
- Retain habitat features including dead wood and trees.
- Restrict use of pesticides for weed control particularly near watercourses and immediately before or during wet weather.
- Regeneration works in riparian areas should include placement of rocks and logs to enhance existing aquatic habitat.
- Undertake regeneration activities in strategic locations to improve habitat connectivity.
- Maintain native grasses in pasture.
- Undertake weed control in accordance with the *Noxious Weeds Act 1993* and best practice (including control of environmental weeds).
- Adopt hygiene protocol standards for the control of disease in frogs and prevent introduction or spread of *Phytophthora cinnamomi* and Myrtle Rust.
- Implement pest management control for vertebrate pests.
- Implement controls to prevent pollution of local waterways and manage riparian and in-stream fish habitat, including restricting access of livestock to riparian areas.
- Control sediment at the catchment and local site scale.
- Identify and manage point and diffuse sources of pollution.
- Land management standards, including management measures to support biodiversity as outlined above, should be included as part of any new tenancy agreements.
- Management measures for any future development within the Commonwealth land should be prepared as part of the associated environmental assessment(s).

The above recommendations do not necessarily provide for future development within the Commonwealth land. Any such development proposal(s) should include development of appropriate management measures of the environmental assessment within the context of the 'avoid/mitigate/offset' hierarchy of impact management.

### 2.5.3. Survey

The following survey activities are recommended to adequately describe the biodiversity values of the study area as part of any future environmental assessment(s):

- Undertake detailed vegetation community and condition mapping for the Commonwealth land at Badgerys Creek. This would involve additional site stratification and vegetation sampling using plot surveys, including full floristics, to supplement the rapid plot assessment undertaken by SMEC in 2014. This additional plot survey would be used to inform preparation of detailed vegetation community and condition mapping.

- Undertake targeted threatened flora survey for the following threatened flora species/ populations in areas of potential habitat in the study area during the appropriate flowering season:
  - *Acacia pubescens* (EPBC and TSC)
  - *Cynanchum elegans* (EPBC and TSC)
  - *Grevillea parviflora* subsp. *parviflora* (EPBC and TSC)
  - *Isotoma sessiliflora* (*Hypsela sessiliflora*) (EPBC and TSC)
  - *Pimelea spicata* (EPBC and TSC)
  - *Pultenaea parviflora* (EPBC and TSC)
  - *Dillwynia tenuifolia* (TSC)
  - *Dillwynia tenuifolia* (TSC listed endangered population)
  - *Grevillea juniperina* subsp. *juniperina* (TSC)
  - *Marsdenia viridiflora* subsp. *viridiflora* (TSC listed endangered population).
- Undertake targeted survey for the following threatened fauna species (all TSC listed, and also EPBC listed where noted):
 

<ul style="list-style-type: none"> <li>– Giant Burrowing Frog (EPBC)</li> <li>– Green and Golden Bell Frog (EPBC)</li> <li>– Regent Honeyeater (EPBC)</li> <li>– Swift Parrot (EPBC)</li> <li>– Grey-headed Flying-fox (EPBC)</li> <li>– Large-eared Pied Bat (EPBC)</li> <li>– Barking Owl</li> <li>– Black-chinned Honeyeater</li> <li>– Diamond Firetail</li> <li>– Flame Robin</li> <li>– Gang-gang Cockatoo</li> <li>– Glossy Black-cockatoo</li> <li>– Hooded Robin</li> </ul>	<ul style="list-style-type: none"> <li>Little Eagle</li> <li>– Little Lorikeet</li> <li>– Powerful Owl</li> <li>– Masked Owl</li> <li>– Scarlet Robin</li> <li>– Speckled Warbler</li> <li>– Square-tailed Kite</li> <li>– Varied Sittella</li> <li>– Cumberland Land Snail</li> <li>– Eastern Bentwing Bat</li> <li>– Eastern Freetail Bat</li> <li>– Greater Broad-nosed Bat</li> <li>– Southern Myotis.</li> </ul>
--	---
- Undertake targeted survey for migratory species with potential habitat in the study area: Cattle Egret, Fork-tailed Swift, Great Egret, Latham’s Snipe, Rainbow Bee-eater, Rufous Fantail and White-throated Needletail.
- Undertake further survey of representative aquatic environments throughout the study area, with targeted surveys of known threatened aquatic flora and fauna.

## 3. HISTORIC HERITAGE

---

### 3.1. Previous investigations

#### 3.1.1. 1997 Draft EIS

Chapter 21 of the Draft EIS addressed the non-Aboriginal (historic) cultural heritage impacts of the then proposed Second Sydney Airport. Discussion was based on a separate specialist investigation documented in *Technical Paper 12: Non-Aboriginal Cultural Heritage* (Godden Mackay 1997).

Historic heritage items were identified through a combination of primary and secondary research, field surveys, reviews of existing heritage studies, and reviews of existing heritage listings. An assessment of significance was undertaken for each item using the criteria provided in the *NSW Heritage Manual* (Heritage Office, Department of Urban Affairs and Planning 1996). The investigation also identified a range of management measures to mitigate impacts.

#### ***Auditor's Report***

The Auditor's Report on the Draft EIS (SMEC 1998) concluded that the investigation achieved all the objectives identified in the EIS Guidelines for the Draft EIS studies and that the Technical Paper followed a methodology that complied with (then) current best practice in the heritage field. It noted that while the information provided in the Draft EIS was limited, and critical analysis of the data and conclusions required reference to the Technical Paper, Chapter 21 was an accurate summary of the Technical Paper.

#### 3.1.2. 1999 Supplement to the Draft EIS

Chapter 18 of the Supplement to the Draft EIS summarised the findings of the Draft EIS and issues raised in submissions. Further information was provided on the methodology and scope of the assessment for the historic heritage investigation including:

- justification for not undertaking a preliminary field survey
- justification for exclusion of historic heritage items not located within or immediately adjacent to the airport options.

It was noted that historic heritage resources within the study area included a diverse range of elements. While some evidence was readily available, much was considered to be concealed or buried. It was therefore impossible to assess this material without detailed, individual site-specific research and physical examination.

The assessment identified an additional nine items as having sufficient cultural significance to warrant entry on the Register of the National Estate (RNE). The nine items were already listed on the relevant LEPs for their respective LGAs.

Additional assessment was undertaken to determine the cumulative impacts of the airport development on historic heritage in the Liverpool LGA. It was concluded that cumulative impacts would not be severe given the affected items were not of high heritage significance and for which the loss of major heritage values would not be irreplaceable. It was also noted that there were comparable heritage items to those impacted, either in other nearby areas or spread throughout the region.

The Supplement to the Draft EIS discussed the then potential listing of the Greater Blue Mountains Area as a World Heritage site. It noted that the basis of the listing related to biological diversity, landscape heritage values and Aboriginal heritage values, rather than historic heritage values. The Greater Blue Mountains Area was subsequently inscribed on the World Heritage List in 2000.

Further details were provided in relation to management measures addressing:

- archaeological assessment and management
- relocation of two impacted cemeteries
- management of National Estate values
- specific management for archaeological resources
- management measures for heritage items close to the site and within the airport options.

### ***Auditor's Report***

The Auditor's Report on the Supplement to the Draft EIS (SMEC 1999) noted that the Supplement had addressed the comments made in public submissions and re-evaluated 23 heritage items (associated with all three airport options) in terms of National Heritage Values. It also noted the identification of an additional nine heritage items and recommended that any future comparison of options include consideration of how each item would be affected. The potential for future excavation to encounter subsurface items of heritage significance was noted.

### **3.1.3. 1999 Environment Australia Assessment Report**

Environment Australia's report summarised the findings in the draft EIS, the Supplement to the Draft and the two Auditor's Reports. The following points were made in relation to the assessment of historic heritage:

- The known heritage values of places in the Badgerys Creek area appear to have been adequately assessed on an individual basis. The understanding of their collective value could have benefited from additional comparative assessment with sites in other similar areas in the region, but their level of significance would be unlikely to change as a result of such an assessment.
- The cumulative impact assessment prepared for the Supplement did not take into account the impacts of airport operations on the setting and ambience of remaining heritage items or the impacts of consequential land uses or infrastructure upon the remaining heritage resources of the region. The loss of 13–17 heritage items within the site and the consequential regional impacts of an airport and associated infrastructure would have a significant impact on the heritage resource of the region. The significance of the remaining heritage sites within the region would be elevated due to the loss of the sites at Badgerys Creek.

The following recommendations were made by Environment Australia:

- A survey of the airport site must be carried out prior to construction, to identify any further above-ground heritage items and potential archaeological deposits. If such places are found, they should be assessed and documented prior to construction, in accordance with established management principles for existing known heritage items.
- A survey must be conducted early in the planning period for a Badgerys Creek airport of all non-Aboriginal regional heritage items within the Badgerys Creek region that might be affected by the operation of an airport. Where heritage items are found that will be affected by operational impacts, funding should be provided for the preparation of a conservation management plan for each site and to undertake measures identified in the plan to mitigate the impacts of airport operations.

### **3.1.4. Other investigations**

There have been no other relevant investigations since 1999.

## 3.2. Relevant legislation and guidelines

### 3.2.1. Commonwealth

#### ***Environment Protection and Biodiversity Conservation Act 1999***

The EPBC Act provides a legal framework for the protection and management of places of national environmental significance. The heritage lists addressed by the EPBC Act include the United Nations Educational, Scientific and Cultural Organization (UNESCO) the WHL, the NHL, and the Commonwealth Heritage List (CHL).

All World Heritage properties in Australia are protected and managed under the EPBC Act. The NHL also protects places that have outstanding value to the nation. The CHL protects items and places owned or managed by Commonwealth Government agencies.

The Australian Government Department of the Environment is responsible for the implementation of national policy, programs and legislation to protect and conserve Australia's environment and heritage. Approval from the Minister is required for controlled actions which would have a significant impact on items and places included on the WHL, NHL or CHL.

Section 341ZA of the EPBC Act requires preparation of a heritage management strategy which identifies the heritage values and appropriate management of places to protect and conserve their Commonwealth Heritage values. The Commonwealth Heritage Management Principles as set out in Schedule 7B (Regulation 10.03D) of the EPBC Regulations, provide the guidelines for the appropriate management of Commonwealth heritage places. The following principle is relevant to the local heritage environment:

3. *The management of Commonwealth Heritage places should respect all heritage values of the place and seek to integrate, where appropriate, any Commonwealth, State, Territory and local government responsibilities for those places.*

Under Section 341ZB, Commonwealth agencies must take all reasonable steps to assist the Minister and the Australian Heritage Council in the identification, assessment and monitoring of the place's Commonwealth Heritage values. Assessment of heritage values is undertaken in accordance with the CHL criteria as set out in EPBC Regulation 2000 (No.1) Regulation 10.03A. The threshold for listing is that the place has significant heritage value against one or more of the criteria.

#### ***National Trust***

The National Trust of Australia is a private, not-for-profit organisation committed to conserving Australia's heritage. Listing with the National Trust of Australia does not have statutory authority, however, it does have a role in raising public awareness of heritage issues.

#### ***Register of the National Estate***

The Register of the National Estate (RNE) was originally established under Section 22 of the *Australian Heritage Commission Act 1975* (AHC Act). Since the EPBC Act came into force and the NHL and CHL were established, the RNE has been phased out. From February 2012 all references to the RNE have been removed from the EPBC Act. The RNE is now being maintained as a non-statutory archive of information about more than 13,000 places throughout Australia.

#### ***Guidelines and strategies***

Commonwealth guidelines and strategies related to historic heritage that are of likely or potential relevance to the study area are listed in the following table with comment provided on the nature of their relevance.

Table 3.1 Commonwealth guidelines and strategies related to historic heritage

Guideline/Strategy	Agency	Comment
Burra Charter: The Australian ICOMOS charter for the conservation of places of cultural significance (2013)	DoE	The Burra Charter and the associated series of Practice Notes provide a best practice standard for managing cultural heritage places in Australia.
EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance (2013)	DoE	Provides overarching guidance on determining whether an action is likely to have a significant impact on a matter protected under national environment law — the EPBC Act.
EPBC Act Policy Statement 1.2 – Significant Impact Guidelines – Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies (2006)	DoE	Applies to: <ul style="list-style-type: none"> <li>any person who proposes to take an action which is either situated on Commonwealth land or which may impact on Commonwealth land, and/or</li> <li>representatives of Commonwealth agencies who propose to take an action that may impact on the environment anywhere in the world.</li> </ul>
Heritage Strategy	DI&RD	Prepared under Section 341ZA of the EPBC Act to guide management of heritage values of the Department’s assets. At the time of preparation of this report, the Strategy was under review by the Department.

### 3.2.2. New South Wales

#### **Heritage Act 1977**

The *Heritage Act 1977* provides protection for heritage places, buildings, works, relics, moveable objects, precincts and archaeological sites that are important to the people of NSW. These include items of historic (non-Aboriginal) and Aboriginal heritage significance. Where these items have particular importance to the people of NSW, they are listed on the State Heritage Register (SHR).

Sections 57 to 69 of the Act address the statutory requirements for items and places listed on the SHR, or which are the subject of an Interim Heritage Order (IHO). Works which include demolition, damage or alteration of a heritage item, place or archaeological site require the approval of the Heritage Council or its delegates.

Sections 139 to 146 of the Act refer to the requirement that excavation or disturbance of land that is likely to contain, or is believed may contain, archaeological relics is undertaken in accordance with an excavation permit issued by the Heritage Council (or in accordance with a gazetted exception under Section 139(4) of the Act). An archaeological relic is defined as meaning

*any deposit, artefact, object or material evidence that:*

- a) *relates to the settlement of the area that comprises NSW, not being Aboriginal settlement; and*
- b) *is of State or local heritage significance.*

Section 170 of the Act requires government departments and agencies to maintain a Heritage and Conservation Register, commonly known as a ‘Section 170 Register’. Clause 21 of the *Heritage Regulation 2012* describes the assets that must be included on a Section 170 Register.

## **Environmental Planning and Assessment Act 1979**

Part 3 of the EP&A Act provides for the making of specific EPIs to regulate land use and development. The study area is wholly within the boundaries of the Liverpool LGA and adjacent to the Penrith LGA (located immediately to the north of Elizabeth Drive). Table 3.2 provides comment on the provisions in these two LEPs that relate to historic heritage.

Table 3.2 EPIs made under the EP&A Act related to historic heritage

<b>EPI</b>	<b>Comment</b>
Liverpool LEP 2008	Clause 5.10 of the Liverpool LEP provides for the protection of items, places and archaeological sites which have been identified as having local heritage significance. There are 12 heritage items and heritage conservation areas identified within or in the vicinity of the study area.
Penrith LEP 2010	Clause 5.10 of the Penrith LEP provides for the protection of items, places and archaeological sites which have been identified as having local heritage significance. There are eight heritage items and heritage conservation areas identified within or in the vicinity of the study area.

## **Guidelines**

NSW guidelines and strategies related to historic heritage that are of likely or potential relevance to the study area are listed in the following table with comment provided on the nature of their relevance.

Table 3.3 NSW guidelines and strategies related to historic heritage

<b>Guideline/Strategy</b>	<b>Agency</b>	<b>Comment</b>
NSW Heritage Manual (1996)	OEH	The primary reference for heritage management in NSW when first published, and parts of the manual have subsequently been replaced by new guidelines. However much of the information remains relevant and is published as individual booklets.
Assessing Heritage Significance (2001)	OEH	Second part of the NSW Heritage Manual providing guidance as to how, why and when to assess significance.
Assessing Significance for Historical Archaeological Sites and Relics (2009)	OEH	Provides advice about how to assess the heritage significance of known and potential archaeological resources, features or deposits and determine whether they are 'relics' as defined by the Act.

## **3.3. Survey methodology**

Heritage places contribute to the understanding and character of a community by providing tangible evidence of its history and identity. At times of change, they help to preserve a connection to the past, and can provide a point of reference for interpreting the past to future generations. Article 15 of the Burra Charter refers to managing change, which should be guided by the cultural significance of the place and its appropriate interpretation. The Burra Charter process also recognises that the development of preferred conservation options requires consideration of a range of other factors which could affect the future of a place. These include:

- requirements of the owner, in this instance the Commonwealth
- the physical condition of the place
- statutory obligations or issues related to heritage and safety requirements.



An environmental survey report for historic heritage assessment was prepared by Australian Museum Consulting (October 2014) to update the understanding of historic heritage in relation to the Commonwealth land at Badgerys Creek and to interpret the findings of the survey in the context of current Commonwealth and NSW legislation and guidance materials.

The survey and reporting methodology is consistent with the principles of the Burra Charter. It has also been informed by the requirements of *EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance*, and *EPBC Act Policy Statement 1.2 – Significant Impact Guidelines – Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies*.

The methodology is also consistent with current NSW best-practice heritage guidelines as identified in the *NSW Heritage Manual* (Heritage Office<sup>2</sup> and Department of Urban Affairs and Planning 1996) and associated supplementary publications including *Conservation Areas* (1996), *Heritage Curtilages* (1996), *Assessing Heritage Significance* (2001) and *Assessing Significance For Historical Archaeological Sites and ‘Relics’* (2009).

To prepare the environmental survey report, the following tasks were undertaken:

- review of existing information relating to the management of the Commonwealth land at Badgerys Creek
- searches of the statutory and non-statutory heritage registers and lists, undertaken in September 2014
- preparation of a thematic history of the site based on primary and secondary documentary resources
- physical survey (surface only) to allow confirmation of previously identified heritage items and identification of any additional historic heritage values that may be present
- preparation of a report describing the results of the background research, the extent of historic heritage items identified in the study area and recommendations for future investigations to support any future assessments that may be undertaken.

A full description of the methodology is provided in the historic heritage report included as Appendix C to this report.

### **Limitations**

The limitations of the historic heritage survey are as follows:

- Limited time for discovery and access of relevant historical documentation and more recent historic and heritage studies with limited availability, such as Council heritage studies.
- Limited time to research relevant historic documents and plans, and a range of potential resources.
- Field survey was limited to two days and undertaken primarily by car (in order to maximise the number of sites inspected in the available time). As such, additional items of interest were opportunistic discoveries. There is potential for other items or places within the study area that could be of interest, but which have may been overlooked.
- Timely access was not available to some properties due to difficulties in meeting required access notification requirements.
- Archaeological sites could only be identified where there were physical remains associated with the original structure(s); as such there is some uncertainty regarding the precise location of some sites.

---

<sup>2</sup> The Heritage Office is now the Heritage Division, Office of Environment and Heritage, Department of Premier and Cabinet.

- The scope of the current investigation has not included a comprehensive survey of listed and potential items in the vicinity of the study area.
- Since acquisition of the land by the Commonwealth the diverse properties have been amalgamated into a single Lot 1 DP 838361. The original Lot and DP numbers for most of the properties within the study area are now more difficult to determine, thus hampering research into the history of these properties.

The time and access limitations encountered during the current investigations mean that further detailed research and assessment of the study area, its local environment and the lands in its vicinity, will be required to inform any proposals for future development. Recommendations to this effect have been made in Section 3.5 of this report. The identified limitations notwithstanding the research and field survey undertaken for the current investigation have added to an understanding of the heritage context of the Commonwealth land at Badgerys Creek and will provide a good basis for future investigations.

### **3.4. Key findings and information gaps**

Under the EPBC Act, owners and managers of Commonwealth land are required to identify and assess items and places under their control for heritage value. Identification of heritage values is the first step in the process of developing management strategies to guide the management and conservation of heritage values of items and places for present and future generations. In 2005, the Department of Transport and Regional Services (the predecessor to the Department of Infrastructure and Development) prepared a heritage strategy that complies with the EPBC Regulations 2000 and Sections 341Z and 341ZA of the EPBC Act.

The strategy outlines the Department's obligations and approach to managing the heritage values of its assets. Appendix 5 to the strategy includes a reference to the Commonwealth land at Badgerys Creek with discussion generally limited to noting past investigations and the outcomes of these.

The local Badgerys Creek environment has remained largely unchanged with land use characterised by large and small rural holdings and residential allotments since the late 1990s. The study area is within John Blaxland's original Luddenham Estate, which was subdivided and sold in smaller land holdings between 1859 and 1864. Technical Paper 12 included inventories for each item identified as having heritage significance together with a brief description and historical outline. The current review of heritage registers and lists, and the update of the historic environment has found that the local heritage environment of the study area has not changed substantially. No new heritage items or potential heritage items were identified within the Commonwealth land; however several new items were identified within the vicinity of the Commonwealth land.

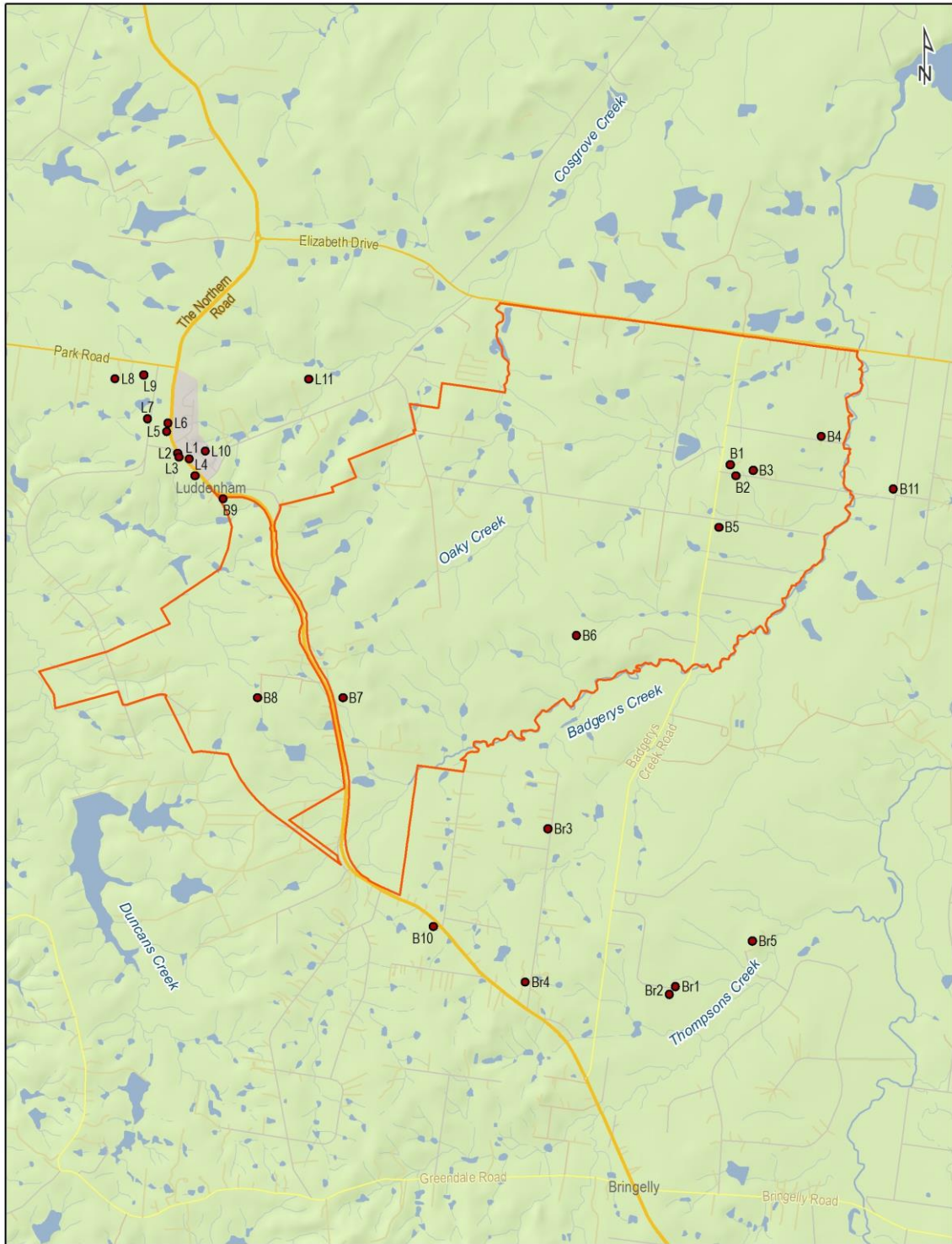
The current investigation identified eight historic heritage places within the Commonwealth land at the Badgerys Creek. It also identified a number of other heritage items and places in the wider study area. These are listed in Table 3.4 and Table 3.5 respectively and their locations shown in Figure 3.1.

Table 3.4 Heritage items within the Commonwealth land at Badgerys Creek

ID	Item	Listing
B1	Badgerys Creek Public School	Liverpool LEP 2008
B2	St John's Anglican Church Group, including church and cemetery	Liverpool LEP 2008
B3	Badgerys Creek Uniting Church cemetery	Not listed
B4	The Farm Cottage complex and associated out-buildings	Not listed
B5	Former Badgerys Creek butchery site	Not listed
B6	Braeburn Homestead sites	Not listed
B7	Former Anchau Vineyard site	Not listed
B8	Vicary's Winery Group, including woolshed, slab horse shed, land area and main house and garden	Liverpool LEP 2008

Table 3.5 Heritage items within the vicinity of the Commonwealth land at Badgerys Creek

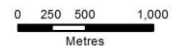
ID	Item	Listing
B9	Lawson's Inn ('The Thistle') site	Liverpool LEP 2008
B10	'St Albans', 1555 The Northern Road Badgerys Creek	Not listed
B11	Federation Cottage, 165 Lawson Street Badgerys Creek	Not listed
L1	Luddenham Public School, the Northern Road Luddenham	Liverpool LEP 2008
L2	Luddenham Progress Hall 3091–3095 The Northern Road Luddenham	Penrith LEP 2010
L3	Luddenham Uniting Church and Cemetery, 3091–3099 The Northern Road, Luddenham	Penrith LEP 2010
L4	Luddenham Anglican Church and Cemetery (St James), 3101–3125 The Northern Road, Luddenham	Penrith LEP 2010
L5	Timber Cottage. 29 The Northern Road, Luddenham	Penrith LEP 2010
L6	Timber Cottage, 41 The Northern Road, Luddenham	Penrith LEP 2010
L7	Brick cottage, 21–55 Campbell Street, Luddenham	Penrith LEP 2010
L8	Brick cottage, 406 Park Street, Luddenham	Penrith LEP 2010
L9	Showground, 428-452 Park Street, Luddenham	Penrith LEP 2010
L10	Willmington Reserve, 17 Jamison Street, Luddenham	Liverpool LEP 2008
L11	Dairy Shed Adams Road, Luddenham	Potential item
Br1	Former OTC Group, including radio receiving station and site of former staff housing, Badgerys Creek Road, Bringelly	Liverpool LEP 2008
Br2	Two water tanks, Badgerys Creek Road, Bringelly	Liverpool LEP 2008
Br3	Dwelling and Rural Lot (Mount Pleasant), 3 Shannon Road, Bringelly	Liverpool LEP 2008
Br4	Evergreen House, 141 Derwent Road, Bringelly	Liverpool LEP 2008
Br5	Kelvin Park Group, including site landscaping, homestead, kitchen wing, servant's quarters, coach house, 2 slab barns and other works and relics, 30 The Retreat, Bringelly	Liverpool LEP 2008
Br6	Bringelly Public School Group, including schoolhouse and former headmaster's residence, 1205 The Northern Road, Bringelly	Liverpool LEP 2008



- Badgerys Creek Historic Sites
- Badgerys Creek Commonwealth Land

Badgerys Creek Studies 3001806

Vector backdrop data © MDS 2014  
Heritage data - Australian Museum Consulting



Location: I:\projects\3001806 - Badgerys Creek Studies\008 DATA\GIS\Mapsv4\_1 Historic sites.mxd

Last updated by: RC10721 on 11/11/2014 at 15:18

Figure 3.1 Listed and potential historic heritage items within and in proximity to the Commonwealth land at Badgerys Creek

### ***Information gaps***

- full appreciation of the heritage values of the eight historic heritage places with reference to CHL criteria
- incomplete understanding of the heritage values of the three identified built heritage places within the study area and options for potential retention of buildings
- research potential and heritage values of the three identified archaeological sites within the study area
- options for management of heritage values associated with the two former church sites and associated cemeteries.

## **3.5. Recommendations**

The aim of the current investigation has been to review the current Badgerys Creek historic heritage environment and to identify where there may be gaps in the current understanding. As noted, the historic heritage environment has remained largely unchanged since the preparation of the Draft EIS and the current investigation has affirmed the previously identified historic heritage items and places.

The historic heritage of the Commonwealth land at Badgerys Creek is embodied in the physical evidence of past activities within the local environment since it was first settled by Europeans, and is demonstrated in the existing built and archaeological heritage of the place. Each of the items and places are likely to be affected by any future development of the site to some degree, and as such a thorough investigation of the historic heritage context of each should be completed to inform their appropriate management.

As previously noted, above, assessment and identification of heritage values is the first step in managing Commonwealth heritage places. The Department's heritage strategy makes reference to Badgerys Creek as not requiring further assessments; however at that time Badgerys Creek was not under consideration for future development. Given recent public announcements by the Australian Government, assessment of the heritage values of the eight listed and potential heritage items is recommended. This would contribute to an improved understanding of the historic heritage values of the Commonwealth land and provide guidance on whether places warrant inclusion on the CHL. Listing on the CHL requires that places are managed appropriately in accordance with a heritage management strategy prepared to guide the management and conservation the heritage values for present and future generations.

The following recommendations are provided in the context of the preceding discussion and should also be considered in the context of 'reasonable and feasible' to the extent that land use permits.

### ***Heritage values***

- Additional research into the historic and current environment of the eight historic heritage places within the footprint of the Badgerys Creek study area should be undertaken to inform any future environmental assessment process, consistent with relevant legislative requirements and best practice heritage assessment methods.

### ***Built heritage places***

The following recommendations relate to the three identified built heritage places (The Badgerys Creek Public School, The Farm Cottage complex and associated out-buildings, Vicary's Vineyard complex) within the study area.

- Options for the possible retention or relocation of original buildings associated with each of the three built heritage places should be explored.

- The archaeological research potential of the three built heritage places should be investigated to determine the likelihood of archaeological resources and relics to be present which could enhance an understanding of the local historic environment.
- Archival photographic recording should be prepared for the original buildings within the context of their landscape setting, local environment and associations with other buildings and features. The recording will ensure that the history and environment of each structure can be retained for future reference and research.
- Dismantling or demolition of timber slab cottages and huts should be monitored to ensure that the technologies used in constructing the buildings are recorded for future reference and research.

### ***Historical archaeological places***

The following recommendations relate to the three identified historical archaeological places (former Badgerys Creek butchery site, Braeburn Homestead sites, former Anchau Vineyard site,) site within the study area.

- An archaeological assessment should be prepared for each of the three identified archaeological sites.
- The assessment should include a detailed investigation of the history, land titles and historic documentation, an assessment of the research potential and heritage values, and an appropriate archaeological management strategy for each individual site.

### ***Church and cemetery heritage***

The following recommendations relate to the two former church sites with associated cemeteries are in Pitt Street.

- An archaeological assessment of the two former church sites should be prepared that considers the research potential of each site, its heritage values and an appropriate archaeological strategy for managing the exhumation of graves, should this be the preferred option.
- If the church sites will, or are likely to, be disturbed by future development activities, determination of the preferred site(s) for relocation of graves and the process of exhumation should be undertaken in consultation with all relevant stakeholder groups throughout the process including members of the families, church groups and religious bodies.

### ***Heritage precinct***

- Options for the creation of a heritage precinct should be considered during the next phase of investigations. The precinct could include graves of local families, timber slab construction cottage(s), the original school building and artefacts and relics recovered from archaeological excavations. The heritage precinct would ensure that an understanding of early life in this rural environment is preserved for future generations.

### ***Heritage in the vicinity of the Commonwealth land***

- Twenty-one listed and potential heritage items have been identified within the vicinity of the Badgerys Creek study area, which warrant further investigation to determine whether there would be impacts to heritage values arising from any future proposed development. Appropriate mitigation measures aimed at avoiding or mitigating impacts on heritage values should also be determined.

## 4. ABORIGINAL HERITAGE

---

### 4.1. Previous investigations

#### 4.1.1. 1997 Draft EIS

Chapter 20 of the Draft EIS addressed the Aboriginal cultural heritage impacts of the then proposed Second Sydney Airport. Discussion was based on a separate specialist investigation documented in *Technical Paper 11: Aboriginal Cultural Heritage* (Navin Officer Heritage Consultants 1997).

Aboriginal heritage items were identified through a combination of primary and secondary research, incorporating review of existing studies, investigation and documentation of the cultural heritage context of the study area, field surveys and consultation. The study area comprised the composite footprint of the three airport options.

The investigation included consultation with two Aboriginal stakeholder groups, the Darug Tribal Aboriginal Corporation and the Korewal Elouera Jerrungarugh Tribal Elders Aboriginal Corporation. The program of Aboriginal consultation included the dissemination of information throughout local Aboriginal communities, discussion of survey results and assessment of heritage values and other issues such as native title within the local Aboriginal communities.

The survey methodology was prepared in accordance with NSW National Parks and Wildlife Service guidelines (NPWS 1997). Assessments of significance were based on the definition of cultural significance used in the Burra Charter. The investigation also identified a range of management measures to mitigate impacts.

#### ***Auditor's Report***

The Auditor's Report on the Draft EIS (SMEC 1998) noted that the Draft Technical Paper on Aboriginal Cultural Heritage, although well written and argued in many sections, had major flaws in logic, data (or lack thereof), interpretation (especially the work of others) and presentation. It further noted that some of these flaws could not be corrected without substantial further field investigations. The flaws included problems in the sampling strategy used in executing the field survey strategy and the fact that no test excavations were carried out.

The Auditor's assessment was that the scientific (or archaeological) significance of the known and unknown cultural heritage resources in the Badgerys Creek area might well prove to be higher than that presented in the draft EIS. Despite this reservation, the Auditor concurred with inferences made in the Draft EIS that the scientific significance of the known and projected cultural heritage resources at Badgerys Creek is low. The Auditor also commented that a cultural heritage management plan would need to be prepared if the airport proposal was to proceed.

#### 4.1.2. 1999 Supplement to the Draft EIS

Chapter 17 of the Supplement to the Draft EIS summarised the findings of the Draft EIS and issues raised in submissions. A response to the issues raised in the Auditor's Report and in submissions was provided, particularly in relation to consultation and methodology.

The response indicated the following:

- Consultation was undertaken in accordance with protocols agreed with Aboriginal groups prior to the commencement of the consultation process.
- Much of the consultation work conducted by Aboriginal representatives in the process of compiling their reports and stated views is 'hidden' from readers of the Draft EIS because this work was conducted orally and within traditional modes of consultation and documented and presented in a way that is deemed culturally appropriate by the relevant group or community.



- The sample survey methodology followed standards recognised within the field of archaeology and complied with the most recent NSW NPWS guidelines (1997). All archaeological surveys conducted in larger study areas invariably involve degrees of sampling.
- Sub-surface testing was not carried out as it was argued that it was not warranted given available data from excavations carried out in adjacent and comparable environments, and that it would have resulted in otherwise avoidable and irreversible damage through excavation to many archaeological sites located outside of the zone of impact.
- The Burra Charter is the most authoritative and recognised statement of heritage principles, objectives and methodology within Australia and allows for the assessment of heritage values which are outside of a strictly archaeological methodology.
- The identification of contemporary Aboriginal cultural values is centred on consultation within the Aboriginal community and reporting in the Draft EIS relies on the actual words of the Aborigines to identify their own cultural values and beliefs regarding the sites and the intangible (non-archaeological) values they contained. The succinctness of these reports and their brevity relative to the majority of the Draft EIS obscures the level of activity on behalf of the Aboriginal study team who compiled them.
- Detailed information pertaining to Aboriginal sites (such as site location and contents) is generally not made available to the public. This is a well-established protocol which ensures the optimal protection for Aboriginal sites. However the available evidence was utilised by the archaeologists and Aboriginal community in preparing all significance assessments.

Further consultation with Aboriginal groups was undertaken to review their opinions on the airport proposal, however no additional input was able to be obtained for inclusion in the Supplement.

One additional field site was added to the Draft EIS database.

An updated search of Native Title claims was undertaken for the Supplement. The claim identified in the Draft EIS had subsequently been rejected. One additional claim, the boundaries of which included the sites of the airport options, had been lodged subsequent to the preparation of the Draft EIS but had not been decided at the time of the preparation of the Supplement to the Draft EIS.

An assessment of the cumulative impacts on the existing or surviving Aboriginal cultural resource in the region surrounding the proposed Second Sydney Airport site was undertaken for the Supplement to the Draft EIS. This actual and predicted cumulative impacts suggested that the development of any airport options would result in a significant impact on the archaeological resource of the Cumberland Plain, but noting that only a very small proportion of the Cumberland Plain had been subject to comprehensive field survey.

It was proposed that the impact mitigation strategies would be implemented in the context of the environmental management plan for the construction of the airport rather than in a standalone cultural heritage management plan, due to the limited options for mitigation.

### ***Auditor's Report***

The Auditor's Report on the Supplement to the Draft EIS (SMEC 1999) noted that the Supplement stated that once a preferred option was selected, a detailed and comprehensive program of subsurface testing and salvage would be conducted within the preferred airport option. The Auditor suggested that the possibility that this testing may reveal items of greater significance than what had been identified on site to date should be considered.

The Auditor noted that the Supplement identified that all of the airport options would impact on sites that are valued by the local Aboriginal community for their cultural significance.

### 4.1.3. 1999 Environment Australia Assessment Report

Environment Australia's report summarised the findings of the draft EIS, Supplement and Auditor's Reports. The following points were made in relation to the assessment of Aboriginal heritage:

- A higher priority could have been given to more detailed supporting anthropological and historical studies to assist in addressing issues relating to Aboriginal cultural significance more effectively.
- More detailed studies into contemporary Aboriginal heritage values, as opposed to archaeological values, would have helped to clarify the nature of the cultural heritage significance of the proposed airport site.
- Further work into contemporary Aboriginal heritage values should be done prior to construction of the airport as part of the conservation management plan.
- Information relating to the implications of native title claims for the airport development has not been provided.
- The survey methodology appears to have been adequate and in accordance with accepted methodological standards in NSW NPWS guidelines.
- The decision not to undertake sub-surface testing for the EIS was appropriate as it could have resulted in unnecessary damage to cultural heritage sites and was in accordance with current best practice in the conservation of cultural heritage.
- A conclusion in Technical Paper 11 Aboriginal Cultural Heritage that 'below the plough zone and within the deeper sedimentary deposits of the lower Badgerys Creek fluvial corridor, the potential for significant archaeological deposits within a regional context cannot be wholly discounted' was not included in the Draft EIS.
- A regional survey of the archaeological and contemporary Aboriginal cultural heritage resources of the Cumberland Plain would assist in identifying the Aboriginal cultural heritage values of the Cumberland Plain and would allow a more accurate assessment of individual sites and suites of sites.
- The suggestion that regional trade-offs may assist in mitigating cumulative impacts induced by the airport development was not taken up in the environmental management measures proposed in the Supplement. The possibility of pursuing such initiatives could be explored in the context of regional environmental planning, in consultation with the local Aboriginal community.

The report made the following recommendations

- The construction program should allow for the excavation and recording in accordance with established practice of any Aboriginal archaeological deposits of regional or national significance found during the planned program of sub-surface testing or during construction.
- An Aboriginal cultural heritage conservation management plan must be developed to guide the management of the Aboriginal heritage of the Badgerys Creek site. This plan should be developed in consultation with the local Aboriginal community, and should include documentation of the significance of the site or parts of the site to Aboriginal communities.

### 4.1.4. Other investigations

There have been no other relevant investigations since 1999.

## 4.2. Relevant legislation and guidelines

Generally Australia's state and territory governments are responsible for the protection of Australia's indigenous heritage places. All States and Territories have laws that protect various types of indigenous heritage.

#### **4.2.1. Commonwealth**

The Commonwealth is responsible for protecting indigenous heritage places that are nationally or internationally significant, or that are situated on land that is owned or managed by the Commonwealth. This protection operates under the EPBC Act.

##### ***Environment Protection and Biodiversity Conservation Act 1999***

The EPBC Act provides a legal framework for the protection and management of places of national environmental significance. The heritage lists addressed by the EPBC Act include the UNESCO WHL, the NHL, and the CHL.

Under Section 341ZB of the EPBC Act, Commonwealth agencies are required to conduct a heritage identification and assessment program to identify which of the places they own or control have Commonwealth Heritage values, including indigenous heritage values. Management of these places must be undertaken in accordance with the Commonwealth Heritage management principles. These are set out in the *Environment Protection and Biodiversity Conservation Regulations 2000*.

##### ***Aboriginal and Torres Strait Islander Heritage Protection Act 1984***

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (ATSIHP Act) is intended to preserve and protect areas and objects in Australia and in Australian waters, that are of particular significance to Aboriginals in accordance with Aboriginal tradition. The ATSIHP Act allows the Environment Minister to make a declaration protecting significant Aboriginal areas or objects, including human remains, from 'threat of injury or desecration'. Emergency declarations can also be made by the Minister, or authorised officers, where there is a serious and immediate threat. The ATSIHP does not protect all forms of Aboriginal heritage; for example, it does not cover areas and objects whose heritage significance is due to their archaeological, scientific or historical interest.

##### ***Native Title Act 1993***

Native title is the recognition by Australian law that Aboriginal peoples or Torres Strait Islanders have rights and interests to land and waters that arise from traditional laws and customs. The *Native Title Act 1993* (Native Title Act) recognises and protects native title in Australia, and establishes a mechanism for determining native title claims. It also provides for negotiations between native title holders or registered native title claimants (native title parties) and other parties regarding the use and management of land and waters, in the form of Aboriginal Land Use Agreements (ILUAs).

The Native Title Registrar of the National Native Title Tribunal (NNTT) keeps three public registers of native title information: the National Native Title Register, the Register of Native Title Claims, and the Register of Aboriginal Land Use Agreements. Registered native title holders are recognised as having a right to speak for Country on Aboriginal culture and heritage.

##### ***Guidelines and strategies***

Commonwealth guidelines and strategies related to Aboriginal heritage that are of likely or potential relevance to the study area are listed in the following table with comment provided on the nature of their relevance

Table 4.1 Commonwealth guidelines and strategies related to Aboriginal heritage

Guideline/Strategy	Agency	Comment
Burra Charter: The Australian ICOMOS charter for the conservation of places of cultural significance (2013)	DoE	The Burra Charter and the associated series of Practice Notes provide a best practice standard for managing cultural heritage places in Australia.
EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance (2013)	DoE	Provides overarching guidance on determining whether an action is likely to have a significant impact on a matter protected under national environment law — the EPBC Act.
EPBC Act Policy Statement 1.2 – Significant Impact Guidelines – Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies (2006)	DoE	Applies to: <ul style="list-style-type: none"> <li>any person who proposes to take an action which is either situated on Commonwealth land or which may impact on Commonwealth land, and/or</li> <li>representatives of Commonwealth agencies who propose to take an action that may impact on the environment anywhere in the world.</li> </ul>
Ask First: A guide to respecting Aboriginal heritage places and values (2002),	DoE	Provides a practical guide for land developers, land users and managers, cultural heritage professionals and many others who may have an impact on Aboriginal heritage. Is intended to ensure that the rights and interests of Aboriginal people in maintaining their heritage is accepted and respected.
Heritage Strategy (2005)	DI&RD	Prepared under Section 341ZA of the EPBC Act to guide management of heritage values of the Department’s assets. At the time of preparation of this report, the Strategy was under review by the Department.

#### 4.2.2. New South Wales

##### ***National Parks and Wildlife Act 1974***

The *National Parks and Wildlife Act 1974* (NPW Act) sets out the requirements for the conservation of nature, ecosystems, biological diversity, landscapes and landforms and objects, places or features of cultural value within the landscape. The NPW Act sets out the responsibilities for the management of national parks.

Under the provisions of the NPW Act, the Director-General of NPWS (now part of OEH) is responsible for the care, control and management of all national parks, historic sites, nature reserves, state conservation areas, karst conservation reserves and regional parks. The Director-General is also responsible, under this legislation, for the protection and care of native fauna and flora, and Aboriginal places and objects throughout NSW.

All Aboriginal Objects are protected under the NPW Act regardless of their significance or land tenure. Aboriginal Objects can include pre-contact features such as scarred trees, middens and open camp sites, as well as physical evidence of post-contact use of the area such as Aboriginal fringe

camps. The NPW Act also protects Aboriginal Places which are defined as a place that 'is or was of special significance with respect to Aboriginal culture'. Aboriginal Places can only be declared by the Minister administering the NPW Act.

Under Section 90 of the NPW Act, it is an offence for a person to destroy, deface, damage or desecrate an Aboriginal Object or Aboriginal Place without the prior issue of an Aboriginal Heritage Impact Permit (AHIP). The Act requires a person to take reasonable precautions and due diligence to avoid impacts on Aboriginal Objects.

The *National Parks and Wildlife Amendment Regulation 2010* commenced on 1 October 2010. This Regulation excludes activities carried out in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010c) from the definition of harm in the NPW Act. That is, test excavations may be carried out in accordance with this Code of Practice, without requiring an AHIP.

### **Heritage Act 1977**

The *Heritage Act 1977* provides protection for heritage places, buildings, works, moveable objects, precincts and archaeological sites that are important to the people of NSW. These include items of Aboriginal and non-Aboriginal heritage significance. Where these items have particular importance to the State of NSW, they are listed on the SHR.

### **Guidelines**

NSW guidelines and strategies related to Aboriginal heritage that are of likely or potential relevance to the study area are listed in the following table with comment provided on the nature of their relevance.

*Table 4.2 NSW guidelines and strategies related to Aboriginal heritage*

<b>Guideline/Strategy</b>	<b>Agency</b>	<b>Comment</b>
Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (2010)	OEH	This Code has been developed to support the process of investigating and assessing Aboriginal cultural heritage. It specifies the minimum standards for archaeological investigation undertaken in NSW under the NPW Act. An Aboriginal cultural heritage assessment that requires an archaeological investigation to be undertaken must be done in accordance with the requirements of this Code
Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (2010)	OEH	This Code is to assist individuals and organisations to exercise due diligence when carrying out activities that may harm Aboriginal objects and to determine whether they should apply for consent in the form of an AHIP.
Aboriginal Cultural Heritage Consultation Requirements for Proponents (2010)	OEH	Focuses on the requirements for consultation with Aboriginal people as part of the heritage assessment process: <ul style="list-style-type: none"> <li>• to determine potential harm on Aboriginal cultural heritage from proposed activities</li> <li>• that informs decision making for any application for an AHIP where it is determined harm cannot be avoided.</li> </ul>
Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (2010)	OEH	Provides best practice guidance for investigating and assessing Aboriginal cultural heritage in NSW, and outlines OEH's requirements for Aboriginal cultural heritage reporting in NSW.

### 4.3. Survey methodology

The Aboriginal heritage survey was prepared with reference to the principles of the Burra Charter, the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010c) and Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW 2010d).

To fulfil the requirements of the investigation, the following tasks were undertaken:

- search and review of the OEH Aboriginal Heritage Information Management System (AHIMS) database, to determine the location and nature of any Aboriginal heritage sites recorded within, or in the vicinity of, the study area
- review of relevant previous archaeological reports specific to the area, to determine the extent of past Aboriginal archaeological research in the region
- review of relevant contextual environmental information and previous land use history
- Targeted survey of the 21 Aboriginal heritage sites identified within areas of moderate and high archaeological potential was undertaken by AM Consulting archaeologists on 22-23 September 2014 (this did not comprise a full archaeological survey of the entire project area and was limited to establishing the current status and condition of previously recorded Aboriginal heritage sites)
- preparation of a report describing the results of the background research, the location and extent of Aboriginal heritage items recorded in the study area, information gaps and requirements for further investigations to support any future assessments.

The aims of the targeted survey were to:

- confirm the location, condition and extent of the previously recorded Aboriginal heritage sites
- identify past or ongoing impacts to the sites
- record relevant data to allow updating of AHIMS sites information
- develop recommendations for options on how to manage identified Aboriginal sites, and for any necessary further archaeological assessments.

Photographs of the study area were taken using a Fuji Finepix HS 20 EXR digital camera. Site coordinates were recorded using a Garmin Oregon 300 handheld GPS unit. Where Aboriginal artefacts were encountered, notes were made regarding their type, size, and material; and descriptions of the site were recorded including the environmental setting and details of any disturbance to archaeological material in the site's vicinity.

In the course of requesting access to site records from the AHIMS, it was noted that there is an OEH policy that if the number of site records requested exceeds 120, then it is necessary to apply for an Aboriginal Heritage Information License Agreement (AHILA). As part of the application process, consultation will need to be undertaken with relevant Aboriginal stakeholders which would need to be taken into consideration with regard to any project program.

A full description of the methodology is provided in the Aboriginal heritage report included as Appendix D to this report.

#### **Limitations**

The limitations of the Aboriginal heritage survey are as follows:

- constrained timeframe for background review, investigation of additional documentary resources and field survey
- time constraints for the field survey has meant that a detailed investigation of each previously identified Aboriginal heritage site within the identified potential and listed heritage item was

not possible; the targeted archaeological survey undertaken for the current investigation inspected 21 Aboriginal sites within zones assessed in the 1997 Draft EIS as having moderate and high archaeological potential

- consultation with the local Aboriginal community was not part of the investigation scope, and therefore it has not been possible to assess the potential cultural or spiritual significance of Aboriginal heritage sites
- a complete version of the Technical Paper 11: Aboriginal Cultural Heritage (Navin Officer 1997) produced for the 1997 Draft EIS was not available for review (the version available for the current investigation did not contain detailed descriptions of Aboriginal sites recorded for that assessment).

In the absence of detailed site information, the current investigation has based the assessment of previous site condition on the limited information available in the AHIMS database.

In order to accommodate the constrained timeframe, survey undertaken for the current investigation targeted high priority Aboriginal heritage sites within areas of high and moderate archaeological potential. This allowed for development of interim management recommendations for each specific site investigated, and assisted in the development of overall management recommendations for the entirety of the Commonwealth Lands at Badgerys Creek. An Aboriginal heritage survey to identify and record a representative sample of material traces and evidence of Aboriginal occupation across the whole of the Commonwealth lands at Badgerys Creek is included as a recommendation of this report.

Assessments of cultural significance, the values of a site to the Aboriginal community itself, can only be carried out by the relevant Aboriginal communities. Archaeological and heritage management best practice requires that representatives of the local Aboriginal community are included as stakeholders in decisions concerning any heritage objects, archaeological places or Sacred Sites. Consultation with Aboriginal community stakeholders is included as a recommendation of this report for any subsequent heritage investigations.

#### **4.4. Key findings and information gaps**

Of the 21 Aboriginal heritage sites<sup>3</sup> within areas of moderate and high archaeological potential, only seven sites could be located and verified during the current survey. These were the two possible scarred tree sites and five stone artefact sites. Impacts recorded during the 1996 survey of the area have continued to affect the condition and visibility of the sites, and the majority of sites are now either being actively impacted by water or stock movements, or are overgrown and obscured by vegetation. These impacts appear to have either obscured the previously recorded artefacts, or to have removed them from the immediate location of the original site recording.

Of the previously recorded Aboriginal heritage sites within areas of moderate and high archaeological potential, the following observations were made during the current survey:

- AHIMS sites 45-5-2630 and 45-5-2634, comprising two possible scarred trees were found to be heavily impacted by ongoing rotting of the heartwood caused by previous damage and stock impacts respectively.
- No artefacts were visible at AHIMS sites 45-5-2685, 45-5-2683, 45-5-2764, 45-5-2768, 45-5-2789, 45-5-2679 and 45-5-2635 due to extensive vegetation, primarily pasture. As these sites were originally recorded as isolated artefacts, difficulty in relocating the artefacts is not unexpected.

---

<sup>3</sup> No figure has been provided showing locations of recorded Aboriginal heritage sites due to the cultural sensitivity of the information.

- No artefacts were visible at AHIMS sites 45-5-2665, 45-5-2693 and 45-5-2632, which were originally recorded as small artefact scatters, now obscured by extensive vegetation, primarily pasture.
- No artefacts were visible at AHIMS sites 45-5-2638 and 45-5-2690 which were being actively impacted by stock movement and water erosion likely to have removed surface artefacts from the immediate vicinity. As these sites were originally recorded as isolated artefacts, difficulty in relocating artefacts is not unexpected.
- No artefacts were visible at AHIMS sites 45-5-2699 and 45-5-2790, originally recorded as small artefact scatters. These sites were being actively impacted by stock movement and water erosion likely to have removed surface artefacts from the immediate vicinity.
- No artefacts were visible at AHIMS site 45-5-2781, originally recorded as a small artefact scatter. Portions of the site's location are partially overgrown by riparian vegetation and pasture, and portions are being heavily impacted by stock activity within a small enclosure.
- Three artefacts were recorded at AHIMS site 45-5-2633, a site associated with a dam originally recorded as comprising 12 artefacts. Impacts from water erosion recorded during the current survey are likely to have removed surface artefacts from the immediate vicinity of the site.
- One artefact was recorded at AHIMS site 45-5-2637, originally recorded as an isolated artefact, now being heavily impacted by ploughing and erosion.
- One artefact was recorded at AHIMS site 45-5-2672, a site associated with a dam that was originally recorded as comprising six artefacts. The site is now predominantly covered by pasture, obscuring vegetation almost completely.
- Only one site contained more visible artefacts than originally recorded. AHIMS site 45-5-2678 was recorded in 1996 as a scatter of 11 artefacts exposed within two small salt pan erosion areas, and during the current survey a total of 64 artefacts were recorded at the site, within extensive exposures caused by ongoing stock impacts and water erosion.

### **Information gaps**

Aboriginal cultural heritage assessments of the study area previously undertaken for the Second Sydney Airport Site Selection Programme and the 1997 Draft EIS predate the introduction of, and do not comply with, the OEH Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010c), and current Commonwealth and State guidelines for Aboriginal community consultation, including *Ask First: A guide to respecting Aboriginal heritage places and values* (Australian Heritage Commission 2002), and the Aboriginal cultural heritage consultation requirements for proponents (DECCW 2010e).

The descriptions and locations of all Aboriginal sites identified within the current study area were omitted from Technical Paper 11, Aboriginal Cultural Heritage Proposal for a Second Sydney Airport at Badgerys Creek or Holsworthy Military Area (Navin Officer 1997), as it was being placed on public exhibition. As such, all Aboriginal site information recorded during the field investigations for the Draft EIS was obtained from AHIMS site cards held by OEH. However, this information is in many cases limited: the recording forms used on the field survey were non-standard, and a number of them do not include any pertinent details or site descriptions.

The archaeological survey undertaken for the current study targeted 21 Aboriginal sites within zones assessed in the 1997 Draft EIS as having moderate and high archaeological potential. Two properties could not be accessed during the survey, and the condition of the Aboriginal sites registered on these properties, AHIMS Site 45-5-2783 (B43) and AHIMS Site 45-5-2682 (B75), could not be verified.

Archaeological investigation of the Aboriginal cultural heritage of the Commonwealth land at Badgerys Creek has not, to date, included archaeological excavations. Archaeological studies within the Cumberland Plain have shown that the presence or absence of surface archaeological materials,



while a potentially significant source of archaeological information regarding past Aboriginal land use and activities, are not a wholly reliable indicator of the distribution of in situ archaeological deposits. Surface expressions of Aboriginal heritage sites reviewed during this investigation were entirely exposed through disturbance, and it is likely that substantial archaeological deposits may remain present within the study area within landforms that have not experienced significant disturbance.

#### **4.5. Recommendations**

The following recommendations are provided in the context of the preceding discussion and should also be considered in the context of 'reasonable and feasible' to the extent that land use permits.

- Aboriginal community consultation should be carried out to ensure the appropriate involvement of Aboriginal stakeholders in the assessment and decision making regarding their heritage. Consultation should comply with *Ask First: A guide to respecting Aboriginal heritage places and values* (Australian Heritage Commission 2002), and address the *Aboriginal cultural heritage consultation requirements for proponents* (DECCW 2010e), as appropriate.
- Full archaeological survey of the Commonwealth land should be undertaken in consultation and engagement with Aboriginal community stakeholders. The survey and assessment should seek to assess a representative sample of all landforms within the area, and should comply with the requirements of the *OEH Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010c).
- A program of archaeological test and salvage excavations should be carried out throughout impact areas resulting from future development or land use activities on the Commonwealth land at Badgerys Creek, in consultation and engagement with Aboriginal community stakeholders. The scope and methodology of the excavation should respond to the results of the archaeological survey and assessment, and should seek to recover and analyse an appropriate representative sample of the Aboriginal archaeological resource of the area.

## 5. HYDROLOGY AND WATER QUALITY

---

### 5.1. Previous investigations

#### 5.1.1. 1997 Draft EIS

Chapter 16 of the Draft EIS addressed the impacts of the then proposed Second Sydney Airport on geology, soils and water (both surface water and groundwater). Discussion was based on a separate specialist investigation documented in *Technical Paper 7: Geology, Soils and Water* (Robyn Tuft and Associates 1997).

#### **Hydrology**

Assessment of flooding impacts was based on hydrological investigations undertaken in relation to airport planning and design. The Draft EIS noted that both Badgerys Creek and South Creek have potential to cause flooding. Areas adjacent to the airport site and downstream were noted as being within the 1 in 100 year flood zone. Temporary creek diversions were identified as being required during construction of the permanent stormwater drainage infrastructure. The Draft EIS indicated that post development runoff volumes would exceed pre-development runoff volumes due to the substantial extent of impervious areas and increased drainage efficiency. The need for flood modelling for the entire South Creek catchment was noted.

#### **Surface water**

The Draft EIS assumed a high value would be attached to clean drinking water supplies, catchment areas, stream habitat value and water quality. The proximity of the airport site to Warragamba Dam, Sydney's primary water supply, and household drinking water tank supplies were strongly associated with a public perception of diminished water quality.

Surface water quality sampling and analysis was undertaken for creeks passing through the project area. Sampling was undertaken at three locations in Badgerys Creek, two locations in Cosgrove Creek and one location each in Thompsons Creek and Duncans Creek. Surface water samples were analysed for a range of chemical, physical and biological parameters. A summary of the chemical water quality results is provided in the water quality results summary in Appendix E.

Assessment of surface water quality was based upon the 1992 Australia and New Zealand Environment Conservation Council (ANZECC) *Guidelines for the Protection of Aquatic Ecosystems*. The results from laboratory analysis were assessed against the 'recreational waters' classification guideline values. Potential drinking water impacts were assessed by estimating concentrations of indicative compounds in water that would result from predicted aerial pollutant levels and comparing these concentrations with ANZECC drinking water guidelines.

#### **Groundwater**

Licensed groundwater bore locations within three kilometres of the study area were identified. Where access was available, bores were manually dipped to determine standing water levels and sampled for a range of chemical parameters.

The Draft EIS included a range of management measures to mitigate impacts during construction and operation, including regular monitoring of surface water.

### ***Auditor's Report***

The Auditor's Report on the Draft EIS (SMEC 1998) provided separate comment on hydrology, surface water quality, and groundwater. The following was noted with regard to hydrology:

- Overall, consideration of the hydrological impacts of construction and operation were addressed in a superficial manner.
- No discussion was provided of flooding information in relation to planning considerations.
- While the Draft EIS acknowledged the likelihood of increased runoff due to large areas of impervious surfaces, no quantitative information was provided on the increase of runoff nor on potential increased downstream flooding.
- No discussion was provided on the potential for upstream flooding.
- No discussion as provided on the potential for permanent changes to natural drainage patterns, including channel stability related to changes in flow volumes or in-stream flow velocities.
- While measures were identified to mitigate flood peaks immediately downstream of the airport site, no discussion was provided of the potential effects of this further downstream.

The Auditor's Report noted that the Draft EIS generally addressed the areas nominated in the EIS Guidelines, but also noted the following shortfalls in the analysis:

- Further investigation was needed of opportunities to reduce the discharge of nutrient loads to minimise impacts on downstream waterways.
- Further investigation should be undertaken to quantify operational impacts on domestic rainwater tanks.
- There would be potential for bird strike associated with the use of reed beds to filter stormwater runoff.

Comments on groundwater noted:

- There was very limited consideration of groundwater issues in the assessment.
- A more detailed study of the groundwater system was needed.
- There was a discrepancy between the Draft EIS and Technical Paper 7 with regard to changes in groundwater levels.
- No consideration was given to disposal or treatment of saline groundwater during construction.

### **5.1.2. 1999 Supplement to the Draft EIS**

Chapter 13 of the Supplement to the Draft EIS summarised the findings of the Draft EIS and issues raised in submissions. In addition to providing further information on hydrology, surface water quality and groundwater issues, discussion was provided on the potential impacts of aircraft emissions on water supply at the regional scale and in relation to domestic rainwater tanks.

#### ***Hydrology***

Hydrological modelling of stormwater runoff was undertaken to investigate the nature of flood flows both immediately downstream of the airport site. This also examined the attenuation of flood flows through the provision of detention basins within the airport site. The analysis was limited to examination of behaviour of flood peaks and no hydraulic modelling was undertaken to assess two-dimensional flooding behaviour downstream.

A qualitative discussion was provided on potential changes to downstream channel morphology associated with the changed hydrological regime.

### ***Surface water quality***

Additional water quality sampling was undertaken at three new locations in South Creek as well as one location in each of Badgerys Creek, Cosgrove Creek, Thompson Creek and Duncans Creeks. Quantitative modelling of water quality was undertaken to examine nutrients (nitrogen and phosphorus), suspended solids, chlorophyll and coliforms, and the impacts of these on downstream receiving waterways. Assessment of surface water quality was based upon the 1992 ANZECC *Guidelines for Fresh and Marine Waters*.

The Supplement to the Draft EIS included discussion on operational sewage flows and opportunities to use treated effluent for non-potable water supply demands.

### ***Groundwater***

The earlier investigation identified two aquifers within the airport options sites, a shallow aquifer in Quaternary alluvium and a deeper regional aquifer within the Bringelly Shale formation. Groundwater flow is in a northeast direction and water quality within both aquifers is saline. Further field investigations were undertaken to improve understanding of hydrogeological characteristics and to inform subsequent development of a groundwater model.

### ***Auditor's Report***

The Auditor's Report on the Supplement to the Draft EIS (SMEC 1999) noted that deficiencies existed in the hydrological and water quality analyses. The Auditor found that the Supplement to the Draft EIS did not adequately present clear reasoning behind the adopted water quality criteria. The Auditor also noted that water quality modelling indicated that the adopted water quality criteria would not be met for a significant proportion of the time of the project.

Overall, the Auditor stated that while deficiencies existed in the hydrologic assessment these could probably be addressed by later studies for detailed design and environmental management. However, the Auditor was not confident that the water quality criteria used and proposed mitigation measures were appropriate in order to achieve satisfactory project outcomes.

### **5.1.3. 1999 Environment Australia Assessment Report**

A number of submissions to the Draft EIS raised concerns about the standard of the existing water quality sampling that was conducted as part of the assessment. The NSW Government submission stated that the water quality sampling appeared to be single samples that were accompanied by inadequate descriptions of sampling conditions.

The Supplement to the Draft EIS conducted further water quality sampling however it was noted that this was limited to four sampling events. The EA assessment report stated that this level of sampling may not provide an adequate representation of the water quality at the site under a range of different environmental conditions. The report emphasised the importance of adequately establishing existing water quality to provide an accurate baseline that any future changes could be benchmarked against.

The EA report noted that the EIS contributed to available information on water quality and hydrology of the area, but further studies needed to be undertaken to inform the design of appropriate environmental management measures.

The report made the following recommendations:

- Time series information must be acquired on the hydrology, hydrogeology, and water quality of the airport site and, as necessary, adjacent areas, and analyses conducted of soil structure and chemistry sufficient for airport design and construction and the design of environmental management measures.

- A water cycle management plan for the airport should be developed in consultation with New South Wales and local government authorities, and integrated into the official environment strategy for the airport. The plan should provide for the integrated management of all principal elements of the water cycle.
- Any water discharged from the airport site must meet quality standards required by the New South Wales Government and, as far as practicable, be consistent with Australian water quality guidelines for fresh waters that are in place at the time.

#### **5.1.4. Other investigations**

##### ***Salinity***

Salinity is known to occur in shallow soils and groundwater seepages in Western Sydney. In 2002, the then NSW Department of Infrastructure, Planning and Natural Resources published a map showing salinity potential in Western Sydney. This showed land in the Badgerys Creek locality to generally have moderate salinity potential. Smaller areas associated with drainage lines were mapped as having known salinity or high salinity potential.

McNally (2009) reported the findings of an investigation into soil and groundwater salinity in the shales of Western Sydney. This noted that salinity in the upper aquifer was low (<1000 mg/L) and was similar to surface water, while in the lower aquifer it was high to very high (10,000–30,000 mg/L). The storage volume of the lower aquifer was very small with groundwater generally confined to unweathered but jointed shale bedrock, generally with depths of >3–6 metres.

Salinity is considered unlikely to be a major issue with regard to existing management of the Commonwealth land. Any development of the land should, however, give appropriate consideration to potential effects on infrastructure (e.g. corrosion), and to both on-site and off-site effects of disturbance of saline groundwater.

##### ***Water quality***

Two investigations into water management in South Creek were undertaken by the Cooperative Research Centre (CRC) for Irrigation Futures that were documented in technical reports (Rae 2007; Singh et al 2009).

In 2009 the then NSW Department of Environment and Climate Change (DECC) published the findings of a catchment-scale investigation into river health and water quality trends in the Hawkesbury-Nepean River system. This drew on water quality data recorded at sites from which long term records were available, many dating back to the early 1980s. The report provided an assessment of long-term trends in water quantity, water quality and a range of biological indicators (where sufficient monitoring data existed). It also provided a benchmark for future assessments.

Sydney Water (2012) has undertaken a review and assessment of water quality trends in the Hawkesbury-Nepean River system over the period 1994-2011 in relation to improved wastewater strategies.

The Hawkesbury-Nepean River Recovery Program (NSW Government 2013), managed by the NSW Government's Office of the Hawkesbury-Nepean in partnership with other NSW agencies, comprised seven projects to improve river health in the Hawkesbury-Nepean River System by making more water available for the environment and reducing nutrient inputs.

The above investigations have improved understanding of water quality characteristics and influences in the Hawkesbury-Nepean River system, and provide direction for management strategies and initiatives aimed at improving water quality. Associated objectives and targets are of relevance with regard to both existing management and to any future development of the Commonwealth land.

## **Flooding**

In March 2014, the NSW Government released a report containing the findings of the first stage of a review into the adequacy and effectiveness of current flood management in the Hawkesbury–Nepean Valley (Department of Primary Industries 2014). The overarching objective of the review was to develop a package of options to ensure the Hawkesbury-Nepean Valley is strategically managed so the community is more resilient to flood risk.

The second stage will involve a more detailed cost benefit analysis of specific flood mitigation and road infrastructure options, and progress the priority actions identified in the first stage to reduce flood risk in the short and longer term. At the time of this investigation, no specific information on the timing of completion of this second stage was publicly available.

The review is considered to have limited bearing on existing management of the Commonwealth land. Any future development of the land should include appropriate consultation with the NSW Office of Water to identify relevant issues for consideration with regard to managing flood risk.

## **5.2. Relevant legislation and guidelines**

### **5.2.1. Commonwealth**

#### ***Environment Protection and Biodiversity Conservation Act 1999***

The specific provisions in the EPBC Act addressing water resource management relate to designation of water resources as a MNES for coal seam gas and large coal mining development. DoE has released significant impact guidelines in this regard.

The EPBC Act contains other provisions that indirectly address the management of water resources, principally in relation to biodiversity conservation such as impacts on wetlands of international importance (Ramsar wetlands), and habitats containing threatened ecological communities, or which are utilised by threatened species and/or migratory species.

#### ***ANZECC Guidelines for Fresh and Marine Water Quality (2000)***

The *Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZECC 2000) were originally released in 1992 to support the National Water Quality Management Strategy (NWQMS). The NWQMS aims to achieve the sustainable use of Australia's (and New Zealand's) water resources by protecting and enhancing their quality while maintaining economic and social development. The NWQMS is a joint strategy developed by the Agriculture and Resources Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council (ANZECC). The Australian National Health and Medical Research Council (NHMRC) is involved in aspects of the strategy that affect public health. The NWQMS aims to meet future needs by providing policies, a process and national guidelines for water quality management<sup>4</sup>.

The Guidelines were subsequently revised and reissued in 2000 to take account of major policy initiatives, a more holistic approach to management of aquatic systems and advances in technical knowledge.

The Guidelines:

- outline the important principles, objectives and philosophical basis underpinning the development and application of the guidelines
- outline the management framework recommended for applying the water quality guidelines to the natural and semi-natural marine and fresh water resources in Australia (and New Zealand)

---

<sup>4</sup> Source: <http://www.environment.gov.au/water/publications/quality/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-1>

- provide a summary of the water quality guidelines proposed to protect and manage the environmental values supported by the water resources
- provide advice on designing and implementing water quality monitoring and assessment programs.

The Guidelines have also been adopted by the NSW Government.

### ***Australian Drinking Water Guidelines 2011***

The 2011 *Australian Drinking Water Guidelines* (ADWG) have been developed by the NHMRC in collaboration with the Natural Resource Management Ministerial Council. The ADWG are designed to provide an authoritative reference to the Australian community and the water supply industry on what defines safe, good quality water, how it can be achieved and how it can be assured. The guidelines address both the health and aesthetic quality aspects of supplying good quality drinking water<sup>5</sup>.

## **5.2.2. New South Wales**

### ***Protection of the Environment Operations Act 1997***

The POEO Act contains a range of provisions addressing protection of water resources, principally in relation to water quality. These include:

- a general provision on the pollution of waters (Section 120)
- licensing of development and activities that are likely or have potential to impact on water quality (and an associated compliance framework)
- a duty to notify the EPA in the event of a pollution incident causing or threatening material harm.

### ***Water Management Act 2000***

The *Water Management Act 2000* provides for the sustainable and integrated management of the water sources of NSW for the benefit of present and future generations. The Act controls the extraction of and use of water (surface water, groundwater), the construction of works in waterways, and the carrying out of activities in or near water sources in NSW.

There are various policies that support the objectives of the Act including:

- The NSW State Groundwater Policy Framework Document (1997)
- The NSW State Groundwater Quality Protection Policy (1998)
- The NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Aquifer Interference Policy (2012)
- NSW Floodplain Harvesting Policy (2013).

### ***Water Act 1912***

The *Water Act 1912* came into force in the early 20th Century. It is being progressively phased out and replaced by the *Water Management Act 2000*, but some provisions are still in force.

### ***EPIs made under the EP&A Act***

Part 3 of the EP&A Act provides for the making of specific EPIs to regulate land use and development. There are two EPIs of potential relevance in relation to water resource management as noted in the following table.

---

<sup>5</sup> Source: <https://www.nhmrc.gov.au/guidelines/publications/eh52>

Table 5.1 EPIs made under the EP&A Act related to hydrology and water resources

EPI	Comment
State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011	<p>The objectives of this SEPP include:</p> <ul style="list-style-type: none"> <li>• providing for healthy water catchments that will deliver high quality water while permitting development that is compatible with that goal</li> <li>• supporting the maintenance or achievement of the water quality objectives for the Sydney drinking water catchment.</li> </ul> <p>The Sydney Drinking Water Catchment is defined according to the map that accompanies the SEPP, and does not include the Commonwealth land at Badgerys Creek. As such, the SEPP does not have any relevance to the existing management of the land. Future development of the land would need to give appropriate considerations to relevant matters associated with off-site impacts.</p>
Sydney Regional Environmental Plan (SREP) 20 – Hawkesbury-Nepean River	<p>This is a deemed SEPP under the EP&amp;A Act. It aims to facilitate consideration of environmental values in a regional context with regard to future land use. The Commonwealth land at Badgerys Creek is located within the Liverpool LGA. Clause 2(1) of the SEPP identifies that the Liverpool LGA is part of the land subject to the SEPP.</p>

### Guidelines

NSW guidelines and strategies related to water resource management that are of likely or potential relevance to the study area are listed in the following table with comment provided on the nature of their relevance.

Table 5.2 NSW guidelines and strategies related to hydrology and water resources

Guideline/Strategy	Agency	Comment
Using the ANZECC Guidelines and Water Quality Objectives, Sydney, 2006	OEH	Provides guidance with regard to application of the ANZECC guidelines in the context of meeting NSW Water Quality Objectives (WQO) and protection levels for individual waterways to manage WQ risks and issues.
Managing Urban Stormwater–Soils and Construction, Vol 1 Managing Urban Stormwater, 2004	OEH	<p>Provides guidance for local councils and practitioners on the design, construction and implementation of measures to improve stormwater management, primarily erosion and sediment control, during the construction-phase of urban development.</p> <p>Colloquially known as ‘The Blue Book’.</p>
Managing Urban Stormwater–Soils and Construction, Vol 2D Main Road Construction, 2008	OEH	Provides guidance, principles and recommended minimum design standards for effective management of erosion and sediment control during the construction of main roads (which commonly involves extensive earthworks).
Acid Sulfate Soils Manual, 1998	DPI (Agriculture)	Comprises the <i>Acid Sulfate Soils Assessment Guidelines</i> and the <i>Acid Sulfate Soils Planning Guidelines</i> . Aims to provide guidance for effective management of risk associated with development in areas containing acid sulfate soils (ASS).
NSW Floodplain Development Manual, 2005	OEH	Provides guidance to local councils in relation to balancing objectives for development on floodplains through a risk management process.



### 5.3. Survey methodology

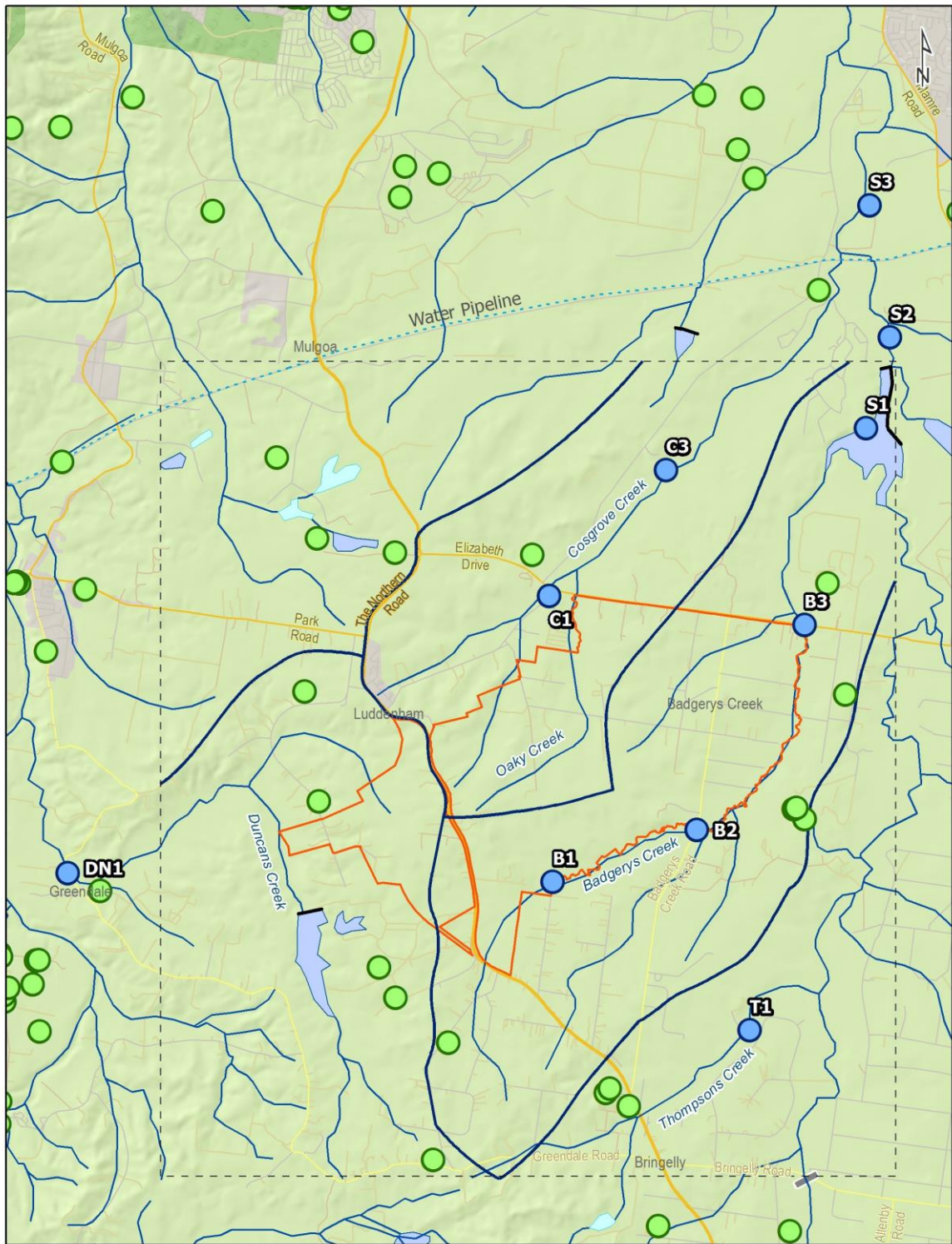
Due to time constraints, the current round of field investigations related to water resources was limited to water quality sampling. Previous sampling and analysis of surface water from local creeks was undertaken in 1996, 1997 and three times in 1998, and was limited to single sampling events. Table 5.1 provides a consolidated summary of the locations and timing of sampling, and identifies the locations sampled for the current investigation. The sampling locations are shown in Figure 5.1.

Table 5.3 Water quality sampling locations

Location	Dec 1996	1997	Sep 1998	Oct 1998	Dec 1998	Sep 2014
South Creek (S1)			✓	✓	✓	
South Creek (S2)			✓	✓	✓	
South Creek (S3)			✓	✓	✓	
Thompsons Creek (T1)		✓	✓	✓	✓	✓
Duncans Creek (D1)		✓	✓	✓	✓	✓
Badgerys Creek (B1)		✓				✓
Badgerys Creek (B2)		✓				✓
Badgerys Creek (B3)	✓	✓	✓	✓	✓	✓
Cosgrove Creek (C1)		✓				✓
Cosgrove Creek (C3)	✓	✓	✓	✓	✓	

The previous sampling locations and sampling events were used as the basis for development of a water quality sampling and analysis plan that would provide new data for comparison with historic data. The plan identified the same parameters that were analysed in previous sampling events as follows:

- Dissolved oxygen (% saturation)
- Dissolved oxygen (mg/L)
- pH
- Conductivity (µS/cm)
- Suspended solids (mg/L)
- Turbidity (NTU)
- Oils and grease
- Total Phosphorus (mg/L)
- Nitrate as N (mg/L)
- Nitrite as N (mg/L)
- Ammonia as N (mg/L)
- Total Kjeldahl Nitrogen (mg/L)
- Total Nitrogen (mg/L)
- MBAS (mg/L)
- Total Organic Carbon (mg/L)
- Phenolics as Phenols (mg/L)
- Iron
- Nickel
- Copper
- Chromium
- Zinc
- Lead
- Cadmium
- Mercury
- TPH C6-C9
- TPH C10-C14
- TPH C15-C28
- TPH C29-C36
- VAC – benzene
- VAC – toluene
- VAC – xylene
- Ethyl Benzene
- VAC – others
- PAHs
- VHCs – 1,2, dichlorbenzene
- VHCs – others.



Badgerys Creek Studies 3001806

● Water sampling site (Draft EIS)      ~ Approximate catchment boundary (Draft EIS)  
 ● Existing bore (Office of Water)  
 - - - Extent of catchment model (Draft EIS)      □ Badgerys Creek Commonwealth Land

Vector backdrop data © MDS 2014  
 0 500 1,000 2,000  
 Metres  
 Last updated by: RC10721 on 11/11/2014 at 15:18

Location: I:\projects\3001806 - Badgerys Creek Studies\008 DATA\GIS\Maps\3\_1 Sub-catchments.mxd

Figure 5.1 Catchments and water quality sampling locations

Field sampling was undertaken on 22 September 2014. The weather was fine with no occurrence of rainfall and with the exception of 0.4 mm recorded on 17 September 2014, there had been no rainfall since 11 September 2014<sup>6</sup>.

Water quality sampling was undertaken by an experienced field technician and comprised a single grab sample at each location. Samples were collected in accordance with recommended preservation and holdings times as advised by the analytical laboratory. Physical parameters (pH, salinity, dissolved oxygen, etc) were recorded in the field using a multi-parameter water quality meter.

Samples were delivered to a NATA accredited laboratory for subsequent analysis the following day (23 September 2014). The full laboratory report of the analytical results are provided as Appendix E to this report. Review of water quality analysis results has been undertaken with reference to the ANZECC 2000 guidelines.

### **Limitations**

The limitations of the water quality survey are as follows:

- Access to Site C3 on Cosgrove Creek was originally via Commonwealth land (associated with an agricultural research station). The land has since been divested and is now in private ownership. As such, this site was not sampled as part of this investigation.
- Access to the three sites on South Creek is also currently via private land. These sites were not sampled as part of the current investigation.

As discussed in Section 5.4.1, the results of the water quality analysis are broadly similar to those from previous sampling rounds, and are considered to reflect the general land use which has not materially changed over this time. It is considered likely that water quality sampling and analysis at the above four sites would have yielded generally similar results to those obtained.

It is also noted that these four sites are downstream of the Commonwealth land. Water quality at these locations will be influenced by activities elsewhere in the catchment.

The water quality investigation for the Draft EIS included a comprehensive survey of aquatic habitats, focussing largely on macroinvertebrates, to derive ecological indicators of water quality. The rationale for this was that ecological characteristics integrate water quality over time and facilitate identification of impacts that may not be detected through limited, discrete temporal sampling of physical and chemical parameters.

Given time constraints, it was not possible to undertake a similar aquatic ecology survey for the current investigation. As such, it is not possible to provide informed comment on water quality with regard to temporal variability and range that might be reflected through macroinvertebrate populations and assemblages.

## **5.4. Key findings and information gaps**

The Commonwealth land at Badgerys Creek extends across three hydrological catchments (refer Figure 5.1) Duncans Creek sits within a small subcatchment that drains directly to the Nepean River. Cosgrove Creek and Badgerys Creek are within two subcatchments that form part of the larger South Creek catchment. The headwaters of the Cosgrove Creek and Duncans Creek subcatchments sit within the Commonwealth land while a small area of the Badgerys Creek subcatchment lies upstream of this land.

South Creek has a catchment area of about 620 km<sup>2</sup>. The area of the Commonwealth land within the catchment is about 1,420 ha (0.14 km<sup>2</sup>). As such, it is expected that it would have a limited influence

---

<sup>6</sup> Source: Bureau of Meteorology online daily weather observations for September 2014 for Badgerys Creek (Station ID 067108)

on hydrology and water quality in the wider catchment. There is also a substantial portion of the South Creek catchment upstream of where the subcatchments containing the Commonwealth land join South Creek at its confluence with South Creek. This will exert an influence on the downstream hydrological and water quality regimes.

Downstream water quality will also be influenced by three Sydney Water sewage treatment plants (St Marys, Quakers Hill, Riverstone). These are operated under a shared environment protection licence administered by OEH.

There is a shallow aquifer in Quaternary alluvium and a deeper regional aquifer within the Bringelly Shale formation in the locality. The Supplement to the Draft EIS indicated that water quality within both aquifers was saline, though as noted in Section 5.1.4, McNally (2009) reported that salinity in the upper aquifer was low and similar to surface water. There are numerous small waterbodies, primarily farm dams, within the area. These likely have connections to the shallow aquifer and may influence water quality within this aquifer.

There are no registered groundwater bores within the boundary of the Commonwealth land. There are, however, a number in the wider surrounding area (refer Figure 5.1) Management of surface water and groundwater resources in the South Creek catchment is subject to the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* and *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* respectively. Both Plans commenced operation on 1 July 2011 and are due for extension/replacement in July 2021.

Water sharing plans contain various rules applying to specific water sources. These may include environmental water rules, access licence dealing rules, rules for access licences, rules for water supply work approvals, rules for making available water determinations, and water allocation account rules. Specific rules have been established for the South Creek catchment for both surface water and groundwater<sup>7</sup>. These can be accessed via the NSW Office of Water website<sup>8</sup>.

#### **5.4.1. Water quality**

Degraded water quality in rural environments is caused by a range of factors including:

- transportation of eroded soil, particularly from stream banks
- excessive nutrients or nutrient enrichment
- chemical contamination by agrochemicals
- detergents/phosphates, organochlorines (although now banned)
- chemicals (e.g. metal contamination, particularly from heavy metals such as iron, lead, copper and mercury)
- salts
- changes to natural hydrological regimes
- inappropriate waste disposal
- seepage of contaminated groundwater into surface waterbodies
- contamination by biological material and pathogens.

These factors manifest as pollutants in aquatic systems as:

- suspended solids or turbidity
- eutrophication, which can lead to the excessive growth of aquatic plants, including algal blooms
- chemical and microbiological contamination

---

<sup>7</sup> The South Creek catchment is located within the Sydney Basin Central resource as established under the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011*.

<sup>8</sup> <http://www.water.nsw.gov.au/>

- salinity.

It should be noted that the ANZECC 2000 Guidelines included changes to guidance values from the 1992 Guidelines for a number of parameters such as:

- replacement of a threshold with a range, e.g. Dissolved Oxygen (DO) changed from '>80 % saturation' to '85–100 % saturation'
- replacement of a range with a threshold, e.g. Total Nitrogen (TN) changed from '0.1–0.75 mg/L' to '>500 µg/L' (>0.5 mg/L)
- inclusion of guidance values where previously none were provided, e.g. Total Petroleum Hydrocarbons (TPH).

The current investigation included the collection of water samples from six of the 10 sites used in the previous investigations. Four sites were not able to be sampled due to access being through private properties. Samples were analysed by a NATA-accredited laboratory and the results reviewed with reference to the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC 2000).

A summary of the analysis results from the current round of sampling, with reference to the ANZECC 2000 Guidelines, is provided as follows.

### ***Dissolved Oxygen (DO)***

- Guideline range: 85-110 % saturation (1992 Guideline also provided a guidance value of >6 mg/L)
- Guideline range met for all sites sampled with the exception of B3 and C1 where DO was measured at 73 % saturation and 48 % saturation respectively
- DO showed an improvement for Thompsons Creek and Duncans Creek

### ***pH***

- Guideline range: 6.5–8.0
- Within Guideline range for all sites sampled
- Generally consistent with historic results, the majority of which also fall within the current Guideline range

### ***Conductivity***

- Guideline range: 122–2200 µS/cm
- Thompsons Creek: Well above Guideline range (6790 µS/cm) but within the upper and lower limits of previous sampling results
- Duncans Creek: Within Guideline range. With one exception, previous results are also within the current Guideline range
- Badgerys Creek: Above Guideline range for B1 and B2; previous results for B3 generally within current Guideline range
- Cosgrove Creek: C1 above Guideline range; C3 not sampled

### ***Turbidity***

- Guideline range: 6–50 NTU
- Within Guideline range for all sites sampled
- Majority of historic results also fall within current Guideline range

### ***Phosphorus***

- Guideline value (Total Phosphorus, TP): 50 µg/L

- Guideline value exceeded for all sites sampled
- Historic results for Thompsons Creek and Duncans Creek were within the 1992 Guideline range (0.01–0.1 mg/L) and do not exceed the current Guideline value suggesting there may have been a land use change or a different land management activity giving rise to increased nutrient runoff

### ***Nitrogen***

- Guideline value (Total Nitrogen, TN): 500 µg/L
- Guideline value exceeded for all sites sampled
- Current results are consistent with previous results which generally exceeded the 1992 Guideline range and would also exceed the current Guideline value

### ***Metals***

- Samples were tested for nickel, copper, chromium, zinc, lead, cadmium and mercury
- All results were below Guideline values
- Exceedances were observed for some historic results, principally in Thompsons Creek (copper, chromium, cadmium, mercury) but also for one sample collected from Badgerys Creek (copper)

### ***Hydrocarbons***

The ANZECC 2000 Guidelines do not provide any specific guidance ranges or threshold values for hydrocarbons. The Guidelines note that given the large number of petroleum-derived hydrocarbons and their wide ranges of toxicities, it is difficult to derive meaningful guidelines.

Exceedances of investigation values were observed for Duncans Creek and Badgerys Creek (B3). These exceedances were at very low levels and could be due to several causes. Both sample locations are in close proximity to roads and water quality may be influenced by stormwater runoff. Low levels of hydrocarbons can also occur naturally and be associated with certain types of vegetation (e.g. camphor laurel).

### ***Summary***

The EA assessment report noted that the water quality of the Badgerys Creek locality was poor with high levels of nutrients and suspended solids. The results from the current round of sampling are broadly consistent with this observation suggesting that there has not been any material change in aspects (such as land use) that influence water quality.

The results of the analyses suggest there has not been any material changes in water quality in the intervening period. Water quality is degraded with elevated levels of nutrients (nitrogen, phosphorus). The results for metals were all below guideline values. Exceedances of investigation values for hydrocarbons were observed for Duncans Creek and Badgerys Creek. Both sample locations are in close proximity to roads and water quality may be influenced by stormwater runoff.

## **5.4.2. Hydrology and flooding**

In terms of landscape setting, the Commonwealth land at Badgerys Creek sits at or near the upper reaches of the three subcatchments that it lies within. There is a small area of the Badgerys Creek subcatchment located upstream. Land use within this part of the subcatchment is largely rural residential with lot size being in the order of two hectares. Based on a review of aerial photography recorded between 2002 and 2014, there appears to have been no material changes in land use in this part of the subcatchment.

No hydrological modelling was undertaken as part of the current investigation to assess flooding behaviour either with the Commonwealth land or downstream. However, given that land use is generally unchanged since the previous investigation, it is unlikely that there would have been any material changes to the local downstream hydrological regime including flooding behaviour.

Given the size of this part of the subcatchment relative to the whole Badgerys Creek subcatchment, it is anticipated that this area would also have only a limited influence on downstream water quality. There is also a large area of the South Creek catchment upstream of the Badgerys Creek confluence that would exert a greater influence on downstream flooding behaviour.

### **5.4.3. Information gaps**

The EA assessment report recommended collection of time-series information on hydrology, hydrogeology and water quality for the Commonwealth land and adjacent areas as necessary. There is still no time-series information available to inform characterisation of the temporal aspects of the hydrological and water quality regimes. These aspects include seasonal patterns, and the influence of antecedent (i.e. wet weather, dry weather) conditions.

With regard to hydrology, this is a relatively lesser issue as there are available rainfall records that can be used to inform development of a rainfall-runoff model as was undertaken for the Supplement to the Draft EIS. However, the absence of local streamflow records will influence the accuracy of calibration of any such model.

Similarly, the absence of time-series streamflow information will constrain the accurate characterisation of pollutant loads. This could be addressed to a degree through concurrent streamflow measurement and water quality sampling, however, measurements (and sampling) over a range of flows and differing antecedent conditions would be required to develop an understanding of the temporal nature of pollutant loads. Typically this information is collected over an extended time frame in the order of multiple years.

While the hydrological modelling of stormwater runoff undertaken for the Supplement to the Draft EIS yielded information on the behaviour of flood peaks no hydraulic modelling was undertaken to assess two-dimensional flooding behaviour downstream. The absence of this information limits assessment of the spatial extent and impacts of flooding, and associated potential impacts on stream channels such as from scour.

Below the confluence of Cosgrove Creek with South Creek (the downstream-most point for the subcatchments containing the Commonwealth land), the flood regime will be influenced by the broader South Creek catchment, both upstream and downstream. In development of a hydraulic model, appropriate consideration would need to be given to delineation of model boundaries. It is noted that hydraulic models have been developed for other areas within the South Creek catchment (such as reported in Ribbons et al (2013)), and could potentially be of use in development of a model to assess flooding behaviour associated with any development proposal for the land.

Technical Paper 7 included a detailed stream survey examining the ecological characteristics of aquatic habitats. This was undertaken both to understand baseline ecological conditions and to compensate (to a degree) for the limitations associated with the measurement of physical and chemical characteristics of water quality. The ecological investigation undertaken as part of the current study did not include survey of any aquatic habitat.

## **5.5. Recommendations**

- While information gaps relating to hydrology and water quality have been identified, consideration should be given to the likely or potential value of this information for management of the Commonwealth land or to any future environmental assessments.

- Previous hydrological modelling should be reviewed to assess whether there have been any material changes in environmental conditions that could have bearing on model outputs. This should also include a review of modelling assumptions to confirm their validity or to guide any required revision.
- Any future development of the land should include appropriate consultation with the NSW Office of Water to identify relevant issues for consideration with regard to management of flood risk both within and outside the boundaries of the Commonwealth land.
- The survey design for investigation of aquatic environments (refer Section 2.5.3) should be developed to also generate suitable data to facilitate characterisation of water quality with regard to ecological indicators.





## 6. OTHER MATTERS

---

### 6.1. Contamination

Contaminated land has the potential to impact surface water and groundwater quality. The study area is characteristic of broad scale rural industries, quarrying and rural residential activities. These activities are generally considered as potentially contaminating land use activities and are likely to have contributed to the observed degraded water quality discussed in the previous section.

Properties in the study area with intensive livestock activity can impact on the surrounding environment. This is associated principally with degradation of water quality via contaminated runoff from paddocks and yards. In addition to nutrients and chemicals, runoff can also transport sediment and plant material (weeds) to receiving waterways and other sensitive areas.

Irrigation practices on rural properties are very diverse. Many fruit, vegetable, dairy and pasture productions depend on irrigation. Irrigation has the potential to impact on land and water quality through the intensive use of water, nutrients, pesticides and machinery. Stormwater runoff from road pavements may contain petroleum products from roads and sealed areas, while tailwater from irrigated land is likely to contain chemical pollutants that could degrade receiving water quality.

The misuse of agricultural chemicals and on site waste disposal can result in damage to human and animal health, including aquatic ecosystems. Overspraying can result in the build-up of pesticides in soils. Overspraying and spray drift can also result in the transport of pesticides to water bodies, particularly drains and dams. Disposal of chemical containers is also an environmental issue characteristic of these types of rural land uses.

Contamination of land and water can also be associated with oils and other petroleum products deposited on roads and sealed areas, and subsequently transport by wind or runoff onto adjacent land or into nearby waterways (as noted in Section 5.4 with regard to the hydrocarbon analysis results for sites D1 and B3).

The National Pollutant Inventory (NPI) is a national database that tracks pollution across Australia. It contains data on 93 substances that have been identified as important due to their possible effect on human health and the environment. The Commonwealth land at Badgerys Creek does not contain any recorded NPI listings. However, there are 17 facilities listed within the Liverpool LGA. These include poultry farms, printing facilities, gas lines and bakeries, some in proximity to the Commonwealth land.

During the site investigations, the historic heritage specialist was advised that the site of the former Anchau vineyard (1880 The Northern Road) had been used for the illegal dumping of waste material. This may have resulted in contamination of the land and there may also be hazardous materials present. In view of this, the site was not accessed for occupational health and safety reasons.

The recommendations made in Section 3.5 include further investigation of this site with regard to historic heritage values. However, prior to any such investigation, the nature of the contamination and/or hazardous materials present should be investigated to inform appropriate management of any associated risks.

#### **Recommendation:**

- Based on the known agricultural land uses of the study area there is a potential for contaminated land to exist in this location. The potential areas of environmental concern and contaminants of concern can be developed by conducting a Preliminary Site Investigation (PSI) of the study area broad scale rural activity. A PSI according to the *National Environmental Protection (assessment of Site Contamination) Measure* (NEPM) 1999, as amended in 2013, states that a PSI will include a desktop study to collect basic site information and identify the

site characteristics (site location, land use, site layout, building construction, geological and hydrogeological setting, historical land uses and activities at the site), a site inspection and interviews with current and past owners, operators and occupiers of the site and preparation of a report

- Prior to any investigation (or similar activity) at 1880 The Northern Road, a detailed site investigation should be undertaken to characterise the nature of any contamination or hazardous materials present, and to inform development of appropriate measures to effectively manage all associated risks. The detailed investigation stage as per NEPM requirements should identify the nature of the contamination and delineate its lateral and vertical extent to a sufficient degree that an appropriate level of risk assessment may be undertaken and, if necessary, provide the basis for the development of an appropriate remediation or management strategy.

## 6.2. Landscape and natural heritage

The Greater Blue Mountains World Heritage Area was formally inscribed on the World Heritage List on 29 November 2000 and was one of 15 World Heritage places included on the NHL on 21 May 2007. Accordingly, the WHL listing details are relevant for the NHL listing. Summary details of the listing are provided in the following table.

Table 6.1 Greater Blue Mountains Area WHL/NHL listing

Place ID	Name	Property Description	Significance
105127	The Greater Blue Mountains Area	About 1,032,649ha, located to the north and to the south of Katoomba, comprising the following eight areas: Wollemi National Park (499,879ha); The Blue Mountains National Park (247,840ha); Yengo National Park (153,483ha); Nattai National Park (47,855ha); Kanangra-Boyd National Park (65,379ha); Gardens of Stone National Park (15,150ha); Jenolan Caves Karst Reserve (2,422ha); and Thirlmere Lakes National Park (641ha).	World National

The Greater Blue Mountains Area satisfies WHL assessment criteria: (ix) Outstanding Examples of ongoing Evolution; and (x) Important Habitats for Conservation of Biological Diversity (see Appendix A for listing details).

The Greater Blue Mountains Area is protected and managed under Part 3 Division 1 Subdivision A 'World Heritage' of the EPBC Act. Under Section 12, a person must not take any action that has, will have or is likely to have a significant impact on the World Heritage values of a World Heritage property unless approval has been given by the Minister under Part 9 of the Act, or if it is decided that approval is not required. Actions not requiring approval are listed under Section 33 of the EPBC Act. Under Section 15(A), substantial penalties apply for taking such an action without approval.

The Greater Blue Mountains Area is managed by OEH in accordance with a bilateral agreement between the Commonwealth and the NSW Government. This is facilitated through the *Greater Blue Mountains World Heritage Area Strategic Plan* (DECC 2009).

**Recommendation**

- Any future environmental assessment(s) associated with development of the Commonwealth land at Badgerys Creek should give appropriate consideration to potential effects on the heritage values of the Greater Blue Mountains Area.



## 7. SUMMARY AND RECOMMENDATIONS

---

### 7.1. Summary

The findings of the current round of investigations are summarised as follows. This includes comments on key information gaps for the respective environmental aspects.

#### ***Biodiversity***

The key findings of the biodiversity investigation noted the following with regard to flora:

- EPBC Act:
  - two endangered ecological communities occur within the Commonwealth land at Badgerys Creek (Cumberland Plain Shale Woodlands and Shale–Gravel Transition Forest, Western Sydney Dry Rainforest and Moist Woodland on Shale)
  - four individuals of *Pultenaea parviflora* were recorded on the southern side of Longleys Road between Ferndale and Taylors Road (this is a significant reduction from the 68 individuals previously recorded along both sides of Longleys Road in this location since the 1999 Supplement to the Draft EIS)
  - no other threatened flora species were recorded on site, however, potential habitat exists for a further five threatened flora species listed under the EPBC Act (*Acacia pubescens*, *Cynanchum elegans*, *Grevillea parviflora* subsp. *parviflora*, *Isotoma sessiliflora*, *Pimelea spicata*)
- TSC Act:
  - four endangered ecological community occur within the Commonwealth land at Badgerys Creek (Cumberland Plain Woodland, Shale Gravel Transition Forest, Moist Shale Woodland, River-flat Eucalypt Forest on Coastal Floodplains)
  - one individual of *Marsdenia viridiflora* (within the extent of the endangered population) was recorded along the eastern side of Badgerys Creek, just north of Gardiner Road
  - 12 new individual *Marsdenia viridiflora* were recorded on the southern side of Longleys Road between Ferndale and Taylors Road
  - potential habitat exists for an additional two species and one endangered population listed under the TSC Act (respectively *Dillwynia tenuifolia*, *Grevillea juniperina* subsp. *juniperina* and *Dillwynia tenuifolia* (Kemps Creek endangered population)).
- Nine noxious weeds declared in the Liverpool LGA were observed in the study area, six of these are also Weeds of National Significance.
- The NSW Office of Water Risk assessment guidelines for groundwater dependent ecosystems indicate that several vegetation communities that occur within the study area are likely to be ‘high probability groundwater dependent ecosystems’.

The key findings of the biodiversity investigation noted the following with regard to fauna:

- The Commonwealth land contains low to moderate quality habitat, including riparian vegetation and grassy woodland vegetation.
- Badgerys Creek has been identified as a potential wildlife corridor in a number of local and regional planning documents.
- Potential habitat is available for threatened fauna species including the Cumberland Land Snail, woodland birds, microchiropteran bats and the Grey-headed Flying-fox.
- There is potential suitable habitat for seven migratory species: Cattle Egret, Fork-tailed Swift, Great Egret, Latham’s Snipe, Rainbow Bee-eater, Rufous Fantail and White-throated Needletail.

There are a number of information gaps that exist due to:

- lack of detailed knowledge of the distribution and condition of threatened species and ecological communities
- new and improved standards for flora and fauna survey required to satisfy updated environmental assessment techniques
- lack of detail concerning aquatic species and habitats
- changes in legislative status of biodiversity.

Results from the site surveys undertaken in the late 1990s would not be suitable for use as part of future environmental assessment as they are now outdated. In the intervening period there have been changes to Commonwealth environmental legislation (most notably the introduction of the EPBC Act) and supporting regulation (such as threatened flora and fauna survey and assessment guidelines), and changes to the suite of listed threatened species (both NSW and Commonwealth).

There have also been changes in the ecological and physical condition of the land associated with the predominantly agricultural land use. This notwithstanding, previous surveys may still provide useful general background information of site conditions and facilitate understanding of the nature of changes over time.

### ***Historic heritage***

There are currently eight historic heritage places within the Commonwealth land at Badgerys Creek, comprising either built heritage or an archaeological site. Specific actions have been provided with regard to future investigation to better characterise the respective heritage values and/or management of each site.

The investigation also identified other heritage items within the vicinity of the Commonwealth land. The majority of these are local heritage items listed under the Liverpool and Penrith LEPs, however two additional items were identified as having potential historic heritage values.

The investigation noted a number of information gaps including a full understanding of the heritage values of the eight historic heritage places with reference to CHL criteria, incomplete understanding of the heritage values of the three identified built heritage places and options for potential retention of buildings, the research potential and heritage values of the three identified archaeological sites, and options for management of heritage values associated with the two former church sites and associated cemeteries.

### ***Aboriginal heritage***

Of the 21 Aboriginal heritage sites within areas of moderate and high archaeological potential, only seven sites could be located and verified during the current survey. These were the two possible scarred tree sites and five stone artefact sites. Impacts recorded during the 1996 survey of the area have continued to affect the condition and visibility of the sites, and the majority of sites are now either being actively impacted by water or stock movements, or are overgrown and obscured by vegetation. These impacts appear to have either obscured the previously recorded artefacts, or to have removed them from the immediate location of the original site recording.

Limited information regarding descriptions and locations of all Aboriginal sites previously identified within the current study area was available due to the assessment documents being made public. As such, all Aboriginal site information recorded during the field investigations for the Draft EIS was obtained from AHIMS site cards held by OEH. However, this information is in many cases limited.

Archaeological investigation of the Aboriginal cultural heritage of the Commonwealth land at Badgerys Creek has not, to date, included archaeological excavations. Surface expressions of Aboriginal heritage sites reviewed during this investigation were entirely exposed through

disturbance, and it is likely that substantial archaeological deposits may remain present within the study area within landforms that have not experienced significant disturbance.

### ***Hydrology and water quality***

The Environment Australia assessment report prepared in 1999 recommended collection of time-series information on hydrology, hydrogeology and water quality for the Commonwealth land and adjacent areas as necessary. There is still no time-series information available to inform characterisation of the temporal aspects of the hydrological and water quality regimes.

The current investigation included the collection of water samples from six of the 10 sites used in the previous investigations. Four sites were not able to be sampled due to access being through private properties. Samples were analysed by a NATA-accredited laboratory and the results reviewed with reference to the *Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZECC 2000).

The results of the analyses suggest there has not been any material changes in water quality in the intervening period. Water quality is degraded with elevated levels of nutrients (nitrogen, phosphorus). The results for metals were all below guideline values. Exceedances of investigation values for hydrocarbons were observed for Duncans Creek and Badgerys Creek. Both sample locations are in close proximity to roads and water quality may be influenced by stormwater runoff.

Based on a review of aerial photography recorded between 2002 and 2014, there appears to have been no material changes in land use in this part of the Badgerys Creek catchment. As such, it is unlikely that there would have been any material changes to the downstream hydrological regime. Given the size of this part of the catchment relative to the whole catchment, it is anticipated that this area would also have only a limited influence on downstream water quality.

### ***Contamination***

There is potential for contamination of land and water associated with agricultural and related land use within the Commonwealth land at Badgerys Creek. While there are no NPI listings within the boundary of the Commonwealth land, there are 17 facilities listed within the wider Liverpool LGA, some in proximity to the Commonwealth land.

During the site investigations, the historic heritage specialist was advised that the site of the former Anchau vineyard (1880 The Northern Road) had been used for the illegal dumping of waste material. This may have resulted in contamination of the land and there may also be hazardous materials present.

### ***Landscape and natural heritage***

The Commonwealth land at Badgerys Creek is in general proximity to the Greater Blue Mountains Area which is included on the World Heritage List. This is not an issue with regard to current management of the land but could be an issue for consideration for any future environmental assessment(s).

## **7.2. Recommendations**

Consistent with current best practice guidance and subject to the outcomes of any further field investigations, future management of the Commonwealth land should consider the 'avoid/mitigate/offset' hierarchy for management of impacts.



The following is a consolidated list of the recommendations made in Sections 2–6 and should be considered in this context.

### **Biodiversity**

To the extent that future land use permits, and management measures are practicable and feasible, consideration should be given to implementing the following recommended management measures to protect and enhance existing ecological assets and values:

- undertake further assessment of remnant vegetation to accurately determine the extent of vegetation communities present, particularly the extent of Moist Shale Woodland and Shale–Gravel Transition Forest components of EPBC listed EECs
- undertake further field assessment to better detail the extent of EPBC Act listed vegetation as a subset of TSC Act listed vegetation in line with patch size and condition thresholds in the determination; survey methods will need to be consistent with current accepted standards and guidelines
- undertake targeted threatened flora and fauna survey for all species listed in Appendix 4 to the biodiversity report (Appendix A) as having a medium to high risk of occurrence would be required to bring the level of information into line with current accepted standards and guidelines; requirements for survey for each of the 12 flora and 33 fauna species requiring survey including duration, timing and technique are detailed in Appendix 4 to the biodiversity report

For any future development proposal(s), where impacts are unavoidable or cannot otherwise be suitably mitigated through management actions, consideration should be given to potential offsetting arrangements consistent with relevant legislative and policy requirements.

The following management measures have been prepared in view of protecting and enhancing existing ecological assets and values within the Commonwealth land:

- protect all moderate to good condition native vegetation in the study area with particular focus upon EPBC listed Cumberland Plain Shale Woodland and Shale–Gravel Transition Forest and Western Sydney Dry Rainforest and Moist Woodland on Shale
- protect nectar producing trees and shrubs and revegetate/rehabilitate degraded sites with appropriate species
- fence off better condition remnants from grazing and protect areas where *Pultenaea parviflora* and *Marsdenia viridiflora* have been recorded
- consider seed collection/propagation of *P. parviflora* and *M. viridiflora* should these populations be at risk of further clearing
- ensure road maintenance and agricultural activities adjacent to Longleys Road and Badgerys Creek Road avoid known *P. parviflora* and *M. viridiflora* populations
- retain mature and hollow bearing trees and supplement with nest boxes
- retain habitat features including dead wood and trees
- restrict use of pesticides for weed control particularly near watercourses and immediately before or during wet weather
- include placement of rocks and logs to enhance existing aquatic habitat for regeneration works in riparian areas
- undertake regeneration activities in strategic locations to improve habitat connectivity
- maintain native grasses in pasture
- undertake weed control in accordance with the *Noxious Weeds Act 1993* and best practice (including control of environmental weeds)

- adopt hygiene protocol standards for the control of disease in frogs and prevent introduction or spread of *Phytophthora cinnamomi* and Myrtle Rust
- implement pest management control for vertebrate pests
- implement controls to prevent pollution of local waterways and manage riparian and in-stream fish habitat, including restricting access of livestock to riparian areas
- control sediment at the catchment and local site scale
- identify and manage point and diffuse sources of pollution
- include land management standards, including management measures to support biodiversity as outlined above, as part of new tenancy agreements
- prepare management measures for any future development within the Commonwealth land as part of the associated environmental assessment(s).

The above recommendations do not necessarily provide for future development within the Commonwealth land. Any such development proposal should include development of appropriate management measures of the environmental assessment.

The following survey activities are recommended to adequately describe the biodiversity values of the study area as part of any future environmental assessment(s):

- Detailed vegetation community and condition mapping should be undertaken for the Commonwealth land at Badgerys Creek. This would involve additional site stratification and vegetation sampling using plot surveys, including full floristics, to supplement the rapid plot assessment undertaken by SMEC in 2014. This additional plot survey would be used to inform preparation of detailed vegetation community and condition mapping.
- Undertake targeted threatened flora survey for the following threatened flora species/populations in areas of potential habitat in the study area during the appropriate flowering season:
  - *Acacia pubescens* (EPBC and TSC)
  - *Cynanchum elegans* (EPBC and TSC)
  - *Grevillea parviflora* subsp. *parviflora* (EPBC and TSC)
  - *Isotoma sessiliflora* (*Hypsela sessiliflora*) (EPBC and TSC)
  - *Pimelea spicata* (EPBC and TSC)
  - *Pultenaea parviflora* (EPBC and TSC)
  - *Dillwynia tenuifolia* (TSC)
  - *Dillwynia tenuifolia* (TSC listed endangered population)
  - *Grevillea juniperina* subsp. *juniperina* (TSC)
  - *Marsdenia viridiflora* subsp. *viridiflora* (TSC listed endangered population).
- Undertake targeted survey for the following threatened fauna species (all TSC listed, and also EPBC listed where noted):
- Giant Burrowing Frog (EPBC)
  - Green and Golden Bell Frog (EPBC)
  - Regent Honeyeater (EPBC)
  - Swift Parrot (EPBC)
  - Grey-headed Flying-fox (EPBC)
  - Large-eared Pied Bat (EPBC)
  - Barking Owl
  - Black-chinned Honeyeater
- Diamond Firetail
- Flame Robin
- Gang-gang Cockatoo
- Glossy Black-cockatoo
- Hooded Robin
- Little Eagle
- Little Lorikeet
- Powerful Owl

- Masked Owl
  - Scarlet Robin
  - Speckled Warbler
  - Square-tailed Kite
  - Varied Sittella
  - Cumberland Land Snail
  - Eastern Bentwing Bat
  - Eastern Freetail Bat
  - Greater Broad-nosed Bat
  - Southern Myotis.
- Undertake targeted survey for migratory species with potential habitat in the study area: Cattle Egret, Fork-tailed Swift, Great Egret, Latham’s Snipe, Rainbow Bee-eater, Rufous Fantail and White-throated Needletail.
  - Further survey of representative aquatic environments throughout the study area, with targeted surveys undertaken for known threatened aquatic flora and fauna.

### **Historic heritage**

Assessing heritage values:

- Additional research into the historic and current environment of the eight historic heritage places within the footprint of the Badgerys Creek study area should be undertaken to inform any future environmental assessment process, consistent with relevant legislative requirements and best practice heritage assessment methods.

Built heritage places:

- Options for the possible retention or relocation of original buildings associated with each of the three built heritage places should be explored.
- The archaeological research potential of the three built heritage places should be investigated to determine the likelihood of archaeological resources and relics to be present which could enhance an understanding of the local historic environment.
- Archival photographic recording should be prepared for the original buildings within the context of their landscape setting, local environment and associations with other buildings and features. The recording will ensure that the history and environment of each structure can be retained for future reference and research.
- Dismantling or demolition of timber slab cottages and huts should be monitored to ensure that the technologies used in constructing the buildings are recorded for future reference and research.

Historic archaeological places:

- An archaeological assessment should be prepared for each of the three identified archaeological sites.
- The assessment should include a detailed investigation of the history, land titles and historic documentation, an assessment of the research potential and heritage values, and an appropriate archaeological management strategy for each individual site.

Church and cemetery heritage:

- An archaeological assessment of the two former church sites should be prepared that considers the research potential of each site, its heritage values and an appropriate archaeological strategy for managing the exhumation of graves, should this be the preferred option.
- Determination of the preferred site(s) for relocation of graves and the process of exhumation should be undertaken in consultation with all relevant stakeholder groups throughout the process including members of the families, church groups and religious bodies.

#### Heritage precinct:

- Options for the creation of a heritage precinct could be considered during the next phase of investigations. The precinct could include graves of local families, timber slab construction cottage(s), the original school building and artefacts and relics recovered from archaeological excavations.

#### Heritage in the vicinity:

- Twenty-one listed and potential heritage items have been identified within the vicinity of the Badgerys Creek study area, which warrant further investigation to determine whether there would be impacts to heritage values arising from any future proposed development.
- Appropriate mitigation measures aimed at avoiding or mitigating impacts on heritage values should also be determined.

#### **Aboriginal heritage**

- Aboriginal community consultation should be carried out to ensure the appropriate involvement of Aboriginal stakeholders in the assessment and decision making regarding their heritage. Consultation should comply with *Ask First: A guide to respecting Aboriginal heritage places and values* (Australian Heritage Commission 2002), and address the *Aboriginal cultural heritage consultation requirements for proponents* (DECCW 2010e), as appropriate.
- Full archaeological survey of the Commonwealth land should be undertaken in consultation and engagement with Aboriginal community stakeholders. The survey and assessment should seek to assess a representative sample of all landforms within the area, and should comply with the requirements of the *OEH Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010c).
- A program of archaeological test and salvage excavations should be carried out throughout impact areas resulting from future development or land use activities on the Commonwealth land at Badgerys Creek, in consultation and engagement with Aboriginal community stakeholders. The scope and methodology of the excavation should respond to the results of the archaeological survey and assessment, and should seek to recover and analyse an appropriate representative sample of the Aboriginal archaeological resource of the area.

#### **Hydrology and water quality**

- While information gaps relating to hydrology and water quality have been identified, consideration should be given to the likely or potential value of this information for management of the Commonwealth land or to any future environmental assessments.
- Previous hydrological modelling should be reviewed to assess whether there have been any material changes in environmental conditions that could have bearing on model outputs. This should also include a review of modelling assumptions to confirm their validity or to guide any required revision.
- Any future development of the land should include appropriate consultation with the NSW Office of Water to identify relevant issues for consideration with regard to management of flood risk both within and outside the boundaries of the Commonwealth land.
- The survey design for investigation of aquatic environments should be developed to also generate suitable data to facilitate characterisation of water quality with regard to ecological indicators.

#### **Contamination**

- Based on the known agricultural land uses of the study area there is a potential for contaminated land to exist in this location. The potential areas of environmental concern and contaminants of concern can be developed by conducting a Preliminary Site Investigation (PSI)

of the study area broad scale rural activity. A PSI according to the *National Environmental Protection (assessment of Site Contamination) Measure* (NEPM) 1999, as amended in 2013, states that a PSI will include a desktop study to collect basic site information and identify the site characteristics (site location, land use, site layout, building construction, geological and hydrogeological setting, historical land uses and activities at the site), a site inspection and interviews with current and past owners, operators and occupiers of the site and preparation of a report

- Prior to any investigation (or similar activity) at 1880 The Northern Road, a detailed site investigation should be undertaken to characterise the nature of any contamination or hazardous materials present, and to inform development of appropriate measures to effectively manage all associated risks. The detailed investigation stage as per NEPM requirements should identify the nature of the contamination and delineate its lateral and vertical extent to a sufficient degree that an appropriate level of risk assessment may be undertaken and, if necessary, provide the basis for the development of an appropriate remediation or management strategy.

#### ***Landscape and natural heritage***

- Any future environmental assessment(s) associated with development of the Commonwealth land at Badgerys Creek should give appropriate consideration to potential effects on the heritage values of the Greater Blue Mountains Area.

## 8. REFERENCES

---

- Australian Heritage Commission 2002, *Ask First: A guide to respecting Aboriginal heritage places and values*, Canberra, ACT.
- Australia ICOMOS 2013, *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*, Burwood, VIC.
- Australia and New Zealand Environment Conservation Council 2002, *Guidelines for the Protection of Aquatic Ecosystems*, ANZECC, Canberra, ACT.
- Biosis Research 1997, *Technical Paper No. 8 Flora and Fauna*, Sydney, NSW.
- Cropper, SC 1993, *Management of Endangered Plants*, CSIRO East Melbourne, Victoria.
- Department of Aviation 1985a, *Second Sydney Airport Site Selection Programme, Draft Environmental Impact Statement*, prepared by Kinhill Stearns, April 1985, Sydney, NSW.
- Department of Aviation 1985b, *Second Sydney Airport Site Selection Programme, Supplement to the Draft Environmental Impact Statement*, prepared by Kinhill Stearns, November 1985, Sydney, NSW.
- Department of the Environment 2013, *Matters of National Environmental Significance – Significant impact guidelines 1.1*, Australian Government Department of the Environment, Canberra, ACT.
- Department of the Environment 2013, *Draft EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)*, Australian Government Department of the Environment, Canberra, ACT.
- Department of the Environment 2013, *EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance*, Australian Government Department of the Environment, Canberra, ACT.
- Department of Environment and Climate Change 2009a, *Hawkesbury-Nepean River Environmental Monitoring Program*, Final Technical Report, Sydney, NSW.
- Department of Environment and Climate Change 2009b, *Greater Blue Mountains World Heritage Area Strategic Plan*, Sydney, NSW.
- Department of Environment and Conservation 2004, *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*, DEC, Hurstville, NSW.
- Department of Environment and Conservation 2006, *Using the ANZECC Guidelines and Water Quality Objectives*, Sydney, NSW.
- Department of the Environment and Heritage 2003, *EPBC Act Administrative guidelines on Significance – Supplement for the Grey-headed Flying-fox*, Australian Government Department of the Environment and Heritage, Canberra, ACT.
- Department of the Environment, Water, Heritage and the Arts 2009, *Significant impact guidelines for the vulnerable green and golden bell frog (Litoria aurea)*, Nationally threatened species and ecological communities EPBC Act policy statement 3.19, Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.
- Department of Sustainability, Environment, Water, Population and Communities 2013, *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*, Australian Government Department of the Environment, Canberra, ACT.
- Department of Environment, Climate Change and Water 2010a, *Cumberland Plain Recovery Plan*, DECCW, Sydney, NSW.

Department of Environment, Climate Change and Water 2010b, *Native Vegetation Interim Type Standard*, Department of Environment, Climate Change and Water NSW, Sydney.

Department of Environment, Climate Change and Water 2010c, *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*, Sydney, NSW.

Department of Environment, Climate Change and Water 2010d, *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*, Sydney, NSW.

Department of Environment, Climate Change and Water 2010e, *Aboriginal cultural heritage consultation requirements for proponents*, Sydney, NSW.

Department of Infrastructure, Planning and Natural Resources 2002, *Guidelines to accompany Map of Salinity Potential in Western Sydney 2002*, DIPNR, Sydney, NSW.

Department of Infrastructure, Planning and Natural Resources 2002, *Salinity Potential in Western Sydney 2002* (map), DIPNR, Sydney, NSW.

Department of Infrastructure and Transport 2012, *Economic and social analysis of potential airport sites*, report prepared by Ernst & Young, February 2012.

Department of Planning 2009, *Assessing Significance for Historical Archaeological Sites and Relics*, prepared by the Heritage Branch, NSW Department of Planning, Sydney, NSW.

Department of Primary Industries 2014, *Hawkesbury–Nepean Valley Flood Management Review Stage One*, Office of Water, Sydney, NSW.

Department of Sustainability, Environment, Water, People and Communities 2006, *EPBC Act Policy Statement 1.2 – Significant Impact Guidelines – Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies*, DSEWPaC, Canberra, ACT.

Department of Transport and Regional Development 1997, *Draft Environmental Impact Statement Second Sydney Airport Proposal*, (Vols 1, 2) prepared by PPK Environment & Infrastructure, Sydney, NSW.

Department of Transport and Regional Services 1999, *Supplement to the Draft Environmental Impact Statement Second Sydney Airport Proposal*, (Vols 3,4,5 )prepared by PPK Environment & Infrastructure, Sydney, NSW.

Department of Transport and Regional Services 2005, *Heritage Strategy*, Canberra, ACT.

Godden Mackay 1997, *Technical Paper No. 12 Non-Aboriginal Cultural Heritage*, Sydney, NSW.

Heritage Office and Department of Urban Affairs and Planning 1996, *NSW Heritage Manual*, HO/DUAP, Sydney, NSW.

McNally, G 2009, *Soil and groundwater salinity in the Wianamatta shales of western Sydney*, presentation to Groundwater in the Sydney Basin Symposium, 4-5 August 2009, Sydney.

Navin Officer Heritage Consultants 1997, *Technical Paper No. 11 Aboriginal Cultural Heritage*, Canberra, ACT.

National Parks and Wildlife Service 1997a, *Western Sydney Urban Bushland Biodiversity Survey*, NPWS, Hurstville, NSW.

National Parks and Wildlife Service 1997b, *Aboriginal Cultural Heritage Standards & Guidelines Kit*, NPWS, Hurstville, NSW.

National Parks and Wildlife Service 2002, *Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney*, Final Edition, NPWS, Hurstville, NSW.

Natural Resource Management Ministerial Council 2007, *Australian Weeds Strategy – A national strategy for weed management in Australia*, Australian Government Department of the Environment and Water Resources, Canberra, ACT.

Natural Resource Management Ministerial Council 2010, *Australia's Biodiversity Conservation Strategy 2010-2030*, Australian Government Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

NSW Government 2013, *Hawkesbury-Nepean River Recovery Program - Final Report*, NSW Department of Primary Industries, Office of Water, Sydney, NSW.

NSW Heritage Office 2001, *NSW Heritage Manual: Assessing Heritage Significance*, Version 2, NSW Heritage Office, Sydney, NSW.

Rae, DJ 2007, *Water Management in South Creek Catchment: Current state, issues and challenges*, CRC for Irrigation Futures Technical Report No. 12/07, Sydney, NSW.

Ribbons, S, Pinto, M, Evans, N, & Nunn, P 2013, *Assessing cumulative flood risk in large urban release areas in the Camden local government area in Sydney's south west*, paper presented at 53<sup>rd</sup> Floodplain Management Association conference, 28–31 May 2013, Tweed Heads, NSW.

Robyn Tuft and Associates 1997, *Technical Paper 7: Geology, Soils and Water*, Canberra, ACT.

Singh, R, Nawarathna, B, Simmons, B, Maheshwari, B & Malano, HM, 2009 *Understanding the Water Cycle of the South Creek Catchment in Western Sydney, Part1: Catchment Description and Preliminary Water Balance Analysis*, CRC for Irrigation Futures Technical Report No. 05/09, Sydney, NSW.

SMEC Australia 1998, *Draft Environmental Impact Statement Second Sydney Airport Proposal*, Auditor's Report, January 1998, Sydney, NSW.

SMEC Australia 1999, *Supplement to Draft Environmental Impact Statement Second Sydney Airport Proposal*, Auditor's Report, June 1999, Sydney, NSW.

Steering Committee 2012, *Joint Study on Aviation Capacity in the Sydney Region*, Australian Government and NSW Government, March 2012.

Sydney Water 2012, *Case Study: Long Term Water Quality Trends in the Hawkesbury-Nepean River (1994-2011)*, Sewage Treatment System Impact Monitoring Program, Vol IV, Sydney Water, Sydney, NSW.



## **APPENDIX A**

### **BIODIVERSITY REPORT**

---

This report has been provided separately for the web-accessible version.

**APPENDIX B**  
**HISTORIC HERITAGE REPORT**

---

This report has been provided separately for the web-accessible version.

## **APPENDIX C**

### **ABORIGINAL HERITAGE REPORT**

---

This report has been provided separately for the web-accessible version.

## **APPENDIX D**

### **RISK ASSESSMENT**

---

This has been provided separately for the web-accessible version.

## **APPENDIX E**

# **WATER QUALITY ANALYSIS RESULTS**

---

This has been provided separately for the web-accessible version.

## DOCUMENT/REPORT CONTROL FORM

---

<b>File Location Name:</b>	\\AUSYFP01\Group\projects\3001806 - Badgerys Creek Studies\009 FinalReport\Final report\WCAG documents\Badgerys Creek Environmental Survey Main Report.docx
<b>Project Name:</b>	Badgerys Creek Environmental Investigation
<b>Project Number:</b>	3001806
<b>Revision Number:</b>	1

### Revision History

Rev #	Date	Prepared by	Reviewed by	Approved for Issue by
0	24-10-2014	Chris Masters	Joy Duncan	Chris Masters
1	30-10-2014	Chris Masters	Joy Duncan	Chris Masters

### Issue Register

Distribution List	Date Issued	Number of Copies
Western Sydney Unit Dept of Investment and Regional Development	30-10-2014	1 (electronic) 3 (printed)
SMEC Project File	30-10-2014	1 (electronic)

### SMEC Company Details

#### James Phillis, Regional Manager, Central Region

L5, 20 Berry Street, North Sydney

Tel:	+61 2 9925 5555	Fax:	+61 2 9925 5556
Email:	<a href="mailto:sydney@smec.com">sydney@smec.com</a>	Website:	<a href="http://www.smec.com">www.smec.com</a>

The information within this document is and shall remain the property of the Department of Investment and Regional Development.