39. Other environmental matters

39.1. Introduction

This chapter provides information on the remaining environmental matters not included in the preceding chapters. The strategic level assessment builds on the consideration of potential impacts associated with the Stage 1 development as appropriate to an indicative long term airport development.

The detailed design of the long term development would be prepared as part of the master planning process under the Airports Act and would therefore be subject to further assessment and approval requirements. This chapter therefore provides an overview of the likely scale of potential impacts associated with the long term development, and considerations for future development.

This chapter presents the following potential issues and impacts:

- biodiversity;
- topography, geology and soils;
- Aboriginal heritage;
- European heritage;
- resource and waste;
- hazard and risk; and
- human health.

39.2. Biodiversity

39.2.1. Existing environment

The airport site is part of an elevated ridge system dividing the Nepean River and South Creek catchments on the Cumberland Plain. The airport site features remnant patches of grassy woodland and narrow corridors of riparian forest within extensive areas of derived grassland, cropland and cleared, developed land. The main land uses are agriculture and low density rural-residential development.

A total of 280 terrestrial plant species, including 28 threatened species under the EPBC Act and the *Threatened Species Conservation Act 1995* (TSC Act), and 78 exotic species have been identified at the airport site. Field surveys confirmed the presence and distribution of five native and two non-native plant community types or vegetation zones at the airport site, including areas of endangered ecological communities listed under both the EPBC Act and the TSC Act. Stands of these plant community types include a variety of disturbance levels including near-intact vegetation in ‘moderate/good – high’ condition, partially cleared or regrowth vegetation in ‘moderate/good – poor’ condition and extensively modified areas in ‘cleared’ condition. Accordingly, nine native and two non-native vegetation zones (plant community types and broad condition classes) were identified and mapped within the airport site, as shown in Figure 39-1A-D.

A total of 172 terrestrial fauna species, including one threatened species under the EPBC Act and eight threatened species under the TSC Act, and a number of introduced species have been identified at the airport site. An additional 21 species of threatened fauna are considered likely to occur.

39.2.2. Assessment of impacts during construction

Construction of the long term development would result in both direct and indirect impacts on terrestrial and aquatic flora and fauna.

39.2.2.1. Direct impacts

Construction of the long term development would result in the removal of approximately 588 hectares of vegetation. The majority of this vegetation (approximately 461 hectares) consists of exotic grassland, cleared land and cropland dominated by exotic species and noxious and environmental weeds. Approximately 127 hectares of native vegetation would be removed. Vegetation removal by vegetation zone is summarised in Table 39–1.

The removal of vegetation (in addition to the loss of streams, artificial wetlands (farm dams) and associated aquatic habitats) at the airport site would result in the loss of foraging, breeding, roosting, sheltering and/or dispersal habitat for various fauna species.

The long term development area would not be cleared until required for future aviation development or other associated uses. This approach means that impacts on biodiversity values would be avoided for as long as is practicable.

Table 39–1 – Estimated vegetation removal by vegetation zone – long term development

Vegetation zone	Conservation status under applicable legislation		Direct impact (hectares)
	EPBC Act status	TSC Act status	
Native vegetation zones			
Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	CEEC	CEEC	43.0
Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)		CEEC	21.3
Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	CEEC	CEEC	11.1
Poor condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)		CEEC	7.0
Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	21.9
Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	10.4
Good condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)	CEEC	EEC	2.5
Poor condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)		EEC	0.6
Good condition artificial freshwater wetland on floodplain (HN630)			9.6
Total native vegetation			**127.4**
Non-native vegetation zones			
Exotic grassland			279.2
Cleared land or cropland			181.4
Total non-native vegetation			**460.6**
Total vegetation			**588.0**

CEEC = critically endangered ecological community; EEC = endangered ecological community.

39.2.2.2. Indirect impacts

The long term development at the airport site is expected to result in a similar set of indirect impacts as for the Stage 1 development (refer to Chapter 16 in Volume 2). Potential indirect impacts would include:

- increased fragmentation of native vegetation and habitat in the locality and region;
- weed invasion of adjacent vegetation or aquatic areas, which may reduce habitat quality for native flora and fauna;
- edge effects, which may reduce habitat quality for native flora and fauna in adjacent areas;
- erosion and mobilisation and transportation of sediment, which could reduce habitat quality for flora and fauna species by reducing plant and animal health in adjacent areas of vegetation and aquatic areas downstream;
- generation of dust, which could reduce plant and animal health in adjacent areas of vegetation;
- the risk of habitat degradation from accidental spills of fuel or the mobilisation of contaminants due to earthworks;
- further alterations to the hydrology of catchments (noting that the airport would be designed to avoid adverse changes to hydrology and may result in an overall improvement in water quality);
- generation of noise, light and vibration, resulting in the disturbance of fauna that reside or use habitats near the construction area; and
- potential spread or introduction of pathogens such as Phytophthora, Myrtle Rust and Chytrid fungus into adjacent native vegetation and downstream habitats through vegetation disturbance and increased human traffic.

39.2.3. Assessment of impacts during operation

The long term development would result in a similar set of operational impacts as for the Stage 1 development (refer to Chapter 16 in Volume 2). Potential operational impacts would include:

- increased risk of bird and bat strike with the increased volume of aircraft traffic and associated need to control bird habitat both on and surrounding the airport site;
- the risk of terrestrial fauna mortality through vehicle strike, although the initial operation of the airport and increased development of industrial and commercial areas around the airport site is likely to result in a reduced risk over time, as less habitat is available for these fauna species;
- the risk of habitat degradation from accidental spills of fuel, pesticides, herbicides or transported goods;
- increased noise, light and vibration which may result in the further displacement of less-tolerant species from habitats adjoining the airport site;
- the risk of fires which may spread to adjacent vegetation; and

- introduction of exotic species.

39.2.4. Assessments of significance

This section summarises impacts on matters of national environmental significance (MNES) and on state-listed threatened species, populations and ecological communities from the construction and operation of the long term development.

39.2.4.1. Impacts on matters of national environmental significance

Assessments of significance for MNES have been prepared in accordance with the Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DoE 2013a) and the Significant Impact Guidelines 1.2 – Actions on, or Impacting upon, Commonwealth Land and Actions by Commonwealth Agencies (DoE 2013b). The assessments of significance are included as Appendix D of Appendix K1 in Volume 4. Assessments of significance were prepared based on the assumption that the entire airport site would be developed.

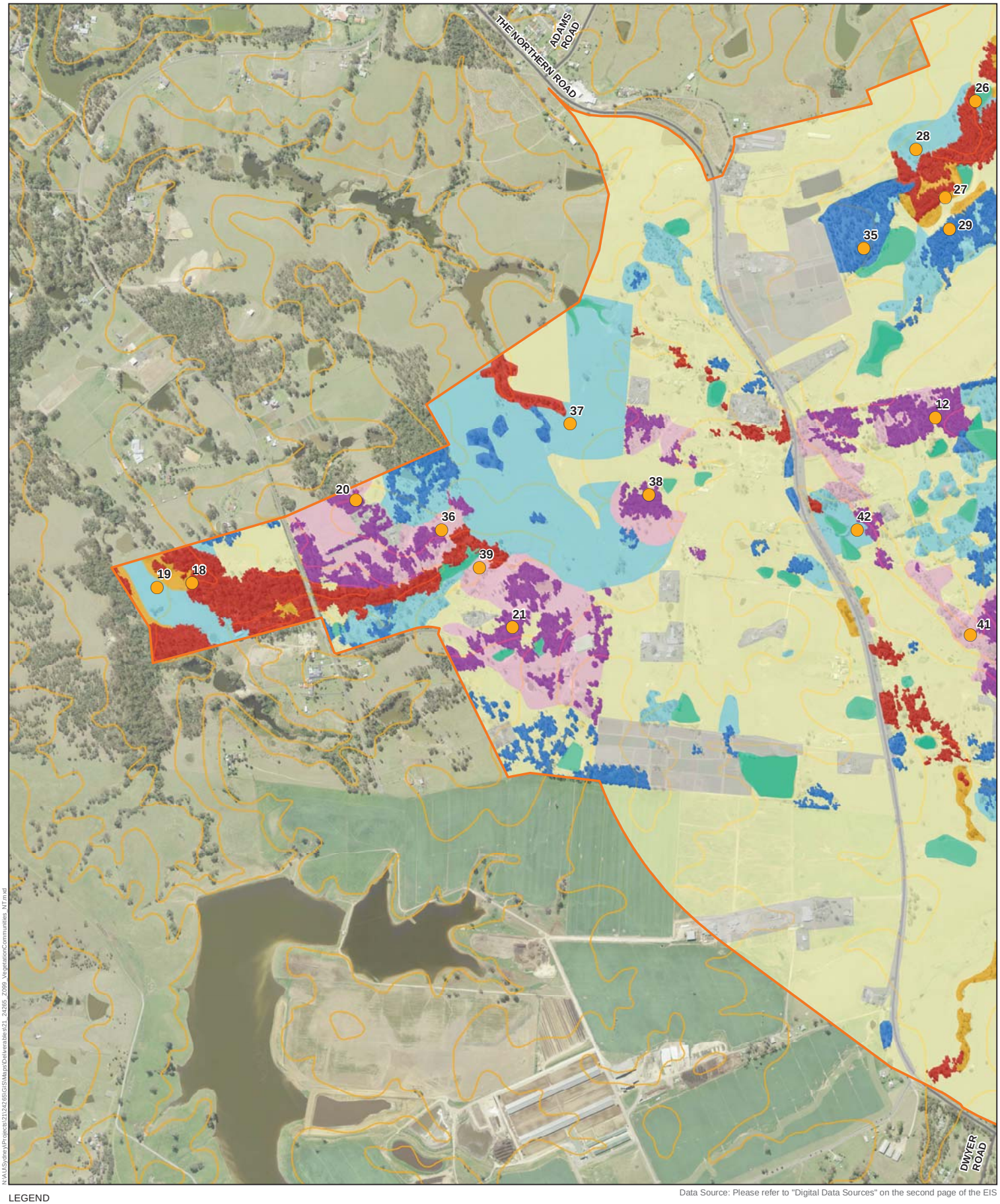
A significant impact was determined for Cumberland Plain Woodland and the Grey-headed Flying-fox. Construction and operation of the long term development would also have a significant impact on plants and animals on Commonwealth land. The key findings of the assessments are summarised in Chapter 16 in Volume 2.

39.2.4.2. Impacts on State-listed threatened species, populations and ecological communities

An assessment of impacts was undertaken for threatened species, populations and ecological communities listed under the TSC Act. A significant impact was determined for one threatened flora population (*Marsdenia viridiflora* subsp. *viridiflora*) and for three threatened ecological communities (Cumberland Plain Woodland, River Flat Eucalypt Forest and Shale-Gravel Transition Forest). In addition, a significant impact was determined for one threatened invertebrate (the Cumberland Plain Land Snail) and four threatened bat species (the Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat). The key findings of the assessment are summarised in Chapter 16 in Volume 2.

39.2.5. Considerations for future development

Chapter 16 in Volume 2 sets out the mitigation and management measures that are proposed to address impacts on terrestrial and aquatic flora and fauna for the Stage 1 development, including an offset for the residual impacts to biodiversity values. These measures would also generally apply to the construction and operation of the long term development. Appropriate offsetting would also be required as part of any future approvals for the long term development.



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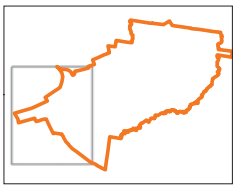
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

- Airport site
- Contour
- Roads
- Plot/transect
- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)
- Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)
- Good condition artficial freshwater wetland (HN630)
- Exotic grassland
- Cleared land or cropland



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Kilometres

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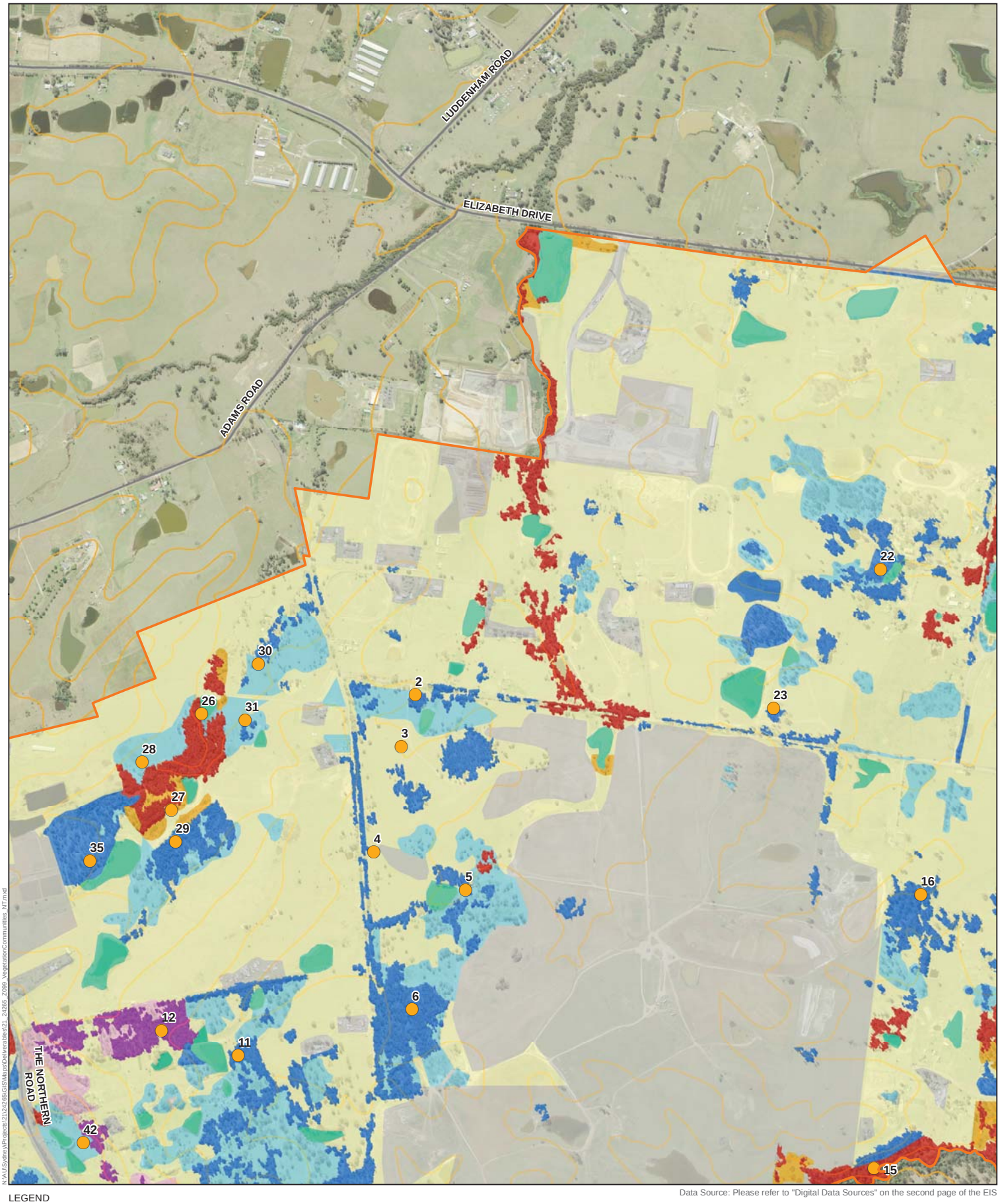
Figure 39-1A - Vegetation zones within the airport site



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LEGEND

- Airport site
- Contour
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- Plot/transect
- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
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- Good condition artficial freshwater wetland (HN630)
- Exotic grassland
- Cleared land or cropland

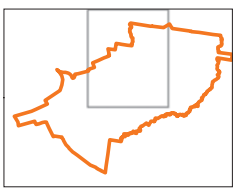

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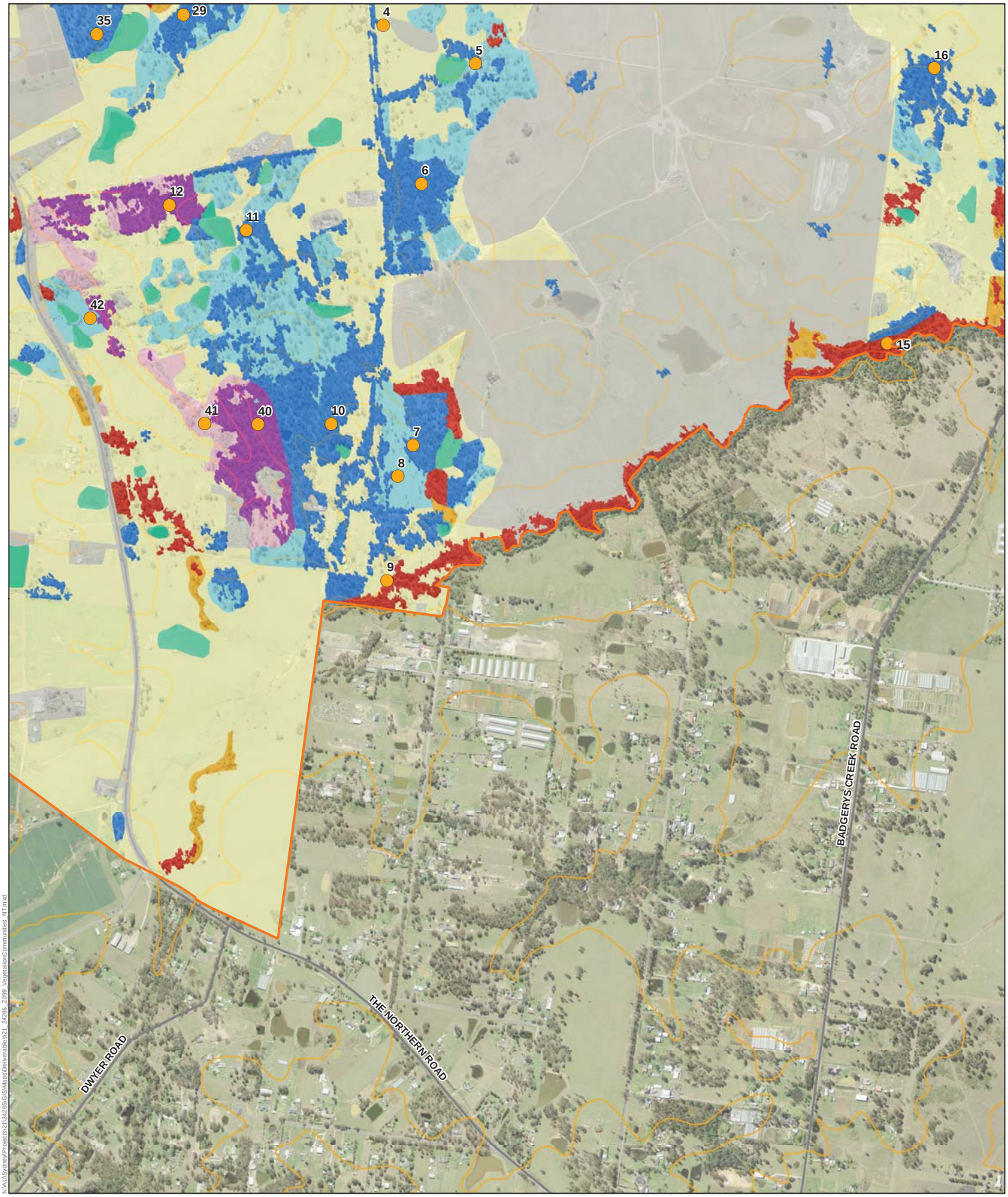
Figure 39-1B - Vegetation zones within the airport site



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Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

- Airport site
- Contour
- Roads
- Plot/transect
- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
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- Exotic grassland
- Cleared land or cropland

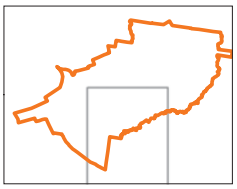

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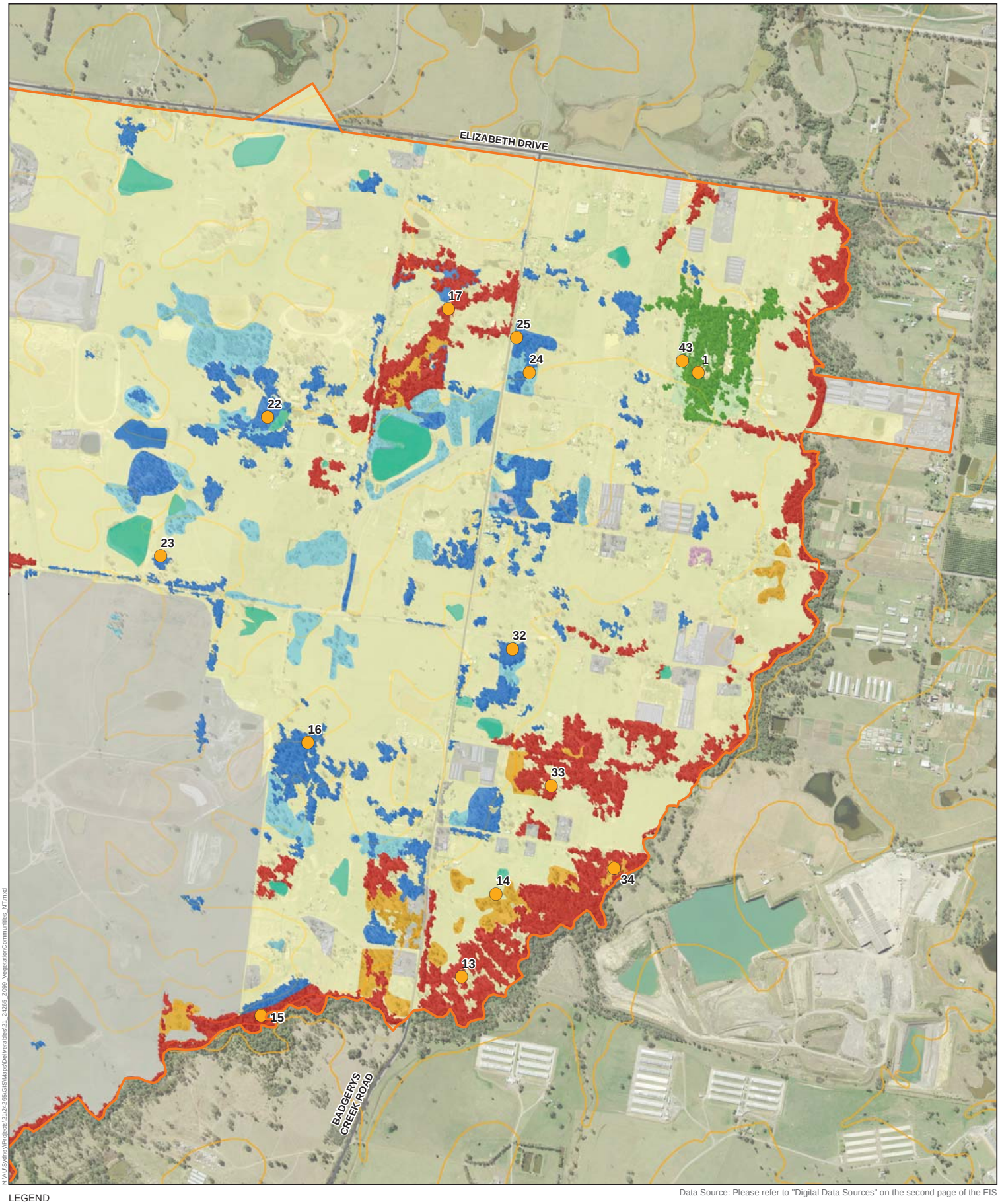
Figure 39-1C - Vegetation zones within the airport site



Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

- Airport site
- Contour
- Roads
- Plot/transect
- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
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- Good condition artficial freshwater wetland (HN630)
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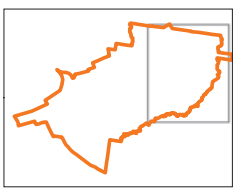

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Figure 39-1D - Vegetation zones within the airport site

39.3. Topography, geology and soils

39.3.1. Existing environment

The airport site is part of an elevated ridge system dividing the Nepean River and South Creek catchments. The site is characterised by rolling landscapes with a prominent ridge in the west of the site, reaching an elevation of about 120 metres above Australian Height Datum (AHD), and smaller ridge lines in the vicinity with elevations of about 100 metres AHD. The topography of the airport site generally slopes away from the ridges in the west, at elevations between 40 metres and 90 metres AHD, with the lower elevations occurring toward Badgerys Creek.

The dominant geological formations beneath the airport site are Bringelly Shale, the Luddenham Dyke and alluvium. Bringelly Shale is a Triassic geological unit mainly comprising claystone and siltstone, with some areas of sandstone. Luddenham Dyke is a Jurassic groundmass of olivine basalt, analcite, augite, feldspar and magnetite that outcrops toward the peak of the ridge in the western portion of the airport site (Bannerman and Hazelton 1990). Alluvium at the airport site consists of Quaternary sedimentary deposits along Cosgrove Creek and Badgerys Creek.

Geotechnical investigations at the airport site generally indicated surficial silt and/or clay topsoils overlying firm residual clays from the weathering of Bringelly Shale, with areas of alluvial gravels, sands, silts and clays associated with Badgerys Creek.

The soils at the airport site are categorised as the Blacktown, Luddenham and South Creek soil landscapes, based on consistent soil type, material, depth and erosion characteristics. Soils are anticipated to be moderately saline, with higher potential for salinity along Badgerys Creek and drainage lines in the south and west of the airport site.

Prior activities at the airport site – including agriculture, light commercial and building demolition – mean there is potential for contaminated land to be present at the airport site.

39.3.2. Assessment of impacts

It is expected that a bulk earthworks programme would be undertaken over the southern portion of the airport site. This would provide a level platform for construction of the long term development including the second runway. The bulk earthworks would change the topography of the southern portion of the airport site from a rolling landscape to an approximately level, built environment.

Clearing and bulk earthworks would increase the surface area and, in some instances, the slope of exposed soil at the airport site. These changes to the landscape would present a risk of increasing erosion. Erosion may occur in the form of runoff during rainfall or windblown dust. Stockpiled topsoil would also present an erosion hazard and would be subject to potential degradation of chemical and physical fertility over time.

The design of the long term development would incorporate landscaped areas and stormwater drainage including grassed swales and detention basins to control the quantity and quality of stormwater runoff. This drainage system would be functional throughout construction and operation to capture surface runoff prior to discharge to receiving waters. Implementation of standard erosion and sediment control measures during earthworks would minimise impacts in relation to soil erosion and degradation.

Construction of the long term development has the potential to interact with existing sources of potential land contamination. Demolition works across the airport site prior to the site preparation and construction of the long term development would include measures to mitigate contamination risks of asbestos and lead based paints. However, historic demolition sites and land use also present a risk of existing contamination. Any contamination discovered during construction would be managed and mitigated to make the land suitable for its intended use and to prevent impacts on human health and the environment.

Accidental release or mobilisation of contaminants has the potential to affect human health and the environment through contact with pathogens (in the case of sewage), inhalation (in the case of asbestos or chemical vapours), or mobilisation to surface waters or bioaccumulation. These events would be avoided in the first instance through the implementation of applicable Australian Standards for the storage and handling of hazardous materials. In the unlikely event of a significant leak of spill or contaminants, remediation would be implemented as soon as practicable.

39.3.3. Considerations for future development

The potential impacts of the construction of the long term development would be typical of a large scale construction project and are expected to be manageable with the implementation of standard stormwater, erosion and dust controls and adherence to industry standards for the storage and handling of chemicals. Other considerations for the mitigation and management of potential impacts arising from future development include designing earthworks and final landforms to integrate with the surrounding landscape with particular emphasis on avoiding steep slopes and the protection of the conservation zone along Badgerys Creek.

39.4. Aboriginal heritage

39.4.1. Existing environment

The airport site has been the subject of a number of previous archaeological assessments. Fifty-one Aboriginal heritage sites have been recorded during these surveys, consisting of surface artefact occurrences and a modified tree. Twenty-three additional sites were recorded at the airport site during the course of the current assessment, which focused on test excavation and characterising the subsurface archaeological resource. The new recordings comprised nine sites with surface artefacts (including a grinding groove site) and 14 sites where subsurface artefacts were confirmed through test pit excavations. The locations of all site recordings to date at the airport site are shown in Figure 39-2.

The test excavation programme included a representative sample of landform types and zones within the airport site. It was determined that a relatively high average artefact incidence occurred across valley floors, basal slopes, first order spurlines and within 100 metres of second, third and fourth order streams.

These findings indicate that Aboriginal heritage sites occur widely across the landscape, but particularly on elevated level ground and slopes within relative proximity of a water source, and that larger sites with higher artefact densities are more likely to be near permanent water.

A more detailed review of the Aboriginal cultural heritage values of the site and surrounding area is provided in Chapter 19 of Volume 2 and in Appendix M1.

39.4.2. Assessment of impacts during construction

Construction of the long term development would affect 23 recorded Aboriginal sites. All of these sites contain artefact occurrences and are listed in Table 39–2.

Eight sites, including the scarred tree (B40) and the grinding groove site (B120), are located within the proposed environmental conservation zone adjacent to Badgerys Creek and would therefore be unaffected by the construction of the long term development.

Table 39–2 – Aboriginal heritage sites directly affected by construction of the long term development

Development area or land use zone	Affected surface sites	Total
North and west of the proposed boundary fence	B3, B15, B31, B42, B46, B59, B66, B67, B68, B74, B75, B76, B90, B95, B104, B117, B118, B123, B124, B125, B126, B133, B132	23
Potentially situated in environmental conservation zone bordering Badgerys Creek	B4, B40, B41, B54, B55, B120, B121, B130,	8
Total		**31**

With regard to the predicted subsurface archaeological resource, construction of the long term development would directly affect approximately 387 hectares of archaeologically sensitive landform. This constitutes about 21 per cent of the airport site. These landform categories, and their affected proportions, are presented in Table 39–3.

The long term development of the airport site would directly affect a large proportion of the remaining Badgerys Creek catchment across the eastern half of the airport site. Consistent with the Stage 1 development, all of the higher relief and prominent topography of the airport site would be transformed into a level and graded platform. This would alter and remove the natural topography, which acts as a means for Aboriginal people to ‘read’ and experience the Aboriginal cultural values of the land.

Table 39–3 – Area and proportion of archaeologically sensitive landforms directly affected by the construction of the long term development

Landform category or feature[1]	Area within long term development area (hectares)	Proportion of airport site	Total of this landform category within whole of airport site (hectares)	Proportion of total landform area within airport site (1,845 hectares[2])
Riparian corridor (100 m either side of drainage line)	112.1	6.1%	369.6	20%
Ridge and spur crests	51.6	2.7%	120.3	6.5%
Broad scale landforms				
Valley floor	136.2	7.4%	184.0	10.0%
Basal slopes	86.7	4.7%	214.2	11.6%
Total	**386.6**	**20.9%**	**888.1**	**48.1%**

Note. 1. These are mutually exclusive categories. The area of fluvial corridors and crests which overlap valley floor or basal slope topography have not been separately tabulated.

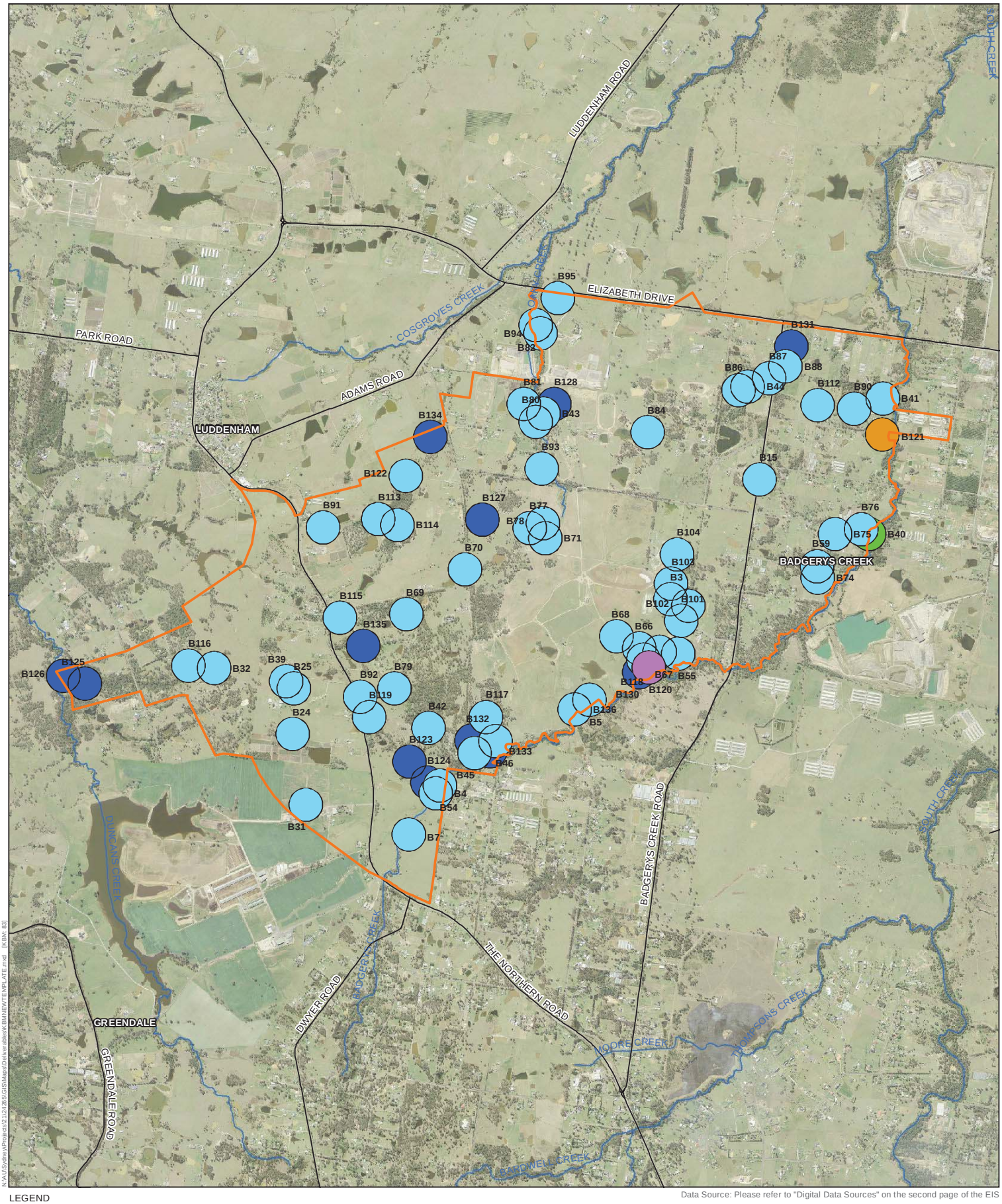
2. This area total includes Commonwealth land that is non-contiguous with the airport site.

39.4.3. Assessment of impacts during operation

Impacts during operation of the long term development would be limited to indirect impacts on adjacent and nearby sites. These may be located within that portion of the Badgerys Creek riparian zone within conservation reserves, or on lands adjoining the airport site. The majority of known Aboriginal heritage sites within approximately 500 metres of the construction impact zone of the long term development consist of artefact occurrences. The heritage values of artefact occurrences are unlikely to be vulnerable to indirect impacts such as loss of context, unless they are subject to public interpretation or visitation based on Aboriginal cultural reasons. The two exceptions are the scarred tree (B40) and the grinding groove site (B120). These sites are situated close to the airport site boundary fence and retain cultural heritage value and potential for public interpretation.

39.4.4. Considerations for future development stages

Chapter 19 in Volume 2 sets out the mitigation and management measures that are proposed to address impacts on Aboriginal heritage for the Stage 1 development. These measures would also generally apply to the construction and operation of the long term development, subject to the assessment of that development as appropriate. These measures may include the conservation of heritage sites, recording and salvage of heritage sites, the commemoration of cultural heritage values at the airport site, curation and repatriation of heritage items, and protocols for the discovery of artefacts and human remains. Consideration would also be given to the requirements of the EPBC Act for the management of places on the airport site with Commonwealth Heritage values.



LEGEND

- Airport site
- gg - grinding groove
- sao + ssao - surface and subsurface artefact occurrence
- st - scarred tree
- sao - surface artefact occurrence
- ssao - subsurface artefact occurrence

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

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Figure 39-2 - Aboriginal heritage at the airport site

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39.5. European heritage

39.5.1. Existing environment

The assessment of European heritage identified 19 European heritage items at the airport site and an additional 22 heritage items in the surrounding area, as shown on Figure 39-3. The identified items are all considered to be generally of local heritage significance.

The identified European heritage items reflect the historical context of the airport site and European settlement more generally, including early attempts to develop local agricultural and pastoral economies and the emergence of settled village communities. These farmlands have continued in rural use and provide insight into early agricultural production.

European settlement around Badgerys Creek began with land grants to settlers in the early nineteenth century for the purpose of establishing large rural estates for agricultural production to feed the colony's growing population. The site was associated with cropping and later vineyards and orchards, and retains an historic association with markets for the supply of meat and livestock to metropolitan Sydney.

The emergence of a settled village and farm community at Badgerys Creek in the last half of the nineteenth century is historically associated with the breakup of the large estates for closer settlement. This is demonstrated in street alignments, subdivision patterns, dwellings, churches and cemeteries, community gathering places, recreation grounds, park reserves and places of education.

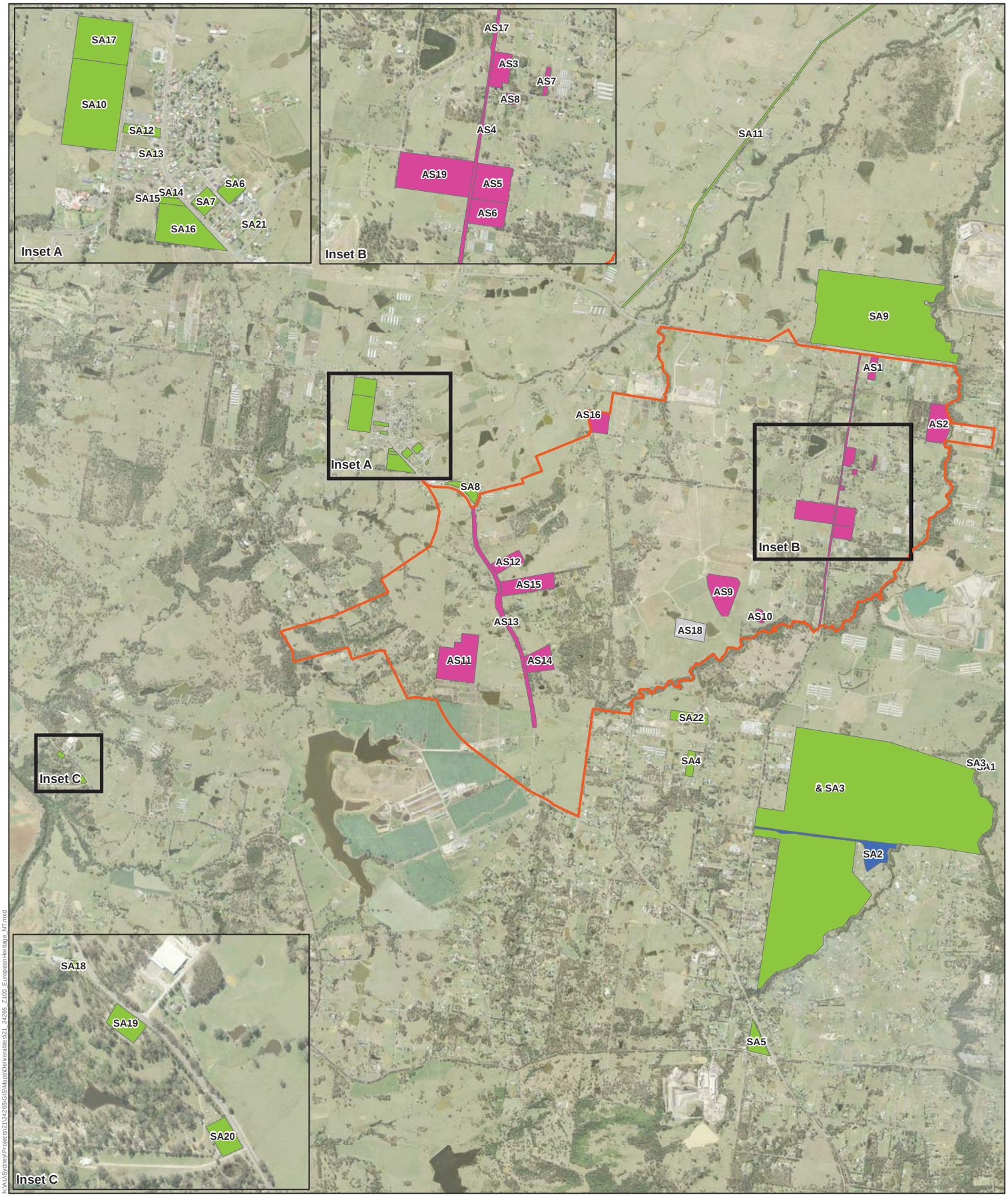
The site includes a public school, which demonstrates the development of public education from the late 1800s. The scale, material and design of the school buildings reflect the evolving fortunes of Badgerys Creek, education reform, the local community and architectural styles.

A more detailed review of the European heritage values of the site and surrounding area is provided in Chapter 20 of Volume 2 and in Appendix M2.

39.5.2. Assessment of impacts

Site preparation activities would take place before construction of the long term development and would involve the removal of any remaining structures from the airport site. The European heritage items identified at the airport site would therefore not be present during the long term development of the airport site.

The European heritage items surrounding the airport site would potentially be present during the construction and operation of the long term development. The long term development would not be expected to have a significant impact on the heritage value or conservation significance of these items. While the landscape and views experienced at these places would change, the changes would not materially affect the European heritage values. Similarly, noise from the construction and operation of the long term development would affect the ambience and amenity of these places, but would not be expected to cause material harm to European heritage structures or items.



Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

- Airport site

European heritage items

- Commonwealth significance
- Local significance
- State significance
- Undetermined significance

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Figure 39-3 - European heritage at the airport site

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Kilometres

N

39.5.3. Considerations for future development stages

A range of measures are proposed to mitigate and manage potential impacts on particular European heritage items at the airport site before site preparation and construction of the Stage 1 development. These measures include archival recording, cultural plantings and exploration of options to relocate structures. The measures to be implemented during Stage 1 are described in more detail in Chapter 20.

The potential impacts of the long term development on the European heritage values at the airport site would be negligible, as all potential impacts would be mitigated and managed prior to the construction of the long term development. Alterations to the landscape, views and ambience would not materially affect European heritage items surrounding the airport site.

39.6. Resources and waste

39.6.1. Waste streams

Establishment of the long term development would involve clearing and a major bulk earthworks programme to achieve a level surface suitable for construction of airport facilities, along with the use of a range of construction materials.

As with any large infrastructure project, the construction and operation of the long term development would involve the consumption of natural resources and has the potential to generate significant quantities of waste.

Key waste streams would include waste vegetation from clearing, waste construction materials such as concrete and timber, food waste and other general waste from terminal facilities, and waste oils, paints and cleaners from maintenance activities. The waste streams that would be generated would be similar to those described for the Stage 1 development included in Chapter 25 of Volume 2.

The volume of resources consumed and waste generated during the construction of the long term development would be similar to the volumes consumed and generated for the construction of the Stage 1 development.

The volume of waste generated during operation, particularly during peak operations, would be substantially greater than during Stage 1 operation. The operational waste volume would increase from about 5,200 tonnes each year during Stage 1, to about 44,000 tonnes each year during the peak operations in the long term.

39.6.2. Considerations for future development stages

As with the management of waste generated by the Stage 1 development, a combination of on-site and off-site management measures would provide a range of options to reuse, recycle, recover and treat waste generated by the long term development. The waste management strategy for the airport would be incrementally augmented in the lead up to the long term development and would incorporate best practice measures including the development of new technologies such as vacuum collection systems if practicable. The implementation of measures to manage waste and thus avoid and mitigate impacts on human health and the environment would be the primary purpose of the waste management strategy.

Despite the increase in waste volume, the overall volume of operational waste would not be significant in the context of the already mature waste management industry in the Sydney region, which has developed to accommodate the needs of many thousands of other commercial waste generators. While the operational long term development would be a major waste generator, the needs of the long term development are expected to be met by the market.

39.7. Hazards and risk

An assessment of hazard and risk was undertaken for the Stage 1 development (refer Appendix H in Volume 4). The assessment identified key hazards and risks associated with the construction and operation of the proposed airport using a precautionary-based approach, consistent with the provisions of the *Work Health and Safety Act 2011* (Cth) and the *Work Health and Safety Act 2011* (NSW). Owing to the preliminary nature of the design, it was not considered appropriate to conduct the full due diligence assessment required by the above legislation. Such an assessment would be conducted subsequently by others.

Despite the assessment being focused on the Stage 1 development, the range of hazards and risks assessed are also relevant to the long term development.

The potential hazards associated with the operation of the proposed airport were divided into airspace hazards (such as bird and bat strike or adverse meteorology) and ground-based hazards (such as fire or flood). The assessment found that the majority of the identified hazards, and their associated risk, would be satisfactorily resolved through:

- further design and approval processes;
- implementation of industry standards; and
- responsibilities of statutory authorities.

Aspects of the above would be undertaken prior to the long term development – including further bird and bat surveys, obstacle limitation surface surveys and protection, design of flight paths and declaration of protected airspace, CASA aerodrome certification, and various separate approval processes for any additional infrastructure. Some of these matters would be revisited or built upon iteratively up to the long term development, such that risks are adequately controlled at all times.

The operation of a second runway, as part of the long term development, would add substantial complexity to the configuration of Sydney basin airspace as well as the expected growth in overall air traffic movements. The development of flight paths associated with the long term development would be subject to a flight path and airspace design and approval process that would include safety as a principal consideration.

A pipeline for the supply of jet fuel would likely be required prior to the realisation of the long term development in 2063. The pipeline would eliminate the transport safety risks associated with the delivery of fuel by road. The corridor for the pipeline would be subject to a separate planning and approval process, which would include consideration of risks to people and property. The timing of the pipeline would be based on negotiation between the airport-lessee company and the fuel supply industry.

The risk of aircraft accidents was assessed by applying contemporary aircraft manufacturer accident data (2013) to expected air traffic movements for the long term development. Based on the expected air traffic movements in 2063, this equated to an accident rate of one in 30 years. It is noted that this rate reflects 2013 accident data and therefore current aircraft technologies and airspace practices. Actual safety performance of the long term airport development would benefit from improvements to technologies and practices over the coming years and decades.

Overall, it is envisaged that the potential hazards and risks of the future development of the airport could be satisfactorily managed in accordance with design and approval processes, industry standards and statutory responsibilities. Progressive improvements to aircraft technologies and airspace practices are expected to occur up to the long term development and would likely be accompanied by improvements in the safety of people and property.

39.8. Human health

An assessment of the predicted risks to human health associated with noise, air emissions, and surface water and groundwater impactsof the long term development was undertaken as part of the preparation of the EIS (refer Appendix G in Volume 4). This health risk assessment builds upon the analysis presented for the Stage 1 development in Chapter 13 of Volume 2.

The health risk assessment was undertaken in accordance with the Australian Government *Guidelines for Health Risk Assessment* (2012) and the *National Health and Medical Research Council Approach to Hazard Assessment for Air Quality* (2006). The health risk assessment uses information about pollutants to estimate a theoretical level of risk for people who might be exposed to defined levels. Health statistics for Sydney have been used as a baseline in the assessment, with information on the health risks of pollutants being drawn from epidemiological studies. Data on existing pollutant levels come from ambient monitoring stations in Western Sydney operated by the NSW Office of Environment and Heritage and the NSW Environment Protection Authority.

The risk assessment process comprises five stages: issue identification, hazard (or toxicity) assessment, exposure assessment, risk characterisation and uncertainty assessment. Through the issues identification stage, it was determined that the primary pathways by which the proposed airport could pose a risk human health were exposure to air pollutants, noise, and surface and groundwater pollutants. While there may be other exposure pathways by which human harm may result, these are considered the primary pathways for which potential health effects of the proposed airport may affect people.

The health risk assessment is based upon the findings of the local and regional air quality, noise and water technical studies undertaken as part of the preparation of the draft EIS. The potential health effects of local air quality, including emissions from aircraft overflights, ground based activity and traffic associated with the proposed airport are key considerations in the assessment.

39.8.1. Assessment of impacts during operation

39.8.1.1. Air quality

The predicted future air quality data used in the health risk assessment has been generated by the local air quality technical report (refer Appendix F1). Given the uncertainties associated with predicting baseline emissions in 2063, as well as emissions from a future aircraft fleet, the long term assessment only considers health impacts associated with exposure to 10 micron (or less) particulate matter (PM_{10}), 2.5 micron (or less) particulate matter ($PM_{2.5}$), and nitrogen dioxide (NO_2). Further details of these limitations are provided in the local air quality technical report at Appendix F1. This chapter also includes an assessment of the predicted risk associated with exposure to ozone, based on data sourced from the regional air quality technical report (refer Appendix F2).

The analysis presented in this section should be viewed in the context of overall health in the Sydney basin. In particular, evidence provided by NSW Health to a Parliamentary Inquiry into health effects of pollution showed that in 2006 it was estimated that between 600 and 1400 deaths per year were attributed to air pollution in the Sydney basin (NSW Parliament 2006).

Particulates

Annual average and 24-hour particulate matter (PM_{10} and $PM_{2.5}$) have been modelled as part of the air quality assessment for the long term development. The average 24 hour National Environmental Protection Measure (NEPM) ambient air quality residential standards for PM_{10} is 50µg/m^3 and for $PM_{2.5}$ is 25µg/m^3.

The highest 24 hour average PM_{10} impact for the long term airport operations is predicted for Rossmore and Mulgoa, with a maximum predicted impact of less than 25µg/m^3. The highest 24 hour average $PM_{2.5}$ impact for airport operations in the long term is predicted for Rossmore and Badgerys Creek, with a maximum predicted impact of less than 16µg/m^3. As such, emissions of particulate matter associated with the long term development would be within NEPM standards.

Having regard to the number of attributable cases from PM_{10} due to long term airport operations, the highest risk is for all-cause mortality from long term exposures, with between two additional deaths per 1000 years and four additional deaths per ten years. All other risks are lower than that predicted for long-term mortality.

Similarly, the highest predicted risk for $PM_{2.5}$ associated with the long term development is for all-cause mortality and cardiopulmonary mortality from long-term exposures with between five additional deaths per 1000 years and three additional deaths per ten years. All other risks are lower than that predicted for these outcomes. The highest predicted impacts are at Rossmore and Kemps Creek.

Nitrogen dioxide

The daily 24-hour nitrogen dioxide concentrations at residential receivers for the long term development are predicted to be low. The air quality assessment identified that for all relevant averaging periods, the nitrogen dioxide levels due to the long term development are below the current NEPM air quality standards. The levels predicted at all residential locations in the vicinity of the airport are similar.

Based on the modelling data, the highest predicted risk is for long-term mortality in people over 30 years of age with between six additional deaths every 100 years and six additional deaths in 10 years predicted for 2063.

Although the predicted nitrogen dioxide levels meet the NEPM standards, it is accepted that there is no threshold for nitrogen dioxide below which adverse health effects are not observed. This means that even meeting the air quality standards means that there is a level of risk associated with exposure to nitrogen dioxide.

Ozone

Peak daily ozone concentrations have been predicted for a number of days of for the long term development and the largest changes in ozone concentration have been calculated. Increases in ozone occur downwind of the airport site which, on most days, is to the south and southwest. Decreases in daily maximum ozone occur only in the vicinity of the airport site and are attributable to ozone suppression by fresh NO_x emissions.

There is general agreement by international agencies including the World Health Organisation and the US EPA that acceptable risk levels fall between one in a million and one in 100,000. The increases in predicted risk for the long term development, falls well within these limits.

For the base year of 2009, the resulting risk for the outcomes assessed is between two in a million (respiratory mortality) and 1.8 in 100,000. For the long term operations, the increase in risk ranges from one in a million for respiratory mortality to nine in a million for emergency department attendances for asthma in children. The largest predicted ozone concentration changes from the airport occur in a different location to the predicted daily peak ozone concentrations.

39.8.1.2. Noise

Aircraft noise

Based on the calculated $L_{night\ outside}$ noise levels, the number of annual additional EEG awakenings in 2063 due to aircraft overflight noise is between zero and ten per person (i.e. up to 0.00114 per cent increase in annual awakenings). The most affected areas would be Luddenham, Greendale and Horsley Park.

To put these results into context, the European Environment Agency (2010) noted that there are usually 24 awakenings per person even during 8-hours of undisturbed sleep at night. For most scenarios the aircraft noise associated with the proposed airport would not increase this number. The exception to this would be in Luddenham where consideration should be given to noise mitigation measures.

In terms of learning and cognitive development in children, hazard quotients less than one are considered to be an acceptable level of risk (enHealth 2012). Most hazard quotients due to the long term development are less than one, indicating that the risk of aircraft overflight noise from each of the proposed modes of operation generally do not pose an unacceptable risk.

In some cases there are marginal exceedances of one. This does not mean that there will be an impact on children's learning and cognitive development but that there is an increased risk, albeit very low. Noise mitigation measures recommended Chapter 31 of the draft EIS would lead to a reduction in this potential risk.

Ground based operations

Noise from ground based operations at the proposed airport site would have a greater impact in the localities closest to the proposed airport, in particular Luddenham. The combined effects of aircraft overflight and ground based operations noise is predicted to lead to an additional 25 EEG awakenings per year (i.e. an 0.3 per cent increase). Other affected areas include Greendale, Kemps Creek, Rossmore and Bringelly.

For ground based sources, the $L_{night\ outside}$ levels predicted for Luddenham exceeded the 55dB threshold. Based on the World Health Organisation exposure response curve, the levels predicted for Luddenham may result in an increase in myocardial infarction of approximately ten per cent. In terms of children's learning and cognitive development, the hazard quotients experienced at Luddenham exceed one suggesting that noise mitigation measures should be implemented.

Noise mitigation measures recommended in Chapter 31 of the EIS would lead to a reduction in this potential risk.

39.8.1.3. Groundwater

Based on available information relating to the types of activities which will be conducted during the long term operation of the proposed airport, there is considered to be minor potential for risks to the environmental values of groundwater in the alluvial and Bringelly Shale aquifers. It is noted however that the potential for exposure to groundwater contaminants by off-site users of extracted groundwater is minimal as bores draw from the Hawkesbury Sandstone aquifer.

39.8.1.4. Surface water

The indicative flight paths for the long term development are located above the catchment areas for Warragamba Dam and Prospect Reservoir. In addition, through consultations there have been concerns raised by parts of the community about the potential for aircraft emissions to impact on the quality of tank water in the area close to the airport site.

Chapter 13 provided a qualitative evaluation of the operation activities and whether there would be an impact to surface water bodies in and around the airport site. This included an assessment of accidental spills of stored chemicals or fuels, release of stored groundwater, aircraft emissions and fuel jettisoning. As with the Stage 1 development, activities associated with the operation of the long term development are considered to have a low risk of impacting on the environmental values of nearby surface water.

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