Urban Capability and Capacity Assessment of the Dural Locality

Urban Capability Capacity Dural

80218062

Prepared for
The Hills Shire Council

15 March 2019

Cardno

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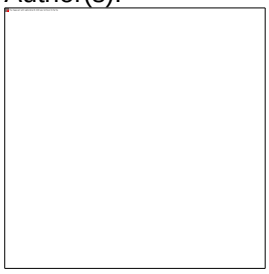

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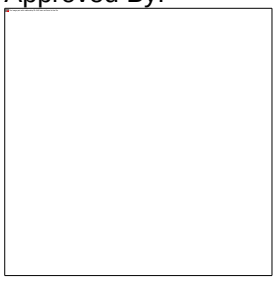

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Executive Summary

The Hills Shire Council (Council) is investigating opportunities for urban growth in the Dural locality. Council has engaged Cardno to undertake a Phase 1 Urban Capability and Capacity Assessment, which has the following three key components – (a) an Environmental Study Report (b) an Infrastructure Capacity Investigation and (c) an Indicative Urban Capability Assessment Plan.

The purpose of the overarching Urban Capability Assessment is to determine the suitability of land on the rural/ urban interface in the Dural locality to sustain urban land uses at higher densities than are permissible under the current urban planning regime. To inform this outcome, assessments have been made of:

- the environmental capability of the land;
- the capacity of service and transport infrastructure; and
- the resultant capability of the land to absorb higher densities of residential development than are currently permitted.

The area of investigation is located mainly within Dural in the area near Round Corner Dural Village, on the northern fringe of the Sydney Metropolitan Area. It is located 50km from the Sydney CBD and 25km from the Parramatta CBD and is characterised by both urban and rural landscapes.

This report documents the outcomes of an environmental study and consequent urban capability analysis of land in Dural.

Environmental database searches and a review of existing Council literature was undertaken to identify potential environmental constraints and thereby potential areas not being capable for growth. Following the desktop review, a site visit was undertaken to validate the information and document the existing environment against the mapping as well as assess the investigation area and its potential environmental constraints in key locations.

The study has identified that the following key environmental considerations will influence future decision-making about land capability in the investigation area:

- Vegetation communities;
- Wildlife corridors;
- Threatened flora and fauna;
- Waterways and threatened aquatic biodiversity;
- Inner and outer riparian corridor;
- 100 year flood prone land; and
- Land with a slope that is greater than 20%.

These environmental factors were mapped and compared to determine where environmental constraints could be managed and still enable some development to occur and where they would prevent development from occurring. In many cases, it is not one single environmental constraint that would prevent development from occurring but a combination of these constraints on the same land that has led to the land being classified as undevelopable. The land classification fed in turn into the overarching urban capability assessment, infrastructure assessment and development capability plan.

Transport and service infrastructure investigations were carried out concurrently with the environmental investigations. These included assessment of local capacity for:

- Road infrastructure;
- Water and wastewater;
- Gas and electricity.

Our assessment with respect to transport / service infrastructure has found that at the existing level of development, the critical road network within and in the vicinity of the Dural Investigation Area is running over its service capacity. Any uplift in development density within the investigation area would require major upgrades to the road network in order to achieve acceptable performance levels. There is currently no government will to invest in the required network upgrades.

Cardno's investigations of the capacity of the existing service infrastructure in the locality to support additional development have found:

- There is no spare capacity in potable and waste water to support additional development in the investigation area and there are no plans to upgrade these services.
- There is very limited spare capacity in the existing electricity supply system in the investigation area. Development yielding more than approximately 230 additional residential units would require upgrading of the local network. The area as a whole has not been identified as a growth area by Endeavour Energy and it does not have any long term infrastructure plans to increase capacity in the area. Gas supplies are also limited in the locality and new supply lines would be required to support development uplift. Supply companies would be likely to require supply extensions or amplifications to be developer funded.

The investigations have found that there are no state government plans to intensify development within the investigation area. The Central City District Plan maps the investigation area within the Metropolitan Rural Area, the intention being that the area would remain rural in character and development density would reflect this. The investigation area has not been identified for future growth in the District Plan. Nor have other state or local strategic plans identified the area as having potential for future growth.

Based on the results of the investigation, Cardno concludes that:

- There are no government plans to encourage additional growth in the investigation area.
- The investigation area has some physical capability for development uplift.
- Constraints arising from lack of capacity in transport and service infrastructure would be likely to preclude any development uplift in the investigation area. At this time, there is no government will to invest in upgrades to these services. Private investment in infrastructure would be necessary to facilitate any substantial development uplift.

Glossary and Abbreviations

AHIMS	Aboriginal Heritage Information Management System
ASS	Acid Sulfate Soils
Baulkham Hills Shire Council	Former Council (is now The Hills Shire Council)
BC Act	*Biodiversity Conservation Act 2016*
BOM	Australian Bureau of Meteorology
Cardno	Cardno (NSW/ACT) Pty Ltd
CBD	Central Business District
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EEC	Endangered Ecological Community, listed under Schedule 1 of the BC Act
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulations	*Environmental Planning and Assessment Regulation 2000*
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
FM Act	*NSW Fisheries Management Act 1994*
Hornsby LEP	Hornsby Local Environment Plan 2013
Infrastructure SEPP	*State Environmental Planning Policy (Infrastructure) 2007*
LEP	Local Environment Plan
LGA	Local Government Area
LPI	Land Property Information (currently known as the Department of Finance, Services and Innovation)
NES	National Environmental Significance. Matters of NES are listed under the EPBC Act
OEH	NSW Office of Environment and Heritage
PMST	Australian Government's Protected Matters Search Tool
SEPP	State Environmental Planning Policy
Shire	Refers to The Hills Shire Council
The Hills District Area	Area covered by The Hills Shire Council
The Hills LEP	The Hills Local Environment Plan 2012
The Hills Shire	Refers to The Hills Shire Council
TSC Act	Former *Threatened Species Conservation Act 1995*
VRZ	Vegetated Riparian Zone

Table of Contents

Appendices

Tables

Figures

1 Introduction

The Hills Shire Council (Council) is investigating opportunities for urban growth in the Dural locality. Council has engaged Cardno to undertake a Phase 1 Urban Capability and Capacity Assessment, which has the following three key components – (a) an Environmental Study Report (b) an Infrastructure Capacity Investigation and (c) an Indicative Urban Capability Assessment Plan.

The purpose of the overarching Urban Capability Assessment is to determine the suitability of land on the rural/ urban interface in the Dural locality to sustain urban land uses at higher densities than are permissible under the current urban planning regime. To inform this outcome, assessments have been made of:

- the environmental capability of the land;
- the capacity of service and transport infrastructure; and
- the resultant capability of the land to absorb higher densities of residential development than are currently permitted.

The assessment takes a holistic approach to determining the capacity and capability of the area.

The area of investigation is mainly within Dural, on the northern fringe of the Sydney Metropolitan Area. Dural is located 50km from the Sydney CBD and 25km from Parramatta CBD. The area within and near the village of Round Corner Dural is a focus of the investigations.

The suburb of Dural lies within both The Hills Shire Local Government Area (LGA) and Hornsby Shire LGA, with Old Northern Road forming the boundary between the two Council areas. Round Corner is a local town centre in the south-western part of Dural.

1.1 Purpose of the Report

The purpose of this report is to identify the environmental features of the land and analyse whether these present constraints to development for urban purposes. The report summarises the findings of the background environmental searches and review of Council documents to develop an environmental suitability analysis of the land.

Council's requirements for the Study are:

> An **Urban Capability and Capacity Assessment** of the Dural Locality, including a recommendation for whether there is merit to proceed with urban land release and approaching the State Government and agencies to endorse an approach and commitment to funding infrastructure and required services for potential urban release area."

> **An assessment of the suitability of land on the rural / urban interface** in the Dural locality to sustain urban land uses, including the **environmental capability** of land and the capacity of services infrastructure in the locality to support additional development.

> Coming out of the above investigations, **a mapped indication of the capability of the land** within the Dural area to absorb development uplift.

1.2 Process

The study has been carried out sequentially as follows:

> Information collection and review
>> Collection of data and review of existing literature for:
>>> Strategic planning, policy and demographics
>>> Environmental elements
>>> Infrastructure elements

> Opportunities / constraints analysis and mapping against the following elements
>> Topography and slope
>> European and Aboriginal heritage

- Bushfire hazard
- Flooding hazard and hydrology
- Biodiversity
- Vegetation communities and wildlife corridors
- Soil landscapes and contaminated lands
- Resource lands
- Scenic character and quality
- Service infrastructure capacity (gas / electricity / water supply / sewer / stormwater)
- Traffic and transport infrastructure capacity

- Urban capability analysis culminating in a land capability map.

1.3 Structure of this Report

The report is presented as a synthesis of the informing environmental and infrastructure investigations. These are included as appendices, the intention being that the overarching report is standalone and can be read in isolation. The informing detailed investigative reports are appended to this overarching report.

The overarching report is structured as follows:

Chapters 1 & 2 provide an introduction to the project, including its purpose and the adopted study process, along with a description of the Investigation Area.

Chapter 3 includes an analysis of the strategic and policy background to the Investigation Area with additional commentary around the existing planning controls that apply to the land.

Chapter 4 evaluates the existing conditions and provides an assessment of the land to determine the physical and environmental suitability and capability of the investigation area. The assessment takes into account the following factors: threatened species and biodiversity; heritage; flooding, creek and watercourse; drainage and stormwater; topography, value of resource lands and scenic quality. Constraints and opportunities of the investigation area are mapped and progressively overlaid leading to a resolved land capability map.

Chapter 5 synthesises the outcomes of the planning and environmental assessment process into a land capability map.

Chapter 6 identifies the traffic/transport and service infrastructure capacity to support urban development within the investigation area. Potential amplification works are also identified to enable future urban development within the investigation area.

The detailed studies that have informed the capability assessment are provided in **Appendices A to E**.

2 Study Area

2.1 Identification of Study Area

The extent and location of the investigation areas for the assessment was determined by Cardno in consultation with The Hills Shire Council. Two areas were defined and mapped in **Figure 3.1 Project Area**. These investigation areas are:

- High Level Investigation Area (outlined in red – **Figure 2.1**)
- Detailed Investigation Area (outlined by black dashed line – **Figure 2.1**)

The Hills and Hornsby Councils have received a number of unsolicited Planning Proposals to rezone land near Round Corner, Dural. The underlying intent of this study is to provide The Hills Council with an independent and fully considered assessment of the capability of the Dural locality, including the land covered by the Planning Proposals, to support higher densities of development. On this basis, the Detailed Investigation Area has been identified to include Round Corner, the lands covered by the Planning Proposals and other nearby concentrations of development. It has also been confined to land within The Hills Local Government Area.

In order to ensure an appropriate context for the study, the broader High Level Investigation Area has been identified to include other local nodes of development and transport connections between these and the Detailed Investigation Area. Edges of the Investigation Areas have essentially been defined by natural features such as local creek lines and by the edges of existing residential development and Arterial Roads (and connecting roads between these).

The High Level Investigation Area encompasses the suburbs of Dural, Glenhaven, Castle Hill and Kenthurst (**Figure 2-1**). The majority of the area is within The Hills Shire Local Government Area (LGA) with a portion along the east side being within the Hornsby LGA (Hornsby Shire Council). This area is bordered by Annangrove Road (Regional Road Number 7141) and creek lines to the north, local connector road Bannerman Road to the west, local connector road Glenhaven Road to the south and various local roads including Hastings Road to the east.

The Detailed Investigation Area is the region under consideration for the environmental and planning study. The High Level Investigation Area provides a wider contextual understanding of the locality and also allows for potential opportunities for connections in the vicinity of the Detailed Investigation Area.

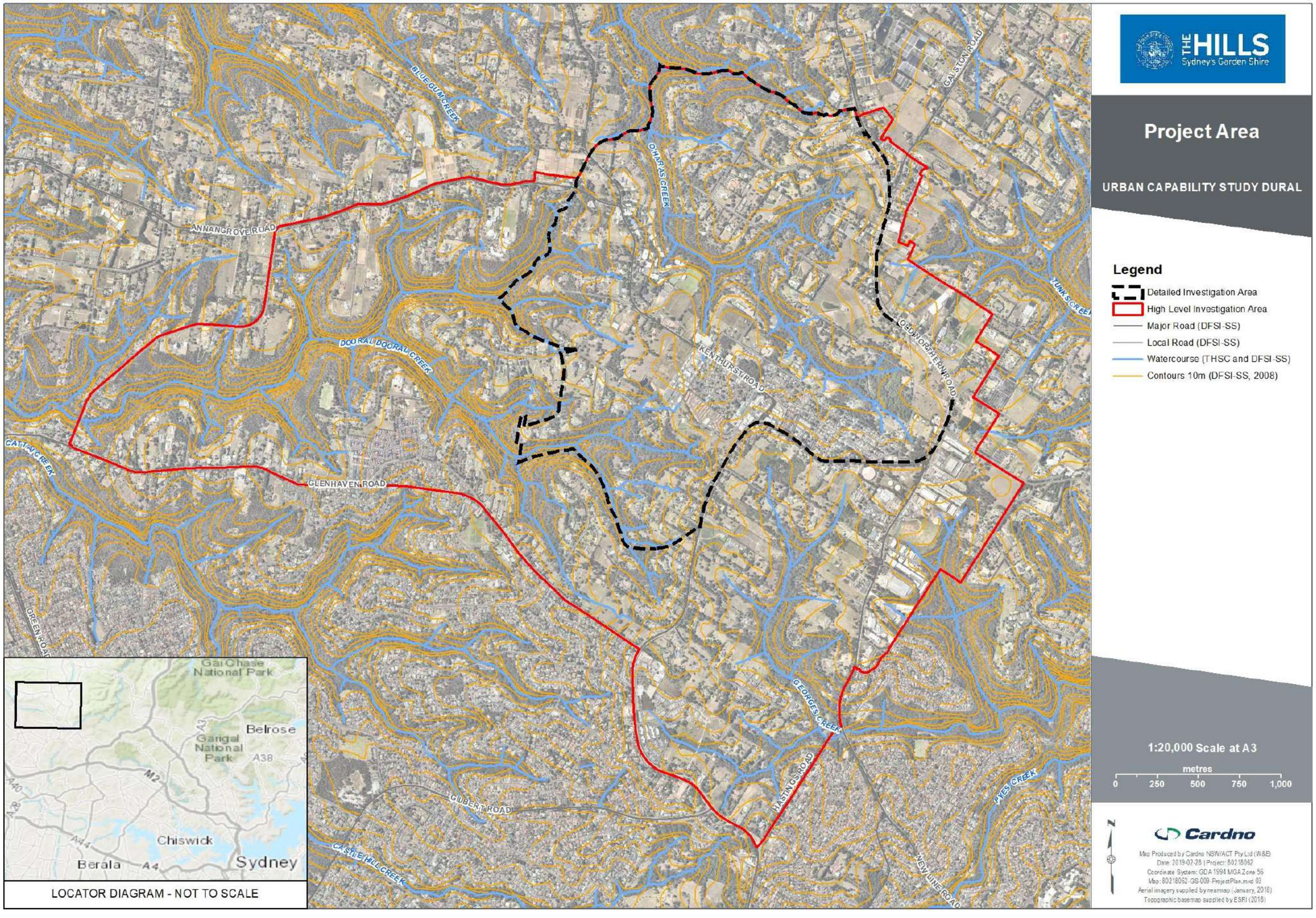


Figure 2-1 Project Area

2.2 Description of the land

2.2.1 Land use and access

The detailed Investigation Area incorporates a mosaic of land uses including:

- Tracts of bushland generally following existing local creek lines;
- Large lot residential areas in semi-rural settings;
- Conventional low density residential areas;
- Medium density housing (largely in the form of Seniors Living developments) and townhouses in Round Corner / Dural; and
- One consolidated retail / commercial precinct (at Round Corner, Dural).

Vehicular access to the area is via regional roads including New Line Road, Old Northern Road, Annangrove Road and Glenhaven Road. Access within the investigation area is via a series of feeder roads and connector roads, many of which are relatively narrow and of a rural or semi-rural character.

2.2.2 Demographics

An overview of the demographics of the investigation area has been derived from a review of demographic data available on the Hills Shire Council website and the Australian Bureau of Statistics (ABS) 2016 Census data base. Investigations were carried out with the objective of identifying existing population densities, age range, levels of employment and income, land tenure and transport profiles. Comparisons were made using similar criteria against the adjacent Castle Hill area and overall statistics for the Sydney Metropolitan Area. The collected data against these criteria is summarised in **Table 2-1**.

The key demographic characteristics of the investigation area are:

- **Development density** – the investigation area has developed at very low density in comparison to other local areas (3.41 dwellings/ha compared to 23.95 dwellings / ha in neighbouring Castle Hill).
- **Employment** – the area enjoys a low rate of unemployment (4.14% compared to 6% for the Sydney Metro Area) and employment types are similar to Castle Hill and the Sydney Metro area.
- **Weekly income** - Higher proportion of the population in the Investigation Area has an income of greater than $2,000 when compared to Greater Sydney.
- **Home ownership** - rates are comparatively high (76.6% of households either own their homes outright or with a mortgage, compared to 59.2% for the Sydney Metro).
- **Car ownership** – rates are very high: 37.87% of households own 3 or more cars and 2% of households do not own a car. This is compared to 14.9% of households in the Sydney Metro Area owning more than 3 cars and 10.7% not owning a car.
- **Trips to work** - are private vehicle dominated (69.1% of the population travel to work by car while 8.96% travel to work by public transport only. Sydney Metro statistics for car travel are also high – 56.6% travel to work by car but public transport is a much more represented mode across the Metro area - 20.6% travel to work by public transport. Others travel via a combination of private and public transport).

Table 2-1 Demographics – comparative analysis between the Investigation Area and local and regional data (Source – Profile ID)

	Investigation Area (Dural/Kenthurst/Glenhaven)	Castle Hill	Greater Sydney
Household Type/Age Categories	0-9 years (11.15%) 10-19 years (14.83%) 20-29 years (11.21%) 30-39 years (8.04%) 40-49 years (13.69%)	0-9 years (12.54%) 10-19 years (13.91%) 20-29 years (10.53%) 30-39 years (11.69%) 40-49 years (14.43%)	0-9 years (12.84%) 10-19 years (11.80%) 20-29 years (14.97%) 30-39 years (15.51%) 40-49 years (13.73%)

	50-59 years (14.11%) 60-69 years (12.66%) 70-79 years (8.63%) 80+ years (5.68%)	50-59 years (13.45%) 60-69 years (11.26%) 70-79 years (6.83%) 80+ years (5.36%)	50-59 years (12.18%) 60-69 years (9.45%) 70-79 years (5.74%) 80+ years (3.77%)
Density Per Hectares	3.41 dwellings / h	23.95 dwellings /h	Data not available
Unemployment Rate	4.14%	4.9%	6%
Employment	Construction (14.81%) Retail Trade (10.411%) Health Care and Social Assistance (10.46%) Professional, Scientific and Technical (10.17%) Education and Training (9.67%)	Construction (7.87%) Retail Trade (10.41%) Health Care and Social Assistance (12.07%) Professional, Scientific and Technical (11.71%) Education and Training (9.75%)	Construction (8.2%) Retail Trade (9.3%) Health Care and Social Assistance (11.6%) Professional, Scientific and Technical (9.8%) Education and Training (8%)
Weekly Income (Individual)	Negative Income/Nil Income (10.78%) $500-$649 (7.36%) $1,000-$1,249 (7.5%) $2,000-$2,999 (8.37%) $3,000 or more (8.37%)	Negative Income/Nil Income (12.39%) $500-$649 (6.38%) $1,000-$1,249 (8.27%) $2,000-$2,999 (8.83%) $3,000 or more (6.57%)	Negative Income/Nil Income (11.3%) $500-$649 (6.6%) $1,000-$1,249 (8.5%) $2,000-$2,999 (6.1%) $3,000 or more (4.5%)
Housing Tenure	Owned with Mortgage (35.29%) Owned outright (41.31%) Rented (7.94%)	Owned with Mortgage (32.33%) Owned outright (29.4%) Rented (15.99%)	Owned with Mortgage (31.5%) Owned outright (27.7%) Rented (32.6%)
Car Ownership	1 Car (18.90%) 2 Cars (36.89%) 3 Cars+ (37.87%) None (1.99%) Not Stated (4.36%)	1 Car (27.10%) 2 Cars (42.12%) 3 Cars+ (22.47%) None (4.13%) Not Stated (4.18%)	1 Car (35.4%) 2 Cars (31.1%) 3 Cars+ (14.9%) None (10.7%) Not Stated (8%)
Trip to Work Mode	Car, as driver (65.79%) Car, as passenger (3.3%) Bus (5.13%) Train (3.83%) Worked at home (9.49%)	Car, as driver (62.1%) Car, as passenger (3.6%) Bus (13%) Train (6.7%) Worked at home (4.7%)	Car, as driver (52.7%) Car, as passenger (3.9%) Bus (6.1%) Train (16.2%) Worked at home (4.4%)

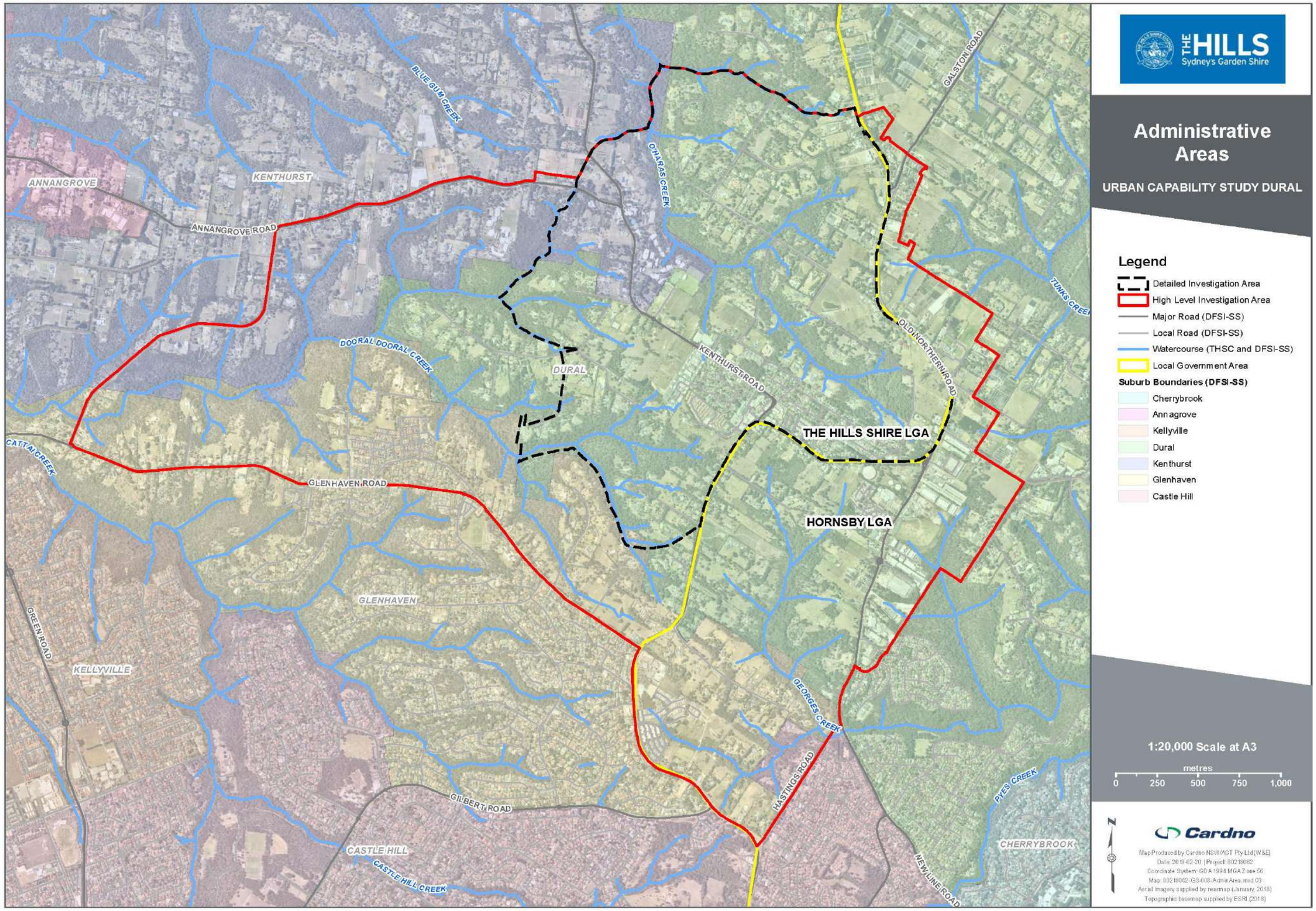


Figure 2-2 Administrative Areas

3 Strategic and Legislative Context

3.1 Urban planning strategy and policy

Analysis of the strategic planning framework that influences the future direction for land within the investigation areas has included a focused review of the following studies, policies and plans:

- *A Metropolis of Three Cities and The Central City District Plan*
- *Local Strategy (including supporting documents)– New Strategic Direction for Baulkham Hills Shire, May 2010*
    - *Environment and Leisure Direction*
    - *Residential Direction*
    - *Waterways Direction*
    - *Rural Lands Strategy (and independent review)*
- *Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River*
- *The Hills Local Environmental Plan, 2012*

3.1.1 Strategy and Policy – key outcomes

The key findings from this review of the strategic policy and background that are of relevance to the land capability assessment are outlined below.

3.1.1.1 Regional planning

All strategic plans reviewed include a broad objective to retain the rural fringe of the Sydney Metropolitan Area. Specifically, both *The Local Strategy* (Baulkham Hills Shire, 2008) and the *Central City District Plan* (Greater Sydney Commission, 2018) identify a limit to urban development along a line to the south of the Investigation Areas (see **Figures 3-1** and **3-2**).

Under the Central City District Plan, land in the Investigation Areas is identified as being within the 'Metropolitan Rural Area. The Plan recognises the contribution that the Central City District's rural areas make to habitat and biodiversity, and in sustaining local rural towns and villages. The rural area of Dural is recognised as being increasingly under pressure for urban development. The Plan notes that:

- A significant proportion of the District's rural land is under-utilised and has the potential to be used for more productive uses;
- Most of the rural area in the District is of high environmental value and is identified in The Hills LEP 2012 as having biodiversity value or being constrained land;
- Maintaining and enhancing the distinctive character of rural villages is a high priority;
- Rural towns will not play a role in meeting regional or district-scale demand for residential growth; and
- Further rural residential development is generally not supported.

According to the Plan, urban development is not consistent with the values of the Metropolitan Rural Area, and will be considered only in specific urban investigation areas. No urban investigation areas are identified in the Central City District. Action 74 of the Central City District Plan is "*Limit urban development to within the Urban Area"*.

The Plan does note that limited growth of rural residential development could be considered where there are no adverse impacts on the amenity of the local area and where the development provides incentives to maintain and enhance the environmental, social and economic values of the Metropolitan Rural Area.

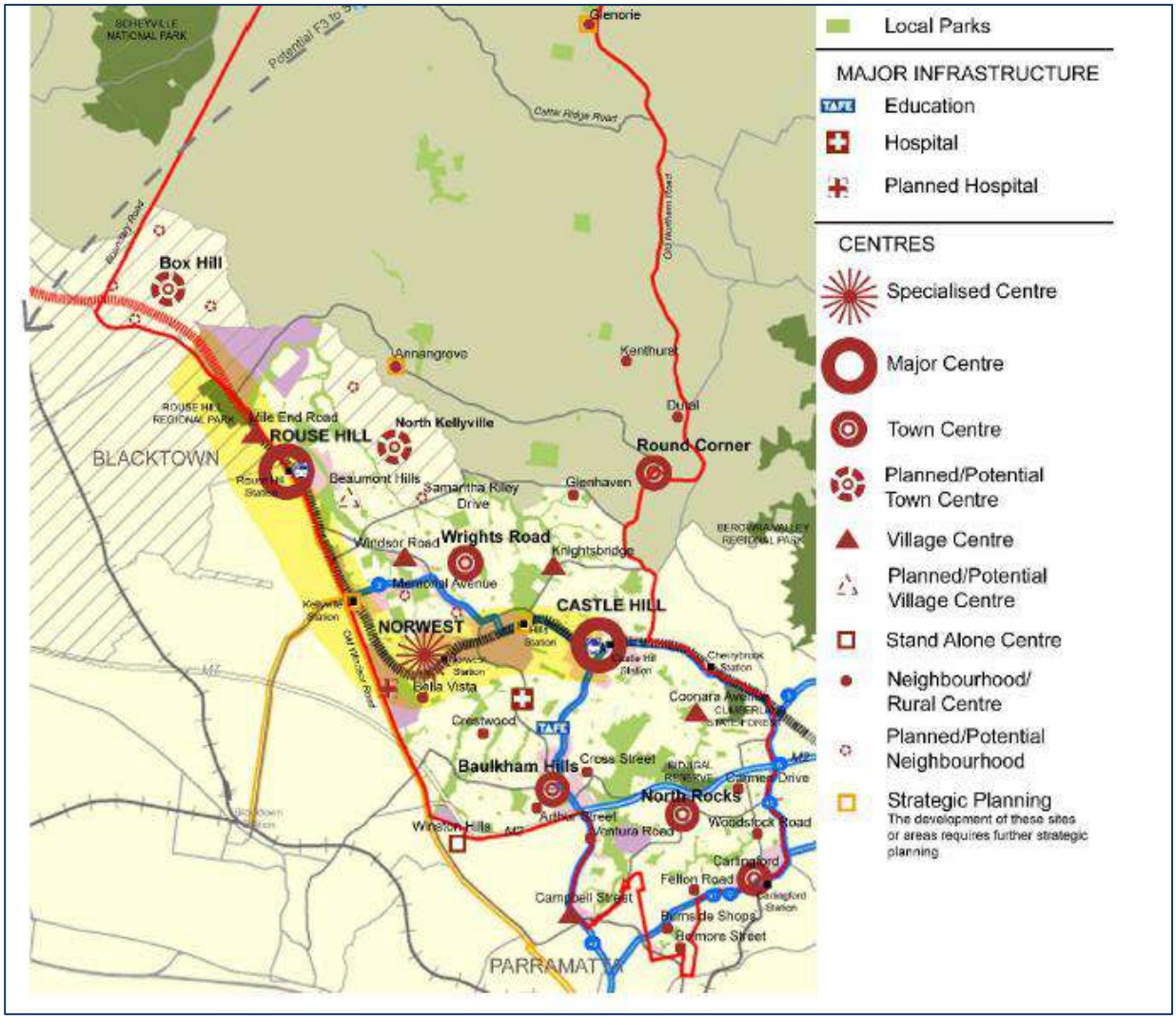


Figure 3-1 Excerpt from Baulkham Hills Shire Structure Plan (Source: Local Strategy – New Direction for Baulkham Hills Shire, 2010)

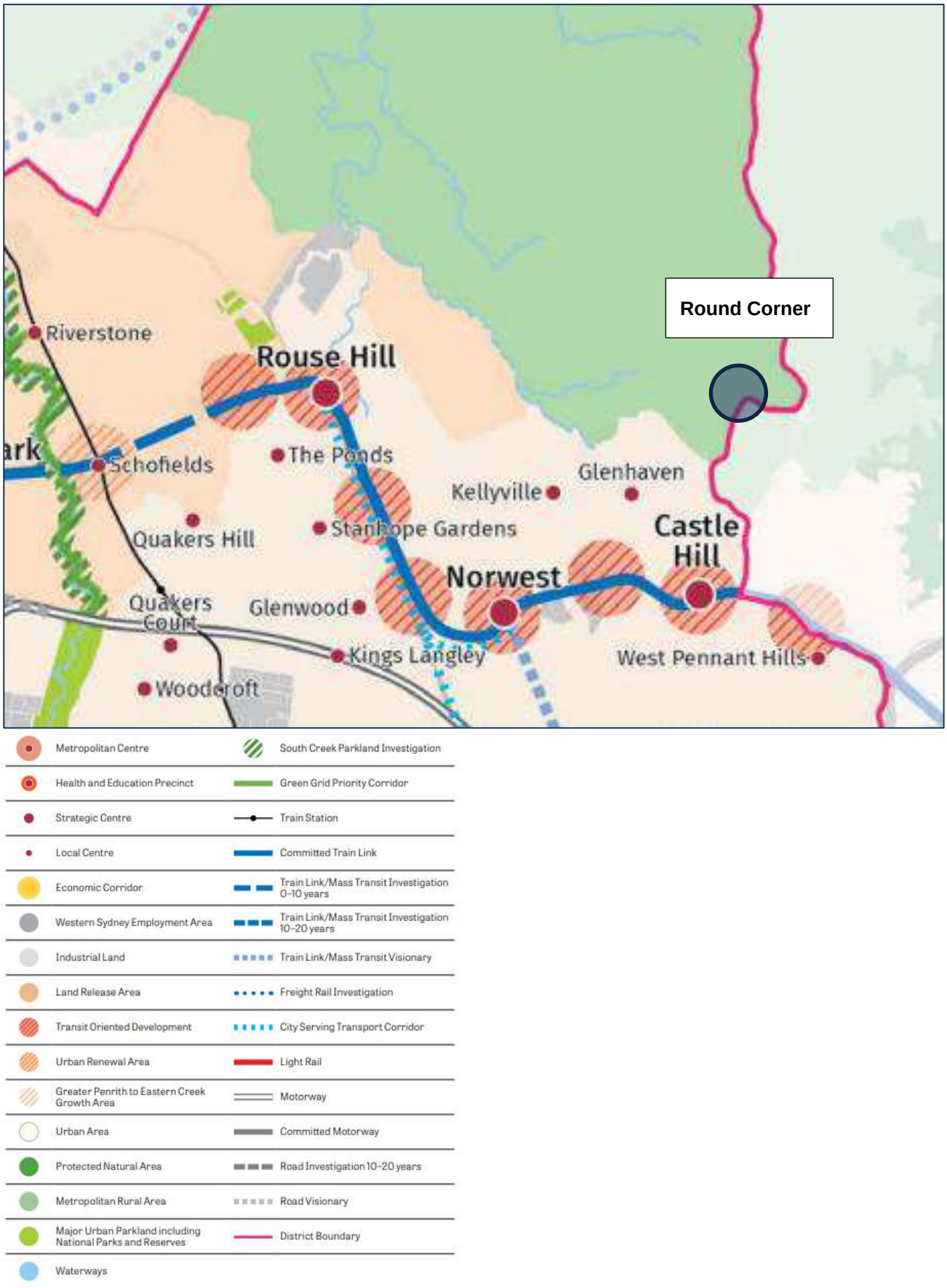


Figure 3-2 Excerpt of Central City District Plan – Structure Plan

At a higher level, the broad elements incorporated in the Strategies can be synthesised into the following principles that are of direct relevance to this Study:

- Balance urban growth – contain urban development to the areas identified in the Structure Plans;
- Protect rural lands and encourage their economic viability;
- Accommodate population growth – provide quality housing and housing choice;
- Provide for economic growth – encourage sustainable growth and provide employment opportunities;
- Ensure adequate service infrastructure;
- Ensure adequate social infrastructure;
- Provide a sustainable living environment;
- Protect water quality, biodiversity and scenic quality;
- Protect natural and cultural heritage;
- Plan for natural hazards;
- Manage and protect the Shire's natural waterways;
- Encourage the delivery of an integrated transport system; and
- Plan for the renewal of existing centres, including rural service centres.

Decisions regarding urban development capability and structure planning in the Investigation Areas should be made with reference to these adopted planning principles.

3.1.2 Local Strategy

The Local Strategy (Baulkham Hills Shire, 2010) provides a long-term framework for planning and management of land use in the Shire for the next twenty-five years (to 2031).

The Local Strategy identifies the following Key Directions which reflect the community outcomes articulated in The Hills 2026 Strategic Community Direction:

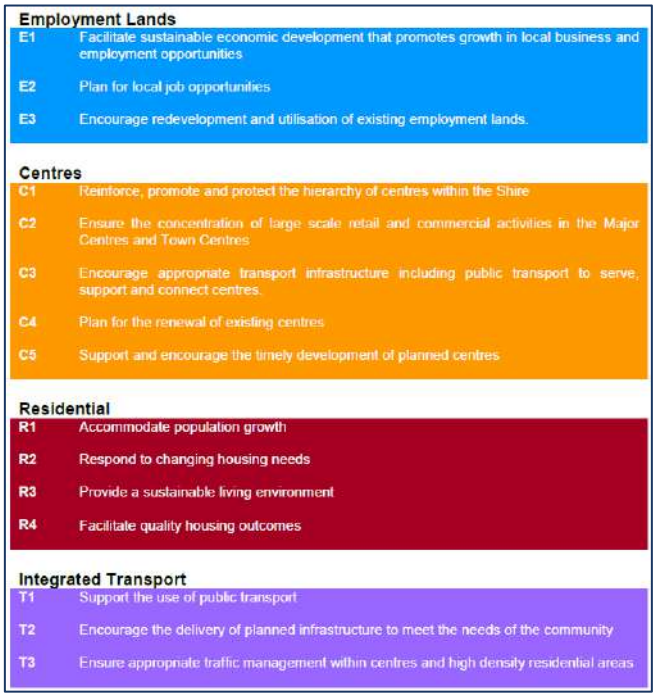


Figure 3-3 Local Strategy Key Directions (Source: Local Strategy – New Direction for Baulkham Hills Shire, 2010)

Each of these key directions has its own sub report. Those with relevance to this project are summarised in the following sections.

2.2.2.1 Environment and Leisure Direction

The *Environment and Leisure Direction* (Baulkham Hills Shire, 2008) is a supporting document to the Local Strategy. It identifies the following key directions and objectives for the desired approach for planning, protection and management of The Hills Shire's environment:

- Protect and manage the Shire's environment and leisure spaces;
- Provide high quality spaces for community recreation and enjoyment;
- Improve the accessibility and connectivity of environment and leisure spaces;
- Provide for public domain spaces that encourage community interaction;
- Conserve the Shire's unique diversity of plants and animals; and
- Protect Aboriginal cultural heritage.

2.2.2.2 Residential Direction

The *Residential Direction* (Baulkham Hills Shire, 2008) is a supporting document to the Local Strategy. It reflects The Hills Shire's approach to the planning, protection and management of residential development. The four key directions are:

- Accommodate population growth;
- Respond to changing housing needs;
- Provide a sustainable living environment – this includes ensuring the protection of cultural heritage as residential growth happens; and
- Facilitate quality housing outcomes.

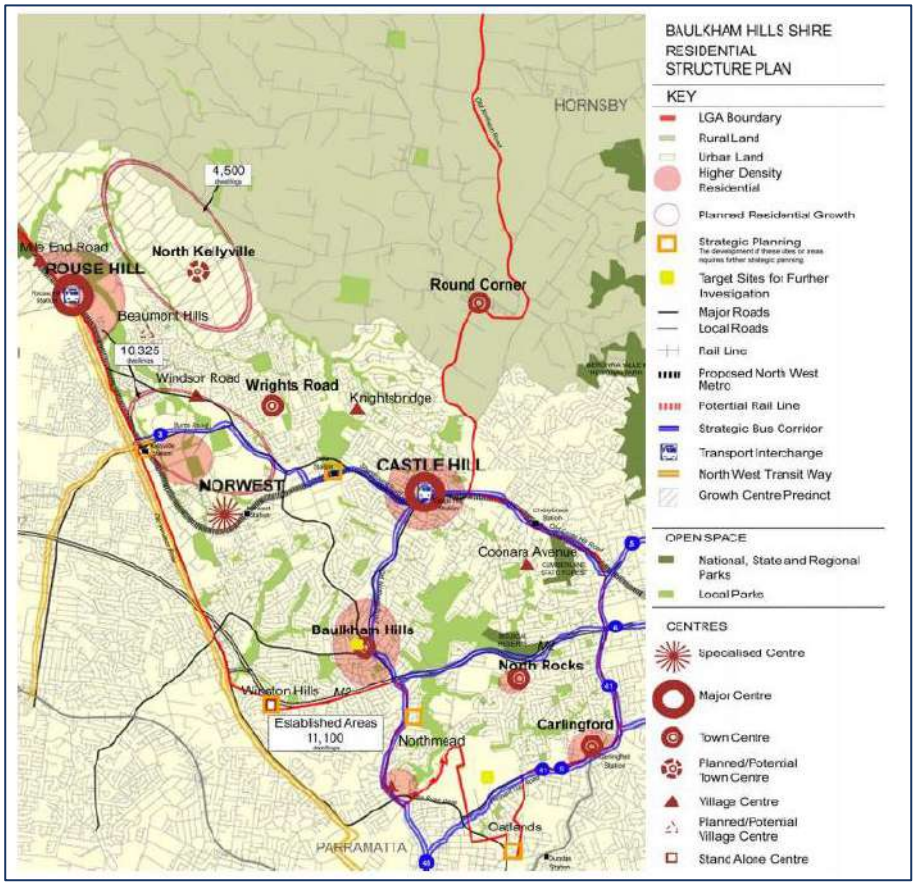


Figure 3-4 Residential Structure Plan (Excerpt Hills Residential Discussion Paper, 2008)

2.2.2.3 Waterways Direction

The *Waterways Direction* (Baulkham Hills Shire, 2008) is a supporting document to the Local Strategy. It aims to provide direction for the long term planning, protection and management of The Hills Shire's waterways. The report sets out the following directions to meet the existing and future needs of the population:

- Manage and plan for floodplain risk and floodplain use;
- Effective stormwater system planning;
- Effectively manage the stormwater system; and
- Manage the Shire's natural waterways – this includes the objective of incorporating heritage into the management of the waterway.

2.2.3 Rural Land Strategy

Adopted in August 2003, the *Rural Lands Strategy* identifies a growth management philosophy which aims to encourage and promote a diverse range of agricultural activities in rural areas and to limit urban expansion/ release areas. The Rural Lands Study identified constraints and strategic priorities for the Shire, along with the following key directions:

- Provide for coordinated and effective growth in the Shire's rural lands;
- Develop a land use framework that will give a level of certainty to the people who live in the rural areas of the Shire;
- Ensure that residents have adequate access to appropriate services and facilities;
- To provide for economic development opportunities that are in keeping with the rural character of the Shire;
- Provide an adequate level of infrastructure for the people who live and work in rural parts of the Shire;
- To ensure that the quality of surrounding waterways is not adversely affected by development;
- Ensure that the ecological integrity of the rural lands are enhanced and maintained;
- Ensure that development has a minimal impact on the scenic and cultural landscape of the Shire;
- To preserve the rural heritage and culture of the Shire; and
- Recognise the impact of natural hazards on future land use and settlement.

The Rural Lands Strategy was used to inform the drafting of the rural zones for The Hills Local Environmental Plan 2012 and for a review of development controls for rural zoned land in the Baulkham Hills DCP.

2.2.4 Independent review of Rural Land Study

Prior to the Rural Lands Strategy being adopted by Council, Connell Wagner undertook an independent review of the Rural Lands Strategy in 2005. The following actions were recommended:

- Immediately investigate all potential village expansions and hold any rezoning around these villages until this work is complete;
- Investigate the potential for smaller transitional lots (i.e. less than two hectares) around villages to support villages, subject to being supplied with water and sewerage services;
- Assess the willingness of landholders to forward-fund the provision of infrastructure especially water and sewerage services;
- Consider rezoning of lands at Maraylya, Nelson and Kenthurst for two hectare subdivision subject to further land capability assessments being undertaken;
- Develop a staging plan for any future land releases if further rezonings are proposed;
- Investigate further differentiation of land use designations into small and large holding areas (agricultural and rural living) zones, and environmental protection zones, to support any rezoning proposals;

- Investigate the future long term development of the former Maroota State Forest and consider an area-specific local environmental plan for the area. In the meantime, defer the area from any future local environmental plan until a clearer understanding of the constraints and opportunities are understood; and
- Review the boundaries of the Local Environmental Plan's 7(a) Environmental Protection zone and consider refinements where necessary. If required, adopt additional environmental protection zones or overlay zones to reflect varying environmental constraints.

As part of this review, stakeholder engagement was conducted with the former NSW Fisheries, which identified that a 50-metre wide riparian zone should be retained next to waterways.

2.2.5 State of the Environment Report

The Hills Shire's State of the Environment Report 2012-2017, 2009-2010, 2008-2009 and 2007-2008 have been reviewed to identify the community's desired outcomes for the environment and to obtain information on the condition of the environment in the local area . The State of the Environment Report 2012-2017 identified a series of community outcomes that are aligned with the objectives of the Environment and Leisure Direction for the Planning, Protection and Management of the Shire's Green Spaces (Baulkham Hills Shire, 2008) identified in Section 1.2 of the report.

- '*Our Shire is green and pollution free'* – Facilitate the reduction of pollution produced from Council and the community and monitor and maintain the natural qualities of the waterways networks.
- *'I can feel close to nature'* – Manage the rehabilitation of local bushland and protect local flora and fauna. Facilitate the protection and enhancement of the Shire's biodiversity and community contribution to environmental protection and facilitate environmental sustainable development practices.
- '*Our natural resources are used wisely'* – Provide services and infrastructure that facilitate resource recovery and the reduction of commercial and residential waste, and build the capacity of the community to adopt affordable sustainable waste management behaviours.

3.2 Planning Controls

A variety of planning controls and guidelines are relevant to proposals for development in the Investigation Areas. These include State Environmental Planning Policies (SEPP's), Regional Environmental Plans (REP's) and the Local Environmental Plan (LEP). Below this, the principal guideline planning document that applies is *The Hills Development Control Plan, 2012.*

3.2.1 The Hills Local Environmental Plan, 2102 (Hills LEP)

The Hills LEP is the overarching Planning Instrument that directs urban planning within the Shire. Much of the critical planning principles in the Hills Local Strategy and the Rural Lands Strategy have been incorporated into the Hills LEP, including:

- Controls around subdivision and dwelling houses which are aimed at minimising unplanned residential development in rural zones, including RU6-Transition lands (Cls.4.2 & 4.2a).
- Controls to manage biodiversity and heritage.
- Controls to manage hazards including bushfire, acid sulphate soils, landslip and flooding risk.

Land within the Investigation Areas is zoned under the LEP as indicated in **Figure 3-5**.

The majority of the land under investigation is zoned RU6 Transition under The Hills LEP 2012. This land is largely rural or natural in character and the zone objectives reflect its rural functions:

- *"To protect and maintain land that provides a transition between rural and other land uses of varying intensities or environmental sensitivities.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*
- *To encourage innovative and sustainable tourist development, sustainable agriculture and the provision of farm produce directly to the public."*

Any intensification of development potential within the RU6 Transition zone would require either a change to the zone or amendments to the controls under the zone.

Figure 3-5 Zoning Plan (excerpt from The Hills Local Environmental Plan, 2012)

4 Environmental Constraints and Opportunities

Cardno has undertaken a review of Council's existing information and undertaken desktop and database searches to establish baseline constraints within the Investigation Areas. For the purpose of the environmental desktop searches, the High Level Investigation Area was used to identify environmental constraints, however results within the near vicinity of this area were also documented. This allowed a wider contextual understanding and will further inform the environmental capability of land within the detailed study area.

4.1 Biodiversity

A review of database searches and The Hills Shire's reports and data was undertaken to provide background information for biodiversity within The Hills Shire and Hornsby Council areas. These include the:

- NSW Office of Environment and Heritage (OEH) BioNet Wildlife Atlas (for species listed under the *Biodiversity Conservation Act 2016 (*BC Act));
- NSW OEH Areas of Outstanding Biodiversity register;
- Commonwealth's EPBC Act Protected Matters Search Tool (PMST) for species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- NSW OEH Bio Banking public register;
- NSW Department of Primary Industries (DPI) – Fisheries Data Portal;
- NSW DPI Threatened Species Database;
- NSW DPI register of Critical Habitat;
- NSW DPI Key Fish Habitat maps;
- The Hills Shire vegetation mapping (GIS) (2018) and
- The Hills Shire State of the Environment Report 2012-2017.

The greater High Level Investigation Area is not subject to Biodiversity Certification under the Biodiversity Conservation (BC) Act. Thus, all impacts to biodiversity within the Detailed Investigation Area would require assessment under the BC Act.

Assessing biodiversity under the BC Act for development or clearing of vegetation/habitat would require consideration of the application of the Biodiversity Offset Scheme (BOS). The BOS is applied through the Biodiversity Assessment Method (BAM) by an accredited assessor. The BOS applies to:

- Local development (assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) that is likely to significantly affect threatened species (as determined by the test of significance in section 7.3 of the BC Act) or triggers the BOS thresholds which includes:
    - The amount of native vegetation being cleared exceeds a threshold area set out in **Table 4-1**; or
    - Whether the impacts occur on an area mapped on the Biodiversity Values map (**Figure 4-1**); or
    - Impacts on any listed threatened entity are considered to be significant (apply the test of significance as per Part 7.3 of the BC Act).
- State significant development/infrastructure (SSD/SSI) unless the Secretary of the Department of Planning and Environment and the Chief Executive of the OEH determine the project is not likely to have a significant impact;
- Biodiversity Certification proposals;
- Clearing of native vegetation in urban areas and zones for environmental conservation that exceeds the BOS thresholds and does not require development consent;
- Clearing of native vegetation that requires approval by the Native Vegetation Panel under the *Local Land Services Act 2016*; and

- Activities assessed and determined under Part 5 of the EP&A Act if the proponent chose to 'opt in'.

Table 4-1 Area thresholds where the BOS applies (source: NSW OEH, 2018)

Minimum lot size associated with the property	Threshold for clearing, above which the BAM and offsets scheme apply
Less than 1 ha	0.25 ha or more
1 ha to less than 40 ha	0.5 ha or more
40 ha to less than 1000 ha	1 ha or more
1000 ha or more	2 ha or more

Proposals in the Detailed Investigation Area have potential to trigger the BOS through the first requirement listed above. The clearing threshold (noted as item 1a above) or "significant impact" (item 1c above) cannot be determined at this stage of planning and would be determined during more detailed investigations. However, development or clearing within areas that coincide within the Biodiversity Values map within the Detailed Investigation Area would require assessment under the BOS. The application of the BOS is determined during the development application stage based on the above requirements and hence has not been applied to land capability at this time.

The State of Environment Report 2012-2017 (The Hills Shire Council, 2017) identified 81 known threatened entities (total of threatened fauna, flora, ecological communities and populations) in The Hills Shire. Further details of the threatened entities are outlined in the following sections:

- Threatened vegetation communities are discussed in **Section 4.1.3**;
- Threatened flora is discussed in **Section 4.2.4**; and
- Threatened fauna is discussed in **Section 4.1.9**.

In addition to the above, additional biodiversity aspects were considered as part of this assessment. This included:

- Stewardship, Bio Banking and Conservation Agreements (see **Section 4.1.2**);
- Wildlife Corridors (see **Section 4.1.5**);
- Threatened Aquatic Biodiversity and Key Fish Habitat (see **Section 4.1.11**); and
- Matters of National Environmental Significance (see **Section 4.1.13**).

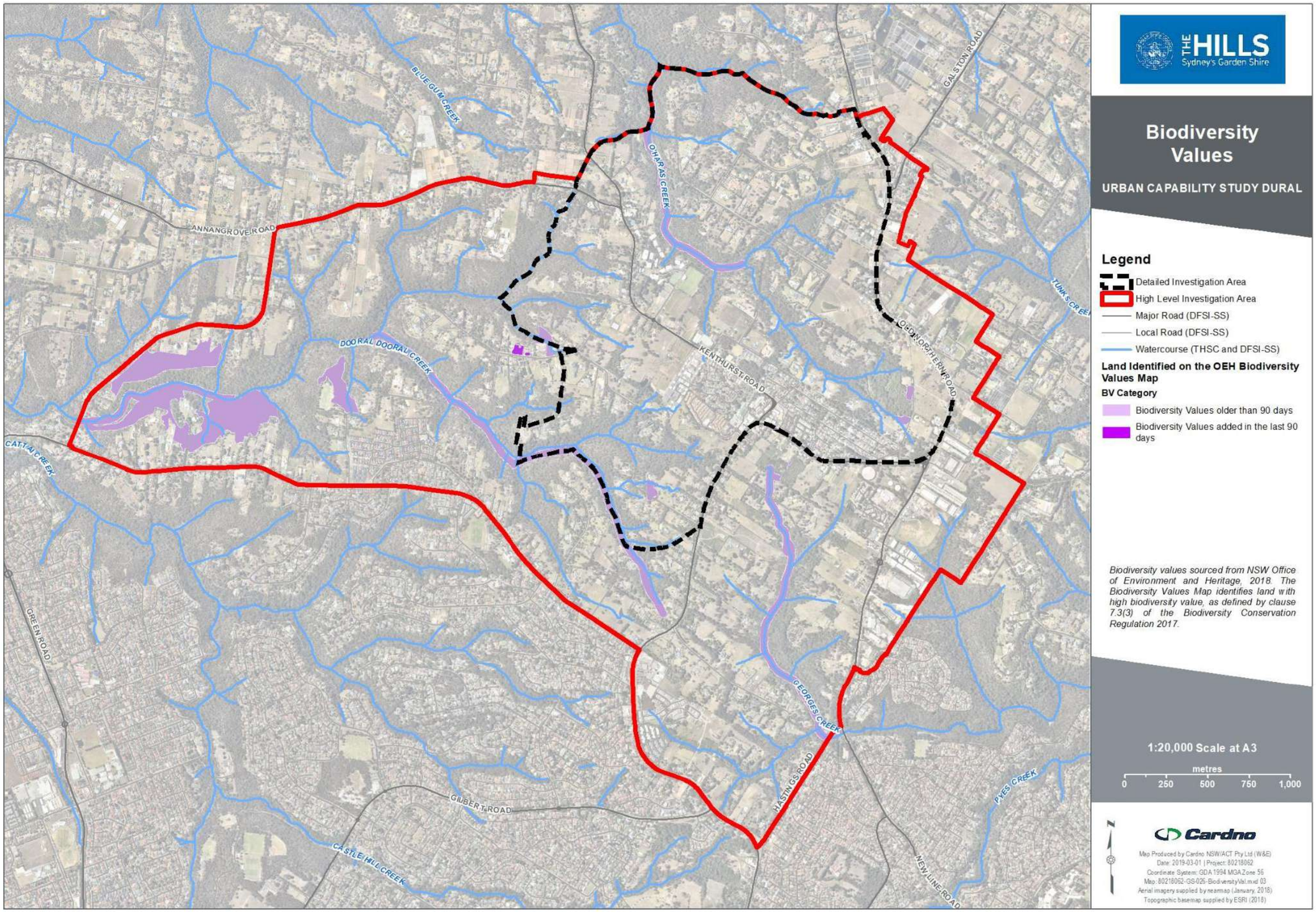


Figure 4-1 Biodiversity Values (OEH, 2017)

4.1.2 Stewardship/Bio Banking and Conservation Agreements

Land for Stewardship/Bio Banking and conservation agreements are identified as offsets in agreement with the Minister for the Environment where vegetation and/or habitat are removed elsewhere and are undertaken under both mandatory and voluntary schemes. Bio Banking agreements under the repealed *Threatened Species Conservation Act 1995* (TSC Act) are now managed as stewardship agreements by the NSW Biodiversity Conservation Trust (BCT) as part of the BOS under the BC Act. Offset areas under the repealed TSC Act were those which matched the biodiversity credit profiles of the areas which required offsetting. Stewardship sites (i.e. offset areas) under the current BC Act may have been created as a credit obligation under the like-for-like rules for the variation rules. As population demands urbanisation into greenfield sites, areas for suitable offsetting will become increasingly difficult to locate. In determining the value of the existing areas, two components should be considered:

- The ability and potential cost to offset high-value vegetation in the event the area is cleared for development; and
- The ecological and economic value of the existing vegetation has in the investigation area in providing suitable offsets for endemic Sydney vegetation.

These two components require detailed vegetation/habitat surveys in accordance with the Biodiversity Assessment Methodology (NSW OEH, 2017) to determine ecological and economic values. As detailed vegetation/habitat surveys were not completed as part of this stage of planning, existing vegetation mapping was used to support a preliminary determination of the ecological values of the Detailed Investigation Area (see **Section 4.1.3**).

A review of existing information was undertaken to determine the presence of any existing stewardship/Bio Banking or conservation agreements. The State of the Environment Report 2012-2017 identified that within The Hills LGA, there are 242.02 hectares of land conserved through private formal conservation agreements. The bio banking register identified that The Hills Shire has five stewardship agreements (Agreements 37, 38, 39, 148 and 454 between 2011 and 2017) of which four are within the Yengo Interim Biogeographic Regionalisation for Australia (IBRA) subregion and one within the Cumberland subregion. There are also five stewardship agreements in the Hornsby Council LGA (Agreements 142, 172, 299, 337 and 338 between 2014 and 2018) of which three are within the Cumberland subregion and two within the Pittwater subregion. The exact locations of these sites are confidential and not publicly available although the agreements are available from http://www.environment.nsw.gov.au/bimsprapp/SearchBiobankingAgreement.aspx?Start=1.

Council (managed by the NSW Government's CT) confirmed that no Stewardship / Bio Banking or Conservation Agreement sites occur within the High Level Investigation Area. As such there are no current implications to land capability as a direct result of existing Stewardship, Biobanking and Conservation Agreements.

4.1.3 Vegetation Communities

A search of the NSW OEH's BioNet Wildlife Atlas and Commonwealth's PMST conducted on 15 March 2018 identified 32 threatened ecological communities (TECs) as known, or are predicted to occur within 10 km of the High Level Investigation Area (refer to **Table 4-2**).

Table 4-2 Threatened Communities (source: NSW BioNet Wildlife Atlas & EPBC Protected Matters Search Tool, 2018)

Community Name	Legal Status (BC Act)	Legal Status (EPBC Act)	Identified to occur within The Hills Shire based on State of the Environment 2017
Blue Gum High Forest	CE	CE	Yes
Blue Mountains Shale Cap Forest	E	CE	No
Castlereagh Scribbly Gum and Agnes Banks Woodlands	CE	E	No
Central Hunter Grey Box-Ironbark Woodland	E	CE	No
Central Hunter Ironbark-Spotted Gum-Grey Box Forest	E	CE	No
Coastal Upland Swamps	E	E	No

Cooks River/Castlereagh Ironbark Forest	E	CE	No
Cumberland Plain Woodlands	CE	CE	Yes
Duffys Forest Ecological Community	E	-	No
Eastern Suburbs Banksia Scrub	E	E	No
Elderslie Banksia Scrub Forest	CE	-	No
Freshwater Wetlands on Coastal Floodplains	E	-	Yes
Hunter Lowland Redgum Forest	E	-	No
Hunter Valley Footslopes Slaty Gum Woodland	V	CE	No
Hunter Valley Weeping Myall Woodland	CE	CE	No
Littoral Rainforest	E	CE	No
Lower Hunter Valley Dry Rainforest	V	-	No
Lowland Rainforest	E	CE	No
Montane Peatlands and Swamps	E	E	No
Pittwater and Wagstaffe Spotted Gum Forest	E	-	No
River-Flat Eucalypt Forest	E	-	Yes
Shale Gravel Transition Forest	E	CE	No
Shale Sandstone Transition Forest	CE	CE	Yes
Southern Sydney sheltered forest on transitional sandstone soils	E	-	No
Subtropical and Temperate Coastal Saltmarsh	E	V	No
Swamp Oak Floodplain Forest	E	-	Yes
Swamp Sclerophyll Forest on Coastal Floodplains	E	-	Yes
Sydney Freshwater Wetlands	E	-	No
Turpentine-Ironbark Forest	E	CE	Yes
Themeda grassland on seacliffs and coastal headlands	E	-	No
Warkworth Sands Woodland	E	CE	No
Western Sydney Dry Rainforest and Moist Woodland on Shale	E	CE	Yes

Note: CE – Critically Endangered, E – Endangered, V-Vulnerable

These results were compared to the native vegetation communities listed in The Hills Shire's State of the Environment 2012-2017 report and GIS vegetation mapping (provided by Council (2018)). It should be noted that at the time of writing, OEH were in the process of updating the mapping for this area as part of the State Vegetation Type Mapping initiative. As The Hills Shire Council have revised their 2008 vegetation mapping in 2018, this information was used to undertake the following ecology assessment.

The GIS vegetation mapping of the High Level Investigation Area (excluding the area covered by Hornsby Council LGA) identified the potential presence of oneThreatened Ecological Community i.e. Shale Sandstone Transition Forest (see **0**), which is listed as critically endangered under the BC Act and EPBC Act.

All of these TECs are listed as critically endangered under the BC Act and EPBC Act and require vegetation to meet specific listing criteria.These can only be investigated during detailed vegetation surveys, which typically occur during the development application stage. Thus, vegetation mapping by Council (2018) and

OEH (2014) have been used to provide a preliminary guide to the location and extent of these Threatened Ecological Communities.

Both Blue Gum High Forest and Sydney Turpentine Ironbark Forest were identified within the Detailed Investigation Area in The Hills Shire Council (2018) mapping but was not present in the NSW OEH (2014) mapping. For the purpose of this report, the OEH mapping has been used as it is the most recent mapping. Therefore, there may still be uncertainty over final classification that can only be confirmed through detailed vegetation surveys.

4.1.4 Implications for Land Capability

Areas of Threatened Ecological Communities are considered to have high ecological value. Development and clearing within these areas and/or areas of native vegetation (not considered Threatened Ecological Communities) have potential to trigger application of the BOS (see above). It is recommended that areas of Threatened Ecological Community and native vegetation are given a land capability Category B. This does not preclude the land from development but acknowledges potential constraints associated with the level of legislative protection.

Riparian corridors may provide an opportunity for establishing stewardship/offsets for vegetation removed in other parts of the detailed study area. This would depend on the condition of vegetation and the ability to meet the necessary criteria.

4.1.5 Wildlife Corridors

There are wildlife corridors at a broader regional scale (e.g. between Marramarra, Scheyville, Berowra Valley and Lane Cove National Parks). The majority of connectivity in the wider region is maintained along the riparian corridors, which are considered high value areas based on the presence of native vegetation and TECs (**Section 4.1.3**). However, some parks and vegetation lots within the High Level Investigation Area also form wildlife corridors and wildlife “stepping stones” at a local scale. These are mapped **Figure 4.2** and include:

- Ellerman Park along Kenthurst Road, and the area between Franlee Road and Old Northern Road, which connects the riparian corridors of O’Haras Creek to Georges Creek;
- Vegetation between Kenthurst Road and Yuruga Road, which connects the riparian corridors of the tributaries of Dooral Creek and O’Haras Creek; and
- Vegetation between Wayfield Road and Old Northern Road, which connects the riparian corridors of Dooral Creek and Georges Creek.

4.1.6 Implications for land capability

Connectivity along these sections may provide critical habitat for mobile fauna (e.g. birds, mammals and reptiles) and are considered to provide moderate to high ecological value assuming the habitat conditions are suitable for fauna.

In their own merits it is recommended wildlife corridors are Category A. However, given they also coincide with native vegetation, they should fall into Category B (see **Section 4.1.3**).

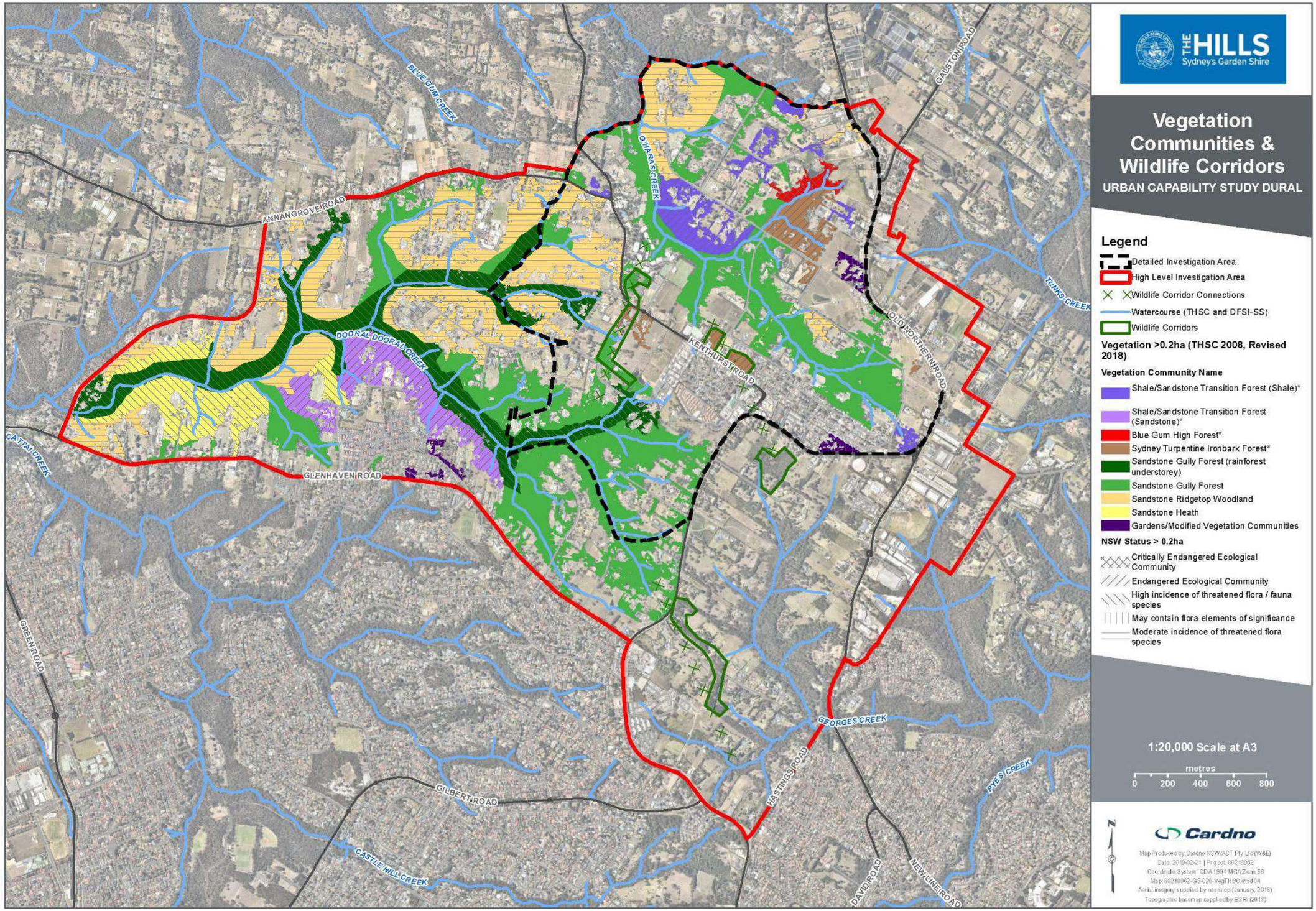


Figure 4-2 Vegetation Communities (THSC, 2018)

4.1.7 Threatened Flora

A search of the NSW OEH's BioNet Wildlife Atlas and Commonwealth's PMST conducted on 15 March 2018 identified 37 threatened flora species in **Table 4-3** as occurring or predicted to occur within 10 km of the High Level Investigation Area. The results were also compared to the flora listed in The Hills Shire's State of the Environment 2012-2017 Report.

Table 4-3 Threatened Flora Species (source: NSW BioNet Wildlife Atlas and EPBC Protected Matters Search Tool, 2018)

Scientific Name	Common Name/s	Legal Status (BC Act)	Legal Status (EPBC Act)	Identified within The Hills Report*
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	E	V	Yes
Acacia gordonii	-	E	E	Yes
Acacia pubescens	Downy Wattle, Hairy Stemmed Wattle	V	V	Yes
Allocasuarina glareicola	-	E	E	No
Asterolasia elegans	-	E	E	Yes
Caladenia tessellata	Thick-lipped Spider-orchid, Daddy Long-legs	E	V	No
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	No
Cynanchum elegans	White-flowered Wax Plant	E	E	No
Darwinia biflora	-	V	V	Yes
Epacris purpurascens var. purpurascens	-	V	-	No
Eucalyptus camfieldii	Camfield's Stringybark	V	V	No
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	No
Eucalyptus scoparia	Wallangarra White Gum	E	V	No
Eucalyptus sp. Cattai	-	CE	CE	Yes
Genoplesium baueri	Yellow Gnat-orchid, Bauer's Midge Orchid	E	E	No
Grevillea shiressii	-	V	V	No
Haloragis exalata subsp. exalata	Wingless Raspwort, Square Raspwort	V	V	No
Haloragodendron lucasii	Hal	E	E	No
Hibbertia spanantha	Julian's Hibbertia	E	CE	No
Hibbertia superans	-	E	-	Yes
Lasiopetalum joyceae	-	V	V	No
Leucopogon fletcheri subsp. fletcheri	-	E	-	No
Leptospermum deanei	Deane's Tea-tree	V	V	No

Melaleuca biconvexa	Biconvex Paperbark	V	V	No
Melaleuca deanei	Deane's Melaleuca	V	V	Yes
Olearia cordata	-	V	V	Yes
Pelargonium sp. Striatellum	Omeo Stork's-bill	E	E	No
Persoonia hirsuta	Hairy Geebung, Hairy Persoonia	E	E	Yes
Persoonia mollis subsp. maxima	-	E	E	Yes
Pimelea curviflora var. curviflora	-	V	V	Yes
Pimelea spicata	Spiked Rice-flower	E	E	No
Pomaderris brunnea	Brown Pomaderris	E	V	No
Pterostylis gibbosa	Illawarra Greenhood, Rufa Greenhood	E	E	No
Pterostylis saxicola	Sydney Plains Greenhood	E	E	No
Pultenaea parviflora	-	E	V	No
Syzygium paniculatum	Magenta Lilly Pilly	E	E	No
Tetratheca glandulosa	-	V	-	No

Note: CE – Critically Endangered, E – Endangered, V-Vulnerable
**State of the Environment 2012-2017 report*

Although there is potential for the majority of these threatened flora species and/or their associated habitat to occur within the Detailed Investigation Area, two species have been identified to have a restricted distribution. These are:

- *Eucalyptus sp.* Cattai, which is listed as critically endangered under the BC Act and EPBC Act; and
- *Hibbertia superans*, which is listed as endangered under the BC Act.

Eucalyptus sp. Cattai occurs between Colo Heights and Castle Hill. It is generally found in shrub, heath and low woodland on sandy soils at locations that are flat and on ridgetops. Potential habitat for this species include the ridgeline to the west of the Dural town centre (refer to the landscape view map **0)**.

Hibbertia superans occurs between Baulkham Hills and South Maroota. This species occurs in open woodland and heathland and prefers disturbed areas. With the exception of the dense riparian corridors (as mapped in **Figure 4-7**) and the Dural town centre to the south-east of the Detailed Investigation Area, all other areas form potential habitat for this species.

Further detailed investigations into the potential occurrence of all threatened flora in **Table 4.3** would be required during the development application stage.

4.1.8 Implications for Land Capability

Given these species have limited distributions, require offsetting and are listed under the BC Act, it is recommended that a Category B be applied to their potential habitats (as identified above). Consideration can also be given to applying Category A to *Hibbertia superans* habitat*,* as unlike *Eucalyptus* sp, it does not trigger requirements under the EPBC Act.

4.1.9 Threatened Fauna

A search of the NSW OEH's BioNet Wildlife Atlas and Commonwealth's PMST was conducted on 15 March 2018. It identified 73 threatened fauna species in **Table 4-4** as occurring or predicted to occur within 10 km of the High Level Investigation Area. The results were also compared to the fauna listed in The Hills Shire's State of the Environment 2012-2017 Report.

Table 4-4 Threatened Fauna Species (NSW Bionet Wildlife Atlas and EPBC Protected Matters Search Tool, 2018)

Scientific Name	Common Name/s	Legal Status (BC Act)	Legal Status (EPBC Act)	Identified within The Hills Report
Anthochaera phrygia	Regent Honeyeater	E	CE	Yes
Artamus cyanopterus	Dusky Woodswallow	V	-	No
Botaurus poiciloptilus	Australasian Bittern	E	E	Yes
Calidris ferruginea	Curlew Sandpiper	E	CE	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Yes
Callocephalon fimbriatum	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	E	-	Yes
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Yes
Caretta caretta	Loggerhead Turtle	E	E	No
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	V	V	No
Chelonia mydas	Green Turtle	V	V	No
Daphoenositta chrysoptera	Varied Sittella	V		Yes
Dasyornis brachypterus	Eastern Bristlebird	E	E	No
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Yes
Dermochelys coriacea	Leatherback Turtle	E	E	No
Diomedea antipodensis	Antipodean Albatross	V	V	No
Diomedea antipodensis gibsoni	Gibson's Albatross	V	V	No
Diomedea epomophora	Southern Royal Albatross	-	V	No
Diomedea exulans	Wandering Albatross	E	E	No
Diomedea sanfordi	Northern Royal Albatross	-	E	No
Epinephelus daemelii	Black Rockcod, Black Cod	V (FM Act)	V	No
Eretmochelys imbricata	Hawksbill Turtle	-	V	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Yes
Glossopsitta pusilla	Little Lorikeet	V	-	Yes
Grantiella picta	Painted Honeyeater	V	V	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	C	Yes
Hieraaetus morphnoides	Little Eagle	V	-	Yes
Heleioporus australiacus	Giant Burrowing Frog	V	V	Yes

Hoplocephalus bungaroides	Broad-headed Snake	E	V	No
Isoodon obesulus	Southern Brown Bandicoot (eastern)	E	E	No
Ixobrychus flavicollis	Black Bittern	V	-	Yes
Lathamus discolor	Swift Parrot	E	CE	Yes
Litoria aurea	Green and Golden Bell Frog	E	V	No
Litoria littlejohni	Littlejohn's Tree Frog	V	V	No
Lophoictinia isura	Square-tailed Kite	V	-	Yes
Macronectes giganteus	Southern Giant-Petrel	E	E	No
Macronectes halli	Northern Giant Petrel	V	V	No
Macquaria australasica	Macquarie Perch	E (FM Act)	E	No
Melithreptus gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Yes
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	No
Miniopterus australis	Little Bentwing bat	V	-	No
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Yes
Mixophyes balbus	Stuttering Frog	E	V	No
Mormopterus norfolkensis	Eastern Freetail Bat	V	-	Yes
Myotis macropus	Large-footed Myotis	V	-	Yes
Natator depressus	Flatback Turtle	-	V	No
Ninox connivens	Barking Owl	V	-	Yes
Numenius madagascariensis	Eastern Curlew	-	CE	No
Pachyptila turtur subantarctica	Fairy Prion (southern)	-	V	No
Petauroides volans	Greater Glider	-	V	No
Petaurus australis	Yellow-bellied Glider	V	-	Yes
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	No
Petroica boodang	Scarlet Robin	V	-	Yes
Petroica phoenicea	Flame Robin	V	-	No
Petroica rodinogaster	Pink Robin	V	-	Yes
Phascolarctos cinereus	Koala	V	V	Yes
Polytelis swainsonii	Superb Parrot	V	V	Yes
Pommerhelix duralensis	Dural Woodland Snail	E	E	Yes
Prototroctes maraena	Australian Grayling	-	V	No

Pseudophryne australis	Red-crowned Toadlet	V	-	Yes
Pseudomys novaehollandiae	New Holland Mouse, Pookila	-	V	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Yes
Rostratula australis	Australian Painted Snipe	E	E	No
Saccolaimus flaviventris	Yellow-bellied Sheathtail bat	V	-	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Yes
Stagonopleura guttata	Diamond Firetail	V	-	Yes
Thalassarche bulleri	Buller's Albatross	-	V	No
Thalassarche cauta	Shy Albatross	V	V	No
Thalassarche cauta steadi	White-capped Albatross	-	V	No
Thalassarche eremita	Chatham Albatross	-	E	No
Thalassarche impavida	Campbell Albatross	-	V	No
Thalassarche melanophris	Black-browed Albatross	V	V	No
Thalassarche salvini	Salvin's Albatross	-	V	No
Tyto novaehollandiae	Masked Owl	V	-	Yes
Tyto tenebricosa	Sooty Owl	V	-	Yes

Note: CE – Critically Endangered, E – Endangered, V – Vulnerable, FM – Fisheries Management Act
**State of the Environment 2012-2017 report*

Although there is potential for the majority of these threatened fauna species and/or their associated habitat to occur within the Detailed Investigation Area, one species has been identified by Council to have a restricted distribution. The Yellow-bellied Glider occurs in mature eucalypt forests and has potential to inhabit all forested areas within the study area including the riparian corridors. This is an isolated population in the area and warrants special consideration. Key threats to this species include:

- Loss and fragmentation of habitat;
- Loss of hollow bearing trees; and
- Loss of feed trees.

Further detailed investigations into the potential occurrence of all threatened fauna in **Table 4-4** would be required during the development of the precinct planning stage. The outcomes of this planning would be implemented during the development application process. Development and clearing in potential habitat for the above species would require targeted surveys.

4.1.10 Implications for Land Capability

The presence of hollow bearing trees and feed trees will contribute to the occurrence of the species and hence the value to the potential habitat for the species. Given the large area, and the level and detail of surveying required, this information would usually be determined during the planning approval process for a development. Consideration for protecting riparian corridors in general due to cumulative impacts is discussed further in **Section 4.10** and may provide a level of compromise.

As stated previously, riparian corridors may provide an opportunity for establishing stewardship/offsets for vegetation removed in other parts of the detailed study area. This would depend on the condition of vegetation and the ability to meet the necessary criteria.

4.1.11 Threatened Aquatic Biodiversity and Key Fish Habitat

Dooral Creek and O'Haras Creek were identified as Key Fish Habitat based on NSW DPI mapping. Dooral Creek was classed as a fair freshwater fish community stream (DPI's Fisheries data portal), however no threatened freshwater species mapping occurred.

No critical habitats were listed on DPI's Critical Habitat Register (15 March 2018). This register identifies any potential critical habitat listed under the *Fisheries Management Act* (FM Act).

There is no potential for estuarine threatened species (Black Cod and Macquarie Perch) to occur within the creeks as identified in **Table 4-4**.

There is potential for listed threatened species Adam's Emerald and Sydney Hawk Dragonflies (DPI Threatened Species Database) to occur within the creeks in the Investigation Area based on distribution mapping.

Key Fish Habitat would require detailed habitat surveys to categorise these habitats and consultation with NSW DPI would be required for any instream works within the Detailed Investigation Area if development was to occur in these areas. All waterways and waterbodies within the Detailed Investigation Area are assumed to be suitable habitat for Adam's Emerald and Sydney Hark Dragonflies. Targeted threatened species surveys for Adam's Emerald and Sydney Hawk Dragonflies during the development application stages would be required.

4.1.12 Implications for Land Capability

Waterways within the detailed investigation area are considered Category B as they are sensitive receiving environments and form potential habitat for species listed under the FM Act. Fish passage is required to be maintained in Dooral Creek and O'Haras Creek.

4.1.13 Serious and Irreversible Impacts

Under Part 6.5 of the BC Act, the determination of serious and irreversible impacts on biodiversity values for the purposes of the biodiversity offsets scheme is to be made in accordance with principles prescribed by the Biodiversity Conservation Regulation 2017. Part 6.7 of the Biodiversity Conservation Regulation 2017 sets out the criteria for serious and irreversible impacts. An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because:

1. It will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
2. It will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
3. It is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
4. The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.

Part 7.3(d) of the Biodiversity Conservation Regulation 2017 states that lands which in the opinion of the Environment Agency Head contains any threatened species or threatened ecological communities that are identified in a list of potential serious and irreversible impacts on biodiversity values may be including on the Biodiversity Values Map and Threshold Tool. A list of potential serious and irreversible impact entities has been published by OEH in conjunction with the document, Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact. Other listed threatened entities may be determined to constitute a serious and irreversible impact entity at the discretion of the decision maker, if the entity is considered to meet one the criteria listed above.

Appendix 2 and Appendix 3 of the *Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact* provides lists of potential serious and irreversible impact species and threatened ecological community entities, respectively.

The following threatened ecological communities known to be present within the High Level Investigation Area are listed in Appendix 3 of the Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact:

- Blue Gum High Forest;

- Cumberland Plain Woodland;
- Shale Sandstone Transition Forest;
- Turpentine-Ironbark Forest; and
- Western Sydney Dry Rainforest and Moist Woodland on Shale.

With reference to **Table 4-3** and **Table 4-4** above, the following threatened species known to be present within the High Level Investigation Area are listed in Appendix 2 of the Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact:

- Flora:
    - *Asterolasia elegans*; and
    - *Eucalyptus sp. Cattai.*
- Fauna:
    - Regent Honeyeater;
    - Swift Parrot; and
    - Sooty Owl.

Determination of a serious and irreversible impact on any listed potential serious and irreversible impact candidate entity or other entity is determined by the thresholds listed in the OEH Threatened Biodiversity Data Collection database. For threatened ecological communities this is a condition threshold (determined through assessment as part of the Biodiversity Assessment Method for an individual development) known as the vegetation integrity score. For threatened flora entities, the threshold is typically the known geographical extent of known populations of the species. For threatened fauna entities, the threshold is typically the presence of restricted critical habitat (breeding caves etc.) known or considered likely to be used by the relevant species (to be determined through survey). For some threatened fauna the threshold can also be mapped areas for which any development or action removing habitat for the species within the mapped area would constitute a serious and irreversible impact on that species. This mapping is held by OEH and would need to be requested as part of the site assessment.

Where no such threshold is listed, the decision maker is required to determine if the projected impacts of the individual development would constitute a serious and irreversible impact on the relevant entity, based on information provided in the assessment and the Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact document.

4.1.14 Implications for Land Capability

Under a Part 4 development a consent authority is required to refuse development consent if a serious and irreversible impact is identified in the assessment for the individual development. Under the Part 5 and State Environmental Planning Policy (Infrastructure) 2007 pathways the consent authority is required to consider additional mitigation measures to reduce the impact on any identified serious and irreversible impact.

4.1.15 Matters of National Environmental Significance

A search of the Protected Matters Search Tool showed thirty migratory species are known or are predicted to occur within 10 km of the greater High Level Investigation Area. No Commonwealth marine areas or wetlands of international importance occur within 10 km of the High Level Investigation Area. A number of threatened species and ecological communities are also known or predicted to occur within 10 km of the High Level Investigation Area. These are discussed in previous **Sections 4.1.3** to **3.1.9**.

Important habitat for migratory species, which are mostly birds, can encompass most of the vegetation areas and the waterways and riparian corridors of the Detailed Investigation Area. Habitat surveys would be required to define these areas during the development application stage.

4.1.16 Implications for Land Capability

Results showed the whole detailed investigation study area would trigger a Matters of National Environmental Significance assessment under the EPBC Act, however Category A classification could be applied as these species only occur periodically in the detailed investigation study area. Impacts from development can be avoided through mitigation measures and habitat within the detailed investigation study area is not exclusive to the area.

4.2 Bushfire Management

Landform has a significant influence on fire behaviour. Fires can move swiftly along the ridges and valleys making control difficult since most roads and all major land clearing (which is associated with the development pattern) run parallel to the direction of the spread of the fires (Baulkham Hills Rural Strategy 2003).

The Hills Shire Council's Bushfire Prone Land Map was certified by the Rural Fire Service in June 2018. The Investigation Area includes bushfire prone land, which is particularly associated with the significant tracts of vegetation in the riparian zones that surround the riparian corridors. The following bushfire risk categories apply to land in the Investigation Area:

- Vegetation Category 1 – Highest bushfire risk;
- Vegetation Category 3 – Medium bushfire risk;
- Vegetation Category 2 – Lower bushfire risk; and
- Vegetation Buffer.

It should be noted the Guideline to Bushfire Prone Area Land Map (NSW Rural Fire Service, 2015) excludes vegetation from mapped as bush fire prone if it is 'managed grassland', agricultural lands, saline wetlands, a single area of vegetation less than 1 hectare in area and 100m separation from other vegetation categories, strips of vegetation less than 20 m in width and not within 20 m of other vegetation categories and multiple areas of vegetation less than 0.25 ha in an area and not within 30 m of each other.

4.2.1 Implications for Land Capability

Environmental hazards such as Bushfire Hazard are generally not considered to be absolute constraints on the capability of land for development at the strategic planning level.

Bushfire risk is required to be considered at the strategic planning stage, where Section 9.1 Direction 4.4 requires Councils to seek the concurrence of the Rural Fire Service Commissioner where planning proposals are inconsistent with this direction.

Clause 5.11 of The Hills LEP 2012 provides that:

Bush fire hazard reduction work authorised by the Rural Fires Act 1997 may be carried out on any land without development consent.

The rationale for this is that bushfire hazard should be assessed on merit and managed through the development approval process in accordance with the Rural Fires Act and relevant Rural Fire Service guidelines for development on bushfire prone land. Measures for management of bushfire hazard can range from using fire resistant building materials and practices, separating built development from the hazard via appropriately considered Asset Protection Zones and management of the bushland that is creating the hazard. Any or all of these measures may be applied to render Bushfire Prone Land suitable for residential development.

On the basis of the above discussion, our conclusion is that bushfire hazard is, of itself, not an impediment to the capability of land to support development. Consequently, for the purposes of this Study, bushfire hazard has been allocated a low rating as a matter for consideration in determining land capability at the strategic planning level.

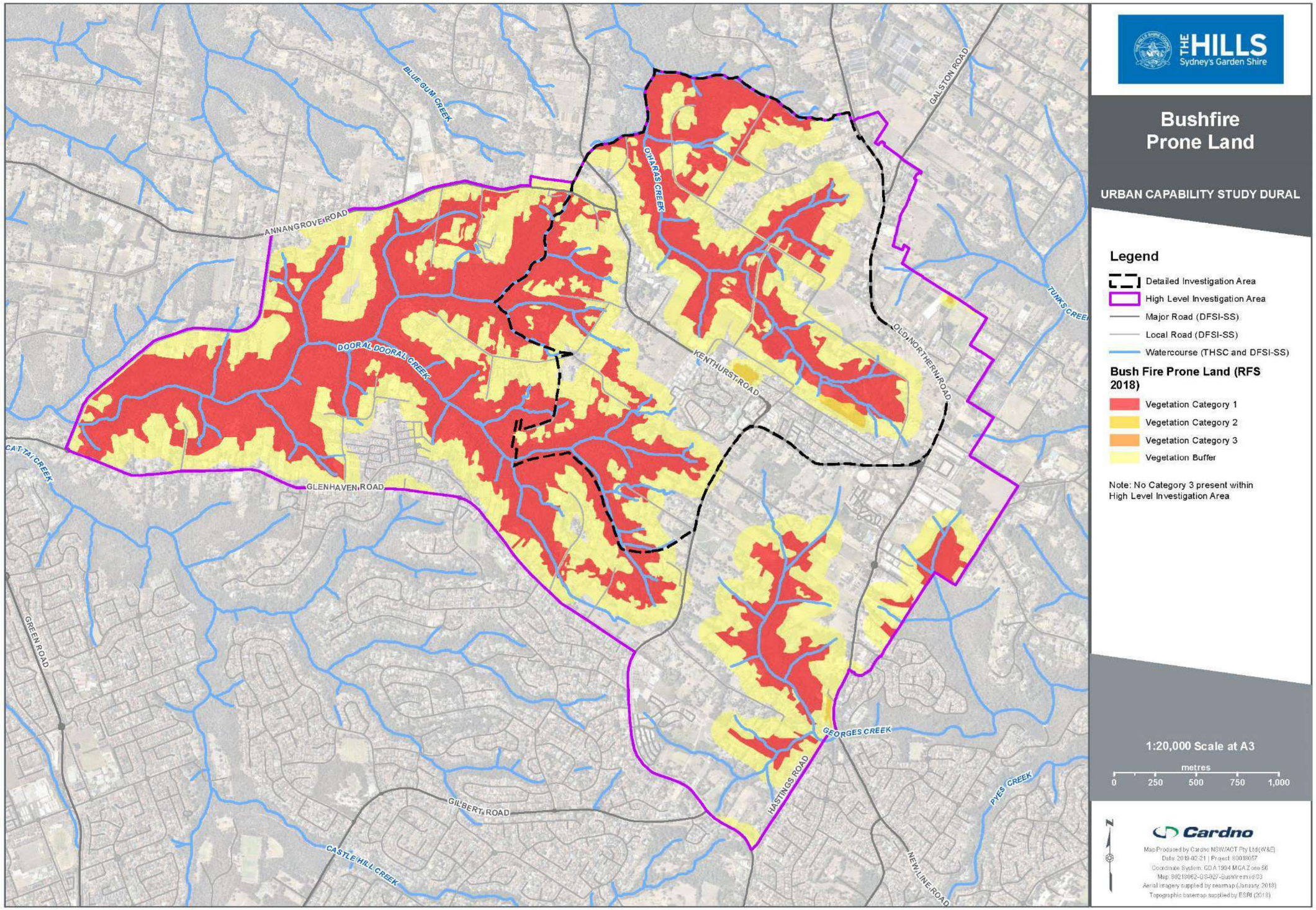


Figure 4-3 Bushfire Constraints mapping

4.3 Heritage

The following background searches were undertaken on 14 May 2018 to identify known Aboriginal and non-Aboriginal heritage. These searches included:

- Commonwealth's Australian Heritage Database;
- Office of Environment and Heritage's State Heritage Inventory;
- Hornsby Local Environment Plan 2013;
- The Hills Local Environment Plan 2012;
- Native Title Register; and
- Office of Environment and Heritage's Aboriginal Heritage Information Management System (AHIMS).

4.3.1 Australian Heritage

The Australian Heritage Database search identified any items of heritage significance that may occur in or in close proximity to the High Level Investigation Area. The Australian Heritage Database contains listings for the World Heritage List, Commonwealth Heritage List and the Register of the National Estate (non-statutory archive). The Register of the National Estate was closed in 2007 and is no longer a statutory list, however it is maintained on a non-statutory basis as a publicly available resource. Non-Aboriginal Australian heritage items in the vicinity of the High Level Investigation Area are shown in **Table 4-5**.

Table 4-5 Non-Aboriginal Australian heritage items in the vicinity of the High Level Investigation Area

Item	Location	Listing
St Judes Anglican Church	965 Old Northern Road, Dural	Registered - Register of the National Estate (Non-statutory archive)
The Pines – House, Outbuildings and Pine Trees	656 Old Northern Road, Dural	Registered - Register of the National Estate (Non-statutory archive)
Glenroy	756 Old Northern Road, Middle Dural (north of high level investigation area)	Rejected Place - Register of the National Estate (Non-statutory archive)

4.3.2 State and Local Heritage

The State Heritage Inventory contains listings for the State Heritage Register, Local Government listings and the Section 170 NSW State Agency Heritage Register.

The State Heritage Inventory and Local Environment Plans for Hornsby and The Hills identified items of heritage significance that occur in or in close proximity to the High Level Investigation Area.

There were no items listed in the vicinity under the NSW Heritage Act for Dural, Kenthurst, Castle Hill and Glenhaven. Local Non-Aboriginal heritage items in the vicinity of the High Level Investigation Area are shown in **Table 4.6** and **Figure 4-4**.

Table 4-6 Non-Aboriginal local heritage items in the vicinity of the High Level Investigation Area

Item	Location	Listing
Old Northern Road (A12)	Old Northern Road between Dural and Wisemans Ferry, Dural and Glenorie	The Hills LEP 2012
Former St Madeleine Sophie Borat Catholic Church (I113)	114A Kenthurst Road, Kenthurst	The Hills LEP 2012
"The Pines" (I87)	656A Old Northern Road, Dural	The Hills LEP 2012
Uniting Church Cemetery (I81)	14 Derriwong Road, Dural	The Hills LEP 2012
Dural Soldiers Memorial Hall (I86)	604 Old Northern Road, Dural	The Hills LEP 2012
House (I85)	600A Old Northern Road, Dural	The Hills LEP 2012
Allens House (I84)	548 Old Northern Road, Dural	The Hills LEP 2012
House (I83)	54–56 Kenthurst Road, Dural	The Hills LEP 2012

Hill Top (I82)	31 Kenthurst Road, Dural	The Hills LEP 2012
House (I112)	70 Kenthurst Road, Kenthurst	The Hills LEP 2012
House (I105)	35–37 Annangrove Road, Kenthurst	The Hills LEP 2012
House (I106)	44 Annangrove Road, Kenthurst	The Hills LEP 2012
Emmanuel Anglican Church (I89)	31A Glenhaven Road, Dural	The Hills LEP 2012
Rosenfels (I88)	23 Glenhaven Road	The Hills LEP 2012
House (I90)	428 Old Northern Road, Dural	The Hills LEP 2012
Street trees and bushland (343)	New Line Road, Dural – Road Reserve (between Pyes Creek and Old Northern Road)	Hornsby LEP 2013
Original alignment of New Line Road (Elouera estate) (344)	New Line Road, Lockyer Close, Dural	Hornsby LEP 2013
House (347)	208 New Line Road, Dural	Hornsby LEP 2013
“Terranova” (346)	260–266 New Line Road, Dural	Hornsby LEP 2013
Roadside trees (448)	Old Northern Road, Glenhaven – Road Reserve (east of Round Corner shops to reservoirs)	Hornsby LEP 2013
‘The Croft’ (342)	11 Harris Road, Dural	Hornsby LEP 2013
House (348)	857 Old Northern Road, Dural	Hornsby LEP 2013
House (349)	873 Old Northern Road, Dural	Hornsby LEP 2013
House, former Uniting Church and chapel (351)	925–935 and 937 Old Northern Road, Dural	Hornsby LEP 2013
St Jude’s Anglican Church and grounds (352)	951–965 Old Northern Road	Hornsby LEP 2013
Swanes Nursery (341)	490–498 Galston Road	Hornsby LEP 2013
House (337)	431 Galston Road	Hornsby LEP 2013
Garden (339)	452 Galston Road	Hornsby LEP 2013
Cemetery (A38)	885–887 Old Northern Road	Hornsby LEP 2013
St Jude’s Anglican Church and grounds (A39)	951–965 Old Northern Road	Hornsby LEP 2013

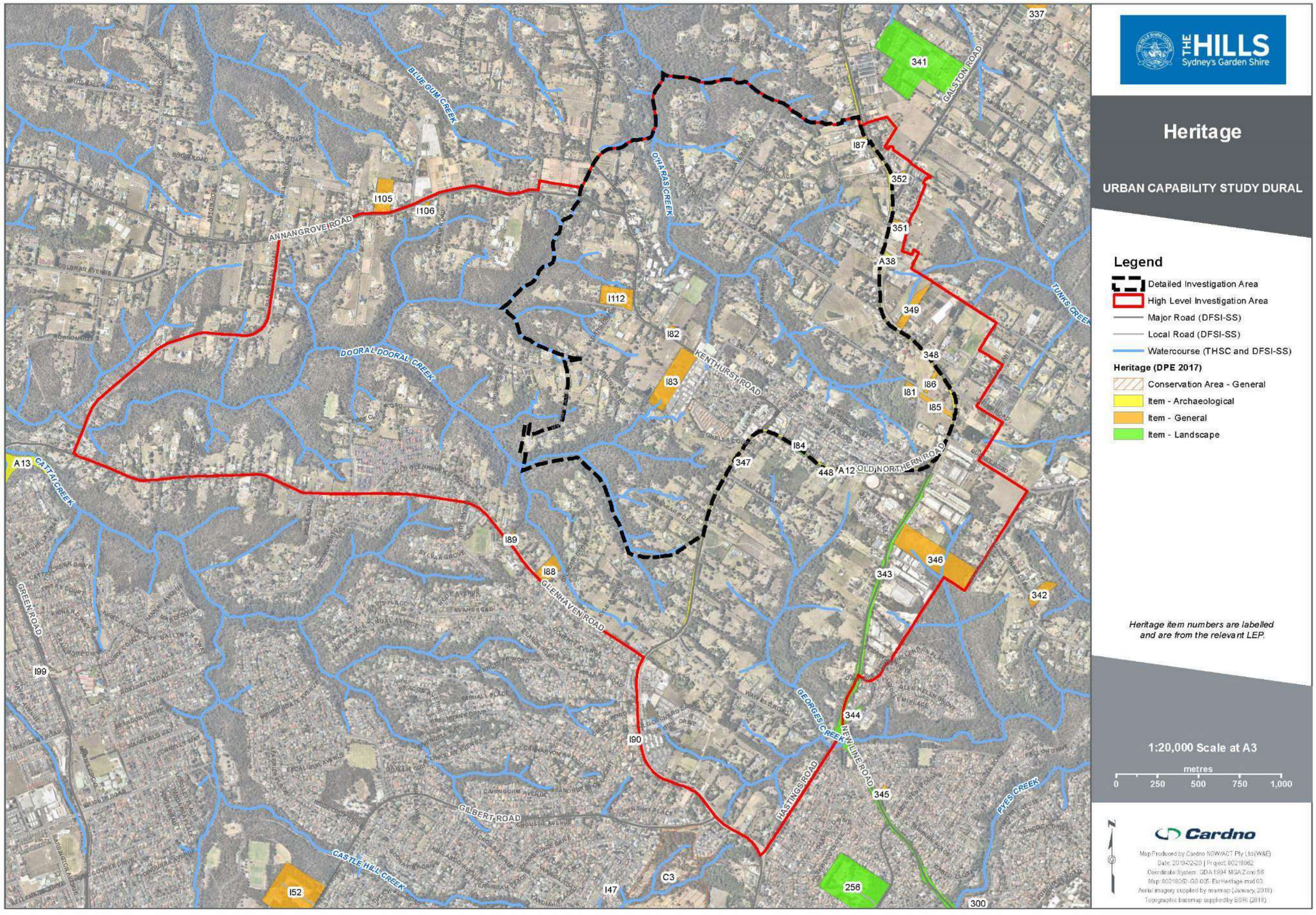


Figure 4-4 Non-Aboriginal Heritage

4.3.3 Native Title Tribunal

A search of the Native Title Register and Claims identified no current claims or existing native titles within The Hills and Hornsby local government areas. There was one non-claimant (native title which does not exist) for an area adjacent to Dural Park near Murrell Place, Dural.

4.3.4 AHIMS

A search of the Aboriginal Heritage Information Management System (AHIMS) was conducted for the High Level Investigation Area, with a 1 kilometre buffer. The search identified 57 Aboriginal sites and no Aboriginal places. It should be noted that the AHIMS database reflects Aboriginal sites that have been officially recorded and included on the list. Large areas of NSW have not been subject to systematic, archaeological survey; hence AHIMS listings may reflect previous survey patterns and should not be considered a complete list of Aboriginal sites within a given area. AHIMS sites were not identified within the Detailed Investigation Area. Refer to Appendix A for AHIMS sites within or in close proximity to the High Level Investigation Area.

4.3.5 Implications for land capability

Heritage values are protected across all land zones by the Hills LEP 2012 and the Hills Development Control Plan 2012. These controls apply regardless of the form or intensity of any proposed development and they would be applied as merit based assessments during future stages of the planning process. Therefore, the protection of heritage should not have bearing on decisions regarding the capability of the lands in the Investigation Areas, although the protection of heritage items may impact on future development patterns.

4.4 Flooding, Creeks and Watercourses

Within the framework of Commonwealth and State legislation and standards, Council has the responsibility to manage the natural water assets within their jurisdiction. While Sydney Water manages the metropolitan water supply and some of the stormwater trunk drainage network in the LGA, Council manages water functions in relation to waterways and water bodies, riparian land, floodplains and sustainable stormwater management, treatment and re-use.

Waterway and water bodies can include natural creeks and rivers, rehabilitated channels, constructed wetlands, man-made stormwater systems and detention basins, as well as open water bodies and wetlands. Waterways are an integral part of the rural and urban environment by the provision of ecosystem services and as a resource. Core activities for waterways management in the LGA include:

- Stormwater system planning;
- Stormwater system management;
- Natural waterways at the urban bushland interface and within rural lands; and
- Floodplain management.

As part of this study, background documentation and database searches were undertaken on 13 May 2018 to identify groundwater and flooding information. This research consisted of the following searches which have been summarised in the appropriate sections below:

- Flood controlled land buffer mapping (The Hills Shire Council);
- Overland Flowpath and Floodplain Mapping (The Hills Shire Council);
- DPI – Office of Water All Groundwater Register;
- Bureau of Meteorology's Groundwater Dependent Ecosystems Atlas;
- Commonwealth's Australian Flood Risk Information Portal; and
- Coastal Wetlands and Littoral Rainforest maps under the Coastal Management State Environmental Planning Policy (SEPP).

4.4.1 Waterways and Water Bodies

There are three named waterways within the High Level Investigation Area. These are:

1. Dooral Creek (flows west across the centre of the High Level Investigation Area);
2. O'Hara's Creek (flows north-west across the north-eastern portion of the High Level Investigation Area); and
3. Georges Creek (flows south-east across the south-eastern corner of the High Level Investigation Area)

These waterways are within the greater Hawkesbury River Catchment and the location and extent of these waterways are illustrated in **Figure 4-7**. All three waterways originate (i.e. headwaters) within the High Level Investigation Area and have a number of unnamed tributaries draining into the main channels. Both O'Hara's Creek and Dooral Creek are located within the Detailed Investigation Area (Detailed Investigation Area). Riparian vegetation along these waterways occurs in varying widths and is limited by infrastructure, developments and cleared areas. Their associated ecological values are discussed in **Section 4.1**.

NSW DPI Office of Water defines 'waterfront land' for the purposes of maintaining important environmental functions of waterways. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 m of the highest bank of the river, lake or estuary.

Riparian corridors (lie within waterfront land and form the transition zone between the terrestrial and aquatic environment. The riparian corridor performs important environmental functions including:

- Providing bed and bank stability and reducing bank and channel erosion;
- Protecting water quality by trapping sediment, nutrients and other contaminants;
- Providing diversity of habitat for terrestrial, riparian and aquatic plants (flora) and animals (fauna);
- Providing connectivity between wildlife habitats;
- Conveying flood flows and controlling the direction of flood flows;

- Providing an interface or buffer between developments and waterways; and/or
- Providing passive recreational uses.

NSW DPI Office of Water set guidelines for defining riparian corridors to provide guidance on controlled activity approval requirements for development applicants. The riparian corridor includes the channel and a vegetated riparian zone (VRZ) on both sides of the waterway (**Figure 4-5**). The width of the VRZ has been standardised for first, second, third and fourth and greater order streams (**Table 4-7**). The defined VRZ allows development applicants to identify constraints and opportunities by the use of the averaging rule and the RC matrix (**Table 4.7**).

The averaging rule allows non riparian corridor works and activities, such as asset protection zones, recreational areas, roads, development lots and infrastructure, to be authorised within the outer riparian corridor, so long as the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. It requires the equivalent area to be offset on the site and be connected to the riparian corridor as illustrated in **Figure 4-6**. Whilst this averaging rule applies to the outer riparian zone, the inner 50% of the riparian zone must be fully protected.

Bridges, cycleways, paths, stormwater outlets and other essential services do not need to be offset, but must comply with the requirements set out in the riparian corridor matrix and other relevant Office of Water controlled activities guidelines. Offline detention basins do not need to be offset so long as there is an equivalent VRZ for the corresponding watercourse and they are built in compliance with the Office of Water's Controlled activities: Guidelines for watercourse crossings and Controlled activities: Guidelines for in-stream works. If a proposed basin will not have an equivalent VRZ for the corresponding watercourse, it may still be built in the outer 50 % of the VRZ but must be offset.

The averaging rule should generally be applied to cleared waterfront land. Development proposals involving waterfront lands that contain existing native vegetation should seek to preserve that riparian vegetation in accordance with the minimum riparian corridor requirements outlined in **Table 4-7**.

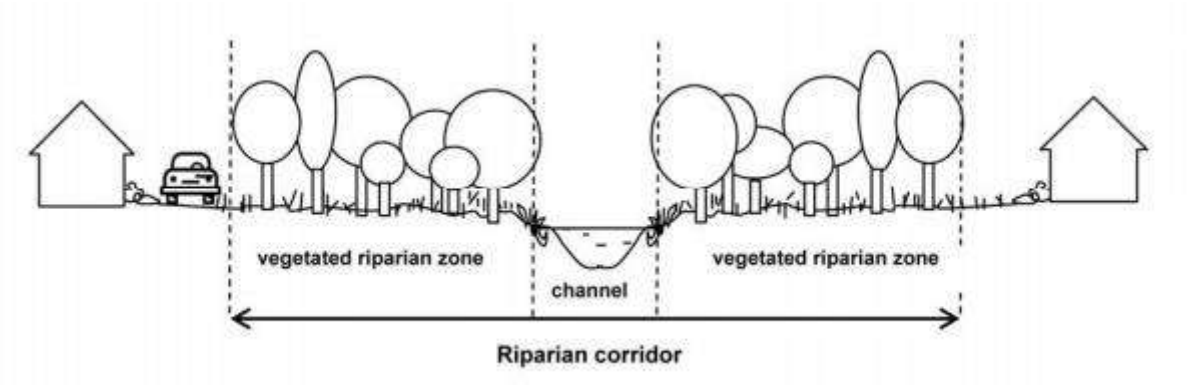


Figure 4-5 The RC and VRZ (source: NSW DPI Office of Water, 2012)

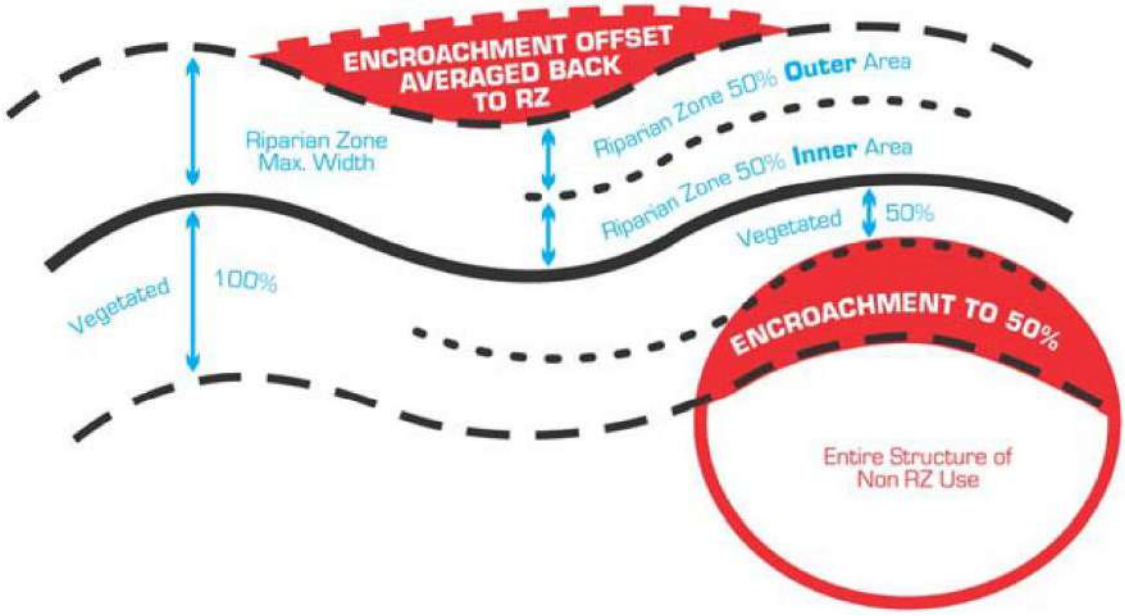


Figure 4-6 The averaging rule (source: NSW DPI Office of Water, 2012

The total riparian corridor width is based on the waterway stream order. Mapping of the riparian corridor for the waterways within the High Level Investigation Area and the Detailed Investigation Area was undertaken based on the stream order classification as per NSW DPI Office of Water guidelines. The riparian corridor includes the waterway channel at the top of bank (ToB) on both sides of a waterway. However, as ToB surveys have not been formally completed for this study, the mapping of riparian corridors, based on The Hills Shire waterway data, is from the waterway centreline, as illustrated in **Figure 4-7.**

Any future planning or development within the High Level Investigation Area or the Detailed Investigation Area would need to assess and consider the waterway channel width to the top of bank when defining the riparian corridor.

Table 4-7 Recommended VRZ and RC widths (source: NSW DPI Office of Water, 2012)

Watercourse type	**VRZ width** (each side of watercourse)	**Total RC width**
1st order	10 metres	20 m + channel width
2nd order	20 metres	40 m + channel width
3rd order	30 metres	60 m + channel width
4th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width

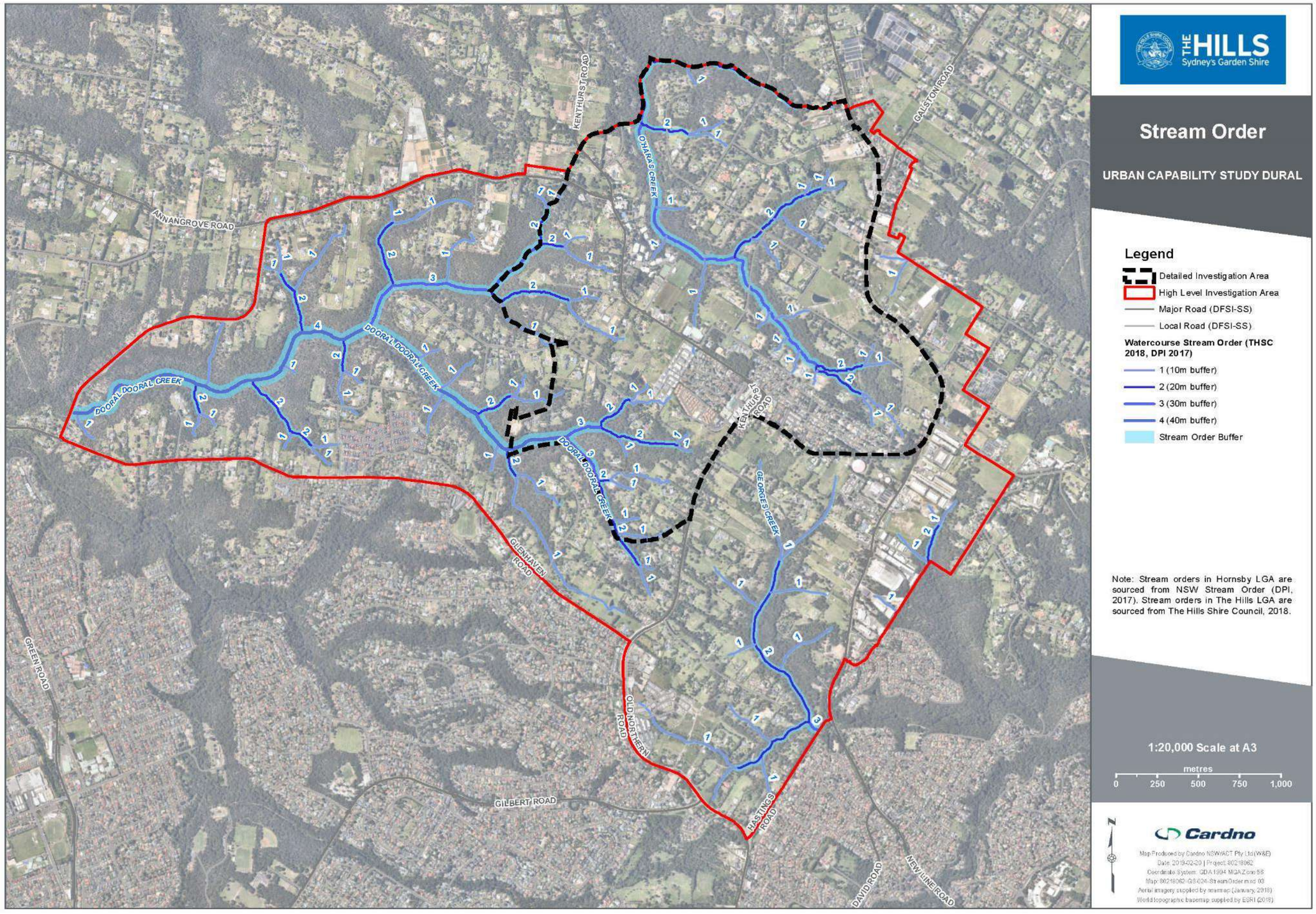


Figure 4-7 Watercourses and Stream Orders

4.4.1.2 Constraints and Opportunities

Under the *Water Management Act 2000* (WM Act), an approval is required to undertake controlled activities on waterfront land, unless the activity is otherwise exempt under Section 91E. Controlled activities include the carrying out of building work, the installation of infrastructure and excavation and deposition of materials. A public authority does not need to obtain a controlled activity approval for any controlled activities that it carries out in or under waterfront land. Furthermore, a controlled activity approval is not required if:

- The waterfront land relates to a river channel that is fully concrete-lined or is a fully enclosed pipe channel;
- The construction or use of fencing, a vehicular crossing or an access track on waterfront land does not impound water and relates to a minor stream in a rural zone;
- The activity is nothing more than removal of vegetation in circumstances that would otherwise be lawful;
- The controlled activity is to be undertaken:
    - In accordance with a WM Act water supply works approval;
    - In accordance with a WM Act harvestable rights order;
    - In accordance with Section 52 (domestic and stock rights) of the WM Act in certain circumstances;
    - In accordance with an approval under Part 2 of the former *Water Act 1912*;
    - By a network operator or pipeline licensee to construct, modify, repair, maintain, or complete emergency work on water or gas infrastructure or licensed pipelines;
    - During an emergency under the direction of a relevant act;
    - In accordance with any mining, crown lands or western lands lease, licence, permit; or
    - In accordance with any lease, licence, permit or other right in force in respect of land under the ownership or control of the maritime authority or a port corporation.

The riparian corridor matrix enables applicants to identify certain works and activities that can occur on waterfront land and in riparian corridors (**Table 4-8**). Applicants should note that the matrix relates to controlled activity approvals under the WM Act only. They are still required to comply with other relevant government legislation, such as threatened species, flood planning levels and fisheries guidelines.

Table 4.8 Riparian corridor matrix (source: NSW DPI Office of Water, 2012)

Stream order	Vegetated Riparian Zone (VRZ)	RC off-setting for non RC uses	Cycleways and paths	Detention basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1st	10m	•	•	•	•	•	•	•		
2nd	20m	•	•	•	•	•		•		
3rd	30m	•	•	•		•			•	•
4th +	40m	•	•	•		•			•	•

4.4.2 Implications for land capability

Existing vegetation and riparian areas provide the opportunity for enhanced passive recreation and amenity for residents and improvements in connectivity for pedestrians and cyclists. Natural watercourses and overland flow paths signal the need for caution to ensure that flood risk or the potential for flood damage is not exacerbated. Uplift in development in the Investigation Area would be likely to trigger a need for

upgrades and enlargements to the stormwater drainage system to ease impacts of overland flow on affected land.

Recommendations with respect to capability for development uplift within Riparian Corridors identified in accordance with the Office of Water recommendations are:

- The inner 50% of the VPZ should be excluded from consideration for uplift in development capability. There are obvious exceptions such as the provision of stormwater infrastructure etc. It is recommended that a 'no go' be applied to this portion of the riparian corridor.
- The outer 50% of the VPZ should not be excluded for uplift capability if that is the only constraint applicable to the area, unless this area is subject to a floodway at the 100-year flood event. Development within this land can be managed through the development approvals process on a merits basis, depending largely on the activity proposed and the ability to offset. The cumulative environmental consideration of riparian corridors is discussed further in **Section 4.10**.

4.4.3 Flooding

4.4.3.1 Flood Prone Land and Flood Prone Land Policy

"Flood Liable Land" or "Flood Prone Land" is defined as land susceptible to flooding up to the probable maximum flood – which is the largest flood likely to ever occur.

The NSW Government's Flood Prone Land Policy defines flood prone land "as a valuable resource that should not be sterilised by unnecessarily precluding its development" as rests the primary responsibility for the management of flood prone land with local councils. The main objective of the policy is to minimise the impact of flooding and flood liability and to reduce losses resulting from floods by utilising environmentally friendly approaches. Local councils are primarily responsible for the management of flood prone land. Councils rely on the State Government Floodplain Development Manual to guide their floodplain risk management across flood prone land.

4.4.3.2 Flood Controlled Land and Flood Control Buffer

"Flood Controlled Land" or a "Flood Control Lot" is a parcel of land where an existing flood related development control applies. These controls aim to ensure that development occurring on flood controlled land is safe and appropriate. The Hills Shire Council, as part of its Development Control Plan (Draft Part C Section 6 – Flood Controlled Land). has identified flood controlled land within the LGA. The plan only applies when a landowner wishes to develop land identified as a flood control lot. The section of the DCP is supported by a map that identifies flood controlled land parcels within The Hills Shire Council. Not all flood controlled land is susceptible to flooding or in other words not considered as "flood prone land".

"Flood Control Buffers" are corridors adopted based on a set of criteria which are successively used to identify land where a flood-related control applies in accordance with Council's Flood Controlled Land DCP. The Hills Shire's flood control buffer mapping is not based on flood modelling and does not identify a flood extent.

The following criteria were used to identify flood controlled land:

Within **urban areas**, where properties are affected by:

- An overland flowpath associated with (being adjacent to, over and downstream of) a stormwater pipe with a diameter of 600mm or greater. A 20 metre buffer corridor is applied (10 metres either side of the flowpath centreline);
- A *watercourse* with a stream order of 2 or greater, various corridor widths are applied:
    - Second order stream – a 40 metre buffer corridor is applied (20 metres either side of the watercourse);
    - Third order streams – a 60 metre buffer corridor is applied (30 metres either side of the watercourse); and
    - Fourth order streams and greater – an 80 metre buffer corridor is applied (40 metres either side of the watercourse).

- The *100-year Annual Recurrence Interval (ARI) flood extent* identified by:
    - The Upper Parramatta River Flood Study 2004;
    - Council's Development Control Plan Part D Section 12 - Carlingford Precinct Plan; and
    - North Kellyville State Environmental Planning Policy Amendment Maps 2008.
- Land zoned as SP2 Infrastructure that is associated with Sydney Water Corporation trunk drainage land.

Within **rural areas**, where properties are affected by:

- A *watercourse* with a stream order of 2 or greater, various corridor widths are applied:
    - Second order stream – a 40 metre buffer corridor is applied (20 metres either side of the watercourse);
    - Third order streams – a 60 metre buffer corridor is applied (30 metres either side of the watercourse); and
    - Fourth order streams and greater – an 80 metre buffer corridor is applied (40 metres either side of the watercourse).

Within The Hills Shire Development Control Plan 2012 flood controlled land applies range of flood planning levels depending on type of land use and potential development. During the assessment of land capability flood controlled land, with the exception of flood control buffers, were not considered as relevant flood planning would mitigate the potential impacts. Also, parts of the development would have different Flood Planning Levels due to the occupancy and use of that part of a building. This combined with the necessity for mitigation options, such as additional infrastructure would be assessed during the planning approval process and would not necessary preclude development. As a result, flood control buffers and 100 year ARI Fringing Flow areas determined by Council as part of the Urban Villages Overland Flow Study were then focussed on to determine their relevance to the study.

4.4.3.3 Stormwater Drainage Infrastructure

The stormwater drainage in the area follows two subcatchments, O'Hara's Creek and Dooral Creek which ultimately flow into the Hawkesbury River. Urbanised sections of each catchment are typically drained by a constructed stormwater system which consists of stormwater pipes and pits. In order to mitigate the potential impact from new development on the stormwater system and floodplains across the area controls governing stormwater capture, treatment and reuse have been established. The ability for stormwater to be managed in conjunction with development is assessed during the development application process and applied through the DCP. Therefore, as stormwater controls are determined on a case by case basis at the planning approval stage, for the purposes of the land capability they have not been considered unless it is not feasible for them to be implemented.

4.4.3.4 Overland Flow Behaviour

To inform Council's flood related development controls, 'DRAFT *The Hills Urban Overland Flow Study'* (2017) was commissioned to define land subject to overland flooding across its older urban areas. The study outcome will allow Council to refine the determination of flood controlled land and will assist Council with the provision of improved flooding advice to the community as well as emergency services, and ensure that future development is completed in a way that is cognisant of the flood risk. In 2015 Council commissioned the 'DRAFT *Urban Villages Overland Flow Study*' to obtain similar information for four additional catchments that drain through a number of smaller villages outside the main urban precincts. The results were analysed to determine where overland flow has the potential to damage property and/or pose a risk to people. The key findings found that areas of significant overland flow tend to be concentrated along defined creeks, drainage depressions and a number of roadways. At present, overland flowpaths within the rural portion of the study area are located away from existing properties. However, a limited number of overland flow paths are predicted to extend through some residential and commercial properties, within the urbanised area of Dural. This is evident in **Figure 4-8**.

As part of this study several forms of information were mapped to determine:

- Overland Flow Paths; and
- Fringing Flow Areas.

“Overland flow paths” are areas subject to overland flow depths and velocities above identified threshold and are considered to have a significant overland flow risk. Results for these areas are mapped in **Figure 4-8**. Overland flow paths will eventually allow Council to more reliably define land subject to flood related development controls (i.e., flood control lots) and provide improved flooding advice to the community and emergency services.

“Fringing flow areas” are subject to shallower and/or slower moving water and are located on the perimeter of the overland flow paths. These areas are delineated by a pink polygon in **Figure 4-8**.

The Draft Urban Villages Overland Flow Study quantifies overland flow behaviour within the study area to enable Council to refine the determination of flood control lots**.**

The Draft Urban Villages Overland Flow Study filtered raw modelling results to remove areas of insignificant inundation from the flood mapping. The filter identifies land that is subject to overland flow depths and velocities above identified thresholds and is considered to have a significant overland flow risk. The application of the abovementioned filtering process generated a number of isolated “puddles” which did not form part of an overland flow path. Therefore, an additional filter was applied whereby all “puddles” less than 100 m^2 in size were also removed from the presentation of results if they did not align with an overland flow path. This overland flow tends to be concentrated along defined waterways, drainage depressions and roadways. However, it is also predicted to potentially impact a number of properties. From reviewing NearMap aerial photography of the Detailed Investigation Area the majority of the 100 year ARI Overland Flowpath areas outside Flood Control Buffers are dams or retention basins on private properties.

The fringing flow category covers the remaining area of land affected by flooding. These are areas that are inundated to a depth of more than 0.1 metres regardless of the velocity of overland flow.

It should be noted that flood control buffers do not necessarily demonstrate flood inundation extents. When assessing flooding in the Detailed Study area, the flood control buffer was only applied in locations where the Draft Urban Villages Overland Flow Study did not model. This can be seen in **Figure 4-8** where the 100 year ARI Fringing Flow areas (mapped in pink) do not always cover the existing flood control buffer areas (mapped in blue). The flood control buffer areas are conservative as it applies a buffer to the existing creek line. For this reason, these areas should be categorised with this in mind. Where flood modelling data exists then the flood control buffer area was not considered as a constraint for land capability. Despite this, both areas were mapped in **Figure 4-8** to demonstrate where areas were refined following additional studies by The Hills Shire Council.

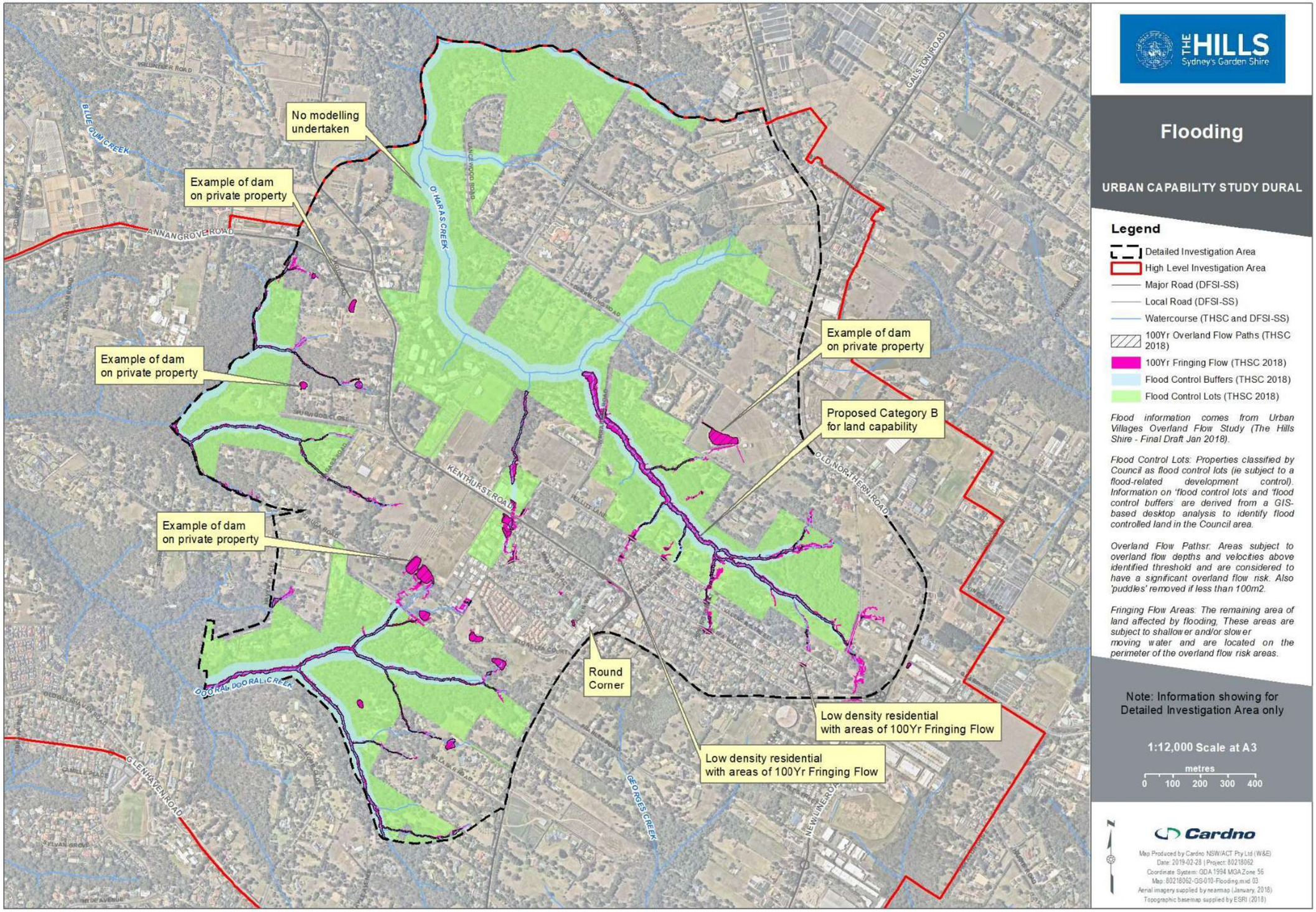


Figure 4-8 Flood Areas

4.4.4 Implications for land capability

The flooding regime (flow velocity, depth and pathways) is affected by land use type and intensity. Alterations to land use or intensity would necessitate revised modelling to determine the flooding impacts. Land use type is classified by trees, grass, shrubs, roads, concrete, water and buildings. Any development will affect the flooding behaviour in the study area and would need to be considered on a larger scale to determine the impact of significant land use change. However, from reviewing the currently modelled 100 year ARI flow path areas are generally:

- Dams on private properties;
- Located within existing streams; and
- Appear in higher density development (when compared to the land in the remaining Detailed Investigation Area) near Round Corner where it appears that a low order stream was present prior to development. The land zoning in this locality is R2 Low Density Residential.

It is recommended that areas in 100 year ARI Fringing Flow areas outside of the Flood Control Buffer could be suitably mitigated for flooding through the application of the Development Control Plan at planning approval stage and as such should be classified as Category A. Areas achieving 100 year ARI Fringing Flow classification within the Flood Control Buffer are recommended to be classified Category B on the basis of their importance to contributing to the wider flooding regime. Where the Draft Urban Villages Overland Flow Study did not model, a conservative approach has been applied and consideration of applying Category B, with the potential for this to be refined in the event further modelling is undertaken.

Water Sensitive Urban Design and Water Re-Use opportunities would be considered for each proposed development at planning approval stage. Flood Control Lots are also identified via the DCP during the planning approval stage and are a mechanism for mitigation to be applied. Hence it has not been considered in the capability of the land.

4.4.5 Groundwater

Groundwater is an essential resource, particularly as surface water resources are often fully allocated, or limited for example during droughts. Stresses on groundwater systems are related to the annual variability of recharge, cycles of user demands, and cumulative effects of domestic and industrial expansion. It is important to balance water demands against resource availability and services provided to the environment. To manage a groundwater system for long term sustainability, climate variability and change impacts on recharge and demand needs to be understood. Understanding the potential effects of climate variability and change on groundwater is more complex than with surface water. Groundwater-residence times can range from days to tens of thousands of years or more, which delays and disperses the effects of climate and challenges efforts to detect responses in the groundwater to climate variability and change. Even without considering climate variability and change, groundwater sustainability is a major challenge because groundwater is a widely distributed resource that is affected by local users and contamination.

The ability of groundwater to recharge balanced with its extraction and movement is integral to maintaining a healthy groundwater system, and ensure the long term sustainability of this resource. Groundwater recharge occurs through percolation from surface water to groundwater and relies on a permeable surface. Development affects the ability for groundwater recharge however this is not seen as a key risk in the investigation area due to the rural land use and the use of licencing to manage boreholes.

4.4.5.1 Boreholes

There are about 30 groundwater bore sites in the High Level Investigation Area. The purposes for these bores are generally irrigational, stock and domestic uses.

4.4.5.2 Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements to maintain their communities of plants, animals and ecological processes. These can occur across both surface and subsurface landscapes and are highly variable. GDEs have their species composition and natural ecological processes determined by groundwater. The Groundwater Dependent Ecosystems Atlas (BoM 2018) was developed to inform groundwater planning and management and is mapped in **Figure 4-9**.

The Atlas identified high to moderate potential for terrestrial groundwater dependent ecosystems (GDE) to occur. Terrestrial ecosystems rely on subsurface presence of groundwater and include all vegetation

ecosystems. The presence of terrestrial GDEs aligns to the location of the riparian corridors within the area and reaffirms the connectivity between water management and the wider ecosystem health.

The Atlas did not identify any potential for aquatic GDE (ecosystems that rely on the surface expression of groundwater). There was no data for Subterranean GDE (ecosystems that includes cave and aquifer ecosystems) in the area (BoM, 2018). GDEs could potentially limit the amount of ground water available to future development but would not constrain the capability of land at this level.

4.4.6 Implications for land capability

Consideration to the groundwater infiltration rates to sustain GDEs usually need to be assessed to understand how alterations to hydrology and geomorphology will impact these GDE's ability to access to groundwater. However, given these GDEs are terrestrial and exist along the creek lines, maintaining adequate flows through these areas would inevitably sustain GDEs. As this is feasible due to the flooding nature of the creeks it is recommended that the capability classification, Category A be applied.

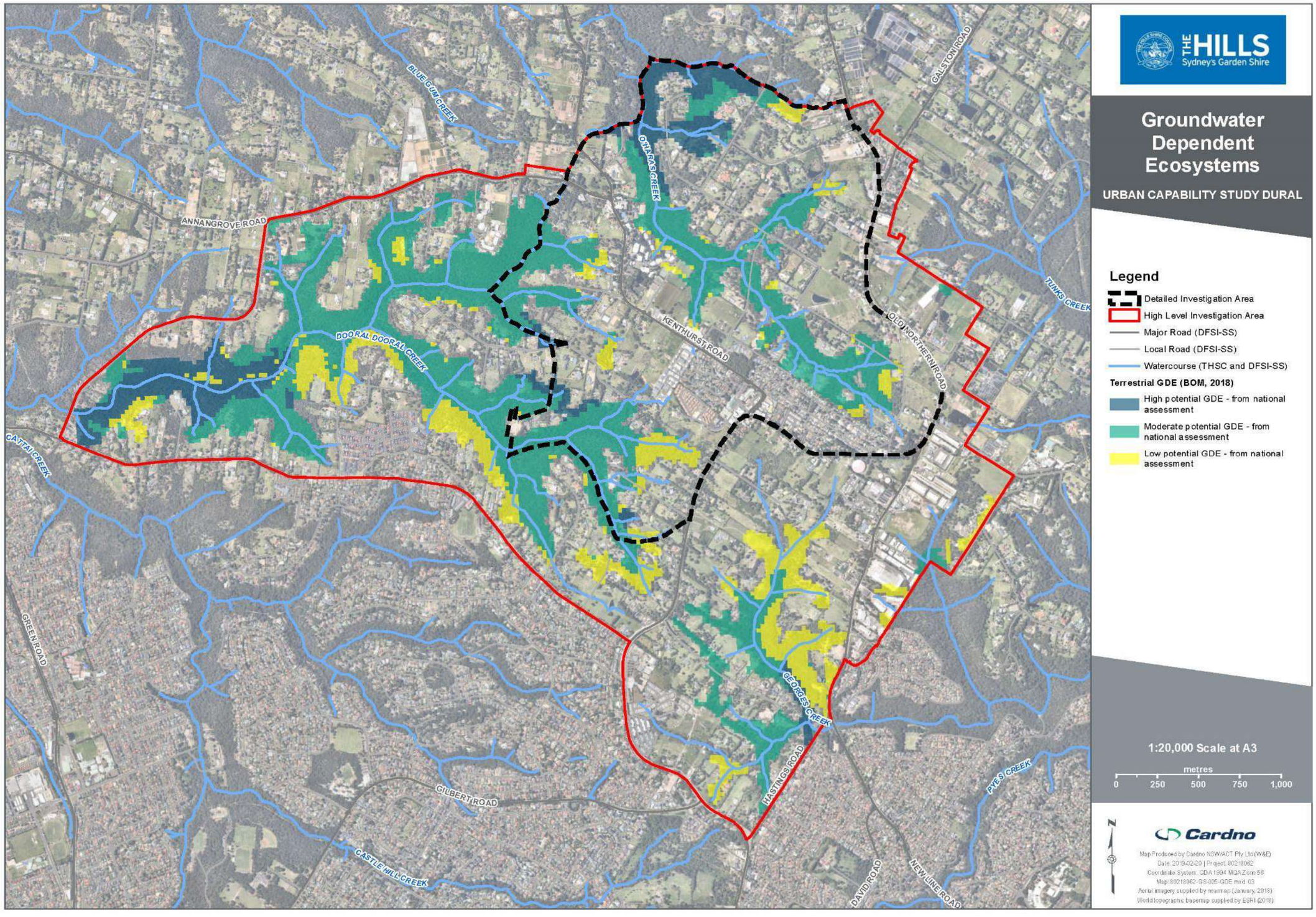


Figure 4-9 Groundwater Dependent Ecosystems (BOM Atlas, 2018)

4.5 Soil Capability and Topography

A search for topography, potential contamination sources, Acid Sulfate Soils, salinity and soil type was conducted on 13 March 2018 using the following sources:

- Hornsby Local Environment Plan 2013;
- The Hills Shire Local Environment Plan 2012;
- Department of Land and Property Information's LiDAR (GIS);
- Environmental Protection Agency (EPA) Contaminated Land Register;
- EPA Contaminated Land Record;
- OEH's *Protection of the Environment Operations Act* Public Register of Licences;
- Sydney 1:100,000 Geological Sheet Series (9130, First Edition 1983);
- Penrith 1:100,000 Geological Sheet Series (9030, First Edition 1991); and
- OEH's Soil Landscape mapping (GIS).

4.5.1 Topography

The slope percentage of the High Level Investigation Area was mapped based on LiDAR data (NSW Department of Land and Property Information 2011). Old Northern Road runs predominantly north-south along a ridgeline from Wisemans Ferry in the north to Castle Hill in the south. The land on either side of Old Northern Road in the Dural area slopes away from the road at gradients that largely range between 0-10 degrees, with some areas of a steeper gradient. The topography also shows high percentages of slope towards the riparian corridors along the creeks (**Figure 4-10**).

4.5.2 Implications for land capability

Steep land is generally considered a constraint to development uplift. Implications for development on steep land increase with the intensity of development and include:

- Land disturbance due to cut and fill operations to support building platforms, external utility zones around buildings and access roads;
- Landslip risk;
- Erosion risk;
- The rate, volume and quality of water leaving the land;
- Loss of vegetation;
- Downslope impacts on adjacent land and water quality; and
- Changes to visual character.

The Low Rise Medium Density Design Guide (NSW Government, 2017) defines a sloping site as "a site with a slope of 15% or greater". The Guide does not preclude medium density development from "sloping sites" but it does provide advice on the constraints and issues that would require consideration to allow acceptable development of medium density housing on such sites. In summary, these include:

- Visual impacts and impacts on local character;
- Land disturbance - cut and fill and the impacts of retaining walls; and
- The overall ability of the land to accommodate development.

The Hills LEP, 2012 maps land with the potential for "landslide risk". The determination of this risk is based on the geotechnical condition of land - a combination of slope, soil type and geology. The relevant clause in the LEP is:

Cl.7.6 Landslide risk
(1) The objective of this clause is to ensure that development is commensurate to the underlying geotechnical conditions and to restrict development on unsuitable land.

(2) This clause applies to land identified as "Landslide Risk" on the Landslide Risk Map.

(3) Before determining a development application for development on land to which this clause applies, the consent authority must consider whether the development's design is responsive to the constraints of landslide risk, including:
(a) site layout, including access,

(b) the building's design and construction methods,

(c) the amount of cut and fill that will be required,

(d) waste water management, stormwater and drainage across the site,

(e) the specific geotechnical constraints of the site.

(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:
(a) is designed, sited, constructed and will be managed to avoid any landslide risk and potential adverse impact on the development or on land in the vicinity of the development, and

(b) will appropriately manage waste water, stormwater and drainage across the site so as to not affect the rate, volume and quality of water leaving the land.

Notwithstanding that land within the Investigation Area is not mapped in the LEP as being subject to landslide risk, this Development Standard in the LEP provides further evidence of the potential negative impacts of higher density development on steep land.

Cardno's advice on the capability of steep land to absorb higher density development is derived from our experience with the implications of such development with respect to the above described criteria. Based on this we have assigned capability categories around slope as indicated in the following table.

Table 4.9 Impacts of Slope on Capability

SLOPE CATEGORY	CAPABILITY OF ABSORBING DEVELOPMENT	COMMENTARY
0-10%	No impact on capability	Slope would not be an impediment to orderly development of land and would not be likely to be a matter for detailed consideration in a development proposal.
11-15%	Moderate impact on capability	Some conventional measures to address slope constraints are likely to be required in formulating a development proposal.
16-20%	Significant impact on capability but not sufficient to preclude potential for development uplift.	Measures in existing planning controls and guidelines would potentially allow for appropriate higher density development. Slopes of this level should not as a single constraint preclude land from potential for development uplift.
Greater than 20%	Major impact on development capability. Land at these slopes should be precluded from consideration for uplift in development intensity.	Higher density development on these slopes would be likely to impact negatively on the environment with respect to one or more of the matters for consideration in the relevant planning controls and guidelines. Implementation of measures in the planning controls would be unlikely to sufficiently address all negative impacts.

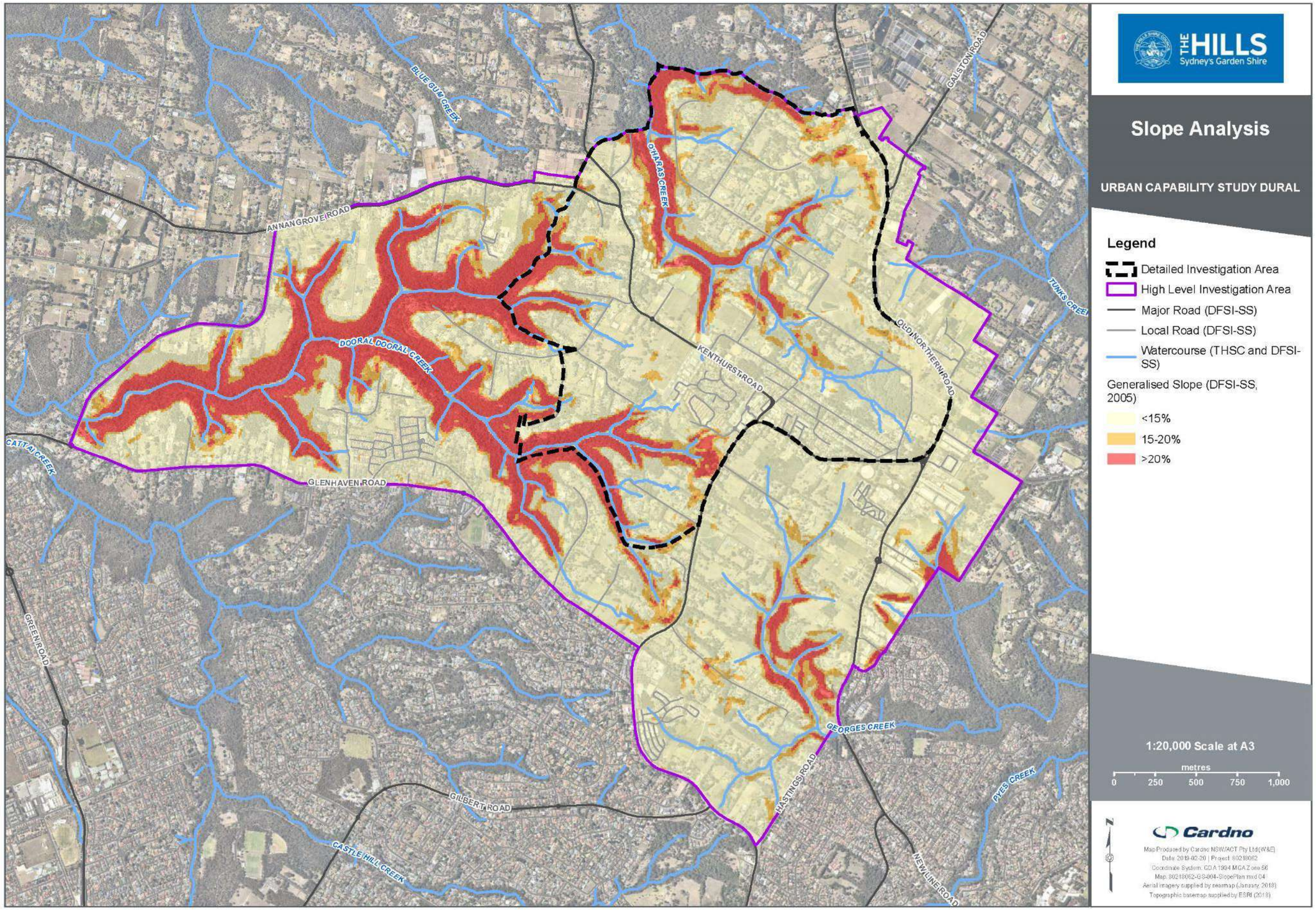


Figure 4-10 Slope Analysis

4.5.3 Contaminated Soils

A search of the EPA Contaminated Land Register indicated one contaminated land site within the vicinity of the study area (137 Annangrove Road, Kenthurst). However, it is noted that the Contaminated Lands Register is not exhaustive and there remains potential for additional contaminated land to be encountered during the works. There is potential for a range of contaminants (i.e. pesticides) to be present due to previous use of the land for agriculture. In addition, as the land is on the fringe of urban developments, there is potential that parts of the area were used for illegal dumping (for example metals or asbestos).

Three sites listed with contaminated land were found to be within the Detailed Study Area, but are located on the eastern boundary along Old Northern Road (see **Figure 4-11** for locations). Two of these sites are immediately adjacent to each other. A summary of all search results in and near to the two study areas is outlined below.

The EPA contaminated land list is a list of NSW contaminated sites notified to EPA (current 9 February 2018). The list was reviewed for suburbs (Dural, Glenhaven, Castle Hill and Kenthurst) and identified five sites:

- Caltex Service Station, 530 Old Northern Road, Dural – located on corner of Kenthurst Road and old Northern Road near the Round Corner Shopping Centre. Within Detailed Investigation Area.
- Woolworths Service Station, 532 Old Northern Road, Dural – located on corner of Kenthurst Road and old Northern Road near the Round Corner Shopping Centre. Within Detailed Investigation Area.
- BP Dural Service Station, 580 Old Northern Road, Dural – located on corner of Derriwong Road and old Northern Road. This site is within the Detailed Investigation Area in the Hornsby LGA.
- Caltex Dural Service Station, 917-923 Old Northern Road, Dural – Near corner of Old Northern Road and Galston Road. Within High Level Investigation Area.
- Vacant Land, 259 McClymonts Road, Kenthurst. Outside Investigation Area.

The Environment Protection Agency (EPA's) *Protection of the Environment Operations Act* public register was searched to identify environmental protection licences and other regulatory information under the Act. Six sites were identified in close proximity (but outside) the High Level Investigation Area at:

- 104A-104B Kenthurst Road, Kenthurst – S91 clean up notice (issued 7 Sept 2017) and S110 variation of clean up notice (5 March 2018).
- 19 Raym Road, Kenthurst - S91 clean up notice (29 July 2016) and penalty notice (29 Nov 2017).
- 425 Galston Road, Dural – S91 clean up notice issued on 22 December 2017.
- 1103 Old Northern Road, Dural – former POEO licence.
- 249 Pitt Town Road, Kenthurst – S91 clean up notice issued on 6 Jul 2017.
- 2C Jones Road Kenthurst – POEO licence.

4.5.4 Implications for land capability

The presence of contamination does not affect the capability of the land for development uplift but may limit the financial benefit of development when consideration of remediation and design costs are understood. The level of remediation and costs would be determined and assessed during the development approval process. For these reasons land containing contamination has not been included as a constraint on capability of the land for development uplift.

4.5.5 Geological landscapes

The regional geology of the High Level Investigation Area is based on the Sydney 1:100,000 Geological Sheet Series (9130, First Edition 1983) and Penrith 1:100,000 Geological Sheet Series (9030, First Edition 1991) which identifies the site as comprising Hawkesbury Sandstone and Ashfield Shale. Hawkesbury Sandstone is a medium to coarse-grained quartz sandstone with minor shale and laminate lenses formed in a previous alluvial environment dating back to the Jurassic period. The Ashfield Shale is comprised of laminate and dark grey shale.

The Hawkesbury Sandstone Formation generally tends to be highly infertile and shallow, and water passes through it easily.

The movement of landslide material can vary from abrupt collapses to slow gradual slides and at rates which range from almost undetectable to extremely rapid. Landslides range in size from a single boulder in a rock fall or topple, to tens of millions of cubic metres of material in a debris flow. They can also vary in their extent, with some occurring very locally and impacting a very small area or hill slope while others affect much larger regional areas. The distance travelled by landslide material can also differ significantly with slides travelling from a few centimetres to many kilometres depending on the volume of material, water content and gradient of the slope. It is important to evaluate slope stability and any landslide threat during development assessments so that effective and timely preventative and/or remedial measures can be implemented.

Factors which influence whether a landslide will occur typically include slope angle, climate, weathering, water content, vegetation, geology, slope stability and the amount of loading on the slope (overloading). Human specific contributions to landslides include:

- Removal of vegetation;
- Interference with, or changes to, natural drainage;
- Leaking pipes such as water and sewer reticulation;
- Modification of slopes by construction of roads, railways, buildings, etc.;
- Overloading of slopes by construction of buildings or earthworks etc.;
- Vibrations from heavy traffic, blasting, etc.; and
- Excavation or displacement of material, including mining and quarrying activities.

Shale in horizontal beddings alone does not present a risk. However, the infiltration of water and retention of water between the horizontal bed of the shale however enables the shale to slide easily. Given the presence of shale in the area, the Australian Government Geosciences Landslide Search portal was used to determine the location of any landslide risk areas. The search did not? return any known locations for landslides however if there is extensive development the risk may evolve.

4.5.6 Implications for land capability

There is a low probability of landslide risk in the area and suitable engineering designs are able to manage geological landscapes. Hence, this environmental aspect is considered to have no implication with regard to the capability of the land to absorb development uplift. It is recommended this is classified as Category A.

4.5.7 Soil Landscapes, Salinity Potential and Acid Sulfate Soils

Soil mapping describes the properties of soils and the landscapes in which they occur. Mapping is used to evaluate land for planning, agricultural use or environmental protection. Soil landscape mapping describes topsoil and subsoil conditions and properties, and their underlying geological formations. This is important in informing the geotechnical constraint in development for the purposes of supporting structures and depth of foundations. It is also used to determine soil fertility and erodability, two important factors for agricultural land.

The Soils Landscapes of the Sydney 1:100,000 Sheet (Office of Environment and Heritage, 2009) identifies the High Level Investigation Area as primarily Glenorie and Gymea with Hawkesbury, Hornsby, Lucas Heights and West Pennant Hills soils in the nearby area. Glenorie and Gymea are both erosional landscapes with high soil erosion hazard (See **Figure 4-11**).

The Hills Shire LEP and Hornsby LEP identified no known occurrence of ASS in the High Level Investigation Area. The Detailed Investigation Area is described as having low to moderate salinity potential (OEH 2016 mapping). Salinity is the accumulation of salt in the land and water to a level that damages the natural and built environment. Salinity usually occurs with other natural resources problems such as decreasing soil and water quality, erosion and loss of native vegetation (OEH 2018). Although there is potential for salinity, it is unlikely to impact on the capability of the land as there are mitigation measures that can be implemented to limit the impact (i.e. exposure-class bricks and salt-resistant concrete).

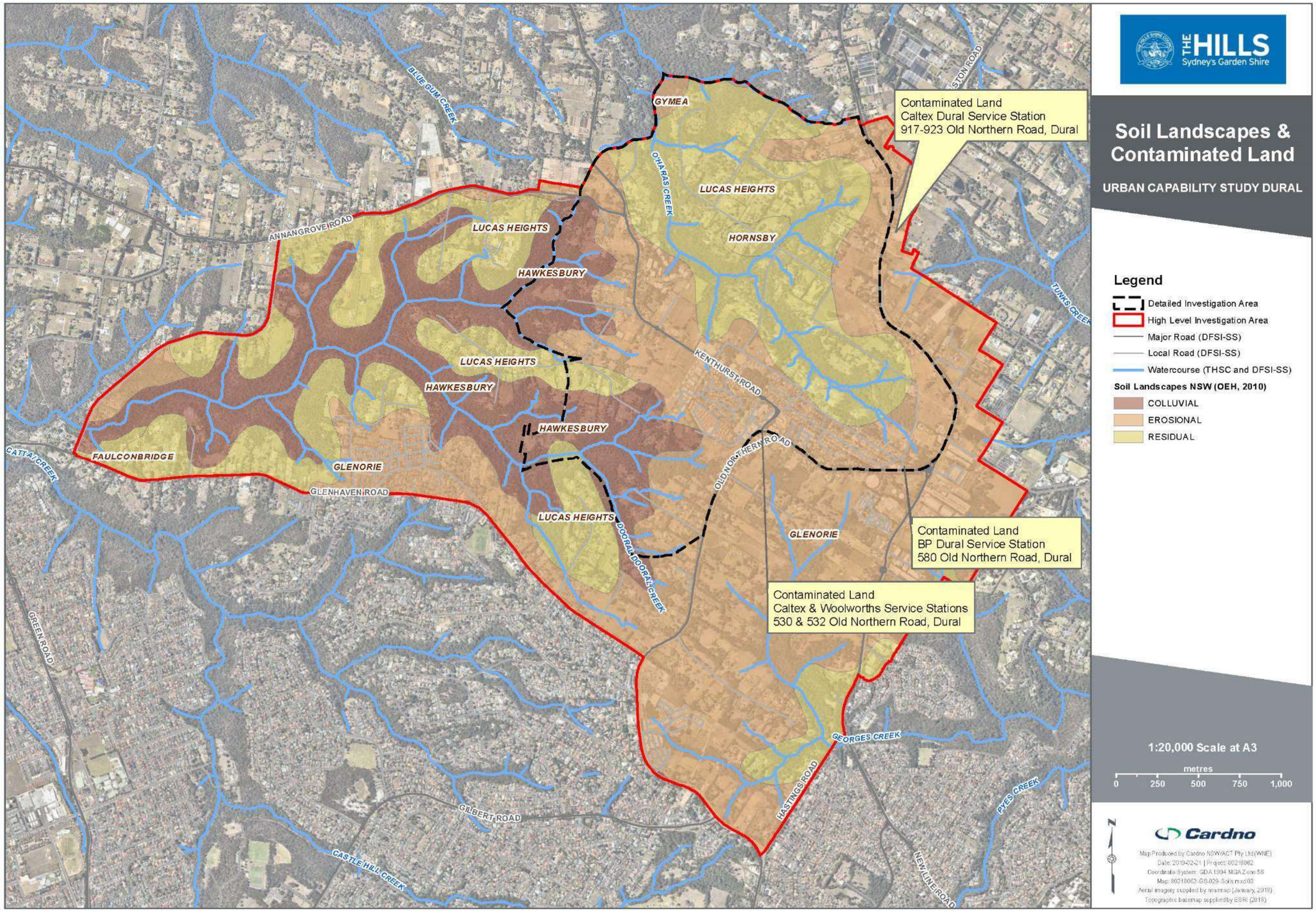


Figure 4-11 Soil Landscape and Contaminated Land area

4.5.8 Implications for land capability

At present the Detailed Study Area is comprised of residential, rural and semi-rural land uses. The ability to continue existing land uses would not be impacted by the soil landscapes and potential salinity. Both these aspects can be managed by control measures applied by the planning controls. These environmental elements are considered to have no implication with regard to the capability of the land to absorb development uplift. It is recommended this land is classified Category A.

4.6 Noise and Vibration

Effective land use planning plays a key role in preventing potential noise impacts, both at the strategic planning level and at a project-specific level. The *Protection of the Environment Operations Act 1997 (POEO Act)* provides regulatory tools for managing noise impacts from new and existing noise-producing developments. Non-regulatory approaches also have an important role to play in managing noise problems and should be used in conjunction with regulatory mechanisms.

The noise sources in the Detailed Investigation Study Area mainly consist of wildlife noise, common residential noise, commercial properties and some light industry, and distant traffic noise (from the main connector roads i.e. Old Northern Road). Currently, the sensitive receivers in the area include churches, schools, nursing homes and residential dwellings.

There are two key sources of noise which are governed by policy:

1. Road Noise - Road Noise Policy (DECCW 2011).
2. Industrial Noise - Noise Policy for Industry' (EPA, 2017)

4.6.1 Road Noise and Vibration

Noise from road related activities includes construction of new freeways, noise from heavy vehicles and the noise from individual vehicles fitted with modified exhaust systems. The manner and location of the noise emission will determine what noise controls are available and ways in which the noise should be assessed.

New road development identified in the area would need to consider the Road Noise Policy (DECCW 2011). This document outlines strategies that address the issue of road traffic noise at nearby potentially affected receivers. Road traffic noise is assessed for:

- Existing roads;
- New project roads;
- Road redevelopment projects; and
- New traffic-generating developments.

There are also transition zones, which represent the area between two of the types of roads listed above.

The Road Noise Policy sets criteria for noise mitigation measures based on the road type and proximity of sensitive receivers This policy is likely to apply to any potential future development along Old Northern Road, New Line Road or any road adjustments along Annangrove Road.

In addition to assessing noise levels during the planning of road upgrades or new roads, there are several strategies currently being implemented to reduce road traffic noise. These strategies aim to:

- Manage the demand for travel;
- Influence the location of new urban development and urban renewal;
- Increase travel choices by expanding and improving the quality of public transport networks, and expanding and increasing the use of facilities for pedestrians and cyclists;
- Maximise the proportion of freight transported by rail; and
- Review parking policies with a view to reducing the provision of car parking.

4.6.2 Industrial Noise and Vibration

Industrial noise is governed by the 'Noise Policy for Industry'. It provides a framework and noise level for the assessment and management of noise impacts from industrial developments such as mines, quarries and large industrial sites that are scheduled under the *Protection of the Environmental and Operations Act 1997 (POEO Act).* This policy may be used to assess and control noise from non-scheduled industrial sources that come under Council control, and to assist in their land-use planning functions. The policy aims to ensure that the potential noise impacts from industrial developments are assessed in a consistent and transparent manner and minimised where reasonable and feasible. In areas of very low background noise, the lowest level that a licence limit will be set at for daytime noise will be raised by 5 dB. This criterion is well below the level at which more than 10% of an exposed community are likely to be highly annoyed and also remains below the World Health Organization recommended levels.

Currently there is no light or heavy industry in the existing high level of investigation study area or the detailed area. There is however, light industrial on the eastern side of New Line Road within Hornsby LGA. It is not anticipated that the light industrial development would impact on the capability of the land within the Detailed Study Area as Old Northern Road traffic noise would be the dominating noise source in this area. It has been assumed light industry is not a consideration for this study however in the event it did apply, there would need to be an assessment and consideration of any mitigation measures such as architectural treatment, change in operations, or offset distances from the light industrial area to enable development to be feasible.

4.6.3 Implications for land capability

Land use planning offers the greatest potential for minimising conflict between road noise and sensitive land uses, followed closely by the development of appropriately designed and noise-insulated buildings. It is therefore important that during the early stages of road planning, noise minimisation is considered during route selection processes for new roads or major realignments. However, in the event future roads are required, or upgrades to existing roads, the above strategies should be applied during design optimisation. For the purposes of the environmental capability study it is considered that noise can be managed and mitigated through:

- At source measures;
- At receptor measures; and
- Land use zoning to limit the location of light industrial uses.

In addition, the implications of road noise on land capability needs to be balanced with the necessity to provide a suitable level of road infrastructure. As part of the planning process, noise assessments are undertaken and used during the planning stages to identify suitable mitigation measures using a hierarchy pollution control approach (eliminate, substitute, control etc.). This is also similar for industrial development.

It is therefore anticipated that noise and vibration should not be applied to land capability but rather considered and assessed during the planning approval process. It is recommended that the land capability be classified as Category A.

4.7 Air Quality

The *Protection of the Environment Operations Act 1997* (POEO Act) sets the statutory framework for managing air quality in NSW, including establishing the licensing scheme for major industrial premises and a range of air pollution offences and penalties. It is supported by the Protection of the Environment Operations (General) Regulation 2009, which provides for:

- The administration of the licensing scheme.
- Economic incentives for licensed businesses and industry to reduce pollution, including emissions to air, through load-based licensing.

Schedule 1 of the POEO Act identifies schedule activities for the purpose of the Act. Activities that are scheduled include extractive activities (clause 19) and road construction (clause 35).

The closest air quality monitoring station is located at Prospect (about 15km south-west of Dural). Pollutants monitored at Prospect include Ozone (O3), nitrogen dioxide (NO2), sulphur dioxide (SO_2), carbon monoxide (CO) and PM10 – specifically referring to fine, airborne particles with an aerodynamic diameter smaller than or equal to 10µm).

The NSW Annual National Environment Protection (Ambient Air Quality) Measure (NEPM) Compliance Report for 2016 (OEH, 2016) reported on the following for the Prospect monitoring site:

- No exceedances of the NO2 1-hour and annual standards were recorded and compliance with the NEPM goal was met
- Ozone levels in the Illawarra, Lower Hunter and Central Coast regions remained below the 1-hour average standards throughout 2016.
- The 1-hour, 24-hour and annual standards for SO2 were not exceeded, and compliance with the NEPM goal was met.
- The NEPM goal for 24-hour PM10 was not exceeded.

Therefore, air quality is unlikely to be a constraint on a regional level. Air quality would require consideration at a localised level during construction.

4.7.1 Implications for land capability

Air quality impacts from development are associated with indirect changes with increased traffic and potential industry. Air quality in the high level investigation area are below acceptable levels and would not be directly affected by additional dwellings. There would be indirect impacts on air quality with increased traffic linked to additional dwellings and vehicle use in the area. This impact however, would not be of sufficient significance to influence capability considerations for development uplift. They would be addressed in the air quality assessment in the event the road infrastructure was upgraded or new roads build. It is recommended the land capability be classified as Category A.

4.8 Value of Resource Lands

Cardno has carried out an assessment of land use and visual / landscape character within the Detailed and High Level Investigation Areas. This exercise was completed by desktop examination of aerial photography and ground truthing via a visit to the investigation areas. A significant finding of the land use assessment was that there is minimal land dedicated to rural purposes remaining in the investigation area - the majority of former rural land in the areas now supports very large single dwelling houses on moderately large single lots. **Figure 4-12** illustrates the existing subdivision pattern in the Areas. When viewed in conjunction with **0** - Visual Landscape Character – it is clear that the original large lot pattern that characterises small rural holdings has been retained with the evolution to “big house / big lot” residential development.

There is potential, however, for the remaining rural lands in the area to perform functions specifically suited to small rural holdings. Our opinion is that any proposal for uplift in development density in the Areas should be measured against the potential loss of opportunities for innovative use of these remnant rural lands.

An assessment of the value of the remaining rural lands in the investigation area has been carried out via a review of recent relevant rural lands studies (and sections within other strategic planning documents of relevance to rural lands) including:

- *The Baulkham Hills Rural Land Study - Village Character Analysis, Urban Design Guidelines (Woods Bagot, 2003)*
- *The Baulkham Hills Rural Land Study Independent Review (Connell Wagner Pty Ltd, 2005)*
- *Local Strategy – New Strategic Direction for Baulkham Hills Shire, May 2010 (sections pertaining to rural lands)*
- *The Central City District Plan*
- *Local Planning Directions under S.117 of the Environmental Planning and Assessment Act, 1979 – Direction 1.2 - Rural Zones*

The following discussion summarises the outcomes of these studies of relevance to the value of the remaining rural lands in the Investigation Areas and provides commentary on the implications of these outcomes for the capability of these lands to support development uplift.

The studies and strategies include consistent references to the following issues facing rural lands within the Hills Shire and their values as part of its land use mosaic:

- Rural lands within the Shire perform the following functions:
    - They provide land for rural production (agriculture, hydroponics, livestock industries and the like);
    - They define the edge of metropolitan areas;
    - They accommodate a range of agricultural uses that contribute to the local and regional economy;
    - They provide a food source for the metropolitan area; and
    - They provide protection for biodiversity, natural and cultural heritage, scenic landscapes and metropolitan water catchments.
- The rural areas that fringe the urban and suburban zones present opportunities for potentially valuable non-traditional rural pursuits.

  The Connell Wagner review refers to the then Department of Primary Industry’s term “urban agriculture”, encompassing boutique farming enterprises, agribusiness and agritourism. The Department saw this use as a viable future for the rural fringe areas and pointed to a need to protect fringe rural lands for such uses via planning controls and economic strategies.
- The long term viability of rural villages is a matter of concern and contingent largely on the economic success of the rural areas that they service.
- Potential uses for rural lands where traditional agricultural uses have become marginal or non-viable should be explored and enhanced. These may include boutique farming operations and agritourism such as farmgate sales, farmstays or restaurants. These alternate uses have potential to reinvigorate rural economies, provide variety in employment forms and retain the character of the rural verges to the Shire’s urban areas.

- Land capability assessment is critical to the strategic decision making process with regard to rural fringe lands. The Connell Wagner report refers to the importance of land capability assessment in the decision making process around intensification of development in the rural fringe. Specifically, the report points to the physical constraints being considered in this study – slope, soils, vegetation, hazards and scenic quality (see Section 3.9), as well as social and economic concerns.
- The S9.1 Planning Direction on Rural Zones requires that a planning proposal must not rezone land from a rural zone to a residential zone and must not increase the permissible density of development within a rural zone, except if that land is within an existing town or village. Inconsistent planning proposals need to justify by a strategy or study or in accordance with a Regional or Subregional Strategy or be of minor significance. The land within the Investigation Areas is zoned RU6 – Transition and the intention of the S.9.1 Direction to protect the agricultural production value of rural land is of relevance to this Study.

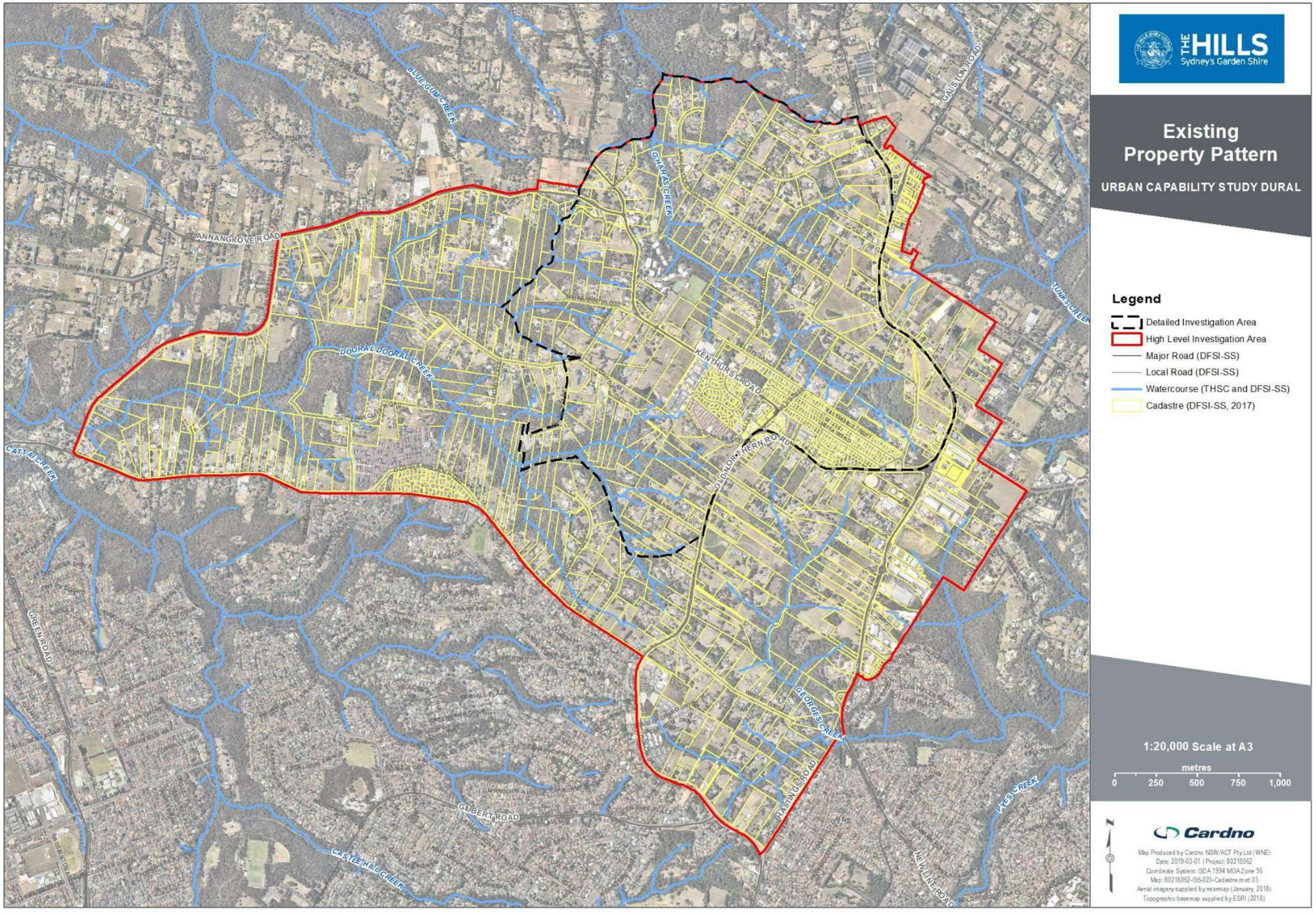


Figure 4-12 Existing subdivision pattern across the Investigation Areas.

The Local Strategy raises similar themes to the Connell Wagner report with regard to fringe rural lands in the Shire and translates these to strategic planning directions. The key directions for rural lands of relevance to this study include:

- Ensure access to services and facilities;
- Provide economic development opportunities;
- Ensure adequate infrastructure;
- Ensure water quality is maintained;
- Ensure the ecological integrity of land is maintained;
- Ensure that development has a minimal impact on the scenic and cultural landscape of the Shire;
- Preserve rural heritage and culture; and
- Plan for natural hazards.

At the metropolitan wide planning level, the Metropolitan Strategy and the Central City District Plan both recognise the value of rural lands and include strategies for their protection and promotion. The lands in the Investigation Areas that are the subject of this Cardno study are mapped in the Central City District Plan as part of the Greater Sydney Metropolitan Rural Area which stretches north from the Rouse Hill Release Area to Wisemans Ferry (see **Figure 4-13** below).

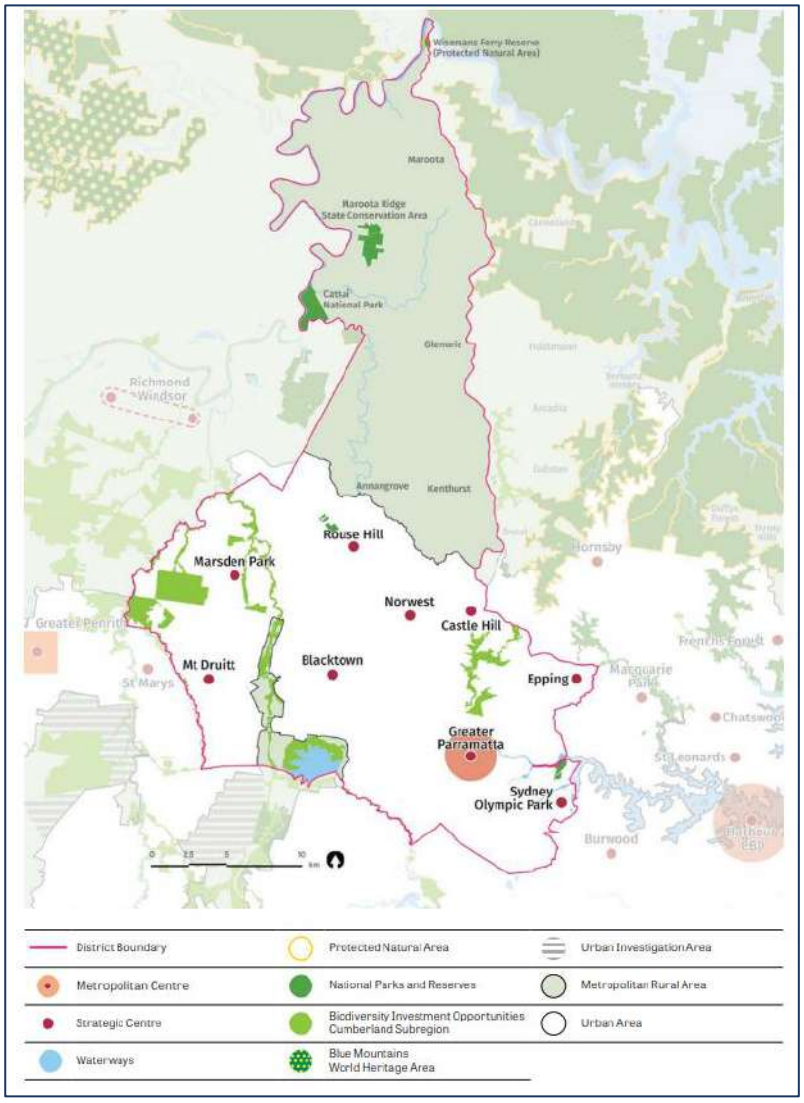


Figure 4-13 Central City District Metropolitan Rural Area and Protected Natural Area.

The District Plan points to a need to protect rural land and to avoid encroachment from incompatible land uses on rural industries. The protection of biodiversity in rural areas is also a stated priority as is the opportunity to re-establish significant ecological communities in rural areas.

Planning Priority C18 in the District Plan is to better manage rural areas. Actions of direct relevance to the outcomes of this Study under Priority C18 include:

- *Protect and support agricultural production by preventing inappropriately dispersed urban activities in rural areas.*
- *Maintain or enhance the values of the Metropolitan Rural Area using place-based planning to deliver targeted environmental, social and economic outcomes.*
- *Limit urban development to within the Urban Area.*

In summary, encroachment of urban development into rural lands will be inconsistent with the current strategies if it results in:

- Loss of land that provides opportunities for agribusiness / agritourism;
- Loss of existing biodiversity or the opportunity to enhance biodiversity and unacceptable impacts on ecological integrity;
- Unacceptable impacts on rural heritage and culture;
- Impacts on water quality and erosion;
- Pressure on availability of infrastructure and services to rural users; and
- Depletion in scenic quality and character.

The current strategic planning policy, as articulated in the above targeted review of the relevant strategic planning studies, is that remnant rural lands in the Sydney Metropolitan urban fringe present a valuable resource that could return significant economic and environmental benefits for the developing City. The scenic qualities of these lands are also integral to their value and may contribute to their viability for local tourism. Further, there are clear directions in the State Government strategies and in the Minister's directions to Council's preparing Planning Proposals that urban development should not encroach onto existing rural lands.

4.8.2 Implications for land capability

Current State Government policy regarding existing rural lands points to their retention unless there is compelling evidence that any change from rural use would have a net benefit when assessed against the above planning principles. Our conclusion with respect to this capability assessment exercise is that any proposal to change use of the existing rural lands remaining in the Investigation Area should be subject to assessment against the principles. Loss of opportunity for alternative rural uses must be a key matter for consideration in the decision making process.

4.9 Scenic / Landscape Quality

Scenic character is a valuable contributor to the amenity and quality of living in an area. Intensification of development will inevitably result in changes to the scenic character of any locality. The key strategic planning documents reviewed in this Study refer regularly to the value of scenic quality and character as a determinant in the decision making process for planning in Sydney's remaining rural lands. In response to this, Cardno has carried out a review of the scenic quality of the Investigation Areas in order to identify the scenic values that contribute to its local character. Implications of these values for the assessment of the land capability are then discussed.

Planning Priority C15 in the Central City District Plan is *"Protecting and enhancing bushland, biodiversity and scenic and cultural landscapes."* With respect to scenic quality, the following statement is made:

"Continued protection of the Central City District's scenic and cultural landscape can complement the protection of biodiversity and habitat, help manage natural hazards, support tourism and help preserve links to Aboriginal cultural heritage." (Central City District Plan, 2017, p.105).

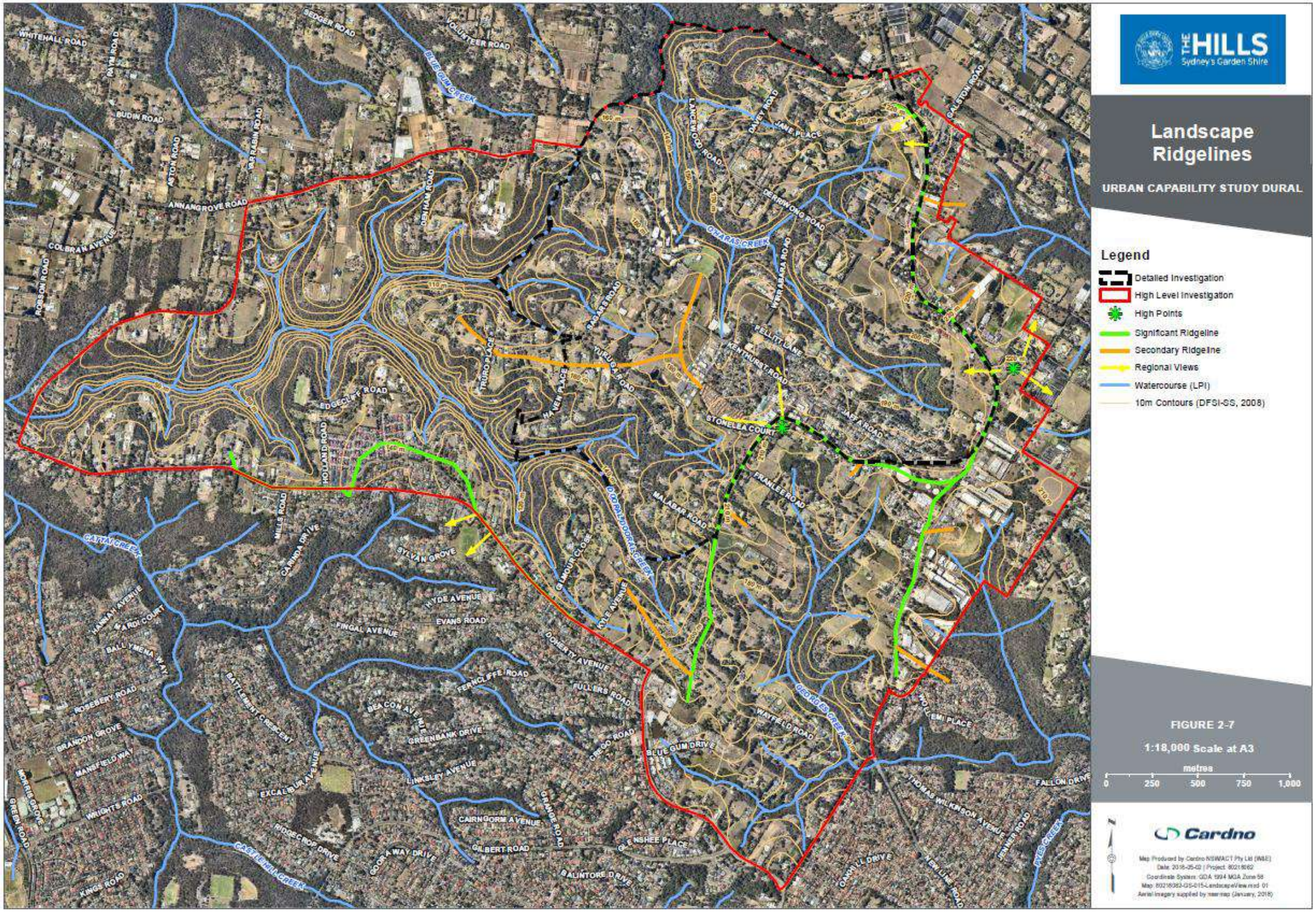
Relevant actions under Planning Priority C15 of the District Plan are:

"66. Identify and protect scenic and cultural landscapes.

67. Enhance and protect views of scenic and cultural landscapes from the public realm."

Translating these actions to the Investigation Areas involves value judgements to determine which identified visual character units are positive contributors to its specific visual character. These have also been mapped in **0** according to visual landscape character classifications.

The subsequent **Table 4-10** then provides a description of each unit, an assessment of its value and consequent implications for land capability.



Visual

Figure 4-14 Landscape Ridgelines

Table 4-10 Visual Character – Significance for Land Capability

VISUAL CHARACTER UNIT	CONTRIBUTION TO SCENIC QUALITY	SIGNIFICANCE FOR LAND CAPABILITY
 Bushland	Very high – bushland is identified in the planning strategies as a critical attribute of the character of the Rural Fringe.	Very positive contributor – bushland should be protected and new development should not encroach on existing bushland in the Investigation Areas.
 Rural / Hobby Farm	High – remnant rural lands are inherent to the scenic character of the rural fringe.	Very positive contributor – the remaining small holding rural lands are critical contributors to the character of the Investigation Areas. Character should be a critical consideration in decisions regarding potential development of these lands.
 Big House / Big Lot Residential	Medium – large dwellings on relatively large lots are increasingly becoming a significant development form in the Investigation Areas. Because they generally retain the subdivision pattern of their former rural holdings, and because the built form tends to be well set back and not significantly visible from roads, these emerging development forms tend to retain the original rural character of the locality.	Neutral contributor – further subdivision of these relatively large residential lots will potentially impact on the rural character of the Areas.
 Recreation	Medium – the expansive undeveloped areas of land that characterise recreational areas are consistent with the rural character of the Areas. The subdivision of this land for other uses would have a negative impact on local visual quality as it will result in loss of the open landscape character that is inherent to rural landscapes.	Positive contributor – subdivision of recreational lands for other purposes will impact on the rural character of the Areas.

 Education	Medium – educational institutions in the Investigation Areas tend to include buildings in settings dominated by landscape – vegetation and open space. As such these institutions are generally consistent with the overall rural character of the areas.	Positive contributor – changes to the intensity of development within the educational institutions in the Investigation Areas has the potential to result in loss of open space and landscape which will potentially impact on the rural character of the Areas.
 Low density residential	Neutral – low density residential development is not contributory to rural character. However, the dominance of landscape over buildings in this development form is generally consistent with the open landscape dominated character of the Investigation Areas.	Negative contributor – the encroachment of low density residential development onto rural lands would have a net negative impact on the rural character of the Areas. This would be tempered by the site sensitive subdivision and retention of existing significant vegetation.
 Medium density residential	Very low	Negative contributor – medium density development is clearly inconsistent with the open, rural character of the Investigation Areas. Impacts on local character should be a significant matter for consideration in any decisions regarding the extension of medium density residential development within the Areas.

 Retail – fine grain	Medium – rural areas typically include small service centres with shops and other retail / service outlets. As such, this form of development is considered to be consistent with the rural character of the Investigation Areas.	Positive contributor – judicious location of small retail centres would not be likely to impact negatively on the rural character of the Areas. The scale of centres should be in accordance with Council's Centres Hierarchy.
 Retail - supermarket	Very low	Highly negative contributor – "big box" retail development such as supermarkets would have a clear negative impact on the rural character of the Investigation Areas.
 Employment	Very low	Highly negative contributor – employment lands generally include large box buildings in hardstand settings. The loss of landscape and open space that results from this development form would be inconsistent with protection of the rural character of the Areas. Impacts on local character should be a significant matter for consideration in decisions regarding the extension of employment lands within the Areas.

4.9.2 Implications for land capability

The Dural locality has a long tradition of rural uses. The area is transitioning from its rural use to a mix of bushland, semi-rural, large lot and medium density residential uses. Notwithstanding this change, the rural and bushland character remains as the major contributor to the scenic quality of Dural. The value of the remaining rural and bushland character of Dural is on two levels:

- Residents are proud of the rural / bushland character of Dural. For many it is reason that they live in the locality.
- The opportunity to experience a rural / bushland landscape close to the city is a contributory factor to the potential of the Dural locality as a local tourist attraction.

Our opinion is that retention of the overarching rural and bushland scenic character of the investigation area should be a principle consideration in the decision making process for any form of development uplift.

4.10 Outcomes – environmental assessment

This section includes a summary of the results of our review into the environmental capability of land in the Detailed Investigation Area. If there is no implication for land capability at the strategic level, then the environmental impacts of any proposal for development would would be assessed and considered at the detailed planning stage. Proposed classifications for the environmental suitability of the land have been identified and applied to the Detailed Study area to inform Cardno's consequent considerations with regard to the land within the Detailed Investigation Area that would be capable of absorbing higher density development.

The environmental suitability of the land to be developed has been based on the following three levels:

1. Category A: Land capable of development with minimal constraints
2. Category B: Land capable of development but with constraints
3. Category C: Land unable to be developed / unsuitable for upscale development

Rationale for Determining the Environmental Capability of Land

In the development of the land capability categories, consideration was given to environmental constraints, legislation and the objectives from Council's strategic planning documents.. Where the impact is already managed through an existing development control measure or if low level mitigation could be implemented, Category A was applied to the constraint. Where constraints required a higher level of consideration and/or were a key strategic objective for the Council then these fell into the Category B. Land unable to be developed (Category C) included constraints where key legislation applied, physical development was not possible or where the area played an integral role in the overall management of the area. Environmental aspects that can be mitigated during construction were considered to be land capable of development with minimal constraints (Category A).

The assessment of the Environmental Constraints and Opportunities in **Section 4** was undertaken on the grounds of each environmental aspect. Throughout the review and assessment clear linkages between key environmental aspects were evident. These linkages are important as when they are considered cumulatively they may change the overall capability of the land.

Environmental assessments of the riparian corridors, receiving sensitive water bodies for key fish habitat, flood control buffer zones and groundwater dependent ecosystems (GDE) may not individually result in the land being identified as Category C, however when these elements are within the same location, cumulatively, it is appropriate to identify these lands as incapable of development. These areas play an important role in hydrology and sustaining terrestrial GDE and for supporting habitat which aids in water quality levels and wildlife corridors. It would result in inappropriate environmental impacts to allow development to occur that would prevent these lands from performing this role.

Key environmental aspects that resulted in land being identified as capable but with constraints (Category B) are:

- Vegetation Communities;
- Wildlife Corridors;
- Threatened Flora;
- Waterways and threatened aquatic biodiversity;
- Outer Riparian Corridor; and
- 100 year ARI Fringing Flow areas within the Flood Control Buffer zone.

Key areas which were considered not suitable for any uplift in development and hence not capable of more intensive development are:

- Inner 50% of riparian corridor; and
- Land with a slope greater than 20%.

The combined environmental constraints mapping according to the following categories will assist with identifying the capability of land in the Investigation Area.

Table 4-3 Environmental Land Capability Outcomes

	Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
1	**Biodiversity**			
	Stewardship/Biobanking and Conservation Agreements	Significant implications No impact on capability	C	There are no current implications to land capability as a direct result of existing Stewardship/Biobanking and Conservation Agreements. However future development may require offsets within the detailed study area and may constrain development potential.
	Vegetation communities	Moderate Implications Low – moderate impact on capability	B	Areas of Threatened Ecological Communities (TECs) are considered to have high ecological value. Development and clearing within these areas and/or areas of native vegetation (not considered TECs) have potential to trigger application of the Biodiversity Offsetting Scheme (see Section 3.1.3). It is recommended that areas of TEC and native vegetation are given a land capability Category B. This does not preclude from development but acknowledges potential constraints associated with the level of legislative protection and ability to find suitable land to offset vegetation removal. Riparian corridors may provide an opportunity for establishing stewardship/offsets for vegetation removed in other parts of the detailed study area. Again this would depend on the condition of vegetation and the ability to meet the necessary criteria.
	Biodiversity Values	Biodiversity Values	B	
	Wildlife Corridors	Moderate Implications Moderate impact on capability	A B	Connectivity along wildlife corridors may provide critical habitat for mobile fauna (e.g. birds, mammals and reptiles) and are considered to provide moderate to high ecological value assuming the habitat conditions are suitable for fauna. In their own merits it is recommended wildlife corridors are Category A. However, given they also coincide with native vegetation, cumulative considerations should classify these areas as Category B (see **Section 4.1.3**)
	Threatened flora	Low-moderate Implications Low- moderate impacts on capability	B A	Given the key flora for THSC LGA have limited distributions, require offsetting and are listed under the BC Act it is recommended a Category B be applied to their potential habitats identified within the report. Consideration can also be given to applying Category A to *Hibbertia superans* habitat, as unlike *Eucalyptus* sp, it does not trigger requirements under the EPBC Act.
	Threatened fauna	Low-High implications	N/A	The presence of hollow bearing trees and feed trees will contribute to the occurrence of the Yellow-bellied Glider and hence the value to the potential habitat for the

	Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
		Low- moderate impacts on land capability. (Note: insufficient information to determine at this phase- see commentary)		species. Given the large area this level and detail of surveying required, this information would usually be determined during the planning approval process for a development. Consideration for protecting riparian corridors in general due to cumulative impacts is discussed further in **Section 4.10** and may provide a level of compromise.
	Threatened aquatic biodiversity	Moderate Implications Moderate impacts on capability	B	Waterways within the detailed investigation area are considered Category B as they are sensitive receiving environments and potential habitat for species listed under the *Fisheries Management Act* and fish passage is required to be maintained in Dooral Dooral Creek and O'Haras Creek.
	Matters of National Environmental Significance	No implications	A	Results showed the whole detailed investigation study area would trigger a MNES assessment, however Category A classification could be applied as these species only occur periodically in the detailed investigation study area. Impacts from development can be avoided through mitigation measures and habitat within the detailed investigation study area not exclusive to the area.
2	**Bushfire management**	No implications	A	Bushfire hazard should be assessed on a merit base and managed through the development approval process in accordance with the Rural Fires Act and relevant Rural Fire Service guidelines for development on bushfire prone land.
3	**Heritage**			
	European heritage	No implications	A	European heritage values are protected across zones within the relevant planning controls and guides.
	Aboriginal heritage	No implications	A	European heritage values are protected across zones within the relevant planning controls and guides.
4	**Flooding, Creeks and Watercourses**			
	Watercourses and groundwater	Significant Implications Moderate-high impact on capability	C	With respect to capability for development uplift within Riparian Corridors identified in accordance with the Office of Water it is recommended: • The inner 50% of the Vegetation Riparian Zone (VPZ) should be excluded from consideration for uplift in development capability. There are obvious

Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
			exceptions such as the provision of stormwater infrastructure etc. It is recommended that a 'no go' be applied to this portion of the riparian corridor. • The outer 50% of the VPZ should not be excluded for uplift capability if that is the only constraint applicable to the area. Development within this land can be managed through the development approvals process on a merits basis, depending largely on the activity proposed and the ability to offset. The cumulative environmental considerations of riparian corridors is discussed further in **Section 4.10**.
		B	
Groundwater dependent ecosystems	Low implications No impact on capability	A	Consideration to the groundwater infiltration rates to sustain GDEs usually need to be assessed to understand how alterations to hydrology and geomorphology will impact these GDE's ability to access to groundwater. However, given these GDEs are terrestrial and exist along the creeklines, which maintain adequate flows through these areas, it would inevitably sustain GDEs. As this is feasible due to the flooding nature of the creeks in this location it is recommended the capability classification, Category A be applied.
Flooding- 100 ARI Fringe Areas	Low- moderate implications Low- moderate impact on capability	A	It is recommended that areas in 100 ARI Fringe areas outside of the Flood Control Buffer could be suitably mitigated for flooding through application of DCP at planning approval stage and as such should be classified as Category A.
		B	Areas achieving 100 ARI Fringe classification within the Flood Control Buffer are recommended to be classified Category B on the basis of their importance to contributing to the wider flooding regime.
Flood Control Buffers	Low- moderate implications Low- moderate impact on capability	B	Where the Draft Urban Villages Overland Flow Study did not model, a conservative approach has been applied and consideration of applying Category B, with the potential for this to be refined in the event further modelling is undertaken.
Flood Control Lots	No implications No impact on capability	A	It should be noted Water Sensitive Urban Design and Water Re-Use opportunities in the planning and management of water would be considered for each proposed development at planning approval stage. Flood Control Lots are also applied via the DCP during the planning approval stage and are a mechanise for mitigation to be applied. Hence it has not been considered in the capability of the land.

	Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
				Stormwater controls are determined on a case by case basis at the planning approval stage, for the purposes of the land capability they have not been considered unless it is not feasible for them to be implemented.
5	**Soil Capability and Topography**			
	Topography 0-10%	No implications No impact on capability	A	Slope would not be an impediment to orderly development of land
	11-15%	Moderate implications Moderate impact on capability	A	Conventional measures likely to be required in formulating a development proposal.
	16-20%	Significant implications Significant impact on capability but not sufficient to preclude potential for development uplift	B	Slopes of this level should not as a single constraint preclude land from potential for development uplift.
	Greater than 20%	Major implications Major impact on development capability. Land at these slopes should be precluded from consideration for uplift in development intensity.	C	Higher density development on these slopes would be likely to impact negatively on the environment. Implementation of measures in the planning controls would be unlikely to sufficiently address all negative impacts.
	Soil Landscapes, Salinity Potential and Acid Sulfate Soils	Low implications No impact on capability	A	At present the detailed study has both residential, rural and semi-rural land use. The ability to continue existing land uses would not be impacted by the soil landscapes and potential salinity. Both these aspects can be managed by control measures applied by the planning controls. These environmental elements are considered to have no implication with regard to the capability of the land to absorb development uplift.
6	**Noise and Vibration**	Low implications No impact on capability	A	As part of the planning process, noise assessments are undertaken and used during the planning stages to identify suitable mitigation measures using a hierarchy pollution control approach (eliminate, substitute, control etc). This is also similar for industrial development.

	Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
				It is therefore anticipated that noise and vibration should not be applied to land capability but rather considered and assessed during the planning approval process. It is recommended the land capability be classified as Category A.
7	**Air Quality**	Low implications No impact on capability	A	Air quality impacts from development are associated with indirect changes with increased traffic and potential industry. Air quality in the high level investigation area are below acceptable levels and would not be directly affected by additional dwellings. There would be indirect impacts on air quality with increased traffic linked to additional dwellings and vehicle use in the area. This impact however, would not be of sufficient significance to influence capability considerations for development uplift. They would be addressed in the air quality assessment in the event the road infrastructure was upgraded or new roads build. It is recommended the land capability be classified as Category A
8	**Value of Resource Lands**	Significant implications	A	Any proposal to change use on the existing rural lands remaining in the investigation area should be subject to assessment against the planning principles for protection of the value of rural lands. Loss of opportunity for alternative rural uses must be a key matter for consideration in the decision making process.
9	**Scenic / landscape quality**	Significant implications		Scenic quality of rural lands is a matter for consideration raised in all of the strategic planning documents. Uplift of development density has significant potential to change scenic / landscape quality.

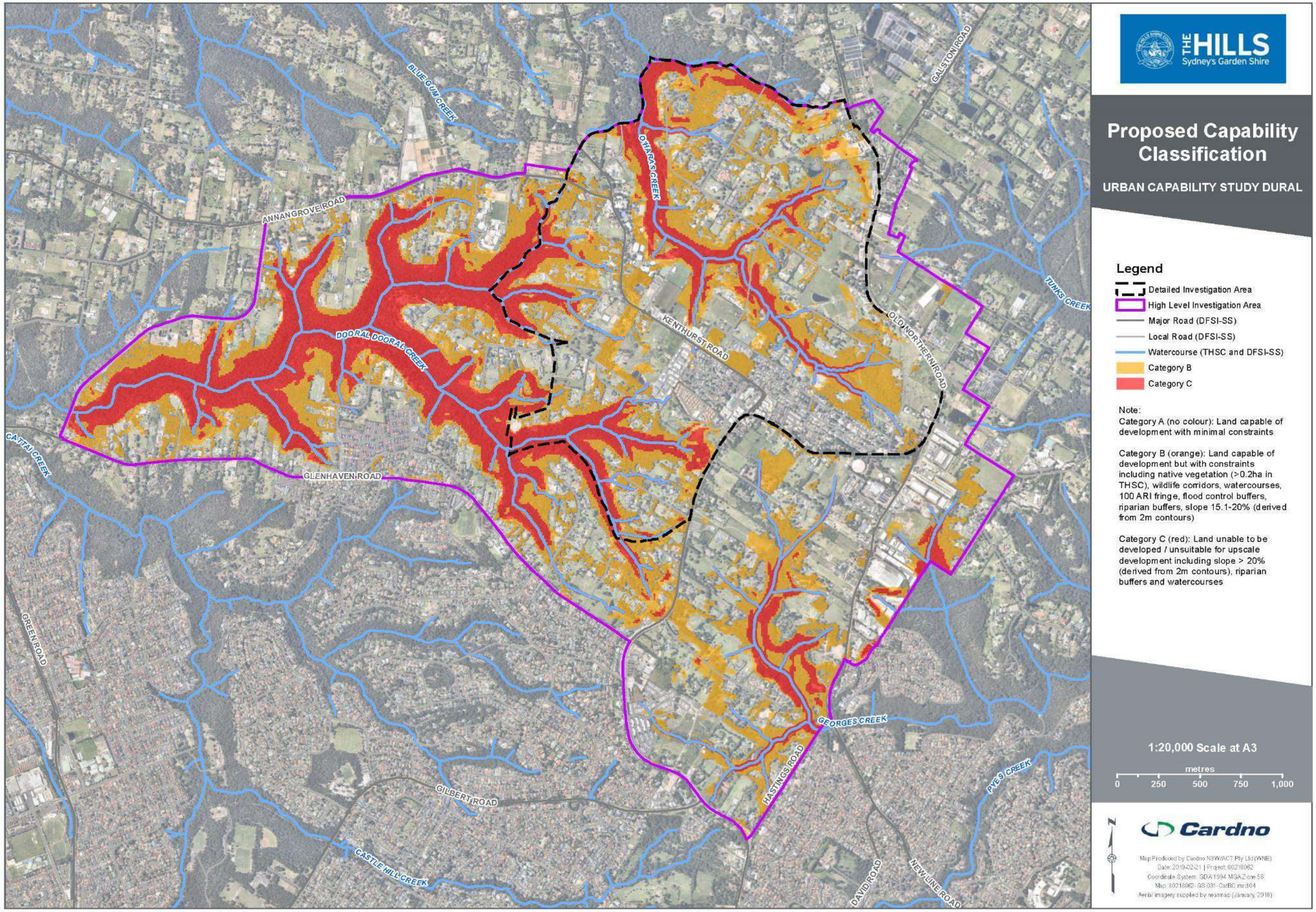


Figure 4-15 Land Capability Classification (Cardno, 2018)

5 Land Capability of Development

The “Land Capable of Development” map illustrates that when assessed against the physical, environmental and perceptual constraints, the land has variable capability for residential uplift.

Developed mixed use / residential land (coloured pink on the map), developed institutional land may be capable of uplift in development density without significant impacts on environmental quality.

Land coloured blue on the map has been found to be generally unconstrained for uplift in development density, subject to the detailed environmental assessment that would accompany a Planning Proposal or a Development Application.

Land coloured green has been found to be highly constrained with regard to environmental quality and hazard and is considered to be unsuitable for higher densities of development.

Land coloured brown has been classified as transitional (buffer) land. This land is considered capable of minimal development uplift, subject to assessment of hazards and impacts on the integrity of the adjoining undevelopable land.

Figure 5-1 identifies land within the Study Area that is capable of development.

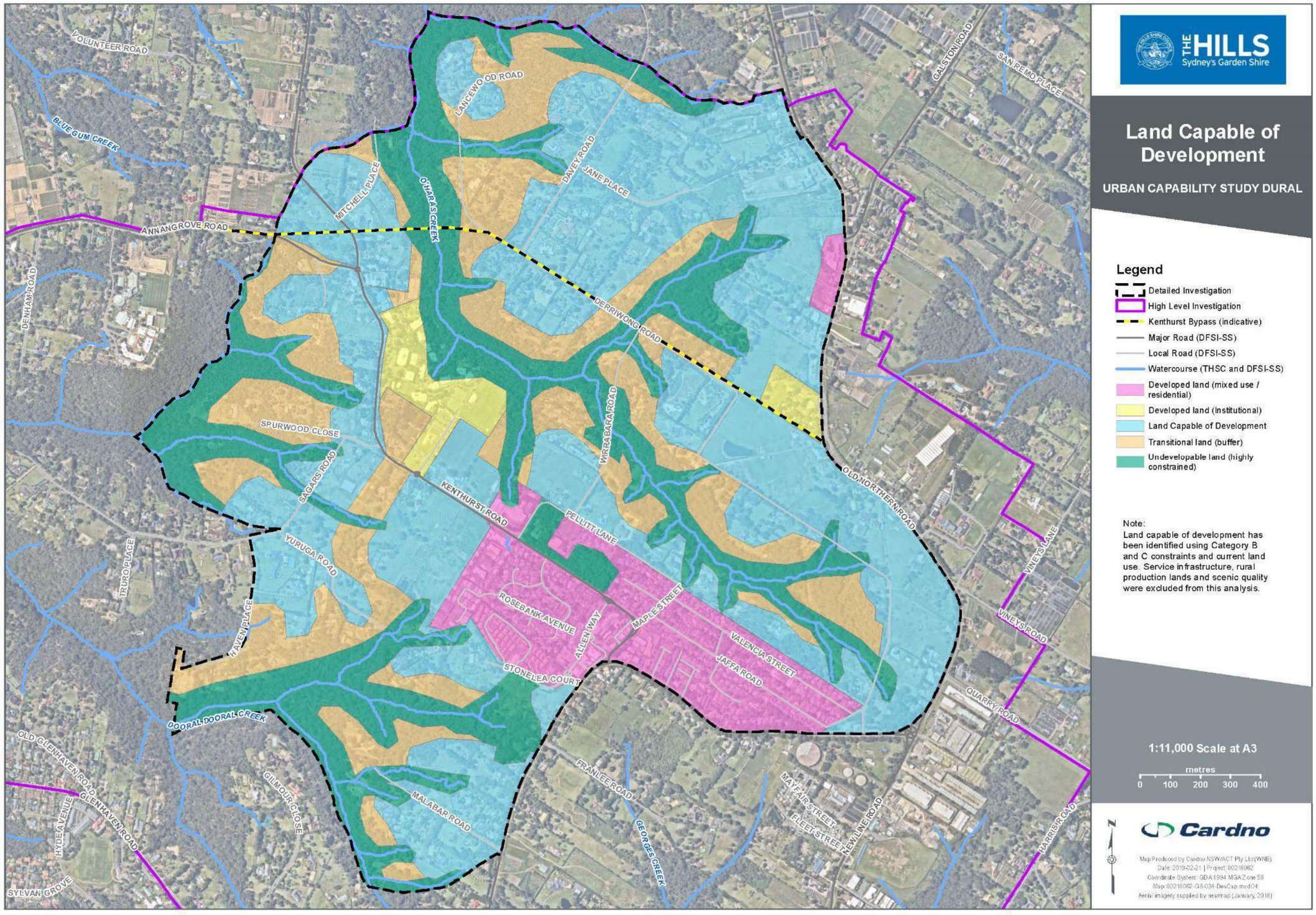


Figure 5-1 Land Capable of Development (Cardno, 2018)

6 Transport and service infrastructure capacity assessment

The environmental capability assessment work described above has culminated in the mapping of land with the potential to absorb additional development density without undue impacts on the quality of the local environment. In order to arrive at decisions regarding development capability it is also imperative that assessments be made of the capacity of local infrastructure to service the increased demands that would result of uplifts in development density. Concurrent with the environmental assessment process, Cardno has carried out an assessment of the existing local capacity for essential services. Results of these assessments are summarised below and detailed in the capacity assessment reports at:

- **Appendix B** – Traffic Report
- **Appendix C** - Potable & Waste Water Report
- **Appendix D** – Gas Service Report
- **Appendix E** – Electrical Report

6.1 Traffic and transport

6.1.1 Current Intersection Analysis

Annangrove Road/Kenthurst Road

The intersection of Annangrove Road / Kenthurst Road is currently operating at a LoS “B” and “A” during the AM and PM peak respectively. This represents an intersection which is operating with acceptable delays and spare capacity. The LoS is based on the worst movement, which in this instance is the left turn movement from car park access, however the volume of traffic associated with this movement is relatively low compared to the major movements (less than 5 vehicles), and as such does not necessarily reflect the intersection as a whole.

Old Northern Road/Kenthurst Road

The intersection of Old Northern Road / Kenthurst Road is currently operating and LoS “C” during the AM and LoS “D” during the PM peak hour. This represents an intersection which is operating satisfactorily however is subject to further investigation into accident history. The crash data set previously reviewed does not indicate any crash cluster or black spots that would indicate issues with the intersection performance.

During the morning period, the right turn from Kenthurst Road operates at LoS “E” whilst during the evening peak this movement deteriorates to LoS “F”. This specific movement is currently operating at capacity.

Old Northern Road/New Line Road

The intersection of Old Northern Road / New Line Road is currently operating and LoS “F” during the AM and PM peak hour. The LoS is based on the worst movement which is the Old Northern Road right turn towards Round Corner / Dural. LoS “F” represents an intersection operating over capacity. The Degree of Saturation also indicates that minor increases to traffic flow may have exponential impacts to the performance (although this is a limitation of the SIDRA software program and may not be realistic in operation as driver behaviour may become more aggressive as delays increase).

Old Northern Road/Quarry Road

The intersection of Old Northern Road / Quarry Road is currently operating and LoS “C” and “B” during the AM and PM peak respectively. This represents an intersection which is operating satisfactorily however is subject to further investigation into accident history. The crash data set previously reviewed does not indicate any crash cluster or black spots that would indicate issues with the intersection performance.

Furthermore, the right turn from Old Northern Road into Quarry Road currently operates at LoS “E” during the AM and PM respectively, which indicates this specific movement is operating at capacity.

Old Northern Road/Vineys Road

The intersection of Old Northern Road / Vineys Road is currently operating and LoS “F” during the AM and PM peak hour. The LoS is based on the worst movement which is the right turn movement from Vineys Road, however the volume of traffic associated with this movement is relatively low compared to the major movements (less than 10 vehicles), and as such does not necessarily reflect the intersection as a whole.

6.1.2 Improvements to Existing Conditions

There are existing constraints on the network that result in unsatisfactory performance, primarily as a result of congestion along Old Northern Road and New Line Road. These upgrades are required to cater for existing conditions and do not take into account additional growth in the Investigation Area.

Based on the existing network performance identified, the following works should be further investigated:

- Upgrade Old Northern Road / New Line Road roundabout to a signalised intersection; and
- Provide midblock lane capacity (i.e. duplication) along Old Northern Road and New Line Road. Widening along New Line Road would likely be from Sebastian Drive to Old Northern Road, whilst widening along Old Northern Road would be from Kentburst Road to New Line

It is evident that conversion of the roundabout to a signalised intersection significantly improves the intersections' performance. Following the upgrade, it is expected that the operation of the intersection would improve from LoS F to LoS C during the morning and from LoS F to LoS D during evening peak hour respectively.

Although the intersection was not necessarily performing unsatisfactorily, the increase in mid-block lane capacity and through movement is expected to improve the intersection by reducing delays in the AM (from LoS C to LoS B) and PM (from LoS D to LoS C) respectively.

6.1.3 Potential Cost Estimate

There are a number of unknown factors with regard to the intersection upgrade and capacity improvements, including utility relocation, subgrade conditions, and drainage. The following cost estimates are very high level and provided for strategic purposes only. They are an indication for the type of upgrade that may be identified by this study and would require further investigation into potential property acquisition, maintenance costs, provision of supporting infrastructure. Estimates should be confirmed by a quantity surveyor.

- Localised traffic signal improvements (e.g additional turning lanes) - $100,000-$300,000
- Significant traffic signal reconstruction - $300,000-$600,000
- New traffic signalised intersection (greenfield) - $500,000 – $1,500,000
- Road widening - $6,500 per metre

The works identified at Old Northern Road / Kenthurst Road are likely to be categorised as localised signal improvements, however the midblock section would be considered as road widening.

The significant upgrade of Old Northern Road / New Line Road would be classified as a new signalised intersection. However, this intersection is a significant upgrade and is expected to require traffic control during the course of construction and potential geometry realignment on approaches. This upgrade alone could cost approximately $5-10 million dollars. As Old Northern Road and New Line Road are both Classified Roads (owned by the NSW State Government), a funding commitment by RMS is required to achieve any upgrades.

6.2 Water and Waste Water

6.2.1 Potable water

Existing service and capacity

The investigation area is currently within the South Dural water supply zone (WSZ), which is ultimately supplied from the Prospect water filtration plant. The zone is supplied by the South Dural reservoirs (WS0288, WS0112 and WS0158) which are located to the south east of the investigation area.

The rural, larger lot properties in the west of the investigation are supplied by dual water mains that follow the Annangrove Road alignment from Dural to Annangrove, for approximately 9 km

Outside of the investigation area, the South Dural WSZ, and consequently the South Dural reservoirs are the primary water supply for the communities of Glenhaven, and parts of Castle Hill and Rogans Hill to the south. To the north of the investigation area, the South Dural reservoirs supply potable water to the community of Kenthurst and the surrounding rural properties.

Planned amplifications

The water distribution pipe network in the vicinity of the Dural investigation area is predicted to have the capacity to support a denser population in the existing township, as well as expansion of the township margin. This expansion would be along the existing road corridors of Kenthurst Road and Old Northern Road, where the existing water mains would have the capacity to provide sufficient potable water.

The available storage at the South Dural Reservoir was identified as the key constraint to growth within this area, as Sydney Water indicated that this reservoir was at capacity. Additional demand would lower the level of performance, and/or the volume of emergency storage to an unsatisfactory level, placing Sydney Water at an unacceptable level of risk. To mitigate risk, Sydney Water would require an additional Reservoir to be constructed.

Potential Cost Estimate

Without considering the costs associated with land acquisition, generally a 1 ML reservoir provides sufficient potable water for approximately 2,000 dwellings. The cost of these structures, including design is approximately $4.0 million for a surface steel structure, or $6.5 million for an elevated structure.

In addition to the additional reservoir, the trunk and distribution network would need to be connected to the new reservoir. A general cost for water main installation would be $750/m. If the new reservoir is located at the existing reservoir location, the capital investment in new pipe would be minimal.

Based on the above, and assuming the pipe network supply to the existing South Dural Reservoir has sufficient capacity, an investment of approximately $4 million into water infrastructure would be needed to provide potable water to an additional 2,000 dwellings within the Dural Township.

6.2.2 Waste Water

Existing service and capacity

Currently, there is minimal sewer infrastructure within the investigation area. The Dural township to the west of Old Northern Road, is the only area that is currently serviced by Sydney Water's sewer network.

The majority of the investigation area is not serviced by Sydney Water sewer, with large rural lots expected to have private septic or pump out sewer arrangements.

Planned amplifications

The sewer network servicing the detailed investigation area, is constrained by the capacity of the existing sewer pumping station and it associated rising main, which is at capacity based on information provided by Sydney Water.

An increase in the sewer load through densification of the existing development area, or development expansion, could generate flow contributions that exceed the capacity of the pumps during wet and dry conditions. This increases the risk of Sydney Water not satisfying their license agreement, as well as generating environment and public health risk. This is not considered acceptable to Sydney Water and augmentation would be needed.

Potential Cost Estimate

To service further development in the detailed investigation area, a new rising main would be required in addition to a new pumping station. It should also be noted that any upgrades of this delivery system would potentially require the receiving gravity sewer to be upgraded also. A summary of potential upfront costs:

- New 4 km rising main along the existing alignment (Old Northern Road)- $6.5 million
- New pumping station - $4.0 million
- Gravity Sewer Upgrade – $2.5 million

It is estimated that an initial investment of $13 million would be required to allow for an additional 3,000 of lots through the densification of the existing Dural Township, or via greenfield growth within the detailed study area. This is an estimate, and does not include works that maybe required that the Castle Hill STP.

6.2.3 Recycled Water

Sydney Water owns and operates a recycled water network from the Rouse Hill advanced water treatment plant that provides recycled water to the existing communities of Rouse Hill, Glenwood, Kellyville, Parklea, Quakers Hill and Castle Hill. In total this scheme currently services 32,000 properties, which is predicted to increase through the redevelopment of the Metro corridor.

The Rouse Hill recycled water catchment does not include the investigation area, and at present Sydney Water do not intend to expand the existing catchment boundaries. Thus, recycled water supply has not been included in this assessment.

6.3 Gas

Existing service and capacity

Jemena Gas Network (NSW) Ltd is responsible for the gas supply to the investigation area.

There are existing gas supplying pipelines running to the investigation area. According to the gas network information from Jemena, a 210kPa gas network main is available at Old Northern Road, Glenhaven Road and part of the Kenthurst Road. The gas network will be further extended to meet future demands as required.

Planned amplifications

Cardno consulted Jemena in relation to their network and development procedures. Jemena indicated that the natural gas is available in the vicinity of the study area and could be extended to supply the proposed development. However, Jemena must ensure that any extension of the distribution system is commercial viable and assessed on a case by case basis. Should the development not prove to be viable for Jemena, a contribution fee may be required to be paid by the developer to assist in economic viability.

6.4 Electrical

The Dural Load area (which includes land in the subject investigation area) has existing capacity to supply small developments of 175 to 230 small/medium sized lots before requiring upgrades to the local 11kV network back to the Kenthurst Zone.

Whilst this capacity can be delivered to multiple locations within the study area, the reticulation cost will vary depending on the particular location.

The investigation area has not been identified as a growth area by Endeavour Energy.

Endeavour Energy does not have any long-term infrastructure plans to increase capacity in the investigation area.

Kenthurst Zone could accommodate approximately 800 to 1100 small/medium sized lots in the short term, before requiring investment in a new zone substation and sub transmission feeders.

Potential Cost Estimate

The costs associated with lead in works would be borne by the developer with contributions from Endeavour Energy dependant on individual projects and their location, however it is expected that this would be installed along existing or proposed roads. An approximate cost for a new 11kV feeder is $688,500 per km, and reimbursement costs from Endeavour Energy would vary depending on the developer’s load and location.

6.5 Conclusion

The table below provides a summary of the capability of existing infrastructure within the vicinity of the site.

Table 6-1 Infrastructure Capability Assessment

	Matter for Consideration	Commentary	Potential Cost Estimate
1	**Traffic**	• The road network within the study area is considered to be currently operating over capacity without taking into account the continual growth of traffic from growth centres (e.g. North West Growth Centre) and other development areas within LGA. This is evident by the midblock summaries showing the majority of the single lane road segments carrying traffic volumes above the theoretical thresholds whilst intersections within the study area also operate below LoS "C". • The assessment identifies road improvements mainly along Old Northern Road and New Line Road that would significantly improve the existing network performance. These improvements are suggested to cater for the current traffic demands, with additional works and improvements likely to be required for further growth. • If intersection capacity and midblock sections are not improved with increased road capacity, then traffic flow efficiency (travel times) will deteriorate further. • Public transport and active transport can also impacted by traffic congestion, with bus service times and reliability likely to deteriorate whilst walking and cycling routes become less attractive as congestion increases. These transport modes should also be considered in future upgrades through provision of separated cycling and walking tracks and bus priority at intersections such as Old Northern Road / Kenthurst Road and Old Northern Road / New Line Road.	The following cost estimates are very high level and provided for strategic planning purposes only. It does not taking into account utility relocation, subgrade conditions and drainage. Further investigation into potential property acquisition, maintenance costs and provisions of supporting infrastructure is also required. • Localised traffic signal improvements (e.g additional turning lanes) - $100,000-$300,000 • Significant traffic signal reconstruction - $300,000-$600,000 • New traffic signalised intersection (greenfield) - $500,000 – $1,500,000 • Road widening - $6,500 per metre ***Note:*** • *The works identified at Old Northern Road / Kenthurst Road are likely to be categorised as localised signal improvements.* • *Midblock section would be considered as road widening.* • *The significant upgrade of Old Northern Road / New Line Road would be classified as a new signalised intersection. However, this intersection is*

	Matter for Consideration	Commentary	Potential Cost Estimate
			a significant upgrade and is expected to require traffic control during the course of construction and potential geometry realignment on approaches. This upgrade alone could cost approximately $5-10 million dollars. • *As Old Northern Road and New Line Road are both Classified Roads (owned by the NSW State Government), a funding commitment by RMS is required to achieve any upgrades.*
2	**Water and Wastewater**	• The investigation determined that Jemena currently has a gas network in the vicinity of the investigation area. • Jemena will cooperate with the developers to improve the network as required, as long as the development is commercially viable. • Should the development not be deemed viable for Jemena, the developer may be required to provide contribution fees to ensure the provision of gas services. • Jemena would determine these contribution fees on a case-by-case basis and was not in a position to provide further advice at this time.	It is estimated that to provide potable water and sewer service to the detailed investigation area, an investment of approximately $20 million would be required to facilitate the initial growth in this area. This initial investment assumes that no augmentation works would be required at; Prospect Water Treatment Plant, to the water delivery network to the South Dural Reservoir, or to the Castle Hill STP. If any of these items are triggered for upgrades, this initial investment would be increased significantly. Additionally, the costs associated with connecting individual development to the water or sewer networks have not been included. This would add additional servicing costs onto developers.

	Matter for Consideration	Commentary	Potential Cost Estimate
3	**Gas**	• The investigation determined that Jemena currently has a gas network in the vicinity of the investigation area. • Jemena will cooperate with the developers to improve the network as required, as long as the development is commercially viable. • Should the development not be deemed viable for Jemena, the developer may be required to provide contribution fees to ensure the provision of gas services. • Jemena would determine these contribution fees on a case-by-case basis and was not in a position to provide further advice at this time.	A full economic evaluation is required to be undertaken by Jemena to determine the costs of the gas network upgrade. Should the development not prove to be viable for Jemena, a contribution fee may be required to be paid by the developer to assist in economic viability of the proposal.
4	**Electricity**	• The Dural Load area (which includes land in the subject investigation area) has existing capacity to supply small developments of 175 to 230 small/medium sized lots before requiring upgrades to the local 11kV network back to the Kenthurst Zone. • Whilst this capacity can be delivered to multiple locations within the study area, the reticulation cost will vary depending on the particular location. • The investigation area has not been identified as a growth area by Endeavour Energy. • Endeavour Energy does not have any long-term infrastructure plans to increase capacity in the investigation area. • Kenthurst Zone could accommodate approximately 800 to 1100 small/medium sized lots in the short term, before requiring investment in a new zone substation and sub transmission feeders	An approximate cost for a new 11kV feeder is $688,500 per km, and reimbursement costs from Endeavour Energy would vary depending on the developer's load and location.

7 Summary and Conclusion

7.1 Planning background

The investigations have found that there are no state government plans to intensify development within the investigation area. The Central City District Plan maps the investigation area within the Metropolitan Rural Area, the intention being that the area would remain rural in character and development density would reflect this. The investigation area has not been identified for future growth in the District Plan. Nor have other state or local strategic plans identified the area as having potential for future growth.

7.2 Transport and service infrastructure constraints

Our assessment with respect to transport / service infrastructure has found that at the existing level of development, the critical road network within and in the vicinity of the Dural Investigation Area is running over its service capacity. Any uplift in development density within the investigation area would require major upgrades to the road network in order to achieve acceptable performance levels. There is currently no government will to invest in the required network upgrades.

7.3 Capacity for service infrastructure (potable and waste water, gas and electricity)

Cardno's investigations of the capacity of the existing service infrastructure in the locality to support additional development have found:

- There is no spare capacity in potable and waste water to support additional development in the investigation area and there are no plans to upgrade these services.
- There is very limited spare capacity in the existing electricity supply system in the investigation area. Development yielding more than approximately 230 additional residential units would require upgrading of the local network. The area as a whole has not been identified as a growth area by Endeavour Energy and it does not have any long term infrastructure plans to increase capacity in the area. Gas supplies are also limited in the locality and new supply lines would be required to support development uplift. Supply companies would be likely to require supply extensions or amplifications to be developer funded.

7.4 Conclusions

Based on the results of the investigation, Cardno concludes that:

- There are no government plans to encourage additional growth in the investigation area.
- The investigation area has some physical capability for development uplift.
- Constraints arising from lack of capacity in transport and service infrastructure would be likely to preclude any development uplift in the investigation area. At this time, there is no government will to invest in upgrades to these services. Private investment in infrastructure would be necessary to facilitate any substantial development uplift.

APPENDIX

A

ENVIRONMENTAL STUDY REPORT

Environmental Study Report

Urban Capability Capacity Dural

80218062

Prepared for
The Hills Shire Council

8 March 2019

Cardno

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Glossary and Abbreviations

AHIMS	Aboriginal Heritage Information Management System
ASS	Acid Sulfate Soils
Baulkham Hills Shire Council	Former Council (is now The Hills Shire Council)
BC Act	*Biodiversity Conservation Act 2016*
BOM	Australian Bureau of Meteorology
Cardno	Cardno (NSW/ACT) Pty Ltd
CBD	Central Business District
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EEC	Endangered Ecological Community, listed under Schedule 1 of the BC Act
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulations	*Environmental Planning and Assessment Regulation 2000*
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
FM Act	*NSW Fisheries Management Act 1994*
Hornsby LEP	Hornsby Local Environment Plan 2013
Infrastructure SEPP	*State Environmental Planning Policy (Infrastructure) 2007*
LEP	Local Environment Plan
LGA	Local Government Area
LPI	Land Property Information (currently known as the Department of Finance, Services and Innovation)
NES	National Environmental Significance. Matters of NES are listed under the EPBC Act
OEH	NSW Office of Environment and Heritage
PMST	Australian Government's Protected Matters Search Tool
SEPP	State Environmental Planning Policy
Shire	Refers to The Hills Shire Council
The Hills District Area	Area covered by The Hills Shire Council
The Hills LEP	The Hills Local Environment Plan 2012
The Hills Shire	Refers to The Hills Shire Council
TSC Act	Former *Threatened Species Conservation Act 1995*
VRZ	Vegetated Riparian Zone

Table of Contents

Appendices

Tables

Figures

1 Introduction

The Hills Shire Council (THSC) is investigating opportunities for urban growth in the Dural locality. The Hills Shire Council has engaged Cardno to undertake a Phase 1 Urban Capability and Capacity Assessment, which has the following three key components –

a) Environmental Study Report

b) Infrastructure Capacity Investigation including Power, Water, Traffic and Gas.

c) Indicative Structure Plan.

The purpose of the overarching Urban Capability Assessment is to determine the suitability of land on the rural/ urban interface in the Dural locality to sustain urban land uses, including the environmental capability of land, potential yields and assessment of infrastructure capacity and funding options. The assessment takes a holistic approach to determining the capacity and capability of the area.

The area of investigation (outlined in Section 1.3) is mainly within Dural, on the northern fringe of the Sydney Metropolitan Area. It is located 50km from the Sydney CBD and 25km from Parramatta CBD. The area within and near the village of Round Corner Dural is the focus of investigations.

The suburb of Dural is located in both The Hills Shire Local Government Area (LGA) and Hornsby Shire LGA, with Old Northern Road forming the boundary between the two Council areas. Round Corner is a local town centre in the south-western part of Dural.

1.1 Purpose of the Report

The purpose of this report is to identify the environmental features of the land and analyse whether these present constraints to development for urban purposes. The report summarises the findings of the background environmental searches and review of Council documents to develop an environmental suitability analysis of the land.

The Environmental Study Report provides high level environmental baseline information to support decision-making about whether there is merit in pursuing an urban land release pathway. This report documents the environmental study that has been undertaken to inform and support decision making about the capability of land in the Dural locality. The research approach adopted for this report included:

- A review of existing studies and database searches;
- A review of strategy and policy documents;
- The identification of legislative requirements;
- A review and analysis of environmental constraints; and
- Establishing recommendations and identifying the next steps for classification of these areas based on the environmental constraints of the land.
- Environmental database searches and a review of existing Council literature was undertaken to identify potential environmental constraints and thereby potential areas not being capable for growth.
- Following the desktop review, a site visit was undertaken to validate the information and document the existing environment against the mapping as well as assess the investigation area and its potential environmental constraints in key locations.

The study has identified that the following key environmental considerations will influence future decision-making about land capability in the investigation area:

- Vegetation communities;
- Wildlife corridors;
- Threatened flora and fauna;
- Waterways and threatened aquatic biodiversity;
- Inner and outer riparian corridor;
- 100 year flood prone land; and

- Land with a slope that is greater than 20%.

These environmental factors were mapped and compared to determine where environmental constraints could be managed and still enable some development to occur and where they would prevent development from occurring. In many cases, it is not one single environmental constraint that would prevent development from occurring but a combination of these constraints on the same land that has led to the land being classified as undevelopable. The land classification will feed into the overarching urban capability assessment, infrastructure assessment and structure plan.

1.2 Description of the Land

1.2.1 Land use and access

The detailed Investigation Area incorporates a mosaic of land uses including:

- Tracts of bushland generally following existing local creek lines;
- Large lot residential areas in semi-rural settings;
- Conventional low density residential areas;
- Medium density housing (largely in the form of Seniors Living developments) and townhouses in Round Corner / Dural; and
- One consolidated retail / commercial precinct (at Round Corner, Dural).

Vehicular access to the area is via regional roads including New Line Road, Old Northern Road, Annangrove Road and Glenhaven Road. Access within the investigation area is via a series of feeder roads and connector roads, many of which are relatively narrow and of a rural or semi-rural character.

1.2.2 Demographics

An overview of the demographics of the investigation area has been derived from a review of demographic data available on the Hills Shire Council website and the Australian Bureau of Statistics (ABS) 2016 Census data base. Investigations were carried out with the objective of identifying existing population densities, age range, levels of employment and income, land tenure and transport profiles. Comparisons were made using similar criteria against the adjacent Castle Hill area and overall statistics for the Sydney Metropolitan Area. The collected data against these criteria is summarised in **Table 1-1**.

The key demographic characteristics of the investigation area are:

- **Development density** – the investigation area has developed at very low density in comparison to other local areas (3.41 dwellings/ha compared to 23.95 dwellings / ha in neighbouring Castle Hill).
- **Employment** – the area enjoys a low rate of unemployment (4.14% compared to 6% for the Sydney Metro Area) and employment types are similar to Castle Hill and the Sydney Metro area.
- **Weekly income** - Higher proportion of the population in the Investigation Area has an income of greater than $2,000 when compared to Greater Sydney.
- **Home ownership** - rates are comparatively high (35.29% of households either own their homes outright or with a mortgage, compared to 31.5% for the Sydney Metro).
- **Car ownership** – rates are very high: 37.87% of households own 3 or more cars and 2% of households do not own a car. This is compared to 14.9% of households in the Sydney Metro Area owning more than 3 cars and 10.7% not owning a car.
- **Trips to work** - are private vehicle dominated (69.1% of the population travel to work by car while 8.96% travel to work by public transport only. Sydney Metro statistics for car travel are also high – 56.6% travel to work by car but public transport is a much more represented mode across the Metro area - 20.6% travel to work by public transport. Others travel via a combination of private and public transport).

Table 1-1 Demographics – comparative analysis between the Investigation Area and local and regional data (Source – Profile ID)

	Investigation Area (Dural/Kenthurst/Glenhaven)	Castle Hill	Greater Sydney
Household Type/Age Categories	0-9 years (11.15%) 10-19 years (14.83%) 20-29 years (11.21%) 30-39 years (8.04%) 40-49 years (13.69%) 50-59 years (14.11%) 60-69 years (12.66%) 70-79 years (8.63%) 80+ years (5.68%)	0-9 years (12.54%) 10-19 years (13.91%) 20-29 years (10.53%) 30-39 years (11.69%) 40-49 years (14.43%) 50-59 years (13.45%) 60-69 years (11.26%) 70-79 years (6.83%) 80+ years (5.36%)	0-9 years (12.84%) 10-19 years (11.80%) 20-29 years (14.97%) 30-39 years (15.51%) 40-49 years (13.73%) 50-59 years (12.18%) 60-69 years (9.45%) 70-79 years (5.74%) 80+ years (3.77%)
Density Per Hectares	3.41 dwellings / h	23.95 dwellings /h	Data not available
Unemployment Rate	4.14%	4.9%	6%
Employment	Construction (14.81%) Retail Trade (10.411%) Health Care and Social Assistance (10.46%) Professional, Scientific and Technical (10.17%) Education and Training (9.67%)	Construction (7.87%) Retail Trade (10.41%) Health Care and Social Assistance (12.07%) Professional, Scientific and Technical (11.71%) Education and Training (9.75%)	Construction (8.2%) Retail Trade (9.3%) Health Care and Social Assistance (11.6%) Professional, Scientific and Technical (9.8%) Education and Training (8%)
Weekly Income (Individual)	Negative Income/Nil Income (10.78%) $500-$649 (7.36%) $1,000-$1,249 (7.5%) $2,000-$2,999 (8.37%) $3,000 or more (8.37%)	Negative Income/Nil Income (12.39%) $500-$649 (6.38%) $1,000-$1,249 (8.27%) $2,000-$2,999 (8.83%) $3,000 or more (6.57%)	Negative Income/Nil Income (11.3%) $500-$649 (6.6%) $1,000-$1,249 (8.5%) $2,000-$2,999 (6.1%) $3,000 or more (4.5%)
Housing Tenure	Owned with Mortgage (35.29%) Owned outright (41.31%) Rented (7.94%)	Owned with Mortgage (32.33%) Owned outright (29.4%) Rented (15.99%)	Owned with Mortgage (31.5%) Owned outright (27.7%) Rented (32.6%)
Car Ownership	1 Car (18.90%) 2 Cars (36.89%) 3 Cars+ (37.87%) None (1.99%) Not Stated (4.36%)	1 Car (27.10%) 2 Cars (42.12%) 3 Cars+ (22.47%) None (4.13%) Not Stated (4.18%)	1 Car (35.4%) 2 Cars (31.1%) 3 Cars+ (14.9%) None (10.7%) Not Stated (8%)
Trip to Work Mode	Car, as driver (65.79%) Car, as passenger (3.3%) Bus (5.13%) Train (3.83%) Worked at home (9.49%)	Car, as driver (62.1%) Car, as passenger (3.6%) Bus (13%) Train (6.7%) Worked at home (4.7%)	Car, as driver (52.7%) Car, as passenger (3.9%) Bus (6.1%) Train (16.2%) Worked at home (4.4%)

1.3 Investigation Area

1.3.1 Identification of the Investigation Area

The extent and location of the investigation areas for the assessment was determined by Cardno in consultation with The Hills Shire Council. Two areas were defined and mapped in **Figure 1-2 Project Area**. These investigation areas are:

- High Level Investigation Area (red boundary); and
- Detailed Investigation Area (black dotted boundary).

The Hills and Hornsby Shire Councils have received a number of unsolicited Planning Proposals to rezone land near Round Corner, Dural. The intent of this study is to provide The Hills Shire Council with an independent and fully considered assessment of the capability of the Dural locality, for future development. On this basis, the Detailed Investigation Area has been identified to include Round Corner, the lands covered by current Planning Proposals in Dural and other nearby concentrations of development. It has also been confined to land within The Hills Local Government Area.

In order to ensure an appropriate context for the study, a broader High Level Investigation Area has been identified which includes surrounding villages and suburban areas, as well as transport connections between these and the Detailed Investigation Area. The edges of the Investigation Areas have been defined by natural features such as local creek lines, edges of existing residential development and by Arterial Roads (and connecting roads between these).

1.3.2 Description of the Investigation Area

The High Level Investigation Area encompasses the suburbs of Dural, Glenhaven, Castle Hill and Kenthurst (see **Figure 1-2**). The majority of the area is within The Hills Shire Local Government Area (LGA) with a portion along the east side being within the Hornsby LGA (Hornsby Shire Council). This area is bordered by Annangrove Road (regional road no.7141) and creek lines to the north, Bannerman Road to the west (a local connector road), Glenhaven Road to the south (a local connector road) and various local roads including Hastings Road to the east.

The Detailed Investigation Area is comprised of the suburbs of Dural, Kenthurst and Glenhaven. The main shopping / residential area is Round Corner, situated on Old Northern Road. The Detailed Investigation Area mainly consists of large, rural lots along the main roads (i.e. Old Northern Road, Glenhaven Road, Kenthurst Road), with dense vegetation along the riparian corridors. Low density residential subdivision in the area is primarily focussed around the Round Corner, Dural centre.

The Detailed Investigation Area is the land that is the subject of this environmental and planning study. The High Level Investigation Area provides a wider contextual understanding of the locality and also allows for potential opportunities for connections in the vicinity of the Detailed Investigation Area.

1.4 Assessment Methodology

The environmental study undertaken to assess the environmental capability of the Investigation Area for uplift in development has included the following tasks:

1.4.1 Desktop Review

A desktop review of information that is held by Council or is available on conventional databases has been used in order to establish baseline constraints within the Detailed Investigation Area. Where appropriate, these baseline constraints have also been mapped with the Higher Level Investigation Area to assist in understanding and assessing the wider implications and indirect impacts. Latest aerial photography available on NearMap has been utilised to cross check database items prior to field validation.

In addition to Council documents, standards, policies and guidelines relevant to each environmental aspect were also reviewed. Where these documents provided information to inform or determine the capability of the land then the information has been summarised in the specific section of the Environmental Constraints and Opportunities section.

The following databases have been reviewed to inform the environmental study:

- Threatened Species and Biodiversity:
    - Conservation Agreements Register;
    - OEH Atlas of NSW Wildlife;

  - OEH Spatial data;
  - Biobanking Registers;
  - Environmental Protection Biodiversity Conservation (EPBC) Database;
  - DPI NSW Fisheries Records;
  - Atlas of Living Australia;
  - Noxious Weed; and
  - OEH Critical Habitat Register and DPI NSW Register of Critical Habitat.
- Heritage
  - Australian Heritage Database;
  - NSW State Heritage Inventory;
  - Local Heritage LEP Heritage listings;
  - Native Title Tribunal;
  - AHIMS; and
  - Section 170 Registers.
- Flooding, Creeks and Watercourses
  - NSW Estuaries;
  - NSW Water Quality and River Flow Objectives;
  - Australian Flood Studies Database;
  - BOM Atlas of Ground Water Dependent Ecosystems; and
  - Groundwater Bores/Wells.
- Soil Capability and Topography
  - Acid Sulfate Soils- NSW Natural Resources Atlas;
  - Contaminated Soils- EPA Contaminated Land Record;
  - Geological landscapes – Resources and Energy maps; and
  - Soil Landscapes - Map data.
- Strategic Planning Framework

A review of the State and Local Government strategic planning framework has been completed to determine medium term planning aspirations for the Hills District in general and the Detailed Investigation Area with regard to targets for:

  - Population;
  - Employment lands;
  - Rural / production lands; and
  - Health, education and social infrastructure.

This background information identified key values for each environmental aspect that may be a consideration in determining land capability.

1.4.2 Constraints Mapping

An initial constraints mapping exercise used information from the desktop review to identify potential areas for consideration. It was also used to develop the assessment methodology and to identify any initial ‘no-go’ areas. This allowed for the identification of focus areas for the next step and engagement of key environmental specialists to discuss:

- Establishing an appropriate methodology of assessing constraints;
- The ability and need to mitigate constraints as part of land capability versus during the development application phase;

- The outcomes of the assessment; and
- Addressing any constraints which have higher levels of complexity.

Environmental Constraints and Opportunities

Analysis of the scientific data was undertaken and environmental constraints and opportunities were reported with consideration given to:

- Background studies;
- Recognised assessment methodology of the constraints for each specialist area;
- Legislative requirements; and
- The Hills Shire Council's strategies, policies and objectives.

A site visit was also undertaken to any areas that required ground truthing due to mapped endangered ecological communities. Such areas were identified and surveyed, where accessible, by Cardno' s ecologist.

The methodologies used in the investigation of environmental constraints and opportunities are outlined in the relevant sections in Chapter 3. The methodology for each environmental aspect was tailored in response to the information available and with the application of the relevant legislation and guidance. Consideration was given to the stage at which the constraint was applicable, for example if it should be applied across the Detailed Study Area or if it should be addressed at the precinct planning or development application stage.

1.4.3 Environmental Capability Recommendations

The environmental capability of land in the Detailed Investigation Area has been established based on the findings outlined in this Study. Generally, existing studies, database information and validation of data using NearMap was used to determine constraints and opportunities. These were mapped and through an iterative process were updated in consultation with Cardno specialists, stakeholder workshops with The Hills Shire Council stakeholders, and as new information became available. Initially constraints and opportunities were assessed by each individual environmental aspect listed in Chapter 3, followed by consideration of cumulative effects. Establishing the environmental capability involved the following key steps:

- The use of overlay of maps and field investigations.
- Identifying potential areas that are unsuitable for urban development based on known environmental constraints.
- Applying a preliminary category classification based on the environmental study information.

Following this analysis, the environmental suitability of the land to be developed was mapped based on three environmental capability categories:

1. Category A: Land capable of development with minimal constraints
2. Category B: Land capable of development but with constraints
3. Category C: Land unable to be developed / unsuitable for urban development

The Environmental Capability Categories of land in the Study Area are identified on **Figure 2-3**.

Consultation with Council

Two workshops were held with Council on 17 May 2018 and 9 November 2018 to:

- Discuss the recommended approach for areas where the environmental capability is particularly complex;
- Review the existing capability of land in the Detailed Investigation Area; and
- Discuss the various management approaches for land identified as being potentially suitable for development.

1.4.4 Next Steps

The environmental constraints classifications will feed into the overarching Urban Capability Assessment for the Dural locality.

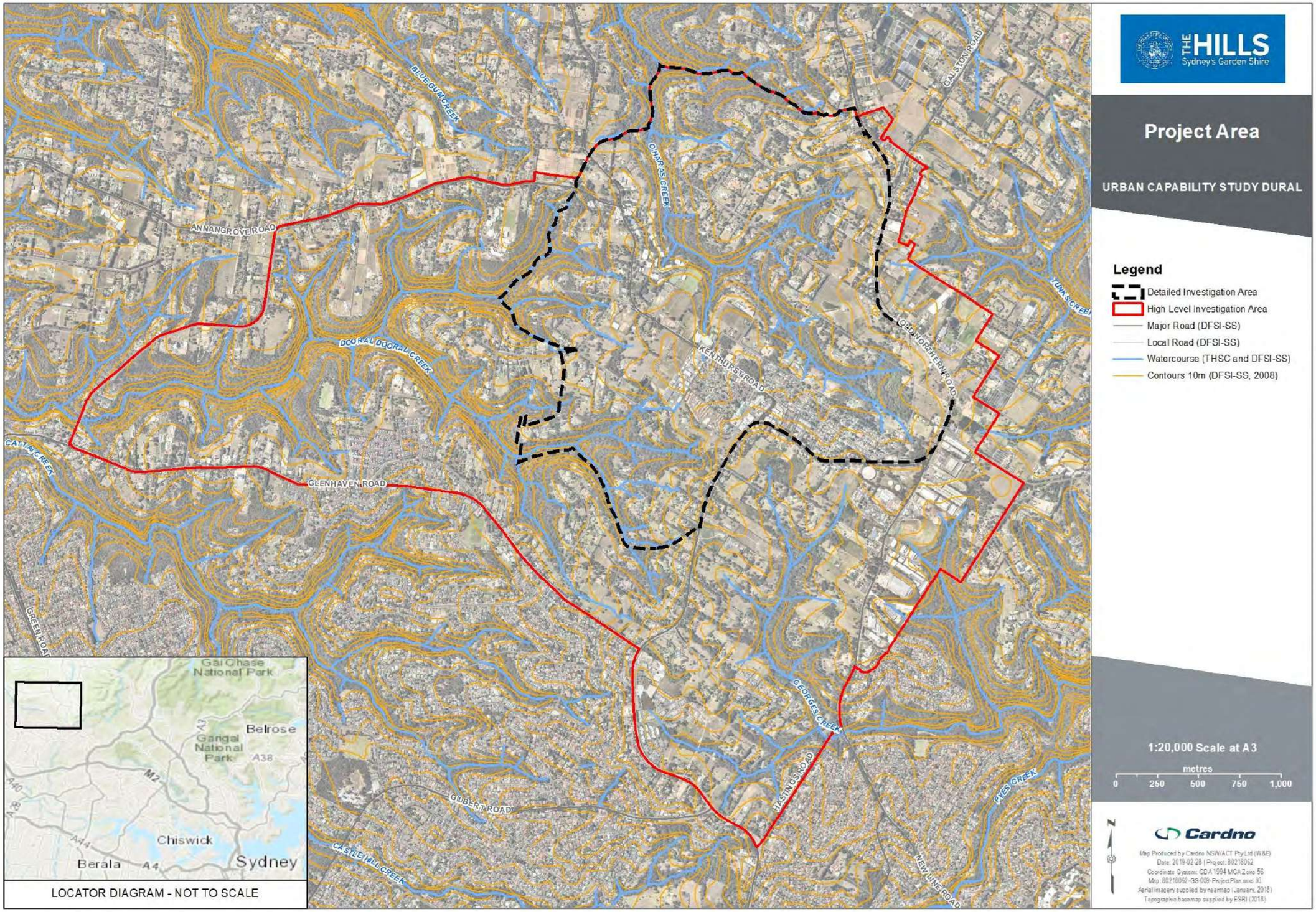

Figure 1-2 Project Area

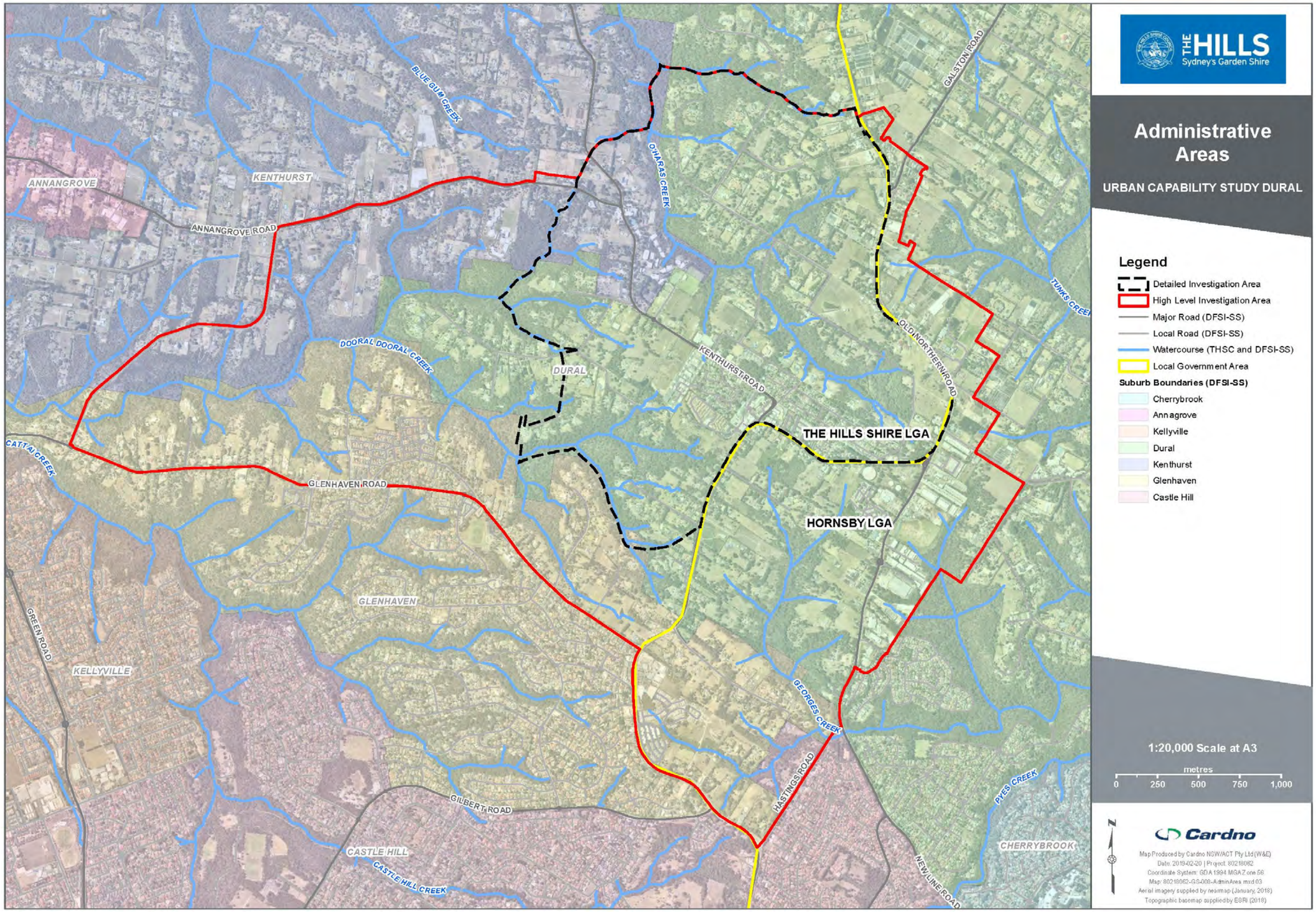

Figure 1-3 **Administrative Areas**

2 Strategic and Legislative Context

2.1 Strategy and Policy

Analysis of the strategic planning framework that influences the future direction for land within the investigation areas has included a focused review of the following studies, policies and plans:

- *A Metropolis of Three Cities and The Central City District Plan*
- *Local Strategy (including supporting documents)– New Strategic Direction for Baulkham Hills Shire, May 2010*
    - *Environment and Leisure Direction*
    - *Residential Direction*
    - *Waterways Direction*
    - *Rural Lands Strategy (and independent review)*
- *Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River*
- *The Hills Local Environmental Plan, 2012*

2.1.1 Strategy and Policy – key outcomes

The key findings from this review of the strategic policy and background that are of relevance to the land capability assessment are outlined below.

2.1.1.1 Regional planning

All strategic plans reviewed include a broad objective to retain the rural fringe of the Sydney Metropolitan Area. Specifically, both *The Local Strategy* (Baulkham Hills Shire, 2008) and the *Central City District Plan* (Greater Sydney Commission, 2018) identify a limit to urban development along a line to the south of the Investigation Areas (see **Figures 2-1, 2-2 & 2-4**).

Under the Central City District Plan, land in the Investigation Areas is identified as being within the 'Metropolitan Rural Area' (see **Figure 3-13**). The Plan recognises the contribution that the Central City District's rural areas make to habitat and biodiversity, and in sustaining local rural towns and villages. The rural area of Dural is recognised as being increasingly under pressure for urban development. The Plan notes that:

- A significant proportion of the District's rural land is under-utilised and has the potential to be used for more productive uses;
- Most of the rural area in the District is of high environmental value and is identified in The Hills LEP 2012 as having biodiversity value or being constrained land;
- Maintaining and enhancing the distinctive character of rural villages is a high priority;
- Rural towns will not play a role in meeting regional or district-scale demand for residential growth; and
- Further rural residential development is generally not supported.

According to the Plan, urban development is not consistent with the values of the Metropolitan Rural Area, and will be considered only in specific urban investigation areas. No urban investigation areas are identified in the Central City District. Action 74 of the Central City District Plan is "*Limit urban development to within the Urban Area"*.

The Plan does note that limited growth of rural residential development could be considered where there are no adverse impacts on the amenity of the local area and where the development provides incentives to maintain and enhance the environmental, social and economic values of the Metropolitan Rural Area.

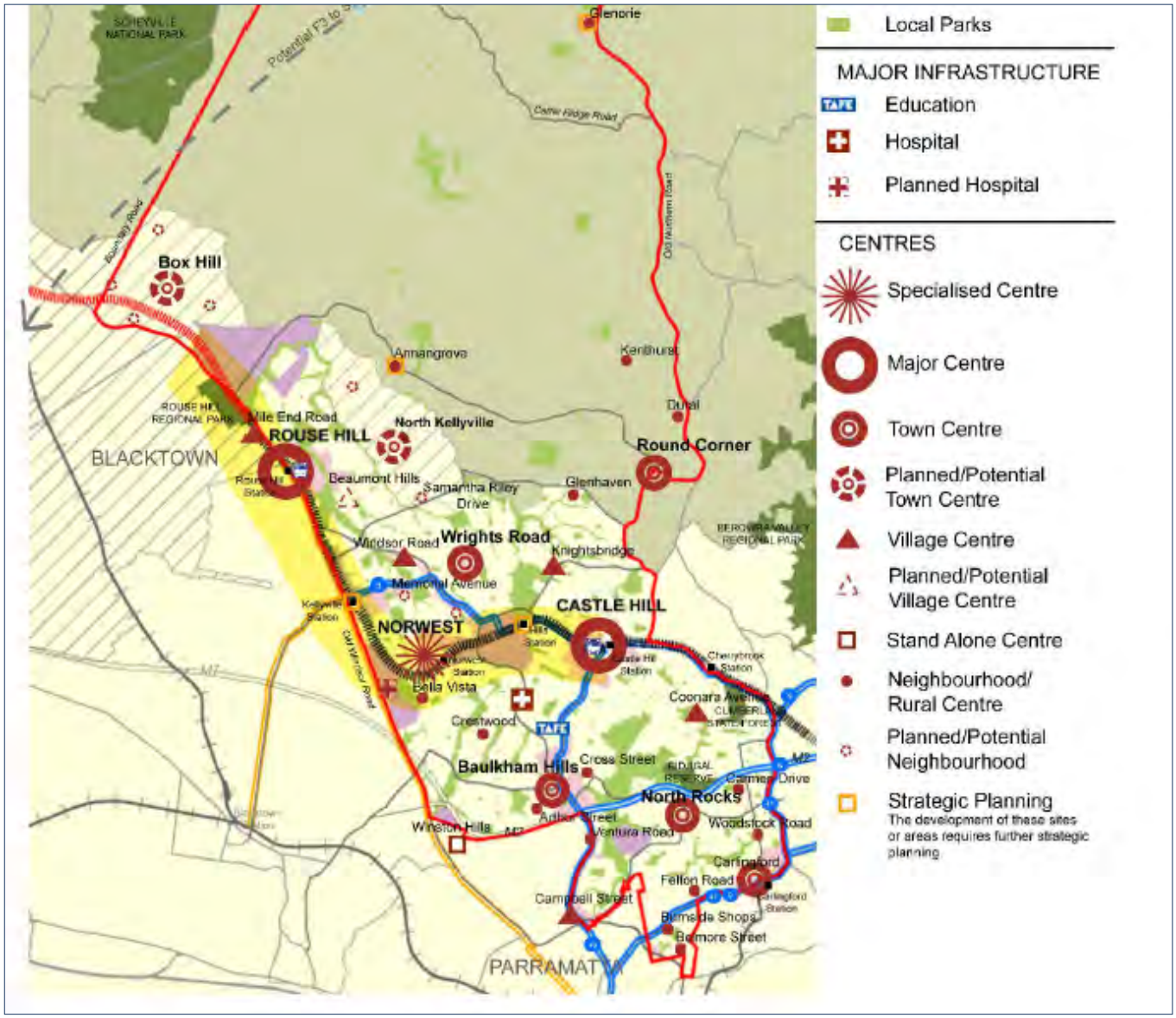

Figure 2-1 **Excerpt from Baulkham Hills Shire Structure Plan (Source: Local Strategy – New Direction for Baulkham Hills Shire, 2010)**

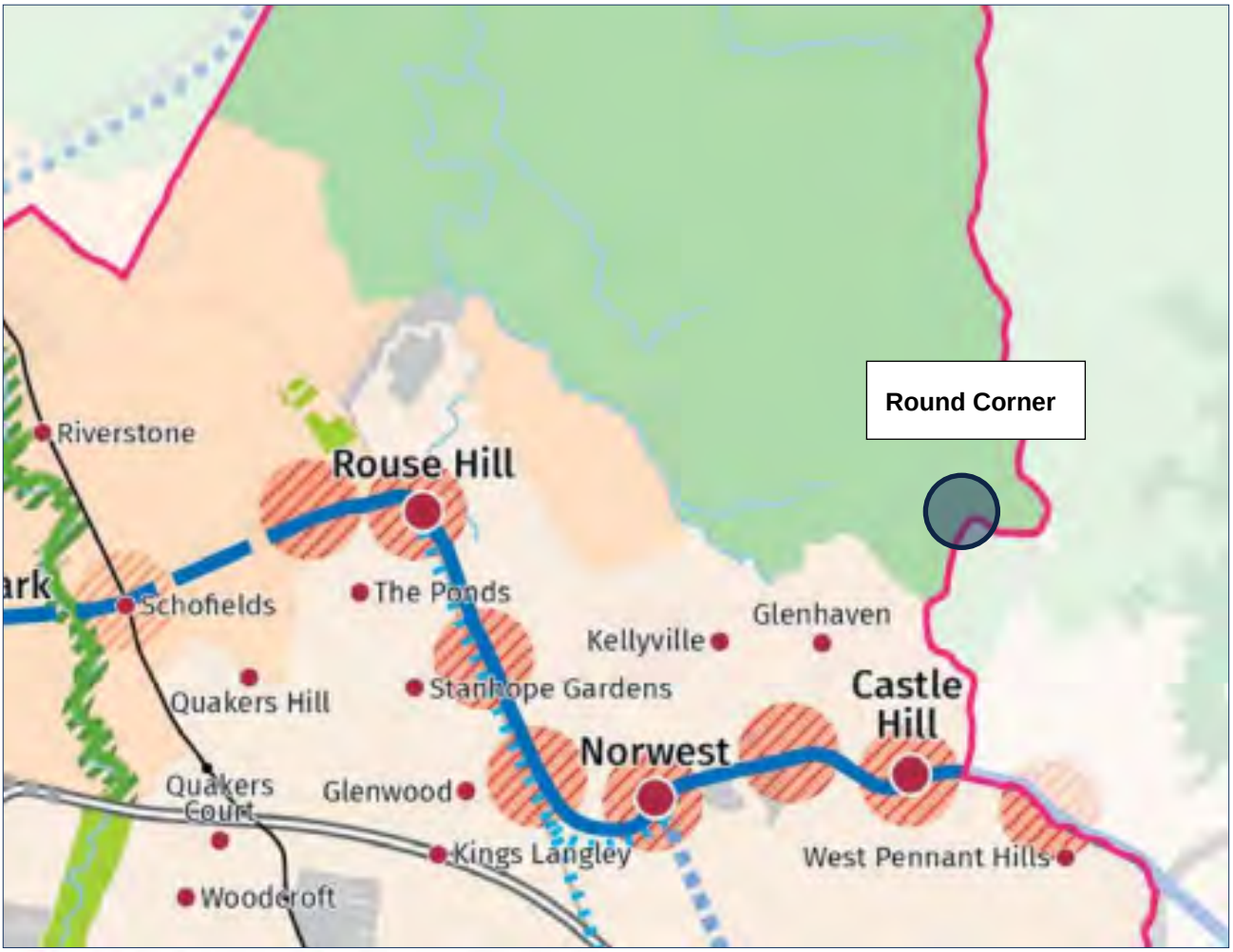

Figure 2-2 **Excerpt of Central City District Plan – Structure Plan**

At a higher level, the broad elements incorporated in the Strategies can be synthesised into the following principles that are of direct relevance to this Study:

- Balance urban growth – contain urban development to the areas identified in the Structure Plans;
- Protect rural lands and encourage their economic viability;
- Accommodate population growth – provide quality housing and housing choice;
- Provide for economic growth – encourage sustainable growth and provide employment opportunities;
- Ensure adequate service infrastructure;
- Ensure adequate social infrastructure;
- Provide a sustainable living environment;
- Protect water quality, biodiversity and scenic quality;
- Protect natural and cultural heritage;
- Plan for natural hazards;
- Manage and protect the Shire's natural waterways;
- Encourage the delivery of an integrated transport system; and
- Plan for the renewal of existing centres, including rural service centres.

Decisions regarding urban development capability and structure planning in the Investigation Areas should be made with reference to these adopted planning principles.

2.1.2 Local Strategy

The Local Strategy (Baulkham Hills Shire, 2010) provides a long-term framework for planning and management of land use in the Shire for the next twenty-five years (to 2031).

The Local Strategy identifies the following Key Directions which reflect the community outcomes articulated in The Hills 2026 Strategic Community Direction:

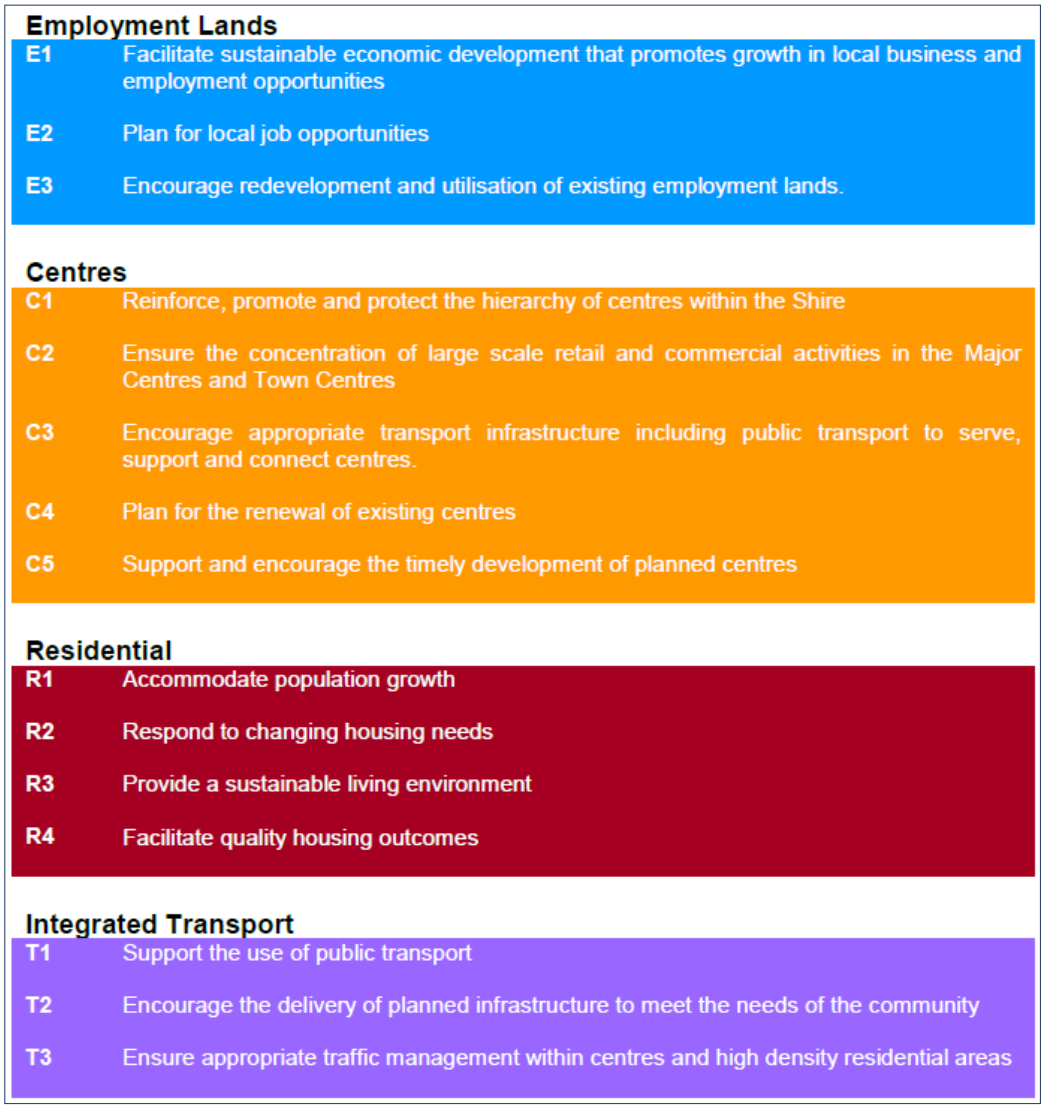

Figure 2-3 **Local Strategy Key Directions (Source: Local Strategy – New Direction for Baulkham Hills Shire, 2010)**

Each of these key directions has its own sub report. Those with relevance to this project are summarised in the following sections.

2.2.2.1 Environment and Leisure Direction

The *Environment and Leisure Direction* (Baulkham Hills Shire, 2008) is a supporting document to the Local Strategy. It identifies the following key directions and objectives for the desired approach for planning, protection and management of The Hills Shire's environment:

- Protect and manage the Shire's environment and leisure spaces;
- Provide high quality spaces for community recreation and enjoyment;
- Improve the accessibility and connectivity of environment and leisure spaces;
- Provide for public domain spaces that encourage community interaction;
- Conserve the Shire's unique diversity of plants and animals; and
- Protect Aboriginal cultural heritage.

2.2.2.2 Residential Direction

The *Residential Direction* (Baulkham Hills Shire, 2008) is a supporting document to the Local Strategy. It reflects The Hills Shire's approach to the planning, protection and management of residential development. The four key directions are:

- Accommodate population growth;
- Respond to changing housing needs;
- Provide a sustainable living environment – this includes ensuring the protection of cultural heritage as residential growth happens; and
- Facilitate quality housing outcomes.

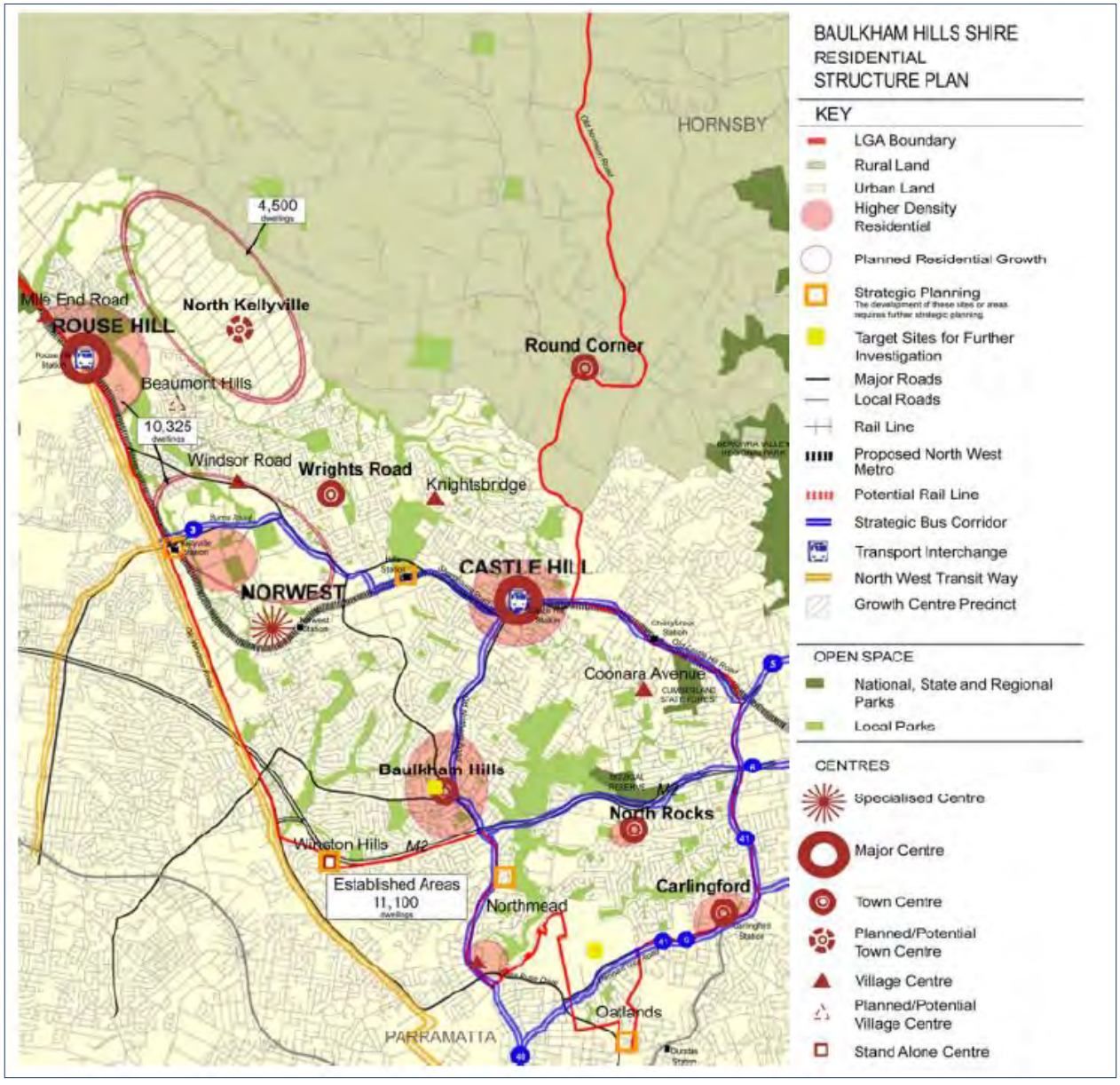

Figure 2-4 **Residential Structure Plan (Excerpt Hills Residential Discussion Paper, 2008)**

2.2.2.3 Waterways Direction

The *Waterways Direction* (Baulkham Hills Shire, 2008) is a supporting document to the Local Strategy. It aims to provide direction for the long term planning, protection and management of The Hills Shire's waterways. The report sets out the following directions to meet the existing and future needs of the population:

- Manage and plan for floodplain risk and floodplain use;
- Effective stormwater system planning;
- Effectively manage the stormwater system; and
- Manage the Shire's natural waterways – this includes the objective of incorporating heritage into the management of the waterway.

2.2.3 Rural Land Strategy

Adopted in August 2003, the *Rural Lands Strategy* identifies a growth management philosophy which aims to encourage and promote a diverse range of agricultural activities in rural areas and to limit urban expansion/ release areas. The Rural Lands Study identified constraints and strategic priorities for the Shire, along with the following key directions:

- Provide for coordinated and effective growth in the Shire's rural lands;
- Develop a land use framework that will give a level of certainty to the people who live in the rural areas of the Shire;
- Ensure that residents have adequate access to appropriate services and facilities;
- To provide for economic development opportunities that are in keeping with the rural character of the Shire;
- Provide an adequate level of infrastructure for the people who live and work in rural parts of the Shire;
- To ensure that the quality of surrounding waterways is not adversely affected by development;
- Ensure that the ecological integrity of the rural lands are enhanced and maintained;
- Ensure that development has a minimal impact on the scenic and cultural landscape of the Shire;
- To preserve the rural heritage and culture of the Shire; and
- Recognise the impact of natural hazards on future land use and settlement.

The Rural Lands Strategy was used to inform the drafting of the rural zones for The Hills Local Environmental Plan 2012 and for a review of development controls for rural zoned land in the Baulkham Hills DCP.

2.2.4 Independent review of Rural Land Study

Prior to the Rural Lands Strategy being adopted by Council, Connell Wagner undertook an independent review of the Rural Lands Strategy in 2005. The following actions were recommended:

- Immediately investigate all potential village expansions and hold any rezoning around these villages until this work is complete;
- Investigate the potential for smaller transitional lots (i.e. less than two hectares) around villages to support villages, subject to being supplied with water and sewerage services;
- Assess the willingness of landholders to forward-fund the provision of infrastructure especially water and sewerage services;
- Consider rezoning of lands at Maraylya, Nelson and Kenthurst for two-hectare subdivision subject to further land capability assessments being undertaken;
- Develop a staging plan for any future land releases if further rezonings are proposed;
- Investigate further differentiation of land use designations into small and large holding areas (agricultural and rural living) zones, and environmental protection zones, to support any rezoning proposals;
- Investigate the future long term development of the former Maroota State Forest and consider an area-specific local environmental plan for the area. In the meantime, defer the area from any future local environmental plan until a clearer understanding of the constraints and opportunities are understood; and

- Review the boundaries of the Local Environmental Plan's 7(a) Environmental Protection zone and consider refinements where necessary. If required, adopt additional environmental protection zones or overlay zones to reflect varying environmental constraints.

As part of this review, stakeholder engagement was conducted with the former NSW Fisheries, which identified that a 50-metre wide riparian zone should be retained next to waterways.

2.2.5 State of the Environment Report

The Hills Shire's State of the Environment Report 2012-2017, 2009-2010, 2008-2009 and 2007-2008 have been reviewed to identify the community's desired outcomes for the environment and to obtain information on the condition of the environment in the local area. The State of the Environment Report 2012-2017 identified a series of community outcomes that are aligned with the objectives of the Environment and Leisure Direction for the Planning, Protection and Management of the Shire's Green Spaces (Baulkham Hills Shire, 2008) identified in Section 1.2 of the report.

- '*Our Shire is green and pollution free'* – Facilitate the reduction of pollution produced from Council and the community and monitor and maintain the natural qualities of the waterways networks.
- *'I can feel close to nature'* – Manage the rehabilitation of local bushland and protect local flora and fauna. Facilitate the protection and enhancement of the Shire's biodiversity and community contribution to environmental protection and facilitate environmental sustainable development practices.
- '*Our natural resources are used wisely*' – Provide services and infrastructure that facilitate resource recovery and the reduction of commercial and residential waste, and build the capacity of the community to adopt affordable sustainable waste management behaviours.

2.2 Planning Controls

A variety of planning controls and guidelines are relevant to proposals for development in the Investigation Areas. These include State Environmental Planning Policies (SEPP's), Regional Environmental Plans (REP's) and the Local Environmental Plan (LEP). Below this, the principal guideline planning document that applies is *The Hills Development Control Plan, 2012.*

2.2.1 The Hills Local Environmental Plan, 2102 (Hills LEP)

The Hills LEP is the overarching Planning Instrument that directs urban planning within the Shire. Much of the critical planning principles in the Hills Local Strategy and the Rural Lands Strategy have been incorporated into the Hills LEP, including:

- Controls around subdivision and dwelling houses which are aimed at minimising unplanned residential development in rural zones, including RU6-Transition lands (Cls.4.2 & 4.2a).
- Controls to manage biodiversity and heritage.
- Controls to manage hazards including bushfire, acid sulphate soils, landslip and flooding risk.

Land within the Investigation Areas is zoned under the LEP as indicated in **Figure 2-5**.

The majority of the land under investigation is zoned RU6 Transition under The Hills LEP 2012. This land is largely rural or natural in character and the zone objectives reflect its rural functions:

- *"To protect and maintain land that provides a transition between rural and other land uses of varying intensities or environmental sensitivities.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*
- *To encourage innovative and sustainable tourist development, sustainable agriculture and the provision of farm produce directly to the public."*

Any intensification of development potential within the RU6 Transition zone would require either a change to the zone or amendments to the controls under the zone.

Figure 2-5 **Zoning Plan (excerpt from The Hills Local Environmental Plan, 2012)**

3 Environmental Constraints and Opportunities

Cardno has undertaken a review of Council's existing information and undertaken desktop and database searches to establish baseline constraints within the Investigation Areas. For the purpose of the environmental desktop searches, the High Level Investigation Area was used to identify environmental constraints, however results within the near vicinity of this area were also documented. This allowed a wider contextual understanding and will further inform the environmental capability of land within the detailed study area.

3.1 Biodiversity

A review of database searches and The Hills Shire's reports and data was undertaken to provide background information for biodiversity within The Hills Shire and Hornsby Council areas. These include the:

- NSW Office of Environment and Heritage (OEH) BioNet Wildlife Atlas (for species listed under the *Biodiversity Conservation Act 2016 (*BC Act));
- NSW OEH Areas of Outstanding Biodiversity register;
- Commonwealth's EPBC Act Protected Matters Search Tool (PMST) for species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- NSW OEH Bio Banking public register;
- NSW Department of Primary Industries (DPI) – Fisheries Data Portal;
- NSW DPI Threatened Species Database;
- NSW DPI register of Critical Habitat;
- NSW DPI Key Fish Habitat maps;
- The Hills Shire vegetation mapping (GIS) (2018) and
- The Hills Shire State of the Environment Report 2012-2017.

The greater High Level Investigation Area is not subject to Biodiversity Certification under the Biodiversity Conservation (BC) Act. Thus, all impacts to biodiversity within the Detailed Investigation Area would require assessment under the BC Act.

Assessing biodiversity under the BC Act for development or clearing of vegetation/habitat would require consideration of the application of the Biodiversity Offset Scheme (BOS). The BOS is applied through the Biodiversity Assessment Method (BAM) by an accredited assessor. The BOS applies to:

- Local development (assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) that is likely to significantly affect threatened species (as determined by the test of significance in section 7.3 of the BC Act) or triggers the BOS thresholds which includes:
    - The amount of native vegetation being cleared exceeds a threshold area set out in **Table 3-1**; or
    - Whether the impacts occur on an area mapped on the Biodiversity Values map (**Figure 3-2**); or
    - Impacts on any listed threatened entity are considered to be significant (apply the test of significance as per Part 7.3 of the BC Act).
- State significant development/infrastructure (SSD/SSI) unless the Secretary of the Department of Planning and Environment and the Chief Executive of the OEH determine the project is not likely to have a significant impact;
- Biodiversity Certification proposals;
- Clearing of native vegetation in urban areas and zones for environmental conservation that exceeds the BOS thresholds and does not require development consent;
- Clearing of native vegetation that requires approval by the Native Vegetation Panel under the *Local Land Services Act 2016*; and

- Activities assessed and determined under Part 5 of the EP&A Act if the proponent chose to 'opt in'.

Table 3-1 Area thresholds where the BOS applies (source: NSW OEH, 2018)

Minimum lot size associated with the property	Threshold for clearing, above which the BAM and offsets scheme apply
Less than 1 ha	0.25 ha or more
1 ha to less than 40 ha	0.5 ha or more
40 ha to less than 1000 ha	1 ha or more
1000 ha or more	2 ha or more

Proposals in the Detailed Investigation Area have potential to trigger the BOS through the first requirement listed above. The clearing threshold (noted as item 1a above) or "significant impact" (item 1c above) cannot be determined at this stage of planning and would be determined during more detailed investigations. However, development or clearing within areas that coincide within the Biodiversity Values map within the Detailed Investigation Area would require assessment under the BOS. The application of the BOS is determined during the development application stage based on the above requirements and hence has not been applied to land capability at this time.

The State of Environment Report 2012-2017 (The Hills Shire Council, 2017) identified 81 known threatened entities (total of threatened fauna, flora, ecological communities and populations) in The Hills Shire. Further details of the threatened entities are outlined in the following sections:

- Threatened vegetation communities are discussed in Section 3.1.3;
- Threated flora is discussed in Section 0; and
- Threated fauna is discussed in Section 3.1.9.

In addition to the above, additional biodiversity aspects were considered as part of this assessment. This included:

- Stewardship, Bio Banking and Conservation Agreements (see Section 3.1.2);
- Wildlife Corridors (see Section 3.1.5);
- Threatened Aquatic Biodiversity and Key Fish Habitat (see Section 3.1.11); and
- Matters of National Environmental Significance (see Section 3.1.13).

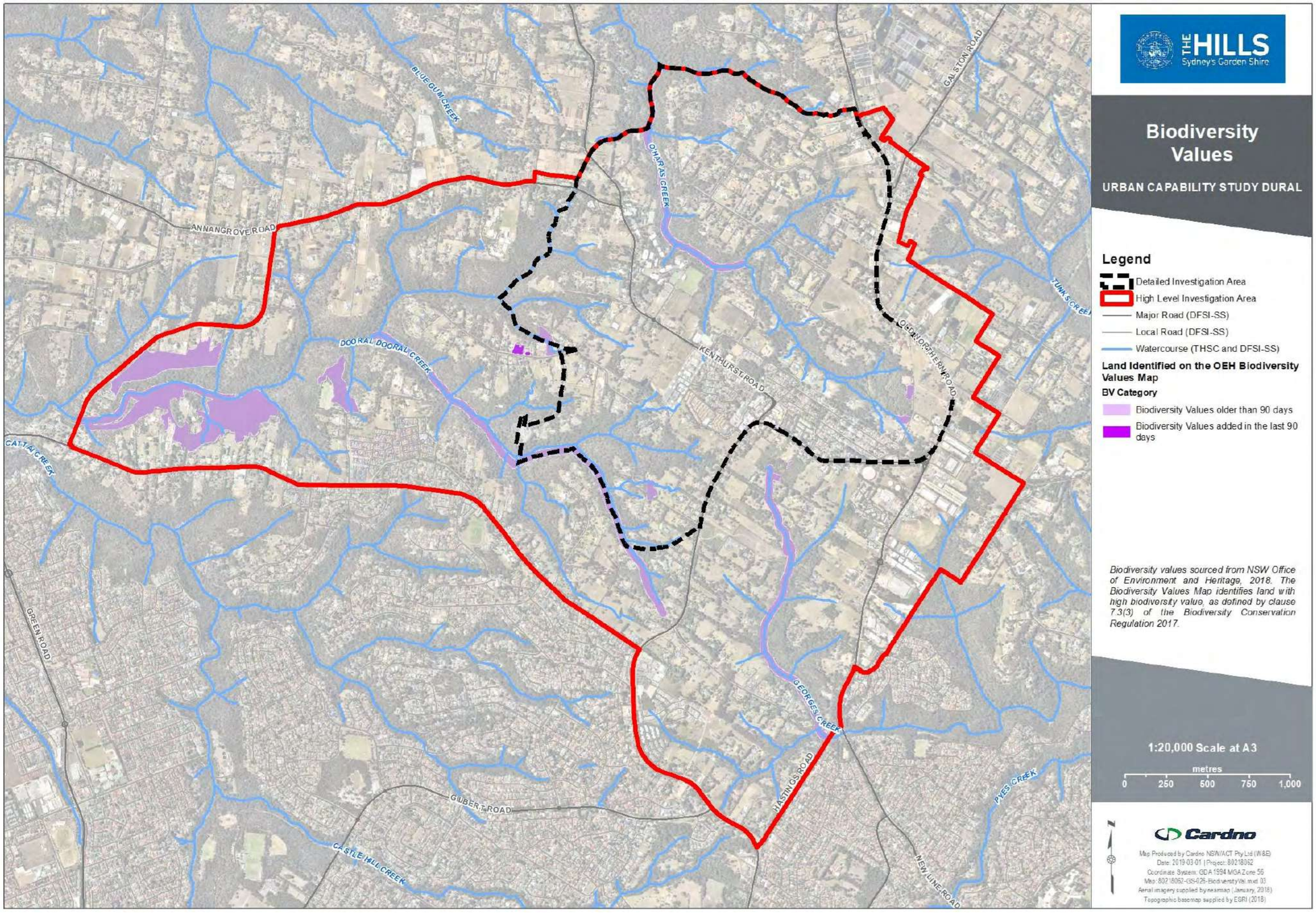

Figure 3-2 **Biodiversity Values (OEH, 2017)**

3.1.2 Stewardship/Bio Banking and Conservation Agreements

Land for Stewardship/Bio Banking and conservation agreements are identified as offsets in agreement with the Minister for the Environment where vegetation and/or habitat are removed elsewhere and are undertaken under both mandatory and voluntary schemes. Biobanking agreements under the repealed *Threatened Species Conservation Act 1995* (TSC Act) are now managed as stewardship agreements by the NSW Biodiversity Conservation Trust (BCT) as part of the BOS under the BC Act. Offset areas under the repealed TSC Act were those which matched the biodiversity credit profiles of the areas which required offsetting. Stewardship sites (i.e. offset areas) under the current BC Act may have been created as a credit obligation under the like-for-like rules for the variation rules. As population demands urbanisation into greenfield sites, areas for suitable offsetting will become increasingly difficult to locate. In determining the value of the existing areas, two components should be considered:

- The ability and potential cost to offset high-value vegetation in the event the area is cleared for development; and
- The ecological and economic value of the existing vegetation has in the investigation area in providing suitable offsets for endemic Sydney vegetation.

These two components require detailed vegetation/habitat surveys in accordance with the Biodiversity Assessment Methodology (NSW OEH, 2017) to determine ecological and economic values. As detailed vegetation/habitat surveys were not completed as part of this stage of planning, existing vegetation mapping was used to support a preliminary determination of the ecological values of the Detailed Investigation Area (see Section 3.1.3).

A review of existing information was undertaken to determine the presence of any existing stewardship/Bio Banking or conservation agreements. The State of the Environment Report 2012-2017 identified that within The Hills LGA, there are 242.02 hectares of land conserved through private formal conservation agreements. The bio banking register identified that The Hills Shire has five stewardship agreements (Agreements 37, 38, 39, 148 and 454 between 2011 and 2017) of which four are within the Yengo Interim Biogeographic Regionalisation for Australia (IBRA) subregion and one within the Cumberland subregion. There are also five stewardship agreements in the Hornsby Council LGA (Agreements 142, 172, 299, 337 and 338 between 2014 and 2018) of which three are within the Cumberland subregion and two within the Pittwater subregion. The exact locations of these sites are confidential and not publicly available although the agreements are available from http://www.environment.nsw.gov.au/bimsprapp/SearchBiobankingAgreement.aspx?Start=1.

Council (managed by the NSW Government's CT) confirmed that no Stewardship / Bio Banking or Conservation Agreement sites occur within the High Level Investigation Area. As such there are no current implications to land capability as a direct result of existing Stewardship, Biobanking and Conservation Agreements.

3.1.3 Vegetation Communities

A search of the NSW OEH's BioNet Wildlife Atlas and Commonwealth's PMST conducted on 15 March 2018 identified 32 threatened ecological communities (TECs) as known, or are predicted to occur within 10 km of the High Level Investigation Area (refer to **Table 3-2**).

Table 3-2 Threatened Communities (source: NSW BioNet Wildlife Atlas & EPBC Protected Matters Search Tool, 2018)

Community Name	Legal Status (BC Act)	Legal Status (EPBC Act)	Identified to occur within The Hills Shire based on State of the Environment 2017
Blue Gum High Forest	CE	CE	Yes
Blue Mountains Shale Cap Forest	E	CE	No
Castlereagh Scribbly Gum and Agnes Banks Woodlands	CE	E	No
Central Hunter Grey Box-Ironbark Woodland	E	CE	No
Central Hunter Ironbark-Spotted Gum-Grey Box Forest	E	CE	No
Coastal Upland Swamps	E	E	No
Cooks River/Castlereagh Ironbark Forest	E	CE	No
Cumberland Plain Woodlands	CE	CE	Yes
Duffys Forest Ecological Community	E	-	No
Eastern Suburbs Banksia Scrub	E	E	No
Elderslie Banksia Scrub Forest	CE	-	No
Freshwater Wetlands on Coastal Floodplains	E	-	Yes
Hunter Lowland Redgum Forest	E	-	No
Hunter Valley Footslopes Slaty Gum Woodland	V	CE	No
Hunter Valley Weeping Myall Woodland	CE	CE	No
Littoral Rainforest	E	CE	No
Lower Hunter Valley Dry Rainforest	V	-	No
Lowland Rainforest	E	CE	No
Montane Peatlands and Swamps	E	E	No
Pittwater and Wagstaffe Spotted Gum Forest	E	-	No
River-Flat Eucalypt Forest	E	-	Yes
Shale Gravel Transition Forest	E	CE	No
Shale Sandstone Transition Forest	CE	CE	Yes
Southern Sydney sheltered forest on transitional sandstone soils	E	-	No
Subtropical and Temperate Coastal Saltmarsh	E	V	No
Swamp Oak Floodplain Forest	E	-	Yes
Swamp Sclerophyll Forest on Coastal Floodplains	E	-	Yes
Sydney Freshwater Wetlands	E	-	No
Turpentine-Ironbark Forest	E	CE	Yes
Themeda grassland on seacliffs and coastal headlands	E	-	No

Warkworth Sands Woodland	E	CE	No
Western Sydney Dry Rainforest and Moist Woodland on Shale	E	CE	Yes

Note: CE – Critically Endangered, E – Endangered, V-Vulnerable

These results were compared to the native vegetation communities listed in The Hills Shire's State of the Environment 2012-2017 report and GIS vegetation mapping (provided by Council (2018)). It should be noted that at the time of writing, OEH were in the process of updating the mapping for this area as part of the State Vegetation Type Mapping initiative. As The Hills Shire Council have revised their 2008 vegetation mapping in 2018, this information was used to undertake the following ecology assessment.

The GIS vegetation mapping of the High Level Investigation Area (excluding the area covered by Hornsby Council LGA) identified the potential presence of one Threatened Ecological Community i.e. Shale Sandstone Transition Forest (see **0**), which is listed as critically endangered under the BC Act and EPBC Act.

All of these TECs are listed as critically endangered under the BC Act and EPBC Act and require vegetation to meet specific listing criteria. These can only be investigated during detailed vegetation surveys, which typically occur during the development application stage. Thus, vegetation mapping by Council (2018) and OEH (2014) have been used to provide a preliminary guide to the location and extent of these Threatened Ecological Communities.

Both Blue Gum High Forest and Sydney Turpentine Ironbark Forest were identified within the Detailed Investigation Area in The Hills Shire Council (2018) mapping but was not present in the NSW OEH (2014) mapping. For the purpose of this report, the OEH mapping has been used as it is the most recent mapping. Therefore, there may still be uncertainty over final classification that can only be confirmed through detailed vegetation surveys.

3.1.4 Implications for Land Capability

Areas of Threatened Ecological Communities are considered to have high ecological value. Development and clearing within these areas and/or areas of native vegetation (not considered Threatened Ecological Communities) have potential to trigger application of the BOS (see above). It is recommended that areas of Threatened Ecological Community and native vegetation are given a land capability Category B. This does not preclude the land from development but acknowledges potential constraints associated with the level of legislative protection.

Riparian corridors may provide an opportunity for establishing stewardship/offsets for vegetation removed in other parts of the detailed study area. This would depend on the condition of vegetation and the ability to meet the necessary criteria.

3.1.5 Wildlife Corridors

There are wildlife corridors at a broader regional scale (e.g. between Marramarra, Scheyville, Berowra Valley and Lane Cove National Parks). The majority of connectivity in the wider region is maintained along the riparian corridors, which are considered high value areas based on the presence of native vegetation and TECs (Section 3.1.3). However, some parks and vegetation lots within the High Level Investigation Area also form wildlife corridors and wildlife "stepping stones" at a local scale. These are mapped **Figure 3.4.** and include:

- Ellerman Park along Kenthurst Road, and the area between Franlee Road and Old Northern Road, which connects the riparian corridors of O'Haras Creek to Georges Creek;
- Vegetation between Kenthurst Road and Yuruga Road, which connects the riparian corridors of the tributaries of Dooral Creek and O'Haras Creek; and
- Vegetation between Wayfield Road and Old Northern Road, which connects the riparian corridors of Dooral Creek and Georges Creek.

3.1.6 Implications for land capability

Connectivity along these sections may provide critical habitat for mobile fauna (e.g. birds, mammals and reptiles) and are considered to provide moderate to high ecological value assuming the habitat conditions are suitable for fauna.

In their own merits it is recommended wildlife corridors are Category A. However, given they also coincide with native vegetation, they should fall into Category B (see Section 3.1.3).

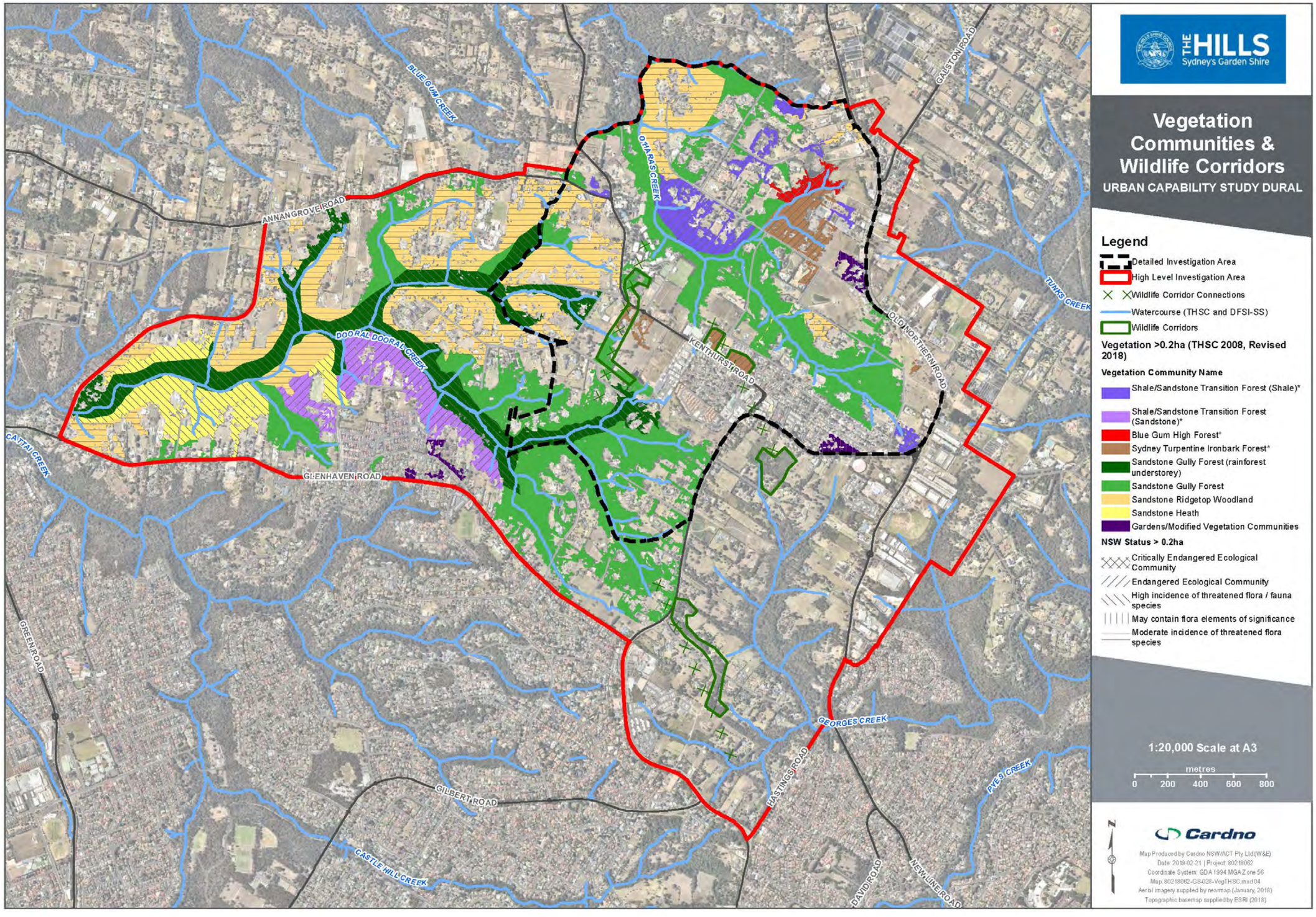

Figure 3-4 Vegetation Communities (THSC, 2018)

3.1.7 Threatened Flora

A search of the NSW OEH's BioNet Wildlife Atlas and Commonwealth's PMST conducted on 15 March 2018 identified 37 threatened flora species in **Table 3-3** as occurring or predicted to occur within 10 km of the High Level Investigation Area. The results were also compared to the flora listed in The Hills Shire's State of the Environment 2012-2017 Report.

Table 3-3 Threatened Flora Species (source: NSW BioNet Wildlife Atlas and EPBC Protected Matters Search Tool, 2018)

Scientific Name	Common Name/s	Legal Status (BC Act)	Legal Status (EPBC Act)	Identified within The Hills Report*
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	E	V	Yes
Acacia gordonii	-	E	E	Yes
Acacia pubescens	Downy Wattle, Hairy Stemmed Wattle	V	V	Yes
Allocasuarina glareicola	-	E	E	No
Asterolasia elegans	-	E	E	Yes
Caladenia tessellata	Thick-lipped Spider-orchid, Daddy Long-legs	E	V	No
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	No
Cynanchum elegans	White-flowered Wax Plant	E	E	No
Darwinia biflora	-	V	V	Yes
Epacris purpurascens var. purpurascens	-	V	-	No
Eucalyptus camfieldii	Camfield's Stringybark	V	V	No
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	No
Eucalyptus scoparia	Wallangarra White Gum	E	V	No
Eucalyptus sp. Cattai	-	CE	CE	Yes
Genoplesium baueri	Yellow Gnat-orchid, Bauer's Midge Orchid	E	E	No
Grevillea shiressii	-	V	V	No
Haloragis exalata subsp. exalata	Wingless Raspwort, Square Raspwort	V	V	No
Haloragodendron lucasii	Hal	E	E	No
Hibbertia spanantha	Julian's Hibbertia	E	CE	No
Hibbertia superans	-	E	-	Yes
Lasiopetalum joyceae	-	V	V	No
Leucopogon fletcheri subsp. fletcheri	-	E	-	No
Leptospermum deanei	Deane's Tea-tree	V	V	No

Melaleuca biconvexa	Biconvex Paperbark	V	V	No
Melaleuca deanei	Deane's Melaleuca	V	V	Yes
Olearia cordata	-	V	V	Yes
Pelargonium sp. Striatellum	Omeo Stork's-bill	E	E	No
Persoonia hirsuta	Hairy Geebung, Hairy Persoonia	E	E	Yes
Persoonia mollis subsp. maxima	-	E	E	Yes
Pimelea curviflora var. curviflora	-	V	V	Yes
Pimelea spicata	Spiked Rice-flower	E	E	No
Pomaderris brunnea	Brown Pomaderris	E	V	No
Pterostylis gibbosa	Illawarra Greenhood, Rufa Greenhood	E	E	No
Pterostylis saxicola	Sydney Plains Greenhood	E	E	No
Pultenaea parviflora	-	E	V	No
Syzygium paniculatum	Magenta Lilly Pilly	E	E	No
Tetratheca glandulosa	-	V	-	No

Note: CE – Critically Endangered, E – Endangered, V-Vulnerable
**State of the Environment 2012-2017 report*

Although there is potential for the majority of these threatened flora species and/or their associated habitat to occur within the Detailed Investigation Area, two species have been identified to have a restricted distribution. These are:

- *Eucalyptus sp.* Cattai, which is listed as critically endangered under the BC Act and EPBC Act; and
- *Hibbertia superans*, which is listed as endangered under the BC Act.

Eucalyptus sp. Cattai occurs between Colo Heights and Castle Hill. It is generally found in shrub, heath and low woodland on sandy soils at locations that are flat and on ridgetops. Potential habitat for this species include the ridgeline to the west of the Dural town centre (refer to the landscape view map **Figure 3-16** in Section 3.9).

Hibbertia superans occurs between Baulkham Hills and South Maroota. This species occurs in open woodland and heathland and prefers disturbed areas. With the exception of the dense riparian corridors (as mapped in **Figure 3-9**) and the Dural town centre to the south-east of the Detailed Investigation Area, all other areas form potential habitat for this species.

Further detailed investigations into the potential occurrence of all threatened flora in **Table 3.3** would be required during the development application stage.

3.1.8 Implications for Land Capability

Given these species have limited distributions, require offsetting and are listed under the BC Act, it is recommended that a Category B be applied to their potential habitats (as identified above). Consideration can also be given to applying Category A to *Hibbertia superans* habitat*,* as unlike *Eucalyptus* sp, it does not trigger requirements under the EPBC Act.

3.1.9 Threatened Fauna

A search of the NSW OEH's BioNet Wildlife Atlas and Commonwealth's PMST was conducted on 15 March 2018. It identified 73 threatened fauna species in **Table 3-4** as occurring or predicted to occur within 10 km of the High Level Investigation Area. The results were also compared to the fauna listed in The Hills Shire's State of the Environment 2012-2017 Report.

Table 3-4 Threatened Fauna Species (NSW BioNet Wildlife Atlas and EPBC Protected Matters Search Tool, 2018)

Scientific Name	Common Name/s	Legal Status (BC Act)	Legal Status (EPBC Act)	Identified within The Hills Report
Anthochaera phrygia	Regent Honeyeater	E	CE	Yes
Artamus cyanopterus	Dusky Woodswallow	V	-	No
Botaurus poiciloptilus	Australasian Bittern	E	E	Yes
Calidris ferruginea	Curlew Sandpiper	E	CE	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Yes
Callocephalon fimbriatum	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	E	-	Yes
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Yes
Caretta caretta	Loggerhead Turtle	E	E	No
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	V	V	No
Chelonia mydas	Green Turtle	V	V	No
Daphoenositta chrysoptera	Varied Sittella	V		Yes
Dasyornis brachypterus	Eastern Bristlebird	E	E	No
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Yes
Dermochelys coriacea	Leatherback Turtle	E	E	No
Diomedea antipodensis	Antipodean Albatross	V	V	No
Diomedea antipodensis gibsoni	Gibson's Albatross	V	V	No
Diomedea epomophora	Southern Royal Albatross	-	V	No
Diomedea exulans	Wandering Albatross	E	E	No
Diomedea sanfordi	Northern Royal Albatross	-	E	No
Epinephelus daemelii	Black Rockcod, Black Cod	V (FM Act)	V	No
Eretmochelys imbricata	Hawksbill Turtle	-	V	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Yes
Glossopsitta pusilla	Little Lorikeet	V	-	Yes
Grantiella picta	Painted Honeyeater	V	V	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	C	Yes
Hieraaetus morphnoides	Little Eagle	V	-	Yes
Heleioporus australiacus	Giant Burrowing Frog	V	V	Yes

Hoplocephalus bungaroides	Broad-headed Snake	E	V	No
Isoodon obesulus	Southern Brown Bandicoot (eastern)	E	E	No
Ixobrychus flavicollis	Black Bittern	V	-	Yes
Lathamus discolor	Swift Parrot	E	CE	Yes
Litoria aurea	Green and Golden Bell Frog	E	V	No
Litoria littlejohni	Littlejohn's Tree Frog	V	V	No
Lophoictinia isura	Square-tailed Kite	V	-	Yes
Macronectes giganteus	Southern Giant-Petrel	E	E	No
Macronectes halli	Northern Giant Petrel	V	V	No
Macquaria australasica	Macquarie Perch	E (FM Act)	E	No
Melithreptus gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Yes
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	No
Miniopterus australis	Little Bentwing bat	V	-	No
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Yes
Mixophyes balbus	Stuttering Frog	E	V	No
Mormopterus norfolkensis	Eastern Freetail Bat	V	-	Yes
Myotis macropus	Large-footed Myotis	V	-	Yes
Natator depressus	Flatback Turtle	-	V	No
Ninox connivens	Barking Owl	V	-	Yes
Numenius madagascariensis	Eastern Curlew	-	CE	No
Pachyptila turtur subantarctica	Fairy Prion (southern)	-	V	No
Petauroides volans	Greater Glider	-	V	No
Petaurus australis	Yellow-bellied Glider	V	-	Yes
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	No
Petroica boodang	Scarlet Robin	V	-	Yes
Petroica phoenicea	Flame Robin	V	-	No
Petroica rodinogaster	Pink Robin	V	-	Yes
Phascolarctos cinereus	Koala	V	V	Yes
Polytelis swainsonii	Superb Parrot	V	V	Yes
Pommerhelix duralensis	Dural Woodland Snail	E	E	Yes
Prototroctes maraena	Australian Grayling	-	V	No

Pseudophryne australis	Red-crowned Toadlet	V	-	Yes
Pseudomys novaehollandiae	New Holland Mouse, Pookila	-	V	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Yes
Rostratula australis	Australian Painted Snipe	E	E	No
Saccolaimus flaviventris	Yellow-bellied Sheathtail bat	V	-	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Yes
Stagonopleura guttata	Diamond Firetail	V	-	Yes
Thalassarche bulleri	Buller's Albatross	-	V	No
Thalassarche cauta	Shy Albatross	V	V	No
Thalassarche cauta steadi	White-capped Albatross	-	V	No
Thalassarche eremita	Chatham Albatross	-	E	No
Thalassarche impavida	Campbell Albatross	-	V	No
Thalassarche melanophris	Black-browed Albatross	V	V	No
Thalassarche salvini	Salvin's Albatross	-	V	No
Tyto novaehollandiae	Masked Owl	V	-	Yes
Tyto tenebricosa	Sooty Owl	V	-	Yes

Note: CE – Critically Endangered, E – Endangered, V – Vulnerable, FM – Fisheries Management Act
**State of the Environment 2012-2017 report*

Although there is potential for the majority of these threatened fauna species and/or their associated habitat to occur within the Detailed Investigation Area, one species has been identified by Council to have a restricted distribution. The Yellow-bellied Glider occurs in mature eucalypt forests and has potential to inhabit all forested areas within the study area including the riparian corridors. This is an isolated population in the area and warrants special consideration. Key threats to this species include:

- Loss and fragmentation of habitat;
- Loss of hollow bearing trees; and
- Loss of feed trees.

Further detailed investigations into the potential occurrence of all threatened fauna in **Table 3-4** would be required during the development of the precinct planning stage. The outcomes of this planning would be implemented during the development application process. Development and clearing in potential habitat for the above species would require targeted surveys.

3.1.10 Implications for Land Capability

The presence of hollow bearing trees and feed trees will contribute to the occurrence of the species and hence the value to the potential habitat for the species. Given the large area, and the level and detail of surveying required, this information would usually be determined during the planning approval process for a development. Consideration for protecting riparian corridors in general due to cumulative impacts is discussed further in Section 4 and may provide a level of compromise.

As stated previously, riparian corridors may provide an opportunity for establishing stewardship/offsets for vegetation removed in other parts of the detailed study area. This would depend on the condition of vegetation and the ability to meet the necessary criteria.

3.1.11 Threatened Aquatic Biodiversity and Key Fish Habitat

Dooral Creek and O'Haras Creek were identified as Key Fish Habitat based on NSW DPI mapping. Dooral Creek was classed as a fair freshwater fish community stream (DPI's Fisheries data portal), however no threatened freshwater species mapping occurred.

No critical habitats were listed on DPI's Critical Habitat Register (15 March 2018). This register identifies any potential critical habitat listed under the *Fisheries Management Act* (FM Act).

There is no potential for estuarine threatened species (Black Cod and Macquarie Perch) to occur within the creeks as identified in **Table 3-4**.

There is potential for listed threatened species Adam's Emerald and Sydney Hawk Dragonflies (DPI Threatened Species Database) to occur within the creeks in the Investigation Area based on distribution mapping.

Key Fish Habitat would require detailed habitat surveys to categorise these habitats and consultation with NSW DPI would be required for any instream works within the Detailed Investigation Area if development was to occur in these areas. All waterways and waterbodies within the Detailed Investigation Area are assumed to be suitable habitat for Adam's Emerald and Sydney Hark Dragonflies. Targeted threatened species surveys for Adam's Emerald and Sydney Hawk Dragonflies during the development application stages would be required.

3.1.12 Implications for Land Capability

Waterways within the detailed investigation area are considered Category B as they are sensitive receiving environments and form potential habitat for species listed under the FM Act. Fish passage is required to be maintained in Dooral Creek and O'Haras Creek.

3.1.13 Serious and Irreversible Impacts

Under Part 6.5 of the BC Act, the determination of serious and irreversible impacts on biodiversity values for the purposes of the biodiversity offsets scheme is to be made in accordance with principles prescribed by the Biodiversity Conservation Regulation 2017. Part 6.7 of the Biodiversity Conservation Regulation 2017 sets out the criteria for serious and irreversible impacts. An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because:

1. It will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
2. It will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
3. It is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
4. The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.

Part 7.3(d) of the Biodiversity Conservation Regulation 2017 states that lands which in the opinion of the Environment Agency Head contains any threatened species or threatened ecological communities that are identified in a list of potential serious and irreversible impacts on biodiversity values may be including on the Biodiversity Values Map and Threshold Tool. A list of potential serious and irreversible impact entities has been published by OEH in conjunction with the document, Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact. Other listed threatened entities may be determined to constitute a serious and irreversible impact entity at the discretion of the decision maker, if the entity is considered to meet one the criteria listed above.

Appendix 2 and Appendix 3 of the *Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact* provides lists of potential serious and irreversible impact species and threatened ecological community entities, respectively.

With reference to **Table 3-2**, the following threatened ecological communities known to be present within the High Level Investigation Area are listed in Appendix 3 of the Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact:

- Blue Gum High Forest;

- Cumberland Plain Woodland;
- Shale Sandstone Transition Forest;
- Turpentine-Ironbark Forest; and
- Western Sydney Dry Rainforest and Moist Woodland on Shale.

With reference to **Table 3-3** and **Table 3-4** above, the following threatened species known to be present within the High Level Investigation Area are listed in Appendix 2 of the Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact:

- Flora:
    - *Asterolasia elegans*; and
    - *Eucalyptus sp. Cattai.*
- Fauna:
    - Regent Honeyeater;
    - Swift Parrot; and
    - Sooty Owl.

Determination of a serious and irreversible impact on any listed potential serious and irreversible impact candidate entity or other entity is determined by the thresholds listed in the OEH Threatened Biodiversity Data Collection database. For threatened ecological communities this is a condition threshold (determined through assessment as part of the Biodiversity Assessment Method for an individual development) known as the vegetation integrity score. For threatened flora entities, the threshold is typically the known geographical extent of known populations of the species. For threatened fauna entities, the threshold is typically the presence of restricted critical habitat (breeding caves etc.) known or considered likely to be used by the relevant species (to be determined through survey). For some threatened fauna the threshold can also be mapped areas for which any development or action removing habitat for the species within the mapped area would constitute a serious and irreversible impact on that species. This mapping is held by OEH and would need to be requested as part of the site assessment.

Where no such threshold is listed, the decision maker is required to determine if the projected impacts of the individual development would constitute a serious and irreversible impact on the relevant entity, based on information provided in the assessment and the Guidance to Assist a Decision-maker to Determine a Serious and Irreversible Impact document.

3.1.14 Implications for Land Capability

Under a Part 4 development a consent authority is required to refuse development consent if a serious and irreversible impact is identified in the assessment for the individual development. Under the Part 5 and State Environmental Planning Policy (Infrastructure) 2007 pathways the consent authority is required to consider additional mitigation measures to reduce the impact on any identified serious and irreversible impact.

3.1.15 Matters of National Environmental Significance

A search of the Protected Matters Search Tool showed thirty migratory species are known or are predicted to occur within 10 km of the greater High Level Investigation Area. No Commonwealth marine areas or wetlands of international importance occur within 10 km of the High Level Investigation Area. A number of threatened species and ecological communities are also known or predicted to occur within 10 km of the High Level Investigation Area. These are discussed in previous Sections 3.1.3 to 3.1.9.

Important habitat for migratory species, which are mostly birds, can encompass most of the vegetation areas and the waterways and riparian corridors of the Detailed Investigation Area. Habitat surveys would be required to define these areas during the development application stage.

3.1.16 Implications for Land Capability

Results showed the whole detailed investigation study area would trigger a Matters of National Environmental Significance assessment under the EPBC Act, however Category A classification could be applied as these species only occur periodically in the detailed investigation study area. Impacts from development can be avoided through mitigation measures and habitat within the detailed investigation study area is not exclusive to the area.

3.2 Bushfire Management

Landform has a significant influence on fire behaviour. Fires can move swiftly along the ridges and valleys making control difficult since most roads and all major land clearing (which is associated with the development pattern) run parallel to the direction of the spread of the fires (Baulkham Hills Rural Strategy 2003).

The Hills Shire Council's Bushfire Prone Land Map was certified by the Rural Fire Service in June 2018. The Investigation Area includes bushfire prone land, which is particularly associated with the significant tracts of vegetation in the riparian zones that surround the riparian corridors. The following bushfire risk categories apply to land in the Investigation Area:

- Vegetation Category 1 – Highest bushfire risk;
- Vegetation Category 3 – Medium bushfire risk;
- Vegetation Category 2 – Lower bushfire risk; and
- Vegetation Buffer.

It should be noted the Guideline to Bushfire Prone Area Land Map (NSW Rural Fire Service, 2015) excludes vegetation from mapped as bush fire prone if it is 'managed grassland', agricultural lands, saline wetlands, a single area of vegetation less than 1 hectare in area and 100m separation from other vegetation categories, strips of vegetation less than 20 m in width and not within 20 m of other vegetation categories and multiple areas of vegetation less than 0.25 ha in an area and not within 30 m of each other.

3.2.1 Implications for Land Capability

Environmental hazards such as Bushfire Hazard are generally not considered to be absolute constraints on the capability of land for development at the strategic planning level.

Bushfire risk is required to be considered at the strategic planning stage, where Section 9.1 Direction 4.4 requires Councils to seek the concurrence of the Rural Fire Service Commissioner where planning proposals are inconsistent with this direction.

Clause 5.11 of The Hills LEP 2012 provides that:

Bush fire hazard reduction work authorised by the Rural Fires Act 1997 may be carried out on any land without development consent.

The rationale for this is that bushfire hazard should be assessed on merit and managed through the development approval process in accordance with the Rural Fires Act and relevant Rural Fire Service guidelines for development on bushfire prone land. Measures for management of bushfire hazard can range from using fire resistant building materials and practices, separating built development from the hazard via appropriately considered Asset Protection Zones and management of the bushland that is creating the hazard. Any or all of these measures may be applied to render Bushfire Prone Land suitable for residential development.

On the basis of the above discussion, our conclusion is that bushfire hazard is, of itself, not an impediment to the capability of land to support development. Consequently, for the purposes of this Study, bushfire hazard has been allocated a low rating as a matter for consideration in determining land capability at the strategic planning level.

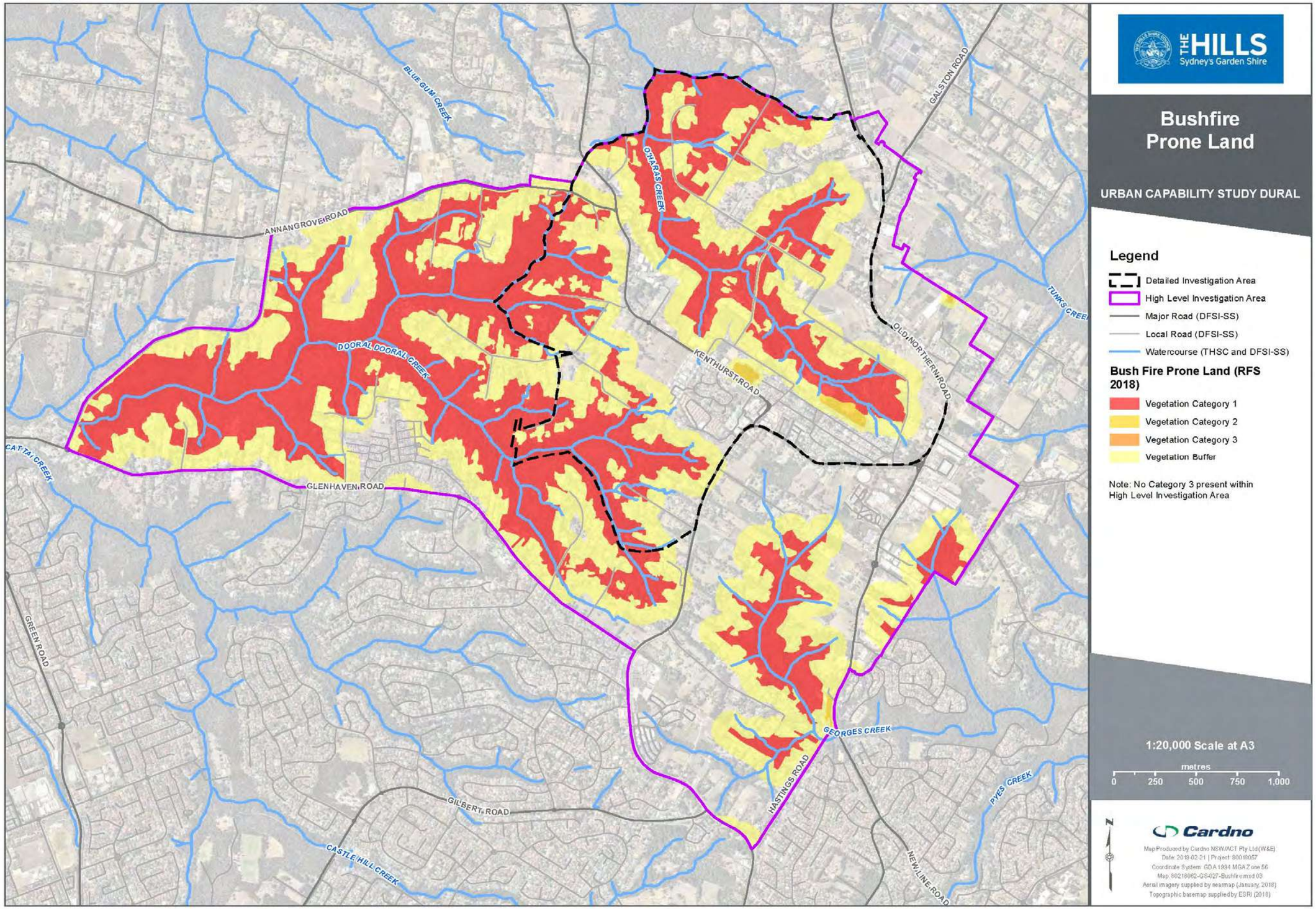

Figure 3-5 Bushfire Constraints mapping

3.3 Heritage

The following background searches were undertaken on 14 May 2018 to identify known Aboriginal and non-Aboriginal heritage. These searches included:

- Commonwealth's Australian Heritage Database;
- Office of Environment and Heritage's State Heritage Inventory;
- Hornsby Local Environment Plan 2013;
- The Hills Local Environment Plan 2012;
- Native Title Register; and
- Office of Environment and Heritage's Aboriginal Heritage Information Management System (AHIMS).

3.3.1 Australian Heritage

The Australian Heritage Database search identified any items of heritage significance that may occur in or in close proximity to the High Level Investigation Area. The Australian Heritage Database contains listings for the World Heritage List, Commonwealth Heritage List and the Register of the National Estate (non-statutory archive). The Register of the National Estate was closed in 2007 and is no longer a statutory list, however it is maintained on a non-statutory basis as a publicly available resource. Non-Aboriginal Australian heritage items in the vicinity of the High Level Investigation Area are shown in **Table 3-5**.

Table 3-5 Non-Aboriginal Australian heritage items in the vicinity of the High Level Investigation Area

Item	Location	Listing
St Judes Anglican Church	965 Old Northern Road, Dural	Registered - Register of the National Estate (Non-statutory archive)
The Pines – House, Outbuildings and Pine Trees	656 Old Northern Road, Dural	Registered - Register of the National Estate (Non-statutory archive)
Glenroy	756 Old Northern Road, Middle Dural (north of high level investigation area)	Rejected Place - Register of the National Estate (Non-statutory archive)

3.3.2 State and Local Heritage

The State Heritage Inventory contains listings for the State Heritage Register, Local Government listings and the Section 170 NSW State Agency Heritage Register.

The State Heritage Inventory and Local Environment Plans for Hornsby and The Hills identified items of heritage significance that occur in or in close proximity to the High Level Investigation Area.

There were no items listed in the vicinity under the NSW Heritage Act for Dural, Kenthurst, Castle Hill and Glenhaven. Local Non-Aboriginal heritage items in the vicinity of the High Level Investigation Area are shown in **Table 3.6** and **Figure 3-6**.

Table 3-6 Non-Aboriginal local heritage items in the vicinity of the High Level Investigation Area

Item	Location	Listing
Old Northern Road (A12)	Old Northern Road between Dural and Wisemans Ferry, Dural and Glenorie	The Hills LEP 2012
Former St Madeleine Sophie Borat Catholic Church (I113)	114A Kenthurst Road, Kenthurst	The Hills LEP 2012
“The Pines” (I87)	656A Old Northern Road, Dural	The Hills LEP 2012
Uniting Church Cemetery (I81)	14 Derriwong Road, Dural	The Hills LEP 2012
Dural Soldiers Memorial Hall (I86)	604 Old Northern Road, Dural	The Hills LEP 2012
House (I85)	600A Old Northern Road, Dural	The Hills LEP 2012
Allens House (I84)	548 Old Northern Road, Dural	The Hills LEP 2012
House (I83)	54–56 Kenthurst Road, Dural	The Hills LEP 2012
Hill Top (I82)	31 Kenthurst Road, Dural	The Hills LEP 2012
House (I112)	70 Kenthurst Road, Kenthurst	The Hills LEP 2012
House (I105)	35–37 Annangrove Road, Kenthurst	The Hills LEP 2012
House (I106)	44 Annangrove Road, Kenthurst	The Hills LEP 2012
Emmanuel Anglican Church (I89)	31A Glenhaven Road, Dural	The Hills LEP 2012
Rosenfels (I88)	23 Glenhaven Road	The Hills LEP 2012
House (I90)	428 Old Northern Road, Dural	The Hills LEP 2012
Street trees and bushland (343)	New Line Road, Dural – Road Reserve (between Pyes Creek and Old Northern Road)	Hornsby LEP 2013
Original alignment of New Line Road (Elouera estate) (344)	New Line Road, Lockyer Close, Dural	Hornsby LEP 2013
House (347)	208 New Line Road, Dural	Hornsby LEP 2013
“Terranova” (346)	260–266 New Line Road, Dural	Hornsby LEP 2013
Roadside trees (448)	Old Northern Road, Glenhaven – Road Reserve (east of Round Corner shops to reservoirs)	Hornsby LEP 2013
‘The Croft’ (342)	11 Harris Road, Dural	Hornsby LEP 2013
House (348)	857 Old Northern Road, Dural	Hornsby LEP 2013
House (349)	873 Old Northern Road, Dural	Hornsby LEP 2013
House, former Uniting Church and chapel (351)	925–935 and 937 Old Northern Road, Dural	Hornsby LEP 2013
St Jude’s Anglican Church and grounds (352)	951–965 Old Northern Road	Hornsby LEP 2013
Swanes Nursery (341)	490–498 Galston Road	Hornsby LEP 2013
House (337)	431 Galston Road	Hornsby LEP 2013
Garden (339)	452 Galston Road	Hornsby LEP 2013
Cemetery (A38)	885–887 Old Northern Road	Hornsby LEP 2013
St Jude’s Anglican Church and grounds (A39)	951–965 Old Northern Road	Hornsby LEP 2013

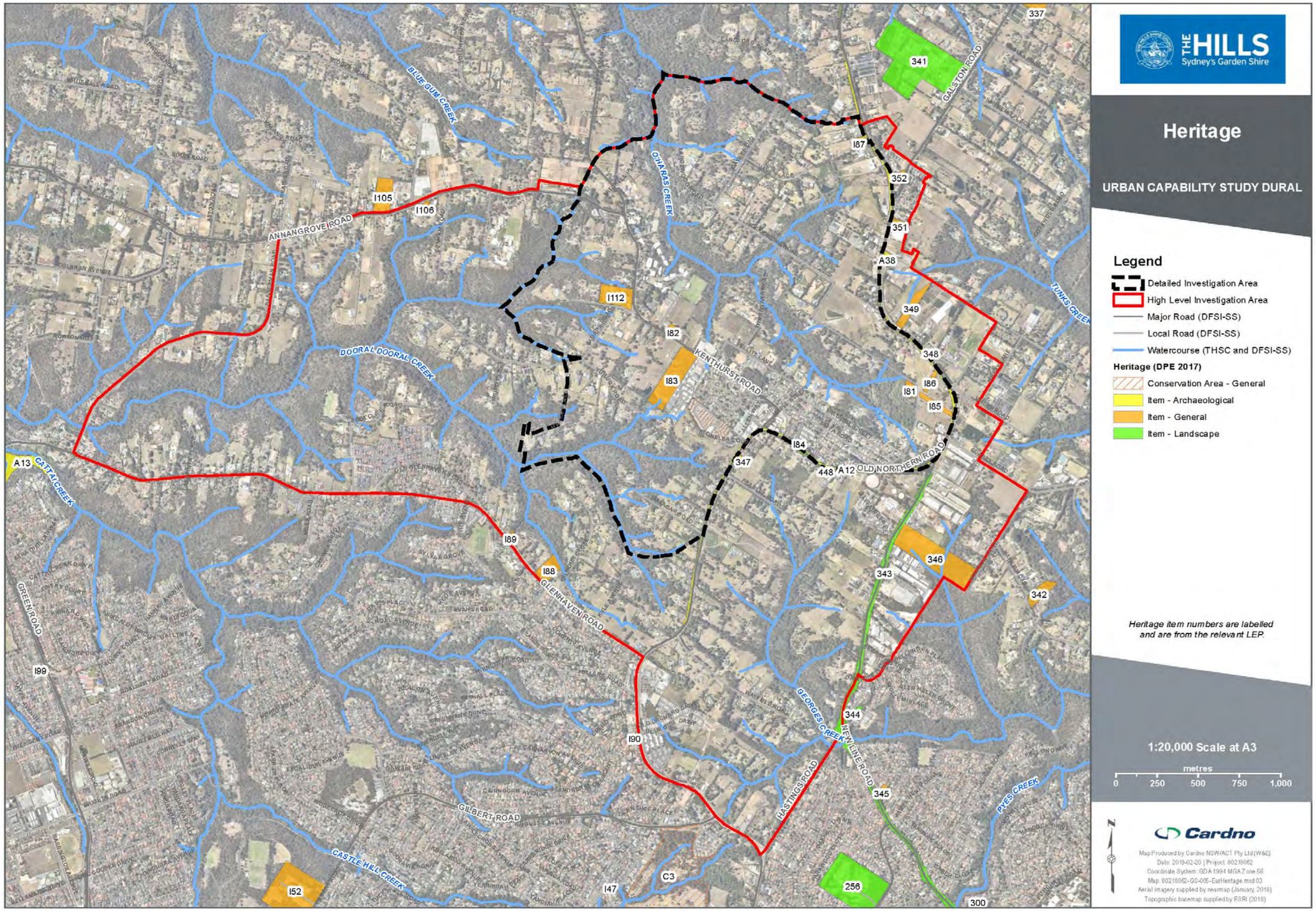

Figure 3-6 **Non-Aboriginal Heritage**

3.3.3 Native Title Tribunal

A search of the Native Title Register and Claims identified no current claims or existing native titles within The Hills and Hornsby local government areas. There was one non-claimant (native title which does not exist) for an area adjacent to Dural Park near Murrell Place, Dural.

3.3.4 AHIMS

A search of the Aboriginal Heritage Information Management System (AHIMS) was conducted for the High Level Investigation Area, with a 1 kilometre buffer. The search identified 57 Aboriginal sites and no Aboriginal places. It should be noted that the AHIMS database reflects Aboriginal sites that have been officially recorded and included on the list. Large areas of NSW have not been subject to systematic, archaeological survey; hence AHIMS listings may reflect previous survey patterns and should not be considered a complete list of Aboriginal sites within a given area. AHIMS sites were not identified within the Detailed Investigation Area. Refer to Appendix A for AHIMS sites within or in close proximity to the High Level Investigation Area.

3.3.5 Implications for land capability

Heritage values are protected across all land zones by the Hills LEP 2012 and the Hills Development Control Plan 2012. These controls apply regardless of the form or intensity of any proposed development and they would be applied as merit based assessments during future stages of the planning process. Therefore, the protection of heritage should not have bearing on decisions regarding the capability of the lands in the Investigation Areas, although the protection of heritage items may impact on future development patterns.

3.4 Flooding, Creeks and Watercourses

Within the framework of Commonwealth and State legislation and standards, Council has the responsibility to manage the natural water assets within their jurisdiction. While Sydney Water manages the metropolitan water supply and some of the stormwater trunk drainage network in the LGA, Council manages water functions in relation to waterways and water bodies, riparian land, floodplains and sustainable stormwater management, treatment and re-use.

Waterway and water bodies can include natural creeks and rivers, rehabilitated channels, constructed wetlands, man-made stormwater systems and detention basins, as well as open water bodies and wetlands. Waterways are an integral part of the rural and urban environment by the provision of ecosystem services and as a resource. Core activities for waterways management in the LGA include:

- Stormwater system planning;
- Stormwater system management;
- Natural waterways at the urban bushland interface and within rural lands; and
- Floodplain management.

As part of this study, background documentation and database searches were undertaken on 13 May 2018 to identify groundwater and flooding information. This research consisted of the following searches which have been summarised in the appropriate sections below:

- Flood controlled land buffer mapping (The Hills Shire Council);
- Overland Flowpath and Floodplain Mapping (The Hills Shire Council);
- DPI – Office of Water All Groundwater Register;
- Bureau of Meteorology's Groundwater Dependent Ecosystems Atlas;
- Commonwealth's Australian Flood Risk Information Portal; and
- Coastal Wetlands and Littoral Rainforest maps under the Coastal Management State Environmental Planning Policy (SEPP).

3.4.1 Waterways and Water Bodies

There are three named waterways within the High Level Investigation Area. These are:

1. Dooral Creek (flows west across the centre of the High Level Investigation Area);
2. O'Hara's Creek (flows north-west across the north-eastern portion of the High Level Investigation Area); and
3. Georges Creek (flows south-east across the south-eastern corner of the High Level Investigation Area)

These waterways are within the greater Hawkesbury River Catchment and the location and extent of these waterways are illustrated in **Figure 3-9**. All three waterways originate (i.e. headwaters) within the High Level Investigation Area and have a number of unnamed tributaries draining into the main channels. Both O'Hara's Creek and Dooral Creek are located within the Detailed Investigation Area (Detailed Investigation Area). Riparian vegetation along these waterways occurs in varying widths and is limited by infrastructure, developments and cleared areas. Their associated ecological values are discussed in Section 3.1.

NSW DPI Office of Water defines 'waterfront land' for the purposes of maintaining important environmental functions of waterways. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 m of the highest bank of the river, lake or estuary.

Riparian corridors (lie within waterfront land and form the transition zone between the terrestrial and aquatic environment. The riparian corridor performs important environmental functions including:

- Providing bed and bank stability, and reducing bank and channel erosion;
- Protecting water quality by trapping sediment, nutrients and other contaminants;
- Providing diversity of habitat for terrestrial, riparian and aquatic plants (flora) and animals (fauna);
- Providing connectivity between wildlife habitats;
- Conveying flood flows and controlling the direction of flood flows;

- Providing an interface or buffer between developments and waterways; and/or
- Providing passive recreational uses.

NSW DPI Office of Water set guidelines for defining riparian corridors to provide guidance on controlled activity approval requirements for development applicants. The riparian corridor includes the channel and a vegetated riparian zone (VRZ) on both sides of the waterway (**Figure 3-7**). The width of the VRZ has been standardised for first, second, third and fourth and greater order streams (**Table 3-7**). The defined VRZ allows development applicants to identify constraints and opportunities by the use of the averaging rule and the RC matrix (**Table 3.8**).

The averaging rule allows non riparian corridor works and activities, such as asset protection zones, recreational areas, roads, development lots and infrastructure, to be authorised within the outer riparian corridor, so long as the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. It requires the equivalent area to be offset on the site and be connected to the riparian corridor as illustrated in **Figure 3-8**. Whilst this averaging rule applies to the outer riparian zone, the inner 50% of the riparian zone must be fully protected.

Bridges, cycleways, paths, stormwater outlets and other essential services do not need to be offset, but must comply with the requirements set out in the riparian corridor matrix (**Table 3-8**) and other relevant Office of Water controlled activities guidelines. Offline detention basins do not need to be offset so long as there is an equivalent VRZ for the corresponding watercourse and they are built in compliance with the Office of Water's Controlled activities: Guidelines for watercourse crossings and Controlled activities: Guidelines for in-stream works. If a proposed basin will not have an equivalent VRZ for the corresponding watercourse, it may still be built in the outer 50 % of the VRZ but must be offset.

The averaging rule should generally be applied to cleared waterfront land. Development proposals involving waterfront lands that contain existing native vegetation should seek to preserve that riparian vegetation in accordance with the minimum riparian corridor requirements outlined in **Table 3-7**.

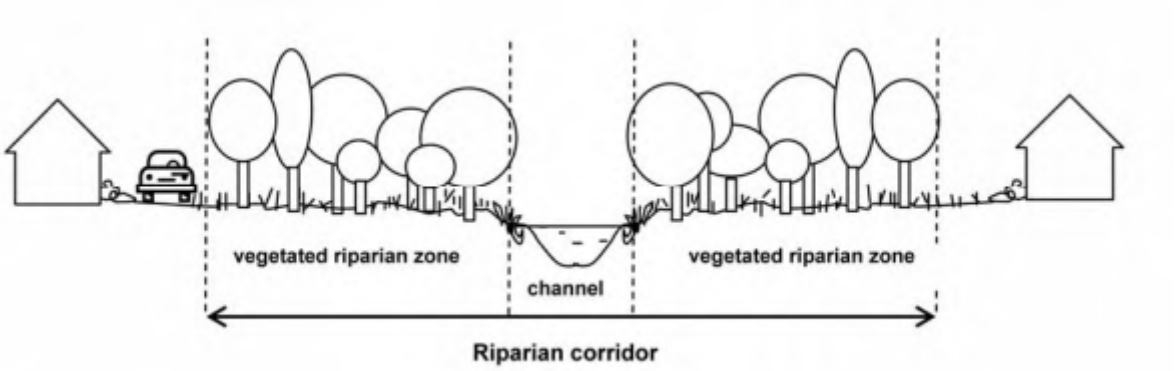

Figure 3-7 The RC and VRZ (source: NSW DPI Office of Water, 2012)

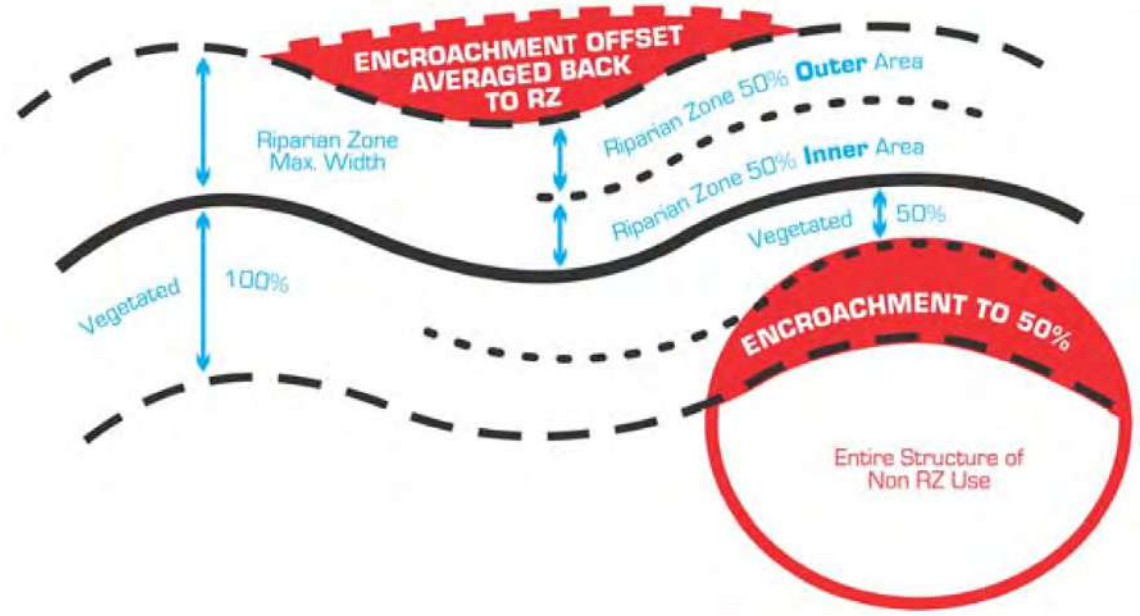

Figure 3-8 The averaging rule (source: NSW DPI Office of Water, 2012)

The total riparian corridor width is based on the waterway stream order. Mapping of the riparian corridor for the waterways within the High Level Investigation Area and the Detailed Investigation Area was undertaken based on the stream order classification as per NSW DPI Office of Water guidelines. The riparian corridor includes the waterway channel at the top of bank (ToB) on both sides of a waterway. However, as ToB surveys have not been formally completed for this study, the mapping of riparian corridors, based on The Hills Shire waterway data, is from the waterway centreline, as illustrated in **Figure 3-9.**

Any future planning or development within the High Level Investigation Area or the Detailed Investigation Area would need to assess and consider the waterway channel width to the top of bank when defining the riparian corridor.

Table 3-7 Recommended VRZ and RC widths (source: NSW DPI Office of Water, 2012)

Watercourse type	**VRZ width** (each side of watercourse)	**Total RC width**
1st order	10 metres	20 m + channel width
2nd order	20 metres	40 m + channel width
3rd order	30 metres	60 m + channel width
4th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width

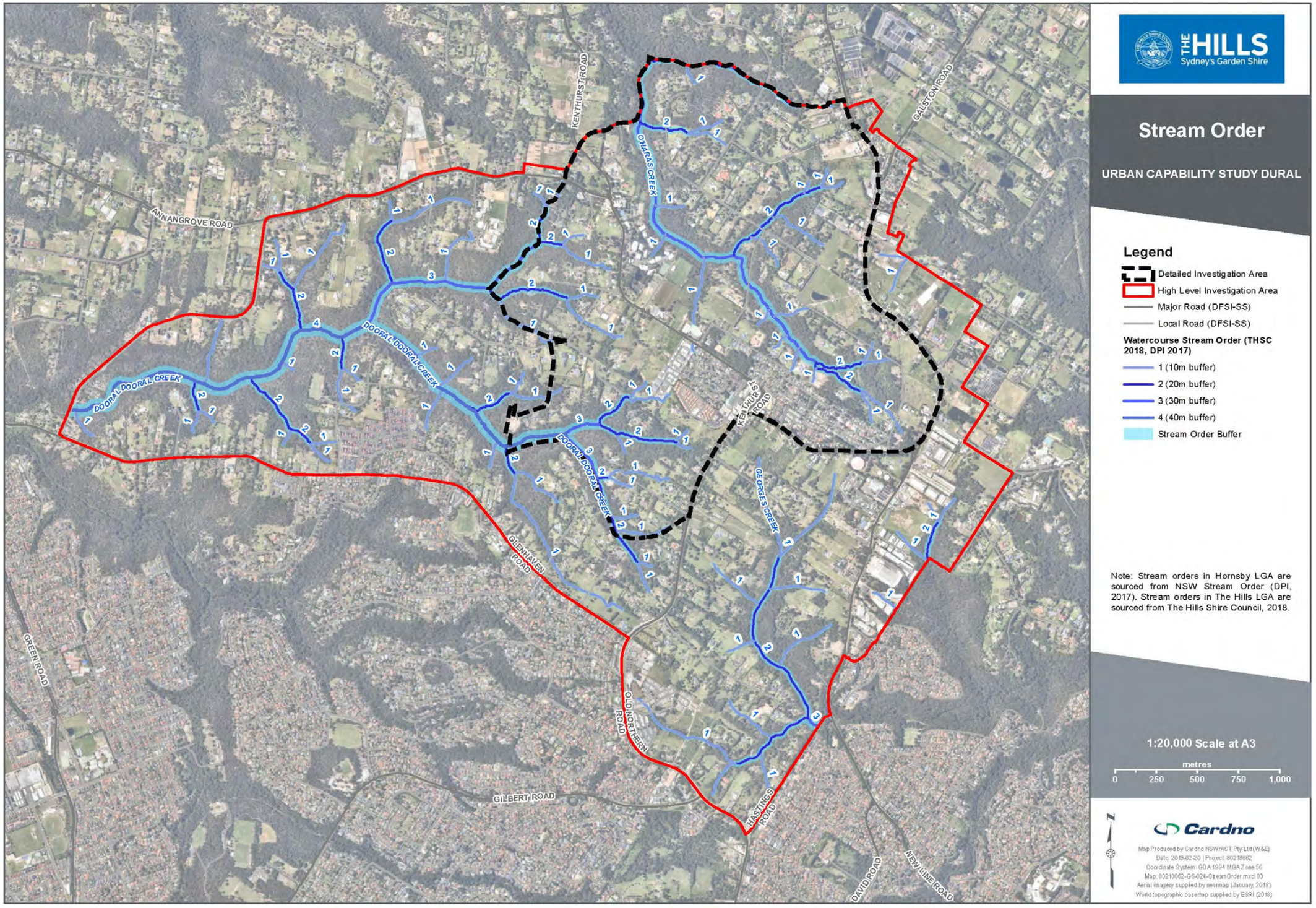

Figure 3-9 Watercourses and Stream Orders

3.4.1.2 Constraints and Opportunities

Under the *Water Management Act 2000* (WM Act), an approval is required to undertake controlled activities on waterfront land, unless the activity is otherwise exempt under Section 91E. Controlled activities include the carrying out of building work, the installation of infrastructure and excavation and deposition of materials. A public authority does not need to obtain a controlled activity approval for any controlled activities that it carries out in or under waterfront land. Furthermore, a controlled activity approval is not required if:

- The waterfront land relates to a river channel that is fully concrete-lined or is a fully enclosed pipe channel;
- The construction or use of fencing, a vehicular crossing or an access track on waterfront land does not impound water and relates to a minor stream in a rural zone;
- The activity is nothing more than removal of vegetation in circumstances that would otherwise be lawful;
- The controlled activity is to be undertaken:
    - In accordance with a WM Act water supply works approval;
    - In accordance with a WM Act harvestable rights order;
    - In accordance with Section 52 (domestic and stock rights) of the WM Act in certain circumstances;
    - In accordance with an approval under Part 2 of the former *Water Act 1912*;
    - By a network operator or pipeline licensee to construct, modify, repair, maintain, or complete emergency work on water or gas infrastructure or licensed pipelines;
    - During an emergency under the direction of a relevant act;
    - In accordance with any mining, crown lands or western lands lease, licence, permit; or
    - In accordance with any lease, licence, permit or other right in force in respect of land under the ownership or control of the maritime authority or a port corporation.

The riparian corridor matrix enables applicants to identify certain works and activities that can occur on waterfront land and in riparian corridors (**Table 3-8**). Applicants should note that the matrix relates to controlled activity approvals under the WM Act only. They are still required to comply with other relevant government legislation, such as threatened species, flood planning levels and fisheries guidelines.

Table 3-8 Riparian corridor matrix (source: NSW DPI Office of Water, 2012)

Stream order	Vegetated Riparian Zone (VRZ)	RC off-setting for non RC uses	Cycleways and paths	Detention basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1st	10m	•	•	•	•	•	•	•		
2nd	20m	•	•	•	•	•		•		
3rd	30m	•	•	•		•			•	•
4th +	40m	•	•	•		•			•	•

3.4.2 Implications for land capability

Existing vegetation and riparian areas provide the opportunity for enhanced passive recreation and amenity for residents and improvements in connectivity for pedestrians and cyclists. Natural watercourses and overland flow paths signal the need for caution to ensure that flood risk or the potential for flood damage is not exacerbated. Uplift in development in the Investigation Area would be likely to trigger a need for

upgrades and enlargements to the stormwater drainage system to ease impacts of overland flow on affected land.

Recommendations with respect to capability for development uplift within Riparian Corridors identified in accordance with the Office of Water recommendations are:

- The inner 50% of the VPZ should be excluded from consideration for uplift in development capability. There are obvious exceptions such as the provision of stormwater infrastructure etc. It is recommended that a 'no go' be applied to this portion of the riparian corridor.
- The outer 50% of the VPZ should not be excluded for uplift capability if that is the only constraint applicable to the area, unless this area is subject to a floodway at the 100-year flood event. Development within this land can be managed through the development approvals process on a merits basis, depending largely on the activity proposed and the ability to offset. The cumulative environmental consideration of riparian corridors is discussed further in Section 4.

3.4.3 Flooding

3.4.3.1 Flood Prone Land and Flood Prone Land Policy

"Flood Liable Land" or "Flood Prone Land" is defined as land susceptible to flooding up to the probable maximum flood – which is the largest flood likely to ever occur.

The NSW Government's Flood Prone Land Policy defines flood prone land "as a valuable resource that should not be sterilised by unnecessarily precluding its development" as rests the primary responsibility for the management of flood prone land with local councils. The main objective of the policy is to minimise the impact of flooding and flood liability and to reduce losses resulting from floods by utilising environmentally friendly approaches. Local councils are primarily responsible for the management of flood prone land. Councils rely on the State Government Floodplain Development Manual to guide their floodplain risk management across flood prone land.

3.4.3.2 Flood Controlled Land and Flood Control Buffer

"Flood Controlled Land" or a "Flood Control Lot" is a parcel of land where an existing flood related development control applies. These controls aim to ensure that development occurring on flood controlled land is safe and appropriate. The Hills Shire Council, as part of its Development Control Plan (Draft Part C Section 6 – Flood Controlled Land). has identified flood controlled land within the LGA. The plan only applies when a landowner wishes to develop land identified as a flood control lot. The section of the DCP is supported by a map that identifies flood controlled land parcels within The Hills Shire Council. Not all flood controlled land is susceptible to flooding or in other words not considered as "flood prone land".

"Flood Control Buffers" are corridors adopted based on a set of criteria which are successively used to identify land where a flood-related control applies in accordance with Council's Flood Controlled Land DCP. The Hills Shire's flood control buffer mapping is not based on flood modelling and does not identify a flood extent.

The following criteria were used to identify flood controlled land:

Within urban areas, where properties are affected by:

- An overland flowpath associated with (being adjacent to, over and downstream of) a stormwater pipe with a diameter of 600mm or greater. A 20 metre buffer corridor is applied (10 metres either side of the flowpath centreline);
- A *watercourse* with a stream order of 2 or greater, various corridor widths are applied:
    - Second order stream – a 40 metre buffer corridor is applied (20 metres either side of the watercourse);
    - Third order streams – a 60 metre buffer corridor is applied (30 metres either side of the watercourse); and
    - Fourth order streams and greater – an 80 metre buffer corridor is applied (40 metres either side of the watercourse).

- The *100-year Annual Recurrence Interval (ARI) flood extent* identified by:
    - The Upper Parramatta River Flood Study 2004;
    - Council's Development Control Plan Part D Section 12 - Carlingford Precinct Plan; and
    - North Kellyville State Environmental Planning Policy Amendment Maps 2008.

- Land zoned as SP2 Infrastructure that is associated with Sydney Water Corporation trunk drainage land.

Within rural areas, where properties are affected by:

- A *watercourse* with a stream order of 2 or greater, various corridor widths are applied:
    - Second order stream – a 40 metre buffer corridor is applied (20 metres either side of the watercourse);
    - Third order streams – a 60 metre buffer corridor is applied (30 metres either side of the watercourse); and
    - Fourth order streams and greater – an 80 metre buffer corridor is applied (40 metres either side of the watercourse).

Within The Hills Shire Development Control Plan 2012 flood controlled land applies range of flood planning levels depending on type of land use and potential development. During the assessment of land capability flood controlled land, with the exception of flood control buffers, were not considered as relevant flood planning would mitigate the potential impacts. Also, parts of the development would have different Flood Planning Levels due to the occupancy and use of that part of a building. This combined with the necessity for mitigation options, such as additional infrastructure would be assessed during the planning approval process and would not necessary preclude development. As a result, flood control buffers and 100 year ARI Fringing Flow areas determined by Council as part of the Urban Villages Overland Flow Study were then focussed on to determine their relevance to the study.

3.4.3.3 Stormwater Drainage Infrastructure

The stormwater drainage in the area follows two subcatchments, O'Hara's Creek and Dooral Creek which ultimately flow into the Hawkesbury River. Urbanised sections of each catchment are typically drained by a constructed stormwater system which consists of stormwater pipes and pits. In order to mitigate the potential impact from new development on the stormwater system and floodplains across the area controls governing stormwater capture, treatment and reuse have been established. The ability for stormwater to be managed in conjunction with development is assessed during the development application process and applied through the DCP. Therefore, as stormwater controls are determined on a case by case basis at the planning approval stage, for the purposes of the land capability they have not been considered unless it is not feasible for them to be implemented.

3.4.3.4 Overland Flow Behaviour

To inform Council's flood related development controls, 'DRAFT *The Hills Urban Overland Flow Study'* (2017) was commissioned to define land subject to overland flooding across its older urban areas. The study outcome will allow Council to refine the determination of flood controlled land and will assist Council with the provision of improved flooding advice to the community as well as emergency services, and ensure that future development is completed in a way that is cognisant of the flood risk. In 2015 Council commissioned the 'DRAFT *Urban Villages Overland Flow Study*' to obtain similar information for four additional catchments that drain through a number of smaller villages outside the main urban precincts. The results were analysed to determine where overland flow has the potential to damage property and/or pose a risk to people. The key findings found that areas of significant overland flow tend to be concentrated along defined creeks, drainage depressions and a number of roadways. At present, overland flowpaths within the rural portion of the study area are located away from existing properties. However, a limited number of overland flow paths are predicted to extend through some residential and commercial properties, within the urbanised area of Dural. This is evident in **Figure 3-10**.

As part of this study several forms of information were mapped to determine:

- Overland Flow Paths; and
- Fringing Flow Areas.

“Overland flow paths” are areas subject to overland flow depths and velocities above identified threshold and are considered to have a significant overland flow risk. Results for these areas are mapped in **Figure 3-8**. Overland flow paths will eventually allow Council to more reliably define land subject to flood related development controls (i.e., flood control lots) and provide improved flooding advice to the community and emergency services.

“Fringing flow areas” are subject to shallower and/or slower moving water and are located on the perimeter of the overland flow paths. These areas are delineated by a pink polygon in **Figure 3-8**.

The Draft Urban Villages Overland Flow Study quantifies overland flow behaviour within the study area to enable Council to refine the determination of flood control lots**.**

The Draft Urban Villages Overland Flow Study filtered raw modelling results to remove areas of insignificant inundation from the flood mapping. The filter identifies land that is subject to overland flow depths and velocities above identified thresholds and is considered to have a significant overland flow risk. The application of the abovementioned filtering process generated a number of isolated “puddles” which did not form part of an overland flow path. Therefore, an additional filter was applied whereby all “puddles” less than 100 m^2 in size were also removed from the presentation of results if they did not align with an overland flow path. This overland flow tends to be concentrated along defined waterways, drainage depressions and roadways. However, it is also predicted to potentially impact a number of properties. From reviewing NearMap aerial photography of the Detailed Investigation Area the majority of the 100 year ARI Overland Flowpath areas outside Flood Control Buffers are dams or retention basins on private properties.

The fringing flow category covers the remaining area of land affected by flooding. These are areas that are inundated to a depth of more than 0.1 metres regardless of the velocity of overland flow.

It should be noted that flood control buffers do not necessarily demonstrate flood inundation extents. When assessing flooding in the Detailed Study area, the flood control buffer was only applied in locations where the Draft Urban Villages Overland Flow Study did not model. This can be seen in **Figure 3-10** where the 100 year ARI Fringing Flow areas (mapped in pink) do not always cover the existing flood control buffer areas (mapped in blue). The flood control buffer areas are conservative as it applies a buffer to the existing creek line. For this reason, these areas should be categorised with this in mind. Where flood modelling data exists then the flood control buffer area was not considered as a constraint for land capability. Despite this, both areas were mapped in **Figure 3-10** to demonstrate where areas were refined following additional studies by The Hills Shire Council.

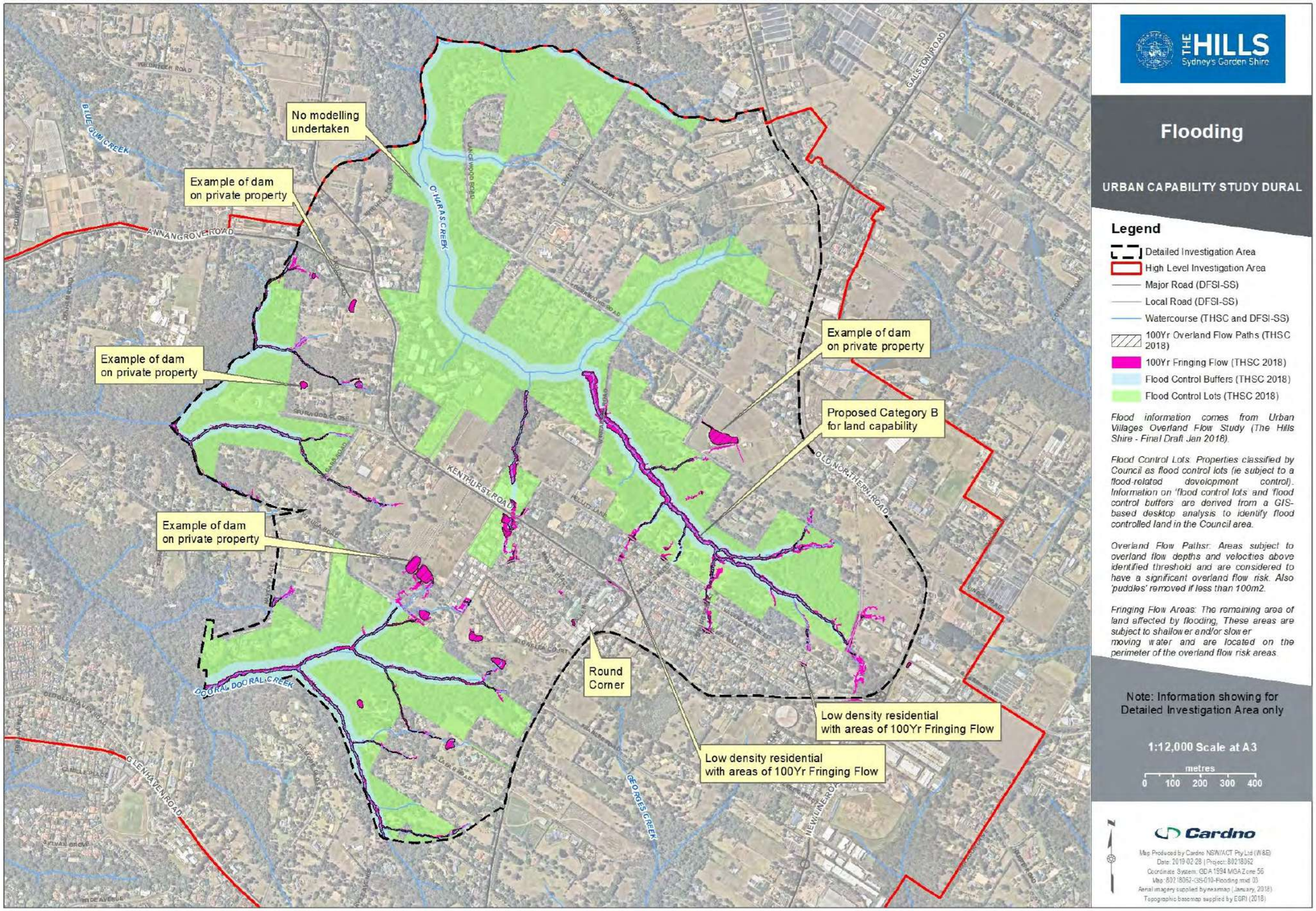

Figure 3-10 Flood Areas

3.4.4 Implications for land capability

The flooding regime (flow velocity, depth and pathways) is affected by land use type and intensity. Alterations to land use or intensity would necessitate revised modelling to determine the flooding impacts. Land use type is classified by trees, grass, shrubs, roads, concrete, water and buildings. Any development will affect the flooding behaviour in the study area and would need to be considered on a larger scale to determine the impact of significant land use change. However, from reviewing the currently modelled 100 year ARI flow path areas are generally:

- Dams on private properties;
- Located within existing streams; and
- Appear in higher density development (when compared to the land in the remaining Detailed Investigation Area) near Round Corner where it appears that a low order stream was present prior to development. The land zoning in this locality is R2 Low Density Residential.

It is recommended that areas in 100 year ARI Fringing Flow areas outside of the Flood Control Buffer could be suitably mitigated for flooding through the application of the Development Control Plan at planning approval stage and as such should be classified as Category A. Areas achieving 100 year ARI Fringing Flow classification within the Flood Control Buffer are recommended to be classified Category B on the basis of their importance to contributing to the wider flooding regime. Where the Draft Urban Villages Overland Flow Study did not model, a conservative approach has been applied and consideration of applying Category B, with the potential for this to be refined in the event further modelling is undertaken.

Water Sensitive Urban Design and Water Re-Use opportunities would be considered for each proposed development at planning approval stage. Flood Control Lots are also identified via the DCP during the planning approval stage and are a mechanism for mitigation to be applied. Hence it has not been considered in the capability of the land.

3.4.5 Groundwater

Groundwater is an essential resource, particularly as surface water resources are often fully allocated, or limited for example during droughts. Stresses on groundwater systems are related to the annual variability of recharge, cycles of user demands, and cumulative effects of domestic and industrial expansion. It is important to balance water demands against resource availability and services provided to the environment. To manage a groundwater system for long term sustainability, climate variability and change impacts on recharge and demand needs to be understood. Understanding the potential effects of climate variability and change on groundwater is more complex than with surface water. Groundwater-residence times can range from days to tens of thousands of years or more, which delays and disperses the effects of climate and challenges efforts to detect responses in the groundwater to climate variability and change. Even without considering climate variability and change, groundwater sustainability is a major challenge because groundwater is a widely distributed resource that is affected by local users and contamination.

The ability of groundwater to recharge balanced with its extraction and movement is integral to maintaining a healthy groundwater system, and ensure the long term sustainability of this resource. Groundwater recharge occurs through percolation from surface water to groundwater and relies on a permeable surface. Development affects the ability for groundwater recharge however this is not seen as a key risk in the investigation area due to the rural land use and the use of licencing to manage boreholes.

3.4.5.1 Boreholes

There are about 30 groundwater bore sites in the High Level Investigation Area. The purposes for these bores are generally irrigational, stock and domestic uses.

3.4.5.2 Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements to maintain their communities of plants, animals and ecological processes. These can occur across both surface and subsurface landscapes and are highly variable. GDEs have their species composition and natural ecological processes determined by groundwater. The Groundwater Dependent Ecosystems Atlas (BoM 2018) was developed to inform groundwater planning and management and is mapped in **Figure 3-11**.

The Atlas identified high to moderate potential for terrestrial groundwater dependent ecosystems (GDE) to occur. Terrestrial ecosystems rely on subsurface presence of groundwater and include all vegetation

ecosystems. The presence of terrestrial GDEs aligns to the location of the riparian corridors within the area and reaffirms the connectivity between water management and the wider ecosystem health.

The Atlas did not identify any potential for aquatic GDE (ecosystems that rely on the surface expression of groundwater). There was no data for Subterranean GDE (ecosystems that includes cave and aquifer ecosystems) in the area (BoM, 2018). GDEs could potentially limit the amount of ground water available to future development but would not constrain the capability of land at this level.

3.4.6 Implications for land capability

Consideration to the groundwater infiltration rates to sustain GDEs usually need to be assessed to understand how alterations to hydrology and geomorphology will impact these GDE's ability to access to groundwater. However, given these GDEs are terrestrial and exist along the creek lines, maintaining adequate flows through these areas would inevitably sustain GDEs. As this is feasible due to the flooding nature of the creeks it is recommended that the capability classification Category A be applied.

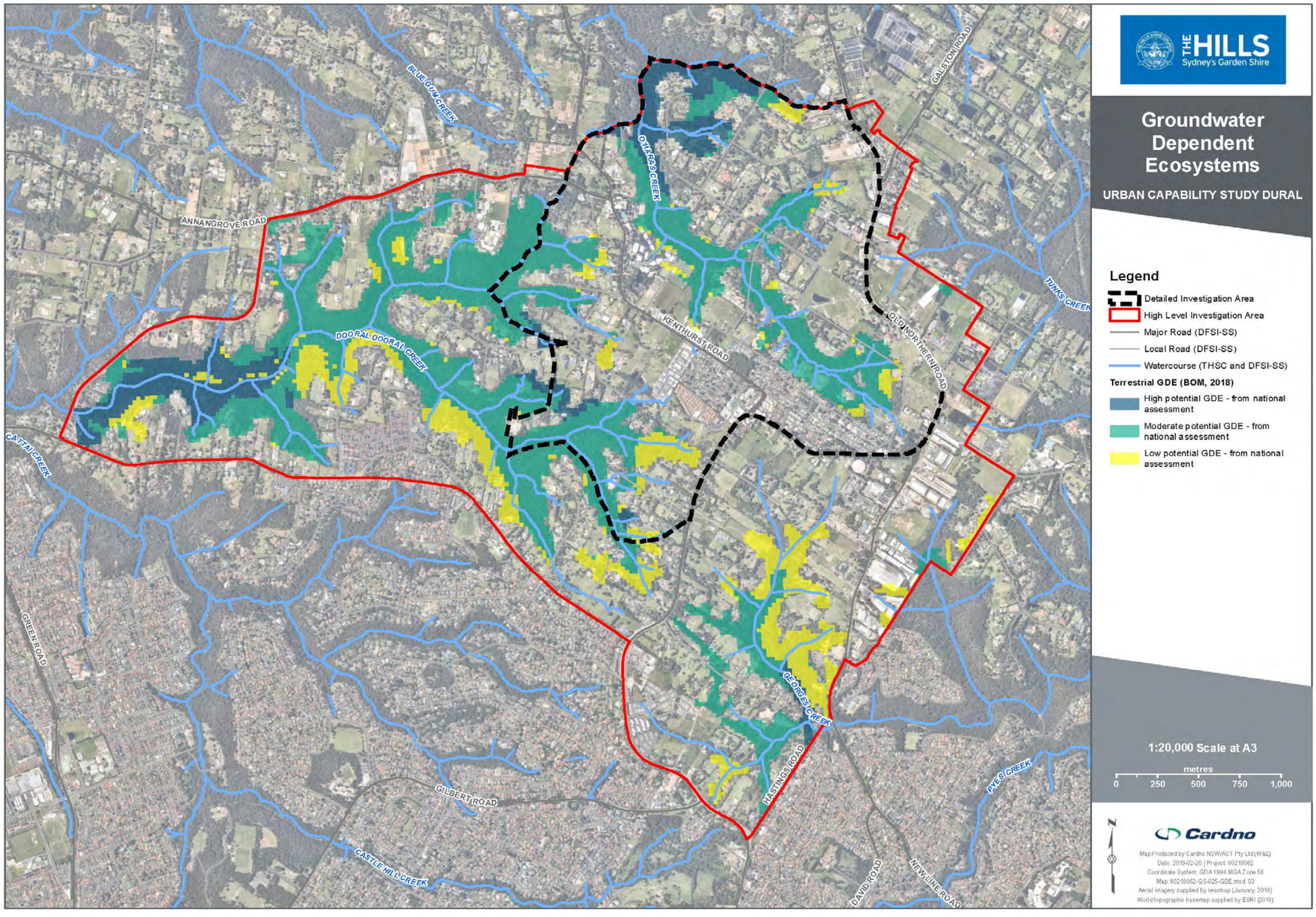

Figure 3-11 **Groundwater Dependent Ecosystems (BOM Atlas, 2018)**

3.5 Soil Capability and Topography

A search for topography, potential contamination sources, Acid Sulfate Soils, salinity and soil type was conducted on 13 March 2018 using the following sources:

- Hornsby Local Environment Plan 2013;
- The Hills Shire Local Environment Plan 2012;
- Department of Land and Property Information's LiDAR (GIS);
- Environmental Protection Agency (EPA) Contaminated Land Register;
- EPA Contaminated Land Record;
- OEH's *Protection of the Environment Operations Act* Public Register of Licences;
- Sydney 1:100,000 Geological Sheet Series (9130, First Edition 1983);
- Penrith 1:100,000 Geological Sheet Series (9030, First Edition 1991); and
- OEH's Soil Landscape mapping (GIS).

3.5.1 Topography

The slope percentage of the High Level Investigation Area was mapped based on LiDAR data (NSW Department of Land and Property Information 2011). Old Northern Road runs predominantly north-south along a ridgeline from Wisemans Ferry in the north to Castle Hill in the south. The land on either side of Old Northern Road in the Dural area slopes away from the road at gradients that largely range between 0-10 degrees, with some areas of a steeper gradient. The topography also shows high percentages of slope towards the riparian corridors along the creeks (**Figure 3-12**).

3.5.2 Implications for land capability

Steep land is generally considered to be a constraint to development uplift. Implications for development on steep land increase with the intensity of development and include:

- Land disturbance due to cut and fill operations to support building platforms, external utility zones around buildings and access roads;
- Landslip risk;
- Erosion risk;
- The rate, volume and quality of water leaving the land;
- Loss of vegetation;
- Downslope impacts on adjacent land and water quality; and
- Changes to visual character.

The Low Rise Medium Density Design Guide (NSW Government, 2017) defines a sloping site as "a site with a slope of 15% or greater". The Guide does not preclude medium density development from "sloping sites" but it does provide advice on the constraints and issues that would require consideration to allow acceptable development of medium density housing on such sites. In summary, these include:

- Visual impacts and impacts on local character;
- Land disturbance - cut and fill and the impacts of retaining walls; and
- The overall ability of the land to accommodate development.

The Hills LEP, 2012 maps land with the potential for "landslide risk". The determination of this risk is based on the geotechnical condition of land - a combination of slope, soil type and geology. The relevant clause in the LEP is:

Cl.7.6 Landslide risk
(1) The objective of this clause is to ensure that development is commensurate to the underlying geotechnical conditions and to restrict development on unsuitable land.

(2) This clause applies to land identified as "Landslide Risk" on the Landslide Risk Map.

(3) Before determining a development application for development on land to which this clause applies, the consent authority must consider whether the development's design is responsive to the constraints of landslide risk, including:

(a) site layout, including access,

(b) the building's design and construction methods,

(c) the amount of cut and fill that will be required,

(d) waste water management, stormwater and drainage across the site,

(e) the specific geotechnical constraints of the site.

(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:

(a) is designed, sited, constructed and will be managed to avoid any landslide risk and potential adverse impact on the development or on land in the vicinity of the development, and

(b) will appropriately manage waste water, stormwater and drainage across the site so as to not affect the rate, volume and quality of water leaving the land.

Notwithstanding that land within the Investigation Area is not mapped in the LEP as being subject to landslide risk, this Development Standard in the LEP provides further evidence of the potential negative impacts of higher density development on steep land.

Cardno's advice on the capability of steep land to absorb higher density development is derived from our experience with the implications of such development with respect to the above described criteria. Based on this we have assigned capability categories around slope as indicated in the following table.

Table 3-9 Impacts of Slope on Capability

SLOPE CATEGORY	CAPABILITY OF ABSORBING DEVELOPMENT	COMMENTARY
0-10%	No impact on capability	Slope would not be an impediment to orderly development of land and would not be likely to be a matter for detailed consideration in a development proposal.
11-15%	Moderate impact on capability	Some conventional measures to address slope constraints are likely to be required in formulating a development proposal.
16-20%	Significant impact on capability but not sufficient to preclude potential for development uplift.	Measures in existing planning controls and guidelines would potentially allow for appropriate higher density development. Slopes of this level should not as a single constraint preclude land from potential for development uplift.
Greater than 20%	Major impact on development capability. Land at these slopes should be precluded from consideration for uplift in development intensity.	Higher density development on these slopes would be likely to impact negatively on the environment with respect to one or more of the matters for consideration in the relevant planning controls and guidelines. Implementation of measures in the planning controls would be unlikely to sufficiently address all negative impacts.

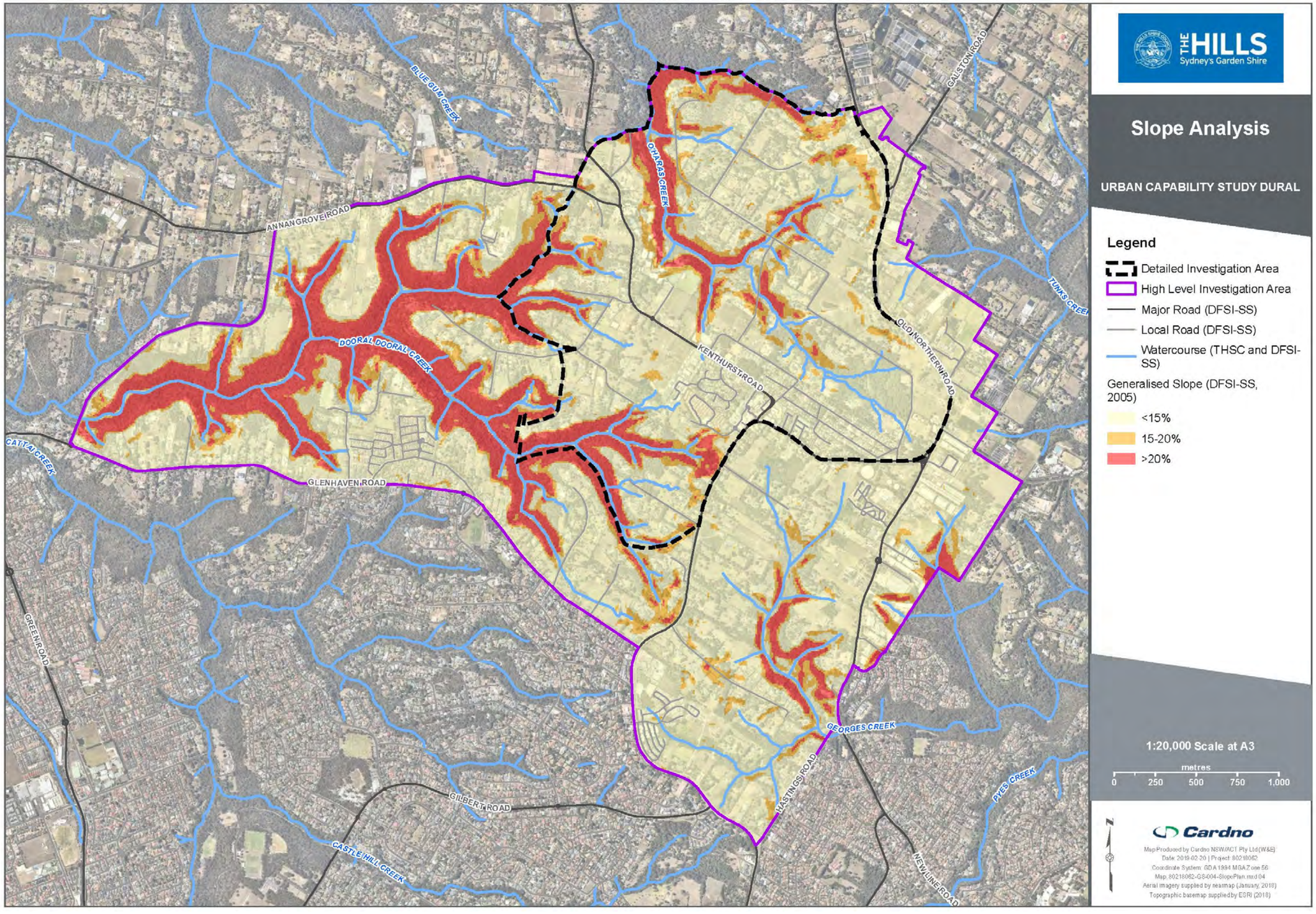

Figure 3-12 Slope Analysis

3.5.3 Contaminated Soils

A search of the EPA Contaminated Land Register indicated one contaminated land site within the vicinity of the study area (137 Annangrove Road, Kenthurst). However, it is noted that the Contaminated Lands Register is not exhaustive and there remains potential for additional contaminated land to be encountered during the works. There is potential for a range of contaminants (i.e. pesticides) to be present due to previous use of the land for agriculture. In addition, as the land is on the fringe of urban developments, there is potential that parts of the area were used for illegal dumping (for example metals or asbestos).

Three sites listed with contaminated land were found to be within the Detailed Study Area, but are located on the eastern boundary along Old Northern Road (see **Figure 3-13** for locations). Two of these sites are immediately adjacent to each other. A summary of all search results in and near to the two study areas is outlined below.

The EPA contaminated land list is a list of NSW contaminated sites notified to EPA (current 9 February 2018). The list was reviewed for suburbs (Dural, Glenhaven, Castle Hill and Kenthurst) and identified five sites:

- Caltex Service Station, 530 Old Northern Road, Dural – located on corner of Kenthurst Road and old Northern Road near the Round Corner Shopping Centre. Within Detailed Investigation Area.
- Woolworths Service Station, 532 Old Northern Road, Dural – located on corner of Kenthurst Road and old Northern Road near the Round Corner Shopping Centre. Within Detailed Investigation Area.
- BP Dural Service Station, 580 Old Northern Road, Dural – located on corner of Derriwong Road and old Northern Road. This site is within the Detailed Investigation Area in the Hornsby LGA.
- Caltex Dural Service Station, 917-923 Old Northern Road, Dural – Near corner of Old Northern Road and Galston Road. Within High Level Investigation Area.
- Vacant Land, 259 McClymonts Road, Kenthurst. Outside Investigation Area.

The Environment Protection Agency (EPA's) *Protection of the Environment Operations Act* public register was searched to identify environmental protection licences and other regulatory information under the Act. Six sites were identified in close proximity (but outside) the High Level Investigation Area at:

- 104A-104B Kenthurst Road, Kenthurst – S91 clean up notice (issued 7 Sept 2017) and S110 variation of clean up notice (5 March 2018).
- 19 Raym Road, Kenthurst - S91 clean up notice (29 July 2016) and penalty notice (29 Nov 2017).
- 425 Galston Road, Dural – S91 clean up notice issued on 22 December 2017.
- 1103 Old Northern Road, Dural – former POEO licence.
- 249 Pitt Town Road, Kenthurst – S91 clean up notice issued on 6 Jul 2017.
- 2C Jones Road Kenthurst – POEO licence.

3.5.4 Implications for land capability

The presence of contamination does not affect the capability of the land for development uplift but may limit the financial benefit of development when consideration of remediation and design costs are understood. The level of remediation and costs would be determined and assessed during the development approval process. For these reasons land containing contamination has not been included as a constraint on capability of the land for development uplift.

3.5.5 Geological landscapes

The regional geology of the High Level Investigation Area is based on the Sydney 1:100,000 Geological Sheet Series (9130, First Edition 1983) and Penrith 1:100,000 Geological Sheet Series (9030, First Edition 1991) which identifies the site as comprising Hawkesbury Sandstone and Ashfield Shale. Hawkesbury Sandstone is a medium to coarse-grained quartz sandstone with minor shale and laminate lenses formed in a previous alluvial environment dating back to the Jurassic period. The Ashfield Shale is comprised of laminate and dark grey shale.

The Hawkesbury Sandstone Formation generally tends to be highly infertile and shallow, and water passes through it easily.

The movement of landslide material can vary from abrupt collapses to slow gradual slides and at rates which range from almost undetectable to extremely rapid. Landslides range in size from a single boulder in a rock fall or topple, to tens of millions of cubic metres of material in a debris flow. They can also vary in their extent, with some occurring very locally and impacting a very small area or hill slope while others affect much larger regional areas. The distance travelled by landslide material can also differ significantly with slides travelling from a few centimetres to many kilometres depending on the volume of material, water content and gradient of the slope. It is important to evaluate slope stability and any landslide threat during development assessments so that effective and timely preventative and/or remedial measures can be implemented.

Factors which influence whether a landslide will occur typically include slope angle, climate, weathering, water content, vegetation, geology, slope stability and the amount of loading on the slope (overloading). Human specific contributions to landslides include:

- Removal of vegetation;
- Interference with, or changes to, natural drainage;
- Leaking pipes such as water and sewer reticulation;
- Modification of slopes by construction of roads, railways, buildings, etc.;
- Overloading of slopes by construction of buildings or earthworks etc.;
- Vibrations from heavy traffic, blasting, etc.; and
- Excavation or displacement of material, including mining and quarrying activities.

Shale in horizontal beddings alone does not present a risk. However, the infiltration of water and retention of water between the horizontal bed of the shale however enables the shale to slide easily. Given the presence of shale in the area, the Australian Government Geosciences Landslide Search portal was used to determine the location of any landslide risk areas. The search did not? return any known locations for landslides however if there is extensive development the risk may evolve.

3.5.6 Implications for Land Capability

There is a low probability of landslide risk in the area and suitable engineering designs are able to manage geological landscapes. Hence, this environmental aspect is considered to have no implication with regard to the capability of the land to absorb development uplift. It is recommended this is classified as Category A.

3.5.7 Soil Landscapes, Salinity Potential and Acid Sulfate Soils

Soil mapping describes the properties of soils and the landscapes in which they occur. Mapping is used to evaluate land for planning, agricultural use or environmental protection. Soil landscape mapping describes topsoil and subsoil conditions and properties, and their underlying geological formations. This is important in informing the geotechnical constraint in development for the purposes of supporting structures and depth of foundations. It is also used to determine soil fertility and erodability, two important factors for agricultural land.

The Soils Landscapes of the Sydney 1:100,000 Sheet (Office of Environment and Heritage, 2009) identifies the High Level Investigation Area as primarily Glenorie and Gymea with Hawkesbury, Hornsby, Lucas Heights and West Pennant Hills soils in the nearby area. Glenorie and Gymea are both erosional landscapes with high soil erosion hazard (See **Figure 3-13**).

The Hills Shire LEP and Hornsby LEP identified no known occurrence of ASS in the High Level Investigation Area. The Detailed Investigation Area is described as having low to moderate salinity potential (OEH 2016 mapping). Salinity is the accumulation of salt in the land and water to a level that damages the natural and built environment. Salinity usually occurs with other natural resources problems such as decreasing soil and water quality, erosion and loss of native vegetation (OEH 2018). Although there is potential for salinity, it is unlikely to impact on the capability of the land as there are mitigation measures that can be implemented to limit the impact (i.e. exposure-class bricks and salt-resistant concrete).

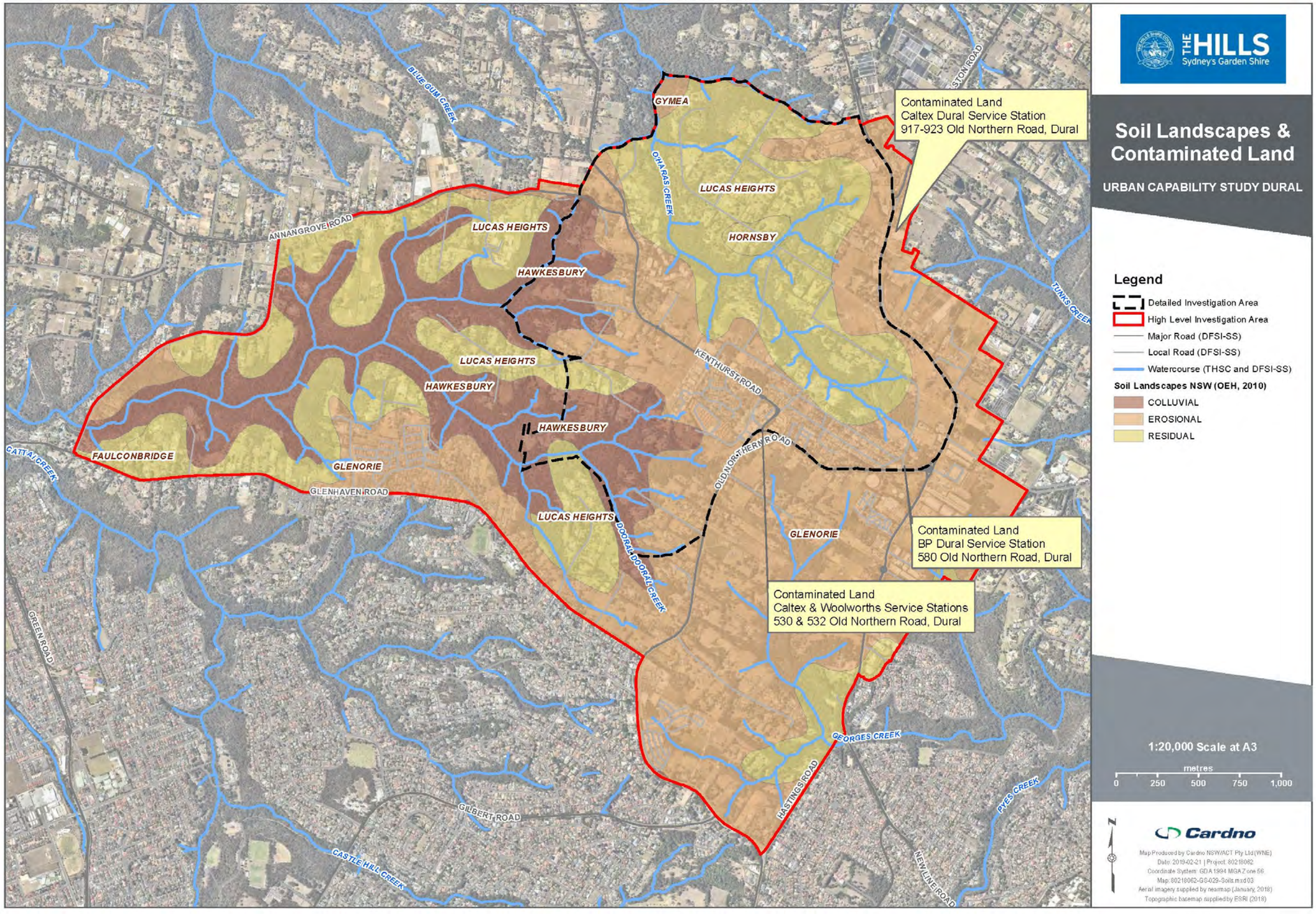

Figure 3-13 **Soil Landscape and Contaminated Land area**

3.5.8 Implications for land capability

At present the Detailed Study Area is comprised of residential, rural and semi-rural land uses. The ability to continue existing land uses would not be impacted by the soil landscapes and potential salinity. Both these aspects can be managed by control measures applied by the planning controls. These environmental elements are considered to have no implication with regard to the capability of the land to absorb development uplift. It is recommended this land is classified Category A.

3.6 Noise and Vibration

Effective land use planning plays a key role in preventing potential noise impacts, both at the strategic planning level and at a project-specific level. The *Protection of the Environment Operations Act 1997 (POEO Act)* provides regulatory tools for managing noise impacts from new and existing noise-producing developments. Non-regulatory approaches also have an important role to play in managing noise problems and should be used in conjunction with regulatory mechanisms.

The noise sources in the Detailed Investigation Study Area mainly consist of wildlife noise, common residential noise, commercial properties and some light industry, and distant traffic noise (from the main connector roads i.e. Old Northern Road). Currently, the sensitive receivers in the area include churches, schools, nursing homes and residential dwellings.

There are two key sources of noise which are governed by policy:

1. Road Noise - Road Noise Policy (DECCW 2011).
2. Industrial Noise - Noise Policy for Industry' (EPA, 2017)

3.6.1 Road Noise and Vibration

Noise from road related activities includes construction of new freeways, noise from heavy vehicles and the noise from individual vehicles fitted with modified exhaust systems. The manner and location of the noise emission will determine what noise controls are available and ways in which the noise should be assessed.

New road development identified in the area would need to consider the Road Noise Policy (DECCW 2011). This document outlines strategies that address the issue of road traffic noise at nearby potentially affected receivers. Road traffic noise is assessed for:

- Existing roads;
- New project roads;
- Road redevelopment projects; and
- New traffic-generating developments.

There are also transition zones, which represent the area between two of the types of roads listed above.

The Road Noise Policy sets criteria for noise mitigation measures based on the road type and proximity of sensitive receivers This policy is likely to apply to any potential future development along Old Northern Road, New Line Road or any road adjustments along Annangrove Road.

In addition to assessing noise levels during the planning of road upgrades or new roads, there are several strategies currently being implemented to reduce road traffic noise. These strategies aim to:

- Manage the demand for travel;
- Influence the location of new urban development and urban renewal;
- Increase travel choices by expanding and improving the quality of public transport networks, and expanding and increasing the use of facilities for pedestrians and cyclists;
- Maximise the proportion of freight transported by rail; and
- Review parking policies with a view to reducing the provision of car parking.

3.6.2 Industrial Noise and Vibration

Industrial noise is governed by the 'Noise Policy for Industry'. It provides a framework and noise level for the assessment and management of noise impacts from industrial developments such as mines, quarries and large industrial sites that are scheduled under the *Protection of the Environmental and Operations Act 1997 (POEO Act).* This policy may be used to assess and control noise from non-scheduled industrial sources that come under Council control, and to assist in their land-use planning functions. The policy aims to ensure that the potential noise impacts from industrial developments are assessed in a consistent and transparent manner and minimised where reasonable and feasible. In areas of very low background noise, the lowest level that a licence limit will be set at for daytime noise will be raised by 5 dB. This criterion is well below the level at which more than 10% of an exposed community are likely to be highly annoyed and also remains below the World Health Organization recommended levels.

Currently there is no light or heavy industry in the existing high level of investigation study area or the detailed area. There is however, light industrial on the eastern side of New Line Road within Hornsby LGA. It is not anticipated that the light industrial development would impact on the capability of the land within the Detailed Study Area as Old Northern Road traffic noise would be the dominating noise source in this area. It has been assumed light industry is not a consideration for this study however in the event it did apply, there would need to be an assessment and consideration of any mitigation measures such as architectural treatment, change in operations, or offset distances from the light industrial area to enable development to be feasible.

3.6.3 Implications for land capability

Land use planning offers the greatest potential for minimising conflict between road noise and sensitive land uses, followed closely by the development of appropriately designed and noise-insulated buildings. It is therefore important that during the early stages of road planning, noise minimisation is considered during route selection processes for new roads or major realignments. However, in the event future roads are required, or upgrades to existing roads, the above strategies should be applied during design optimisation. For the purposes of the environmental capability study it is considered that noise can be managed and mitigated through:

- At source measures;
- At receptor measures; and
- Land use zoning to limit the location of light industrial uses.

In addition, the implications of road noise on land capability needs to be balanced with the necessity to provide a suitable level of road infrastructure. As part of the planning process, noise assessments are undertaken and used during the planning stages to identify suitable mitigation measures using a hierarchy pollution control approach (eliminate, substitute, control etc.). This is also similar for industrial development.

It is therefore anticipated that noise and vibration should not be applied to land capability but rather considered and assessed during the planning approval process. It is recommended that the land capability be classified as Category A.

3.7 Air Quality

The *Protection of the Environment Operations Act 1997* (POEO Act) sets the statutory framework for managing air quality in NSW, including establishing the licensing scheme for major industrial premises and a range of air pollution offences and penalties. It is supported by the Protection of the Environment Operations (General) Regulation 2009, which provides for:

- The administration of the licensing scheme.
- Economic incentives for licensed businesses and industry to reduce pollution, including emissions to air, through load-based licensing.

Schedule 1 of the POEO Act identifies schedule activities for the purpose of the Act. Activities that are scheduled include extractive activities (clause 19) and road construction (clause 35).

The closest air quality monitoring station is located at Prospect (about 15km south-west of Dural). Pollutants monitored at Prospect include Ozone (O3), nitrogen dioxide (NO2), sulphur dioxide (SO_2), carbon monoxide (CO) and PM10 – specifically referring to fine, airborne particles with an aerodynamic diameter smaller than or equal to 10µm).

The NSW Annual National Environment Protection (Ambient Air Quality) Measure (NEPM) Compliance Report for 2016 (OEH, 2016) reported on the following for the Prospect monitoring site:

- No exceedances of the NO2 1-hour and annual standards were recorded and compliance with the NEPM goal was met
- Ozone levels in the Illawarra, Lower Hunter and Central Coast regions remained below the 1-hour average standards throughout 2016.
- The 1-hour, 24-hour and annual standards for SO2 were not exceeded, and compliance with the NEPM goal was met.
- The NEPM goal for 24-hour PM10 was not exceeded.

Therefore, air quality is unlikely to be a constraint on a regional level. Air quality would require consideration at a localised level during construction.

3.7.1 Implications for land capability

Air quality impacts from development are associated with indirect changes with increased traffic and potential industry. Air quality in the high level investigation area are below acceptable levels and would not be directly affected by additional dwellings. There would be indirect impacts on air quality with increased traffic linked to additional dwellings and vehicle use in the area. This impact however, would not be of sufficient significance to influence capability considerations for development uplift. They would be addressed in the air quality assessment in the event the road infrastructure was upgraded or new roads build. It is recommended the land capability be classified as Category A.

3.8 Value of Resource Lands

Cardno has carried out an assessment of land use and visual / landscape character within the Detailed and High Level Investigation Areas. This exercise was completed by desktop examination of aerial photography and ground truthing via a visit to the investigation areas. A significant finding of the land use assessment was that there is minimal land dedicated to rural purposes remaining in the investigation area - the majority of former rural land in the areas now supports very large single dwelling houses on moderately large single lots. **Figure 3-14** illustrates the existing subdivision pattern in the Areas. When viewed in conjunction with **Figure 3-16** - Visual Landscape Character – it is clear that the original large lot pattern that characterises small rural holdings has been retained with the evolution to “big house / big lot” residential development.

There is potential, however, for the remaining rural lands in the area to perform functions specifically suited to small rural holdings. Our opinion is that any proposal for uplift in development density in the Areas should be measured against the potential loss of opportunities for innovative use of these remnant rural lands.

An assessment of the value of the remaining rural lands in the investigation area has been carried out via a review of recent relevant rural lands studies (and sections within other strategic planning documents of relevance to rural lands) including:

- *The Baulkham Hills Rural Land Study - Village Character Analysis, Urban Design Guidelines (Woods Bagot, 2003)*
- *The Baulkham Hills Rural Land Study Independent Review (Connell Wagner Pty Ltd, 2005)*
- *Local Strategy – New Strategic Direction for Baulkham Hills Shire, May 2010 (sections pertaining to rural lands)*
- *The Central City District Plan*
- *Local Planning Directions under S.117 of the Environmental Planning and Assessment Act, 1979 – Direction 1.2 - Rural Zones*

The following discussion summarises the outcomes of these studies of relevance to the value of the remaining rural lands in the Investigation Areas and provides commentary on the implications of these outcomes for the capability of these lands to support development uplift.

The studies and strategies include consistent references to the following issues facing rural lands within the Hills Shire and their values as part of its land use mosaic:

- Rural lands within the Shire perform the following functions:
    - Provide land for rural production (agriculture, hydroponics, livestock industries and the like);
    - Define the edge of metropolitan areas;
    - Accommodate a range of agricultural uses that contribute to the local and regional economy;
    - Provide a food source for the metropolitan area; and
    - Provide protection for biodiversity, natural and cultural heritage, scenic landscapes and metropolitan water catchments.
- The rural areas that fringe the urban and suburban zones present opportunities for potentially valuable non-traditional rural pursuits.

  The Connell Wagner review refers to the then Department of Primary Industry’s term “urban agriculture”, encompassing boutique farming enterprises, agribusiness and agritourism. The Department saw this use as a viable future for the rural fringe areas and pointed to a need to protect fringe rural lands for such uses via planning controls and economic strategies.
- The long term viability of rural villages is a matter of concern and contingent largely on the economic success of the rural areas that they service.
- Potential uses for rural lands where traditional agricultural uses have become marginal or non-viable should be explored and enhanced. These may include boutique farming operations and agritourism such as farmgate sales, farmstays or restaurants. These alternate uses have potential to reinvigorate rural economies, provide variety in employment forms and retain the character of the rural verges to the Shire’s urban areas.
- Land capability assessment is critical to the strategic decision making process with regard to rural fringe lands. The Connell Wagner report refers to the importance of land capability assessment in

the decision making process around intensification of development in the rural fringe. Specifically, the report points to the physical constraints being considered in this study – slope, soils, vegetation, hazards and scenic quality (see Section 3.9), as well as social and economic concerns.

- The S9.1 Planning Direction on Rural Zones requires that a planning proposal must not rezone land from a rural zone to a residential zone and must not increase the permissible density of development within a rural zone, except if that land is within an existing town or village. Inconsistent planning proposals need to justify by a strategy or study or in accordance with a Regional or Subregional Strategy or be of minor significance. The land within the Investigation Areas is zoned RU6 – Transition and the intention of the S.9.1 Direction to protect the agricultural production value of rural land is of relevance to this Study.

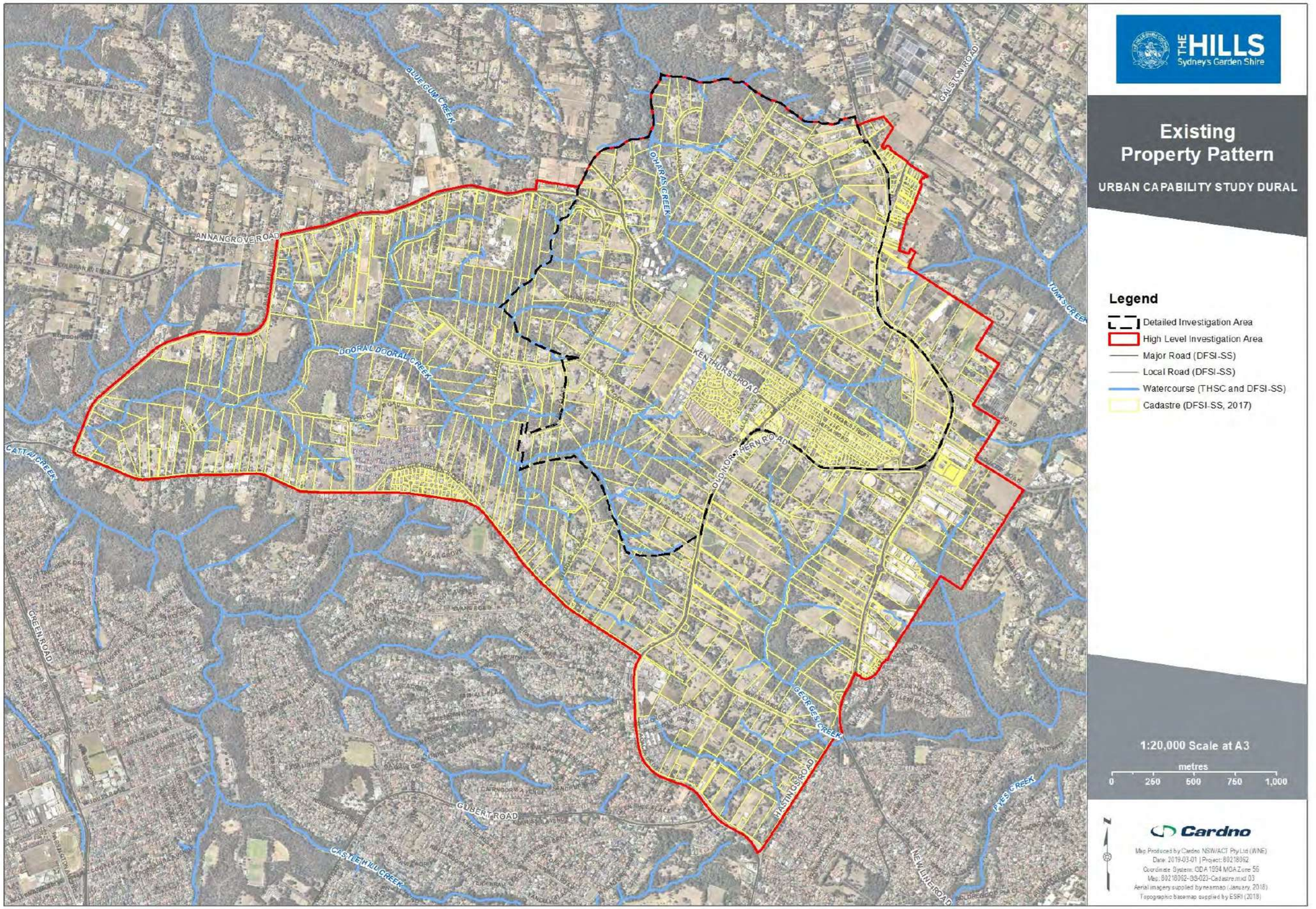

Figure 3-14 **Existing subdivision pattern across the Investigation Areas.**

The Local Strategy raises similar themes to the Connell Wagner report with regard to fringe rural lands in the Shire and translates these to strategic planning directions. The key directions for rural lands of relevance to this study include:

- Ensure access to services and facilities;
- Provide economic development opportunities;
- Ensure adequate infrastructure;
- Ensure water quality is maintained;
- Ensure the ecological integrity of land is maintained;
- Ensure that development has a minimal impact on the scenic and cultural landscape of the Shire;
- Preserve rural heritage and culture; and
- Plan for natural hazards.

At the metropolitan wide planning level, the Metropolitan Strategy and the Central City District Plan both recognise the value of rural lands and include strategies for their protection and promotion. The lands in the Investigation Areas that are the subject of this Cardno study are mapped in the Central City District Plan as part of the Greater Sydney Metropolitan Rural Area which stretches north from the Rouse Hill Release Area to Wisemans Ferry (see **Figure 3-15** below).

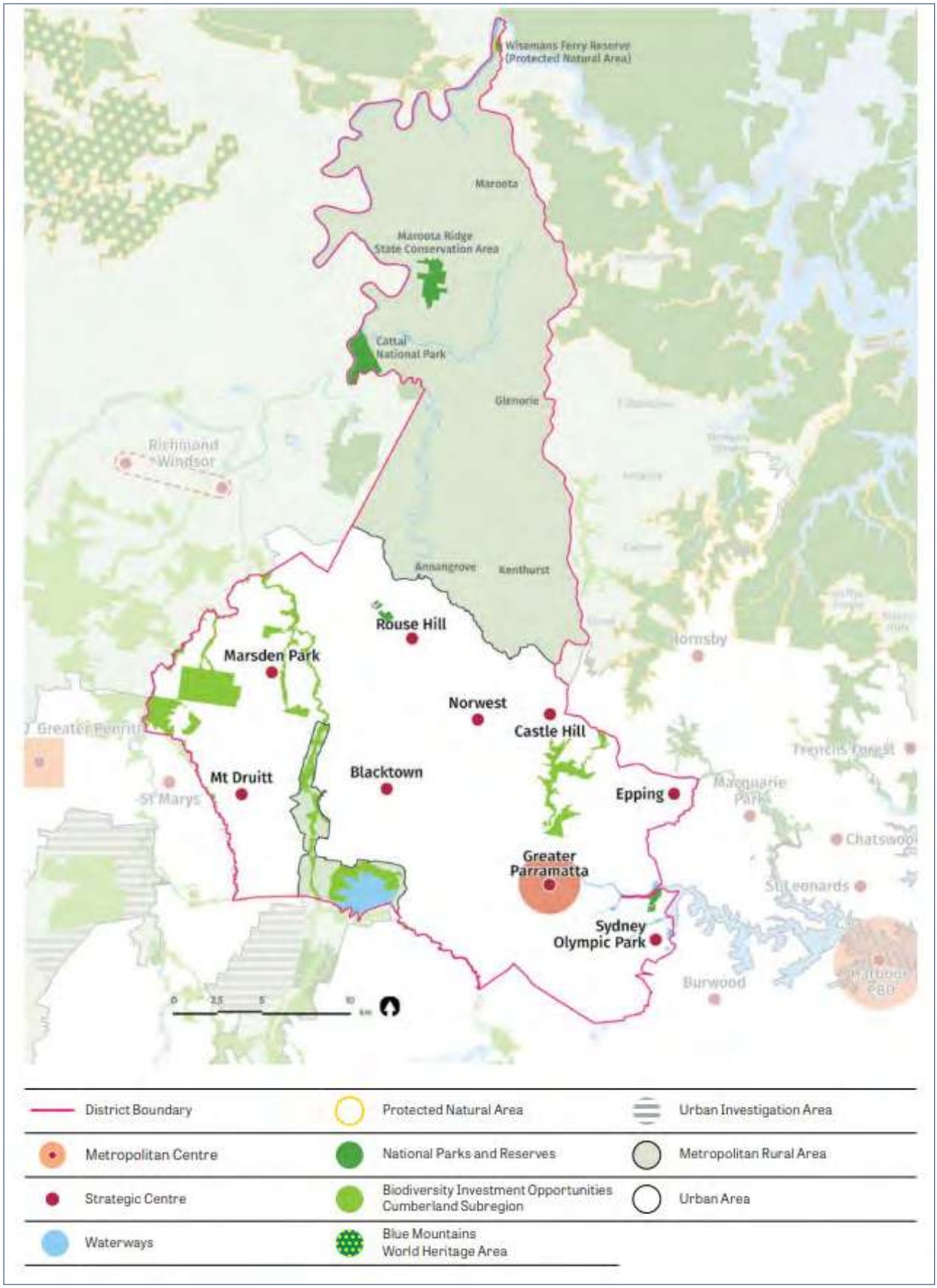

Figure 3-15 Central City District Metropolitan Rural Area and Protected Natural Area.

The District Plan points to a need to protect rural land and to avoid encroachment from incompatible land uses on rural industries. The protection of biodiversity in rural areas is also a stated priority as is the opportunity to re-establish significant ecological communities in rural areas.

Planning Priority C18 in the District Plan is to better manage rural areas. Actions of direct relevance to the outcomes of this Study under Priority C18 include:

- Protect and support agricultural production by preventing inappropriately dispersed urban activities in rural areas.
- Maintain or enhance the values of the Metropolitan Rural Area using place-based planning to deliver targeted environmental, social and economic outcomes.
- Limit urban development to within the Urban Area.

In summary, encroachment of urban development into rural lands will be inconsistent with the current strategies if it results in:

- Loss of land that provides opportunities for agribusiness / agritourism;
- Loss of existing biodiversity or the opportunity to enhance biodiversity and unacceptable impacts on ecological integrity;
- Unacceptable impacts on rural heritage and culture;
- Impacts on water quality and erosion;
- Pressure on availability of infrastructure and services to rural users; and
- Depletion in scenic quality and character.

The current strategic planning policy, as articulated in the above targeted review of the relevant strategic planning studies, is that remnant rural lands in the Sydney Metropolitan urban fringe present a valuable resource that could return significant economic and environmental benefits for the developing City. The scenic qualities of these lands are also integral to their value and may contribute to their viability for local tourism. Further, there are clear directions in the State Government strategies and in the Minister's directions to Council's preparing Planning Proposals that urban development should not encroach onto existing rural lands.

3.8.2 Implications for land capability

Current State Government policy regarding existing rural lands points to their retention unless there is compelling evidence that any change from rural use would have a net benefit when assessed against the above planning principles. Our conclusion with respect to this capability assessment exercise is that any proposal to change use of the existing rural lands remaining in the Investigation Area should be subject to assessment against the principles. Loss of opportunity for alternative rural uses must be a key matter for consideration in the decision making process.

3.9 Scenic / Landscape Quality

Scenic character is a valuable attribute that contributes to the amenity and quality of living in an area. Intensification of development will inevitably result in changes to the scenic character of any locality. The key strategic planning documents reviewed in this Study refer regularly to the value of scenic quality and character as a determinant in the decision making process for planning in Sydney's remaining rural lands. In response to this, Cardno has carried out a review of the scenic quality of the Investigation Areas in order to identify the scenic values that contribute to its local character. Implications of these values for the assessment of the land capability are then discussed.

Planning Priority C15 in the Central City District Plan is *"Protecting and enhancing bushland, biodiversity and scenic and cultural landscapes."* With respect to scenic quality, the following statement is made:

"Continued protection of the Central City District's scenic and cultural landscape can complement the protection of biodiversity and habitat, help manage natural hazards, support tourism and help preserve links to Aboriginal cultural heritage." (Central City District Plan, 2017, p.105).

Relevant actions under Planning Priority C15 of the District Plan are:

"66. Identify and protect scenic and cultural landscapes.

67. Enhance and protect views of scenic and cultural landscapes from the public realm."

Translating these actions to the Investigation Areas involves value judgements to determine which identified visual character units are positive contributors to its specific visual character. These have also been mapped in **Figure 3-16** according to visual landscape character classifications.

The subsequent **Table 3-10** then provides a description of each unit, an assessment of its value and consequent implications for land capability.

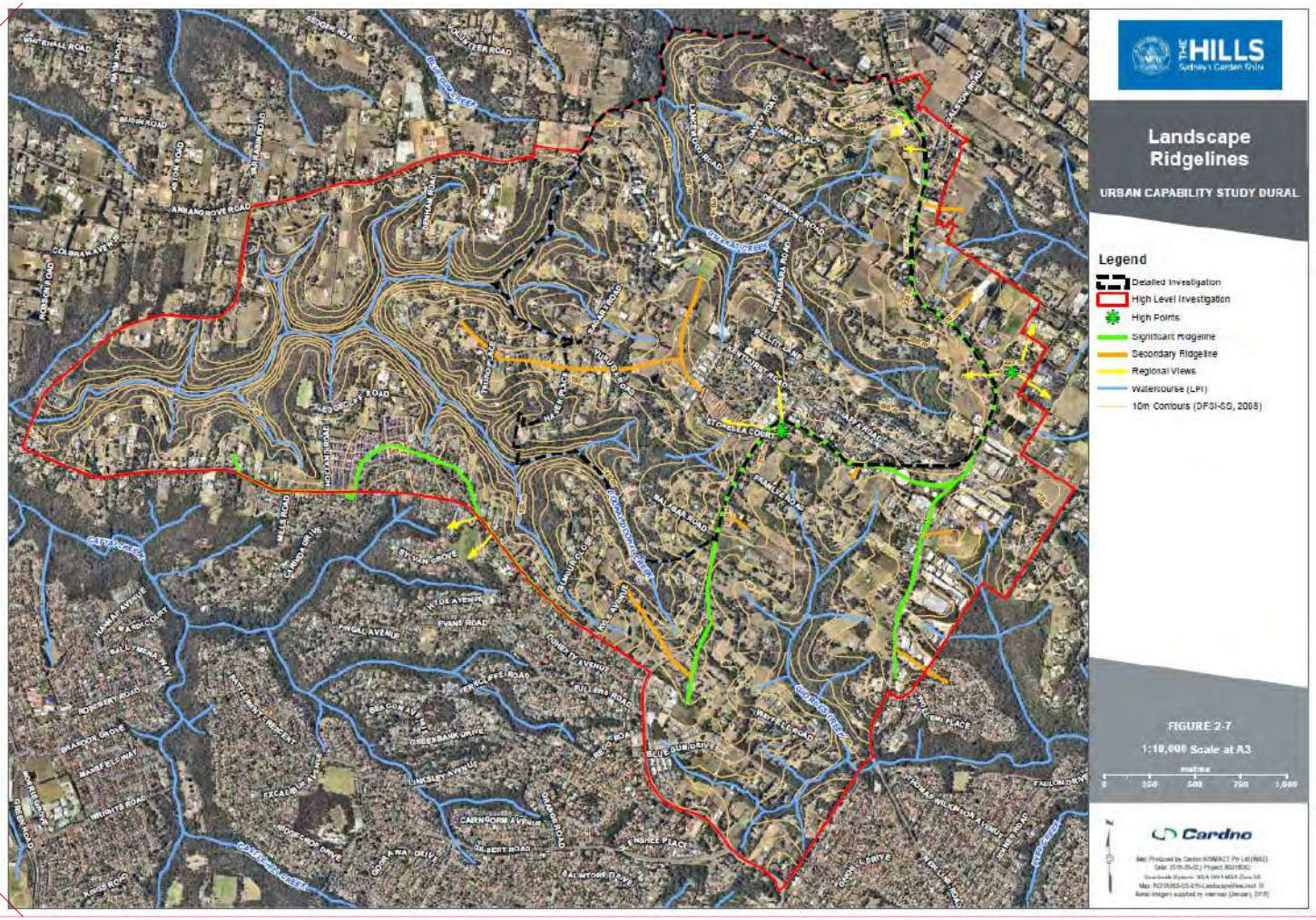

Figure 3-16 Visual Landscape Character

Commented [A1]: Map to be updated.

Commented [BI2]: Suggest identifying important view corridors on this map (such as those towards the Blue Mountains in Round Corner and also at the Dural Local Centre).

Table 3-10 Visual Character – Significance for Land Capability

VISUAL CHARACTER UNIT	CONTRIBUTION TO SCENIC QUALITY	SIGNIFICANCE FOR LAND CAPABILITY
 Bushland	Very high – bushland is identified in the planning strategies as a critical attribute of the character of the Rural Fringe.	Very positive contributor – bushland should be protected and new development should not encroach on existing bushland in the Investigation Areas.
 Rural / Hobby Farm	High – remnant rural lands are inherent to the scenic character of the rural fringe.	Very positive contributor – the remaining small holding rural lands are critical contributors to the character of the Investigation Areas. Character should be a critical consideration in decisions regarding potential development of these lands.
 Big House / Big Lot Residential	Medium – large dwellings on relatively large lots are increasingly becoming a significant development form in the Investigation Areas. Because they generally retain the subdivision pattern of their former rural holdings, and because the built form tends to be well set back and not significantly visible from roads, these emerging development forms tend to retain the original rural character of the locality.	Neutral contributor – further subdivision of these relatively large residential lots will potentially impact on the rural character of the Areas.
 Recreation	Medium – the expansive undeveloped areas of land that characterise recreational areas are consistent with the rural character of the Areas. The subdivision of this land for other uses would have a negative impact on local visual quality as it will result in loss of the open landscape character that is inherent to rural landscapes.	Positive contributor – subdivision of recreational lands for other purposes will impact on the rural character of the Areas.

 Education	Medium – educational institutions in the Investigation Areas tend to include buildings in settings dominated by landscape – vegetation and open space. As such these institutions are generally consistent with the overall rural character of the areas.	Positive contributor – changes to the intensity of development within the educational institutions in the Investigation Areas has the potential to result in loss of open space and landscape which will potentially impact on the rural character of the Areas.
 Low density residential	Neutral – low density residential development is not contributory to rural character. However, the dominance of landscape over buildings in this development form is generally consistent with the open landscape dominated character of the Investigation Areas.	Negative contributor – the encroachment of low density residential development onto rural lands would have a net negative impact on the rural character of the Areas. This would be tempered by the site sensitive subdivision and retention of existing significant vegetation.
 Medium density residential	Very low	Negative contributor – medium density development is clearly inconsistent with the open, rural character of the Investigation Areas. Impacts on local character should be a significant matter for consideration in any decisions regarding the extension of medium density residential development within the Areas.

 Retail – fine grain	Medium – rural areas typically include small service centres with shops and other retail / service outlets. As such, this form of development is considered to be consistent with the rural character of the Investigation Areas.	Positive contributor – judicious location of small retail centres would not be likely to impact negatively on the rural character of the Areas. The scale of centres should be in accordance with Council's Centres Hierarchy.
 Retail - supermarket	Very low	Highly negative contributor – "big box" retail development such as supermarkets would have a clear negative impact on the rural character of the Investigation Areas.
 Employment	Very low	Highly negative contributor – employment lands generally include large box buildings in hardstand settings. The loss of landscape and open space that results from this development form would be inconsistent with protection of the rural character of the Areas. Impacts on local character should be a significant matter for consideration in decisions regarding the extension of employment lands within the Areas.

3.9.2 Implications for land capability

The Dural locality has a long tradition of rural uses. The area is transitioning from its rural use to a mix of bushland, semi-rural, large lot and medium density residential uses. Notwithstanding this change, the rural and bushland character remains as the major contributor to the scenic quality of Dural. The value of the remaining rural and bushland character of Dural is on two levels:

- Residents are proud of the rural / bushland character of Dural. For many it is reason that they live in the locality.
- The opportunity to experience a rural / bushland landscape close to the city is a contributory factor to the potential of the Dural locality as a local tourist attraction.

Our opinion is that retention of the overarching rural and bushland scenic character of the investigation area should be a principle consideration in the decision making process for any form of development uplift.

4 Recommendations and Conclusions

This section includes a summary of the results of our review into the environmental capability of land in the Detailed Investigation Area. If there is no implication for land capability, this environmental aspect will be assessed and considered at the detailed planning stage. Proposed classifications for the environmental suitability of the land have been identified and applied to the Detailed Study area to inform structure planning

The environmental suitability of the land to be developed has been based on the following three levels:

1. Category A: Land capable of development with minimal constraints
2. Category B: Land capable of development but with constraints
3. Category C: Land unable to be developed / unsuitable for upscale development

Rationale for Determining the Environmental Capability of Land

In the development of the land capability categories, consideration was given to environmental constraints, legislation and the objectives from Council's strategic planning documents. Where the impact is already managed through an existing development control measure or if low level mitigation could be implemented, Category A was applied to the constraint. Where constraints required a higher level of consideration and/or were a key strategic objective for the Council then these fell into the Category B. Land unable to be developed (Category C) included constraints where key legislation applied, physical development was not possible or where the area played an integral role in the overall management of the area. Environmental aspects that can be mitigated during construction were considered to be land capable of development with minimal constraints (Category A).

The assessment of the Environmental Constraints and Opportunities in Section 3 was undertaken on the grounds of each environmental aspect. Throughout the review and assessment clear linkages between key environmental aspects were evident. These linkages are important as when they are considered cumulatively they may change the overall capability of the land.

Environmental assessments of the riparian corridors, receiving sensitive water bodies for key fish habitat, flood control buffer zones and groundwater dependent ecosystems (GDE) may not individually result in the land being identified as Category C, however when these elements are within the same location, cumulatively, it is appropriate to identify these lands as incapable of development. These areas play an important role in hydrology and sustaining terrestrial GDE and for supporting habitat which aids in water quality levels and wildlife corridors. It would result in inappropriate environmental impacts to allow development to occur that would prevent these lands from performing this role.

Key environmental aspects that resulted in land being identified as capable but with constraints (Category B) are:

- Vegetation Communities;
- Wildlife Corridors;
- Threatened Flora;
- Waterways and threatened aquatic biodiversity;
- Outer Riparian Corridor; and
- 100 year ARI Fringing Flow areas within the Flood Control Buffer zone.

Key areas which were considered not suitable for any uplift in development and hence not capable of more intensive development are:

- Inner 50% of riparian corridor; and
- Land with a slope greater than 20%.

The combined environmental constraints mapping according to the following categories will assist with identifying the capability of land in the Investigation Area.

Table 4-1 Environmental Land Capability Outcomes

	Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
1	**Biodiversity**			
	Stewardship/Biobanking and Conservation Agreements	Significant implications No impact on capability	C	There are no current implications to land capability as a direct result of existing Stewardship/Biobanking and Conservation Agreements. However future development may require offsets within the detailed study area and may constrain development potential.
	Vegetation communities	Moderate Implications Low – moderate impact on capability	B	Areas of Threatened Ecological Communities (TECs) are considered to have high ecological value. Development and clearing within these areas and/or areas of native vegetation (not considered TECs) have potential to trigger application of the Biodiversity Offsetting Scheme (see Section 3.1.3). It is recommended that areas of TEC and native vegetation are given a land capability Category B. This does not preclude from development but acknowledges potential constraints associated with the level of legislative protection and ability to find suitable land to offset vegetation removal. Riparian corridors may provide an opportunity for establishing stewardship/offsets for vegetation removed in other parts of the detailed study area. Again this would depend on the condition of vegetation and the ability to meet the necessary criteria.
	Biodiversity Values	Biodiversity Values	B	
	Wildlife Corridors	Moderate Implications Moderate impact on capability	A B	Connectivity along wildlife corridors may provide critical habitat for mobile fauna (e.g. birds, mammals and reptiles) and are considered to provide moderate to high ecological value assuming the habitat conditions are suitable for fauna. In their own merits it is recommended wildlife corridors are Category A. However, given they also coincide with native vegetation, cumulative considerations should classify these areas as Category B (see Section 3.1.3)
	Threatened flora	Low-moderate Implications Low- moderate impacts on capability	B A	Given the key flora for THSC LGA have limited distributions, require offsetting and are listed under the BC Act it is recommended a Category B be applied to their potential habitats identified within the report. Consideration can also be given to applying Category A to *Hibbertia superans* habitat, as unlike *Eucalyptus* sp, it does not trigger requirements under the EPBC Act.
	Threatened fauna	Low-High implications	N/A	The presence of hollow bearing trees and feed trees will contribute to the occurrence of the Yellow-bellied Glider and hence the value to the potential habitat for the

	Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
		Low- moderate impacts on land capability. (Note: insufficient information to determine at this phase- see commentary)		species. Given the large area this level and detail of surveying required, this information would usually be determined during the planning approval process for a development. Consideration for protecting riparian corridors in general due to cumulative impacts is discussed further in Section 4 and may provide a level of compromise.
	Threatened aquatic biodiversity	Moderate Implications Moderate impacts on capability	B	Waterways within the detailed investigation area are considered Category B as they are sensitive receiving environments and potential habitat for species listed under the *Fisheries Management Act* and fish passage is required to be maintained in Dooral Dooral Creek and O'Haras Creek.
	Matters of National Environmental Significance	No implications	A	Results showed the whole detailed investigation study area would trigger a MNES assessment, however Category A classification could be applied as these species only occur periodically in the detailed investigation study area. Impacts from development can be avoided through mitigation measures and habitat within the detailed investigation study area not exclusive to the area.
2	**Bushfire management**	No implications	A	Bushfire hazard should be assessed on a merit base and managed through the development approval process in accordance with the Rural Fires Act and relevant Rural Fire Service guidelines for development on bushfire prone land.
3	**Heritage**			
	European heritage	No implications	A	European heritage values are protected across zones within the relevant planning controls and guides.
	Aboriginal heritage	No implications	A	European heritage values are protected across zones within the relevant planning controls and guides.
4	**Flooding, Creeks and Watercourses**			
	Watercourses and groundwater	Significant Implications Moderate-high impact on capability	C	With respect to capability for development uplift within Riparian Corridors identified in accordance with the Office of Water it is recommended: • The inner 50% of the Vegetation Riparian Zone (VPZ) should be excluded from consideration for uplift in development capability. There are obvious

Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
			exceptions such as the provision of stormwater infrastructure etc. It is recommended that a 'no go' be applied to this portion of the riparian corridor. • The outer 50% of the VPZ should not be excluded for uplift capability if that is the only constraint applicable to the area. Development within this land can be managed through the development approvals process on a merits basis, depending largely on the activity proposed and the ability to offset. The cumulative environmental considerations of riparian corridors is discussed further in Section 4.
		B	
Groundwater dependent ecosystems	Low implications No impact on capability	A	Consideration to the groundwater infiltration rates to sustain GDEs usually need to be assessed to understand how alterations to hydrology and geomorphology will impact these GDE's ability to access to groundwater. However, given these GDEs are terrestrial and exist along the creeklines, which maintain adequate flows through these areas, it would inevitably sustain GDEs. As this is feasible due to the flooding nature of the creeks in this location it is recommended the capability classification, Category A be applied.
Flooding- 100 ARI Fringe Areas	Low- moderate implications Low- moderate impact on capability	A	It is recommended that areas in 100 ARI Fringe areas outside of the Flood Control Buffer could be suitably mitigated for flooding through application of DCP at planning approval stage and as such should be classified as Category A.
		B	Areas achieving 100 ARI Fringe classification within the Flood Control Buffer are recommended to be classified Category B on the basis of their importance to contributing to the wider flooding regime.
Flood Control Buffers	Low- moderate implications Low- moderate impact on capability	B	Where the Draft Urban Villages Overland Flow Study did not model, a conservative approach has been applied and consideration of applying Category B, with the potential for this to be refined in the event further modelling is undertaken.
Flood Control Lots	No implications No impact on capability	A	It should be noted Water Sensitive Urban Design and Water Re-Use opportunities in the planning and management of water would be considered for each proposed development at planning approval stage. Flood Control Lots are also applied via the DCP during the planning approval stage and are a mechanise for mitigation to be applied. Hence it has not been considered in the capability of the land.

	Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
				Stormwater controls are determined on a case by case basis at the planning approval stage, for the purposes of the land capability they have not been considered unless it is not feasible for them to be implemented.
5	**Soil Capability and Topography**			
	Topography 0-10%	No implications No impact on capability	A	Slope would not be an impediment to orderly development of land
	11-15%	Moderate implications Moderate impact on capability	A	Conventional measures likely to be required in formulating a development proposal.
	16-20%	Significant implications Significant impact on capability but not sufficient to preclude potential for development uplift	B	Slopes of this level should not as a single constraint preclude land from potential for development uplift.
	Greater than 20%	Major implications Major impact on development capability. Land at these slopes should be precluded from consideration for uplift in development intensity.	C	Higher density development on these slopes would be likely to impact negatively on the environment. Implementation of measures in the planning controls would be unlikely to sufficiently address all negative impacts.
	Soil Landscapes, Salinity Potential and Acid Sulfate Soils	Low implications No impact on capability	A	At present the detailed study has both residential, rural and semi-rural land use. The ability to continue existing land uses would not be impacted by the soil landscapes and potential salinity. Both these aspects can be managed by control measures applied by the planning controls. These environmental elements are considered to have no implication with regard to the capability of the land to absorb development uplift.
6	**Noise and Vibration**	Low implications No impact on capability	A	As part of the planning process, noise assessments are undertaken and used during the planning stages to identify suitable mitigation measures using a hierarchy pollution control approach (eliminate, substitute, control etc.). This is also similar for industrial development.

	Matter for Consideration	Implication for Land Capability Assessment	Proposed Capability Classification	Commentary
				It is therefore anticipated that noise and vibration should not be applied to land capability but rather considered and assessed during the planning approval process. It is recommended the land capability be classified as Category A.
7	**Air Quality**	Low implications No impact on capability	A	Air quality impacts from development are associated with indirect changes with increased traffic and potential industry. Air quality in the high level investigation area are below acceptable levels and would not be directly affected by additional dwellings. There would be indirect impacts on air quality with increased traffic linked to additional dwellings and vehicle use in the area. This impact however, would not be of sufficient significance to influence capability considerations for development uplift. They would be addressed in the air quality assessment in the event the road infrastructure was upgraded or new roads build. It is recommended the land capability be classified as Category A
8	**Value of Resource Lands**	Significant implications	A	Any proposal to change use on the existing rural lands remaining in the investigation area should be subject to assessment against the planning principles for protection of the value of rural lands. Loss of opportunity for alternative rural uses must be a key matter for consideration in the decision making process.
9	**Scenic / landscape quality**	Significant implications		Scenic quality of rural lands is a matter for consideration raised in all of the strategic planning documents. Uplift of development density has significant potential to change scenic / landscape quality.

5 Next Steps

This report will form part of the Urban Capacity and Capability assessment, along with assessments of infrastructure capacity, which examine the availability, and capacity of services in the Study Area.

6 References

Baulkham Shire Council State of the Environment Report 2008-2009

Baulkham Shire Council State of the Environment Report 2007-2008

Baulkham Shire Council (2008) Local Strategy

Baulkham Shire Council (2008) Waterway Direction

Baulkham Shire Council (2008) Environment and Leisure Direction

Baulkham Shire Council (2008) Plan of management for Natural Areas

Baulkham Shire Council (2008) Residential Direction

Baulkham Shire Council (2003) Rural Lands Strategy

Bureau of Meteorology (2018) Groundwater Dependent Ecosystems Atlas <http://www.bom.gov.au/water/groundwater/gde/>

Connell Wagner (2005) Baulkham Hills Rural Land Study Independent Review

Ecological (2014) Flora and Fauna Assessment Report – 582 Old Northern Road

The Hills Shire Council State of the Environment Report 2012-2017

The Hills Shire Council State of the Environment Report 2009-2010

The Hills Shire Council Development Control Plan 2012

The Hills Shire Council End of Term Report 2012-2017

The Hills Shire Council Final Draft Report Urban Villages Overland Flow Study 2018

The Low Rise Medium Density Design Guide (NSW Government, Department of Planning and Environment, 2017)

Office of Environment and Heritage (Mar 2018) Salinity http://www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/salinity

Local Strategy – New Strategic Direction for Baulkham Hills Shire, May 2010 (sections pertaining to rural lands)

APPENDIX

A

Aboriginal Search Results

This appendix is not to be made publically available.

AHIMS sites identified within or in close proximity to the High Level Investigation Area are shown in the table below, and in **Figure 6-1**.

AHIMS Site	Site Name	Site Type	Location
45-5-0151 / 45-5-0152	Blue Gum Creek, Kenthurst	Artefact; Art (Pigment or Engraved)	Annangrove Road – on edge of High Level Investigation Area
45-5-0153 / 45-5-0154	Blue Gum Creek, Annangrove	Grinding Groove; Art (Pigment or Engraved)	Outside High Level Investigation Area
45-5-0291	Hawkesbury Lookout Glenhaven	Open Camp Site	Off Bannerman Road, within High Level Investigation Area
45-5-2343	Ship Shelter	Art (Pigment or Engraved)	Off Bannerman Road, within High Level Investigation Area
45-6-0749	Cherrybrook 5	Art (Pigment or Engraved)	Outside High Level Investigation Area
45-6-0945	Rogans Hill, Glenhaven	Grinding Groove; Water Hole	Outside High Level Investigation Area

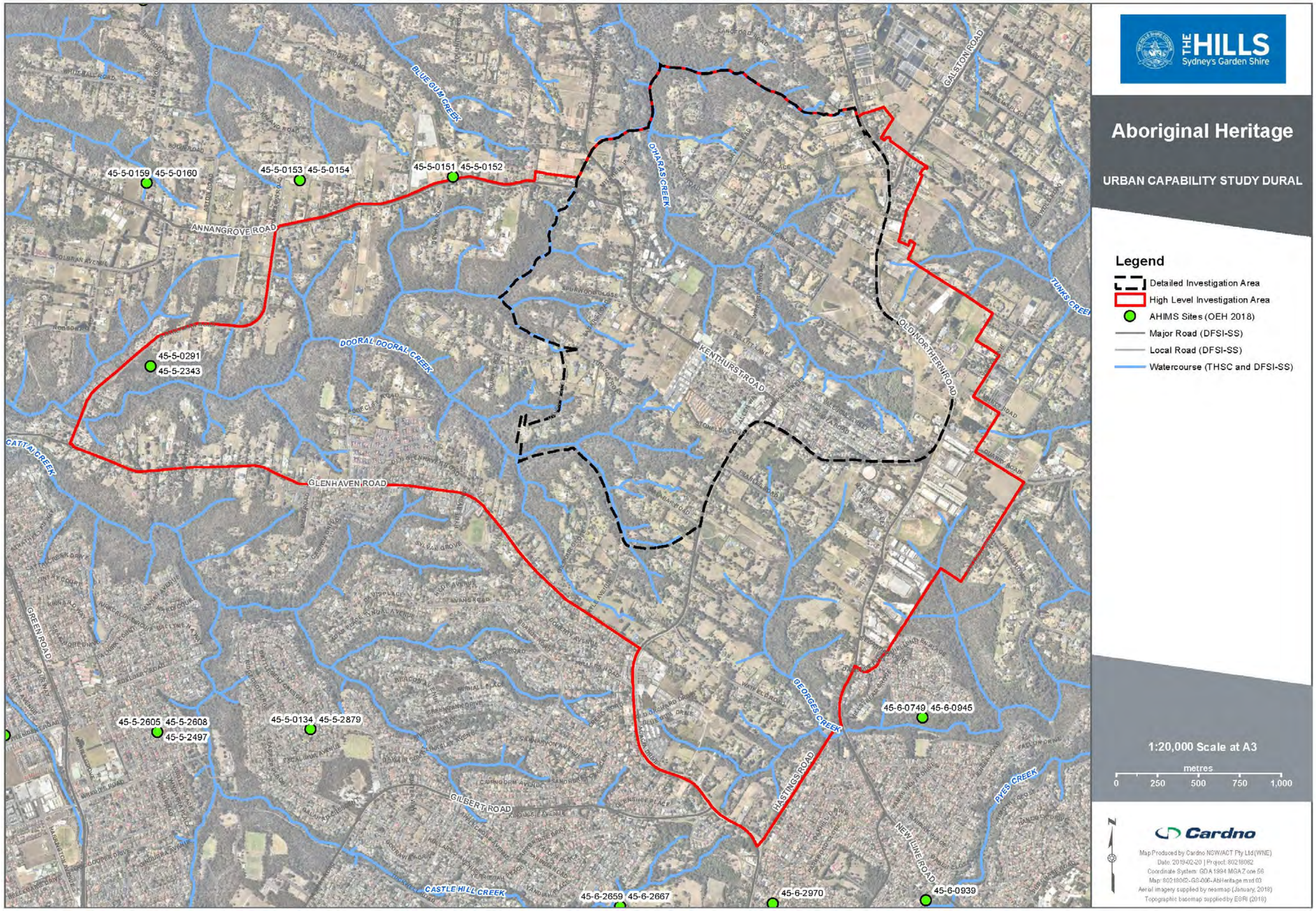

Figure 6-1 Aboriginal Heritage

APPENDIX

B

SITE PHOTOS

Vegetation and cleared land at 1 Annangrove Road, Kenthurst

Turpentine tree - 1 Annangrove Road, Kenthurst

Vegetation at 3 Malabar Road, Dural

Vegetation at 3 Malabar Road, Dural

Modified landscape and vegetation at 4 Jane Place, Dural

Modified landscape at 4 Jane Place, Dural

	
Remnant vegetation at 35 Derriwong Road, Dural	Remnant vegetation at 35 Derriwong Road, Dural
	
Exotic vegetation at 80 Kenthurst Road, Kenthurst	Potential corridor of scattered vegetation – The Hills Grammar School (links across road with 80 Kenthurst Road, Kenthurst)

	
Vegetation at 572 – 578a Old Northern Road, Dural	Vegetation at 572 – 578a Old Northern Road, Dural

	
Edna Brown Reserve, Dural	Edna Brown Reserve, Dural

	
Ellerman Park, Dural	Ellerman Park, Dural
	
Vegetation near end of Jane Place, Dural	Cleared land near end of Jane Place, Dural

Vegetation (Blue Gum) along Lancewood Road and Derriwong Road, Dural

Vegetation along Lancewood Road and Derriwong Road, Dural

Vegetation at end of Lancewood Road, Dural

Clearing and vegetation at end of Lancewood Road, Dural

Vegetation at Pellitt Lane, Dural

Blackbutt trees within backyards of Pellitt Lane, Dural

Ecology Survey

Ground-truthing of the Detailed Investigation Area was conducted on 3 May 2018 by Cardno's ecologist.

Due to the size of the Detailed Investigation Area, areas with slope over 20% and within 50m of watercourse (mapped by DPI, 2011) were removed from the vegetation survey as these areas will be unsuitable for redevelopment in the future. Aerial imagery (Nearmap) was also used to identify and remove areas of clustered residential land from the survey. The survey targeted mapped ecologically endangered communities (OEH 2014 mapping) and potential viable corridors to confirm presence / absence and health. Where properties were unable to be accessed, conservation priority values were determined based on vegetation sighted from roadside, OEH mapped vegetation and known records of threatened species. A flora and fauna assessment (Ecological 2014) for a Development Application proposal at the Timber Mill site (582 Old Northern Road, Dural) identified Shale/Sandstone Transition Forest (low to moderate condition). This confirms the OEH 2014 mapping in this location and was not surveyed by Cardno.

Conservation priority values were defined as:

- High – Good condition vegetation, endangered ecological community present or expected to be present;
- Moderate – No threatened vegetation, good vegetation condition, potential habitat value for threatened species or as a corridor;
- Low – Area sighted as being heavily cleared or covered in exotic vegetation.

Survey results

The following properties were identified as requiring further ground-truthing based on the above criteria and were visited on 3 May 2018 by Cardno's ecologist. This section presents the preliminary findings of the site visit (refer to Appendix B for site photos and **Figure 6-2** on the following page for property locations).

1 Annangrove Rd, Kenthurst

This was a highly disturbed site with cattle. The area was dominated by smoothed-barked apple (*Angophora costata*) with a very large one in the middle of the site, likely to have large hollows. Turpentine forest was identified in the south-western corner of the site. Site is considered to have high conservation value. No Shale / Sandstone Transition Forest identified during the visit.

3 Malabar Rd, Dural

Was unable to gain access to this property or the potential corridor. Based on vegetation sighted from the roadside, the site does have some Turpentine (*Syncarpia glomulifera*) and Smoothed-barked Apple. No Blue Gums sighted. Site is likely to have high conservation value.

4 Jane Pl, Dural

Was unable to gain access to this property. Trees in front yard were mainly exotic species. Most trees looked planted. The vegetation identified from the front of the property was highly modified with low conservation value. The mapped Shale/ Sandstone Transition Forest could not be identified as access to the property was not gained. This part of the property would require further investigation and has been considered high conservation value.

Jane Pl (end of street), Dural

This site was previously mapped in The Hills Shire 2008 mapping as potentially having Blue Gum forest but was since removed in the OEH 2014 mapping. This was a highly disturbed site with many weed species. Access to the dam was unable to be gained due to the density of the weeds. This site was considered to have low conservation value based on preliminary findings.

35 Derriwong Rd (and 33 Derriwong Road), Dural

This site was previously mapped in The Hills Shire 2008 mapping as potentially having turpentine / Ironbark forest but was since removed in the OEH 2014 mapping. This site hosted remnant vegetation with Black Butt (*Eucalyptus pilularis)* dominated to the south. Many turpentine trees were sighted north of the creek line. One very large Smoothed-barked Apple was present at the northern end. The native vegetation in the bush block was considered high conservation value. The other properties were predominantly exotic planted species. These other properties would require further investigation (as mapped shale/sandstone) and has therefore been considered high conservation value.

Lancewood Rd and Derriwong Rd, Dural

Was unable to gain access to this property. Patches of turpentine was sighted on the western property with one large blue gum. Many planted trees with modified understory. This area would require further investigation (mapped shale / sandstone) and has been considered high conservation value.

Lancewood Rd (end of street), Dural

This site is dominated by Black Butt trees and has been considered moderate conservation value for the large remnant patch of vegetation. This site could act as a potential corridor. There has been encroachment on the eastern side of the block with structures such as a fireplace and beehives and planted vegetation and garden beds. .

80 Kenthurst Rd (and 43 Kenthurst Road), Kenthurst

This site is a potential corridor connecting over the road to 43 Kenthurst Road (The Hills Grammar School). 80 Kenthurst Road is dominated by exotic planted species and considered to have low conservation value.

572-578a Old Northern Rd, Dural

This site has many large remnant trees with little native understorey including various Stringybarks and Ironbarks (*Eucalyptus paniculata*). This site is likely to have Shale/sandstone transition forest. Considered high conservation value.

Edna Brown Reserve, Dural

This reserve is highly modified with planted native and exotic trees. Mowed lawn/garden present in the understorey with a kids playground present. Some blackbutts, smoothed-barked apple and a turpentine present. Limited ecological value, considered to have low conservation value based on preliminary findings.

Ellerman Park, Dural

This site had turpentine/ironbark forest present and is likely has a population of the Dural Woodland snail. Active land care management is present on this site. Considered to have very high conservation value.

Pellitt Lane, Dural

Was unable to gain access to these properties. Blackbutt trees dominated the back yards. There is high potential for threatened flora, *Epacris* sp, based on atlas records. Low conservation value in cleared areas of properties.

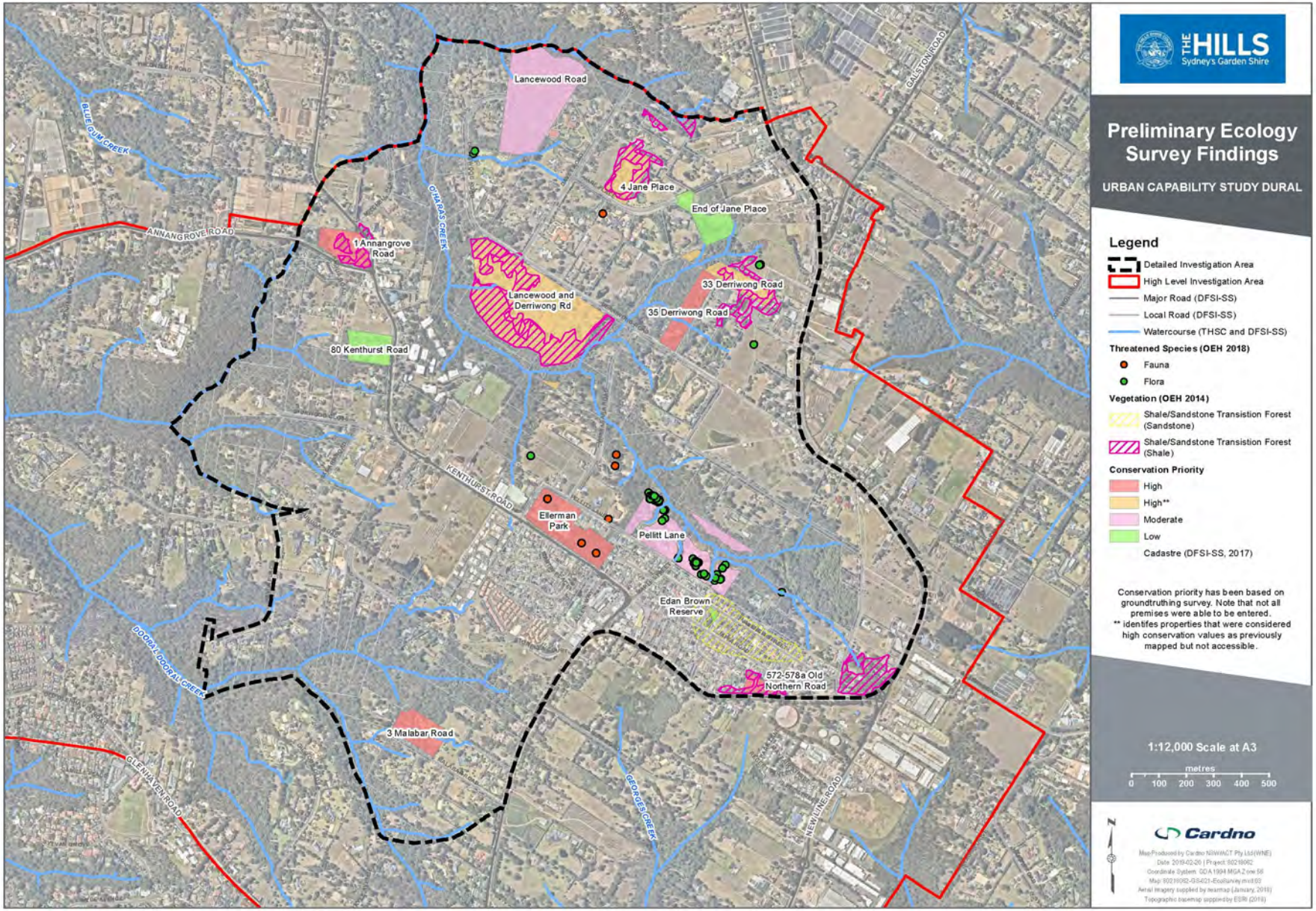

Figure 6-2 Ecological survey locations and conservation value

APPENDIX

B

TRAFFIC REPORT

Traffic Base Modelling

Dural Capability and Capacity Assessment

80218062

Prepared for

The Hills Shire Council

13 March 2019

Cardno

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Approved By:

Hayden Calvey – Senior Traffic Engineer — Date Approved 6/03/2019

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01	4/08/2018	Draft	Sabal Sharma	Hayden Calvey
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Glossary and Abbreviations

AVD	Average Vehicle Delay
CBD	Central Business District
DOS	Degree of Saturation
LGA	Local Government Area
LoS	Level of Service
RMS	Roads and Maritime Services
SIDRA (v.7)	SIDRA Intersection modelling software – Version 7
TfNSW	Transport for New South Wales
THSC	The Hills Shire Council

Table of Contents

Tables

Figures

1 Introduction

The Hills Shire Council (THSC) is investigating opportunities for urban growth in the Dural locality. The Hills Shire Council has engaged Cardno to undertake a Phase 1 Urban Capability and Capacity Assessment, which has the following three key components –

a) Environmental Study Report

b) Infrastructure Capacity Investigation including Power, Water, Traffic and Gas.

c) Indicative Structure Plan.

The purpose of the overarching Urban Capability Assessment is to determine the suitability of land on the rural/ urban interface in the Dural locality to sustain urban land uses, including the environmental capability of land, potential yields and assessment of infrastructure capacity and funding options. The assessment takes a holistic approach to determining the capacity and capability of the area.

The area of investigation (outlined in Section 1.3) is mainly within Dural, on the northern fringe of the Sydney Metropolitan Area. It is located 50km from the Sydney CBD and 25km from Parramatta CBD. The area within and near the village of Round Corner Dural is the focus of investigations.

The suburb of Dural is located in both The Hills Shire Local Government Area (LGA) and Hornsby Shire LGA, with Old Northern Road forming the boundary between the two Council areas. Round Corner is a local town centre in the south-western part of Dural.

1.1 Description of the Land

1.1.1 Land use and access

The detailed Investigation Area incorporates a mosaic of land uses including:

- Tracts of bushland generally following existing local creek lines;
- Large lot residential areas in semi-rural settings;
- Conventional low density residential areas;
- Medium density housing (largely in the form of Seniors Living developments) and townhouses in Round Corner / Dural; and
- One consolidated retail / commercial precinct (at Round Corner, Dural).

Vehicular access to the area is via regional roads including New Line Road, Old Northern Road, Annangrove Road and Glenhaven Road. Access within the investigation area is via a series of feeder roads and connector roads, many of which are relatively narrow and of a rural or semi-rural character.

1.1.2 Demographics

An overview of the demographics of the investigation area has been derived from a review of demographic data available on the Hills Shire Council website and the Australian Bureau of Statistics (ABS) 2016 Census database. Investigations were carried out with the objective of identifying existing population densities, age range, levels of employment and income, land tenure and transport profiles. Comparisons were made using similar criteria against the adjacent Castle Hill area and overall statistics for the Sydney Metropolitan Area.

The key demographic characteristics of the investigation area are:

- **Development density** – the investigation area has developed at very low density in comparison to other local areas (3.41 dwellings/ha compared to 23.95 dwellings / ha in neighbouring Castle Hill).
- **Employment** – the area enjoys a low rate of unemployment (4.14% compared to 6% for the Sydney Metro Area) and employment types are similar to Castle Hill and the Sydney Metro area.
- **Weekly income** - Higher proportion of the population in the Investigation Area has an income of greater than $2,000 when compared to Greater Sydney.
- **Home ownership** - rates are comparatively high (35.29% of households either own their homes outright or with a mortgage, compared to 31.5% for the Sydney Metro).

- **Car ownership** – rates are very high: 37.87% of households own 3 or more cars and 2% of households do not own a car. This is compared to 14.9% of households in the Sydney Metro Area owning more than 3 cars and 10.7% not owning a car.
- **Trips to work** - are private vehicle dominated (69.1% of the population travel to work by car while 8.96% travel to work by public transport only. Sydney Metro statistics for car travel are also high – 56.6% travel to work by car but public transport is a much more represented mode across the Metro area - 20.6% travel to work by public transport. Others travel via a combination of private and public transport).

1.2 Investigation Area

1.2.1 Identification of the Investigation Area

The extent and location of the investigation areas for the assessment was determined by Cardno in consultation with THSC. Two areas were defined and mapped in **Figure 1-1**. These investigation areas are:

- High Level Investigation Area (red boundary)
- Detailed Investigation Area (black dotted boundary)

The Hills and Hornsby Shire Councils have received a number of unsolicited Planning Proposals to rezone land near Round Corner, Dural. The intent of this study is to provide The Hills Shire Council with an independent and fully considered assessment of the capability of the Dural locality, for future development.

On this basis, the Detailed Investigation Area has been identified to include Round Corner, the lands covered by current Planning Proposals in Dural and other nearby concentrations of development. It has been confined to land within The Hills Local Government Area.

In order to ensure an appropriate context for the study, a broader High Level Investigation Area has been identified which includes surrounding villages and suburban areas, as well as transport connections between these and the Detailed Investigation Area. The edges of the Investigation Areas have been defined by natural features such as local creek lines, edges of existing residential development and by Arterial Roads (and connecting roads between these).

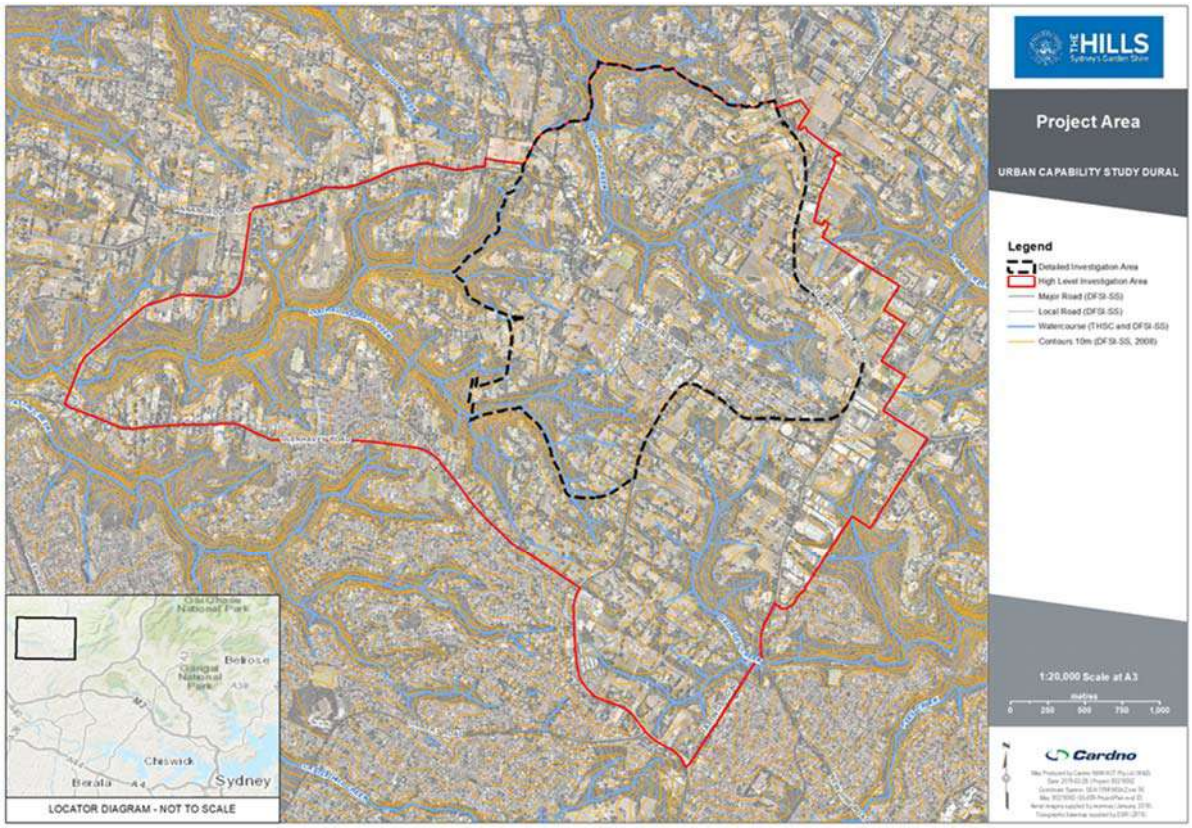


Figure 1-1 Study Area

1.2.2 High Level Investigation Area

The High Level Investigation Area encompasses the suburbs of Dural, Glenhaven, Castle Hill and Kenthurst (see **Figure 2-1**). The majority of the area is within The Hills Shire LGA with a portion along the east side being within the Hornsby Shire LGA. This area is bordered by Annangrove Road (regional road no.7141) and creek lines to the north, Bannerman Road to the west (a local connector road), Glenhaven Road to the south (a local connector road) and various local roads including Hastings Road to the east.

1.2.3 Detailed Investigation Area

The Detailed Investigation Area is comprised of the suburbs of Dural, Kenthurst and Glenhaven. The main shopping / residential area is Round Corner, situated on Old Northern Road. The Detailed Investigation Area mainly consists of large, rural lots along the main roads (i.e. Old Northern Road, Glenhaven Road, Kenthurst Road), with dense vegetation along the riparian corridors. Low density residential subdivision in the area is primarily focussed around the Round Corner, Dural centre.

The Detailed Investigation Area is the land that is the subject of this environmental and planning study. The High Level Investigation Area provides a wider contextual understanding of the locality and allows for potential opportunities for connections in the vicinity of the Detailed Investigation Area.

2 Purpose of the Report

This report has been prepared to inform the Hills Shire Council of the current baseline capacity conditions and constraints based on existing traffic volume data. The following scope of works has been undertaken:

- Review existing road network including traffic, public transport, cycling and walking networks within the study area
- Assess intersection performance and mid-block performance against RMS and Austroads requirements.
- Identify potential short term capacity improvements to address existing deficiencies in the road network

The analysis of this traffic report is based on the 2013 survey data provided by Council and updated to reflect the 2018 existing conditions. As agreed with Council, the study area is focused on the following intersections:

- Annangrove Road / Kenthurst Road
- Kenthurst Road / Old Northern Road
- Old Northern Road / New Line Road
- Old Northern Road / Quarry Road
- Old Northern Road / Vineys Road

Figure 2-1 (below) shows the study area and the intersections.

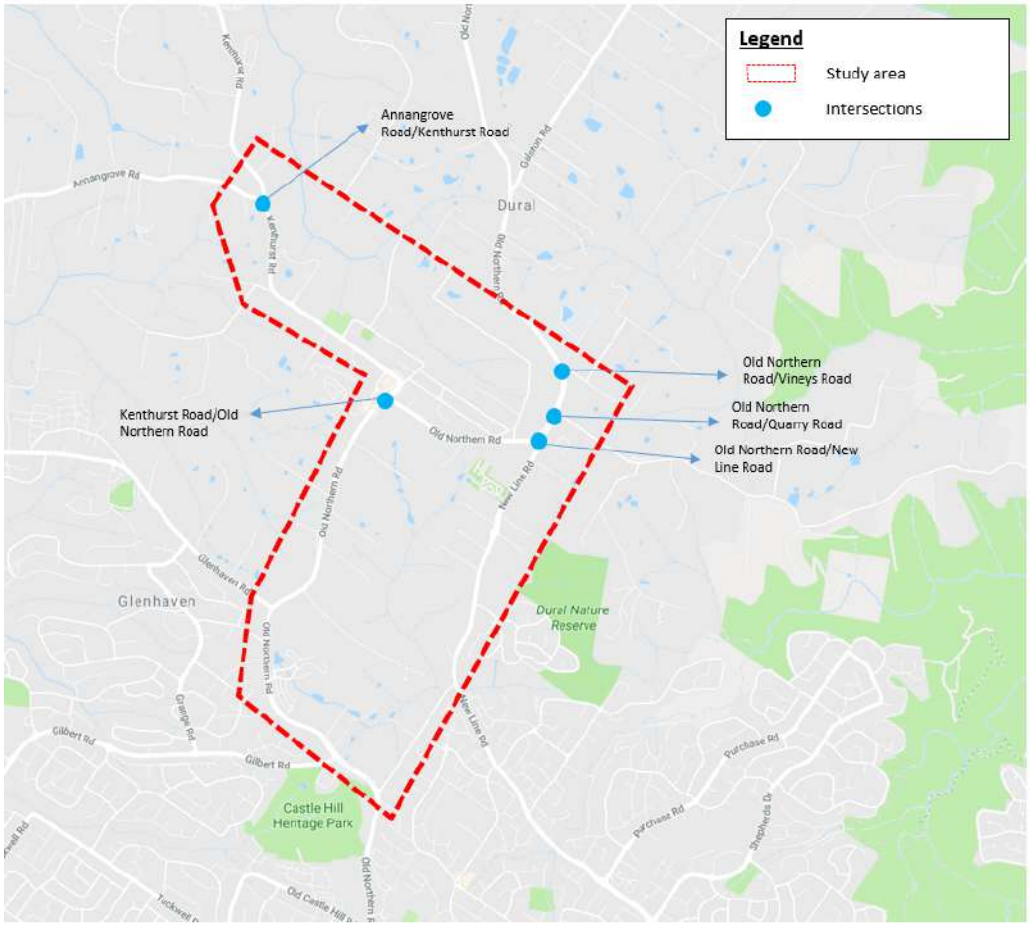


Figure 2-1 Study Area and Intersections

This report also identifies the appropriate steps to progress with the study in order to identify opportunities to improve the road network.

2.2 Context

Old Northern Road / New Line Road is a key north-south corridor providing access to Pennant Hills to the south and Maroota (and further) to the north. It is identified as a tertiary freight corridor which is typically a route which provides connections to the local road system and lower order roads in the State road network. They carry lower volumes of heavy vehicles (less than 2,000 heavy vehicles per day).

Kenthurst Road / Annangrove Road is an east-west connection from Round Corner to Rouse Hill and the wider North West Growth Centre. With the expansion of the growth centre to the west of the study area, the increase in employment density is likely to attract trips along Annangrove Road through the study area.

3 Traffic Volume Summary

3.1 Overview

RMS have a number of permanent count stations which record daily traffic flows by direction and in some cases by vehicle classification.

Figure 3-1 shows the location of the two count stations, number 74228 and 73038, located on New Line Road and Old Northern Road respectively.

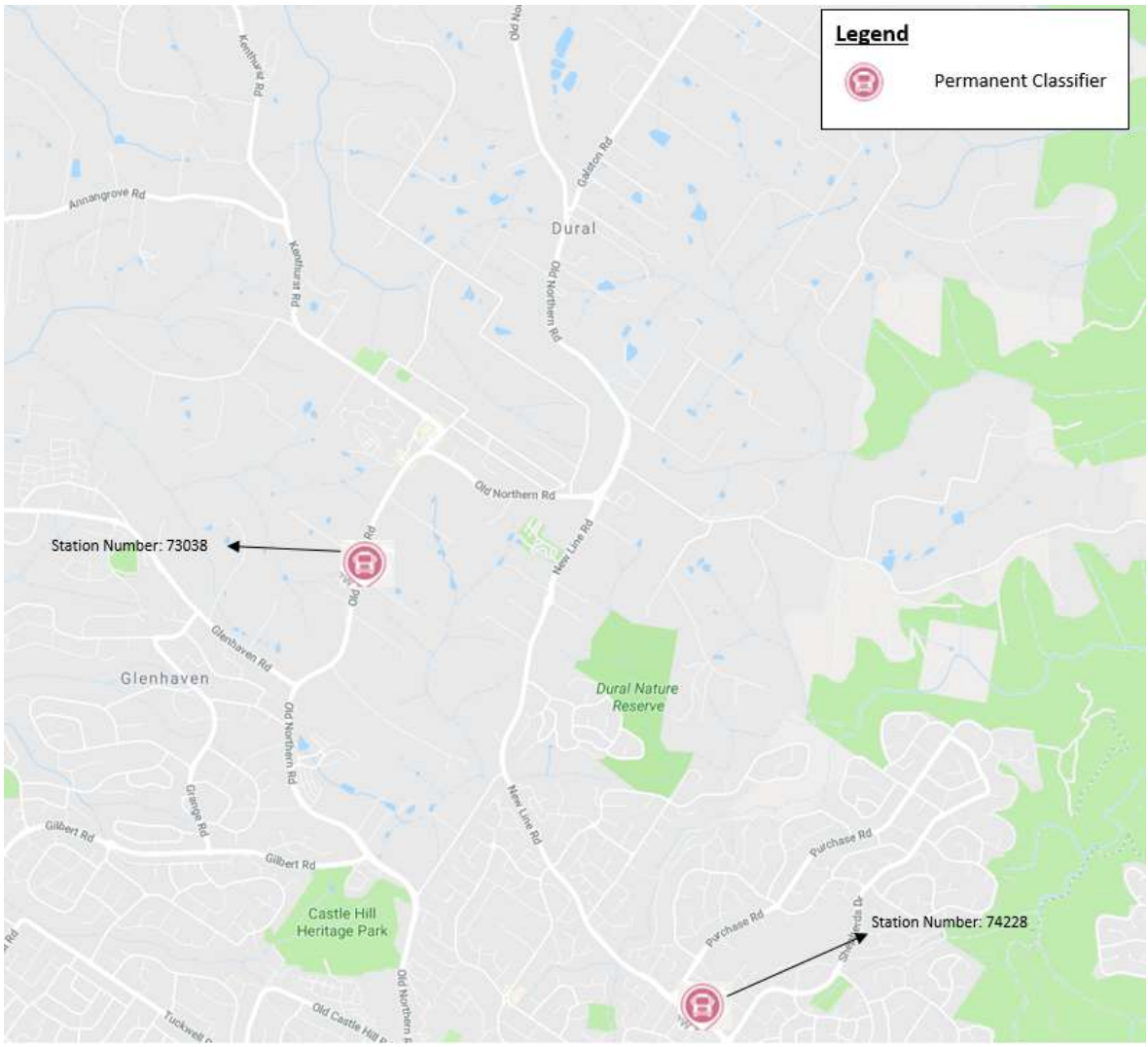


Figure 3-1 Location of Permanent Traffic Volume Count Stations

Located on New Line Road is a permanent count station (no. 74228) which records both northbound and southbound vehicle data. **Table 3-1** below summarises the two-way traffic flow at this location, near Tennyson Close, Cherrybrook.

Table 3-1 New Line Road Traffic Volume History (110m South of Tennyson Close)

Direction	Year 2009	2010	2011	2012	2013
Northbound	14,427	14,396	14,149	14,100	13,964
Southbound	15,356	15,386	15,217	15,190	15,235
Total	29,783	29,782	29,366	29,290	29,199
Direction	Year 2014	2015	2016	2017	2018
Northbound	13,975	14,079	14,138	14,389	14,362
Southbound	15,349	15,442	15,583	15,967	16,019
Total	29,324	29,521	29,721	30,356	30,381

The numbers in **Table 3-1** represents all days Annual Average Daily Traffic. This includes volumes from all days of the week with no exclusion for public holidays or weekends

New Line Road is observed to carry approximately 30,000 vehicles daily. The daily traffic profile shows that the southbound direction is the peak direction, constantly carrying higher volumes than the northbound direction. It is also evident that from 2009 to 2013 volumes have been gradually declining, although would be considered to be a constant traffic volume (at a rate of 0.49% per year) however is then seen to increase from 2013 to 2017 (rate of 1% per year).

Permanent count station (no. 73038) is located on Old Northern Road, south of Malabar Road which records both northbound and southbound traffic. Figure 3-1 shows the location of count stations. **Table 3-2** summarises the two-way traffic flow at this location.

Table 3-2 Old Northern Road Traffic Volume History (40 m South of Malabar Road)

Direction	Year 2008	2009	2010	2011	2012
Northbound	10,032	9,392	9,395	9,242	9,428
Southbound	9,539	8,657	8,445	8,280	8,397
Total	19,571	18,049	17840	17522	17,825
Direction	Year 2013	2014	2015	2016	2017
Northbound	9,642	9,402	-	9,871	9,037
Southbound	8,523	8,311	-	8,727	8,099
Total	18,165	17,713	-	18,598	17,136

Note: data for 2018 is not available

The numbers in **Table 3-2** represents all days Annual Average Daily Traffic. This includes volumes from all days of the week with no exclusion for public holidays or weekends

The Old Northern Road is observed to carry generally 19,000 vehicles daily. The daily traffic profile shows that the volumes in the northbound direction constantly carries higher volumes than the volumes in the southbound direction. From 2008 to 2011 traffic volumes were gradually declining, Traffic volumes fluctuated from 2011 to 2017. Traffic volumes from 2008 to 2017 have decreased by 1.39% per year.

The South Dural Planning Proposal cites that the future growth estimates have been calculated from recent strategic transport models and historical growth (*Transport Management and Accessibility Plan*, WSP 2016), resulting in the following growth estimates:

- 2016 to 2021; 1.4% p.a in the AM peak and 1.8% p.a in the PM peak
- 2021 to 2031: 1.3% p.a in the AM peak and 1.4% p.a in the PM peak

The above growth rates, are obtained from strategic models held by RMS and TfNSW and appear to be higher that the historic growth rates calculated from the two count stations, however this can be expected as new developments come online (i.e. North West Growth Centre).

Intersection surveys, undertaken by Austraffic on Wednesday, 11 December 2013, have been made available to Cardno for the purpose of this capacity and capability assessment

In order to account for traffic growth since 2013, and to reflect current traffic volumes in 2018, the higher growth rates adopted in the South Dural Planning Proposal (*Transport Management and Accessibility Plan*, WSP 2016), have been taken into consideration when analysing the current 2018 intersection performances, being 1.4% p.a in the AM peak and 1.8% p.a in the PM peak.

The AM peak assessment is based on the individual traffic flow of each intersection, which is predominantly 8:15-9:15am. The PM peak assessment is similarly based on the individual traffic flow of each intersection which is 3:00-4:00pm. The resulting traffic volumes are shown in **Figure 3-2** and **Figure 3-3**.

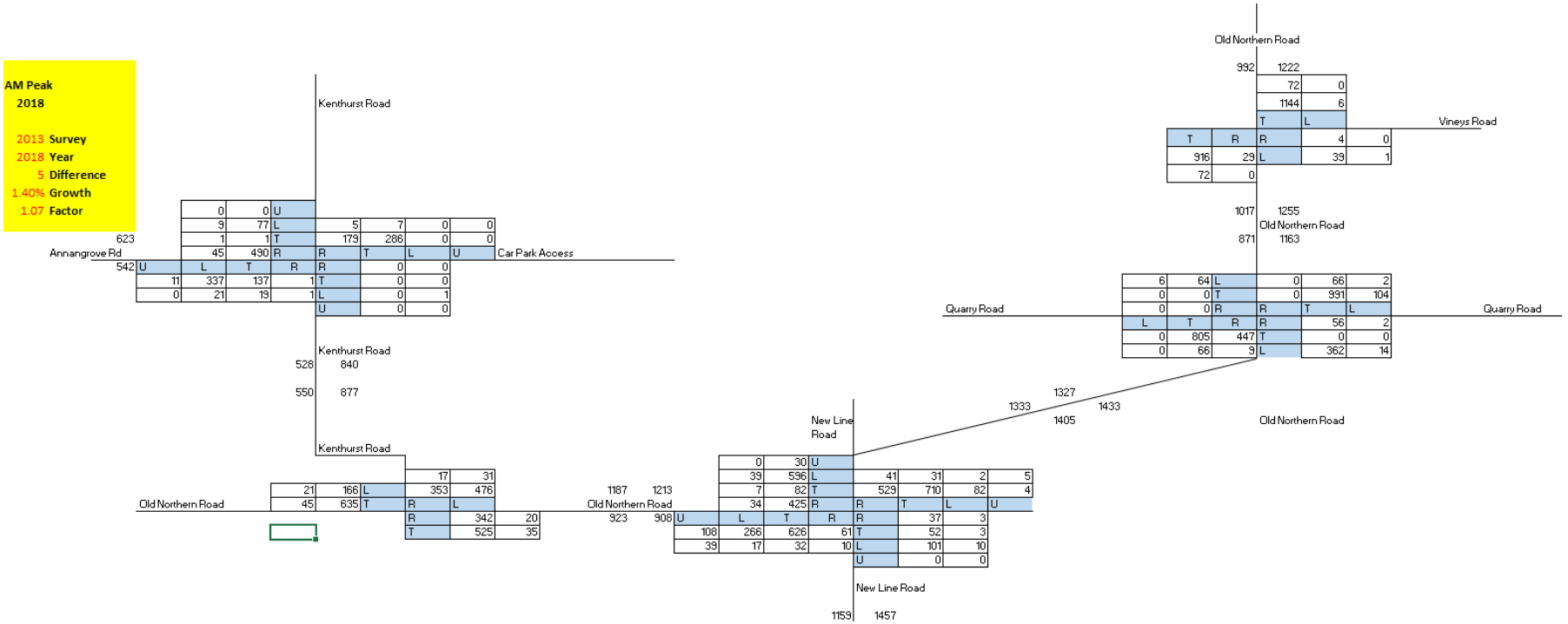


Figure 3-2 AM Peak Hour Traffic Volume

The diagram as shown in **Figure 3-2** represents the AM peak for 2018 base which has been obtained from 2013 traffic count data plus 5 years of growth (at 1.40% per annum).

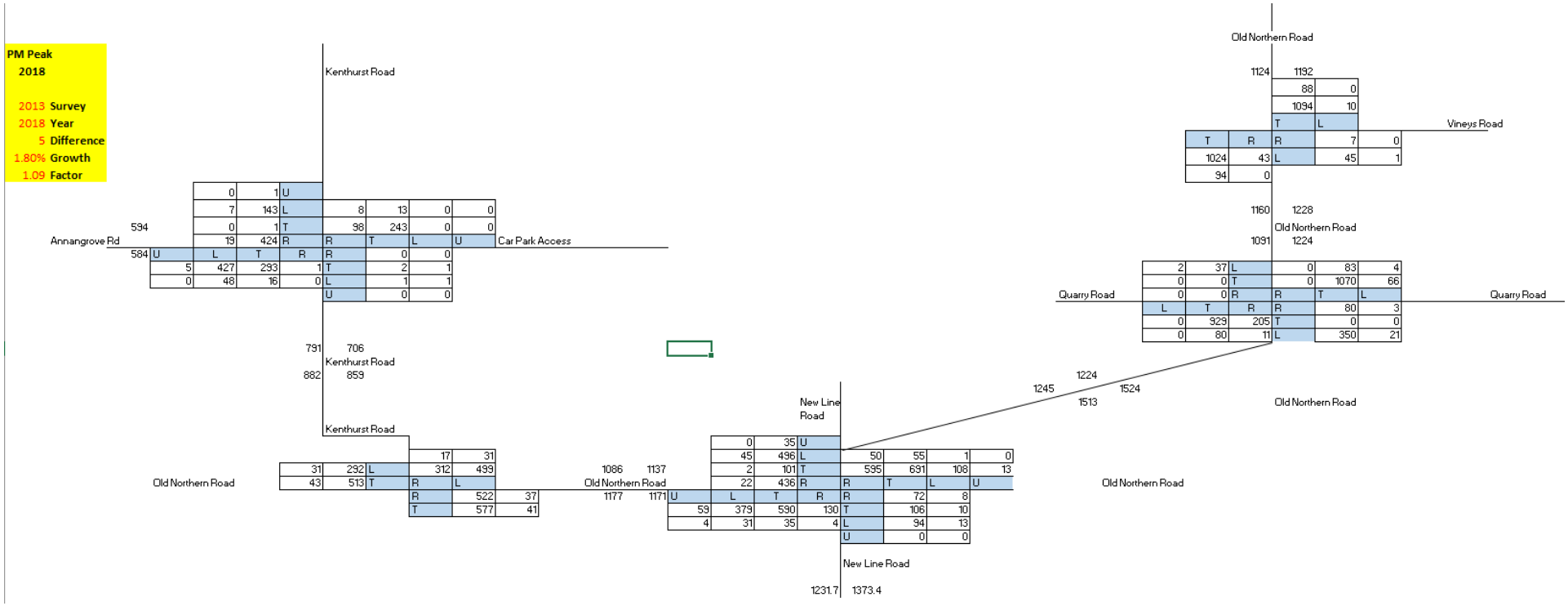


Figure 3-3 **PM Peak Hour Traffic Volume**

The diagram as shown in **Figure 3-3** represents the PM peak for 2018 base which has been obtained from 2013 traffic count data plus 5 years of growth (at 1.80% per annum).

3.2 Midblock Capacity

The midblock capacity has been reviewed using the criteria established by the RTA Guide to Traffic Generating Development (Version 2.2), referred to as the RMS Guide. The criteria is shown in the following table.

Table 3-3 Midblock Capacity Criteria (RMS Guide)

Level of Service	One Lane (veh/hr)	Two Lanes (veh/hr)
A	200	900
B	380	1,400
C	600	1,800
D	900	2,200
E	1,400	2,800
F	>1,400	>2,800

The above criteria has been applied to the midblock traffic volumes as shown below, depending on a single or two lane mid-block profile. The volumes are based on the 2018 volumes (which account for growth since the 2013 survey).

Table 3-4 Midblock Traffic Analysis, Year 2018

Road Segment	Travel Direction	AM Traffic Volume	AM Level of Service	PM Traffic Volume	PM Level of Service
Annangrove Road, west of Kenthurst Road	Eastbound	623	D	594	C
	Westbound	542	C	584	C
Kenthurst Road from Annangrove Road to Old Northern Road	Northbound	550	C	882	D
	Southbound	877	D	859	D
Old Northern Road from Kenthurst Road to New Line Road	Eastbound	1,213	E	1,137	E
	Westbound	923	D	1,177	E
Old Northern Road, from New Line Road to Quarry Road	Northbound	1,333	B	1,245	B
	Southbound	1,433	B	1,524	C
Old Northern Road, from Quarry Road to Vineys Road	Northbound	1,017	E	1,160	E
	Southbound	1,255	E	1,228	E
New Line Road, south of Old Northern Road	Northbound	1,159	E	1,232	E
	Southbound	1,457	F	1,373	E
Old Northern Road, north of Vineys Road	Northbound	992	E	1,124	E
	Southbound	1,222	E	1,192	E

These data on **Table 3-4** are estimates that have been derived from the 2013 traffic count data plus 5 years of growth (at 1.40% and 1.80%.per annum) for AM and PM peak respectively. The AM and PM peak hours used in the 2013 traffic count are the individual peak hours identified for each of the intersection from the survey conducted between (7:30 am – 09:30 am) and (2:45 pm – 5:00 pm)

The RTA guide states that the LoS obtained using this methodology should be used only for strategic planning purposes only, and are not to be intended as a substitute for intersection analysis.

4 Active & Public Transport

4.1 Public Transport

The study area has a number of bus routes, with varying frequencies. The below figure outlines the routes available whilst **Table 4-1** summarises the frequencies.

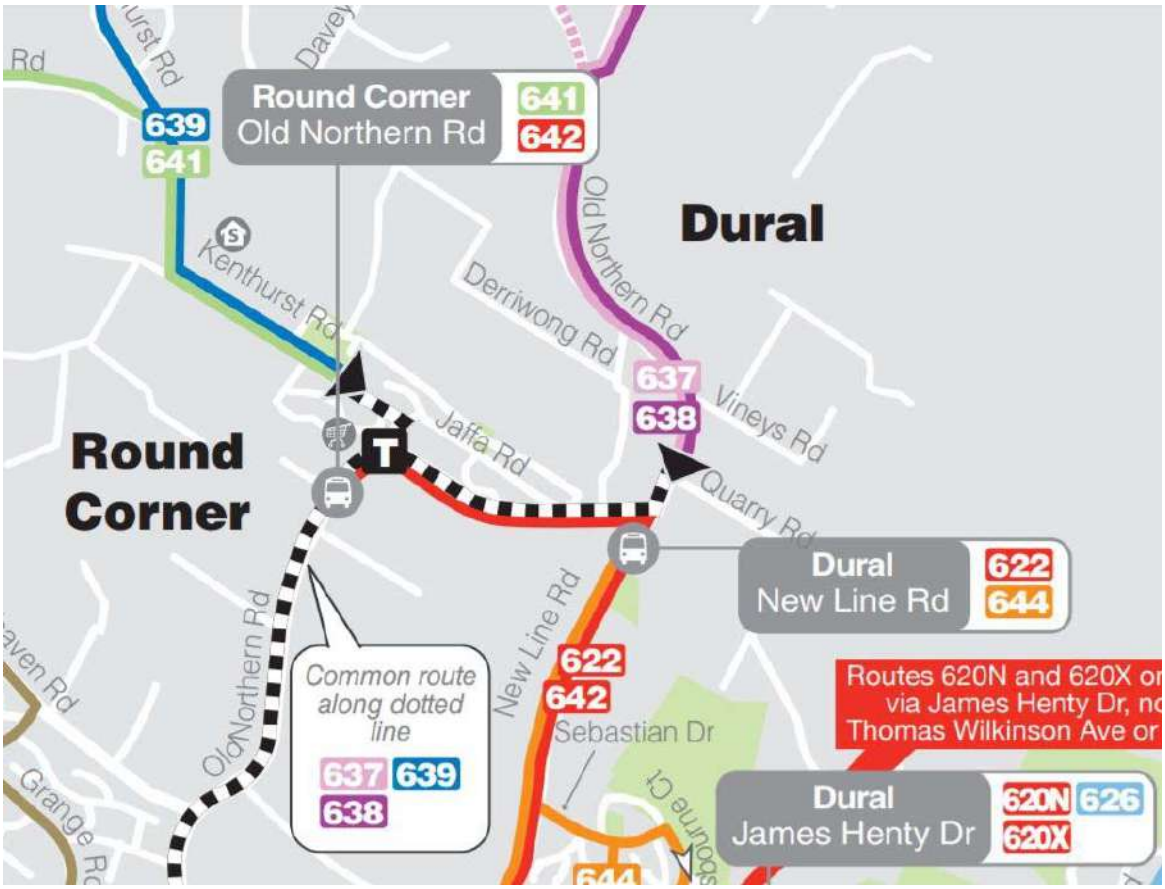


Figure 4-1 **Bus Network**

Table 4-1 Bus Frequencies

Bus Route	Direction	AM Peak frequency	PM Peak frequency	Daily services	First/Last Bus
622	Dural to Milsons Point via Cherrybrook	20mins	-	6	06:10 / 07:50
	Milsons Point to Dural via Cherrybrook	-	30mins	7	15:35 / 18:55
637	Glenorie to Castle Hill via Glaston & Round Corner	28-60mins	11-16mins	17	05:42 / 20:55
	Castle Hill to Glenorie via Round Corner & Glaston	78mins	25mins	16	07:02 / 21:55
638	Berrilee to Pennant Hills via Round Corner	76mins	48mins	9	06:01 / 17:17
	Pennant Hills to Berrilee via Round Corner	-	51mins	8	06:29 / 19:12
639	Kenthurst to Castle Hill	96mins	-	4	06:38 / 16:30
	Castle Hill to Kenthurst	-	-	3	12:14 / 14:41
641	Rouse Hill Town Centre to Dural	2.5hrs	-	4	06:26 / 17:20
	Dural to Rouse Hill Town Centre	-	45-60mins	7	07:04 / 18:39
642	Round Corner Dural to City Wynyard	23-40mins	-	7	05:40 / 09:35
	City Wynyard to Round Corner Dural	-	33-53mins	6	16:05 / 19:26
644	Dural to Castle Hill via Ravensbourne Cct	62mins	-	7	06:44 / 15:55
	Castle Hill to Dural via Ravensbourne Cct	-	30-60mins	7	10:35 / 17:45
642X	Round Corner Dural to City Wynyard via Lane Cove Tunnel	5-36mins	60mins	29	04:50 / 18:41
	City Wynyard to Round Corner Dural via Lane Cove Tunnel	-	5-18mins	33	08:30 / 23:28

There are a number of bus routes that circulate through the study area, however the uptake of public transport is currently below 4%. The low percentage of bus users can be attributed to the following two factors.

- There is low frequency of bus service, and
- The longer bus journey travel times as a result of traffic congestion.

A combination of these factors contribute to the low number of people choosing public transport.

Pedestrian connectivity through the study area is generally limited to the Round Corner town centre (in terms of pedestrian facilities), which appears to be in keeping with the rural setting of the study area where footpaths are mostly located in high density areas and not adjacent to large homesteads.

Cycling is generally limited to on-road only, sharing the carriageway with vehicles. There are no dedicated cycle lanes and shared paths identified within the study area. However, according to RMS, the 2m wide footpath along Kenthurst Road and Old Northern Road is a shared path (although supporting signage appears to be lacking in for this area).

5 Crash Data

Crash data for the period 2013 to 2017 for the study area was accessed through TfNSW Centre for Road Safety. **Figure 5-1** shows the location of crashes within the study area.

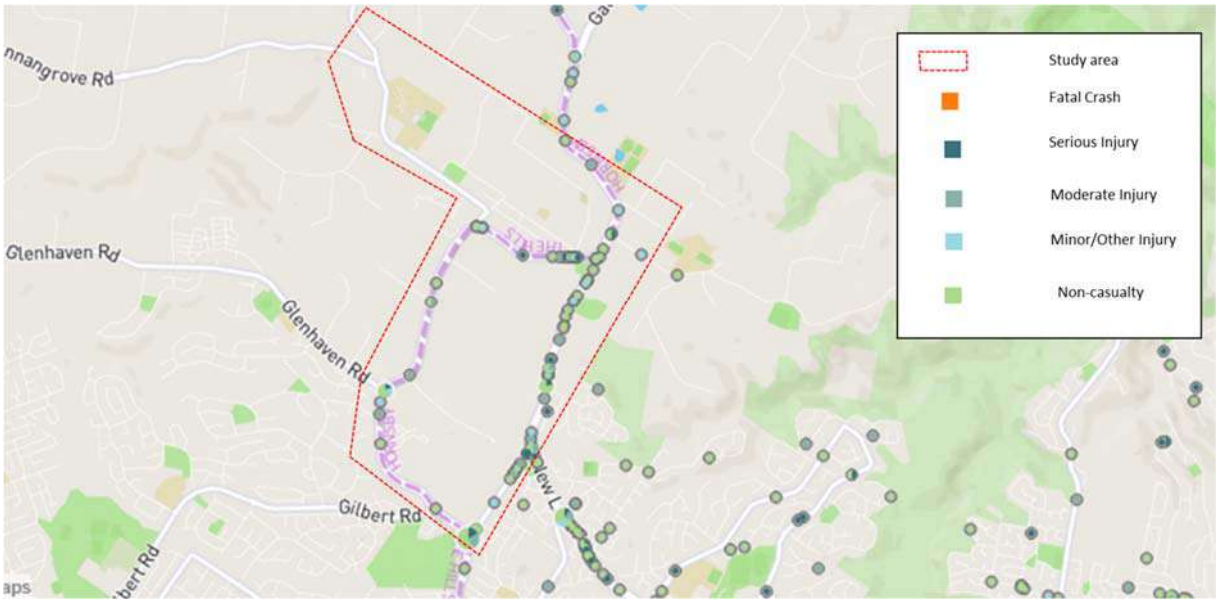


Figure 5-1 **Crash locations by injury severity within study area between 2013-2017**

The following key findings were identified from the analysis of the crash data:

- Most of the crashes in the study area occurred along New Line Road. No fatalities were recorded in the study area.
- There were a total of four crashes recorded at the Old Northern Road / Kenthurst Road intersection. Two of the crashes were non casualty (tow away) and two of them were minor crashes.
- There were a total of two crashes recorded at the Old Northern/ Quarry Road intersection. One of the crash was a serious injury crash and another one was non casualty crash (tow away).
- There were no crashes recorded at Annangrove Road/Kenthurst Road Intersection.
- There was one minor crash recorded at Old Northern Road/Vineys Road Intersection.
- A total of three crashes were recorded at Old Northern road/ New Line road roundabout. All three crashes were non casualty (tow away).

6 Existing Intersection Performance

6.1 Methodology

The surveyed traffic volumes of Wednesday, 11 December 2013, with the additional growth to 2018 (1.4% p.a in the AM peak and 1.8% p.a in the PM peak as previously identified), have been assessed using SIDRA v7 in network function. The SIDRA network capabilities has been adopted to represent potential queuing through intersections.

6.2 Intersection Layouts

The assessed intersection geometry is shown below in **Figure 6-1** and is considered to be the '2018 Base Case'. The base case is derived from the 2013 traffic count data plus 5 years of growth (at 1.40% and 1.80%.per annum) for AM and PM peak respectively.

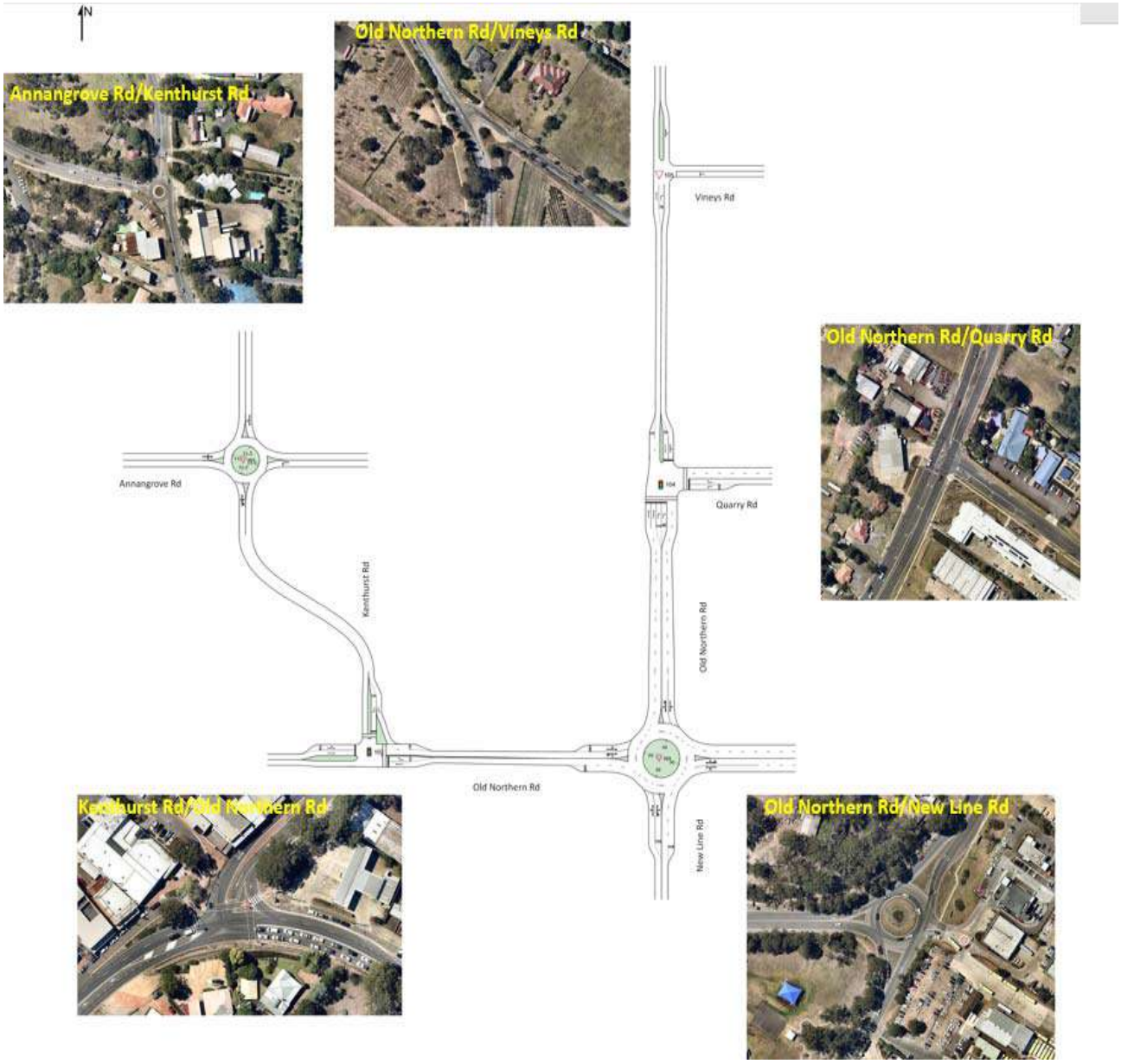


Figure 6-1 Existing Road Layout

6.3 Performance Criteria

The above intersections have been assessed using SIDRA (v7) based on the identified peak hours. The key indicator of intersection performance is typically the Level of Service (LoS), where results are placed on a scale from 'A' to 'F', outlined in **Table 6-1**.

Table 6-1 Level of Service Criteria (RMS Guide)

Level of Service	Average Delay per Vehicle (sec/veh)	Traffic Signals, Roundabout	Give way & Stop Signs
A	< 14	Good Operation	Good Operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study
D	43 to 56	Operating near capacity	Near Capacity & accident study
E	57 to 70	At Capacity, at signals incidents will cause excessive	At capacity, requires other control mode
F	>70	Unsatisfactory and requires additional capacity	Unsatisfactory and requires additional capacity

The Average Vehicle Delay (AVD) provides a measure of the operational performance of an intersection and determines the LoS when applying the RMS method. It should be noted that the AVD's should be taken as a guide only as longer delays could be tolerated in some locations (i.e. inner city conditions) and on some roads (i.e. minor side street intersecting with a major arterial route). For traffic signals, the weighted average delay over all movements should be utilised. For roundabouts and priority control intersections (sign control) the critical movement for assessing LoS should be the movement with the highest average delay.

The Degree of Saturation (DoS) is another measure of the operational performance of individual intersections. For intersections controlled by traffic signals, both queue length and delay increase rapidly as DoS approaches 1.0. It is usual to attempt to keep DoS to less than 0.9. Degrees of Saturation in the order of 0.7 generally represent satisfactory intersection operation. When DoS exceed 0.9 queues can be anticipated.

6.4 Current Intersection Analysis

The following intersection analysis is illustrated in **Figure 6-2** and **Figure 6-3**.The intersection assessment has been undertaken using SIDRA v7 network input parameters. This is to enable the model to see the impact of queue propagation, which cannot be adequately captured in the single site mode. The network summary available through the SIDRA v7 program is based on the average speed compared to the desired speed, which has been set to 60km/h. The SIDRA model identifies the average travel speed is 35.8km/h in the AM and 35.3km/h in the PM. The network saturation is based on the worst intersection within the network model, which is the Old Northern Road / New Line Road intersection which performs at LoS “F” during both morning and evening peak hour, with DoS exceeding 1, again indicating a network which is over capacity.

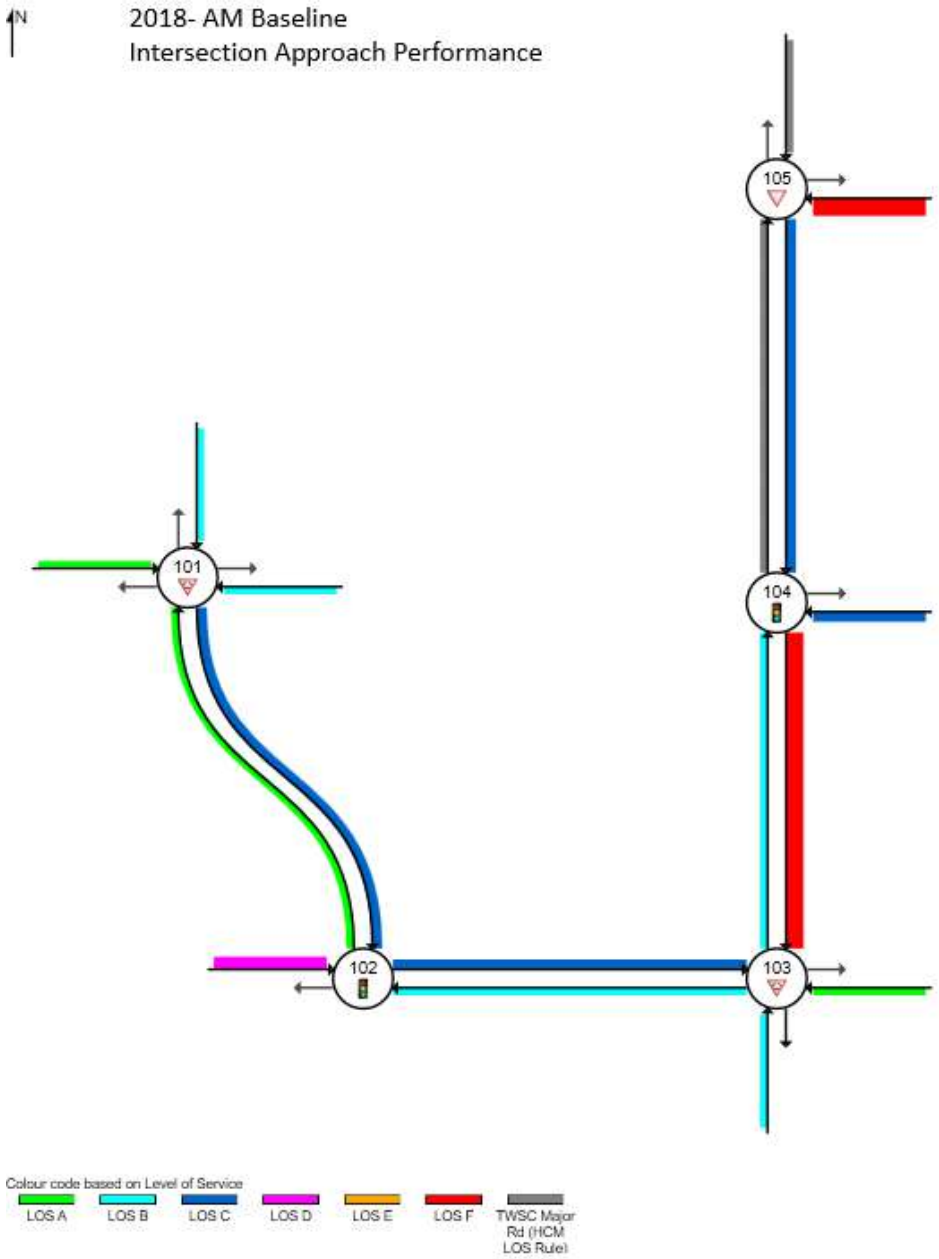


Figure 6-2 2018 AM Peak Hour Network Intersection Approaches

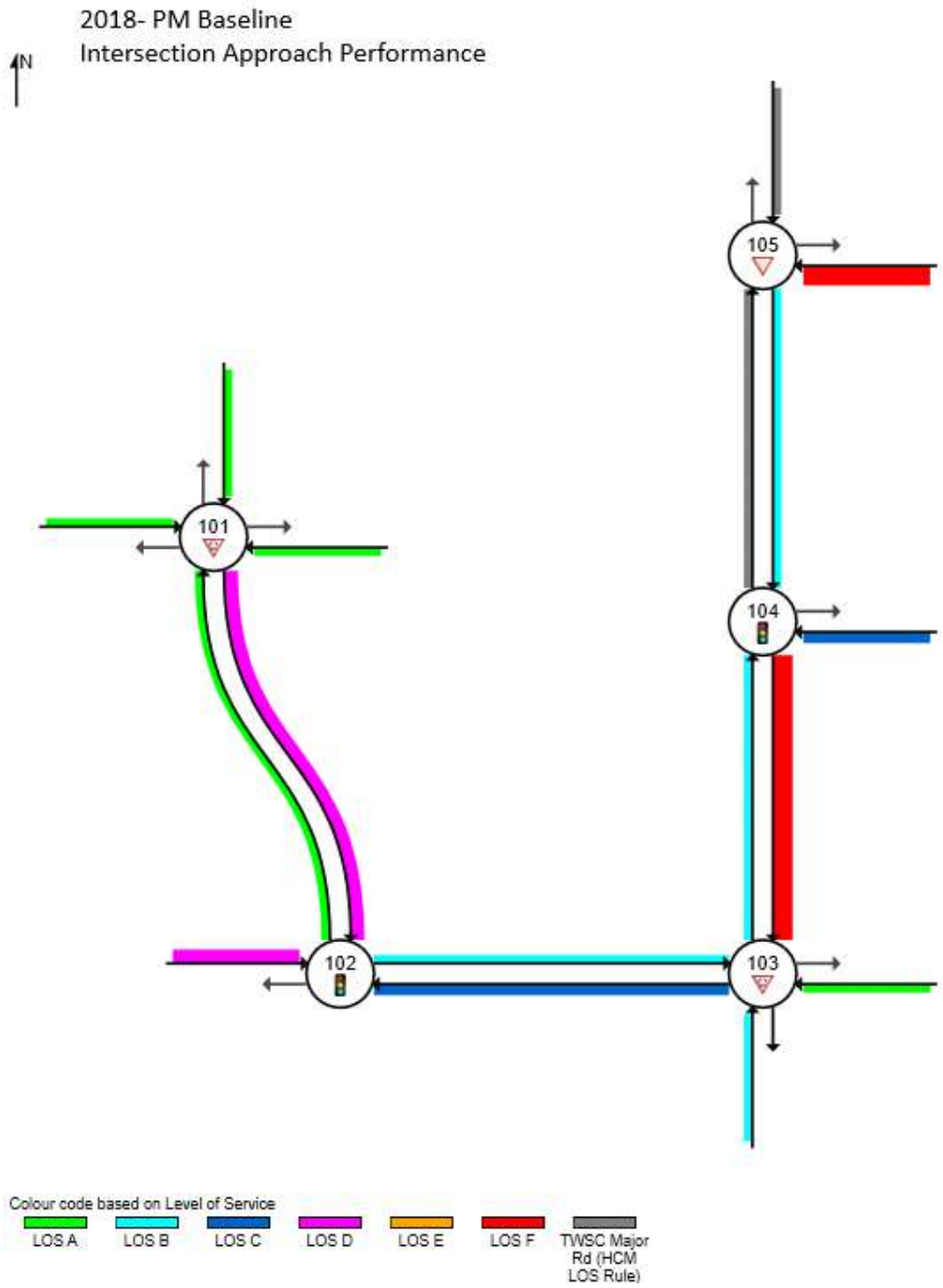


Figure 6-3 2018 PM Peak Hour Network Intersection Approaches

It should be noted that for, traffic signals, the average movement delay and level of service over all movements is taken. For roundabouts and priority control signals intersection (with Stop and Give Way signs or operating under the T-junction rule) the critical movement for level of service assessment with the worst movement delay is taken. These results are based from the 2013 traffic count data plus 5 years of growth (at 1.40% and 1.80%.per annum) for AM and PM peak respectively

Table 6-2 Annangrove Road / Kenthurst Road

Period	Degree of Saturation	Average Delay	Level of Service
AM	0.698	19.8	B
PM	0.638	13.3	A

The intersection of Annangrove Road / Kenthurst Road is currently operating at a LoS “B” and “A” during the AM and PM peak respectively. This represents an intersection which is operating with acceptable delays and spare capacity. The LoS is based on the worst movement, which in this instance is the left turn movement from car park access, however the volume of traffic associated with this movement is relatively low compared to the major movements (less than 5 vehicles), and as such does not necessarily reflect the intersection as a whole.

Table 6-3 Old Northern Road / Kenthurst Road

	Degree of Saturation	Average Delay	Level of Service
AM	0.896	37.0	C
PM	0.906	44.1	D

The intersection of Old Northern Road / Kenthurst Road is currently operating and LoS “C” during the AM and LoS “D” during the PM peak hour. This represents an intersection which is operating satisfactorily however is subject to further investigation into accident history. The crash data set previously reviewed does not indicate any crash cluster or black spots that would indicate issues with the intersection performance.

During the morning period, the right turn from Kenthurst Road operates at LoS “E” whilst during the evening peak this movement deteriorates to LoS “F”. This specific movement is currently operating at capacity.

Table 6-4 Old Northern Road / New Line Road

	Degree of Saturation	Average Delay	Level of Service
AM	1.165	175.8	F
PM	1.189	190.8	F

The intersection of Old Northern Road / New Line Road is currently operating and LoS “F” during the AM and PM peak hour. The LoS is based on the worst movement which is the Old Northern Road right turn towards Round Corner / Dural. LoS “F” represents an intersection operating over capacity. The Degree of Saturation also indicates that minor increases to traffic flow may have exponential impacts to the performance (although this is a limitation of the SIDRA software program and may not be realistic in operation as driver behaviour may become more aggressive as delays increase).

Table 6-5 Old Northern Road / Quarry Road

	Degree of Saturation	Average Delay	Level of Service
AM	0.927	32.0	C
PM	0.816	20.9	B

The intersection of Old Northern Road / Quarry Road is currently operating and LoS “C” and “B” during the AM and PM peak respectively. This represents an intersection which is operating satisfactorily however is subject to further investigation into accident history. The crash data set previously reviewed does not indicate any crash cluster or black spots that would indicate issues with the intersection performance.

Furthermore, the right turn from Old Northern Road into Quarry Road currently operates at LoS “E” during the AM and PM respectively, which indicates this specific movement is operating at capacity.

Table 6-6 Old Northern Road / Vineys Road

	Degree of Saturation	Average Delay	Level of Service
AM	0.839	497.7	F
PM	1.349	802.5	F

The intersection of Old Northern Road / Vineys Road is currently operating and LoS “F” during the AM and PM peak hour. The LoS is based on the worst movement which is the right turn movement from Vineys Road, however the volume of traffic associated with this movement is relatively low compared to the major movements (less than 10 vehicles), and as such does not necessarily reflect the intersection as a whole.

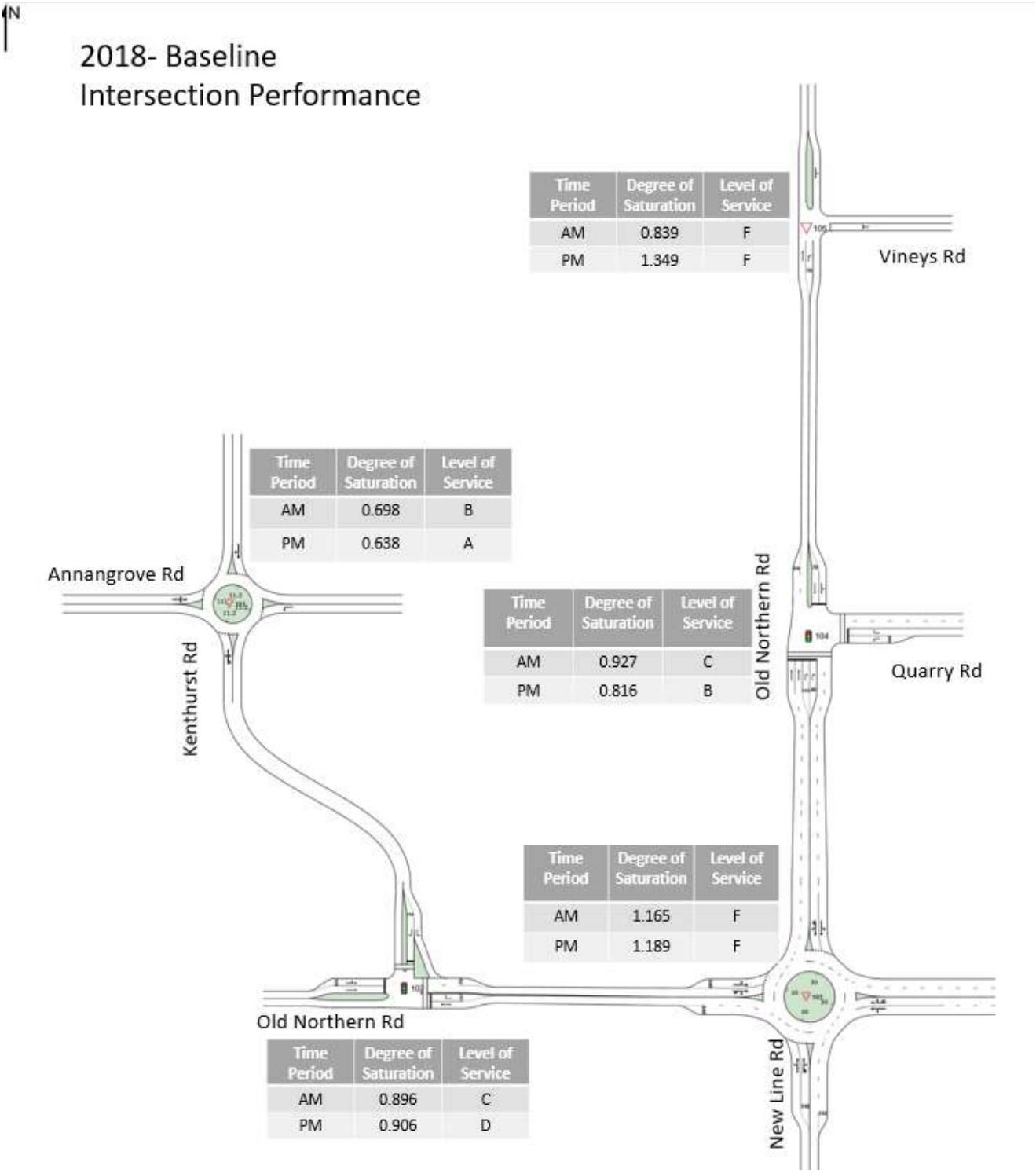


Figure 6-4 2018 Intersection Performance Summary

7 Improvements to Existing Conditions

There are existing constraints on the network that result in unsatisfactory performance, primarily as a result of congestion along Old Northern Road and New Line Road. These upgrades are required to cater for existing conditions and do not take into account additional growth in the Investigation Area.

Based on the existing network performance identified, the following works should be further investigated:

- Upgrade Old Northern Road / New Line Road roundabout to a signalised intersection; and
- Provide midblock lane capacity (i.e. duplication) along Old Northern Road and New Line Road. Widening along New Line Road would likely be from Sebastian Drive to Old Northern Road, whilst widening along Old Northern Road would be from Kentburst Road to New Line Road

The preliminary upgrades identified are summarised in the following tables.

Table 7-1 Old Northern Road / New Line Road Proposed Layout

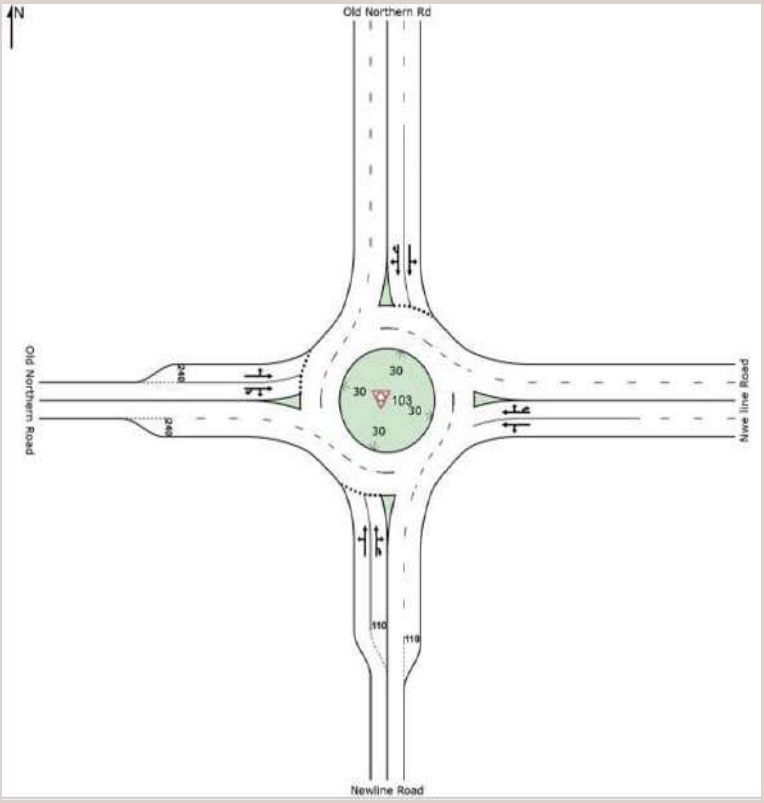
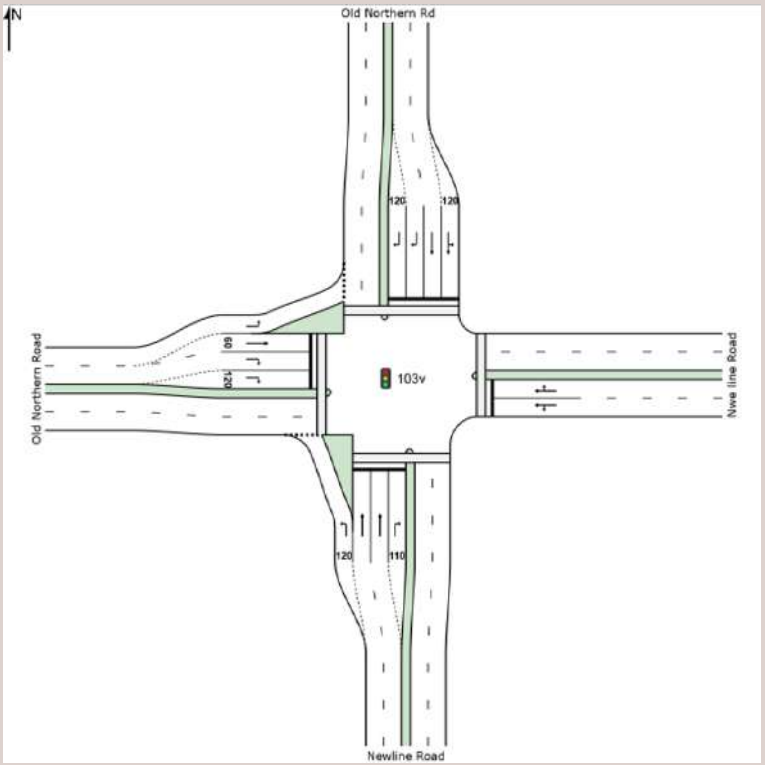
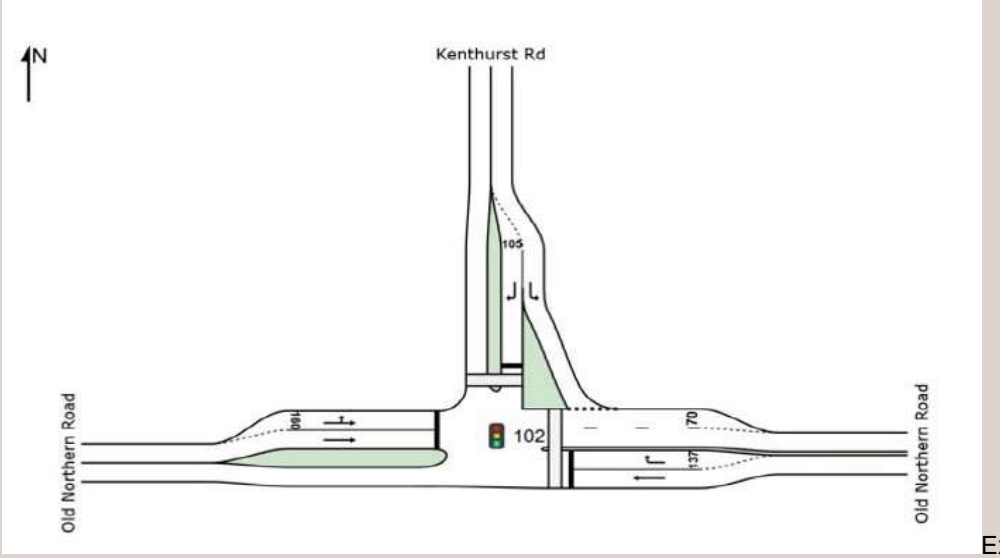
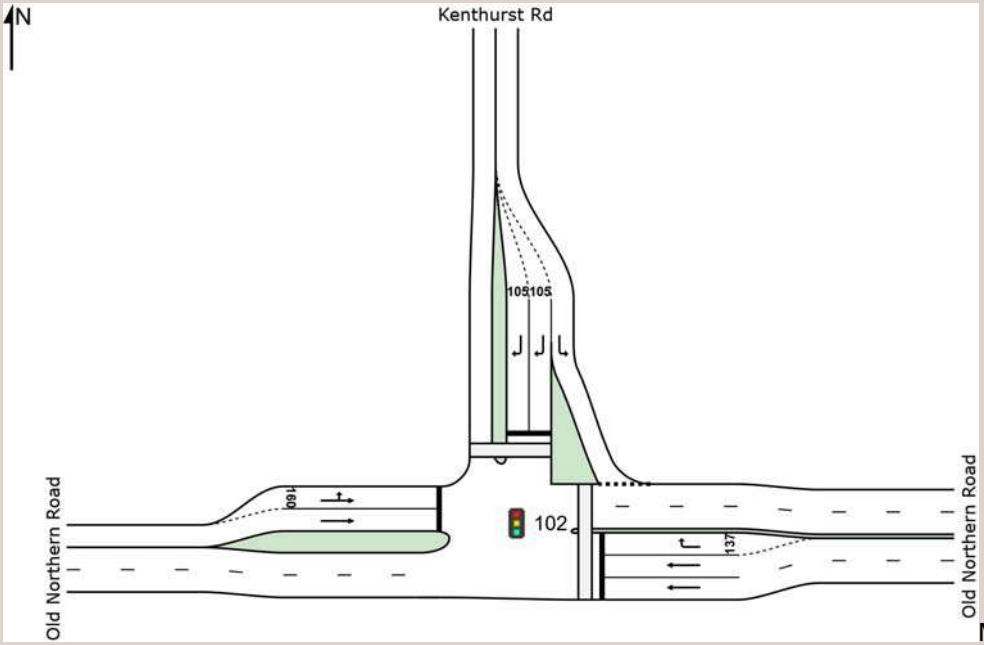
Old Northern Road / New Line Road Proposed Layout	
	Existing Layout
	Mitigation Layout

Table 7-2 Old Northern Road / Kenthurst Road Layout

Old Northern Road / Kenthurst Road Layout	
	Existing Layout
	Mitigation Layout

The resulting intersection performance is summarised in **Table 7-3** and **Table 7-4**.

Table 7-3 Old Northern Road / New Line Road Improvement

Scenario	Time	Degree of Saturation	Average Delay	Level of Service
Existing	AM	1.165	175.8	F
	PM	1.189	190.8	F
Upgrade	AM	0.901	38.5	C
	PM	0.925	45.1	D

It is evident that conversion of the roundabout to a signalised intersection significantly improves the intersections' performance. Following the upgrade, it is expected that this intersection would operate at LoS C and LoS D during the morning and evening peak hour respectively.

Table 7-4 Old Northern Road / Kenthurst Road Improvement

Scenario	Time	Degree of Saturation	Average Delay	Level of Service
Existing	AM	0.896	37.0	C
	PM	0.906	44.1	D
Upgrade	AM	0.863	21.4	B
	PM	0.838	32.5	C

Although the intersection was not necessarily performing unsatisfactorily, the increase in mid-block lane capacity and through movement is expected to improve the intersection by reducing delays in the AM and PM respectively.

8 Potential Cost Estimate

There are a number of unknown factors with regard to the intersection upgrade and capacity improvements, including utility relocation, subgrade conditions, and drainage. The following cost estimates are very high level and provided for strategic purposes only. They are an indication for the type of upgrade that may be identified by this study and would require further investigation into potential property acquisition, maintenance costs, provision of supporting infrastructure. Estimates should be confirmed by a quantity surveyor.

- Localised traffic signal improvements (e.g additional turning lanes) - $100,000-$300,000
- Significant traffic signal reconstruction - $300,000-$600,000
- New traffic signalised intersection (greenfield) - $500,000 – $1,500,000
- Road widening - $6,500 per metre

The works identified at Old Northern Road / Kenthurst Road are likely to be categorised as localised signal improvements, however the midblock section would be considered as road widening.

The significant upgrade of Old Northern Road / New Line Road would be classified as a new signalised intersection. However, this intersection is a significant upgrade and is expected to require traffic control during the course of construction and potential geometry realignment on approaches. This upgrade alone could cost approximately $5-10 million dollars. As Old Northern Road and New Line Road are both Classified Roads (owned by the NSW State Government), a funding commitment by RMS is required to achieve any upgrades.

9 Summary

Based on the information supplied by The Hills Shire Council, the road network within the study area is considered to be currently operating over capacity. This does not account for the continual growth of traffic as growth centres (e.g. North West Growth Centre) and other development areas begin to open up and operate, which will place further strain on the network. This is evident by the midblock summaries showing the majority of the single lane road segments carrying traffic volumes above the theoretical thresholds whilst intersections within the study area also operate below LoS “C”.

The assessment identifies road improvements mainly along Old Northern Road and New Line Road that would significantly improve the existing network performance. These improvements are suggested to cater for the current traffic demands, with additional works and improvements likely to be required for further growth.

If intersection capacity and midblock sections are not improved with increased road capacity, then traffic flow efficiency (travel times) will deteriorate further. This can lead to driver frustration and increased road safety risks.

Furthermore, public transport and active transport can also be influenced by traffic congestion, with bus service times and reliability likely to deteriorate whilst walking and cycling routes become less attractive as congestion increases. These transport modes should also be considered in future upgrades through provision of separated cycling and walking tracks and bus priority at intersections such as Old Northern Road / Kenthurst Road and Old Northern Road / New Line Road.

APPENDIX

C

POTABLE & WASTE WATER REPORT

Infrastructure Investigation - Potable & Waste Water

Dural

80218062

Prepared for
The Hills Shire Council

7 March 2019

Cardno®

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2	03/12/18	Final Draft	Steven Bessell	Rafal Piwonski
3	06/03/2019	Final Issue	Michael Buchta	Glenn Bigland

Glossary and Abbreviations

AHD	Australian Height Datum
CBD	Central Business District
IPAR	Independent Pricing and Regulatory Tribunal NSW
km	kilometre
L/s	litres per second
ML	megalitre
mm	millimetre
m/s	mitres per second
STP	Sewage Treatment Plan
SP	Sewage Pump
THSC	The Hills Shire Council
WSZ	Water Supply Zone
WSA03-2011	Water Supply Code of Australia

Table of Contents

Appendices

Tables

Figures

1 Introduction

The Hills Shire Council (THSC) is investigating opportunities for urban growth in the Dural locality. The Hills Shire Council has engaged Cardno to undertake a Phase 1 Urban Capability and Capacity Assessment, which has the following three key components –

a) Environmental Study Report

b) Infrastructure Capacity Investigation including Power, Water, Traffic and Gas.

c) Indicative Structure Plan.

The purpose of the overarching Urban Capability Assessment is to determine the suitability of land on the rural/ urban interface in the Dural locality to sustain urban land uses, including the environmental capability of land, potential yields and assessment of infrastructure capacity and funding options. The assessment takes a holistic approach to determining the capacity and capability of the area.

The area of investigation (outlined in Section 1.3) is mainly within Dural, on the northern fringe of the Sydney Metropolitan Area. It is located 50km from the Sydney CBD and 25km from Parramatta CBD. The area within and near the village of Round Corner Dural is the focus of investigations.

The suburb of Dural is located in both The Hills Shire Local Government Area (LGA) and Hornsby Shire LGA, with Old Northern Road forming the boundary between the two Council areas. Round Corner is a local town centre in the south-western part of Dural.

1.1 Purpose of the Report

The purpose of this Potable and Waste Water repot is to identify the existing potable water and sewer infrastructure capacity. This report is a subset of component (b) The Infrastructure Capacity investigation.

This report has been prepared for the benefit of the Hills Shire Council to highlight potential capacity constraints as identified by Cardno.

The analysis has been undertaken in two key phases:

- Identifying existing infrastructure using Sydney Water's Hydra asset database; and
- Consultation with Sydney Water's Growth Planning and Development group to identify system constraints and capacities to service future development.

This report also identifies the appropriate steps to progress consultation with Sydney Water to develop a service plan if future development is pursued.

1.2 Description of the Land

1.2.1 Land use and access

The detailed Investigation Area incorporates a mosaic of land uses including:

- Tracts of bushland generally following existing local creek lines;
- Large lot residential areas in semi-rural settings;
- Conventional low density residential areas;
- Medium density housing (largely in the form of Seniors Living developments) and townhouses in Round Corner / Dural; and
- One consolidated retail / commercial precinct (at Round Corner, Dural).

Vehicular access to the area is via regional roads including New Line Road, Old Northern Road, Annangrove Road and Glenhaven Road. Access within the investigation area is via a series of feeder roads and connector roads, many of which are relatively narrow and of a rural or semi-rural character.

1.2.2 Demographics

An overview of the demographics of the investigation area has been derived from a review of demographic data available on the Hills Shire Council website and the Australian Bureau of Statistics (ABS) 2016 Census

database. Investigations were carried out with the objective of identifying existing population densities, age range, levels of employment and income, land tenure and transport profiles. Comparisons were made using similar criteria against the adjacent Castle Hill area and overall statistics for the Sydney Metropolitan Area.

The key demographic characteristics of the investigation area are:

- **Development density** – the investigation area has developed at very low density in comparison to other local areas (3.41 dwellings/ha compared to 23.95 dwellings / ha in neighbouring Castle Hill).
- **Employment** – the area enjoys a low rate of unemployment (4.14% compared to 6% for the Sydney Metro Area) and employment types are similar to Castle Hill and the Sydney Metro area.
- **Weekly income** - Higher proportion of the population in the Investigation Area has an income of greater than $2,000 when compared to Greater Sydney.
- **Home ownership** - rates are comparatively high (35.29% of households either own their homes outright or with a mortgage, compared to 31.5% for the Sydney Metro).
- **Car ownership** – rates are very high: 37.87% of households own 3 or more cars and 2% of households do not own a car. This is compared to 14.9% of households in the Sydney Metro Area owning more than 3 cars and 10.7% not owning a car.
- **Trips to work** - are private vehicle dominated (69.1% of the population travel to work by car while 8.96% travel to work by public transport only. Sydney Metro statistics for car travel are also high – 56.6% travel to work by car but public transport is a much more represented mode across the Metro area - 20.6% travel to work by public transport. Others travel via a combination of private and public transport).

1.3 Investigation Area

1.3.1 Identification of the Investigation Area

The extent and location of the investigation areas for the assessment was determined by Cardno in consultation with THSC. Two areas were defined and mapped in **Figure 1-1**. These investigation areas are:

- High Level Investigation Area (red boundary)
- Detailed Investigation Area (black dotted boundary)

The Hills and Hornsby Shire Councils have received a number of unsolicited Planning Proposals to rezone land near Round Corner, Dural. The intent of this study is to provide The Hills Shire Council with an independent and fully considered assessment of the capability of the Dural locality, for future development.

On this basis, the Detailed Investigation Area has been identified to include Round Corner, the lands covered by current Planning Proposals in Dural and other nearby concentrations of development. It has been confined to land within The Hills Local Government Area.

In order to ensure an appropriate context for the study, a broader High Level Investigation Area has been identified which includes surrounding villages and suburban areas, as well as transport connections between these and the Detailed Investigation Area. The edges of the Investigation Areas have been defined by natural features such as local creek lines, edges of existing residential development and by Arterial Roads (and connecting roads between these).

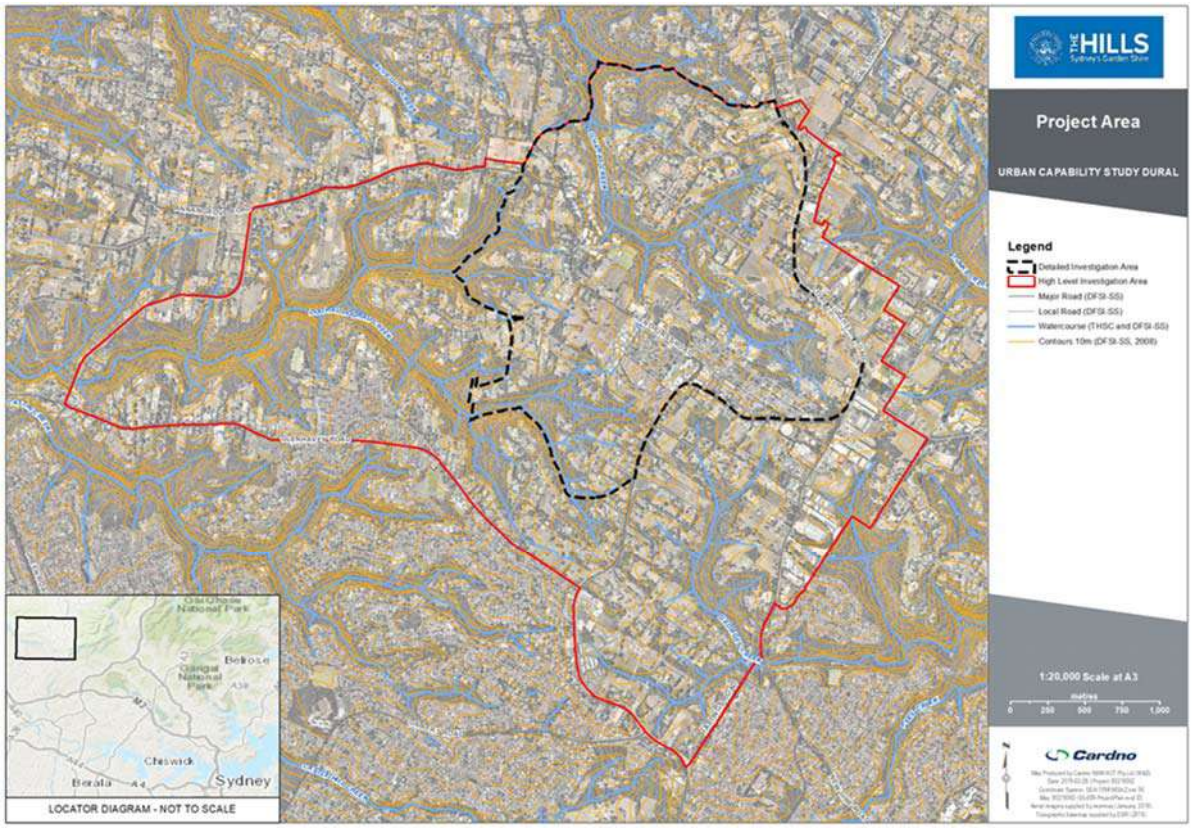

Figure 1-1 **Study Area**

1.3.2 High Level Investigation Area

The High Level Investigation Area encompasses the suburbs of Dural, Glenhaven, Castle Hill and Kenthurst (see **Figure 1-1**). The majority of the area is within The Hills Shire LGA with a portion along the east side being within the Hornsby Shire LGA. This area is bordered by Annangrove Road (regional road no.7141) and creek lines to the north, Bannerman Road to the west (a local connector road), Glenhaven Road to the south (a local connector road) and various local roads including Hastings Road to the east.

1.3.3 Detailed Investigation Area

The Detailed Investigation Area is comprised of the suburbs of Dural, Kenthurst and Glenhaven. The main shopping / residential area is Round Corner, situated on Old Northern Road. The Detailed Investigation Area mainly consists of large, rural lots along the main roads (i.e. Old Northern Road, Glenhaven Road, Kenthurst Road), with dense vegetation along the riparian corridors. Low density residential subdivision in the area is primarily focussed around the Round Corner, Dural centre.

The Detailed Investigation Area is the land that is the subject of this environmental and planning study. The High Level Investigation Area provides a wider contextual understanding of the locality and allows for potential opportunities for connections in the vicinity of the Detailed Investigation Area.

2 Existing Infrastructure

Sydney Water is the water authority that currently provides potable water and sewer services to the existing Dural community and wider investigation area.

2.1 Potable Water

The investigation area is currently within the South Dural water supply zone (WSZ), which is ultimately supplied from the Prospect water filtration plant. The zone is supplied by the South Dural reservoirs (WS0288, WS0112 and WS0158) which are located to the south east of the investigation area. Due to the proximity of the reservoirs, the existing higher density residential/commercial community of Dural is bisected by a number of bulk supply mains (>500 mm), branch supply mains (~250 mm) and local reticulation mains (150/100 mm).

The rural, larger lot properties in the west of the investigation are supplied by dual water mains that follow the Annangrove Road alignment from Dural to Annangrove, for approximately 9 km. These branch supply mains are sized as 375 mm mains in the east and are gradually downsized to 150 mm in the vicinity of Annangrove. Local reticulation mains (150 mm to 100 mm) connect to these mains, providing potable water to properties north and south of Annangrove Road.

Outside of the investigation area, the South Dural WSZ, and consequently the South Dural reservoirs are the primary water supply for the communities of Glenhaven, and parts of Castle Hill and Rogans Hill to the south. To the north of the investigation area, the South Dural reservoirs supply potable water to the community of Kenthurst and the surrounding rural properties.

A map of existing Sydney Water potable water network within the study area is included in Appendix A.

2.2 Waste Water

Currently there is minimal sewer infrastructure within the investigation area. The Dural township to the west of Old Northern Road, is the only area that is currently serviced by Sydney Water's sewer network. This sewer service consists of small diameter gravity sewer mains (150 mm to 225 mm) draining to a sewer pumping station (Sydney Water ID SP1111), which is located off Wirrabara Road. The flows are collected at the pumping station and pumped into the Castle Hill sewage treatment plant (STP) catchment via a 4 km, 250 mm pressure main.

The pressure main from SP1111 follows the north/south Old Northern Road alignment to the northern boundary of Glenhaven. At this point it follows the local road network of Fullers Road, Grange Road and Ferncliffe Road as the main travels west. The pressure main discharges into a 300 mm gravity sewer that crosses Ferncliffe Road in the vicinity of a small Cattai Creek tributary. Once discharged into the gravity network, the flows are drained to the Castle Hill STP, which is approximately 2.5 km downstream.

The majority of the investigation area is not serviced by Sydney Water sewer, with large rural lots expected to have private septic or pump out sewer arrangements.

The 180 mm pressure main from the Galston Glenorie pressure sewer networks is installed within New Line Road, to the east of the Dural Township. This 180 mm pressure main follows the New Line Road alignment and discharges into the West Hornsby STP sewer catchment, upstream of pumping station SP0641.

A map of existing Sydney Water waste water network within the study area is included in Appendix A.

2.3 Recycled Water

Sydney Water owns and operates a recycled water network from the Rouse Hill advanced water treatment plant that provides recycled water to the existing communities of Rouse Hill, Glenwood, Kellyville, Parklea, Quakers Hill and Castle Hill. In total this scheme currently services 32,000 properties, which is predicted to increase through the redevelopment of the Metro corridor.

The Rouse Hill recycled water catchment does not include the investigation area, and at present Sydney Water do not intend to expand the existing catchment boundaries. Thus, recycled water supply has not been included in this assessment.

3 Current Capacity

3.1 Sydney Water Consultation

Sydney Water's Growth Planning and Development group were engaged to discuss

- the existing network capacity,
- potential servicing opportunities and
- long-term strategy for the detailed investigation and high level investigation areas .

This engagement was done in the form of an introductory email and follow up face to face meeting on 19 April 2018.

The key outcomes of the meeting with Sydney Water were:

- Based on the high level development information available from Council, Sydney Water are not in a position to provide definitive answers on existing system capacities and the number of available connections.
- Sydney Water did advise that there is minimal existing capacity within the existing potable water network, and no spare capacity in the sewer network.
- The investigation area has not been identified by the Department of Planning and Environment as a future growth area, thus has not been included in the latest growth servicing plan (Sydney Water Growth Servicing Plan (2017 - 2022)). This means that Sydney Water have not allocated funds to do works in this area, under the existing funding period (2017-2022).
- Sydney Water have not undertaken any strategic planning for water and sewer service for the investigation area.
- Current Sydney Waters focus is on servicing the growth associated with the known Metro and North West Growth Corridors.
- Sydney Water have received feasibility applications for sewer and water connection from private developers in the investigation area. These small scale developments have all triggered the need for upgrades to the existing network.

3.2 Potable Water

Sydney Water were not able to provide information regarding spare capacity within the existing potable water network. This is due to the yield and timing of the proposed development not currently being known.

3.2.1 Water Mains

Based on the existing water mains, the Dural Township is the logical location for redevelopment without triggering significant investment in trunk water mains. The existing township has a number of large capacity mains (250 mm to 375 mm) that could service new development, via minor lead-in investment.

As the investigation area moves west, the mains are reduced in diameter to 150 mm and 200 mm. The combined capacity of these mains can service approximately 560 residential lots, based on the Sydney Water edition of the Water Supply Code of Australia (WSA03-2011). Thus, any development west of the junction of Kenthurst Road and Annangrove Road, would potentially require upsizing of the existing water network.

3.2.2 Reservoir Capacity

The key constraint for the water supply of the investigation area is believed to be the capacity of the South Dural water reservoirs (WS0288 and WS0158). At present the South Dural reservoirs have a storage capacity of 69 ML. This storage provide peak day potable water supply to the water supply zone, and to upstream reservoirs, which is equivalent to meeting Sydney Water's requirements to service 30,000 residential lots. Development above this, would require additional reservoir storage to be constructed at the existing reservoir site, or at a new site, with the size determined by the extent of the future development.

It should be noted that Sydney Water indicated that there is minimal reserve potable water storage available within the existing system and that any proposed development would be subject to hydraulic model assessment to determine the impact on the existing network performance.

3.3 Waste Water Constraints

3.3.1 Existing Sewer Lines

The existing sewer network is limited to the current Dural Township. The gravity sewer servicing the township is consistent with minimum diameter installation (150 mm to 225 mm), however these mains may have capacity to accommodate additional population densities and connection from small scale development of neighbouring residential lands. Based on Sydney Water standards a 150 mm sewer can have 170 upstream lots connected, while a 225 mm sewer can service 460 upstream lots. Remaining available capacity would need to be determined by Sydney Water after analysis development applications.

3.3.2 Sewer Pumping Stations/mains

The key constraint is the capacity of the sewer pumping station (SP1111) and 250 mm rising main that services the entire Dural Township. The pumping station has a capacity of 68 L/s, which is equivalent to servicing approximately 1,850 Lots. At this pump capacity the rising main has a calculated velocity of 1.4 m/s, which is within the preferred velocity range (1 to 1.5 m/s) for pressure mains. Based on Sydney Water standards, 2.5 m/s is the maximum velocity in a pressure main, which equates to a flow of 120 L/s, or approximately 3,000 residential lots. Thus, there is a potential that SP1111 could be upgraded to accommodate additional flows without triggering rising main upgrades. Considering the existing rising main is 4 km in length, upgrading the pumps to achieve 120 L/s would significantly increase the differential head (pressure within the main) that the pump is discharging against. This would result in a significantly larger pumping and power requirement, which may also trigger upgrades to the civil structures (wet well) and electrical components to accommodate the larger pumps at the pumping station.

3.3.3 Gravity Sewer Mains

The gravity sewer network downstream of the rising main discharge is a 300 mm gravity sewer. The maximum allowable upstream connections to a 300 mm sewer is approximately 1,000 residential lots. Based on the existing upstream population, this 300 mm gravity sewer currently exceeds the maximum upstream allowable connections. Any upgrades to the pumping capacity at SP1111, may trigger upgrades of 900 m of the existing 300 mm sewer to accommodate the additional flow.

3.3.4 Sewerage Treatment

The treatment capacity of the Castle Hill STP and Rouse Hill STP are currently under investigation within Sydney Water. This investigation is driven by the growth within existing catchment areas, which is predominately driven by the Metro Corridor, to ensure Sydney Water continues to meet its licence requirements.

Growth within this investigation area has the potential to expedite upgrade works at Castle Hill STP, and influence the economic viability of augmentation strategies. It is recommended that Council communicate the potential yields and development timing, in the form of a development plan, to Sydney Water as soon as practical. This would ensure that proposed growth would be incorporated into the upgrade strategies for local and regional treatment facilities.

The works currently been undertaken at Castle Hill and Rouse Hill STPs, we can assume that there is treatment capacity to accommodate growth in the investigation area. The extent and timing of this growth would need to be discussed with Sydney Water, and incorporated into their upgrade strategies for regional wastewater treatment.

The 180 mm pressure main from Galston and Glenorie is currently at capacity, with no potential for additional connection from Dural.

3.3.5 Potential Development

As per the potable water network, Sydney Water did not provide direct advice on the available capacity of the sewer network or a list of current constraints, as planning works have not been undertaken in this area. The above information has been put together based on network configuration review and industry experience. Sydney Water would seek to determine capacity constraints through strategic planning exercises, utilising hydraulic models of the network and treatment facilities.

Sydney Water did indicate that there are a number of private developers seeking connection into the existing sewer network at Dural. In addition to traditional lead in infrastructure, developers are also required to contribute to the upgrading of the downstream sewer infrastructure if they wish to connect. Based on this,

Sydney Water have advised that there is no spare capacity within the existing sewer network (pipes and pumps).

There is a potential to development in the vicinity of the existing Dural Township could apply to Sydney Water for wastewater servicing under the minor service extension policy. This policy requires a lot owner, or collection of lot owners, to submit an application to Sydney Water (including relevant fees) who will provide an estimated cost for providing a system extension. The costs associated with the extension is 100% funded by the private lot owners, with Sydney Water determining the distribution of minor extension service charges based on a methodology set by IPART.

If the lot owner, or 50% of the collection of lot owners agree to the minor extension charges, Sydney Water will deliver the required infrastructure to the boundary connection. It is the responsibility of the lot owner to engage and pay a licensed plumber to connect to the lay private service lines.

It should be noted that Sydney Water would only consider building minor service extensions if there is no impact on the performance of water or wastewater services for their existing customers. Considering the incapacity of the downstream sewer pumping station (SP1111), costs associated with upgrading works (new pumping station, rising main, gravity network) would incorporated into the minor extension charges.

4 Summary

Sydney Water have identified that the existing potable water reservoir storage and sewer networks that service the investigation area, do not have sufficient reserve capacity to service future, and that any development within this area would trigger trunk network upgrades. This has been shown with small scale development applications triggering upgrades within the Sydney Water trunk networks.

The investigation to date has identified that initial development fronts would be around the densification of the existing township and new green field development of the fringes of the existing Dural community, identified as the detailed study area. Considering the constraints on the existing water and sewer networks, any development would trigger upfront investment in water and sewer infrastructure capacity upgrades.

4.1 Potable Water

The water distribution pipe network in the vicinity of the Dural investigation area as described in **Section 2.1**, is predicted to have the capacity to support a denser population in the existing township, as well as expansion of the township margin. This expansion would be along the existing road corridors of Kenthurst Road and Old Northern Road, where the existing 200 to 450 mm water mains would have the capacity to provide sufficient potable water. Determination of the actual capacity available would require detailed assessment by Sydney Water.

The available storage at the South Dural Reservoir was identified as the key constraint to growth within this area, as Sydney Water indicated that this reservoir was at capacity. Additional demand would lower the level of performance, and/or the volume of emergency storage to an unsatisfactory level, placing Sydney Water at an unacceptable level of risk.

To mitigate risk, Sydney Water would require an additional Reservoir to be constructed. Based on Nearmap aerial photography, there is not sufficient space on the existing reservoir site to accommodate an additional reservoir. Acquisition of a surrounding lot, or equally suitable lot (elevation of ~215 m AHD) would potentially be required to construct the new reservoir.

Without considering the costs associated with land acquisition, generally a 1 ML reservoir provides sufficient potable water for approximately 2,000 dwellings. The cost of these structures, including design is approximately $4.0 million for a surface steel structure, or $6.5 million for an elevated structure.

In addition to the additional reservoir, the trunk and distribution network would need to be connected to the new reservoir. A general cost for water main installation would be $750/m. If the new reservoir is located at the existing reservoir location, the capital investment in new pipe would be minimal.

Based on the above, and assuming the pipe network supply to the existing South Dural Reservoir has sufficient capacity, an investment of approximately $4 million into water infrastructure would be needed to provide potable water to an additional 2,000 dwellings within the Dural Township.

4.2 Waste Water

The sewer network servicing the detailed investigation area, is constrained by the capacity of the existing sewer pumping station and it associated rising main, which is at capacity based on information provided by Sydney Water.

An increase in the sewer load through densification of the existing development area, or development expansion, could generate flow contributions that exceed the capacity of the pumps during wet and dry conditions. This increases the risk of Sydney Water not satisfying their license agreement, as well as generating environment and public health risk. This is not considered acceptable to Sydney Water and augmentation would be needed.

The existing 250 mm rising main that discharged flows from SP1111, has a discharge capacity of 60 L/s. At these flows, a differential head of approximately 90 m is predicted. This is at the maximum limit for standard submersible pumping units. Thus, further upgrade in pumping capacity would require non-standardised pump configurations (via pumps in series or a booster configuration) to allow for the flows to be increased.

These options are costly in terms of capital expenditure, as off the shelf products are not readily available for construction and maintenance, but would also require specialist training for Sydney Water's operations staff. It would be suspected that Sydney Water would not agree to this upgrade.

To service further development in the detailed investigation area, a new rising main from SP1111 to the Castle Hill STP gravity network would be required in addition to a new pumping station. It should also be noted that any upgrades of this delivery system would potentially require the receiving gravity sewer to be upgraded also. A summary of potential upfront costs:

- New 4 km rising main along the existing alignment (Old Northern Road)- $6.5 million
- New pumping station - $4.0 million
- Gravity Sewer Upgrade – $2.5 million

It is estimated that an initial investment of $13 M would be required to allow for an additional 3,000 of lots through the densification of the existing Dural Township, or via greenfield growth within the detailed study area. This is an estimate, and does not include works that maybe required that the Castle Hill STP.

4.3 Investment Summary

It is estimated that to provide potable water and sewer service to the detailed investigation area, an investment of approximately $20 million would be required to facilitate the initial growth in this area.

This initial investment assumes that no augmentation works would be required at; Prospect Water Treatment Plant, to the water delivery network to the South Dural Reservoir, or to the Castle Hill STP. If any of these items are triggered for upgrades, this initial investment would be increased significantly.

In addition to this, the costs associated with connecting individual development to the water or sewer networks have not been included. This would add additional servicing costs onto developers.

It should be noted that these costs assume a development yield of 2,000 to 3,000 additional dwellings, and is contained within the detailed investigation area. It is also based on network interpretation and knowledge. Any development within this area will need to be modelled within Sydney Water's water and sewer software models as part of Sydney Water's planning gateway process. This process would allow Sydney Water to develop the optimised augmentation strategy for both water and sewer servicing that meets the needs of their operational license, and consequently to develop the appropriate developer contribution/commercial agreement.

5 Next Step

This report outlines the existing base case potable water and sewer capacity, based on consultation with Sydney Water. To progress this further, Sydney Water require the following from Council:

- A development plan, including development staging, yields and land-use type. This should then be discussed with Sydney Water's Growth and Planning Group to ensure the projected growth is incorporated into the existing strategic plans/upgrade works for critical catchment assets, such as Castle Hill STP.
- Lodge the intention to develop with the Department of Planning and Environment to trigger Sydney Water to initiate investigation.

Sydney Water are eager to work with Council for the redevelopment of this area, with the first step being a strategic plan to provide water and sewer services to the proposed development area, once the yield and timing is understood. However, it should be noted that as Sydney Water's current pricing path is set (Growth Servicing Plan) Sydney Water are not in a position to fund investigative works until post 2022, if it is included in the next growth plan. Council can fund these works, which would be technically supported by Sydney Water, if Council wishes to undertake planning works prior to this date.

6 Conclusion

Consultation with Sydney Water identified that the existing capacity of the potable water reservoirs and sewage pumping stations, within the detailed investigation area, do not have sufficient spare capacity to accommodate redevelopment/development within the investigation area.

This is primarily due to the area being located on the fringes of Sydney Water's networks, which have been sized to service low density rural communities.

The redevelopment of this area would require installation of trunk water and sewer networks, including new water reservoir/s, sewer pump stations and potentially a new treatment plant or upgrade to an existing plant.

Due to the lack of existing infrastructure capacity, a large volume of up front capital investment would be required to service the interim development yields. Servicing this interim development is considered critical, and should be a key focus of any strategic plan for the region.

APPENDIX

A

Existing SWC Assets

Cardno

Capability and Capacity - Sewer Network

URBAN CAPABILITY STUDY DURAL

Legend

- Sewer Pumping Station (Sydney Water)
- Detailed Investigation Area
- High Level Investigation Area
- Cadastre (DFSI-SS, 2017)

Sewer Mains Network (Hydra, 2018)

- < 300 mm
- 300 - 500mm
- 500 - 750 mm
- > 750 mm
- Pressure Main < 375 mm

1:20,000 Scale at A3

m
0 250 500 750 1,000

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-11-30 | Project: 80218062
Coordinate System: GDA 1994 MGA Zone 56
Map: 80218062-GS-035-HydraNetwork_Sewer.mxd 01
Aerial imagery supplied by nearmap (November, 2018)

Capability and Capacity - Water Network

URBAN CAPABILITY STUDY DURAL

Legend

- Water Reservoir (Sydney Water)
- Detailed Investigation Area
- High Level Investigation Area
- Cadastre (DFSI-SS, 2017)

Water Mains Network (Hydra, 2018)

- < 300 mm
- 300 - 500 mm
- 500 - 750 mm
- > 750 mm

1:20,000 Scale at A3

m
0 250 500 750 1,000

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-11-30 | Project: 80218062
Coordinate System: GDA 1994 MGA Zone 56
Map: 80218062-GS-013-HydraNetwork_Water.mxd 02
Aerial imagery supplied by nearmap (November, 2018)

APPENDIX

D

GAS SERVICE REPORT

Infrastructure Investigation – Gas Service

Dural

80218062

Prepared for

The Hills Shire Council

7 March 2019

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1		Draft for review	Ashwin Prakash	
2	21/11/2018	Final Review	Rafal Piwonski	Rafal Piwonski
3	06/03/2019	Final	Michael Buchta	Glenn Bigland

Glossary and Abbreviations

CBD	Central Business District
kPa	Kilopascals
LGA	Local Government Area
MJ/hr	Mega joules per Hour
THSC	The Hills Shire Council

Table of Contents

Tables

Figures

1 Introduction

The Hills Shire Council (THSC) is investigating opportunities for urban growth in the Dural locality. The Hills Shire Council has engaged Cardno to undertake a Phase 1 Urban Capability and Capacity Assessment, which has the following three key components –

a) Environmental Study Report

b) Infrastructure Capacity Investigation including Power, Water, Traffic and Gas.

c) Indicative Structure Plan.

The purpose of the overarching Urban Capability Assessment is to determine the suitability of land on the rural/ urban interface in the Dural locality to sustain urban land uses, including the environmental capability of land, potential yields and assessment of infrastructure capacity and funding options. The assessment takes a holistic approach to determining the capacity and capability of the area.

The area of investigation (outlined in Section 1.3) is mainly within Dural, on the northern fringe of the Sydney Metropolitan Area. It is located 50km from the Sydney CBD and 25km from Parramatta CBD. The area within and near the village of Round Corner Dural is the focus of investigations.

The suburb of Dural is located in both The Hills Shire Local Government Area (LGA) and Hornsby Shire LGA, with Old Northern Road forming the boundary between the two Council areas. Round Corner is a local town centre in the south-western part of Dural.

1.1 Purpose of the Report

The purpose of this report is to identify the existing gas supply network capacity in and around the study area and to determine it's ability to accommodate further development.

The Gas Capacity Report provides high-level network information to support decision-making about whether there is merit in pursuing an urban land release pathway. This report documents the existing infrastructure study that has been undertaken to inform and support decision-making about the capability of land in the Dural locality.

The research approach adopted for this report included:

- A review of existing infrastructure; and
- Consultation with gas asset owner;

1.2 Description of the Land

1.2.1 Land use and access

The detailed Investigation Area incorporates a mosaic of land uses including:

- Tracts of bushland generally following existing local creek lines;
- Large lot residential areas in semi-rural settings;
- Conventional low density residential areas;
- Medium density housing (largely in the form of Seniors Living developments) and townhouses in Round Corner / Dural; and
- One consolidated retail / commercial precinct (at Round Corner, Dural).

Vehicular access to the area is via regional roads including New Line Road, Old Northern Road, Annangrove Road and Glenhaven Road. Access within the investigation area is via a series of feeder roads and connector roads, many of which are relatively narrow and of a rural or semi-rural character.

1.2.2 Demographics

An overview of the demographics of the investigation area has been derived from a review of demographic data available on the Hills Shire Council website and the Australian Bureau of Statistics (ABS) 2016 Census database. Investigations were carried out with the objective of identifying existing population densities, age

range, levels of employment and income, land tenure and transport profiles. Comparisons were made using similar criteria against the adjacent Castle Hill area and overall statistics for the Sydney Metropolitan Area.

The key demographic characteristics of the investigation area are:

- **Development density** – the investigation area has developed at very low density in comparison to other local areas (3.41 dwellings/ha compared to 23.95 dwellings / ha in neighbouring Castle Hill).
- **Employment** – the area enjoys a low rate of unemployment (4.14% compared to 6% for the Sydney Metro Area) and employment types are similar to Castle Hill and the Sydney Metro area.
- **Weekly income** - Higher proportion of the population in the Investigation Area has an income of greater than $2,000 when compared to Greater Sydney.
- **Home ownership** - rates are comparatively high (35.29% of households either own their homes outright or with a mortgage, compared to 31.5% for the Sydney Metro).
- **Car ownership** – rates are very high: 37.87% of households own 3 or more cars and 2% of households do not own a car. This is compared to 14.9% of households in the Sydney Metro Area owning more than 3 cars and 10.7% not owning a car.
- **Trips to work** - are private vehicle dominated (69.1% of the population travel to work by car while 8.96% travel to work by public transport only. Sydney Metro statistics for car travel are also high – 56.6% travel to work by car but public transport is a much more represented mode across the Metro area - 20.6% travel to work by public transport. Others travel via a combination of private and public transport).

1.3 Investigation Area

1.3.1 Identification of the Investigation Area

The extent and location of the investigation areas for the assessment was determined by Cardno in consultation with THSC. Two areas were defined and mapped in **Figure 1-1.** These investigation areas are:

- High Level Investigation Area (red boundary)
- Detailed Investigation Area (black dotted boundary)

The Hills and Hornsby Shire Councils have received a number of unsolicited Planning Proposals to rezone land near Round Corner, Dural. The intent of this study is to provide The Hills Shire Council with an independent and fully considered assessment of the capability of the Dural locality, for future development.

On this basis, the Detailed Investigation Area has been identified to include Round Corner, the lands covered by current Planning Proposals in Dural and other nearby concentrations of development. It has been confined to land within The Hills Local Government Area.

In order to ensure an appropriate context for the study, a broader High Level Investigation Area has been identified which includes surrounding villages and suburban areas, as well as transport connections between these and the Detailed Investigation Area. The edges of the Investigation Areas have been defined by natural features such as local creek lines, edges of existing residential development and by Arterial Roads (and connecting roads between these).

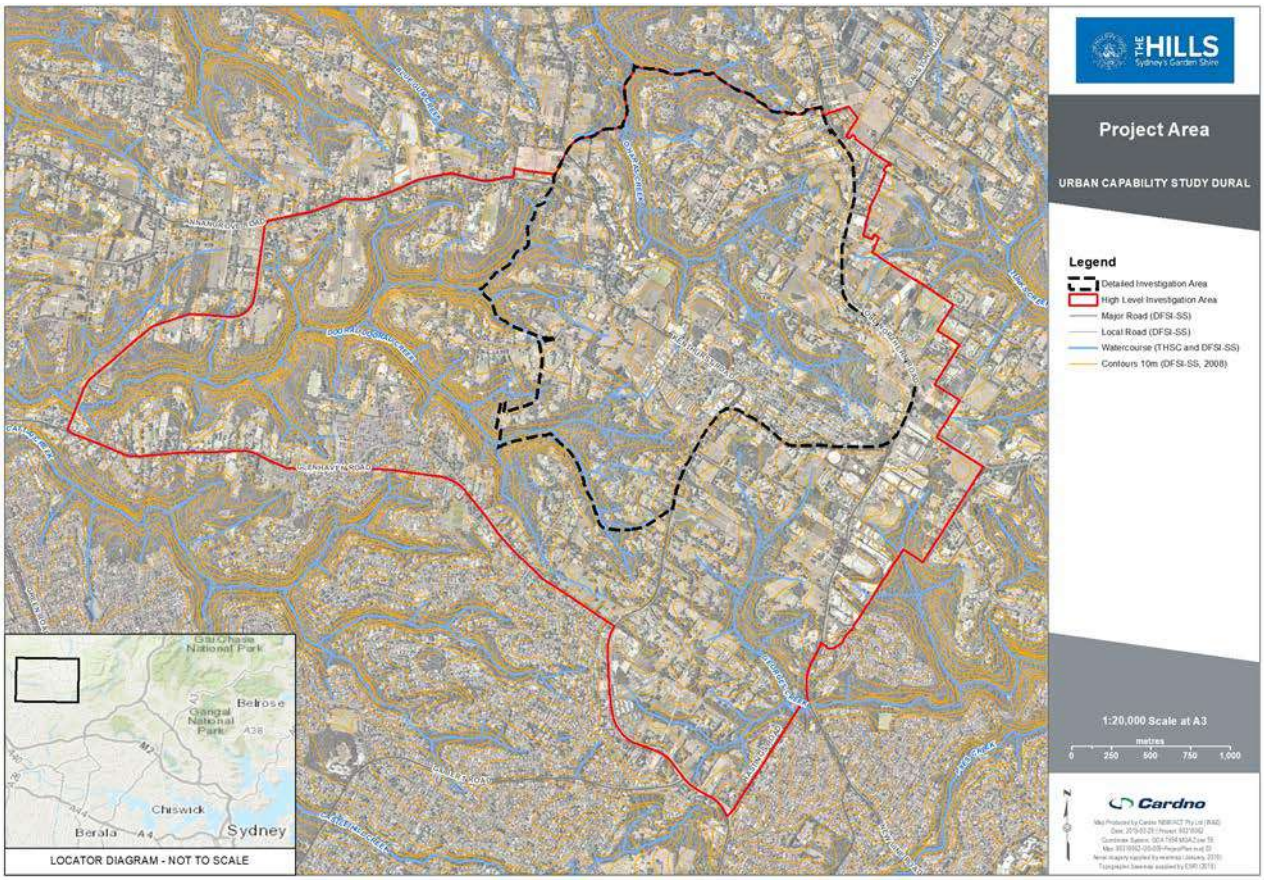

Figure 1-1 Study Area

1.3.2 High Level Investigation Area

The High Level Investigation Area encompasses the suburbs of Dural, Glenhaven, Castle Hill and Kenthurst (see **Figure 1-1**). The majority of the area is within The Hills Shire LGA with a portion along the east side being within the Hornsby Shire LGA. This area is bordered by Annangrove Road (regional road no.7141) and creek lines to the north, Bannerman Road to the west (a local connector road), Glenhaven Road to the south (a local connector road) and various local roads including Hastings Road to the east.

1.3.3 Detailed Investigation Area

The Detailed Investigation Area is comprised of the suburbs of Dural, Kenthurst and Glenhaven. The main shopping / residential area is Round Corner, situated on Old Northern Road. The Detailed Investigation Area mainly consists of large, rural lots along the main roads (i.e. Old Northern Road, Glenhaven Road, Kenthurst Road), with dense vegetation along the riparian corridors. Low density residential subdivision in the area is primarily focussed around the Round Corner, Dural centre.

The Detailed Investigation Area is the land that is the subject of this environmental and planning study. The High Level Investigation Area provides a wider contextual understanding of the locality and allows for potential opportunities for connections in the vicinity of the Detailed Investigation Area.

2 Existing Network

There are existing gas supplying pipelines running to the investigation area. According to the gas network information from Jemena, a 210kPa gas network main is available at Old Northern Road, Glenhaven Road and part of the Kenthurst Road (**Figure 2-1**). The gas network will be further extended to meet future demands as required.

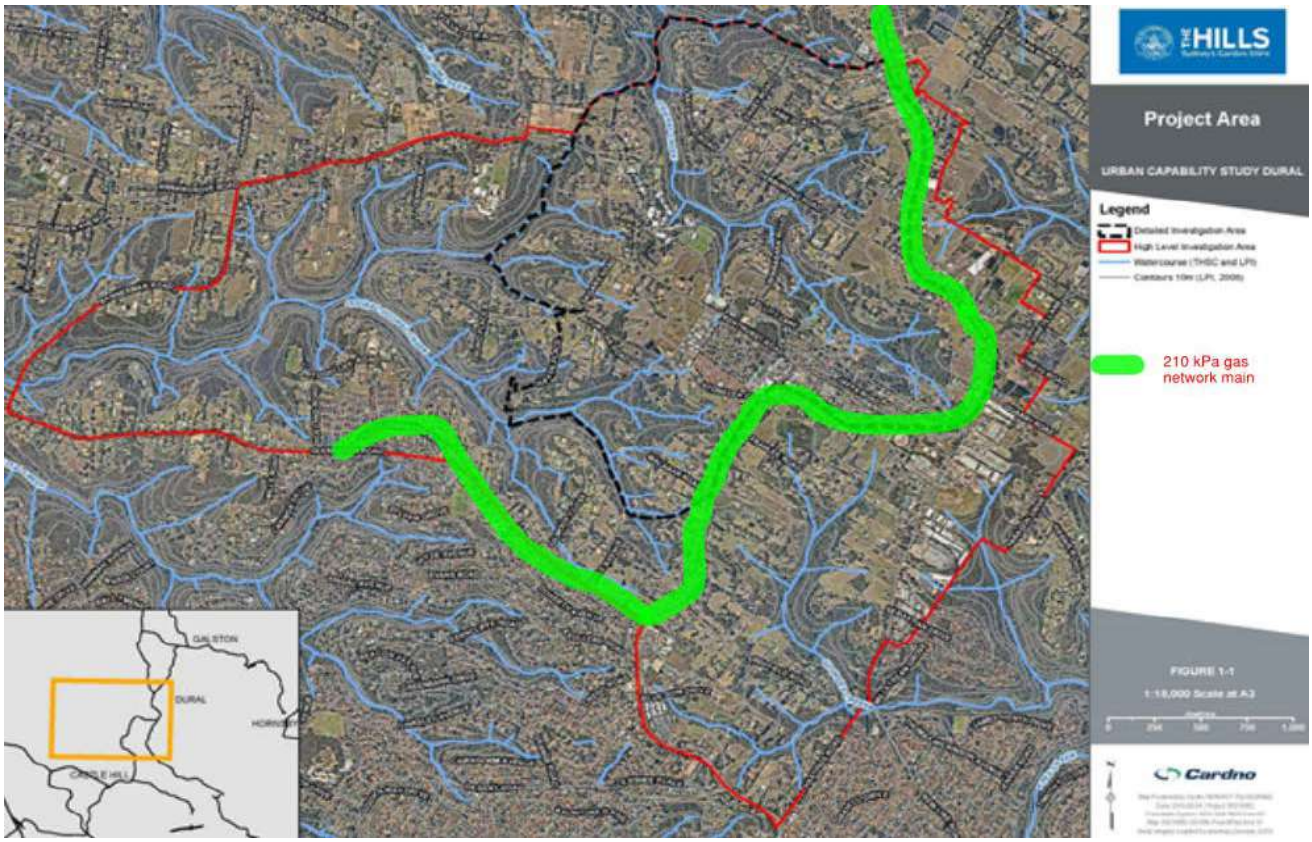

Figure 2-1 Gas main (210 kPa)

3 Proposed Development Demand

The estimated gas consumption for the proposed development has been calculated. The proposed size and number of dwellings have not been determined at the time of this assessment. The following has been assumed to estimate the gas demand:

1. 2000 lots; 3 bedrooms and 3 bathrooms each; and
2. 2000 units; 3 bedrooms and 2 bathrooms each.

Table 3-1 below details the gas usage rates assumed for the demand estimate.

Table 3-1 Appliances gas consumption assumption

Appliance	Gas consumption (MJ/h)
Gas heater (for 1-2 bathrooms)	160
Gas heater (for 3 bathrooms)	200
Gas cooktop	30
Gas flued heater	30
Bayonet outside (Barbecue on balcony)	50

The daily peak development demand has been calculated based on the rates in **Table 3-1** above and the daily consumption routine assumed below:

1. Peak cooking will occur between 11:00 to 13:00 and 18:00 to 20:00 for lunch and dinner respectively;
2. Peak water heating will occur between 20:00 to 22:00 for showers; and
3. Heating will occur between 18:00 to 8:00 during the winter months.

Figure 3-1 below displays the estimated daily gas consumption hour by hour in a winter season scenario. The peak gas demand for the proposed development is estimated at 720,000 MJ/h.

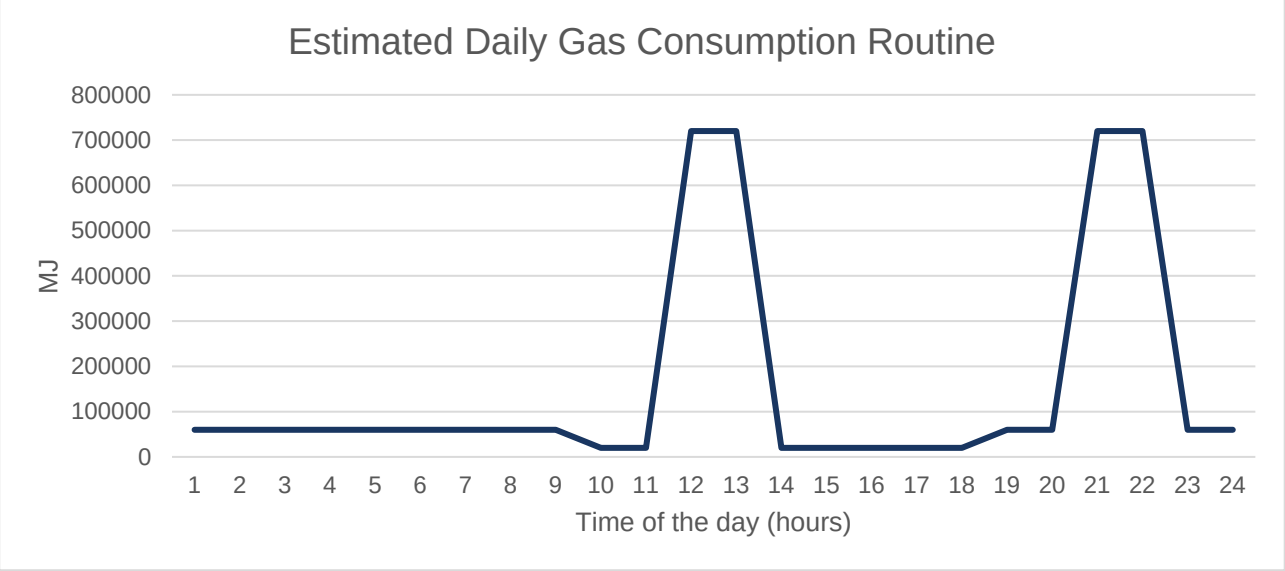

Figure 3-1 Estimated daily gas consumption routine

3.2 Jemena Consultation

Cardno consulted Jemena on their network and development procedures in order to establish whether a gas network is likely to be developed for the purpose of the proposed development. The following points have been conveyed by Jemena:

1. Natural Gas is available in the vicinity of the study area and could be extended to supply the proposed development;
2. The Jemena policy is to extend gas mains to all developments wherever possible, depending upon economic viability;
3. In consideration of Jemena's shareholders' interests and under NSW regulation, Jemena Gas Networks (NSW) Ltd is required to ensure that any extension of the natural gas distribution system is commercially viable and therefore must assess each request for supply on an individual basis;
4. Upon the provision of the final approved layout and gas load configurations for the development a full economic evaluation can be undertaken to determine the availability of natural gas to the area;
5. Should the development not prove to be viable for Jemena, a contribution fee may be required to be paid by the developer to assist in economic viability of the proposal;
6. To assist in the planning of supply to this area:
    a. Jemena confirms that suitable gas mains are located within the vicinity of the study area and that these mains have adequate capacity to service this proposal at this time;
    b. To enable a thorough economic evaluation, Jemena will require an accurate breakdown of the dwellings and any commercial loads proposed for the area once all approvals and zonings are in place;
    c. In order to enhance the viability of gas supply to the region, developers should allow for the provision of all trenching required throughout their sites at no cost to Jemena;

To allow a full supply assessment to be undertaken, Jemena will require planning approval advice and all relevant drawings as soon as they are available.

4 Conclusion

The investigation determined that Jemena currently has a gas network in the vicinity of the investigation area.

Jemena will cooperate with the developers to improve the network as required, as long as the development is commercially viable.

Should the development not be deemed viable for Jemena, the developer may be required to provide contribution fees to ensure the provision of gas services.

Jemena would determine these contribution fees on a case-by-case basis and was not in a position to provide further advice at this time.

APPENDIX

E

ELECTRICAL REPORT

Infrastructure Investigation - Electrical

Dural Town Centre

80218062

Prepared for

The Hills Shire Council

13 March 2019

Contact Information

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Version	Effective Date	Description of Revision	Prepared by	Reviewed by
1	29/10/2018	Initial Release	James Howard	Rafal Piwonski
2	06/03/2019	Final	Vida Rahgoui	Glenn Bigland

Glossary and Abbreviations

ABS	Australian Bureau of Statistics
AEMO	Australian Energy Market Operator
BSP	Bulk Supply Point
C	Cable
CB	Circuit Breaker
CBD	Central Business District
D	Duct
ESOO	Electrical Statement of Opportunities
EX	Existing
FDR	First Tier, Downstream and Related Entities
LGA	Local Government Area
MVA	Mega Volt Amp
PC	Pull Cable
STJ	Straight Through Joint
T&R	Trenching and Reticulation
THSC	The Hills Shire Council
VAPR	Victorian Annual Planning Report
ZS	Zone Substation

Table of Contents

Appendices

Tables

Figures

1 Introduction

The Hills Shire Council (THSC) is investigating opportunities for urban growth in the Dural locality. The Hills Shire Council has engaged Cardno to undertake a Phase 1 Urban Capability and Capacity Assessment, which has the following three key components –

a) Environmental Study Report

b) Infrastructure Capacity Investigation including Power, Water, Traffic and Gas.

c) Indicative Structure Plan.

The purpose of the overarching Urban Capability Assessment is to determine the suitability of land on the rural/ urban interface in the Dural locality to sustain urban land uses, including the environmental capability of land, potential yields and assessment of infrastructure capacity and funding options. The assessment takes a holistic approach to determining the capacity and capability of the area.

The area of investigation (outlined in Section 1.3) is mainly within Dural, on the northern fringe of the Sydney Metropolitan Area. It is located 50km from the Sydney CBD and 25km from Parramatta CBD. The area within and near the village of Round Corner Dural is the focus of investigations.

The suburb of Dural is located in both The Hills Shire Local Government Area (LGA) and Hornsby Shire LGA, with Old Northern Road forming the boundary between the two Council areas. Round Corner is a local town centre in the south-western part of Dural.

1.1 Purpose of the Report

The purpose of this report is to identify the existing electrical network capacity in and around the study area and to determine it's ability to accommodate further development.

The Electrical Capacity Report provides high level network information to support decision-making about whether there is merit in pursuing an urban land release pathway. This report documents the existing infrastructure study that has been undertaken to inform and support decision-making about the capability of land in the Dural locality.

The research approach adopted for this report included:

- A review of existing infrastructure; and
- Consultation with electrical asset owner;
- The identification of legislative requirements.

1.2 Description of the Land

1.2.1 Land use and access

The detailed Investigation Area incorporates a mosaic of land uses including:

> Tracts of bushland generally following existing local creek lines;

> Large lot residential areas in semi-rural settings;

> Conventional low density residential areas;

> Medium density housing (largely in the form of Seniors Living developments) and townhouses in Round Corner / Dural; and

> One consolidated retail / commercial precinct (at Round Corner, Dural).

Vehicular access to the area is via regional roads including New Line Road, Old Northern Road, Annangrove Road and Glenhaven Road. Access within the investigation area is via a series of feeder roads and connector roads, many of which are relatively narrow and of a rural or semi-rural character.

1.2.2 Demographics

An overview of the demographics of the investigation area has been derived from a review of demographic data available on the Hills Shire Council website and the Australian Bureau of Statistics (ABS) 2016 Census

database. Investigations were carried out with the objective of identifying existing population densities, age range, levels of employment and income, land tenure and transport profiles. Comparisons were made using similar criteria against the adjacent Castle Hill area and overall statistics for the Sydney Metropolitan Area.

The key demographic characteristics of the investigation area are:

- **Development density** – the investigation area has developed at very low density in comparison to other local areas (3.41 dwellings/ha compared to 23.95 dwellings / ha in neighbouring Castle Hill).
- **Employment** – the area enjoys a low rate of unemployment (4.14% compared to 6% for the Sydney Metro Area) and employment types are similar to Castle Hill and the Sydney Metro area.
- **Weekly income** - Higher proportion of the population in the Investigation Area has an income of greater than $2,000 when compared to Greater Sydney.
- **Home ownership** - rates are comparatively high (35.29% of households either own their homes outright or with a mortgage, compared to 31.5% for the Sydney Metro).
- **Car ownership** – rates are very high: 37.87% of households own 3 or more cars and 2% of households do not own a car. This is compared to 14.9% of households in the Sydney Metro Area owning more than 3 cars and 10.7% not owning a car.
- **Trips to work** - are private vehicle dominated (69.1% of the population travel to work by car while 8.96% travel to work by public transport only. Sydney Metro statistics for car travel are also high – 56.6% travel to work by car but public transport is a much more represented mode across the Metro area - 20.6% travel to work by public transport. Others travel via a combination of private and public transport).

1.3 Investigation Area

1.3.1 Identification of the Investigation Area

The extent and location of the investigation areas for the assessment was determined by Cardno in consultation with THSC. Two areas were defined and mapped in **Figure 1-1**. These investigation areas are:

- High Level Investigation Area (red boundary)
- Detailed Investigation Area (black dotted boundary)

The Hills and Hornsby Shire Councils have received a number of unsolicited Planning Proposals to rezone land near Round Corner, Dural. The intent of this study is to provide The Hills Shire Council with an independent and fully considered assessment of the capability of the Dural locality, for future development.

On this basis, the Detailed Investigation Area has been identified to include Round Corner, the lands covered by current Planning Proposals in Dural and other nearby concentrations of development. It has been confined to land within The Hills Local Government Area.

In order to ensure an appropriate context for the study, a broader High Level Investigation Area has been identified which includes surrounding villages and suburban areas, as well as transport connections between these and the Detailed Investigation Area. The edges of the Investigation Areas have been defined by natural features such as local creek lines, edges of existing residential development and by Arterial Roads (and connecting roads between these).

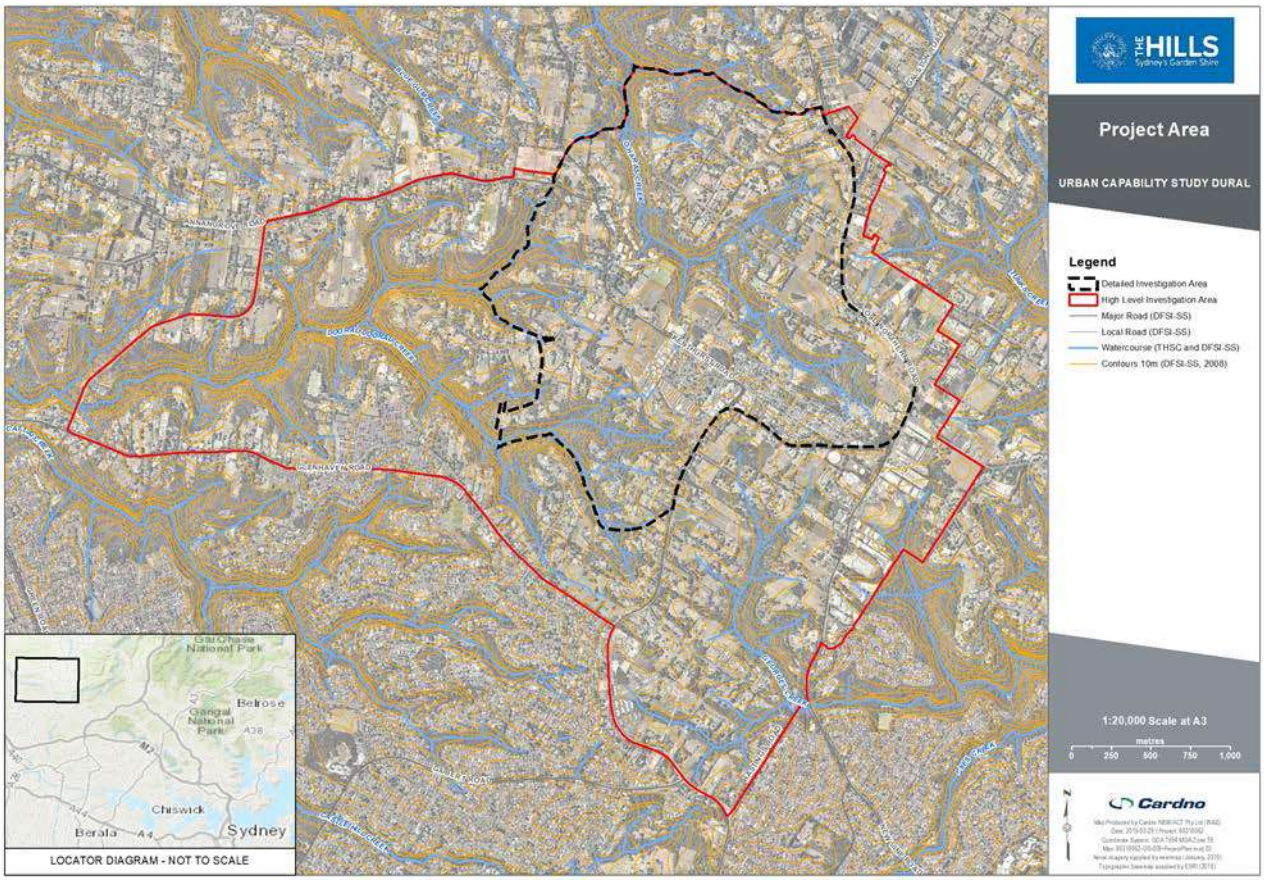


Figure 1-1 Study Area

1.3.2 High Level Investigation Area

The High Level Investigation Area encompasses the suburbs of Dural, Glenhaven, Castle Hill and Kenthurst (see **Figure 1**). The majority of the area is within The Hills Shire LGA with a portion along the east side being within the Hornsby Shire LGA. This area is bordered by Annangrove Road (regional road no.7141) and creek lines to the north, Bannerman Road to the west (a local connector road), Glenhaven Road to the south (a local connector road) and various local roads including Hastings Road to the east.

1.3.3 Detailed Investigation Area

The Detailed Investigation Area is comprised of the suburbs of Dural, Kenthurst and Glenhaven. The main shopping / residential area is Round Corner, situated on Old Northern Road. The Detailed Investigation Area mainly consists of large, rural lots along the main roads (i.e. Old Northern Road, Glenhaven Road, Kenthurst Road), with dense vegetation along the riparian corridors. Low density residential subdivision in the area is primarily focussed around the Round Corner, Dural centre.

The Detailed Investigation Area is the land that is the subject of this environmental and planning study. The High Level Investigation Area provides a wider contextual understanding of the locality and allows for potential opportunities for connections in the vicinity of the Detailed Investigation Area.

2 Existing Network

The investigation areas are located at the boundary of the Ausgrid and Endeavour Energy network areas, with the majority of customers being supplied from Endeavour Energy.

The study area is located on the boundary of the Endeavour Energy and Ausgrid network load areas. The boundary between the two organisations follows the local government boundaries, however in reality the physical electrical assets may cross the boundaries to meet individual customer needs or as local government boundaries have changed over time.

2.1 Transmission Network

Figure 2 shows the electrical transmission network in the area. TransGrid have a 330/132kV Bulk Supply Substation located near Galston providing power to both the Ausgrid and Endeavour Energy Networks. The 132kV transmission feeders pass the subject area to the North and East.

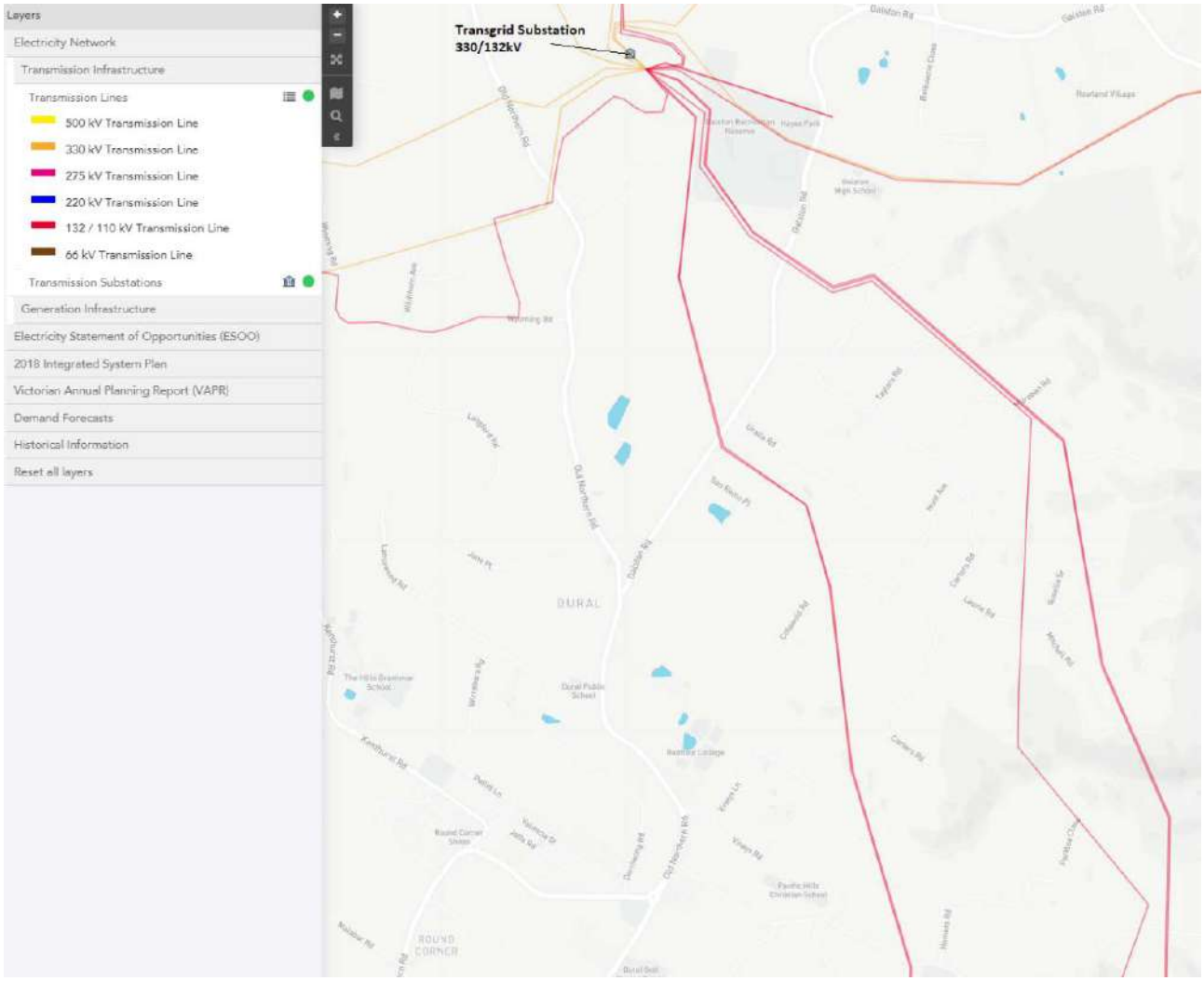


Figure 2: Electrical transmission network

(Source: Australian Energy Market Operator (AEMO) http://www.aemo.com.au/aemo/apps/visualisations/map.html)

It is anticipated that any future transmission works that would be required in the area would come from the direction of the TransGrid Substation located in the north if required. **Figure 3** shows the substation location on map.

Figure 3: Transgrid substation locality map

(Source: Google Map)

2.2 Sub-transmission Network - Ausgrid

The local Ausgrid sub transmission network (shown in Figure 4) is part of the national 132kV transmission network, which is located on the Eastern Side of Old Northern road, with the nearest Zone Substations being located at Galston and Pennant Hills.

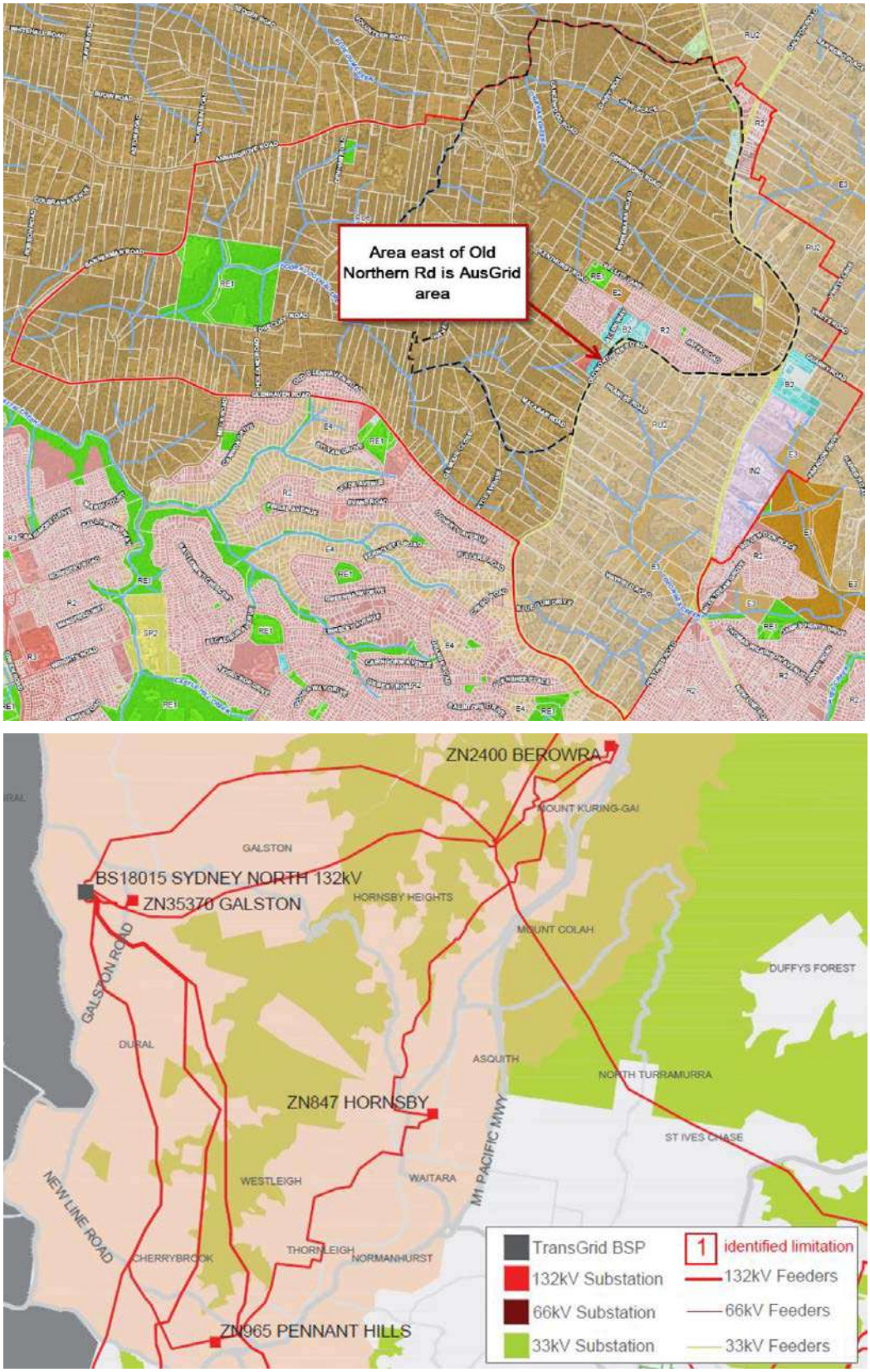


Figure 4: Ausgrid Load Area and Sub-transmission Network

The Galston and Pennant Hills Substations have some capacity (as shown in **Table 1**), but are located further away than the Endeavour Energy Zone Substations.

Summer Loads (Mega Volt Amps)	Firm Capacity	Actual Load 2016/17	Forecast 2021/22	Available Capacity
Galston	38.1	12.4	11.1	24
Pennant Hills	106.9	91.9	77.7	15

Table 1: Ausgrid Zone Substation Forecast

2.3 Sub-transmission Network - Endeavour

The local Endeavour Energy sub-transmission network consists of a mixture of voltages at 132kV, 66kV and 33kV as shown in the extracts for the Endeavour Energy network plans. These assets are around the edges of the subject area and are not located in the Town centre area.

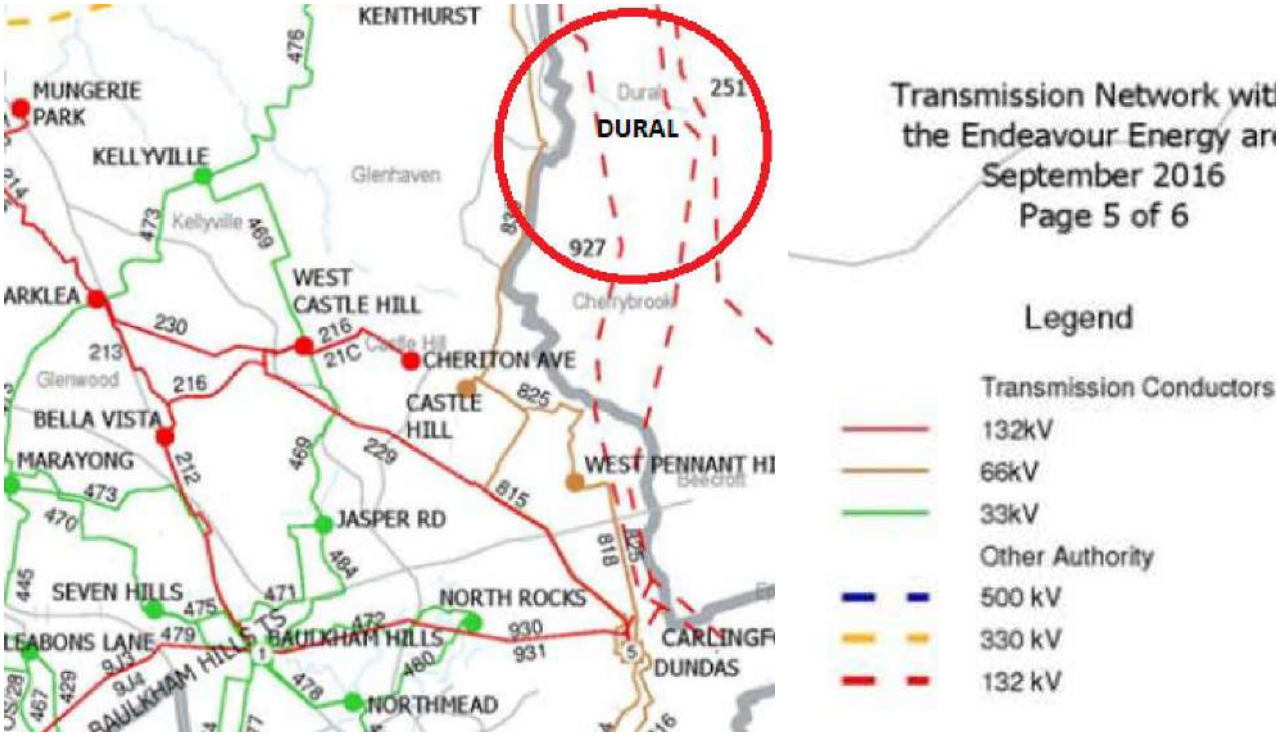


Figure 5: Endeavour Energy Sub-transmission Network Plan (Western Sydney and extract of Dural load area)

The surrounding Zone Substations shown in the table below with the forecast Mega Volt Amp (MVA) loads are sourced from the Annual Distribution Planning Report, which indicates that there is some capacity available.

Summer Loads (MVA)	Firm Capacity	Actual Load 2017	Forecast 2022	Available Capacity
Kellyville	25	20.0	17.5	5
Kenthurst	25	23.3	17.7	1.7
Castle Hill	50	25.6	26	24
Cheriton Ave	45	33.8	36.0	11
West Castle Hill	65	47.5	48.8	16

Table 2: Endeavour Energy Zone Substation Forecast

As the majority of the Dural Investigation Area is within the Endeavour Energy network area the remainder of this report focuses on the Endeavour network. A technical enquiry was submitted to Endeavour Energy to assess the capacity of the local network within the study area (see Section 4 of this report).

3 Endeavour Energy Network planning

A desktop review of the network planning documents available on-line identified the following information.

3.1 Network Development

Endeavour Energy have undertaken load forecasting for their network surrounding the study area and have identified the following limitations in the vicinity of the study area:

- The transmission feeder from Kenthurst to Kellyville is at capacity and Endeavour plan to transfer loads to other substations and monitor
- West Castle Hill Zone Substation is forecast to be at Capacity Summer 2024 (monitor)
- Cheriton Ave Zone Substation is forecast to be at Capacity Summer 2026 (monitor)
    - Proposed commercial development Nov 2026
- Transmission feeders into West Castle Hill Zone Substation are forecast to be at capacity summer 2027 (investigation)
- Transmission feeders near the load study area are forecast to be at capacity in early 2020's.

This indicates that the network area has some capacity available, based on current load forecasts, until the mid 2020's, when further infastructure works would be required. This capacity has not been specifically allocated to the study area.

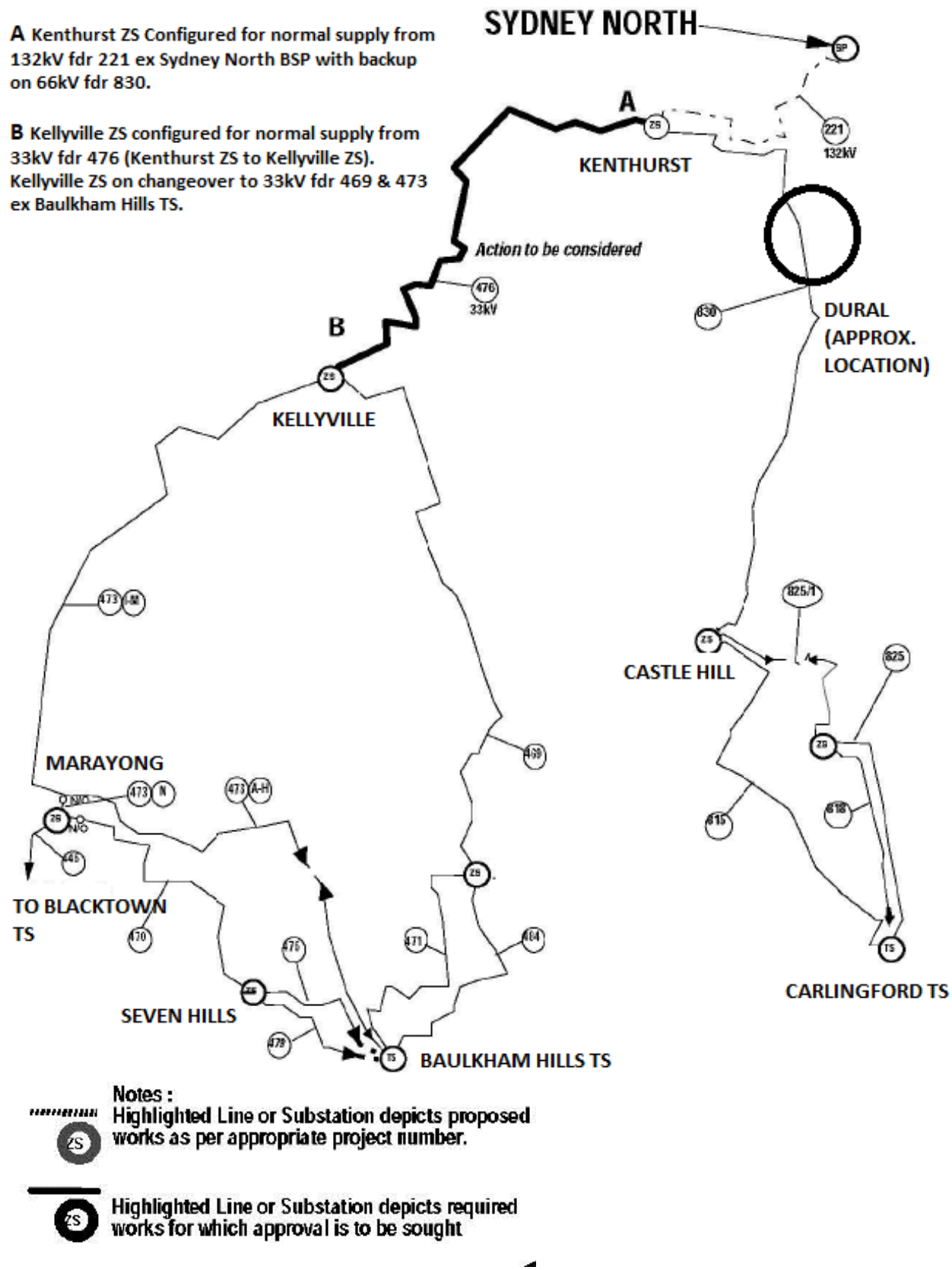
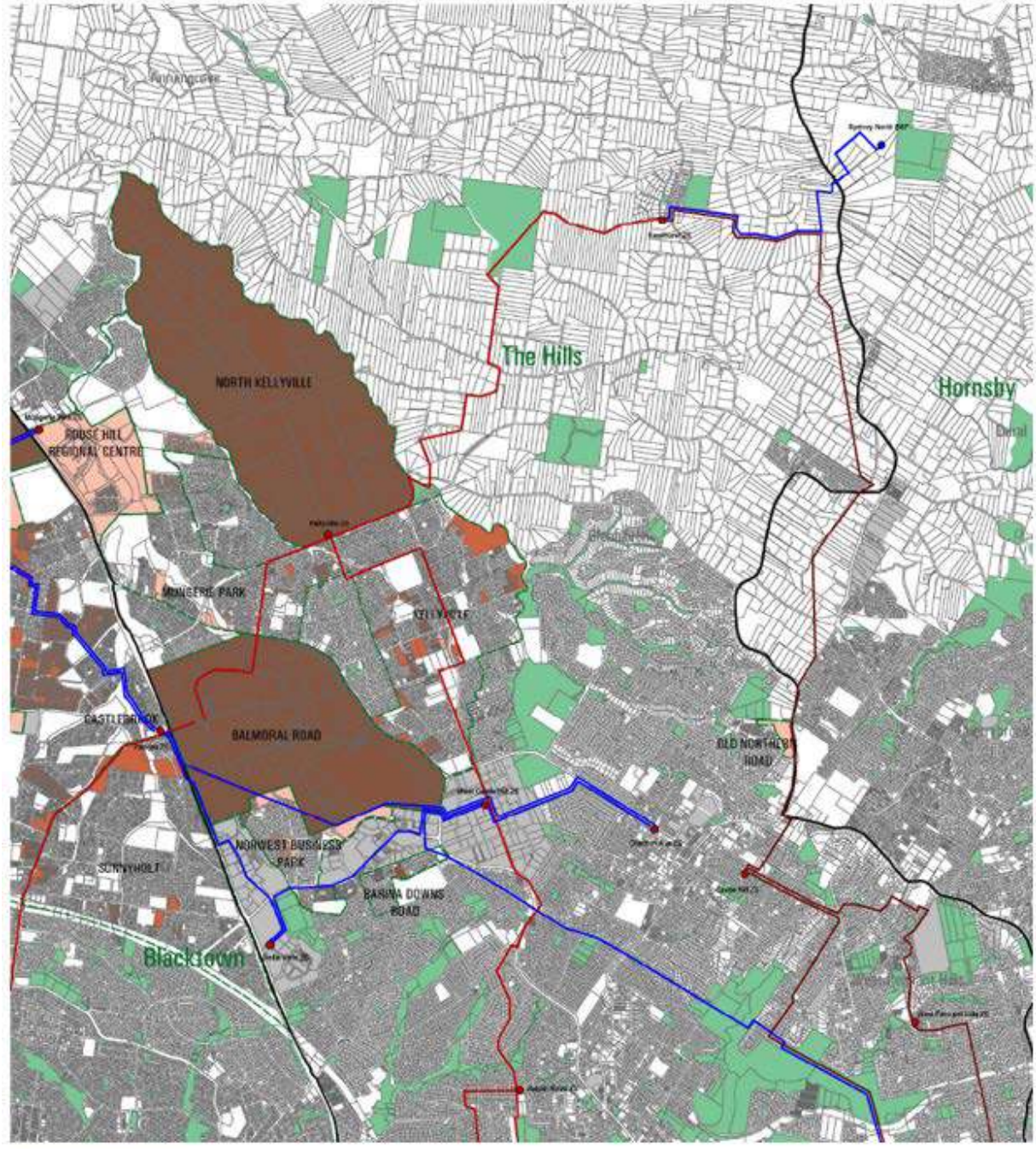
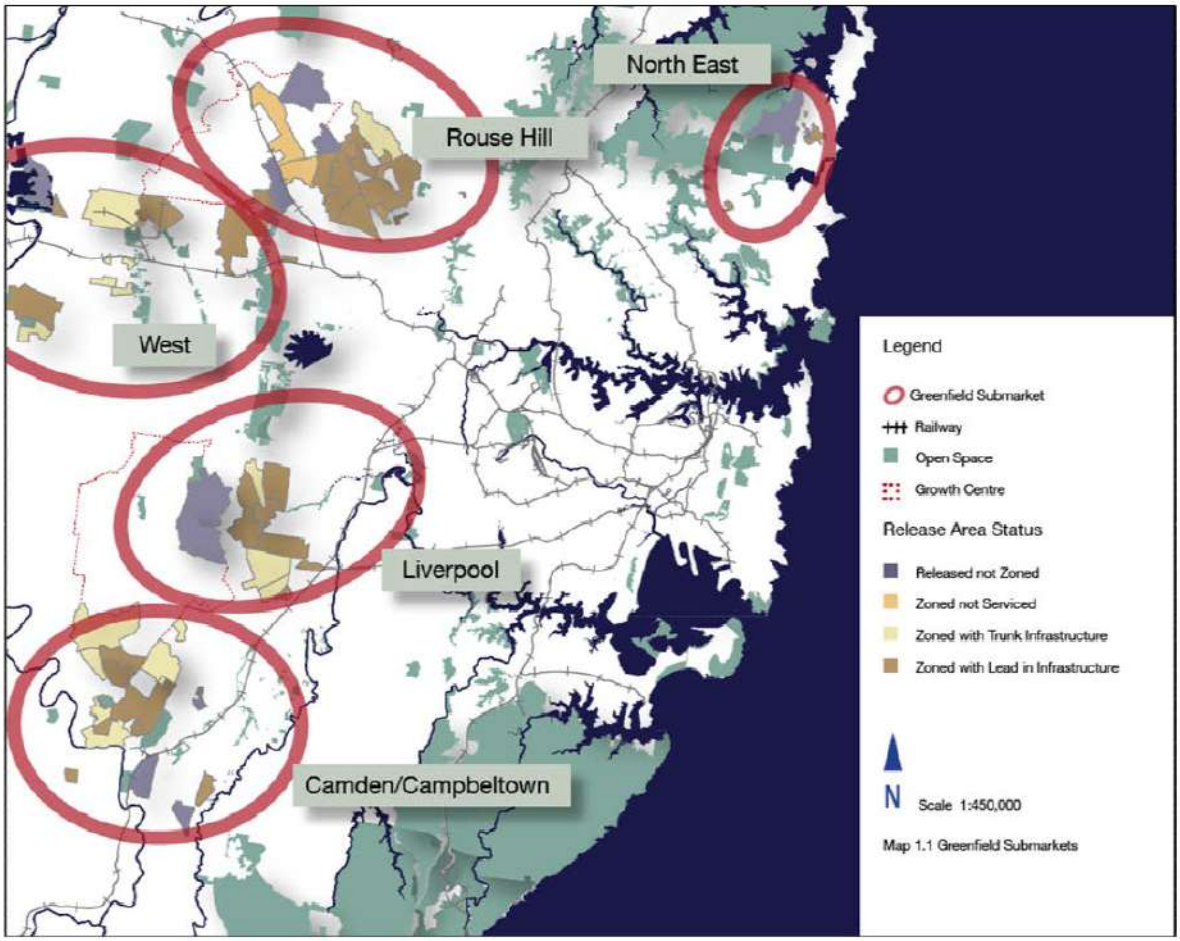


Figure 6: Diagram of network constraints Kenthurst to Kellyville

3.2 Growth Areas

Endeavour Energy have identified a number of development hotspots in their planning documentation in line with proposed state government land releases. One of these is located in the North West sector of Sydney around Rouse Hill.





Figure(s) 7: Endeavour Energy Development Hot Spots and Norwest Sector

As shown in Figure 7, Endeavour Energy have identified development and growth 'hot spots' which are focused along the new North West metro line currently under construction. Their mapping does not identify the Dural Town centre area as a major growth centre. Hence, Endeavour Energy forecasts and future plans are not focused in the study area and an increase in development would require a change in their forecasting and installation of additional infrastructure.

Endeavour Energy's planning documentation identifies the following known development in the Hills Shire Council area:

North West Infill		Current Dwelling Projections			Service Availability	Servicing Status						Comments
LGA	Major Sites (>200 Dwellings)	Total Potential Dwellings to 2025	Short Term 10/11-14/15	Medium Term 15/16-19/20	(see Key)	Development Stage	Initial Servicing Strategy	Works Required	Anticipated Delivery for initial servicing	Ultimate Servicing Stratery	Works Required or Major Phase	
The Hills Shire	North Rocks Road Northmead (21 Windsor Rd)	299	150	149	■	Developer Application	Under investigation		as per application	Northmead ZS		Substation built; awaiting completion of development
	Carlingford Precinct	913	284	629	■	Developer Application	Dundas ZS	Feeder Works	as per application	Dundas ZS		
	Castle Hill (North West Rail Link Station Precinct)	4400	-	-	■	Government Announcement	Cheriton Ave ZS	Distribution Feeder Development		Cheriton Ave ZS	Distribution Feeder Development	
	Showground (North West Rail Link Station Precinct)	3600	-	-	■	Government Announcement	West Castle Hill ZS	Distribution Feeder Development		West Castle Hill ZS	Distribution Feeder Development	Priority Precinct (Showground Station)
	Norwest (North West Rail Link Station Precinct)	4350	-	-	■	Government Announcement	Bella Vista ZS	Distribution Feeder Development		Bella Vista ZS	Distribution Feeder Development	
	Bella Vista (North West Rail Link Station Precinct)	4400	-	-	■	Government Announcement	Bella Vista ZS	Distribution Feeder Development		Bella Vista ZS	Distribution Feeder Development	Priority Precinct (Bella Vista Station)
	Kellyville North (North West Rail Link Station Precinct)	4400	-	-	■	Government Announcement	Mungerie Park ZS	Distribution Feeder Development		Mungerie Park ZS	Distribution Feeder Development	Priority Precinct (Kellyville Station)
	Rouse Hill (North West Rail Link Station Precinct)	950	-	-	■	Government Announcement	Mungerie Park ZS	Distribution Feeder Development		Mungerie Park ZS	Distribution Feeder Development	
Blacktown	Cudgegong Road (North West Rail Link Station Precinct)[1]	3500*	-	-	■	Government Announcement	Mungerie Park ZS	Distribution Feeder Development		Mungerie Park ZS	Distribution Feeder Development	
	Blacktown CBD (Northern Precinct)	618	168	450	■	Preliminary	Marayong ZS			Marayong ZS	Possible Augment	Augment subject to developer activity

North West Greenfield		Current Dwelling Projections			Service Availability	Servicing Status						Comments
LGA	Major Sites (>200 Dwellings)	Total Potential Dwellings to 2025	Short Term 10/11-14/15	Medium Term 15/16-19/20	(see Key)	Development Stage	Initial Servicing Strategy	Works Required for Interim Strategy	Anticipated Delivery for initial servicing	Ultimate Servicing Stratery	Works Required or Major Phase	
The Hills Shire	Balmoral Road	6035	1247	760	■	Civil Works Commenced	Parklea ZS	Initial supply via lead in works from Parklea ZS		Parklea ZS, Kellyville ZS	Augment Kellyville ZS	Ultimate potential 6000 dwellings
	Barina Downs Road	125	83	42	●	Ongoing Development	Bella Vista ZS	in place	Delivered	West Castle ZS + Bella Vista ZS		
	Box Hill	9600	0	1150	▲	Rezoned (2013)	Limited Initial capacity	Feeder Works	2017	New ZS - Box Hill ZS	ZS Site Required	ZS site under negotiation
	Box Hill North	4100	n/a	n/a	▲	Gateway Determination	Limited Initial capacity	Feeder Works	2017	New ZS - Box Hill ZS	ZS Site Required	ZS site under negotiation
	Kellyville	583	434	149	■	Ongoing Development	West Castle Hill ZS + Kellyville ZS	Distribution Feeder works	As per application	Kellyville ZS	Augment Kellyville ZS	
	Mungerie Park	324	292	32	●	Initial Enquiry	Mungerie Park ZS	Delivered	As per application	Mungerie Park ZS	-	
	North Kellyville	4500	35	450	■	Civil Works	Mungerie Park ZS	2 x 22kV feeders	1x 22kV feeder under construction	Kellyville ZS	Augment Kellyville ZS	Ultimate potential of 4500 dwellings
	Norwest Business Park	595	282	253	●	Ongoing Development	Bella Vista ZS	Lead in works	As per application	TBD	-	
	Old Northern Road	45	0	0	TBD	TBD	TBD					Development expected beyond 2020
	Rouse Hill Regional Centre	1522	619	911	●	Building work ongoing	Parklea ZS	in place	Delivered	Mungerie Park ZS	Delivered	

Employment Lands/Industrial			Service Availability	Servicing Status						Comments
LGA	Major Sites	Total Hectares	(see Key)	Development Stage	Initial Servicing Strategy	Works Required	Anticipated Delivery for initial servicing	Ultimate Servicing Stratery	Works Required or Major Phase	
Camden	Turner Road	96	●	Preliminary	Narellan ZS	Lead in Distribution Works		Narellen ZS	Possible Augment	Some capacity is available at Narellan ZS. Final servicing depends on actual requirements.
Liverpool	Hoxton Park Airport	40	●	Ongoing Development	Hinchinbrook ZS	Lead in Distribution Works	Delivered	Hinchinbrook ZS	Delivered	
	Kemps Creek	Future	▲	Servicing from Zone Substations under development for the South West Sector strategy						
Hills Shire	Annangrove	118	●		-	-	-	Mungerie Park ZS	Delivered	
Penrith	Erskine Park	403	●	Ongoing Development	Mamre ZS		2013	Mamre ZS	Delivered	
	Kemps Creek	Future	▲	Servicing from Zone Substations under development for the South West Sector strategy						
Penrith/Fairfield	South of Sydney Water Pipleine	340	▲	Developer Enquiries	Eastern Creek ZS	Lead in distribution works		New ZS Southpipe	ZS Required	

Key:

●	There is capacity in the electricity subtransmission system to service development in the short to medium term. However, some lead in infrastructure and reticulation works may need to be delivered by the developer.
■	There is some capacity in the subtransmission system in adjacent networks to service the development in the short term. In the medium term, Endeavour Energy may undertake subtransmission works to service the area at an appropriate time
▲	Endeavour Energy will need to undertake major subtransmission development works in order to be able to service this area.

Figure 8: Extracts of known development in The Hills Shire Council Area

4 Endeavour Energy Advice

A technical enquiry was submitted to Endeavour Energy to confirm their Zone Substation capacities and determine the capacity of the local 11kV network. A copy of the report is attached in Appendix A.

4.1 Zone Substation

Endeavour Energy's advice dated 26 June 2018stated that there is 5.4MVA of zone substation capacity available from Kenthurst Zone (located in Jones Road, near Kenthurst Road) which would allow for approximately:

- 830 low density lots; or
- 1080 medium density lots

This capacity relates to overall network capacity and is not exclusive to the study area.

Developments larger than this could potentially trigger the construction of a new zone substation that would require transmission feeders to be installed from the surrounding areas to the new substation. It is envisaged that this would be from the transmission network to the north of the development site.

The costs associated with a new zone would be borne by Endeavour Energy, however land and easements may be required for the substation and feeder routes.

Figure 9: Endeavour Energy 11kV Feeders

4.2 11kV Feeders

Endeavour Energy advised that there are four 11kV feeders suppling the Dural load area as shown in Figure 9 above, with varying capacity available.

This was clarified in a subsequent email after the initial report that there is 0.31MVA to 1.46MVA (Average 1.14MVA) of 11kV capacity available across four feeders which would allow for approximately:

- 175 additional low density lots; or
- 228 additional medium density lots in the study area.

Developments larger than this could potentially trigger additional 11kV lead in works from one of the local Zone Substations.

The costs associated with lead in works would be borne by the developer with contributions from Endeavour Energy dependant on individual projects and their location, however it is expected that this would be installed along existing or proposed roads. An approximate cost for a new 11kV feeder is $688,500 per km, and reimbursement costs from Endeavour Energy would vary depending on the developer's load and location.

Trenching & Ducts:	
- (T&R)HV Heavy Trenching & Reinstatement /km	$526,000
- (D) Lay HV Ducts in Trench /km	$23,000
Lay Cable:	
- (PC) Pull HV cable in Duct /km	$13,000
- (C) 11kV 300mm2 CU 3C XLPE /km	$105,000
Joints:	
- (1 x STJ in Trench (HV)/400m) 2 approx/km	$2,820
One off cost per feeder:	
- ZS CB Termination	$4,432
- Protection Settings	$4,915
- Testing HV Cable	$5,579
- ZS Access & Supervision	$3,776
Total Cost before Reimbursement	$688,522

Table 3: 11kV Feeder Costs ($/km)

5 Conclusion

The Dural Load area (which includes land in the subject investigation area) has existing capacity to supply small developments of 175 to 230 small/medium sized lots before requiring upgrades to the local 11kV network back to the Kenthurst Zone.

Whilst this capacity can be delivered to multiple locations within the study area, the reticulation cost will vary depending on the particular location.

The investigation area has not been identified as a growth area by Endeavour Energy.

Endeavour Energy does not have any long-term infrastructure plans to increase capacity in the investigation area.

Kenthurst Zone could accommodate approximately 800 to 1100 small/medium sized lots in the short term, before requiring investment in a new zone substation and sub transmission feeders.

APPENDIX

A

ENDEAVOUR ENERGY
TECHNICAL REVIEW REQUEST

26 June 2018

Endeavour Energy Ref: ENL3075 – 2014/02306/001

Cardno (NSW) Pty Ltd
Level 9 No 203 Pacific Highway
ST LEONARDS NSW 2065

Attention: James Howard

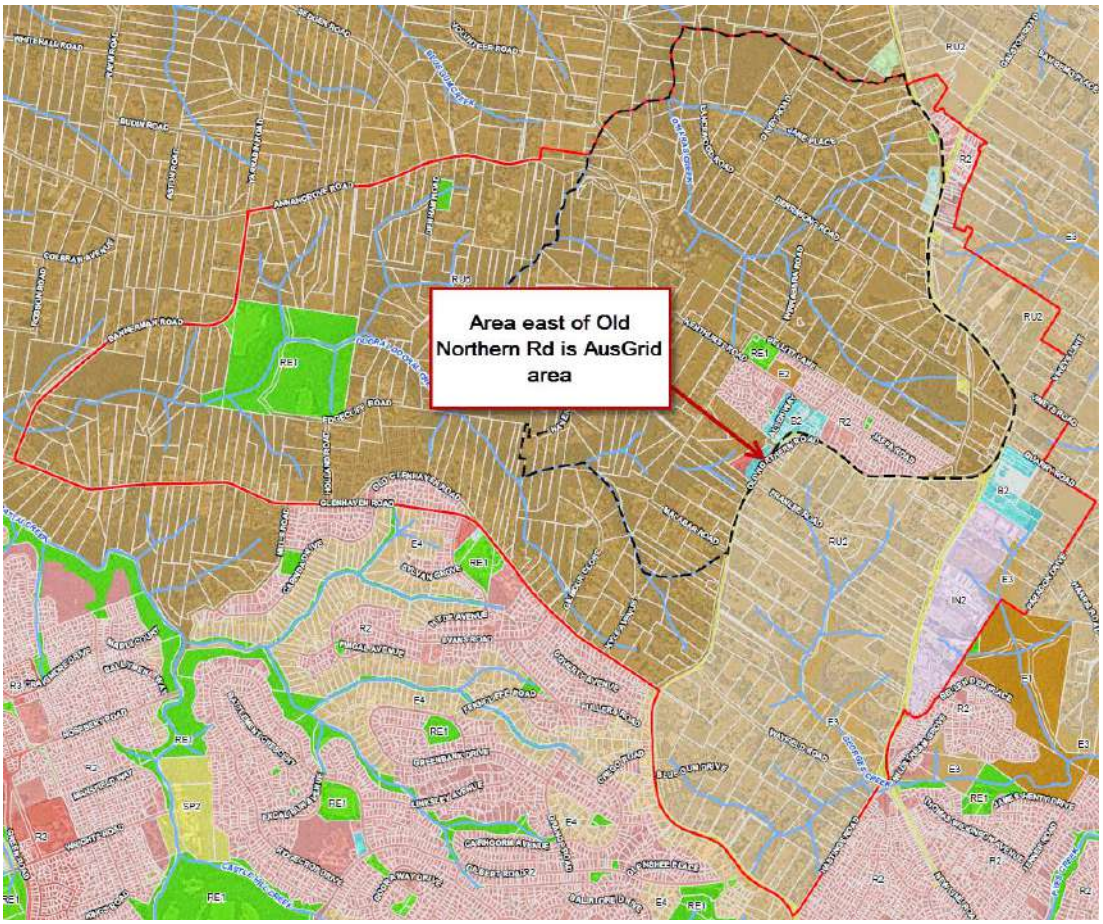
TECHNICAL REVIEW REQUEST

ENL3075 – Planning review of DURAL

Thank you for your enquiry application and the payment of fees to facilitate the enquiry request at the above location. Your application has been registered under ENL3075. Please quote this reference number on all future correspondence.

Your enquiry wishes to determine whether electrical capacity is available in the area before significant lead in works are required and the available capacity in the area from MVA to Lots to determine what size development would trigger a need to establish a new zone substation due to load or number of 11kV feeders being excessive. Also, provide the number, capacity and forecast load for the feeders in the study area.

The area east of Old Northern Rd to the red line border is predominantly supplied by AusGrid and will not be considered in the assessment of load



Electrical supply to Dural area is at 11kV and is predominantly from Kenthurst Zone Substation with minor supply coming from Kellyville Zone Substation and Castle Hill Zone Substation. Kenthurst Zone Substation has recorded a peak maximum demand of 19.6MVA in summer 2017/2018. The available capacity limit is 25MVA. This leaves 5.4MVA spare capacity. Calculating the number of Lots required which will trigger another Zone Substation is based on maximum demand calculations and the size of the development, i.e;

- Low density (>350m2) at 6.5kVA will yield 830 Lots
- Medium density(<350m2) at 5kVA will yield 1080 Lots

It is unlikely that excessive 11kV feeders will trigger a new Zone Substation. Also note, there is no set figure of load demand that immediately triggers a requirement for a Zone Substation. It is normally a case by case situation to determine when a Zone Substation is required.

Analysis at 11kV level shows there are 4 11kV feeders supplying Dural and surrounding areas. The 4 11kV feeders have the following maximum loads;

- Feeder s744 recorded a maximum load of 3.42 MVA
- Feeder s740 recorded a maximum load of 4.19MVA
- Feeder s738 recorded a maximum load of 2.8 MVA
- Feeder s735 recorded a maximum load of 3.04 MVA

Unfortunately, due to the lack of applications in the area, it is hard to estimate the forecast load for these feeders. There does not seem to be much activity in Dural at this stage so the 11kV feeders have been steady. This may change however if the land is zoned differently for example.

Below is a Google Map showing the 4 11kV feeders of interest and Kenthurst Zone Substation within the Dural shaded area.

Should you have any enquiries regarding your application please contact me.

Yours faithfully,

M Grimwood

Matthew Grimwood
Contestable Works Project Manager
Ph: 02 9853 7916
Email: matthew.grimwood@endeavourenergy.com.au

APPENDIX

B

ENDEAVOUR ENERGY 11KV UPDATE

Rafal Piwonski

From: Matthew Grimwood <Matthew.Grimwood@endeavourenergy.com.au>
Sent: Thursday, 28 June 2018 4:19 PM
To: James Howard
Cc: Glenn Bigland
Subject: RE: ENL3075 - Area DURAL - Matthew Grimwood

Hi James,

Sure. All the 11kV feeder have a limit of 4.5MVA, so the difference is as per below;

- Feeder s744 recorded a maximum load of 3.42 MVA and spare capacity is 1.08MVA
- Feeder s740 recorded a maximum load of 4.19MVA and spare capacity is 0.31MVA
- Feeder s738 recorded a maximum load of 2.8 MVA and spare capacity is 1.7MVA
- Feeder s735 recorded a maximum load of 3.04 MVA and spare capacity is 1.46MVA

Regards,
Matt Grimwood
Contestable Works Project Manager
Network Connections
T : 98537916

490 Hoxton Park Rd, Hoxton Park
http://www.endeavourenergy.com.au

From: James Howard [mailto:James.Howard@cardno.com.au]
Sent: Thursday, 28 June 2018 4:04 PM
To: Matthew Grimwood <Matthew.Grimwood@endeavourenergy.com.au>
Cc: Glenn Bigland <glenn.bigland@cardno.com.au>
Subject: RE: ENL3075 - Area DURAL - Matthew Grimwood

Hi Matthew

Would you be able to add what the spare capacity on the 11kV feeders are, in the same manner as the zone spare capacity?

James Howard
MANAGER, ELECTRICAL INFRASTRUCTURE
CARDNO

Phone +61 2 9496 7700 Fax +61 2 9439 5170 Direct +61 2 9496 7770 Mobile 0408 162 006
Address Level 9 - The Forum, 203 Pacific Highway, St Leonards, New South Wales 2065 Australia
Postal PO Box 19, St Leonards NSW 1590
Email james.howard@cardno.com.au Web www.cardno.com

From: Matthew Grimwood [mailto:Matthew.Grimwood@endeavourenergy.com.au]
Sent: Wednesday, 27 June 2018 2:46 PM
To: James Howard <James.Howard@cardno.com.au>
Subject: RE: ENL3075 - Area DURAL - Matthew Grimwood

Hi James,

Please find attached, the technical review request for the Dural area. Please let me know if you need any further information regarding your enquiry.

Regards,
Matt Grimwood
Contestable Works Project Manager
Network Connections
T : 98537916

490 Hoxton Park Rd, Hoxton Park
http://www.endeavourenergy.com.au

Endeavour Energy

From: James Howard [mailto:James.Howard@cardno.com.au]
Sent: Tuesday, 26 June 2018 9:58 AM
To: Matthew Grimwood <Matthew.Grimwood@endeavourenergy.com.au>
Subject: FW: ENL3075 - Area DURAL - Matthew Grimwood

Hi Matthew

I am following up on this technical request, my number is 0408162006

Thanks

James Howard
MANAGER, ELECTRICAL INFRASTRUCTURE
CARDNO

Cardno

Phone +61 2 9496 7700 Fax +61 2 9439 5170 Direct +61 2 9496 7770 Mobile 0408 162 006
Address Level 9 - The Forum, 203 Pacific Highway, St Leonards, New South Wales 2065 Australia
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Email james.howard@cardno.com.au Web www.cardno.com

From: James Howard
Sent: Monday, 28 May 2018 2:21 PM
To: Matthew Grimwood <Matthew.Grimwood@endeavourenergy.com.au>
Subject: RE: ENL3075 - Area DURAL - Matthew Grimwood

Hi Matthew

We have based our report on the 2017 Distribution Annual Planning Report, which is based on Summer Actual 2017 and Forecast 2022.

I have attached the information we extracted from the Endeavour and Ausgrid Report. I am not sure what you assume at the Zone Substation level for lots MVA by my conclusion is that based on current forecast there is Zone capacity in the area until the mid 2020's.

Summer	Firm Capacity	Actual 17	FC 22	Available Capacity	Lots	Comments
Kellyville	25	20.0	17.5	5	?	
Kenthurst	25	23.3	17.7	1.7	?	
Castle Hill	50	25.6	26	24	?	
Cheriton Ave	45	33.8	36.0	11	?	
West Castle Hill	65	47.5	48.8	16	?	

James Howard
MANAGER, ELECTRICAL INFRASTRUCTURE
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From: Matthew Grimwood [mailto:Matthew.Grimwood@endeavourenergy.com.au]
Sent: Monday, 28 May 2018 9:54 AM
To: James Howard <James.Howard@cardno.com.au>
Subject: RE: ENL3075 - Area DURAL - Matthew Grimwood

Hi James,

Thanks for the payment. Are you able to answer the below question?

One question with your enquiry. You have requested information at the 11kV level. You question asks, 'could you please advise the number, capacity and forecast load for the feeders in the study area'. Are you asking for number of proposed feeders or are you asking for the existing feeder data?

Regards,
Matt Grimwood
Contestable Works Officer
T : 9853 7916

51 Huntingwood Drive, Huntingwood NSW 2148
http://www.endeavourenergy.com.au

From: Matthew Grimwood **On Behalf Of** CWTech
Sent: Friday, 27 April 2018 4:32 PM
To: James Howard (James.Howard@cardno.com.au) <James.Howard@cardno.com.au>
Subject: ENL3075 - Area DURAL - Matthew Grimwood

Hi James,

Please find attached the Payment Advice letter.

Once payment is receipted, Endeavour Energy will provide an enquiry assessment.

One question with your enquiry. You have requested information at the 11kV level. You question asks, 'could you please advise the number, capacity and forecast load for the feeders in the study area'. Are you asking for number of proposed feeders or are you asking for the existing feeder data?

Regards,
Matt Grimwood
Contestable Works Officer
T : 9853 7916

51 Huntingwood Drive, Huntingwood NSW 2148
http://www.endeavourenergy.com.au