

5.3.2 Groundwater dependent ecosystems

Existing Conditions

There are no groundwater dependent ecosystems and no known aquifer or cave systems within the Precinct.

There are also no natural wetlands or swamps within or adjacent to the Precinct. A number of farm dams provide an artificial form of wetland habitat, however the quality of the habitat is considered to be generally marginal.

Impacts and assessment

A number of artificial wetlands outside of riparian zones will be lost, however the quality of these habitats is considered to be generally marginal

A number of new wetlands will be established across the Precinct as part of water quality and flood controls which would mitigate the loss of the above wetland habitats.

Management Response

To prevent and control rubbish dumping and the establishment of nuisance species such as ibis and mosquito fish, significant management of open wetland areas will be required. The DCP will incorporate provisions for the ongoing management of wetlands.

5.3.3 Riparian corridors

Existing Conditions

Together with representatives of the Department of Natural Resources (DNR) and the Department of Environment and Conservation (DEC) the riparian corridors in the precinct were categorised to ensure that significant riparian habitat was retained in the ILP and appropriate riparian buffer zones implemented. Watercourses were categorised based on the following overarching environmental objectives (DNR and GCDC):

- **Category 1:** Environmental Corridor - to provide biodiversity linkages by maintaining connectivity for the movement of aquatic and terrestrial fauna and flora along the riparian corridor and between key destinations.
- **Category 2:** Terrestrial and Aquatic Habitat - to provide basic habitat and preserve and emulate as much as possible a natural functioning watercourse.
- **Category 3:** Bank Stability and Water quality - to prevent accelerated rates of soil erosion and enhance water quality.

As shown in **Figure 20**, South Creek is identified as a Category 1 stream. Its tributaries were rated as Category 2 streams and a small watercourse was rated Category 3.

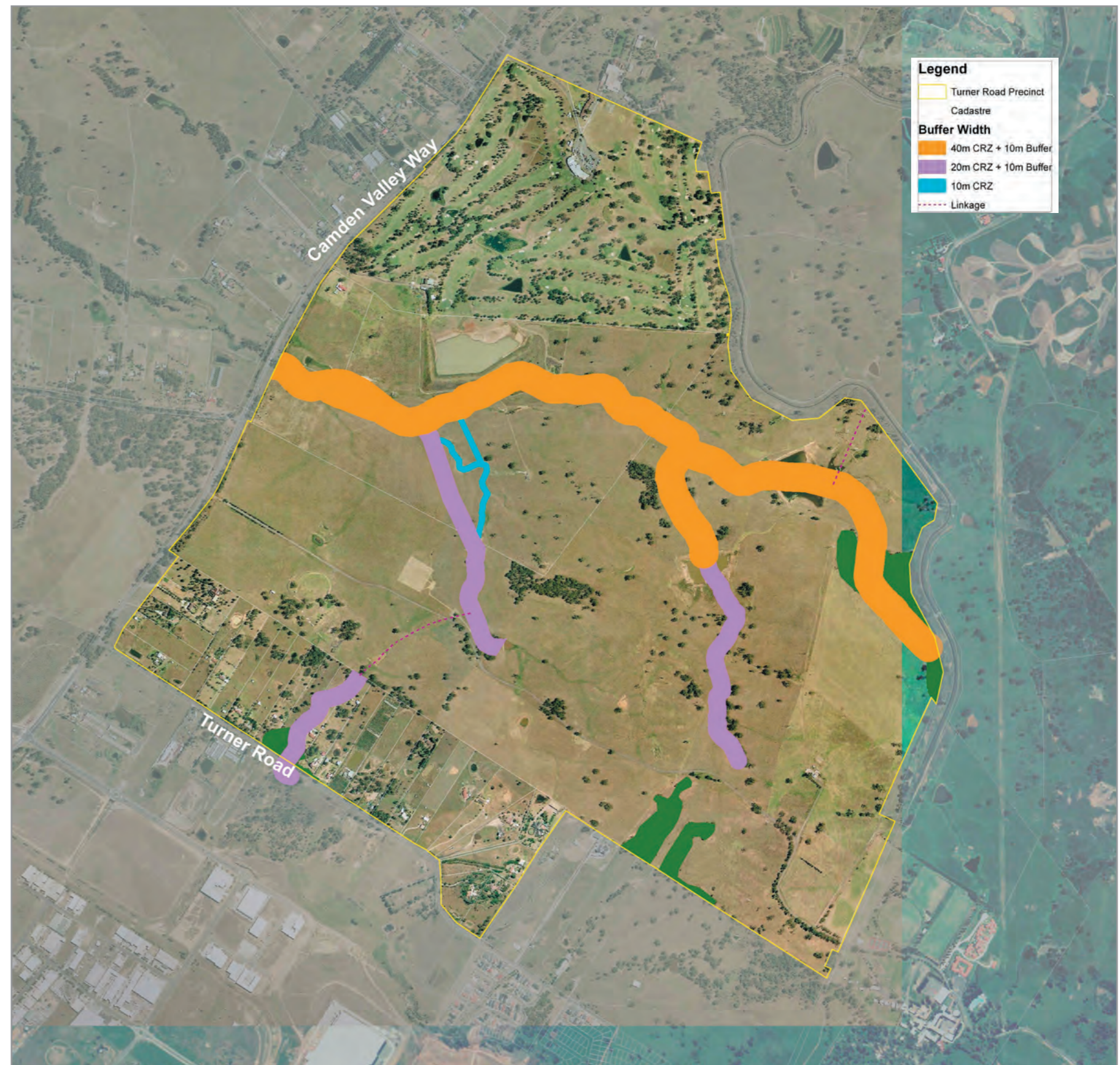


Figure 19 - Priority areas for conservation

Source: Eco Logical Australia

Impacts and assessment

The dimensions of Core Riparian Zones (CRZ) and buffer zones provided in the draft ILP are as follows:

- Category 1 stream: 40m CRZ and 10m additional buffer on each side; and
- Category 2 stream: 20m CRZ and additional 10m buffer on each side.

Category 3 streams identified within the Precinct but not reflected in the ILP may need to accommodate 10 metre buffers. Alternatively they may be downgraded to engineered drainage lines as has occurred with other Category 3 streams in the Precinct. This was considered to be appropriate with those streams as they are the upper reaches of their respective waterways and currently perform drainage functions without providing any significant habitat.

Management Response

The categorisation and treatment of various streams is not yet finalised. As such, the riparian corridor mapping and the management response should be read as indicative at this stage.

Final riparian buffer locations, particularly for South Creek will need further negotiation with government agencies to ensure that a Category 1 outcome can be achieved for South Creek in locations where the power line easement intersects the natural creek line. The categorisation and treatment of the Category 3 streams also needs to be resolved.

Planning controls for riparian corridors will be incorporated into the DCP for the Precinct. The key objectives will be to:

- provide bed and bank stability;
- protect water quality;
- provide continuity and connectivity;
- integrate with floodplain processes;
- manage edge effects at riparian/urban interface; and
- protect of natural values within channels.

5.3.4 Aquatic habitats

The assessment found that there are no aquatic threatened species that require protection under the *Fisheries Management Act 1994* and no suitable habitat for aquatic threatened species was observed on the site. Despite this finding it needs to be noted that the natural state of the majority of watercourses is ephemeral and that during times of flow they provide aquatic habitat and connectivity for species that are not linked during dry conditions.

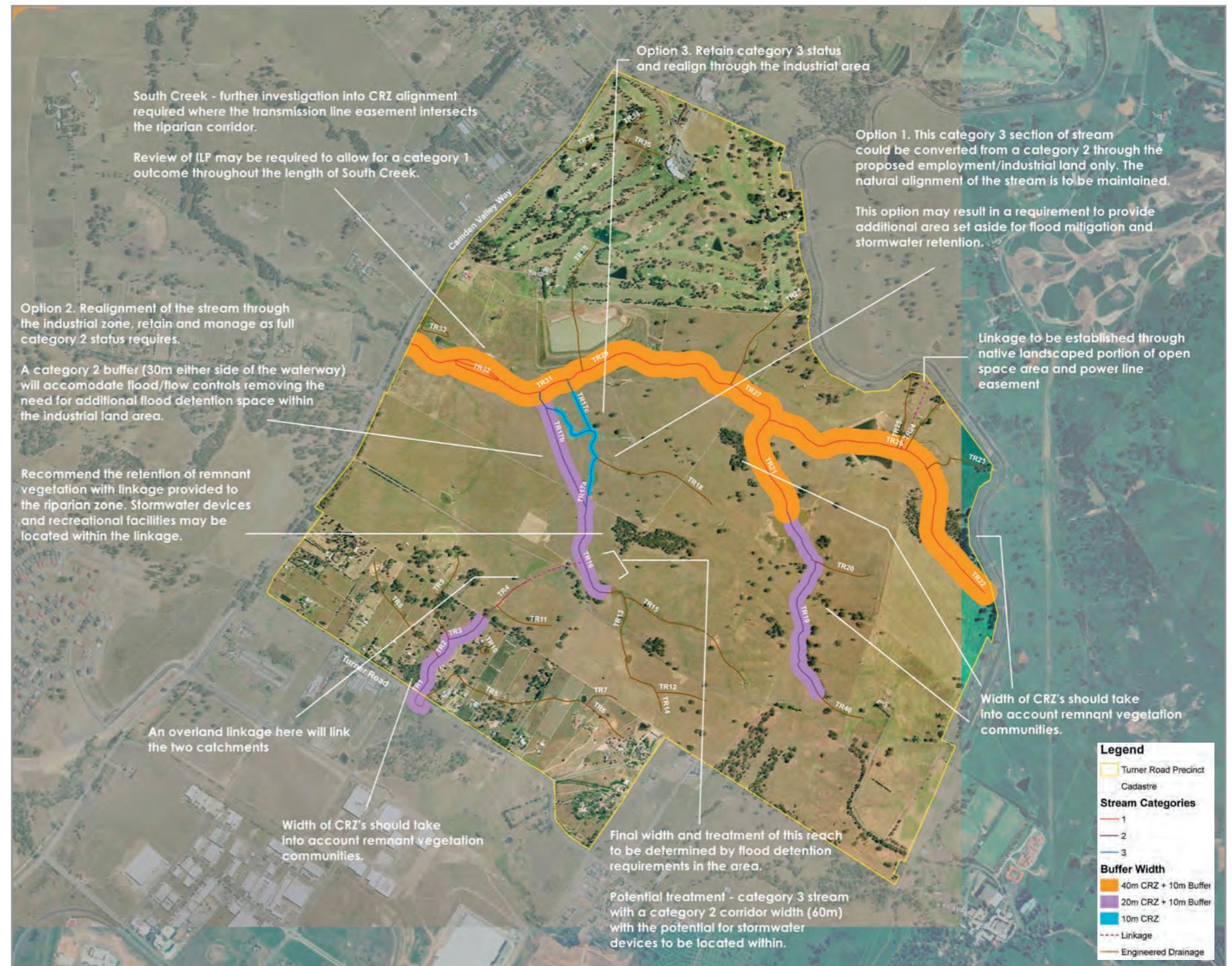


Figure 20 – Riparian corridors

Source: Eco Logical Australia

5.4 Bushfire

Although the land associated with the Turner Road Precinct has been largely cleared of vegetation, proposed development for urban purposes will involve the revegetation of the riparian corridors so creating a potential bushfire risk. Accordingly, the risk of bushfire was investigated so that appropriate management of risk could be incorporated into the draft ILP.

Work was commissioned to assess existing and potential bushfire hazards across the site (**Appendix E**). The aim of the study was to ensure that the statutory requirements for bushfire protection are met and that innovative management frameworks are achieved across bushfire and vegetation issues.

The study took into account the existing conditions of the site, the proposed removal and regeneration of vegetation and positioning of new development. It also considered the relevant legislative requirements of the *Rural Fires Act 1997*, the TSC Act, the EP&A Act and SEPP (Sydney Region Growth Centres) 2006, as well as the policy requirements of Planning for Bushfire Protection 2006 (PBP 2006).

5.4.1 Bushfire conditions

The Precinct has predominantly been cleared for grazing, with isolated paddock trees, narrow linear strands of vegetation along riparian zones and small regenerating stands of Cumberland Plain Woodland remaining. Vegetation is primarily confined to South Creek although smaller patches are also found along unnamed ephemeral creeklines.

When the Turner Road Precinct is developed, the main riparian corridor will be located through the middle of the Precinct as shown in **Figure 9** and will interface with both residential development and employment land.

5.4.2 Potential impacts and assessment

The risk of bushfire on a site is derived from a combination of factors. These include vegetation structure, the slope of the land and the topographic position of the asset. Bushfire risk is increased where land slopes and development is at a higher level than vegetation. This is because fires travel at greater speed and at greater intensity up an incline.

In the case of Turner Road, residential and employment land uses will adjoin the riparian corridors thus potentially creating a bushfire risk. Based on the draft ILP, the threat of bushfire in the Precinct was assessed to be low. This is due to the gentle slopes, linear nature of vegetation proposed and low fuel loads associated with the vegetation communities.

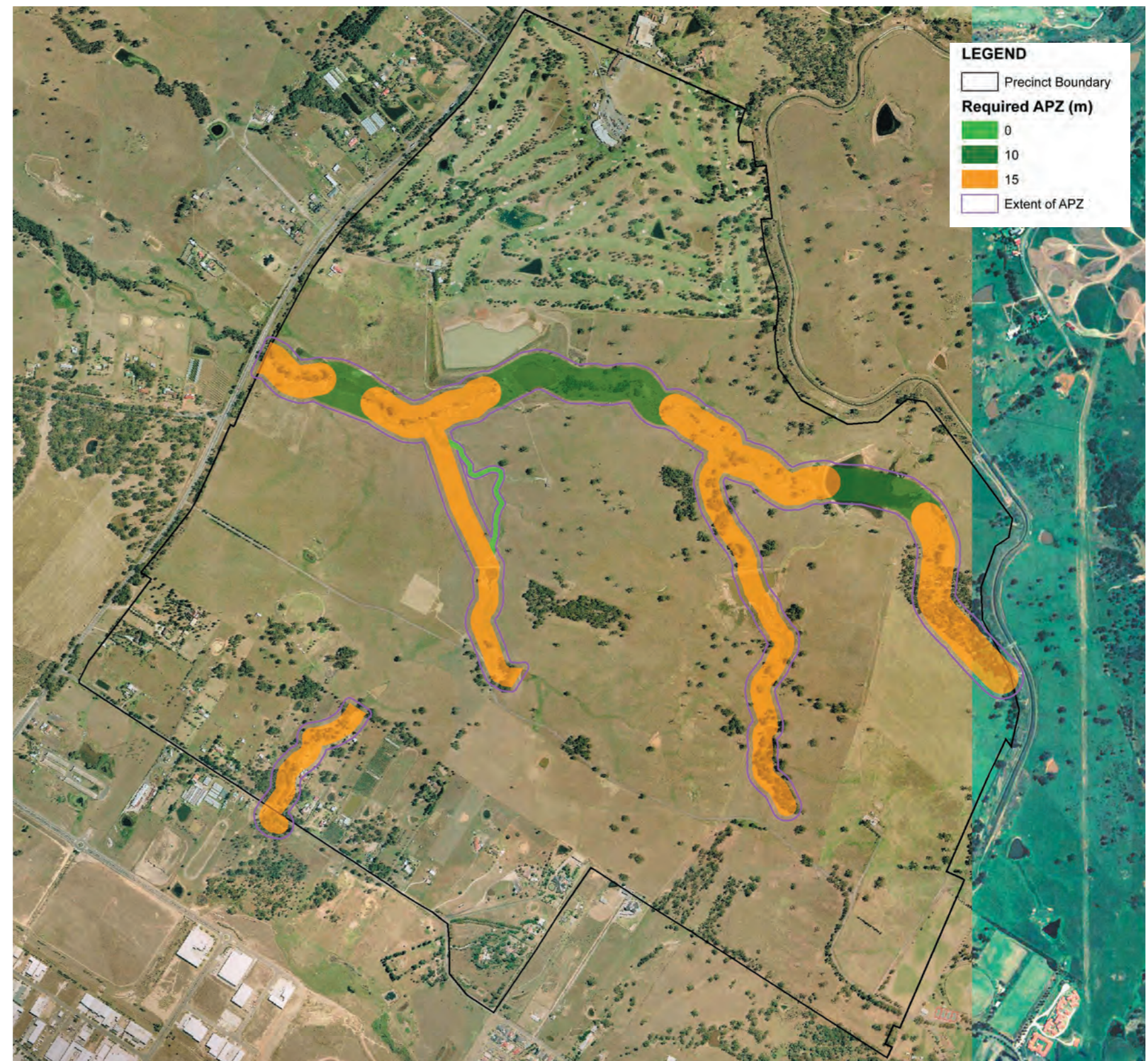


Figure 21 – Asset Protection Zones

Source: Eco Logical Australia

5.4.3 Management response

Asset Protection Zones

As shown in **Figure 21**, the bushfire risk will generally require an Asset Protection Zone (APZ) of 15 metres for residential and employment uses adjacent to future bushland, with flat areas requiring 10 metres.

In most cases the majority of APZs will be contained within the perimeter road easement and front yard setbacks. However, additional protection measures will be appropriate for some land uses, as follows:

- **Schools:** Require APZs more than double the width of those required for residential areas. Schools should be designed so that sports fields are located in the APZ.
- **Employment lands:** PBP 2006 generally applies. However, a perimeter road should separate employment land and adjoining vegetation.
- **Childcare facilities:** Require larger APZs and should not be placed near bushfire hazards.

These matters will be covered in the DCP.

APZs meeting ‘acceptable solution’ requirements are identified below in **Table 6**. Where these minimum APZs are implemented, buildings immediately adjacent to the APZ will require construction to Level 3 of AS3959-1999. However, if lower construction standards are used, development will need special protection - meaning that APZ widths will be increased beyond those shown below.

It is noted that alternative solutions for APZs may be required in some instances – particularly in order to manage land take or for reasons of design. While this is to be avoided, in these instances measures such as increasing construction standards or implementing appropriate fuel management regimes will be necessary.

Other management measures

With the establishment of appropriate APZs as set out in the table above there will be no significant risk of bushfire to the Turner Road Precinct. Nevertheless the following additional measures will be implemented through the DCP to further mitigate potential impacts:

- Where appropriate, perimeter roads or fire trails for emergency access and egress will be provided in accordance with PBP 2006.
- Neighbourhood parks and Category 3 riparian zones will be managed as ‘fuel reduced’ areas and no additional APZs will be necessary provided that perimeter roads are constructed.
- Temporary APZs will need to be established around each stage of the development. This could be avoided if lots fronting the riparian interface are developed first and APZs established from the outset.
- APZs are to be outside of CRZs.

Table 6 - APZ requirements

Slope (degrees)	Woodland		Forested Wetlands	
	Residential (metres)	Special Protection (metres)	Residential (metres)	Special Protection (metres)
Up slope/flat	10	40	15	50
Down slope				
>0 - 5	15	50	20	60
>5 -10	20	60	25	75
>10 -15	25	70	35	90
>15 -18	30	75	45	95

Source: Eco Logical Australia from Planning for Bushfire Protection (2006)

5.5 Aboriginal cultural heritage

Aboriginal cultural heritage (ACH) refers to the historic, archaeological, social and aesthetic values of a place, object or tradition that relates to Aboriginal occupation either before or after European arrival.

The Development Code incorporates the Aboriginal Cultural Heritage Framework which sets out the processes for establishing and protecting Aboriginal cultural heritage, including protocols for how Aboriginal communities are to be involved in identifying their heritage. ACH is to be recognised and protected in consultation with the Aboriginal community and may involve high priority areas for protection, medium priority areas where impacts need to be mitigated or off-set, and areas of low cultural heritage significance. Areas may also require further detailed assessment including surveys and excavations. Amongst the objectives in the GCDC for indigenous cultural heritage is that of incorporating areas of ACH into the open space network as a means of protection and conservation.

Prior to European settlement the Camden region was occupied by various Aboriginal language groups including the Darug, Dharawal and Gundungurra people. Although these groups have not lived in the area of the Turner Road Precinct for quite some time, the Camden region was an attractive area for occupation by Aboriginal groups and thus the potential for further discovery of archaeological artefacts is high. Accordingly, specialists in Aboriginal archaeology were commissioned to undertake a Stage 2 Cultural Heritage Investigation of the Precinct (located at **Appendix F**).

The investigation took into account the statutory requirements of the NPW Act (as amended), the objectives of the Growth Centres Development Code and the Aboriginal Cultural Heritage Framework.

5.5.1 Existing conditions

Accounts of early settlers indicate that several Aboriginal groups lived in the Camden area and that a number of corroborees were held on various homesteads.

Most of the over 4,000 archaeological sites recorded on the Cumberland Plain are open artefact scatters. Previous specialist investigations in the Cumberland Plain area have found that the primary determinant for Aboriginal open site locations is proximity to water, while ridge top locations between drainage lines may also contain limited archaeological evidence. As the Turner Road Precinct is located at the head waters of South Creek (a third order stream) and contains hill features, it has the potential to contain Aboriginal archaeological artefacts.

Based on previous work in the region and using general stream order models, the study predicted that the location of archaeological features within the Precinct would vary according to gross geomorphic factors and proximity to water. It was further predicted that land used for agriculture would be in the least disturbed condition and thus the most likely area where Aboriginal sites would have survived. Land that had been used for public purposes was classified as having moderate potential for containing intact deposits, while rural residential land was classified as having the lowest potential.

5.5.2 Impacts and assessment

A surface survey across the Precinct identified that there is extensive archaeological evidence for indigenous use of these landscapes prior to and at European contact. However, as a result of previous land uses, most of the Precinct has been heavily modified. The sites identified during the survey and areas of ground-truthed sensitivity are shown in **Figure 22**. Land within Zone 1 (shown in yellow and approximately 55 hectares in area) was nominated as having the highest potential for containing intact archaeological deposit.

During the survey of the Precinct, 14 sites and three potential archaeological deposits (PAD) were recorded (see **Figure 23**). A range of sites were encountered across the Precinct, including open lithic scatters, isolated surface finds and scarred trees. Sites were recorded on less than 25% of the exposures encountered and appear to be more frequently located close to water sources although a number of low density open camp sites and isolated finds were recorded adjacent to hillslopes, about 500 metres from permanent or semi-permanent water. Five identified sites and all three PADS are located within the Zone 1 areas as shown in yellow in **Figure 22**. Zone 1 has good potential for intact archaeological evidence (see **Table 7**).

Table 7 – Management zones showing management outcomes

Management Zone	Archaeological sensitivity	Management outcome
Zone 1	Good potential for intact archaeological evidence	Conservation zone (CCZ) to be selected from this zone. Remainder to be developable, but may require salvage of representative landscapes.
Zone 2	Moderate potential for intact archaeological evidence	Developable land. Some salvage of representative landscape units not in Zone 1 may be required.
Zone 3	Low potential for intact archaeological evidence	Developable land with no constraints – no further archaeological work required.
Zone 4	No potential for intact archaeological evidence	Developable land with no constraints – no further archaeological work required. Clearances not technically required for these lands as likelihood of relics surviving here is so low.

Source: Jo McDonald Cultural Heritage Management

No areas within the Precinct were identified as having very high or high archaeological potential. However, a significant proportion of land was assessed as having good archaeological potential - parts of which are located within riparian corridors. As these corridors will not be subject to a high level of development, they provide the opportunity to achieve a meaningful indigenous outcome within the Precinct (see **Figure 23**).

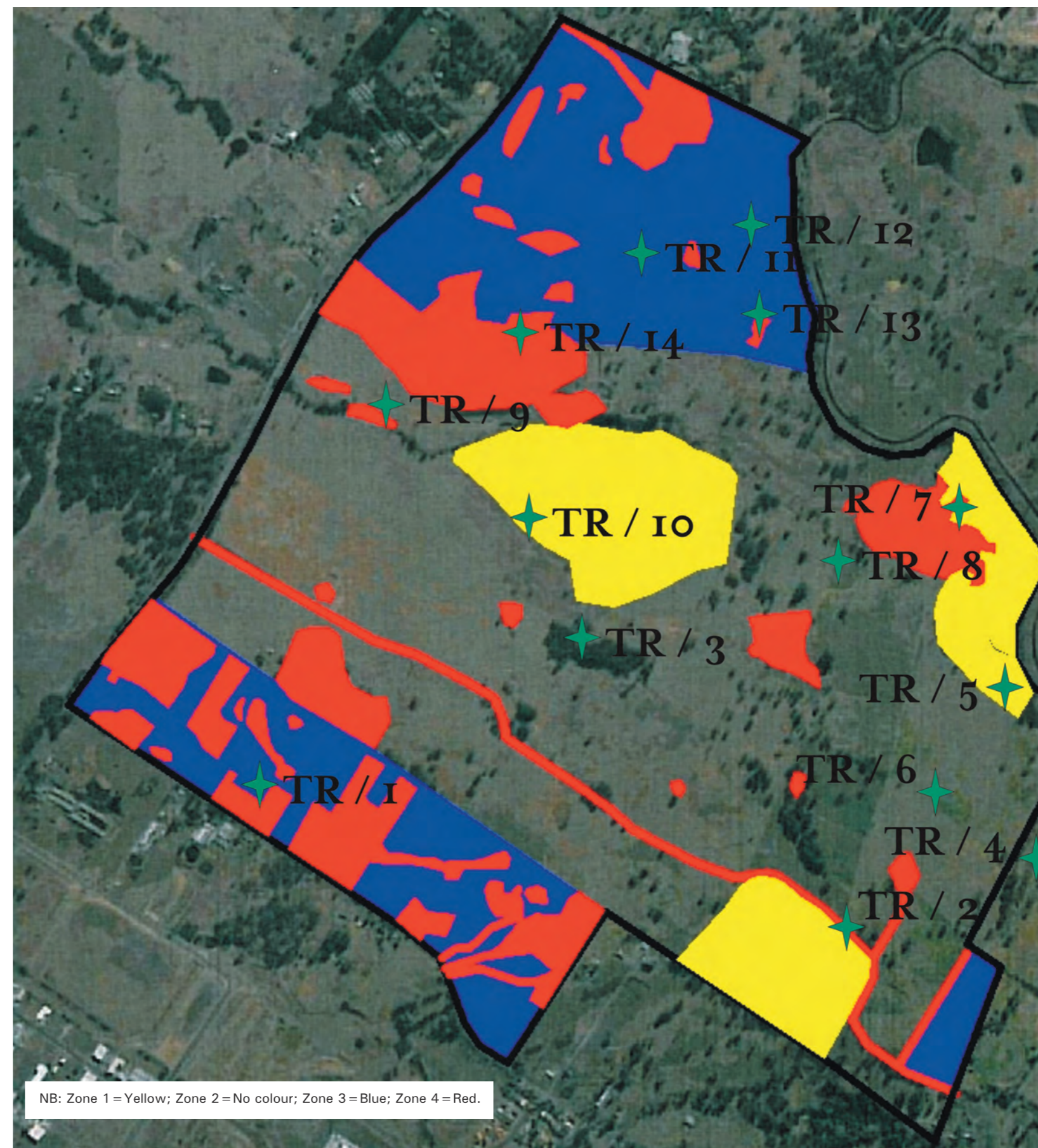


Figure 22 – Identified sites overlaid on ground-truthed sensitivity mapping

Source: Jo McDonald Cultural Heritage Management

5.5.3 Management response

A Conservation Management Strategy (CMS) is to be applied to the Turner Rd Precinct with the aim of conserving a representative sample of intact archaeological landscapes.

Within the Turner Road Precinct, four Management zones were defined ranging from Good Archaeological Potential (Zone 1) to No Archaeological sensitivity (Zone 4). A Conservation Zone - representative of an intact landscape - is to be selected from Zone 1 lands and it is foreseen that, once identified, no development or archaeological investigation would occur within the Conservation Zone.

Approximately 55 hectares of land within Turner Precinct has been identified as falling in Zone 1 representing around 10% of the total land area from the Precinct. Generally a desired conservation outcome would be between 5-10% of the development area, although no standard is currently applied by DEC in Western Sydney. (Criteria for the selection of suitable landscapes as conservation areas are provided in the contractors' report at **Appendix F**).

Specifically, the Zone 1 lands on the banks of South Creek on the eastern side of the Precinct, focusing particularly on PAD-TR1 (see **Figure 23**), will provide a suitable Conservation Zone and be representative of riparian land forms. A Plan of Management will be required for the Conservation Zone to ensure appropriate protection and management of archaeological and cultural values.

The land falling within the Zone 1 areas but outside of the defined conservation area would all be deemed developable. Where these will be impacted, a program of archaeological salvage excavation will be required prior to their destruction. Management principles to guide the selection of areas for salvage will take the form of current best practice approaches (i.e. sampling a defined area usually around 6 hectares in size and achieving open area excavation in the order of 100 square metres). Recommendations for specific areas of salvage should be made once the Conservation Zone has been identified.

The salvage of Zone 1 lands will provide archaeological evidence and context for the conservation area and mitigation against destruction by development of the identified surface sites. Once the Conservation Zone has been identified, development impacts finalised and locations chosen for salvage, a 'whole of development' Section 90 consent should be sought from DEC for the Turner Road Precinct.

Further discussion is required with Aboriginal stakeholders to develop an indigenous heritage strategy for the Turner Road Precinct. The stakeholders involved in the consultation process will provide individual reports on the cultural significance of the sites and landscapes within the Precinct. These cultural significance assessments should be taken into consideration in conjunction with the scientific significance of the landscapes when developing a conservation outcome.

The above measures are considered appropriate within the context of providing both residential and employment land as required by the Structure Plan. The nominated area for a conservation zone also aligns with the proposed riparian corridor and open space on the eastern side of the precinct - so fulfilling two conservation objectives.

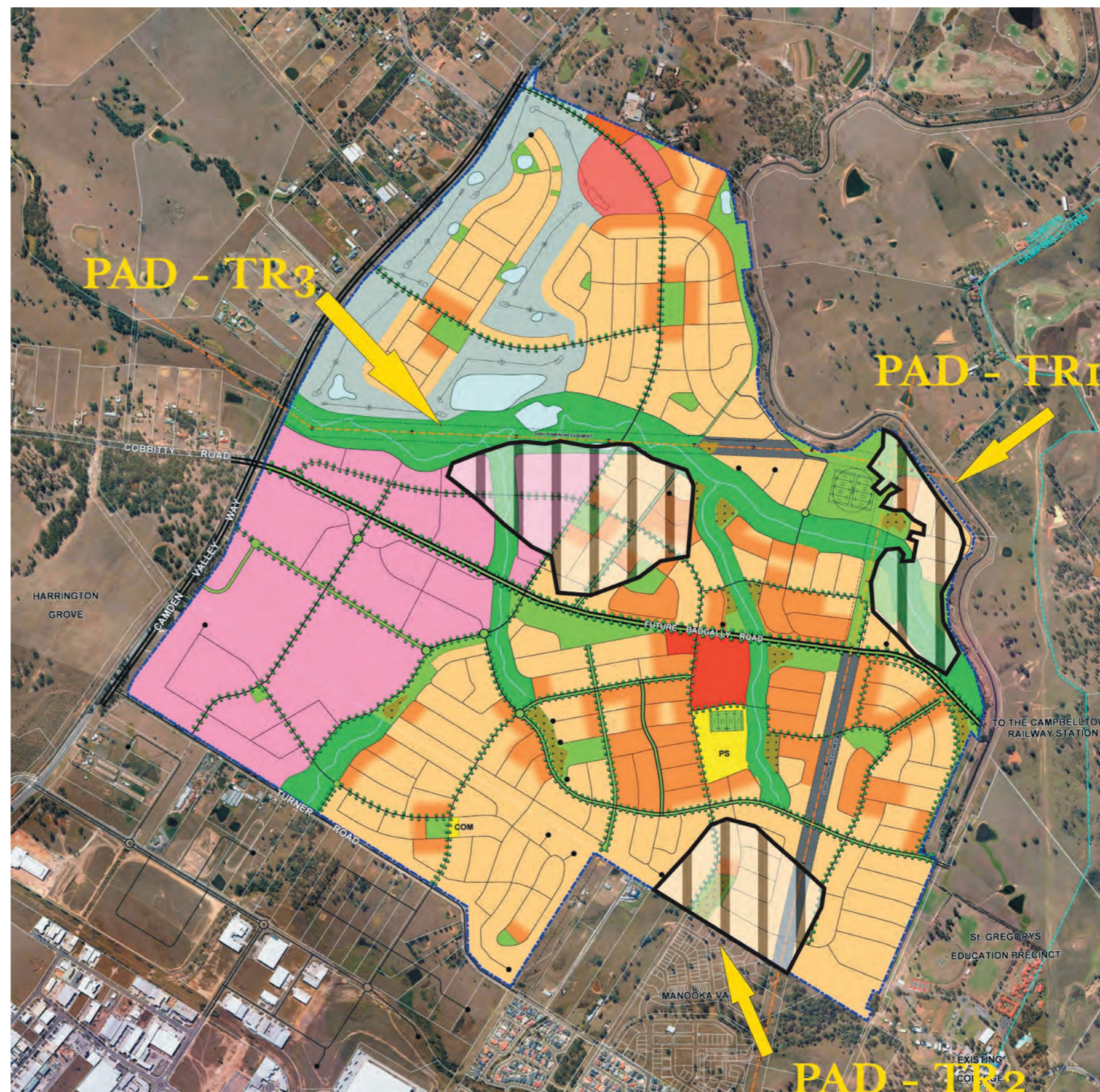


Figure 23 – Potential Archaeological Deposits

Source: Jo McDonald Cultural Heritage Management

5.6 Non-indigenous cultural heritage

Europeans have occupied the Camden area since the early 1800s as its geology, soils, microclimate and proximity to the Nepean River make it ideal farming country. Accordingly, the Turner Road Precinct has a long history of agricultural use.

The GCDC requires that precinct planning respects cultural heritage. Given its historical importance, the GCC commissioned a Heritage Assessment of the Precinct (see **Appendix G**). The aim of the assessment was to identify and describe the heritage values within the Precinct, review existing documentation for identified heritage items and recommend appropriate measures to ensure a comprehensive and co-ordinated approach to protecting and integrating heritage assets in the draft ILP.

5.6.1 Existing conditions

Upper Canal System

The Sydney Water Supply Canal – also known as the Upper Canal – forms the eastern boundary of Turner Road Precinct (see **Figure 24**) but is outside the Precinct.

Listed on the State Heritage Register (SHR) and Camden LEP 48, the Upper Canal has functioned as part of Sydney’s water supply system for over 120 years and, apart from maintenance and other improvements, has changed little.

The Canal is of aesthetic and scientific heritage significance. It is aesthetically significant as it runs in a serpentine route through a rural bushland setting forming an impressive landscape element with sandstone and concrete lined edges. It is scientifically significant as it demonstrates techniques of canal building and evidence of engineering practice. As a whole it is an excellent example of 19th century hydraulic engineering including the use of gravity to feed water along its full length.

Badgally Estate, St Gregory’s Cottage and other buildings

The land associated with the Turner Road Precinct was first awarded as a land grant to George Molle (circa 1814) who was a Lieutenant Governor under Governor Macquarie and owned several grants within the Camden Area. The area was named ‘Molle’s Main’ after Molle’s hometown of Mains in Scotland.

Molle’s son, William Molle, took ownership of the estate in 1817 and following a number of tenancies the estate was sold to Edward Moore in 1866 who renamed the estate ‘Badgally’. In 1876 Moore built a new large house on the estate in which he and his family lived. The house was later to become the first section of St Gregory’s Agricultural College. It is likely that the road known as Badgally Road was first laid out around the same time that the house was built, acting as a link to Camden Valley Way.

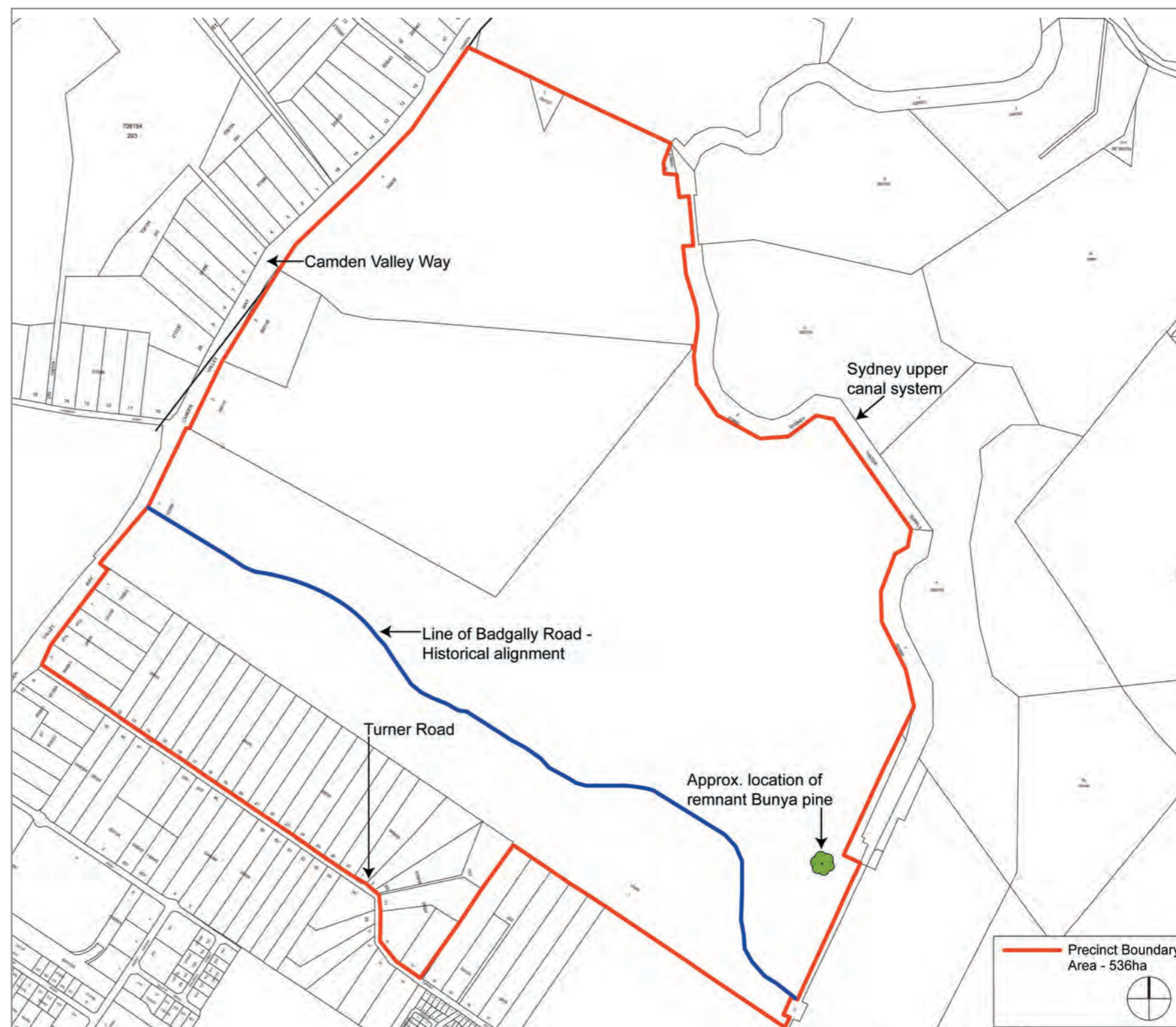


Figure 24 – Non-indigenous heritage features

Source: Godden Mackay Logan

In 1907, 87 acres of land was taken from the estate for the construction of what is now the Upper Canal, and at this time a small cottage was built next to the canal. The cottage and one acre of land was purchased by St Gregory's College in 1937. The former location of the cottage is now marked by a remnant Bunya Pine.

During 1915 and 1918 a number of large subdivisions were made from the Badgally Estate, mainly to the east of the (current) Turner Road Precinct, reducing the size of the estate to 911 acres. Then, in 1922 the estate was purchased by Thomas Donovan and members of the St Vincent de Paul Society. Donovan helped to establish the St Gregory's Agricultural School at Badgally, using the house as the first classrooms and boarding house. The college was the first Catholic agricultural school in Australia and used the surrounding farmlands as a working farm to teach the male students agricultural practice. The college continued to own the former Badgally Estate until after the Second World War.

During the 1950s and 1960s several smaller lots were established within the Turner Road Precinct; and by 1970 Turner Road had been surveyed, scattered development had commenced, and the Camden Valley Golf Resort had been established in the north of the Precinct.

5.6.2 Impacts and assessment

Based on an assessment of the draft ILP, following potential impacts of the plan on the heritage values of the Precinct were identified.

Upper Canal System

The area on the eastern side of the Precinct that adjoins the uncovered section of the Upper Canal is proposed for low and medium density residential with some open space including riparian corridors. The height and scale of the development could potentially compromise the 'rural-bushland' setting of this uncovered section of the canal, defined as an impressive landscape element with sandstone and concrete lined edges. However, the open space areas along the main riparian corridor create a partial transition zone to the eastern boundary of the Precinct so ensuring that the bushland setting of the Upper Canal is retained.

Badgally Estate

Badgally Road, shown in **Figure 24**, is a surviving remnant of the Badgally Estate. While the draft ILP proposes partial retention of the historic road alignment at the entrance to St Gregory's College, the remaining section between Camden Valley Way and the College will be removed.

Former St Gregory's Cottage and the remnant Bunya Pine

The location of the former St Gregory's Cottage is marked by a prominent Bunya Pine located at the junction of the Canal and an existing road running north from the eastern end of Badgally Road (see **Figures 24 & 25**). This remnant planting has the potential to be culturally significant as a marker of the former early twentieth century cottage. Development in this location as indicated in the draft ILP could result in the loss of this tree.

Potential archaeological resources

There is some potential for the survival of historical archaeological relics within the Precinct at historic homestead and farm locations, historic roads and the former St Gregory's Cottage. Development for urban purposes could disturb potential archaeological relics that could provide evidence of:

- pre-settlement landscape and the landscape soon after settlement;
- early agriculture and stock handling activity; and
- nineteenth and early twentieth century domestic occupation.

Where relics exist they will most likely be concentrated around former habitations and along historic roadways. The exact locations of some of the homesteads within the Turner Road Precinct, including Molle's 'commodious cottage', are unknown.



Figure 25 –Bunya Pine

Source: Godden Mackay Logan

5.6.3 Management response

The following measures are recommended to address the heritage issues of the Precinct. Where relevant, development controls in relation to setbacks, heights and the management of archaeological relics and historic places will be reflected in the Turner Road DCP.

Upper Canal System

The Upper Canal System is of State heritage significance. The following measures, have been included in the DCP to reinforce the 'rural bushland' setting of the uncovered sections of the Canal:

- provision of a landscape corridor or perimeter road between the eastern boundary of the Precinct and the Canal; and
- height and setback controls for residential development in this location.

Badgally Estate and Badgally Road

The assessment recommends considering retaining the alignment of the existing Badgally Road for the purposes of interpreting this historic road as an important access road between the former Badgally Estate (later part of St Gregory's College) and Camden Valley Way.

The draft ILP does not propose the retention of the existing Badgally Road. The proposed Badgally Road is to be a new four-lane sub-arterial linking the Precinct and Oran Park with Campbelltown Railway Station and is critical to proposed road network and public transport strategies for the South-West Growth Centre.

Given these conflicting objectives, the retention of the existing of the Badgally Road is not considered reasonable. The name of (the new) Badgally Road interprets its history and a plaque marking its historical alignment and role could be placed at an appropriate location. In addition, the small retained portion of the original alignment could become "Old Badgally Road".

Former St Gregory's Cottage and remnant Bunya Pine

To ensure its retention and for the purposes of interpreting this remnant cultural planting as an important landscape element of the former St Gregory's Cottage, the Bunya Pine is to be retained and suitably interpreted.

Potential archaeological resources

Maps of areas of potential archaeological significance and specific controls have been included within the DCP which requires further investigation to be carried out in these areas prior to development in accordance with the NSW Heritage Manual and provisions of the *Heritage Act 1977*.

5.7 Water cycle management

Urban development increases the impervious proportion of catchments, leading to increases in the frequency, volume and magnitude of stormwater flows. Unless water cycle management measures are introduced, this can result in erosion of streams and increased pollutants being washed into local waterways

It is an objective of the Development Code to ensure that any future development within the Growth Centres incorporates stormwater management principles which mitigate these adverse environmental impacts.

In order to achieve this objective for the Turner Road Precinct, work was commissioned on the management of stormwater quantity and quality and flooding and to prepare a Water Sensitive Urban Design (WSUD) Strategy (see **Appendix C**).

5.7.1 Flooding

Existing Conditions

Turner Road experiences Sydney's sub-tropical climate with rainfall occurring predominantly in late summer and autumn. The mean annual rainfall – measured at Camden Airport – is 828.2mm and the mean number of rain days varies between approximately 7 and 11 days per month. This indicates that there is a high likelihood of rainfall occurring in any month throughout the year.

Turner Road is undulating in relief. The majority of the Precinct has slopes of less than 5% and varies between flat grades along South Creek and tributaries (particularly in the vicinity of Camden Valley Way), to steep slopes (6 - 10%) in the south-east corner. The majority of the site drains to South Creek, although a small proportion drains to the Narellan Creek catchment.

Impacts and assessment

The 100 year Average Recurrence Interval (ARI) flood levels for pre- and post-development conditions are shown in Figures 26 and 27 respectively. Most of the Precinct is generally located above the 1 in 100 year flood level, however this is subject to further detailed creek rehabilitation design. Exceptions to this relate primarily to the locations of existing farm dams.

All farm dams within the precinct are proposed to be either removed or relocated away from the natural creek line. The effect of this removal or relocation of farm dams will be the re-instatement of flood lines to more natural levels along the creeks. As can be seen from **Figure 26**, the existing farm dams cause flood lines to be greater than those along natural creek lines as the height of dams walls result in greater ponding of water.

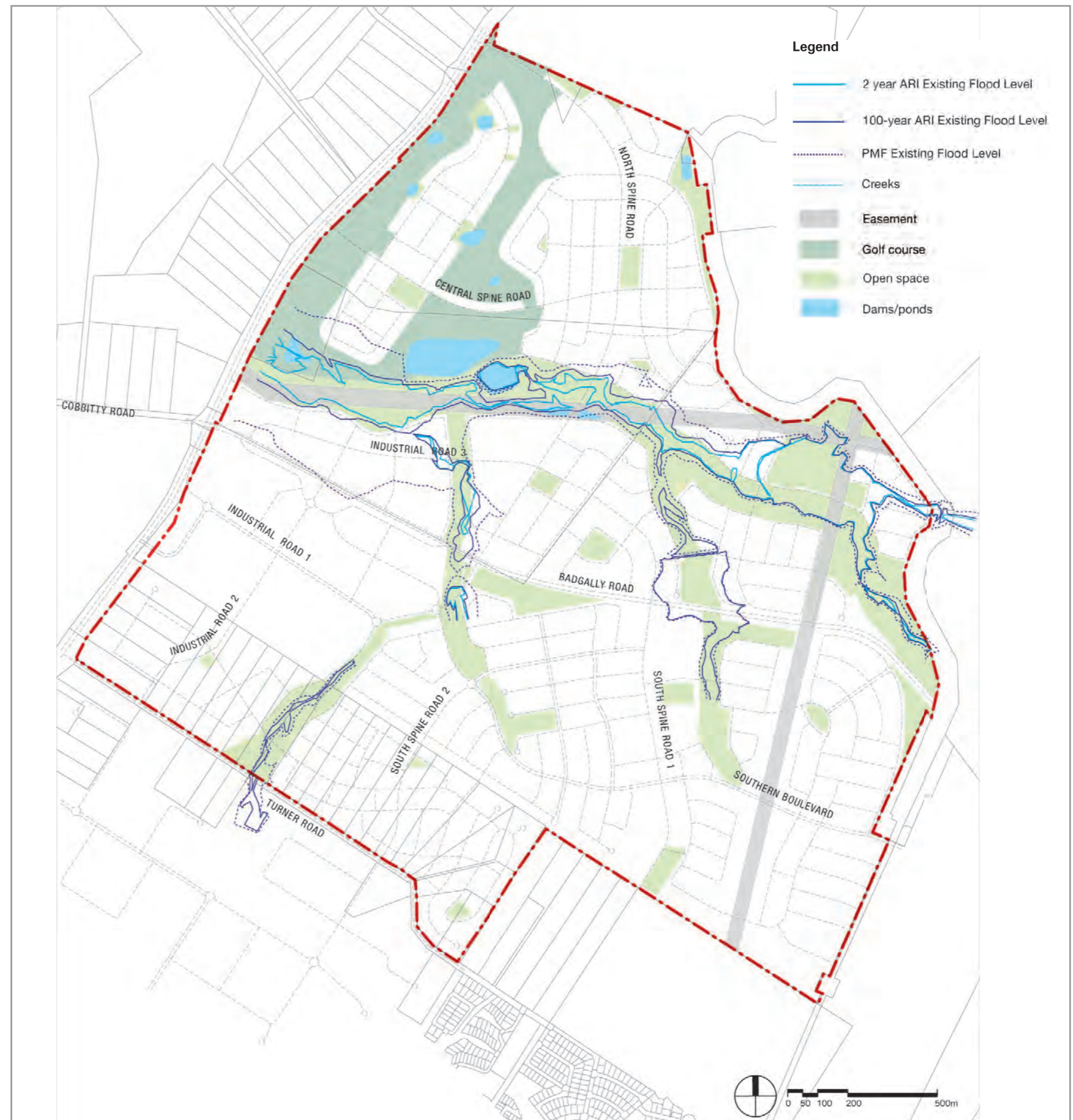


Figure 26 – Existing flood levels

Source: GHD