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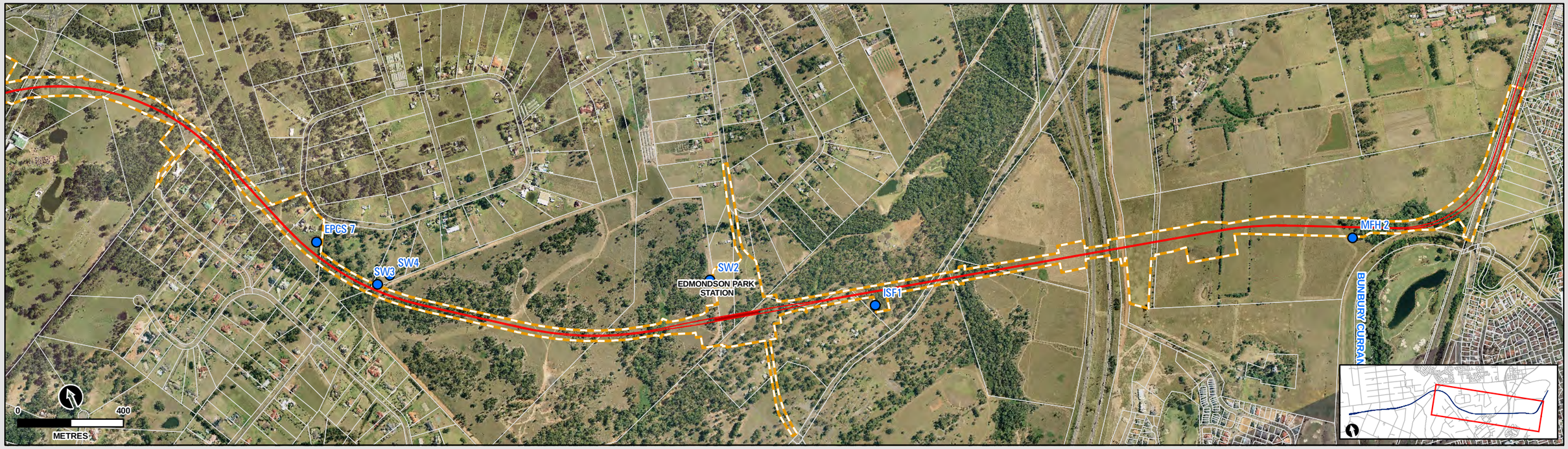


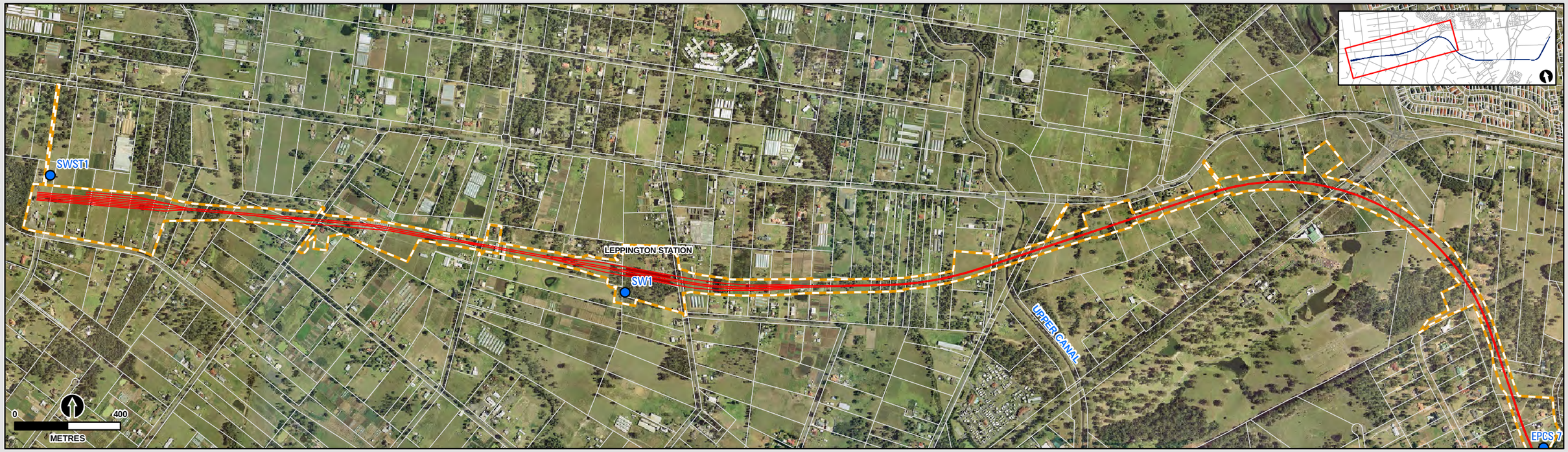


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Cadastre
Rail stations
Drainage
Proposed track
Clearing footprint *
Aboriginal heritage site **

**Figure 4-9** Existing Aboriginal heritage sites

* **Note:** *Clearing footprint includes likely stockpiles and construction compounds*
***Heritage locations sourced from the Australian Museum Business Services 2010*

**Table 4-14 Areas of archaeological sensitivity**

| Area | Location | Archaeological sensitivity | Details |
|---|---|---|---|
| 1 | South-east of project area | Low | Known to contain low density background scatter of stone artefacts. Contains Site MFH#2 (refer Table 4-12). |
| 2 | Within Ingleburn Army Camp | Moderate | Known to contain sites with a moderate density of stone artefacts, in a relatively undisturbed area near a creek confluence. |
| 3 | Near south-east corner of the Edmondson Park Release Area (Landcom land) | High | Known to contain sites with a moderate density of stone artefacts, in a relatively undisturbed area near a creek confluence.<br>Site EPCS4 has high potential for in situ subsurface archaeological deposit. |
| 4 | Within the centre of the Edmondson Park Release Area (Landcom land) | Moderate | Known to contain several sites with a moderate density of stone artefacts. |
| 5 | Near the north-west corner of the Edmondson Park release area (Landcom land) | High | In immediate vicinity of Cabramatta Creek.<br>Contains a moderate density of stone artefacts. |
| 6 | Adjacent to Jardine Drive | Moderate | Comprises a ridge landform with relatively minor disturbance and isolated find Site EPCS7. |
| 7 | North-west and adjacent to the crest | Low | Known to contain sites with low to moderate density of stone artefacts (SWRL Sites 6, 8 and 10; EPCS5 and 6, and LLB1 Edmondson Park)[1]. |
| 8 | Adjacent to Camden Valley Way, near Bringelly – Old Cowpasture Road intersection | Low | Low, swampy area which is relatively undisturbed and contains SWRL Site 3. |
| 9 | Adjacent to the east of Upper Canal and south of Bringelly Road | Moderate | Relatively undisturbed with some mature vegetation.<br>Known to contain project SWRL Sites 4 and 7[1]. |
| 10 | West of and adjacent to Rickard Road | Low | Vegetated area which is relatively undisturbed<br>Site SW1 is located in the vicinity. |
| 11 | Back of properties on McCann Road | High | Immediate vicinity of Kemps Creek, in a vegetated area which is relatively undisturbed.<br>Contains SWRL Site 9[1]. |

Note 1: SWRL Sites 1 to 9 refer to new sites identified during additional field surveys undertaken for the project in 2008 and 2010 (refer to Section 12.3.2 for further discussion on these sites). Site LLB1 Edmondson Park refers to an isolated find previously identified by Navin Officer (2003) (refer Section 4.2.3 of Technical Paper 6 in Volume 2b for further discussion).

### 4.7.4 Aboriginal cultural significance

Cultural significance concerns the value of a site or feature to a particular community group — in this case the local Aboriginal community or communities. Aspects of social significance are relevant to sites, items and landscapes that are important, or have become important, to the local Aboriginal community. This importance involves both traditional links with specific areas, as well as an overall concern by Aboriginal people for sites and landscapes generally and their continued protection.

Aboriginal cultural significance may include social, spiritual, historic and archaeological values. Aboriginal cultural significance assessments can only be made by the relevant Aboriginal communities.

Aboriginal communities consulted throughout the development of the project have indicated that, while all Aboriginal heritage sites recorded contain intrinsic cultural significance, there are no further specific cultural significances attached to the identified sites.

Ongoing consultation would be undertaken with local Aboriginal groups to ascertain any addition items of Aboriginal cultural significance as discussed in Section 6.3 of Technical Paper 6 - Aboriginal Heritage (Volume 2b).

## 4.8 Historic heritage

A full historic heritage assessment has been undertaken by AMBS, which built on the previous assessment for the Concept Plan EA. The report is provided in Technical Paper 7 in Volume 2b. The existing historic heritage environment is summarised in this section, while the assessment findings and proposed mitigation measures are summarised in Chapter 14. The identified historic heritage items are illustrated in Figure 4-10.

The heritage items that are located in proximity to the project corridor and associated infrastructure are listed in Table 4-15. The table also notes which Act the item is protected under and in which register it is listed.

**Table 4-15 Heritage items and listings**

| Heritage item | Protected under | Listed in | Significance[1] |
|---|---|---|---|
| Hurlstone Agricultural High School | *NSW Heritage Act 1997* (NSW Heritage Act) | Campbelltown LEP 2002 | Local significance |
| Macquarie Field House | EPBC Act<br>NSW Heritage Act | Register of the National Estate<br>State Heritage Register<br>National Trust of Australia (NSW)<br>Campbelltown LEP No 112 | National significance<br>State significance |
| Ingleburn Army Camp<br>Ingleburn Village site | EPBC Act<br>NSW Heritage Act | Commonwealth Heritage List<br>Register of the National Estate<br>Campbelltown LEP 2002<br>Liverpool LEP 2008 | National significance |

| Heritage item | Protected under | Listed in | Significance[1] |
|---|---|---|---|
| Denham Court and Chapel | EPBC Act<br>NSW Heritage Act | Register of the National Estate<br>State Heritage Register<br>National Trust of Australia (NSW)<br>Campbelltown LEP 2002 | State significance |
| Upper Canal System (Prospect Reservoir) | NSW Heritage Act | State Heritage Register<br>Liverpool LEP 2008<br>National Trust of Australia (NSW) | State significance |
| Row of Bunya Pines, Bringelly Road | NSW Heritage Act | Liverpool LEP 2008 | Local significance |
| Forest Home | NSW Heritage Act | Liverpool LEP 2008 | Local significance |

Note 1: The full statement of significance is provided in Appendix A of Technical Paper 7 in Volume 2b of this report

The previous heritage assessment undertaken for the Concept Plan EA also identified a number of non-listed heritage items, which are summarised in Table 4-16. No new heritage items were identified in areas that were not surveyed in the previous assessment.

**Table 4-16 Non-listed heritage items identified during the heritage assessment for the Concept Plan EA**

| Item/Area | Location | Statement of significance |
|---|---|---|
| Denham Court, Cowpasture Road and Camden Valley Way viewsheds | Denham Court, Cowpasture Road and Camden Valley Way | The Denham Court viewshed is significant because it allows contemporary visitors to generate some understanding of how the Cumberland Plains were during the 19th Century. Housing development has had a drastic impact upon the number of historic viewsheds that remain on the Cumberland Plain. For this reason alone the Denham Court viewshed is assessed to be of moderate State significance.<br>The Cowpasture Road and Camden Valley Way viewsheds are also important as they show a view of what the early subdivision of agricultural parcels in this region of the Cumberland Plain were like. |
| Cowpasture Road and Camden Valley Way | Cowpasture Road and Camden Valley Way | Cowpasture Road and Camden Valley Way are significant as early examples of communication and transportation routes for goods, produce and services from Parramatta and Sydney Cove to the Cumberland Plains. These roads are also significant for their aesthetic qualities in a landscape that is rapidly changing from rural to urban. Although these roads are not the oldest in the colony, they are relatively early roads for this region. They also represent historic road alignments that have been subject to subsequently less modifications than many of the older existing roads in NSW.<br>Cowpasture Road and Camden Valley Way are assessed to be of moderate State significance. |
| Historic fence line remnants | Tenanted parcel, Leppington | The historic fence line remnants are significant for their ability to contribute to our understanding of changing landscape practices and usage. The remains reflect the shift over time from large, single ownership estates, to smaller tenanted holdings. These remnant fence lines are assessed to be of moderate to low local significance. |

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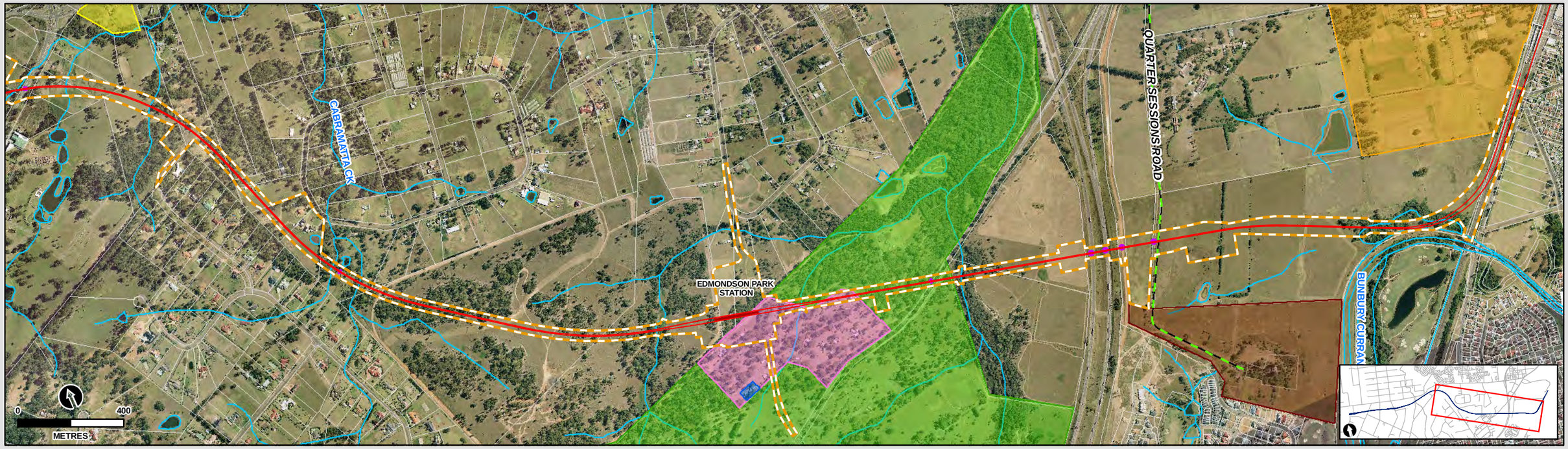


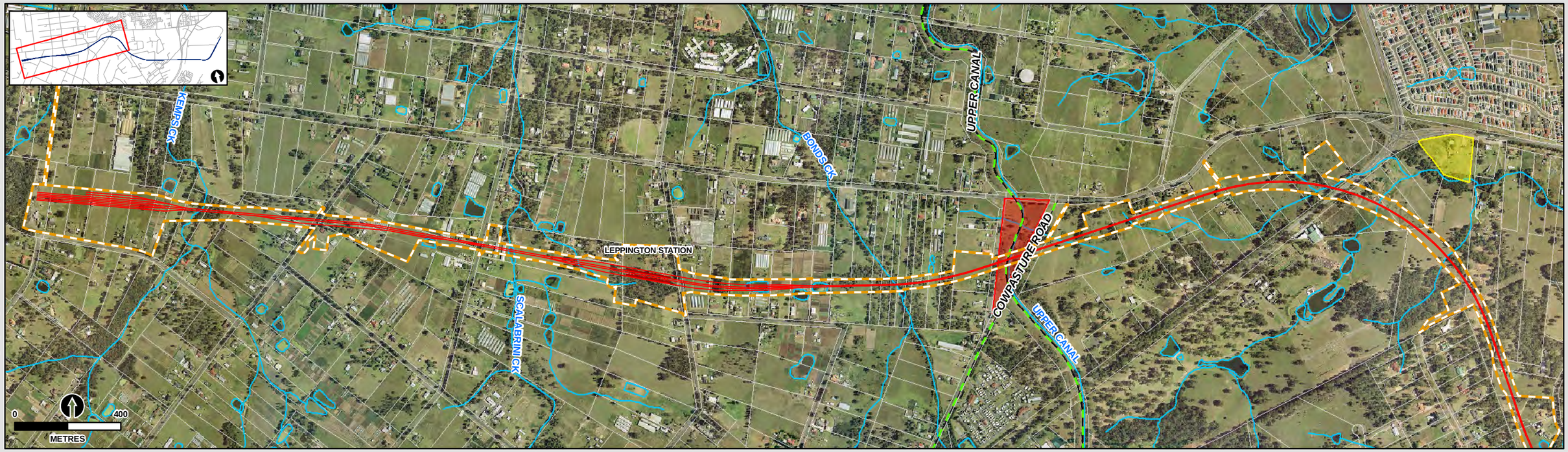


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- Cadastre
- Rail stations
- Drainage
- Proposed track
- Clearing footprint *
- Forest Home Edmondson
- Hurlstone Agricultural High School
- Ingleburn Defence Site
- Ingleburn Village
- Macquarie Fields House
- Riley-Newsum Residences
- Upper Canal Bunya Pines
- Historic Heritage Lines

*Heritage locations sourced from the Australian Museum Business Services 2008

**Figure 4-10** Existing historic heritage items

* Note: Clearing footprint includes likely stockpiles and construction compounds

## 4.9 Soils, geology and hydrogeology

The existing geology and soils of the project area were described in Section 5.2.3 of the Concept Plan EA (PB 2006a) and the *South West Rail Link Environmental Issues Study Summary Report* (Connell Wagner 2003).

Additional geotechnical investigations have been undertaken since the Concept Plan approval and are documented in the *Geotechnical Desk Study – South West Rail Link* (Global Arc 2008a). Using this information, a summary of the soils, geology and hydrogeology of the project area is provided in the following sections.

### 4.9.1 Soil landscape

The soil landscape along the project alignment (as indicated on the *1:100,000 Soil Landscape Series Sheet 9030 for Penrith*; Hazelton et al. 1989) comprises the South Creek, Blacktown and Luddenham soil landscape units. These soil landscapes tend towards moderate to high erosion risk and low to moderate fertility.

### 4.9.2 Geological setting

The geology of the of the study area (as indicated on the *1:100,000 Geological Series Sheet 9030 for Penrith*; NSW Department of Mineral Resources 1991) is predominately underlain by the Wianamatta Group of Triassic age, which compromises shale, carbonaceous claystone, laminate, fine to medium grained lithic sandstone, rare coal and tuff that is predominately of marine origin. The majority of the investigation area is underlain by Bringelly Shale. To the east of the investigation area, the Ashfield Shale and Mitchinbury Sandstone outcrops stratigraphically overlay the Bringelly Shale. The creek systems are flanked by surficial Quaternary fluvial deposits, comprising medium-grained sands, clays and silts.

Dolerite dykes of Jurassic age intrude the Bringelly Shale and form locally prominent ridgelines. A north-west to south-west trending ridgeline crosscuts the Badgerys Creek and Kemps Creek catchments. The Luddenham Dyke extends for approximately 8.5 kilometres and attains a maximum thickness of 10 metres to 12 metres, dipping to the south-west at approximately 85 degrees.

### 4.9.3 Hydrogeological setting

The hydrological regime of the project area is dictated by the structural and textural characteristics of the Bringelly Shale. Bringelly Shale is typically characterised by negligible porosity and permeability as well as low groundwater velocities due to the fine-grained and consolidated nature of the interbedded claystones and siltstones. Groundwater quality in the shale is typically brackish (poor) and commonly has naturally high concentrations of some metals.

Perched groundwater may be present in localised fill areas overlying the weathered shale, especially after a significant rainfall event. Groundwater is likely to be hydraulically connected to the creek systems. Environmental receptors, such as creek systems or low lying areas, may occur at locations where groundwater discharges. Salt scalding may occur in low lying areas where saline water from the Bringelly Shale discharges.

Standing water levels across the Badgerys Creek area within the Bringelly Shale are variable, depending on the location within the landscape. Typically the elevation of groundwater within the Bringelly Shale is a subdued reflection of the topography, with the

depth to groundwater deeper beneath elevated landscape locations and shallower down gradient. Water levels measured within the Bringelly Shale vary between 3.5 metres and 11.7 metres below ground level.

The watertable within the alluvial aquifer is within 1 to 4 metres of the ground surface and within one metre of creek levels. These water levels suggest a degree of connection between the alluvial aquifer, creeks and possible base flow to creeks. In each case, measured groundwater levels in the alluvial aquifer were higher than those in the shale aquifer indicating the two systems are not hydraulically linked.

Groundwater flow within the alluvial aquifer is localised in a down hydraulic gradient towards the creeks. Groundwater flow within the Bringelly Shale is complex, but predominately in a south-westerly direction. Locally, the presence of dolerite dykes can create barriers to groundwater flow and cause groundwater mounding and natural outbreaks of salinity. The Luddenham Dyke influences groundwater flow, with a groundwater mound formed on the topographical high in the Badgerys Creek and Kemps Creek areas.

### 4.9.4 Salinity risk

Salts are naturally present in soil and rock and mobilised in the subsurface by groundwater movement. Urban salinity is primarily caused by rising water tables (due to altered land use practices) and/or disrupted groundwater flow paths. Salts deposited from shallow groundwater are often highly corrosive and can degrade building materials such as bricks, concrete and steel structures.

Occurrences of saline soils and groundwater are known to occur in western Sydney. The area has been recognised by the NSW Office of Water (NOW) as prone to the development of dryland salinity. To improve awareness of salinity hazards in western Sydney, NOW (formerly the Department of Land and Water Conservation) published a draft map of salinity hazards (Department of Land and Water Conservation 2003), which is presented in Figure 4-11. This map takes account of the topography and geometry of the landscape, known salinity occurrences, and rock and soil types to divide western Sydney into three units of salinity hazard.

As indicated in Figure 4-11, the project area is mapped as containing areas of localised salinity hazard. This hazard ranking corresponds to areas covering the Bringelly Shale, where no salinity outbreaks have been mapped. However, unidentified saline areas may occur in this hazard zone.

The remainder of the project area, including low lying areas adjacent to the major creek lines and indistinct drainage lines, are mapped as areas of extensive salinity hazard. Areas of extensive salinity hazard are areas where geologic or soil mapping indicate the presence of susceptible materials (like sodic soils), and topographic or groundwater settings that predispose a site to salinity. Often this category covers lower slopes and drainage lines that can become waterlogged and result in saline seeps and scalds.

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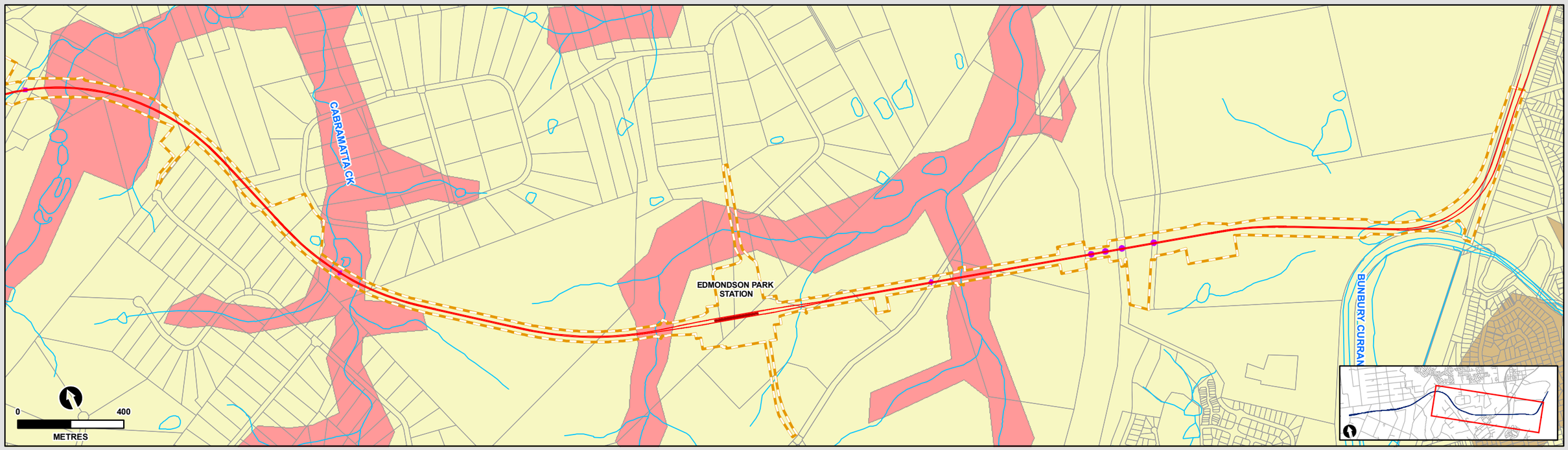


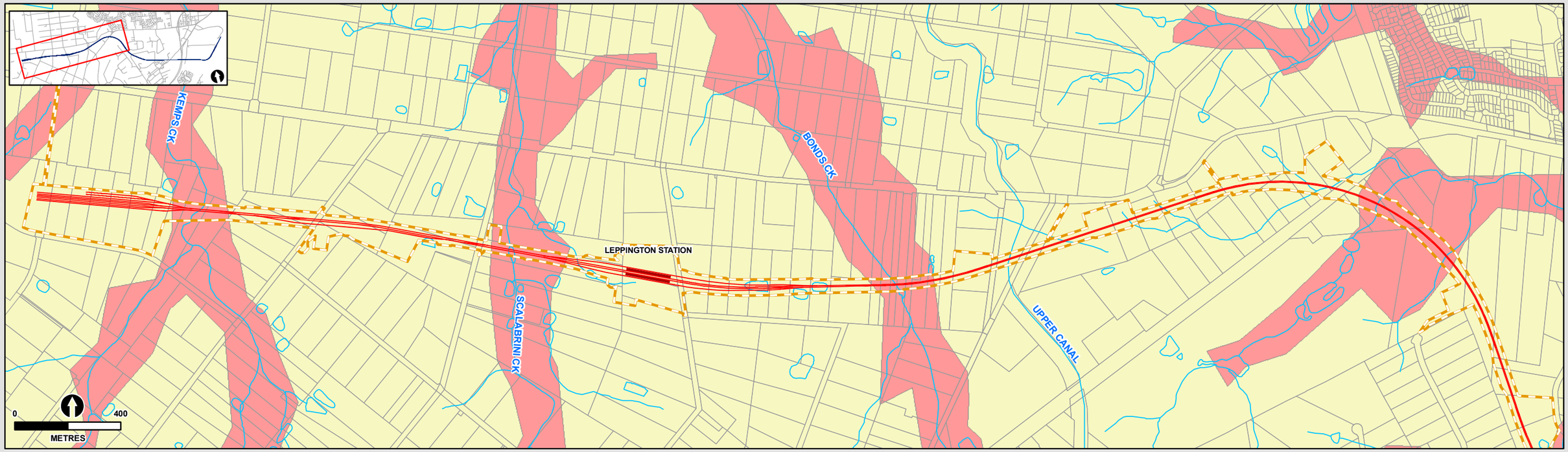


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Cadastre
Rail stations
Drainage
Proposed track
Clearing footprint *

**Salinity Hazard**

Areas of Extensive Salinity Hazard
Areas of Localised Hazard
Areas of no Known Hazard

**Figure 4-11** Salinity Hazard Mapping

* Note: Clearing footprint includes likely stockpiles and construction compounds

## 4.10 Future environment

### 4.10.1 Masterplanning of the SWGC

The project would be situated in and service the SWGC. The land in this area is being released to respond to Sydney's growing population. As such, development would occur throughout the SWGC at different stages. The SWGC Structure Plan (GCC 2008) is shown in Figure 4-11.

#### Masterplanning of Edmondson Park and Leppington town centres

Urban development around the interchanges at Edmondson Park and Leppington will be guided by masterplans that address urban form including road layouts, public domain, densities and building heights. The functioning of each centre will be influenced primarily by the built form of the station precincts (station accesses, pedestrian and cyclist provisions, bus interchanges and parking provisions).

At both centres, masterplans are being developed; however, neither of these had been finalised at the time of placing this EA on exhibition. TIDC is currently liaising with DoP regarding Leppington, and Landcom and Liverpool City Council regarding Edmondson Park. Matters in discussion include requirements for station interchange facilities and road and bridge requirements at Day 1 of operations (i.e. 2016) as well as during the various development stages of the town centres.

Importantly, while town centre masterplans already exists for Edmondson Park, and is defined in both an adopted Liverpool Council *Local Environmental Plan 2008* and development control plan, the current masterplanning process at this location is intended to supersede these adopted plans and achieve a more effective urban form.

TIDC's main objectives in working with government stakeholders on the masterplanning being undertaken by Landcom during the delivery phase of the project are to have the planning for the development of the town centres integrating and supporting the new stations, as well as providing a high level of safety, accessibility and amenity for all at the town centres and station precincts.

### 4.10.2 Impacts of climate change on future hydrology

Research into the potential impacts of climate change has been rapidly evolving over recent years. Current reports indicate that climate change is likely to result in more frequent and intense storms as well as sea level rises. Changes in flood behaviour due to climate change have the potential to increase the risk of inundation and associated impacts of the project.

The project area is prone to inundation from a number of creeks, and the urbanisation of the catchment will also lead to substantial changes. The impacts of climate change and associated ramifications on development decisions could be significant, and an assessment of the potential impacts on flood behaviour is, therefore, essential.

Studies undertaken by the Commonwealth Scientific and Research Organisation (CSIRO) in conjunction with the Bureau of Meteorology (BoM) in 2007 (CSIRO 2007) investigated past and likely future changes to climate in NSW. The outcomes estimate that extreme rainfall (defined as a 1 in 40 year 1 day total rainfall event) would be likely to increase by up to 12% for the Sydney metropolitan catchments as well as the Hawkesbury-Nepean catchment by 2030.

The NSW Department of Environment, Climate Change and Water (DECCW) *Draft Floodplain Risk Management Guideline – Practical Consideration of Climate Change* recommends a sensitivity analysis for increases in rainfall of between 10% and 30%. However, given the research undertaken by CSIRO/BoM, it is considered that a rainfall increase of 10% would provide an appropriate assessment of the effects of increases in rainfall due to climate change on the catchments of the project. Consideration of increases in rainfall and the effects on flooding are discussed further in Chapter 11.

A more detailed assessment of the hydraulic, drainage and flooding issues is provided in Chapter 11 and Technical Paper 3 (Hydrology) in Volume 2b.

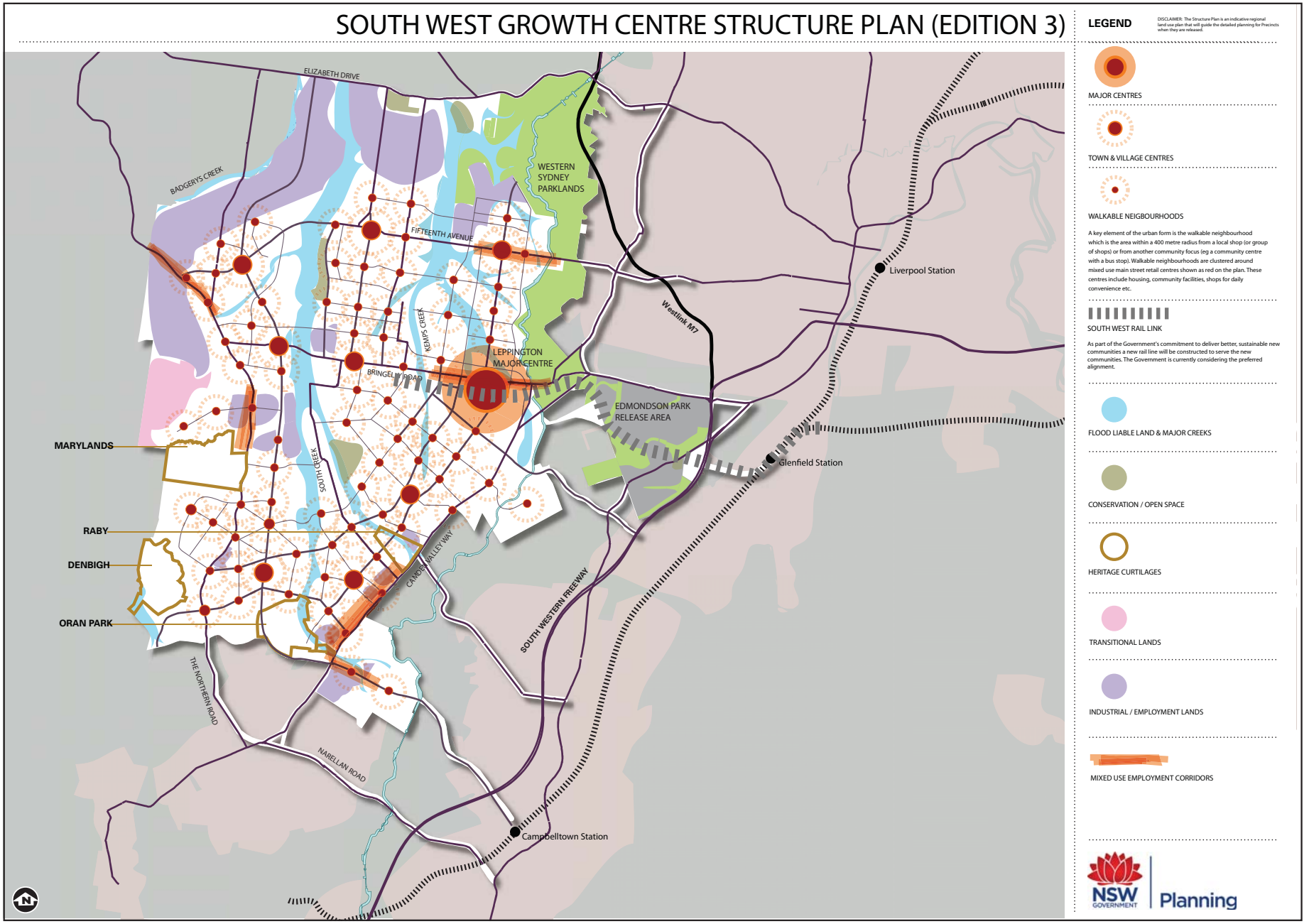


**Figure 4-12** South West Growth Centre Structure Plan