

5. Development of the project since Concept Plan

Chapter 5 provides a discussion on the design development of the Glenfield to Leppington Rail Line project (the project) that has occurred since the South West Rail Link (SWRL) Concept Plan approval in August 2007. The design was developed through further and more detailed studies. The current concept design has been developed as a preferred option addressing environmental, social and economic constraints of the SWRL corridor and surrounds.

This chapter also discusses the options development process, including the vertical and horizontal alignment, road and watercourse crossings, stations and the Leppington Train Stabling Facility. Furthermore, it details the analysis (through environmental design workshops, environmental risk analysis and investigation into sustainability initiatives) undertaken to arrive at the current preferred option for the project. The chapter concludes with a discussion on how the project has been designed to provide for an extension past Rossmore in the future, should it be required.

This chapter provides a preamble to Chapter 6, which describes the physical works, operational and construction aspects of the project for which project approval is sought.

5.1 Overview of the Concept Plan

The Concept Plan for the SWRL, as approved, is documented in:

- the *South West Rail Link Environmental Assessment and Concept Plan* (PB 2006)
- the *South West Rail Link Submissions Report* (PB 2007)
- the Concept Plan Minister's Conditions of Approval (MCoA) dated 29 August 2007.

The Concept Plan approval defines the SWRL Concept Plan as follows:

'The South West Rail Link, being the construction and operation of a new dual-track electrified rail line, between East Rossmore and Glenfield, comprising the:

- Stage A (Glenfield rail corridor) project:
 - the full construction and operation of Glenfield North Flyover (and associated track reconfigurations) independent of Stage B projects, if required
 - the partial construction of the Glenfield South Flyover
 - establishment of temporary construction sites, generally in the locations shown in Figure 4-5 of the *South West Rail Link Submissions Report*, dated May 2007, prepared by Parsons Brinckerhoff.
- Stage B1 (Glenfield Station) project: the construction and operation of the Glenfield station upgrade and associated ancillary infrastructure.
- Stage B2 (remaining works) project(s) [now referred to as Glenfield to Leppington Rail Line]: the construction and operation of the remainder of the South West Rail Link and associated ancillary infrastructure, including:
 - the remainder of the [Glenfield] Southern Flyover
 - a new dual-track electrified rail line between the existing rail corridor at Glenfield and East Rossmore
 - two new stations at Edmondson Park and Leppington
 - a stabling facility at East Rossmore'.

The Concept Plan approval approved a high level Concept Plan for the SWRL, which contemplated an ongoing detailed planning phase during which the SWRL would be subject to further detailed design and environmental assessment.

5.2 Design development for project approval

The project has been subject to ongoing design development since the Concept Plan approval in August 2007. The design development since the Concept Plan approval was based on the following objectives:

- to achieve a high level of environmental and sustainability performance for the construction and operation of the project
- to achieve value for money in the project construction and operation
- to meet RailCorp's anticipated operational objectives for the project
- to address the design issues relevant to the project as set out in the Minister's Conditions of Approval (MCoA) and Statement of Commitments (SoC) for the Concept Plan.

The options assessed and features of the design that have been amended are described in this section, along with assessment of compliance of the amended project with the Concept Plan approval.

5.2.1 Compliance of the project with the Concept Plan approval

This section seeks to demonstrate that the project as proposed in this Environmental Assessment (EA) is consistent with the scope and intent of the Concept Plan approval.

Section 20.3 of the Concept Plan EA outlined the scope of the Concept Plan approval, while Section 20.5 of Concept Plan EA established the scope of additional design and environmental assessment that was proposed to be undertaken for the following elements post Concept Plan Approval, as summarised below:

- **SWRL corridor design development and infrastructure:** As described in Section 20.5.1 of the Concept Plan EA, further design development was proposed to better define some elements of the rail infrastructure within and, in some cases, outside of the approved rail corridor, including where necessary (and relevant to the changes proposed in this EA):
 - structures, including rail overbridges, waterway crossings (bridges and reinforced concrete box culverts), retaining walls and noise walls
 - earthworks – embankments and cuttings
 - gantry structures and electrical infrastructure
 - adjustments and relocation of utility services
 - trackwork.

Section 20.5.1 of the Concept Plan EA also noted that more detailed designs for the rail alignment and associated infrastructure would be prepared.

- **Edmondson Park and Leppington stations:** As described in Section 20.5.3 of the Concept Plan EA, additional design and environmental assessment was proposed to be undertaken for the following elements (as relevant to the changes proposed in this EA):
 - transport interchange facilities – access, parking, bus bays and kiss-and-ride.

- **Leppington Train Stabling Facility:** As described in Section 20.5.4 of the Concept Plan EA, additional assessment was proposed for the stabling facility to cover future design work, including where necessary (and relevant to the changes proposed in this EA):
 - location, engineering and architectural design of buildings and associated structures
 - yard lay-out, trackwork and signalling
 - access and parking facilities.
- **Construction sites:** As described in Section 20.5.5 of the Concept Plan EA, additional assessment was proposed to confirm the exact location, number, footprint and layout of the proposed construction sites.

In addition to the further design and environmental assessment foreshadowed by Section 20.5 of the Concept Plan EA, MCoA 2.4(f) required that the project footprint be confirmed 'identifying any additional land required for operational noise mitigation measures, flood mitigation measures and ancillary infrastructure not identified in Conditions 1.1 (a) to (c)'. (Documents referred to in Conditions (a) to (c) comprise Major Project Application 06_0158, the Concept Plan EA and the Concept Plan Submissions Report (PB 2007).) Ancillary infrastructure, as defined in Schedule 2 of the MCoA, comprises 'other infrastructure required for the construction and operation of the [SWRL], including supporting infrastructure such as provision for bus, taxi, kiss and ride, parking, pedestrians and cyclists; and temporary construction sites'.

MCoA 2.4(f) also requires that a 'review [of] patronage and mode-share predictions [be undertaken], taking into account planned progressive land use change, and describe how the design of kiss and ride, taxi, bus, parking, pedestrian and cycle provisions....accommodates the predicted demand'.

By virtue of the provisions outlined above, all design developments since the Concept Plan approval, as proposed in this EA, are considered to be consistent with the Concept Plan approval — as they are consistent with the scope of further design development foreshadowed by Section 20.5 of the Concept Plan EA and MCoA 2.4(f), and/or they represent such minor deviations from the Concept Plan as approved, that they are 'generally consistent with the scope and intent of the concept plan' as required by MCoA 2.4 (b).

Demonstration of the project's compliance with the Concept Plan approval, following the design development to date, is provided in Table 5-1, which also provides a summary of the relevant aspects of the project design that were approved under the Concept Plan. Table 5-1 also provides a discussion on how the proposed design changes are consistent with the original Concept Plan approval.

Table 5-1 presents a summary of the main design and operational changes made to the SWRL project since concept approval and concludes that the changes are generally consistent with the SWRL concept approval as they do not materially alter the nature of the project.

Table 5-1 Compliance of the project with the Concept Plan Approval

Element of the project	Design approved under the Concept Plan	Design proposed in this EA	Consistency with the Concept Plan approval
Location of Glenfield Southern Flyover	South of Salisbury Avenue (approximate Chainage 42.300 kilometres)	Relocated approximately 70 metres south of the alignment approved under the Concept Plan	As described in Section 5.2.1, Section 20.5.1 of the Concept Plan EA provided that 'further design development is required to better define some elements of the rail infrastructure within and, in some cases, outside of the [approved rail] corridor, including where necessary... structures, including overbridges, waterway crossings (bridges and reinforced concrete box culverts), retaining walls and noise walls'. The location of the Glenfield Southern Flyover was broadly defined in Figure 20-2 of the Concept Plan EA. While this EA seeks to relocate the flyover structure 70 metres south of the location approved under the Concept Plan, this change would not substantially increase the impact of the project and, as such, is considered to be generally consistent with the Concept Plan approval. Furthermore no additional properties are impacted due to the proposed modification to the alignment.
Horizontal alignment of rail corridor west of Glenfield junction	Horizontal alignment as shown in Figure 20-2 of the Concept Plan EA	Rail corridor alignment relocated approximately 70 metres to the south of the approved corridor for a distance of 1.3 kilometres (refer Figure 6-1a to c in this EA)	Section 3.2.1 of the Concept Plan EA (PB 2006) states that 'the purpose of the Concept Plan EA is to fix the SWRL corridor alignment...for the purpose of corridor (property) acquisition and facilitation of ongoing land use planning within the South West Growth Centre'.
Horizontal alignment of rail corridor east of Leppington Station	Horizontal alignment as shown in Figure 20-2 of the Concept Plan EA	Realignment of the rail corridor approximately 37 metres to the north of the approved corridor for a distance of approximately 0.8 kilometres and the modification of the track alignment from a curved to a straight track (refer Figure 6-1l in this EA)	MCoA 2.4(f) requires that the project footprint be confirmed 'identifying any additional land required for operational noise mitigation measures, flood mitigation measures and ancillary infrastructure not identified in the' Major Project Application 06_0158, the Concept Plan EA and the Concept Plan Submissions Report (PB 2007). Furthermore, Section 20.5.1 of the Concept Plan EA states that 'more detailed designs for the rail alignment and associated infrastructure...would be prepared'. The horizontal alignment of the project is broadly consistent with the horizontal alignment approved under the Concept Plan. While the project as proposed in this EA involves two minor deviations of the rail corridor (i.e. west of Glenfield Junction and East of Leppington Station) relative to the Concept Plan, these changes would not substantially change the impact of the project and, as such, are generally considered to be consistent with the Concept Plan approval. Furthermore no additional properties are impacted due to the proposed modification to the alignment.

Element of the project	Design approved under the Concept Plan	Design proposed in this EA	Consistency with the Concept Plan approval
Dickson Road crossing	Cross over Dickson Road via an underbridge	Cross under Dickson Road via an overbridge	The proposed design changes to the Dickson Road and Eastwood Road crossings were made as a result of further design development since the approval of the Concept Plan and are consistent with the further design development foreshadowed by Section 20.5.1 of the Concept Plan EA and MCoA 2.4(f), as discussed in Section 5.2.1. As such they are considered to be consistent with the Concept Plan approval.
Eastwood Road crossing	Flyover road bridge	A road overbridge with Eastwood Road on embankment and the SWRL alignment in cutting	
Rail corridor width	Approximately 40 metres, increasing to approximately 60 metres around the proposed stations and approximately 200 metres around the stabling facility	Parts of the rail corridor widened marginally beyond the approved rail corridor to accommodate embankment works and other ancillary infrastructure, such as access/maintenance roads, substations, transport interchanges and commuter car parks	Overall, the extent of the project footprint beyond the approved corridor is relatively minor, and has taken into account the need to avoid impacts on environmentally sensitive areas. The proposed design changes were made as a result of further design development since the approval of the Concept Plan and are consistent with the further design development foreshadowed by Section 20.5.1 of the Concept Plan EA and MCoA 2.4(f), as discussed in Section 5.2.1. As such they are considered to be consistent with the Concept Plan approval.
Edmondson Park Station and associated car parking provisions	Station would contain an overhead concourse with stairs and lifts as well as staff and ticketing facilities. The platform would be a single 170 metre long island platform, with design provision for future extension to 210 metres. The station would provide approximately 250 car parking spaces on day 1 of operation.	Station would contain a 170 metre long single island platform serviced by an overhead concourse containing ticket booths, staff facilities, centrally located stairs and a lift. The station would provide approximately 400 car parking spaces on day 1 of operation. These spaces would be contained in two at-grade car parks located outside the approved rail corridor on the northern and southern sides of the station.	<i>Car park locations</i> The inclusion of the proposed at-grade car parks outside the approved rail corridor on the northern and southern sides of Edmondson Park and Leppington stations are considered to be consistent with the Concept Plan approval as this infrastructure is consistent with the further design development foreshadowed by Section 20.3.3 of the Concept Plan EA and MCoA 2.4(f), as discussed in Section 5.2.1. <i>Car parking provisions</i> Sections 20.3.3 and 20.5.3 of the Concept Plan EA provide that further design development would be undertaken for a number

Element of the project	Design approved under the Concept Plan	Design proposed in this EA	Consistency with the Concept Plan approval
Leppington Station and associated car parking provisions	Station would contain two island platforms served by an overhead concourse with stairs and lifts as well as staff and ticketing facilities. The station would provide approximately 1,000 car parking spaces on day 1 of operation.	Station would contain two 170 metre long island platforms served by an overhead concourse containing ticket booths, staff facilities, two centrally located stairs and a lift. The station would provide approximately 850 car parking spaces on day 1 of operation. These spaces would be contained in two at-grade car parks located outside the approved rail corridor on the northern and southern sides of the station.	
Integral Energy, Camden Valley Way and Leppington substations, and section hut at Edmondson Park Station	At least one additional substation was outlined as likely to be required along the proposed alignment; however, the location of this substation was not defined	Three substations would be required in the following locations: - Integral Energy Substation – south of the rail corridor off Cassidy Street, Denham Court - Camden Valley Way Substation – west of Camden Valley Way - Leppington Substation – at the Leppington Train Stabling Facility. A section hut is also proposed south of Edmondson Park Station.	The Integral Energy, Camden Valley Way and Leppington substations, and the section hut at Edmondson Park Station, are consistent with the further design development foreshadowed by Section 20.5.1 of the Concept Plan EA and MCoA 2.4(f), as discussed in Section 5.2.1. Therefore, this infrastructure is considered to be consistent with the Concept Plan approval.
Leppington Train Stabling Facility	Stabling of 12 eight-carriage trains on opening, with ultimate provision for up to 20 eight-carriage sets as demand for rolling-stock increases. A staff car park for approximately 30 cars.	Stabling of 12 eight-carriage trains on opening, with ultimate provision for up to 20 eight-carriage sets as demand for rolling-stock increases. Two machine sidings (i.e. rows of tracks) to accommodate train maintenance vehicles. A staff car park for approximately 60 cars.	Section 20.5.4 of the Concept Plan EA provides that the 'size location of the stabling facility has been determined'. Section 20.5.4 also states that 'additional assessment is proposed for the stabling facility to cover future design work, including where necessary...yard lay-out, trackwork and signalling...[and] access and parking facilities'. The proposed design changes would not alter the size or location of the Leppington Train Stabling Facility and are consistent with the further design development foreshadowed by Section 20.5.4 of the Concept Plan EA. Therefore, the proposed changes are considered to be consistent with the Concept Plan approval.

Element of the project	Design approved under the Concept Plan	Design proposed in this EA	Consistency with the Concept Plan approval
Construction sites	Eight construction sites were proposed for the project, as shown in Figure 8-2 of the Concept Plan EA.	Eleven construction compounds and seven stockpile sites are proposed, as shown in Figure 6-17 in this EA.	As discussed in Section 5.2.1, the proposed amendments to the location, number and sizes of the construction sites are consistent with the future design development foreshadowed by Section 20.5.5 of the Concept Plan EA and MCoA 2.4(f) (i.e. relating to the confirmation of the construction footprint, including ancillary infrastructure). Therefore, the amendments to the construction sites are considered to be consistent with the Concept Plan approval.
Commencement of construction	2009	2010 (subject to project approval)	While the Concept Plan EA assumed construction would commence in 2009, this was not part of the MCoA and is not a material consideration when determining compliance of the EA with the Concept Plan approval.
Commencement of operations	2012	2016	While the Concept Plan EA assumed operations would commence in 2012, this was not part of the MCoA and is not a material consideration when determining compliance of the EA with the Concept Plan approval.

5.2.2 Vertical and horizontal alignment

Vertical alignment

Design development of the vertical alignment has been influenced by the required operational specifications for efficiency (and associated reductions in energy use), and to address the constraints that result from the project crossing existing infrastructure such as roads and watercourses, and the surrounding topography.

A simulation exercise was undertaken to evaluate train performances on the Concept Plan alignment as part of the design development process. As a result of this simulation, a number of areas were revisited to determine if the vertical alignment and, therefore, the overall operational efficiency of the project, could be improved. The areas investigated included:

- Glenfield South Junction to Hume Highway and the Campbelltown Road crossing
- Edmondson Park Station and the Cabramatta Creek crossing
- Leppington Station to the road crossings at Dickson Road and Eastwood Road.

These areas and the options for each are discussed in further detail below.

Glenfield South Junction to Hume Highway and the Campbelltown Road crossing

A number of options were considered to reduce the 2.35% grade from Glenfield South Junction to Campbelltown Road. The options considered were:

- Base option - Maintain initial 2.35% grade, but lower track after Hume Highway and over Campbelltown Road. Track would rise after Campbelltown Road to Creek No. 6.
- Option 1A— Lower track to reduce grade from 2.35% to 1.61% through Hume Highway to Creek No. 6, with an at-grade crossing at Campbelltown Road. This would remove the 'peak' over Campbelltown Road.
- Option 1B— Maintain a 2.35% grade through Hume Highway to Creek No. 6, with an at-grade crossing at Campbelltown Road. This would also remove the 'peak' over Campbelltown Road.
- Option 2A— Lower track to reduce grade from 2.35% to 1.14% through Hume Highway and beneath Campbelltown Road. Track would rise after Campbelltown Road to Creek No. 6.
- Option 2B— Maintain initial 2.35% grade, but lower track through Hume Highway and beneath Campbelltown Road. Track would rise after Campbelltown Road to Creek No. 6.

A preferred option was identified following consideration of these options at a Transport Infrastructure Development Corporation (TIDC) civil value management workshop on 18 January 2010. The base option was selected as the preferred option, which was to provide a rail line underpass beneath the Hume Highway, which continues in a cutting and then passes over Campbelltown Road. Although there are a number of benefits to options which pass under Campbelltown Road, such as improved visual appearance and less noise impacts, the preferred option would reduce potential flooding of the rail corridor, the need for additional earthworks and maintenance associated with constructing a rail line under a main road. Options for the crossing at Campbelltown Road are still being considered.

Minor adjustments to the vertical and horizontal alignment would continue through detailed design.

Edmondson Park Station and the Cabramatta Creek Crossing

The objective for further assessment of the Edmondson Park Station and Cabramatta Creek crossing was to remove the 'peak' caused by the rail line following the contours of the natural topography, to the west of Edmondson Park Station. The alternative considered was to raise Edmondson Park Station by one metre to address drainage issues and lower the track after the station to remove the 'peak' and rejoin the base alignment after Cabramatta Creek.

The options to lower the track and remove the peak would require an increase in excavation to a depth of approximately 6 metres at Edmondson Park, and also an increase in the embankment height over Cabramatta Creek by two metres. These options were considered at the TIDC civil value management workshop on 18 January 2010. It was the opinion of attendees that the operational benefits would not be commensurate with the increased earthworks and, therefore, has been retained.

Leppington Station to the road crossings at Dickson Road and Eastwood Road

The previous alignment included a 'peak' in the track west of Leppington Station to allow it to travel over Dickson Road with an at-grade crossing at Eastwood Road (which would be made into a cul-de-sac). The objective for further assessment of this crossing was to remove this 'peak'.

The alternative considered to lower Leppington Station by 2 metres to meet urban design requirements (to facilitate integration with the future town centre), and lower the track west of the station to reduce the maximum track height. Dickson Road and Eastwood Road would both be 'road over rail' bridges.

The TIDC civil value management workshop on 18 January 2010 considered this option. It was determined that a 'road over rail bridge' would be the optimum option for Eastwood Road and Dickson Road. This option would result in an improved alignment, removing the peak to the west of Leppington Station. It would also maintain the Eastwood Road as a primary access road in the South West Growth Centre (SWGC). Therefore, this option was chosen as the preferred alignment at this location.

Horizontal alignment

The design of the projects horizontal alignment has been developed since Concept Plan Approval to address environmental constraints. These minor changes have all been accommodated within the SWRL corridor approved in the Concept Plan, with the exception of a number of amendments to the alignment detailed in Section 5.2.1. These changes are discussed in further detail in Section 6.1.2. A number of ancillary structures would also be placed outside the approved SWRL corridor. These include substations, construction access roads, transport interchanges and commuter car parks. The locations of the commuter car parks, construction access roads and compounds are indicative only subject to detailed design. Those structures located outside the corridor are shown in Figure 6-1 (a to t).

Relocation of the Glenfield Southern Flyover

The Glenfield Southern Flyover has been relocated approximately 70 metres south of the alignment approved under the Concept Plan. The proposed relocation of the Southern Flyover was a result of changes to the configuration of Glenfield Station, which were approved as part of the Review of Environmental Factors (REF) for the Glenfield Transport Interchange. The design development of the Glenfield Transport Interchange undertaken subsequent to the Concept Plan Approval resulted in a design that no longer required relocation of the existing platforms as previously proposed. However, this has resulted in a need to relocate the Southern Flyover further south so that the proposed SWRL operates efficiently and safely. Further design development for the Southern Flyover has been ongoing to minimise the potential flooding risk from Bunbury Curran Creek.

The proposed relocation of this structure also requires a change to the rail corridor alignment immediately west of Glenfield Junction, between approximate Chainages 42.30 and 43.60 kilometres. The proposed corridor would be relocated by up to approximately 70 metres to the south of the approved corridor for a distance of approximately 1.3 kilometres, as shown in Figures 6-1a to 6-1c.

5.2.3 Road crossings

Crossing of Eastwood Road

In order to determine the most feasible preferred concept design for the Eastwood Road crossing to support the operational requirements of the SWRL, two design options were considered subsequent to the Concept Plan Approval, as follows:

- Option 1— a road underbridge (i.e. road under the rail line) with Eastwood Road in cutting and the proposed SWRL on embankment.
- Option 2— a road overbridge (i.e. road over the rail line) with Eastwood Road on embankment and the proposed SWRL in cutting.

Option 1 would involve realignment of Eastwood Road for a total of 305 metres, with a maximum cutting depth of approximately 2.7 metres. Option 2 would involve realignment of Eastwood Road for a total of 440 metres, and construction of a 9.7 metre embankment. The TIDC value options workshop on 18 January 2010 determined that the preferred option was a road overbridge (Option 2).

A third option would involve closure of Eastwood Road and provision of a cul-de-sac at either side of the corridor. This option is not supported by NSW Department of Planning (DoP), as road access needs to be maintained at Eastwood Road, which would become a primary access road in the SWGC.

Option 2 was subsequently selected and forms the basis of this EA.

Crossing of Hume Highway

A number of design options were considered for the proposed crossing of the Hume Highway, in order to minimise the impact on the Highway and provide a suitable rail line gradient. The options considered included:

- Option 1— Cut and cover bridge: a bridge carrying the highway over the rail line with embankments sloping down to the railway.
- Option 2— Cut and cover bridge: a bridge carrying the highway over the rail line with retaining walls on either side of the corridor.

- Option 3— Canopy steel tubing tunnel: a tunnel carrying the rail corridor under the highway.

The advantages and disadvantages of each option have been evaluated, as summarised in Table 5-2.

Table 5-2 Advantages and disadvantages of Hume Highway crossing options

Option No.	Advantages/disadvantages
1	Advantages: ▪ RailCorp's preferred option. Disadvantages: ▪ substantial timeframe to construct side tracks ▪ safety concerns during construction ▪ significant environmental impacts and approval requirements associated with construction and temporary use of a three-lane temporary freeway diversion (northbound and southbound) during construction ▪ increased engineering complexity.
2	Advantages: ▪ Less construction complexity. Disadvantages: ▪ safety concerns during construction ▪ significant environmental impacts and approval requirements associated with the construction and temporary use of a three-lane temporary freeway diversion (northbound and southbound) during construction ▪ RTA least preferred option due to temporary traffic disruptions.
3	Advantages: ▪ minimal impact on road users ▪ would avoid significant environmental impacts associated with construction of a three-lane temporary freeway diversion during construction ▪ RTA's preferred option due to reduced impact on existing traffic flow at critical location. Disadvantages: ▪ increased engineering complexity.

Each option was assessed considering the above advantages and disadvantages, and using a scoring system discussed in the *Hume Highway Options Assessment Report* (TIDC 2008). The scoring system was based on performance with regard to program, cost, asset management, design, environmental impact, planning approvals required, procurement, risk, and safety in construction and operation. Option 3 was considered the preferred option based on this assessment and was subsequently selected as the preferred option for this crossing. The overriding reason that Option 3 was selected was that it would avoid the need for diversion of the Hume Highway during construction, which as discussed above, would involve major construction issues and significant environmental impacts.

TIDC and the RTA are currently working together to further refine the design details of Option 3.

5.2.4 Stations

Station design options

A series of design options were considered at a Station Value Management Workshop on 25 March 2008, for the proposed stations at Edmondson Park and Leppington subsequent to the Concept Plan Approval. These options explored possible station configurations to address the following design objectives:

- provide adequate capacity for predicted station patronage
- provide clear and unambiguous circulation of station users
- facilitate good supervision of paid and unpaid areas of the station
- facilitate efficient station operations and maintenance
- create a seamless pedestrian connection across the rail corridor for non-rail users
- create a civic identity for the stations at the heart of the future town centres.

The preferred station options locate each station within a cutting, which is viewed as an efficient station configuration, with an at-grade unpaid connection across the rail corridor, and a double stair and lift connection between the paid concourse and each platform.

A number of options were prepared for the configuration of the Edmondson Park Station, as shown in Figure 5-1. These options were assessed at a TIDC stations value management workshop on 18 January 2010 where Option 1 was selected as the preferred option. Option 1 was seen as having the following benefits:

- a simple concourse slab layout
- good unpaid cross rail connection
- an efficient circulation layout
- good surveillance of the paid concourse
- a rectilinear layout that facilitates a simple roof canopy form, covering the whole concourse.

It was also determined that the principles of Option 1 (the preferred option) would apply to both the Edmondson Park Station and Leppington Station designs.

Subsequent to the TIDC stations value management workshop, an alternative layout was developed that would improve the concourse alignment features of the preferred option for each station, as shown in Figures 5-2 and 5-3. This layout would relocate the station facilities to the northern and southern sides of the paid concourse (located to the western side). The amended layout was considered to have the following benefits:

- improved visibility of the paid concourse from the surrounding station precinct
- clear visual connection across the rail corridor
- improved civic presence.

Further development of the preliminary concept design resulted in the elimination of the need for ticket gates at Edmondson Park Station and, therefore, provision of a single shared concourse, which would increase access within the station. Further design development of the Leppington Station design resulted in minor changes to the width of the station concourse, which has been reduced in size.

The preferred option for each station is illustrated in Figures 5-4 and 5-5, and presented in more detail in Chapter 6.

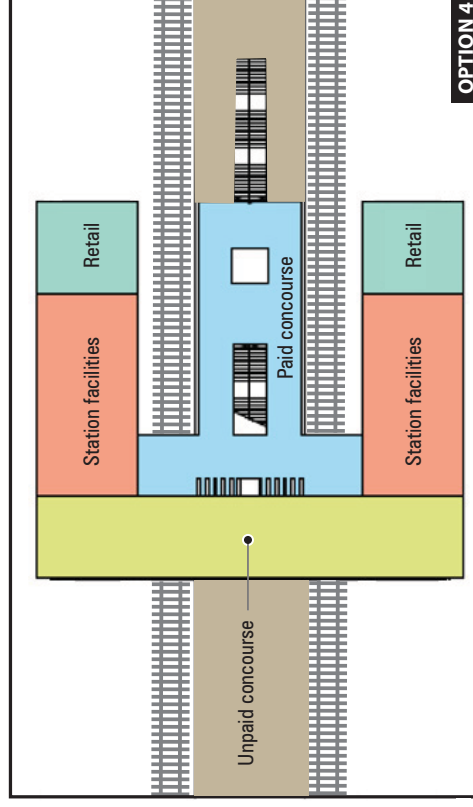
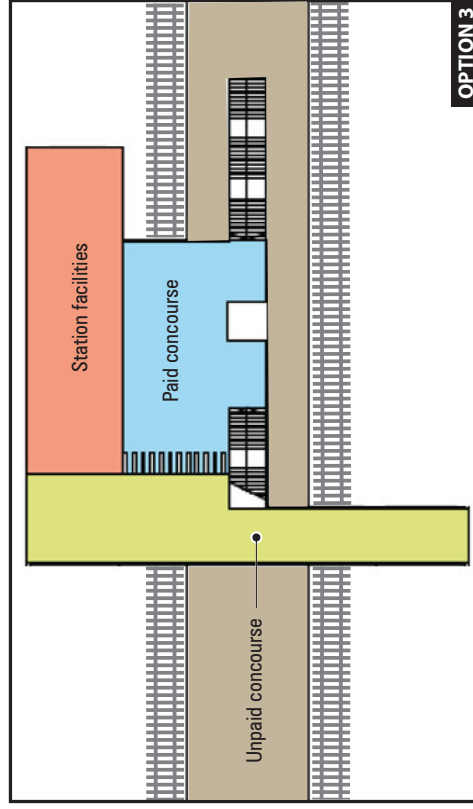
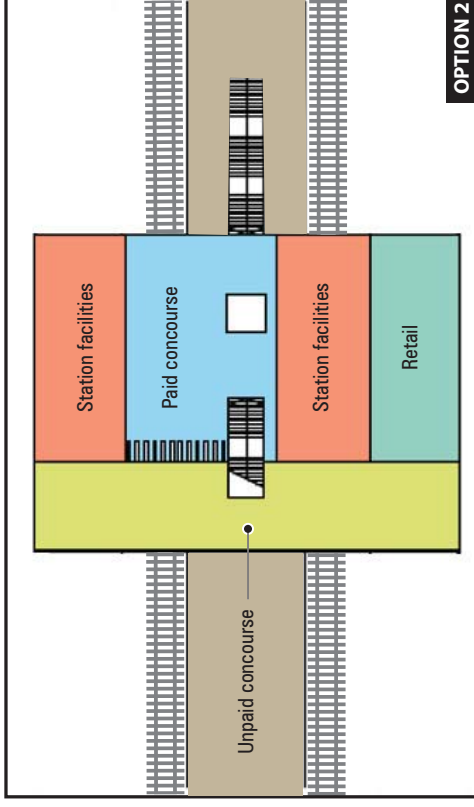
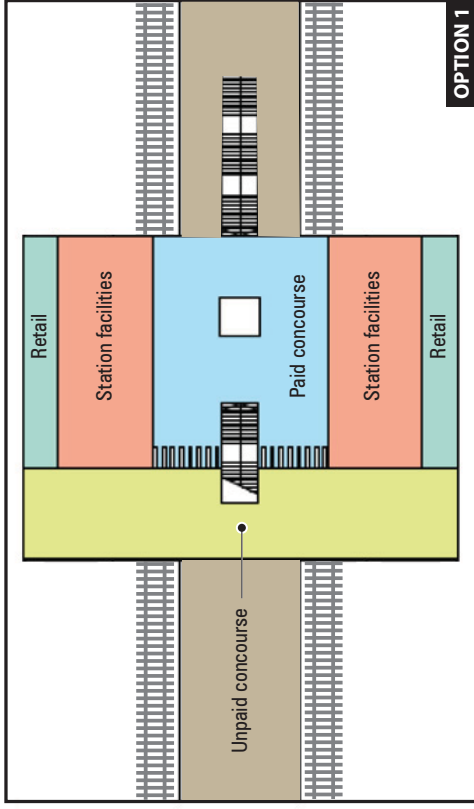


Figure 5-1 Edmondson Park Station options

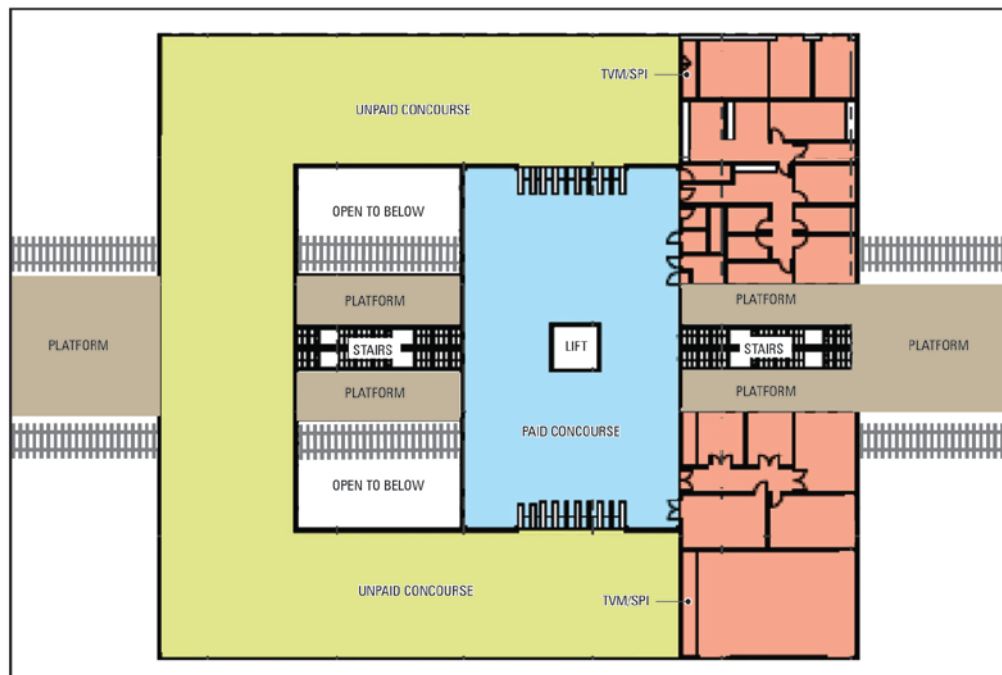


Figure 5-2 Edmondson Park Station alternative concourse alignment

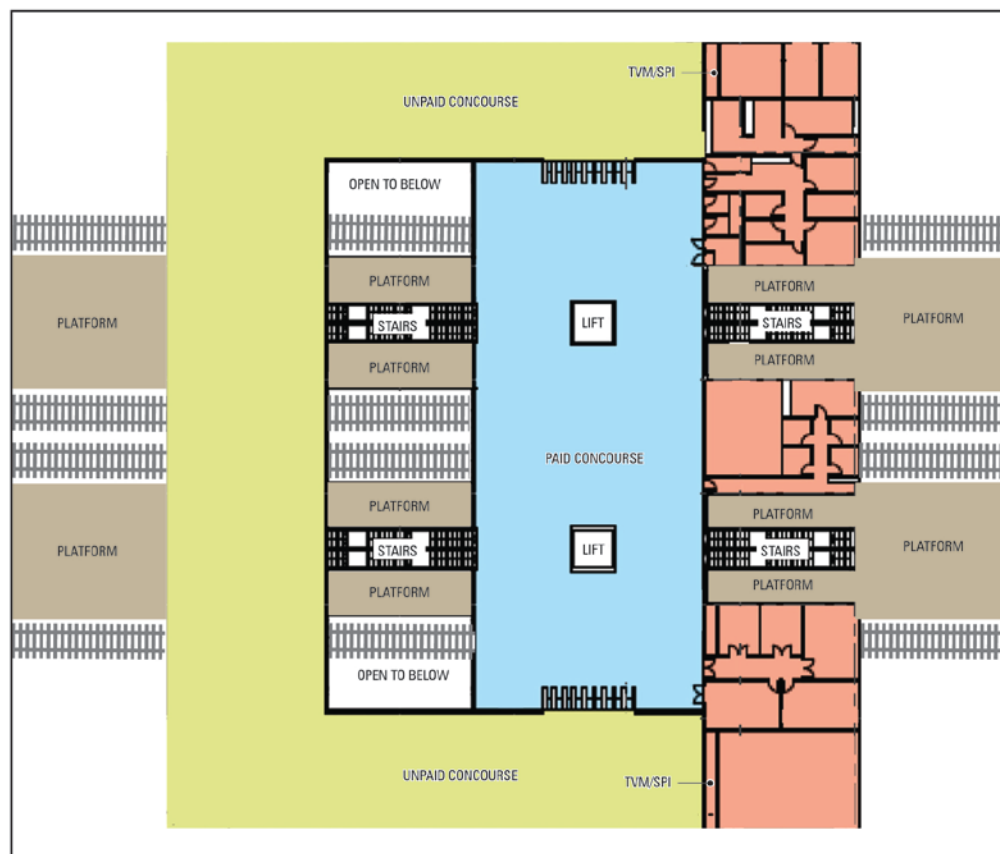


Figure 5-3 Leppington Station alternative concourse alignment

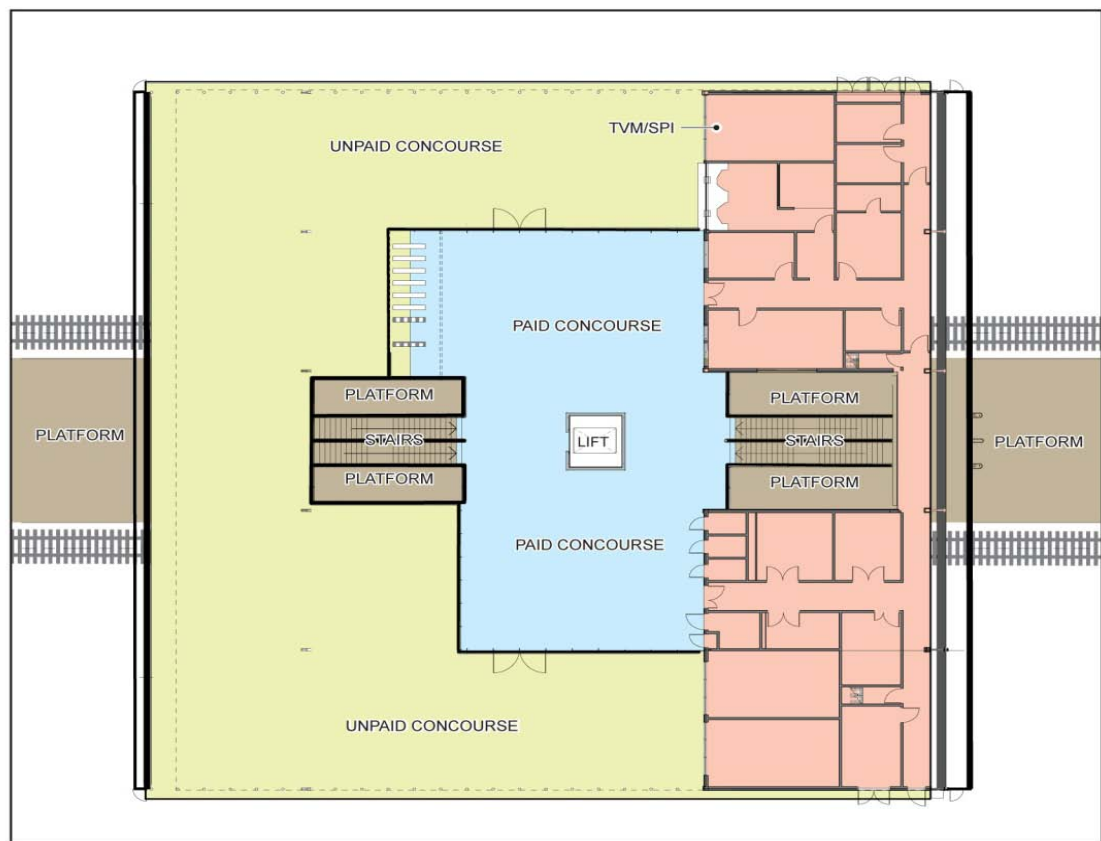


Figure 5-4 Edmondson Park Station preferred concourse alignment

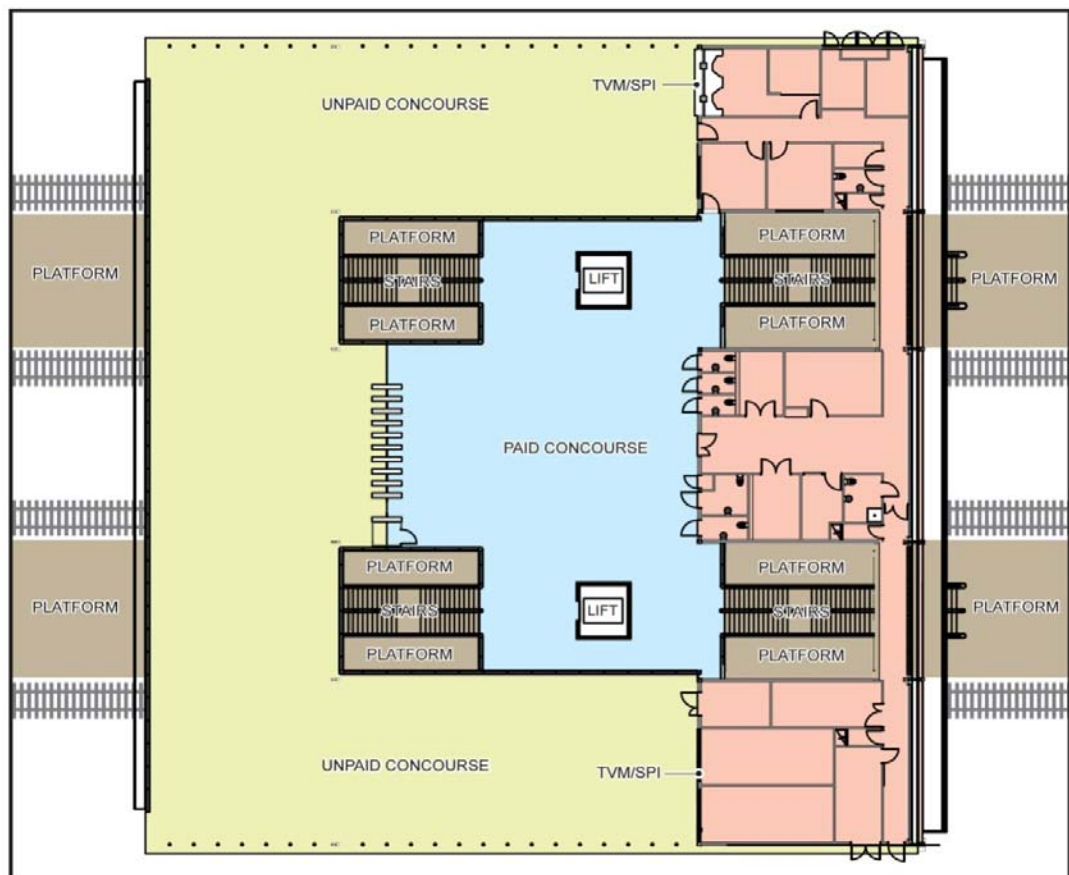


Figure 5-5 Leppington Station preferred concourse alignment

Ongoing design development at stations

Coordination with masterplanning of station precincts

Following recommencement of the project development, TIDC engaged Cox Richardson Architects and Planners to undertake a peer review of the 2008 SWRL plans in relation to the masterplanning of the town centres. This review confirmed that the stations at Edmondson Park and Leppington had been designed in such a way as to allow for maximum flexibility for the future development of the centres. This is principally because the stations have been designed in a cutting, open to the air, with the concourses at or near to ground level. This layout would allow for level access to each station within the town centres to achieve good physical and visual integration via the station concourses.

The review also identified that additional issues must be addressed as part of detailed design of the stations so that each station becomes a seamless component of the adjacent public open spaces and road networks, as those plans are developed.

The key features included in the station designs to facilitate their integration into the future masterplanned town centres include:

- station concourse designs that allow for an at-grade pedestrian link providing easy transition to both sides of the rail line in the town centres
- location of the bus interchanges adjacent to the stations to allow for efficient and safe passenger transfers
- provision of commuter car parking in close proximity to the stations to increase accessibility and convenience for users, with enough flexibility, if required, to shift or phase out this parking over the longer term, as the centres develop.

As part of the overall planning of the new town centres, the planning of the station precincts will be required to support the future use of the stations through adoption of the principles of transit-oriented development and good urban design. Specifically, RailCorp's *Station Design Guide* (2008) provides clear principles for the design of station precincts and transport interchanges, stating that a station precinct should be designed to fulfil the following design objectives:

- to attract patronage and encourage use of stations by simplifying the connections with the existing and future urban fabric as well as providing convenience, clarity and quality of arrival sequence to the stations
- to provide memorable urban spaces by establishing a continuity of image for all station public spaces, as well as introducing local variations to create a local identity at each station
- to create an image for the rail corridor from both the rail journey and local community perspective
- to provide a level of enjoyment and comfort by creating safe, convenient and efficient environments around the stations
- to create a coordinated urban character by developing a shared palette of public domain elements that allow for local variations.

TIDC would seek to engage in the promotion of good design principles in the future development of the Edmondson Park and Leppington town centres. This is addressed further in the project approval SoCs in Chapter 17.

Edmondson Park Station

As part of the design development since approval of the Concept Plan, ongoing meetings have been held with TIDC, Landcom and Liverpool City Council. Whilst there has been a consensus between TIDC and Landcom on issues such as the importance of the civic presence of the station as the hub of the proposed town centre, further discussions are underway to confirm the location of the potential future road crossings over the rail line, and the level of the concourse in relation to the surrounding ground levels. The proposed plans for Edmondson Park Station show a potential future extension of Croatia Avenue on the northern side of the Station to the proposed road linking Campbelltown Road, south of the station. This proposed bridge crossing is not part of the project and has not been assessed in this EA.

The proposed road is to be positioned slightly further east than the alignment shown in the Liverpool City Council LEP 2008 for Edmondson Park (refer to Figures 6-1e, 6-1q and 6-7). The re-alignment of this road has been proposed so that a future overbridge would pass over the eastern end of the station and not directly over the central part of the station. This realignment would improve the interaction with the station and interchange, allowing better visibility along the platform improving the safety and security. The proposed realignment of this future road has been prepared in consultation with Liverpool City Council and Landcom. The repositioning of the proposed road would require an amendment to the *Liverpool Local Environmental Plan 2008*. Further consultation between TIDC, Liverpool City Council and Landcom will occur to further progress the design and construction of the proposed road.

Preliminary traffic investigations undertaken by Landcom in 2008 suggest that two road bridges over the rail corridor would be sufficient to cater for the future traffic requirements at the Edmondson Park town centre. This differs from Liverpool City Council's current DCP which indicates three crossings at the town centre. The design of the project would not preclude the building of these future road bridges at Edmondson Park.

The station concourse level should be as near as is practicably possible to the surrounding road and pedestrian interchanges, allowing level and easy access across the rail line. A number of factors – most notably the creek crossings immediately east and west of the station, and the natural south to north landfall across the station location – situate the station concourse level above the surrounding natural ground level. Options are being investigated within the station precinct that would result in the ground level being immediately adjacent to the station.

TIDC would seek to engage in the promotion of good design principles in the future development of the Edmondson Park town centre. This is addressed further in the SoC in Chapter 17.

Leppington Station

Consultation with the Strategic Land Release Project Office of DoP has occurred since the Concept Plan Approval to discuss integration options for the Leppington town centre and station.

Furthermore, the Strategic Land Release Project Office of DoP, TIDC and the NSW Roads and Traffic Authority (RTA) are in discussions regarding the road network requirements for the future town centre and the road network interface with Leppington Station. A precinct plan is currently being prepared for Leppington North.

5.2.5 Leppington Train Stabling Facility

The design of the proposed Leppington Train Stabling Facility has been refined with the inclusion of noise mitigation measures (earth mounds and acoustic noise walls) to minimise acoustic impacts on the existing and anticipated future surrounding environment. In addition, the opportunity for use of low-volume horn testing would be further explored with RailCorp following project approval, and the feasibility of placing a roofing structure on the facility to further minimise noise. These mitigation measures are discussed further in Chapter 10.

5.3 Environmental input into design development

5.3.1 Integrated Design Workshops

Subsequent to the approval of the Concept Plan, the Australian Centre for Value Management, on behalf of TIDC, has facilitated three Integrated Design Workshops (IDWs). The objectives of these workshops were to:

- bring together the design and environmental assessment team for the project to determine the key environmental principles to inform the design development
- update external stakeholders on the SWRL project and to review the current preferred layout of the concept design for the project
- highlight and minimise potential risks as part of the design process.

Table 5-3 provides a summary of these workshops, lists those who attended and the key issues raised.

Table 5-3 Summary of IDWs

Workshop	Attendees	Purpose	Issues raised
No. 1 (13 March 2008)	Technical Advisors (TAs), representatives of TIDC and PB (including environmental assessment team), RailCorp.	Establish key principles for design, planning, environment, operation, construction and operational elements to inform the design development stage.	▪ The outcomes of the SWRL planning need to be reflected in the masterplanning for the region. ▪ The planning should be for "low key" facilities at each of the stations rather than major interchanges. ▪ There appears to be a greater understanding within the team of all the parts of the project and how they fit together.
No. 2 (22 April 2008)	TAs, representatives of TIDC and PB (including environmental assessment team), RailCorp.	Assess and refine the draft concept design in light of principles established at the IDWs.	▪ Most items of the design can be taken forward. There are areas of the design that cannot move forward without further input/approval from external stakeholders. ▪ There is a need to integrate consideration of noise and other environmental assessment impacts into the concept design as soon as possible. ▪ The concept design should be taken forward to IDW 3 for review by external government stakeholders.

Workshop	Attendees	Purpose	Issues raised
No. 3 (2 May 2008)	Key state and local government agency stakeholders and core TIDC, TA, RailCorp and PB staff (including environmental assessment team).	To provide an opportunity for stakeholder review and feedback of the design to date.	▪ Further consultation is required regarding the relationship and alignment of the concept design with the masterplanning of Edmondson Park and Leppington . ▪ Further consultation is required regarding commuter car parking issues (i.e. timing, location, size, multi uses, etc). ▪ There is uncertainty regarding the future land use around the train stabling facility.

These workshops provided valuable input that has resulted in positive changes to the design of the project from that approved in the Concept Plan. The earlier sections of this chapter discuss changes that have been made to the design to address the issues raised in these workshops.

5.3.2 Ongoing environmental assessment and design development

Following exhibition of this EA, any submissions from stakeholders would be considered to determine whether the project may benefit from further design modifications. Any such design modifications would be reassessed, and the description of any changes to environmental impacts documented in the Submissions Report. If the changes are significant, a Preferred Project Report would be prepared.

Concurrent with this process, further design development is being and would be undertaken, including detailed design and construction planning following project approval, with the objective of minimising environmental impacts and promoting the principles of sustainable development.

Objectives of the design development process are:

- to minimise the project footprint in sensitive areas including native vegetation and potential Aboriginal deposits
- retention of habitat connectivity at watercourse crossings
- construction planning to minimise environmental impacts and disturbance to surrounding communities.

Any changes as a result of this further design development would be documented in the Submissions Report or Preferred Project Report, and additional assessment undertaken to confirm any new impacts associated with the design changes. Mechanisms for the achievement of sustainable development and environmental performance are addressed in Chapter 16.

5.3.3 Environmental risk assessment

Subsequent to the approval of the Concept Plan and throughout the design stage of the project, a number of environmental risk assessments have been undertaken. These assessments were based on site investigations and identified a number of key constraints regarding both natural and built environmental features. These constraints had a significant impact on the design of the project, prompting a number of key design changes

throughout the length of the corridor. A summary of some key environmental risks and examples of the design responses are shown in Table 5-4.

Table 5-4 Environmental risks and responses through design

Environmental risk	Design responses
Impact on waterways and potential for flooding of proposed SWRL and surrounding areas	▪ modification to excavation and embankment levels ▪ inclusion of bridges/culverts for crossings over key waterways and drainage corridors ▪ protection of key natural watercourses by providing bridges and modifying bridge spans ▪ incorporation of water sensitive urban design along the rail corridor ▪ accommodation of additional flood mitigation design margins to account for uncertainties associated with climate change
Visual impacts on future suburban centres at Edmondson Park and Leppington	▪ integration of urban design and landscape features at stations (interfaces with future town centres) and along the railway corridor ▪ relocation of sectioning hut outside of the core of the Edmondson Park Town Centre
Future planned road widening projects	▪ design of road crossing (under and over) bridges with additional lanes to allow for approved and planned road widening projects (e.g. Campbelltown Road crossing) ▪ maintenance of road access at all existing road crossings
Noise and vibration impacts on surrounding land uses	▪ location of railway in cuttings and construction of embankments on either side of the corridor ▪ consideration of mitigation measures
Impact on items of heritage	▪ modifications to horizontal and vertical alignment and incorporation of urban design and landscaping features
Disruption to existing services and utilities	▪ modification of excavation and embankment levels where railway would cross key services ▪ design of vertical alignment to facilitate crossing of the SWRL by major utilities
Impact on threatened flora and fauna	▪ minimisation of the project footprint in ecologically sensitive areas, in particular to minimise impacts on threatened species and endangered ecological communities ▪ location of construction compounds outside of environmentally sensitive areas ▪ maintenance of habitat connectivity including riparian and aquatic habitat connectivity at watercourse crossings

5.3.4 Sustainability in design, construction and operation

The *South West Rail Link Sustainability Report* (Arup 2008) was prepared describing the process of integrating sustainability considerations into the design process for the project from Glenfield South to the Leppington Train Stabling Facility. A key element of this process was collaboration between the project design team and the Sustainability Advisor (Arup) in identifying design initiatives which would enhance the overall sustainability of the project. Stakeholder and community involvement has also been an important element in the development of the project's sustainability agenda.

Sustainability issues and initiatives were raised and discussed at the IDWs and consultant interface meetings, with a range of initiatives incorporated through the design process (e.g. enhancements for pedestrian and cyclist access, energy efficiency, etc.). A broader sustainability workshop was also held in March 2008 to discuss and identify opportunities for promoting sustainability throughout the project. This identified a range of key initiatives, such

as water harvesting, total water cycle management and preparation of a carbon strategy. Following the workshops, meetings were held with the design team to refine the initiatives raised and further discuss the practicalities of incorporating sustainability measures into the concept design.

The culmination of this process was the inclusion of a range of sustainability initiatives into the concept design for the project from Glenfield South to the Leppington Train Stabling Facility.

The process also identified opportunities for considering further sustainability measures as part of the next stages of project development, including the following:

- Resource-efficient construction methods, including post-tension concrete slab construction and prefabrication construction techniques, would be used to minimise waste and resource consumption.
- Spoil would be reused in reinforced soil walls and embankments and earth mounds for noise mitigation. Topsoil would be reused on-site.
- Free-cooling ventilation systems and skylights would be incorporated within 'back of house' and office areas to maintain internal thermal comfort while minimising energy demand.
- Subject to further cost benefit analysis and resolution of maintenance issues, renewable energy would be generated using photovoltaic cells on station roofs.
- Stormwater would be harvested for use at the stations.
- Energy management systems would be installed in all buildings to monitor the use of energy consumption.
- All cleared vegetation would be recycled as mulch for landscape areas.
- Interpretive signage that provides information on the heritage of the area would be incorporated into the station designs.

Core sustainability principles would be developed for the design and construction of the project covering the following themes as identified in the Concept Plan SoCs:

- a) Energy
- b) Greenhouse emissions
- c) Water
- d) Community and Stakeholder Involvement
- e) Biodiversity
- f) Resource recycling/ minimisation.

To develop the principles a benchmarking exercise would be undertaken to enable clear sustainability goals and objectives to be determined which would provide clear result areas and targets under each theme. These goals/indicators would form a sustainability management strategy for the Project, which would be regularly reviewed and updated throughout the design development, construction and operation of the project.

In 2009, TIDC released the *Sustainable Design Guidelines for Stations, Commuter Car Parks and Maintenance Facilities* (the 'Sustainable Design Guidelines'; TIDC 2009). These guidelines identify a number of sustainability objectives and initiatives based on the following six themes:

- a) Energy
- b) Materials and waste
- c) Biodiversity and heritage
- d) Water
- e) Pollution control
- f) Community benefit.

The six themes identified in the Concept Plan are also included in the TIDC's Sustainable Design Guidelines (2009). Future detailed design options for extension of the SWRL would need to comply with TIDC's Sustainable Design Guidelines (TIDC 2009).

5.4 Potential future extension to the SWRL

Options for a potential future extension of the project beyond Rossmore have been investigated by NSW Transport and Infrastructure (T&I). The design and location of the project, including the Leppington Train Stabling Facility, do not preclude a potential future extension of the SWRL beyond Rossmore. The precise location of any extension or future terminus would be determined by operational needs and the patterns of future development.

Although there is potential for an extension of the SWRL past Rossmore in the future, any such extension is not part of the scope of works for the current SWRL project or this EA, and would be subject to a separate environmental assessment and approvals process.

5.5 Potential quadruplication of the SWRL

The concept design does not preclude the future potential quadruplication of the SWRL (i.e. upgrading the SWRL to a four-track rail corridor). Bridges and other civil structures have been designed to allow for future conversion to a four-track arrangement. Such a proposal for quadruplication does not form part of the scope of works for the current SWRL project or this EA, and would be subject to a separate environmental assessment and approvals process.

5.6 Potential future train wash facility

The project involves the provision of land for a potential future train wash facility adjacent to the Eastwood Road crossing. The facility would allow trains to be washed without impacting on the movement of trains along the corridor. However, approval of a potential future train wash facility is not being sought in this EA.