PART

C2

ENVIRONMENTAL ASSESSMENT – NON-KEY ISSUES

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17. Other environmental issues

17.1 Socioeconomic

17.1.1 Assessment approach

A *Social and Economic Impact Assessment* (HillPDA 2010) has been completed for the project and is included as Technical Paper 6 in Volume 2. The social and economic impact study assessed the level of impact on an economic or social activity within the study area and determined if it is a positive or negative impact. The assessment of likely impacts resulting from a particular proposal allows for the identification, prediction and, where possible, quantification of impacts as either likely benefits or negative impacts.

To assess the social and economic impacts of the project the following methodology was applied:

- review relevant, available project-related information and assessments
- profile the existing geographic, social groups, community facilities and businesses that may be influenced by the project
- inspect site on 16 August 2010
- scope the likely changes/impacts that may occur as a result of the project
- research relevant studies and literature establishing the impacts of similar proposals and issues
- make a desktop analysis of potential negative and positive impacts, and direct and indirect impacts during construction and operational stages
- identify appropriate mitigation measures, including plans and strategies for monitoring and managing the impacts during construction and operational stages.

17.1.2 Existing environment

Demographic, employment and travel profiles

Key features of the local demographic, employment and travel profiles are listed below using the Australian Bureau of Statistics (ABS) Census Data (2006) and the Bureau of Transport Statistics (BTS) Journey to Work Data (2006).

- The primary suburbs of influence (Annandale, Ashfield, Dulwich Hill, Haberfield, Hurlstone Park, Leichhardt, Lewisham, Lilyfield, Marrickville, Petersham and Summer Hill) have a resident population of just under 130,000 people comprising 44% of the total population of the three LGAs in the study area.

- The suburbs along the project are characterised by their inner city location and proximity to Sydney CBD. The resident population has a propensity towards being within the key working ages of 15 to 44 years, forming households occupied by couples with no children (although anecdotal evidence suggests there has been a baby boom in the inner west since the census), residing within medium to high density dwellings and being employed in more senior roles as a manager or professional.

- The study area generated over 52,500 jobs and approximately 85,000 residents of the study area were employed. Employment was largely related to health care and social assistance (which includes nurses, carers, general medical practitioners, welfare support workers) in addition to retail. These two industries reflect the area's service-orientated role and its dual role of supporting the local community as well as more regional services for Sydney. Manufacturing was another predominant form of local employment, reflecting its tradition as an industrial area.

- Population forecasts indicate the study area will grow by approximately 26,000 residents by year 2036, with the greatest growth occurring within the Marrickville LGA with an increase of approximately 12,500 residents.

- Forecasts indicate that employment within the study area will continue to grow, with an anticipated net increase of approximately 17,000 jobs by 2036. The main growth industries are proposed to be retail trade, health care and social assistance, and public administration and safety.

- Compared to the Sydney average (13%), the study area has a higher portion of households without a car (20%) and has a greater reliance on the use of public transport and other sustainable means of travel.

Sensitive receivers

A number of community and business stakeholders located near the project could be impacted by it. Sensitive receivers are those who are potentially impacted on by the project; it is important to note that there are varying degrees of 'sensitivity' to impacts. While not considered sensitive receivers in conventional terms, other uses such as recreational areas, public space and places of work may also be influenced by amenity and environmental impacts. Table 17.1 identifies potential sensitive receivers.

Table 17.1 Potential sensitive receivers

Type of sensitive receivers	Comment	Specific examples
Local residents	The project affects a number of local residents, particularly those located within streets immediately next to the proposed project corridor, as well as residents located within streets that provide access to the work sites for construction vehicles.	Bedford Crescent, James Street, Weston Street, Francis Street and a number of other locations within the corridor
Child care centres	A number of child care centres are located within 100 m of the corridor.	Explore and Develop (Old Canterbury Rd), Kegworth Out of Hours Care, Bambini of Lilyfield, Early Achievers Child Care Centre
Educational facilities	There are a number of educational facilities, where the affected community comprises staff, students and resident families.	Orange Grove Public School; Kegworth Public School; Dulwich Hill Public School, Sydney Community College and Sydney College of the Arts
Entertainment and leisure facilities	There are a number of parks and recreation grounds within the Study Area, as well as restaurants and cafes.	Leichardt Bowling and Recreational Club, Haberfield Tennis Centre, Blackmore Park Playing Fields
Recreational areas	There are numerous parks and reserves along the project corridor. The project corridor also follows Hawthorne Canal (between Allen Street and Lewisham Interchange stop) and terminates 500 m away from the Cooks River.	Whites Creek Valley Park, Pioneers Memorial Park, Blackmore Park, Hawthorne Canal Reserve, Lambert Park, Hoskins Park, Johnson Park and Arlington Recreational Reserve
Religious and community centres	The rail corridor passes a number of churches and community centres.	Scout Hall, Greek Orthodox Church of St Gerasimos, Our Lady of Snows Society, Uniting Church in Australia (Parramatta Rd), Buddhists Association of Engaged, Greek Orthodox Church of the Holy Unmercenaries
Local businesses	The project affects a number of local businesses, particularly those located within streets immediately next to the proposed project corridor, as well as businesses located within streets that provide access to the work sites for construction vehicles.	Businesses along Darley Road, Norton Street, Parramatta Road, New Canterbury Road, Longport Street Summer Hill Mills site (former Mungo Scott Mills), Lord Sixty Seven Pty Limited, P&C Consulting Pty Limited
Film industry	There is a site next to Blackmore Oval that is used by the film industry.	Canal Road Film Centre

17.1.3 Construction impacts

Potential social and economic impacts during construction are summarised below and described further in Technical Paper 6 in Volume 2.

Economic impacts

In general, it is anticipated the majority of impacts are likely to be within the primary area of influence and those within the suburbs through which the project traverses. Any negative impacts associated with proposed road closures and other disruption from construction are likely to be only felt in the immediate vicinity of the construction compounds and affect minimal people, while the beneficial effects of construction on the economy will be broader in geographic scale. Construction activities and impacts for the project would be short term. Construction works are proposed to take 12 months, with construction of many areas anticipated to be less than this.

Economic impacts would include:

- Viability of local business: this could include a slight negative impact from a decrease in trade/demand for services due to noise, vibration, access and visual amenity, congestion and road closures. Some businesses may benefit from increased trade from construction works or demand for construction-related services. Implementation of the construction environmental management plan (CEMP) is expected to reduce this to a neutral impact.

- Construction multipliers: construction is a key industry within Australia and for every dollar spent on the project, a further $2.87 expenditure (RBA Bulletin 1996–97) in the economy would potentially result. This would potentially result in a significant economic benefit.

- Construction jobs: the project would generate approximately 350 jobs as a direct effect during construction, resulting in a significant benefit.

- Property acquisition: potential acquisition of two government owned properties. This would have a neutral impact.

Social impacts

- Construction disruption: local residents and businesses are likely to have concerns about disruption and disturbances resulting from constructing the project, which may result in a slight negative impact.

- Impact to amenity: sensitive receivers may be disrupted due to noise, vibrations, dust and increased traffic congestion. Mitigation and management measures have been recommended to reduce these impacts (refer to Section 17.1.5).

- Access to services and jobs: all access to businesses, community and educational services would be maintained during the project's construction; however, there may be some minor hindrance to access in some areas from construction-related traffic.

- Visual amenity: construction sites, work sheds, machinery and other equipment would detract from the visual integrity and character of areas around stop locations.

17.1.4 Operational impacts

The potential social and economic impacts during operation are summarised below and described further in Technical Paper 6 in Volume 2.

Economic impacts

Key economic impacts are as follows:

- The level of trade and demand for services: this would potentially increase in the immediate vicinity of stops due to improved accessibility creating a larger customer base, increased pedestrian activity close to stops, an enhanced level of amenity and a greater awareness of the suburbs close to proposed stops as destinations.
- Road-based congestion: once completed, the project would support a modal shift to help reduce road congestion creating a slight benefit.
- Property values: the project would deliver a number of improvements that would enhance the aesthetic and recreational amenity of the area, which could result in higher values for residential properties.
- Access to jobs: local residents have improved access to a direct commute to, and therefore access, jobs within Pyrmont, the CBD, and regional centres such as Burwood, resulting in a slight benefit.
- Workforce availability: local business could benefit from a large labour pool, greater staff choice and a broader available skill set.
- Increased private production: major public investment would benefit private production and the economy.
- Stimulus for development and investment: increased confidence as a result of transport investment is likely to result in additional private investment and development throughout the study area resulting in a slight benefit.

Social impacts

Key social impacts are as follows:

- Community interaction: the existing rail corridor severs the existing communities on either side of the rail corridor. Pedestrian links across the rail corridor at the nominated stops and including the GreenWay shared path between Iron Cove and the Cooks River would help to improve the ability for communities to interact.
- Impact to amenity: there are potential impacts to a few sensitive receivers that relate to noise as a result of light rail movements. However, despite being more frequent than the previous freight rail service, they would be less significant for noise emissions. It is therefore considered this impact would be a slight negative.
- Access to services and jobs: residents and commuters would be provided with an efficient and reliable transport mode to access popular centres, such as retail, cultural and entertainment facilities, resulting in a significant benefit.

- Visual amenity: the operation of the project activates a disused goods line, which could reduce the likelihood it would be subject to degradation, vandalism and graffiti. Amenity would also improve due to the GreenWay, and landscape improvements along the rail corridor and new public space.

- Access to public spaces and urban connectivity: urban connectivity would be enhanced through pedestrian/cycle bridges linking areas previously segregated by the rail corridor. The integration of stop locations along the GreenWay shared path and the new pedestrian bridge over Hawthorne Canal would lead to a significant benefit. The majority of proposed light rail passengers would walk to the stops; however, there may be some impacts on local streets due to on-street commuter parking. A draft commuter parking strategy is being prepared and would be finalised in consultation with relevant authorities. The draft provides recommendations to reduce car travel to the proposed stops.

- Health and wellbeing: the project provides significant opportunities to increase the local resident and workforce's opportunity to walk, cycle and travel via public transport across the Inner West. These opportunities often correlate with positive improvements to physical and mental health and wellbeing.

- Community involvement: dedicating new and retaining existing bushcare sites along the corridor would promote fauna habitat, increase connectivity of communities involved in bushcare and foster continued community involvement. This would result in a significant benefit.

- Safety and operation: the project would activate areas around stop locations and increase activity along the GreenWay shared path at various hours of the day, encouraging passive surveillance. Stop designs incorporating CCTV, lighting and emergency help points would reduce the opportunity for crime and increase the sense of safety and security resulting in a benefit.

- Social sustainability: the project provides significant positive opportunities to increase the social sustainability of the local community through enhanced opportunities for access to services, jobs and recreational facilities, as well as reduced travel times and environmental enhancements through reduced reliance on the private car and integration of the GreenWay shared path.

17.1.5 Management of impacts

The economic and social impacts that create negative impacts can be mitigated through appropriate management plans, including:

- CEMP and associated construction traffic management plan (refer to Section 19.2.4)

- disseminating information to the community via information lines, Transport NSW website and regular newsletters (refer to Section 3.2.4)

- construction noise and vibration management plan (CNVMP) (refer to Section 19.2.3)

- risk and safety management plan taking into consideration the principles of crime prevention through environmental design (CPTED)

- urban design and landscape strategy to mitigate adverse visual impacts and enhance the integration of the project with surrounding community.

During detailed design, local businesses and the community would be consulted regarding potential impacts resulting from construction activities. Technical Paper 6 in Volume 2 provides a detailed assessment of the economic and social impacts of the project both with and without mitigation.

With mitigation, it was determined all economic impacts would be a slight positive (impact having minimal effect, could be short term and may be confirmed to a small area) or a neutral impact (no discernable or predictable positive or negative impact). Nearly all social impacts (with mitigation) were determined to have a neutral or slight positive impact. The exceptions were visual amenity during construction and impact to amenity (noise) during operation, which are proposed to have a slight negative impact but these are likely to be short-term and/or confined to small areas.

17.2 Aboriginal heritage

This section addresses the Aboriginal heritage assessment requirements and summarises the assessment undertaken for this project. The complete *Sydney Light Rail Extension Stage 1 Heritage Impact Assessment* is contained in Volume 2 (Technical Paper 3).

17.2.1 Assessment approach

The Aboriginal heritage assessment is broadly consistent with the processes and principles set out in the *Australia ICOMOS Burra Charter* (the Australia ICOMOS charter for the conservation of places of cultural significance). The assessment of Aboriginal scientific significance has been undertaken in accordance with the NSW National Parks and Wildlife Service (NPWS; now DECCW) Aboriginal Heritage Guidelines (DEC 1997).

The Director-General's Requirements (DGRs) require an appropriate and justified level of consultation with relevant stakeholders including Local Aboriginal Land Councils, but there is no specific requirement to undertake consultation in accordance with Department of Environment, Climate Change and Water (DECCW) guidelines.

Consultation was undertaken in order to:

- identify the Aboriginal cultural heritage values of the study area
- provide an opportunity for the local Aboriginal community to comment on the Aboriginal heritage assessment process, and on the outcomes and recommendations of draft heritage assessment reporting
- integrate Aboriginal heritage values and recommendations for management into the assessment report.

A 'Notice of Aboriginal Consultation' was placed in the *Inner West Courier* on 29 July 2010, inviting Aboriginal parties with cultural knowledge of the area to register an interest in being consulted in relation to the project, by 12 August 2010. No responses to the advertisement were received.

A search and review of previously recorded sites in DECCW's AHIMS database was undertaken on 5 August 2010 prior to any survey of the project.

A site survey of the project for Aboriginal heritage was conducted by AMBS and Aboriginal community representatives from the Metropolitan Local Aboriginal Land Council (MLALC) and the Darug Aboriginal Cultural Heritage Assessments (DACHA) on 19 August 2010. The field survey was in accordance with the methodology sent out and agreed by all parties who registered interest in the project.

A draft Aboriginal heritage assessment report was provided to each group for review and comment. Comments have been incorporated into the Technical Paper 3 in Volume 2.

17.2.2 Existing environment

The AHIMS database records 52 registered Aboriginal sites within approximately three kilometres of the project (refer to Figure 17.1 and Table 17.2), but no registered Aboriginal sites along the project. The closest site recorded is approximately 230 metres north-east of the Lilyfield end of the project. This site is known as Lilyfield Cave (AHIMS site #45-6-2278) and is a shelter with midden, located in a cliff-face on a disused property on Lilyfield Road.

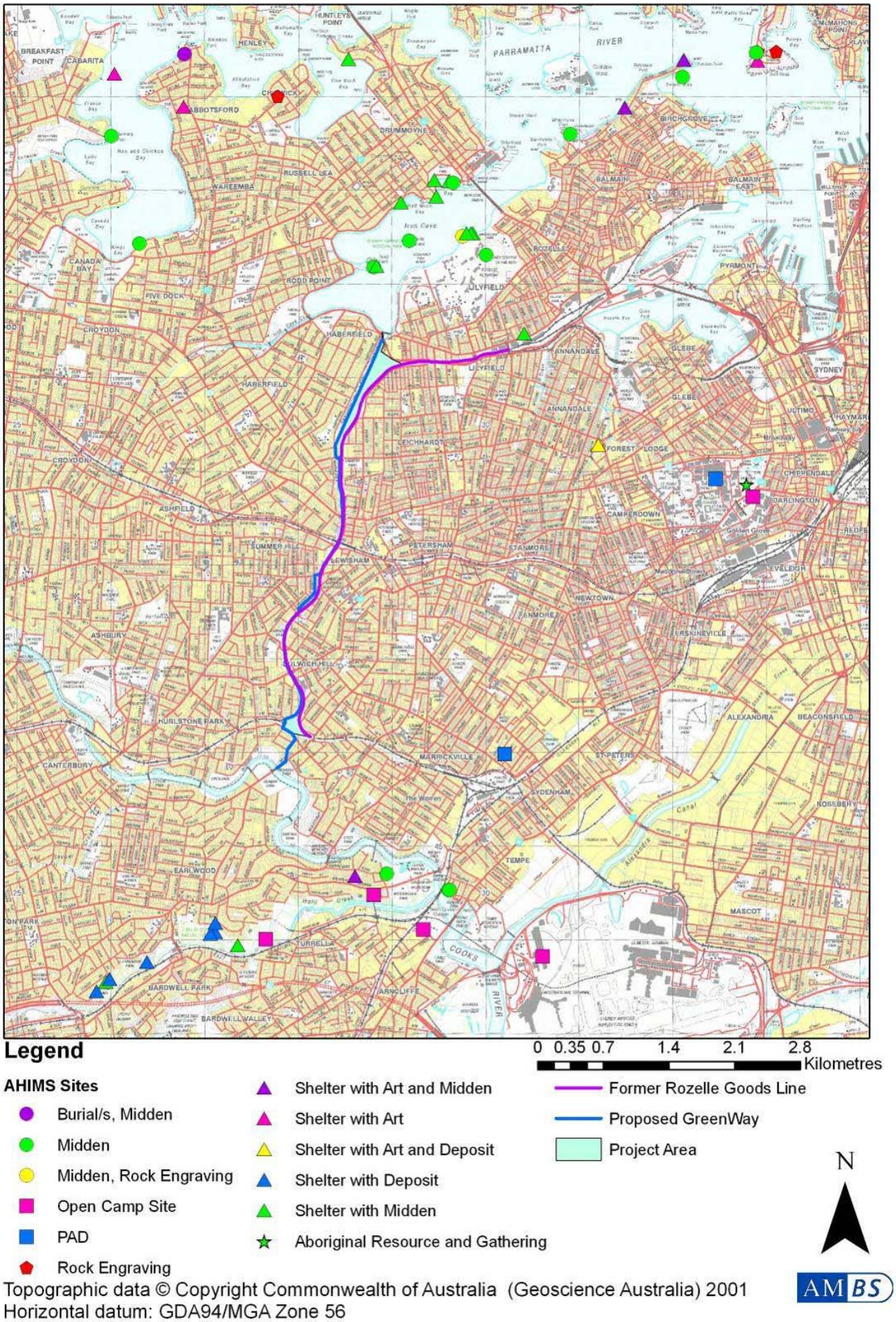

Figure 17.1 Location of previously recorded Aboriginal sites within three kilometres of the project

Table 17.2 A summary of Aboriginal sites previously recorded near the project

Site type	Count	Percent
Shelter with midden	14	27%
Midden	12	23.1%
Shelter with deposit	6	11.5%
Open camp site	5	9.7%
Shelter with art	3	5.8%
Rock engraving	3	5.8%
Midden, shelter with art	2	3.8%
Potential archaeological deposit (PAD)	2	3.8%
Shelter with art and deposit	1	1.9%
Shelter with art and midden	1	1.9%
Midden, rock engraving	1	1.9%
Burial/s, midden	1	1.9%
Aboriginal resource and gathering	1	1.9%
Total	**52**	**100%**

On the basis of the archaeological sites registered in the region and review of previous archaeological studies, the following conclusions can be drawn regarding the potential presence and location of Aboriginal heritage sites within the landscape of the study area:

- Aboriginal occupation of the project area would most likely have been more intense around the creeks (Long Cove Creek and the Cooks River) and the harbour at Long Cove. The land in the vicinity of Long Cove has been reclaimed, and the former coastline/creek line and land near the Cooks River has now been extensively developed. Therefore, no in situ Aboriginal sites are likely to be present in these areas
- although parts of the project in Lilyfield and Dulwich Hill have underlying Hawkesbury Sandstone, these areas have been disturbed by the existing rail corridor and development of roads, parks and residential areas; therefore, no sandstone sites (e.g. shelters, engravings, axe grinding grooves) are likely to remain
- middens, shelters with middens, and burials are generally located close to the foreshore of the harbour. Because of the distance of the project from the harbour and the fact that the northern section near Iron Cove has been reclaimed, such sites are unlikely to be found
- the project area has been extensively cleared and no remnant vegetation remains. As such, no scarred or carved trees are present
- there is no suitable stone resource material within the project, so quarries would not be present
- the vast majority of the project has been subject to previous disturbance for rail, road, canal or residential/commercial construction, and parts have been reclaimed. The green areas/parks have also been disturbed by landscaping and the construction of facilities, including paths. As such, the probability that any Aboriginal sites are present is very low.

17.2.3 Potential impacts

No Aboriginal sites, places or objects were identified during the site survey and no areas of potential archaeological deposit or Aboriginal sensitivity were identified for the project. Therefore, the project would not have an impact on Aboriginal heritage.

17.2.4 Management of impacts

Whilst it is considered unlikely that any evidence of previous occupation by Aboriginal people remains within the project area, the following mitigation measure is recommended:

- Should any Aboriginal objects be exposed during construction works, excavation or disturbance to the area should cease, and advice should be sought from the registered Aboriginal parties and Cultural Heritage Division of DECCW.

17.3 Hydrology and groundwater

The project's potential impacts on the existing hydrological and groundwater systems within the study area were assessed. Potential mitigation and management options have been recommended and are discussed below. Detailed flood modelling or assessment was not undertaken.

17.3.1 Assessment approach

The following methodology was used to assess the hydrological impacts of the project:

- The site was visited to gain an appreciation of the setting of the alignment within the local drainage catchments and the existing drainage features of the disused rail corridor.
- Topographic data for the alignment and associated drainage catchments were obtained and reviewed, including two metre contour data (NSW Department of Lands) and light detection and ranging (LiDAR) data for selected sections of the alignment.
- Published data from local council flood studies was reviewed for watercourses next to the alignment.
- Information on the existing drainage infrastructure for the disused rail corridor was reviewed from previous studies (Cardno Lawson Treloar 2010; Equatica 2009; GHD 2010).
- The topographic data were used to identify the local drainage catchments next to the alignment and the location and elevation of the alignment in relation to potential overland flow paths within the catchments.
- Locations where the alignment could form a barrier to overland flow from the local catchments were identified.
- Locations where reinstatement of the rail corridor could significantly alter the proportion of impermeable area within the local catchments were identified.

- Potential sources of flooding of the alignment from major watercourses, such as Cooks River, Iron Cove, Hawthorne Canal and the Lower Parramatta River, were identified. Available information on the existing/disused drainage assets was reviewed and potential upgrades required to drain the new rail line to current standards were identified.

- Available information on existing/disused stormwater treatment and erosion protection measures was reviewed and potential upgrades required to treat run-off and protect against erosion to current standards were identified.

- Potential construction impacts on stormwater run-off quantity and quality were identified, with temporary mitigation measures that may need to be considered during the construction phase to protect local catchments and watercourses.

The following data were reviewed to inform the hydrological and groundwater desktop assessment:

- AAMHatch LiDAR — West Metro dataset

- Cardno Lawson Treloar 2010, *Leichhardt Flood Study, Draft Report*, prepared for Leichhardt Council

- Meinhardt Infrastructure & Environment Pty Ltd 2010, *Summer Hills Flour Mills 2-32 Smith Street and 16-32 Edward Street, Summer Hill, Hawthorne Canal — Flood Assessment*, prepared for EG Funds Management

- Department of Lands, two metre topographic contour

- Equatica 2009, *Tennyson Street Subcatchment Management Plan*, prepared for Marrickville Council

- RailCorp 2009, *ESC 420 Track Drainage*, Engineering Standard

- Sydney 1:100,00 geological sheet

- NSW Office of Water (NOW) groundwater database.

17.3.2 Receiving environment

Existing hydrological environment

There are four major watercourses near the project: Whites Creek, Hawthorne Canal, Cooks River and the Lower Parramatta River. The project lies mainly within the Hawthorne Canal catchment, with the far north-eastern portion of the project (east of Lilyfield stop) lying next to the lower end of the Whites Creek catchment. The other watercourses and their associated floodplains are at lower levels than the alignment. The local drainage sub-catchments of Hawthorne Canal and potential overland flow paths within these sub-catchments are shown in Figure 17.2.

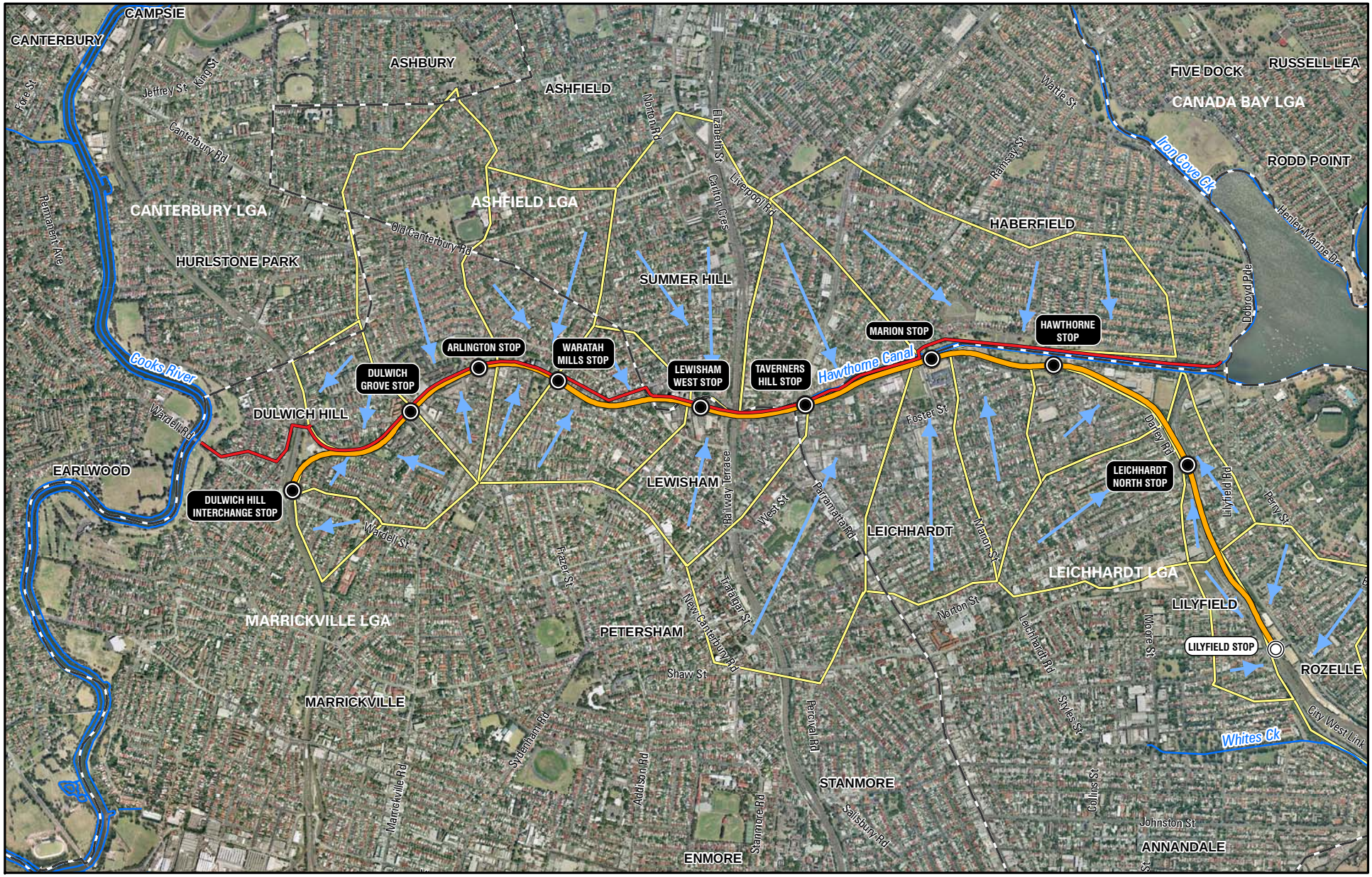

Figure 17.2 Local drainage sub-catchments adjacent to the alignment

The two sub-catchments at the north-eastern end of the alignment in the Lilyfield area are not sub-catchments of Hawthorne Canal, but are local urban drainage sub-catchments that drain to Rozelle Bay via the rail corridor in this area.

Whites Creek is an open channel that, within the project area, runs alongside the existing light rail line next to Railway Parade in Leichhardt, draining into Rozelle Bay. Whites Creek tends to run full in a five year ARI event. The creek is in a different catchment to the project area.

Hawthorne Canal runs alongside the proposed light rail and GreenWay shared path alignment from Iron Cove to Arlington stop. The canal is a concrete waterway that starts in Lewisham and flows into Iron Cove Bay. It was originally a natural waterway known as Long Cove Creek that has been straightened and given artificial banks. The canal forms the border between the Leichhardt and Haberfield local government areas (LGAs).
The catchment for Hawthorne Canal is approximately 670 hectares in size, with around 270 hectares inside the Leichhardt LGA and the remainder in Marrickville and Haberfield LGAs (Cardno Lawson Treloar 2010).

Drainage from the southern end of the alignment (from Dulwich Grove stop to Dulwich Hill Interchange) flows overland and through Marrickville Council's stormwater drainage system to Cooks River. On the eastern side of the alignment from Dulwich Grove stop to Dulwich Hill Interchange, stormwater drains through swales to a low point adjacent to Blackwood Ave, where it passes through a culvert onto the western side of the alignment. Drainage on the western side of the alignment flows south from Dulwich Grove stop to Jack Shanahan Park through swales and passes into a pipe under the park (Equatica 2009).

Implications of climate change for future hydrology

Climate change could increase flood risk to the existing environment containing the project. Potential impacts are as follows:

- Increased tidal flood risk to the light rail alignment and GreenWay shared path adjacent to Hawthorne Canal downstream of Marion Street. Potential sea level rises of an increase above 1990 mean sea levels of 40 cm by 2050 and 90 cm by 2100 (Sea Level Rise Policy Statement, NSW Department of Environment and Climate Change 2009) have been adopted in Leichhardt Council planning studies. Sea level rise would increase the frequency of flooding due to surge tides, increase the vulnerability of the foreshore to wave overtopping and would also adversely affect the discharge characteristics of local stormwater systems with outlets to the Lower Parramatta River.

- Increased stormwater flooding to parts of the alignment at or lower than adjacent land levels. An overall increase of 5% in the rainfall intensity of the two-hour storm is predicted by 2030, and an increase of 13% is predicted by 2070 (Climate Change in Australia — Technical Report, Bureau of Meteorology 2007). Increased rainfall intensity would cause more frequent and severe flooding due to surcharging of local drainage systems and overtopping of Hawthorne Canal. This would be expected to affect low-lying parts of the alignment, longitudinal drainage systems within the alignment, along overland flow paths at the toe of the raised rail embankments and upstream of cross-drainage structures that take local catchment run-off under the alignment.

A detailed assessment of the risk of climate change, and appropriate flood risk mitigation measures is outlined in Chapter 16.

Groundwater

The majority of the project is underlain by dark Grey shale and laminate of the Ashfield Shale (Sydney 1:100,000 geological sheet). The Ashfield Shale forms a thin veneer over the Hawkesbury Sandstone. Between the stops of Marion, Hawthorne and Leichhardt North the project partly follows Hawthorne Canal, which has been partially in-filled with composite fill. Hawkesbury Sandstone crops out at the extremities of the rail extension at Dulwich Hill and Lilyfield.

Groundwater is present within the unconfined, unconsolidated fill and estuarine sediments along Hawthorne Canal, and in the underlying Ashfield Shale and Hawkesbury Sandstone.

A review of water bores registered with the NSW Office of Water (NOW) indicates there are 25 registered bores within a five-kilometre radius of the project. Although the data within the NOW database are limited, analysis indicates that groundwater along the project has a low usage with only one bore registered for domestic use. The remainder of the bores were constructed as test bores or monitoring wells.

Groundwater levels along the project are typically shallow, ranging between 1.4 and six metres below ground level, and are influenced by the position in the landscape and closeness to discharge features. The shallowest groundwater levels across the project area are expected within the composite fill next to Hawthorne Canal.

The region receives relatively high rainfall and Sydney Water provides a reticulated water supply to residential, industrial and commercial properties in the study area. The groundwater quality within the estuarine sediments and Ashfield Shale is typically brackish and not suitable for domestic use. Groundwater quality within the Hawkesbury Sandstone is typically of good quality with low hydraulic conductivity; however, it is not used within the project area due to other reliable water supply options.

The composite fill that in-fills the former Long Reach Creek around Hawthorne Canal is likely to consist of estuarine sand, mud, demolition rubble, and industrial and household waste. Consequently the quality of groundwater is expected to be variable and possibly contaminated. It is likely the sediments at this location are hydraulically connected to the canal and may be influenced by tidal fluctuations.

Groundwater quality within the Ashfield Shale is typically variable and saline. High salinities reflect the connate salts within the marine shale unit and low formation permeability. Groundwater flow within the shale is typically along bedding planes and within joints and fractures. The aquifer has low permeability and limited fracture connectivity.

Groundwater within the Hawkesbury Sandstone occurs in perched horizons within the weathered sandstone and within the deeper regional aquifer. Groundwater flow within the perched horizon is limited and dominated by intergranular flow in the weathered sandstone. In contrast groundwater flow within the deeper aquifers is along both primary features, such as less well cemented zones within the sandstone, and secondary structural features, such as joints, shear zones, faults and bedding plane partings. Groundwater quality within the Hawkesbury Sandstone is typically of good quality with salinity less than 1000 milligrams a litre (higher when in contact with the Ashfield Shale) and suitable for drinking water with the appropriate treatment.

Impacts of existing rail corridor on local drainage sub-catchments

Where the light rail alignment is elevated, run-off from adjacent high ground is diverted along the toe of the rail embankment and nearby streets into the urban drainage system. In some locations cross-drainage structures exist to take flow across the corridor under the embankment. The Leichhardt Flood Study (Cardno Lawson Treloar 2010) identifies approximately 11 cross-drainage structures between Leichhardt North stop and Taverners Hill stop. The study did not identify any cross-drainage structures between Lilyfield stop and Leichhardt North stop but did indicate stormwater structures that drained into the rail corridor. These would need further consideration in detailed design.

At Leichhardt North stop, the outbound platform would be above a cess drain. If a thin slab is used, then drain capacity is unlikely to be affected as the size of drain would not change significantly. This needs to be considered further during detailed design.

The *Tennyson Street Subcatchment Management Plan* (Equatica 2009) identifies one cross-drainage structure in the corridor located within the Cooks River catchment area. Cross-drainage structures between Parramatta Road and New Canterbury Road in the Hawthorne Canal catchment have not been identified. Further study of structures in this area would be made in detailed design.

At Dulwich Hill Interchange, an existing sewer pipe has been broken behind the sectioning hut where it protrudes from the cut face. Establishing a stop at this location would require this service to be relocated. The cess drains just to the north of Dulwich Hill are likely to have reasonable capacity although they are heavily vegetated, which would need to be removed.

Where cross-drainage structures exist and have not been maintained, they may cause obstruction to flow and create localised flooding at the inlets. These structures would need to be made operable during construction.

Where the alignment is in-cut, run-off collects at the toe of the embankments and drains away along existing drainage channels or pit and pipe networks. These structures also convey rainfall run-off from the surrounding urban drainage networks. If these longitudinal drainage structures are in disrepair and blocked, there could be ponding and flooding on the alignment and the surrounding urban areas. These channels and networks should be made operable during construction.

Within the Leichhardt LGA, the disused rail corridor forms a major hydraulic control, with significant ponding occurring upstream of the line. The ponding is largely caused by the under capacity of the culverts under the rail line connecting to Hawthorne Canal. Flooding from the canal is limited to the west of the rail line, and does not affect many properties within the Leichhardt LGA. However, flood levels within the canal can affect the conveyance of flows from the culverts crossing from the eastern side of the rail line (Cardno Lawson Treloar 2010).

17.3.3 Potential impacts

Hydrology and flooding

There is a risk of the alignment flooding in locations where it is at or below surrounding land. Three areas of flood risk have been identified, as described below.

Flood risk area 1 — Lilyfield stop to Leichardt North stop

The existing Lilyfield stop, the rail corridor and tunnel connecting Lilyfield stop to Leichhardt North stop, including the cutting and tunnel sections, are at risk of flooding (Cardno Lawson Treloar 2010). Part of the alignment in this area is flooded at the five year ARI event and upwards; however, the flood depths and velocities are low in this area, with depths not exceeding 0.01 metre for the probable maximum flood (PMF) (Cardno Lawson Treloar 2010). The area floods from a combination of ponding due to direct rainfall into the rail corridor and some overflow from nearby local drainage sub-catchments. Given that the flood depths are very low, it is unlikely operations would be affected significantly, even during major storms. Low depth surface water ponding in the rail corridor is likely during frequent events, but this could be managed through upgrading and/or restoring the longitudinal drainage system.

As the flood risk to this area is low under PMF conditions, increased flooding due to climate change would not significantly increase the existing low level of risk, and on the basis of sensitivity analysis, climate change risk has not been modelled.

Flood risk area 2 — Lewisham West stop

A flood assessment of Hawthorne Canal was undertaken for a development proposal at the Summer Hill Flour Mill site next to Edward and Smith Streets (Meinhardt Infrastructure & Environment 2010). This assessment involved hydrologic and hydraulic modelling of the canal between the flour mill site and a point approximately 250 metres downstream of Longport Street. The area assessed includes the proposed Lewisham West stop and the GreenWay shared path alignment where it passes underneath Longport Street and the Inner West Rail Line.

This flood assessment indicates the following flood risk to the project:

- Approximately 80 metres of the light rail alignment and GreenWay shared path directly adjacent to the flour mill building is at risk of flooding for the 20 year ARI event and upwards. Flood depths range from 0.3 to 1.5 metres for the 100 year ARI event in this area, with an average depth of approximately 0.8 metres.
- The GreenWay shared path underpass under Longport Street and approximately 60 metres of the alignment upstream of the underpass are at risk for the 100 year ARI event and upwards; however, flood depths for the 100 year ARI event are shallow along the alignment and through the underpass at around 0.1 metres or less.
- The site of the proposed Lewisham West stop is not at risk of flooding up to the 100 year ARI event.

The key flood risk area would therefore be the 80 metre section of the alignment directly next to the flour mill building. The alignment upstream of this point may also be at risk; however, this is outside the area modelled for the flood assessment. A detailed flood study of Hawthorne Canal in this area is recommended at the detailed design stage to determine the full extent of flood risk to the alignment in the Summer Hill area. The flood study should also consider the impacts of climate change on flooding from the Hawthorne Canal, which was not addressed in the previous study, and which would assess impacts of increased rainfall intensity and sea level rise in the tidally influenced part of Hawthorne Canal further downstream. Depending on the results of the flood study, mitigation measures may need to be implemented to protect the alignment.

Flood risk area 3 — GreenWay shared path east of Hawthorne Stop

The Estuarine Planning Levels Study for the foreshore region of the Leichhardt Local Government Area (Cardno Lawson Treloar April 2009) provides planning levels (i.e. minimum topographic levels for built development) to protect development against tidal inundation under a combination of the following conditions:

- 100 year ARI surge tide in Lower Parramatta River
- sea level rise of 0.9 metres based on the NSW sea level rise planning benchmark of an increase above 1990 mean sea levels of 40 cm by 2050 and 90 cm by 2100 (Sea Level Rise Policy Statement, NSW Department of Environment and Climate Change 2009).
- wave overtopping risk based on different foreshore edge treatment measures.

The highest planning level provided in the study is 3.38 metre AHD for the outlet of Hawthorne Canal for the worst case edge treatment measure. The alignment and proposed stops are well above these planning levels and therefore not at risk from tidal flooding.

However, the GreenWay shared path is at risk of tidal flooding where it runs along Hawthorne Canal east of the proposed Hawthorne stop. Hawthorne Canal is not subject to wave overtopping risk over the majority of its length as it extends inland; however, the canal could overtop under still water surge tide levels. For most of the GreenWay shared path length the ground levels are around 2 metre AHD, which is below the 100 year ARI still water tidal surge level of 2.4 metres AHD, with allowance for 0.9 metres of sea level rise. Under these conditions most of the parkland and adjacent roads would also be flooded.

Mitigating this risk by raising the GreenWay shared path above the flood level would not be practical as it would require raising it by at least 0.5 metres above existing ground levels. This would affect the overland flood flow paths and would cause localised increases in flood velocities and hazards as the elevated GreenWay shared path was overtopped. Having an elevated pathway allowing access into a flooded area would also be unacceptable because it would expose public users to flood risk. The only practical mitigation measures for this risk are to design the path to resist erosion during flooding conditions and to close it during surge tide conditions.

Other flooding issues

There is a localised risk of flooding of the alignment and the GreenWay shared path from local catchment/Hawthorne Canal flow near Marion stop for the 100 year ARI event (Cardno Lawson Treloar 2010). As no flood levels are available for the Hawthorne Canal, this risk would be further clarified during detailed design.

At Hawthorne stop, the stop would be above the 100 year ARI flood level; however, once the paths are ramped down to the existing level on the canal side of the stop, there is a risk these paths would be flooded.

Special consideration must be given to the design of the new bridge over Hawthorne Canal to ensure it does not affect upstream flood levels. The bridge would be located in a tidal section of the canal, so rising sea levels would result in higher flood levels at this location. Modelling the canal during the detailed design stage would confirm the bridge levels and configuration.

Construction and operational impacts on existing flooding processes

The project's construction is not anticipated to affect existing flooding as long as standard construction flood management procedures are followed. This includes maintaining existing drainage lines and overland flow pathways at all times, using temporary measures if necessary.

There are no anticipated operational impacts of the project on flooding processes due to:

- as the existing disused alignment will be re-used, there is no ground-raising proposed that would obstruct or displace floodwater
- no significant increase in impermeable area at stops as they are generally within land that is already fully developed
- where minor increase in impermeable area is required, the upgraded drainage system can be designed to ensure no worse than existing run-off rates through on site detention
- the upgraded longitudinal drainage system should be designed to existing appropriate standards (i.e. RailCorp and Transport Construction Authority (TCA)), which allow for increased rainfall intensities due to climate change and would improve the capacity of the longitudinal and cross-drainage infrastructure.

Groundwater

Given the rail line is already constructed, the impact of the project on groundwater is expected to be minimal as no new tunnels or major cuttings are required. Likely impacts may be associated with platform construction where excavations for lift shafts, stairs or other infrastructure may intersect the watertable, such as through fuel or other contaminant run-off.

The construction phase of the project could contaminate underlying aquifers.

During construction, excavations could also intersect isolated bodies of perched water within the weathered shale horizon or within the fill associated with Hawthorne Canal. There is also the possibility piles may intercept shallow groundwater and become unstable because of unconsolidated saturated material. Shallow groundwater would be easily drained, but is expected to be too saline to discharge into the local creeks or stormwater system. Depending on the volume of water that may be intersected, disposal options include discharge into Hawthorne Canal or transported in a tanker off-site for disposal. Discharge into Hawthorne Canal would require approval from the relevant authority, which would likely be Sydney Water or the local council. Water quality and discharge volume should be assessed before seeking approval.

17.3.4 Management of impacts

17.3.4.1 Construction impacts

Flood mitigation

The area immediately next to the Summer Hill flour mill building is at risk of flooding in a 20 year ARI event. A detailed flood study should be undertaken for Hawthorne Canal to determine the risk to the alignment in the area and upstream, and to investigate mitigation measures required to protect proposed operations.

A flood management plan (FMP) should be developed for the construction phase, including emergency evacuation procedures if a flood occurs. Otherwise, typical construction flood management procedures apply; including monitoring the potential for heavy rainfall to occur and, as needed, works ceased and equipment removed from flow paths before the rainfall event. Some additional management options could be looked at in further detail during detailed design, including installing a flood bund east of the construction site; however, the impacts of such measures would need further study.

Elsewhere along the alignment no significant flood risks are likely and typical construction flood management procedures apply. This includes maintaining existing drainage lines and overland flow pathways at all times using temporary measures if necessary.

Water quality management and sediment and erosion control

Localised flooding of excavation sites would need to be considered during construction. Water pumping facilities would need to be installed along the corridor to remove any water that would be pooled during the project's construction as a result of groundwater seepage or surface water flows.

Any water collected from the site must be treated and discharged in accordance with the current guidelines, including the Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) Guidelines for Fresh and Marine Water Quality and The Blue Book — Managing Urban Stormwater: Soils and Construction (Landcom 2004), to avoid any potential contamination or local stormwater system impacts. Depending on the quality of any collected water that requires disposal, treatment could be required during either the project's construction and/or operation phase to meet DECCW licence requirements for stormwater discharge or Sydney Water requirements for sewer discharge.

Where existing longitudinal pit and pipe drainage exists and needs to be reinstated/repaired, scour/erosion protection measures may need to be reinstated or improved at outlets to watercourses or drainage lines. Typical scour/erosion protection measures would be concrete energy dissipating structures or dumped stone rip rap.

Groundwater

Groundwater impacts would be considered during detailed design, especially in relation to any excavation works associated with lift shafts, stairs and stop platforms. Where excavations are proposed, exploration drilling would take place and monitoring wells constructed to assess the presence of perched and shallow groundwater. A minimum of four monitoring wells should be installed along the project, especially at Hawthorne stop, Marion stop and Dulwich Hill interchange, with monitoring on a quarterly basis. The monitoring wells should be sampled before construction to establish the background groundwater level and groundwater quality conditions if groundwater discharge is required.

A dewatering plan should be incorporated into the CEMP. This would include details for water disposal options, impacts on the local environment, water quality, estimates of water volumes, and how to register for a licence with NOW.

During construction, bunds would be positioned around potential sources of contamination, such as fuel, to contain any spill. The groundwater wells would be monitored during the construction phase to detect any subsurface migration of contaminants from any spills. With weathered, clayey shale, most contamination would be absorbed to the unsaturated soil and rock profile and is unlikely to reach the Ashfield Shale Bedrock.

Exploratory drilling should allow for better assessment of the depth to groundwater; the piles should be designed to accommodate appropriate management of groundwater to reduce the potential instability of the piles.

17.3.4.2 Operational impacts

Flood mitigation

Mitigation options for the key risk area next to the Summer Hill flour mill building may be limited, as the project is aligned with the existing infrastructure of the disused rail corridor. A detailed flood study should be undertaken for Hawthorne Canal to determine the risk to the alignment in the area and upstream, and to investigate mitigation measures required to protect proposed operations. Providing flood protection to the alignment in the form of raised bunds or barriers may not be feasible as this may exacerbate flooding to nearby land and properties by displacing floodwater that would currently be stored within the rail corridor. It is possible that the only feasible mitigation measures are evacuation and closure of the line in this area, covered by a flood/emergency management plan.

Mitigation options for the key risk area along the GreenWay shared path east of the proposed Hawthorne Stop are similarly limited. The GreenWay shared path and most of the surrounding parkland and nearby roads would be flooded under surge tide conditions. Mitigating this risk by raising the GreenWay shared path above the flood level would not be practical as it would require raising it by at least 0.5 m above existing ground levels. This would affect the overland flood flow paths and would cause localised increases in flood velocities and hazards as the elevated GreenWay shared path was overtopped. Having an elevated pathway allowing access into a flooded area would also be unacceptable as it would expose public users to flood risk. The only practical mitigation measures for this risk are to design the path to resist erosion during flooding conditions and to close it during surge tide conditions.

Elsewhere there may be flood risk from local catchment run-off where the light rail alignment and GreenWay shared path are at normal ground level. Detailed local drainage catchment assessments should be undertaken during detailed design to determine the level of risk. Mitigation, such as raising levels including stop entrances, may be appropriate; however, the level of risk should be balanced against any adverse visual impacts of raising floor/building/walkway levels or upstream impacts.

Drainage infrastructure — surface water management

Any existing drainage structures must be repaired and/or any new drainage structures must be designed to meet current standards. These standards are assumed to be the same or similar to RailCorp and TCA standards, including:

- no surface flooding in rail corridor up to 50 year ARI event
- no overtopping of rail up to 100 year ARI event
- no adverse impacts to nearby land upstream and downstream of the corridor
- the minimum design life of all track drainage components will be 50 years with consideration given to site location and groundwater conditions (RailCorp 2009)
- allowance for increased rainfall intensity associated with climate change in drainage system design (TCA 2010).

It may not be possible to achieve the standards of 'no surface flooding in the rail corridor up to the 50 year ARI event', or the 'no overtopping of rail up to 100 year ARI event' in the key flood risk area next to the Summer Hill flour mills building. Floodwater at this site enters the rail corridor from Hawthorne Canal and may be difficult to control or mitigate. The most feasible construction and operation management strategy in this area may be to implement a FMP, which would include monitoring, evacuation and closure.

Where the GreenWay shared path is at ground level it is assumed to be on existing adequately drained land and no requirements additional to standard landscaping measures are required. However, the positioning of the GreenWay shared path midway up batters would require drainage treatments, without creating scour problems on the batters. These would be considered further during detailed design.

Best practice environmental design principles to promote water conservation would be incorporated into stop design. This includes on-site water capture and retention for cleaning, and then used for irrigation where possible; and water efficient landscaping. Rainfall harvesting and reuse would be further considered during detailed design.

Water quality management and sediment and erosion control

The corridor may contain potential contamination. Stormwater run-off could also become contaminated with sediments, fuels, oils and/or other materials that may wash into the stormwater system from stops and exposed surfaces within the rail corridor and eventually to Hawthorne Canal and Cooks River.

There are a number of different treatment options available to minimise impacts on water quality that would be determined during detailed design. They would be required to trap litter, oil, organics and sediment, and where practical would be at outlet points from the site drainage system into the local council's drainage system, or outlet points flowing into Hawthorne Canal or Cooks River. The *Urban Stormwater Best Environmental Management Practices Guidelines* (Stormwater Committee 1999) would be consulted during detailed design to determine the most appropriate treatment. Maintenance access would also be required.

Groundwater

From the desktop review it appears that groundwater would have minimal impact on the operation of the project. Some long-term seepage could occur during operation if platform infrastructure were to intersect perched groundwater, though the impact is not considered significant.

Exploratory drilling and installing monitoring wells before construction should allow for a better assessment of seepage rates, and incorporating the outcomes in the detailed design should reduce the potential impacts of seepage to platform infrastructure. Should seepage be expected, the drainage at stops would be designed to direct water away from platform infrastructure.

Potential impacts to groundwater quality and changes in groundwater levels are expected to be minimal during the project's operation.

17.4 Topography and soils

17.4.1 Existing environment

Topography

The topography along the project is relatively flat ranging from less than 10 metres Australian height datum (AHD) near the shoreline at Iron Cove to 30 metres AHD further inland (Central Mapping Authority of NSW Parramatta River Topographic Map 9130–3N — 1:25,000).

In the northern portion of the project the topography is part of a catchment that generally drains towards Hawthorne Canal (tidal) running north-east, which receives stormwater discharging into Iron Cove. For the southern portion, near Dulwich Hill, the topography forms part of the Cooks River catchment at the southern end of the proposed GreenWay shared path.

Soils and geology

Soil landscape

- The following soil landscapes have been identified along the proposed project alignment, based on a review of the Soil Conservation Service of NSW Sydney Soil Landscapes Series Sheet 9130 (1: 100,000) (1983): Blacktown soil landscape grouping along the light rail from the proposed Lilyfield stop to Leichhardt North stop and south from Old Canterbury Road to New Canterbury Road.
- Gymea soil landscape grouping is from the proposed Leichhardt North stop and Charles Street, Leichhardt.
- The rail corridor is also considered to consist of engineered ground as a result of the construction of the rail tracks within the corridor. Some areas include disturbed terrain (such as between the proposed Leichhardt North stop to Taverners Hill stop) where fill material and reclaimed land has been used for the ground material under the rail tracks.
- Birrong Soil Landscape Grouping is along the project from the proposed Taverners Hill stop to Old Canterbury Road.

The soil landscapes near the project are shown in Figure 17.3 and described further below.

Blacktown soil landscape

The Blacktown soil landscape is derived primarily from weathering processes and is characterised by gently undulating hills on Wianamatta Group shales. The Blacktown soil landscape comprises shallow to moderately deep hard setting mottled texture contrast soils, Limitations of the landscape include moderately reactive, highly plastic subsoil, low soil fertility and poor soil drainage.

Gymea soil landscape

The Gymea soil landscape is derived primarily from erosion processes and is characterised by undulating to rolling rises and low hills on Hawkesbury Sandstone. Limitations of the landscape include localised steep slopes, high soil erosion hazard, rocky outcrops, shallow highly permeable soil, very low soil fertility.

Disturbed terrain

The disturbed terrain occurs along Hawthorne Canal and is characterised by level plain to slight undulating terrain, extensively disturbed by human activity, including complete disturbance, removal or burial of soil. Natural soil has been replaced with fill that includes soil, rock, building and construction waste materials. Original vegetation has been replaced with turf or grassland.

Soils within disturbed terrain comprise turf fill areas that are commonly capped with up to 40 centimetres of sandy loam or up to 60 centimetres of compacted clay over fill or waste materials. Limitations of the disturbed terrain depends on the nature of the fill material present, which is subject to mass movement hazards, impermeable soil, poor drainage, and localised very low fertility and potential toxic and contaminated materials.

Birrong soil landscape

The Birrong Soil Landscape Grouping is derived primarily from fluvial processes. The landscape is characterised by level to gently undulating alluvial floodplains draining Wianamatta Group Shales. Possible limitations of the soil landscape include localised flooding, high soil erosion hazard, saline subsoils, seasonal waterlogging and very low soil fertility.

Acid sulfate soils

Acid sulfate soils (ASS) are acidic soil horizons or layers resulting from the aeration of soil materials that are rich in iron sulfides, primarily pyrite (FeS_2). They are generally likely to be present in:

- marine and estuarine sediments of the recent (Holocene) geological age
- soils that are usually not more than five metres above mean sea level
- marine or estuarine settings.

One area of high probability of acid sulfate soil materials occurs in bottom sediments where Hawthorne Canal meets Iron Cove according to the *Department of Land and Water Conservation Acid Sulfate Soil Risk Map — Edition Two, 1997* (1:25000). This corresponds with the proposed section of the GreenWay shared path in this area. There is no known occurrence of ASS materials in the remaining alignment of the project.

The ASS risk map for the area surrounding the project is shown in Figure 17.4.

Geology

Geology beneath the proposed light rail extension from Lilyfield stop to Trevor Street, Lilyfield is characterised by Hawkesbury Sandstone and visible in railway cuttings that comprise medium to coarse grained quartz sandstone. A thin layer of Ashfield Shale is present at Lilyfield stop. Ashfield Shale is present from Trevor Street, Lilyfield to just east of Norton Street, Leichhardt.

Hawkesbury Sandstone lies beneath the light rail just east of Norton Street, Leichhardt to the northern most part of the proposed GreenWay shared path towards Kegworth Street (near the midpoint of the proposed stops at Marion and Taverners Hill).

Ashfield shale from the Wianamatta Group lies beneath the proposed light rail extension and GreenWay shared path between Kegworth Street, and intersection of Ewart Street and Ness Avenue, Dulwich Hill.

From this point, the geology changes back to Hawkesbury Sandstone and remains until the southernmost point of the proposed GreenWay shared path near the Cooks River.

The geology groupings identified along the proposed light rail corridor and GreenWay shared path comprise:

- Ashfield Shale, which is part of the Wianamatta Group, comprising black to dark–Grey shale and laminate (north of Trevor Street, Lilyfield to Leichhardt North stop, Marion Street, Lewisham to Blackwood Avenue, Dulwich Hill).
- Hawkesbury Sandstone comprising medium to coarse grained quartz sandstone (Lilyfield stop to Beames Street, Lilyfield, Leichhardt North stop to Hawthorne stop, Blackwood Avenue, Dulwich Hill to Dulwich Hill Interchange stop and the intersection of Riverside Crescent and Wardell Road, Marrickville).
- Stream Alluvial and Estuarine Sediment comprising silty to peaty quartz sand, silt, and clay and ferruginous and humic cementation in places and shell layers common (along the GreenWay shared path from Parramatta River to Marion Street, Leichhardt and from intersection of Riverside Crescent and Wardell Road towards the Cooks River).
- Mittagong formation comprising interbedded shale, laminite and medium-grained quartz sandstone, which is two to three metres thick, exists between the Hawkesbury Sandstone and Ashfield Shale (Department of Mineral Resources 1983).

The geology near the project is shown in Figure 17.5.

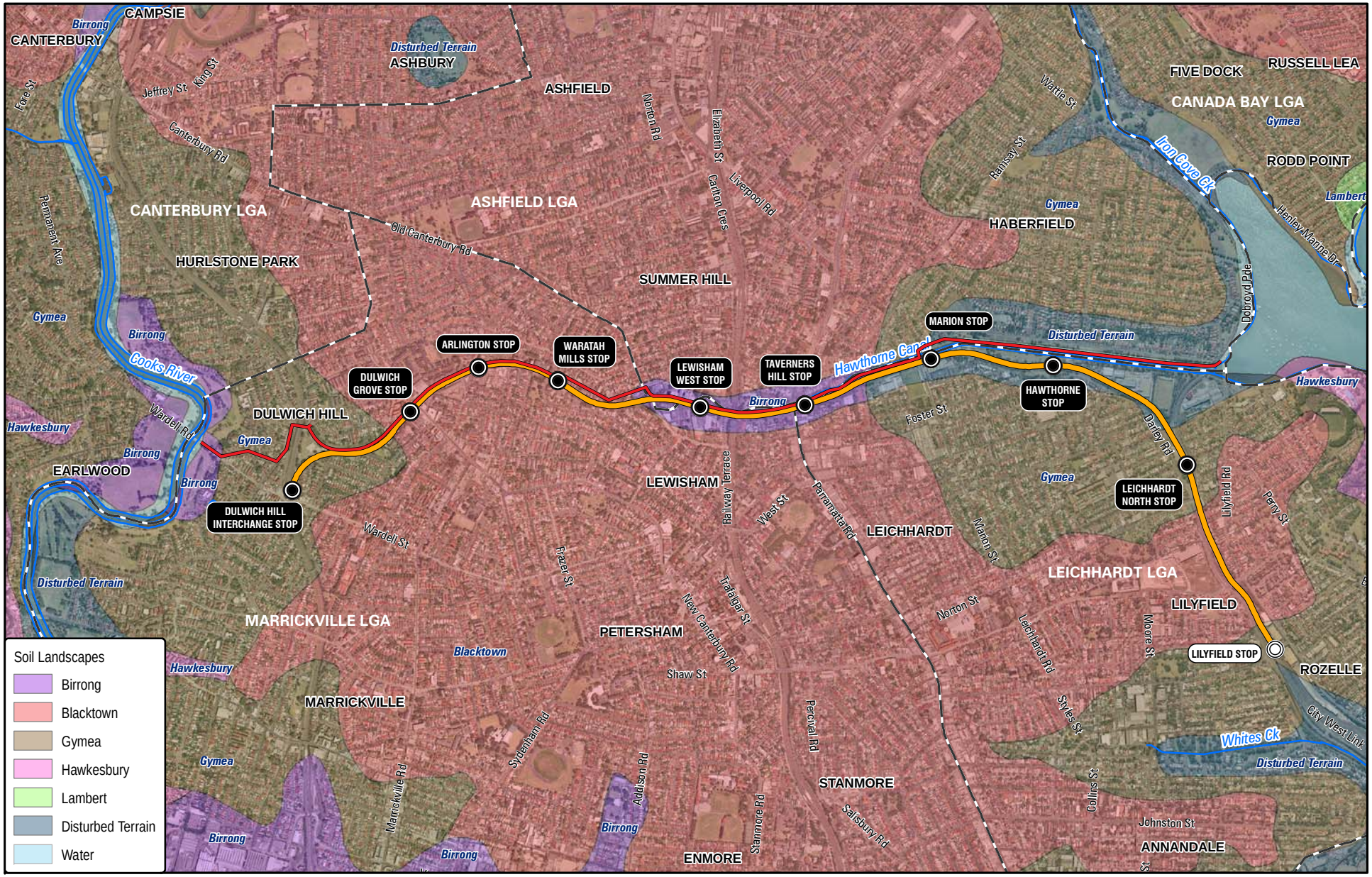

Figure 17.3 Soil landscapes in the vicinity of the project

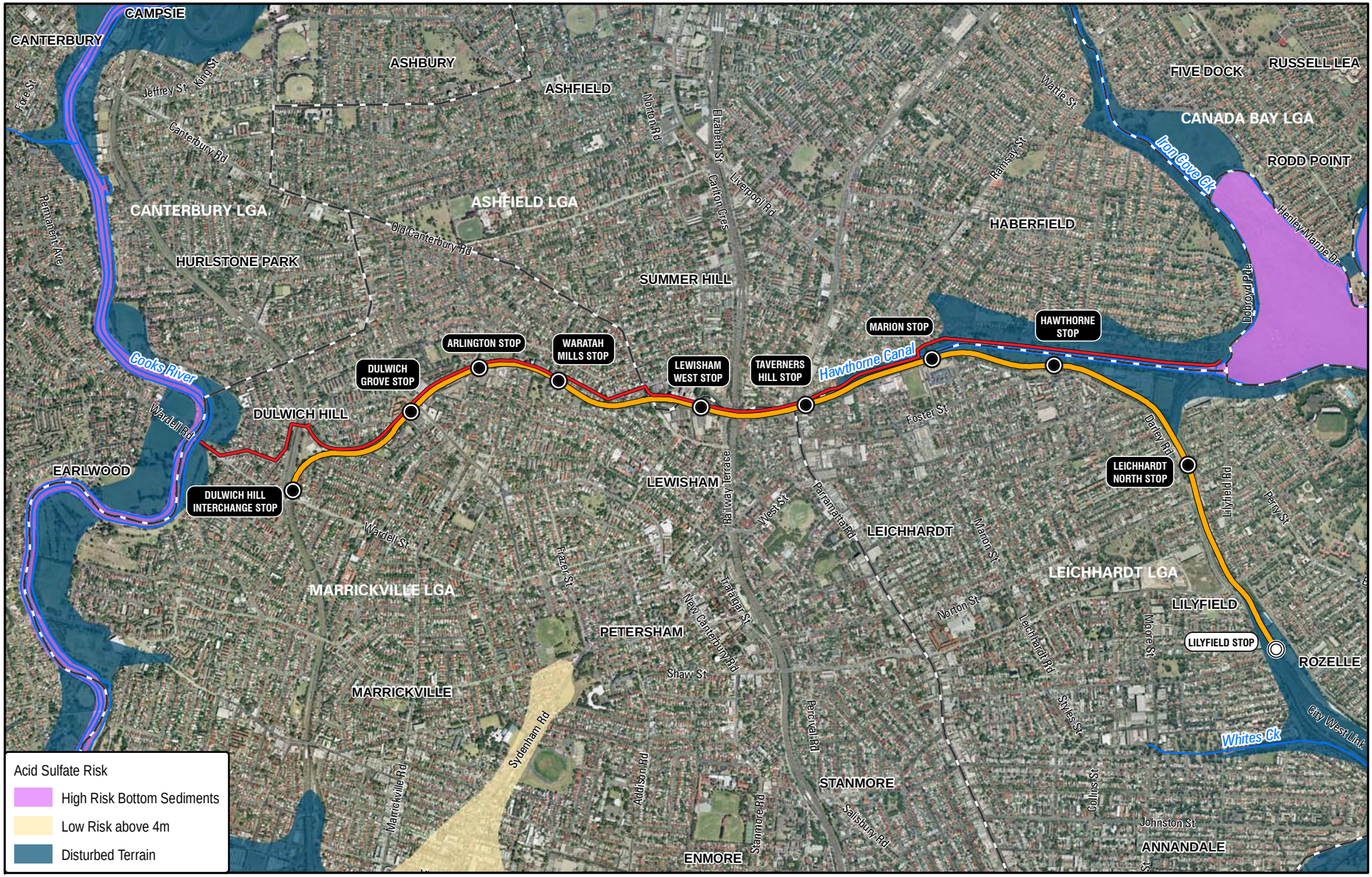

Figure 17.4 Acid Sulfate Soils risk map

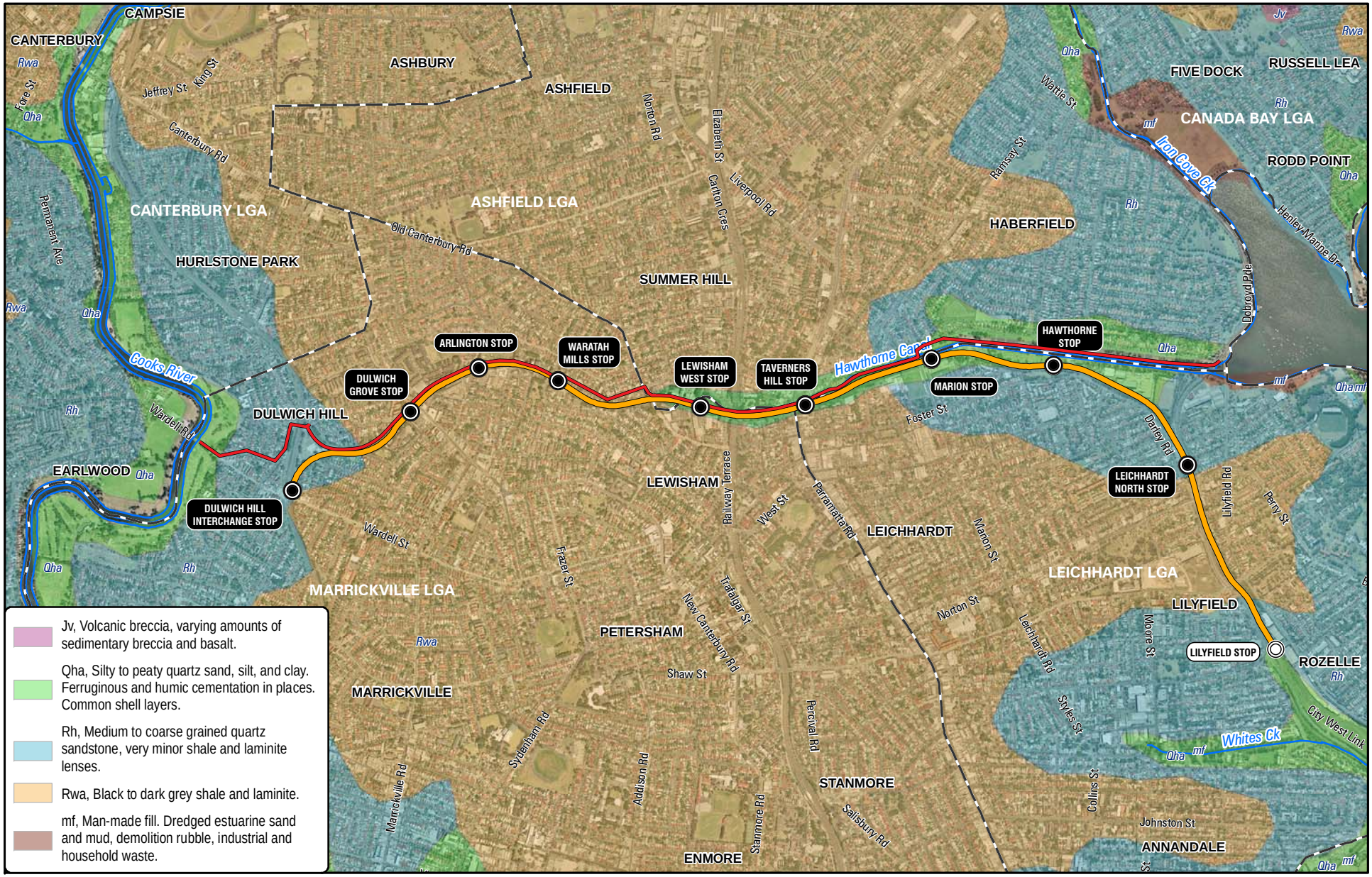

Figure 17.5 Geology in the vicinity of the project

17.4.2 Potential impacts

Construction

Topography

Earthworks would be required along the project alignment and at each of the stop locations. The earthworks would result in alterations to the existing topography. Table 17.3 describes the general earthworks that would be required at each of the stops.

Table 17.3 Stop topography and proposed earthworks

Stop	Existing topography	Proposed earthworks
Leichhardt North	Generally level with at-grade platforms to be constructed.	Earthworks to level ground for stop platform and access path installation. Minor works required for lift at eastern side of stop.
Hawthorne	Built at a slight grade to surrounding land.	Earthworks to level ground for stop platform and access path installation. Cut and fill works required for additional graded paths to stop.
Marion	Proposed on existing raised rail embankment (i.e. built on–embankment)	Earthworks to level ground for stop platform and access path installation. Potential excavation works for construction of lifts and stairway.
Taverners Hill	Proposed on existing raised rail embankment (i.e. built on–embankment).	Earthworks to level ground for stop platform and access path installation. Potential excavation works for construction of lifts and stairway.
Lewisham West	Built at a slight grade to surrounding land.	Earthworks to level ground for stop platform and access path installation.
Waratah Mills	Built at a slight grade to surrounding land.	Earthworks to level ground for stop platform and access path installation.
Arlington	Built at a slight grade to surrounding land.	Potential excavation widening works to existing embankment for construction of lifts and stairway/s.
Dulwich Grove	Built within in an existing deep incised cutting.	Potential excavation widening works to existing embankment to accommodate stop platforms and associated stair access.
Dulwich Hill Interchange	Built within in an existing deep incised cutting.	Potential excavation widening works to existing embankment to accommodate stop platforms and associated stair access.

Further investigation at the detailed design phase would confirm the proposed works and specific requirements for earthworks associated with GreenWay shared path and stop construction works.

Soils and geology

The establishment of construction compounds and general earthworks for the GreenWay shared path, access paths and general structure (i.e. bridge and drainage structures) construction would expose the natural ground surface and subsurface. The soils exposed are likely to be moderately erodible when exposed. Potential impacts associated with soil erosion include the removal of topsoil, exposure of buried structures, sedimentation and increased turbidity levels in waterways and/or stormwater systems and reduced air quality. Measures proposed to manage these impacts are discussed in Section 17.6 (air quality) and in Section 17.3 (hydrology).

Earthworks and bank excavations would be required along the rail corridor to accommodate the GreenWay shared path. These works could cause the rail corridor embankments to become unstable. At detailed design there would be further geotechnical investigations to determine the extent of earthworks, excavations and piling required. Embankment stabilisation treatments would then be determined to mitigate impacts.

Piling works would be required to construct the light rail stop substructures at Leichhardt North, Hawthorne, Marion and Taverners Hill stops, support structures for passenger lifts, bridge foundation works and the GreenWay shared path support structures (where the path is elevated). These works could impact on the underlying geology. In particular, impacts on groundwater and the water table might occur near Hawthorne Canal given its tidal nature. Construction works that could have an impact would include piling for the proposed elevated sections of GreenWay shared path in this area, such as the proposed pedestrian bridge at Hawthorne stop. Mitigation measures to minimise impacts would be determined during detailed design.

Acid sulfate soils

Known areas of high probability of occurrence of ASS materials have been identified where the GreenWay shared path along Hawthorne Canal feeds into Iron Cove. The risk this would pose to the majority of the GreenWay shared path construction works would be expected to be minimal as construction works would be near the surface. The new pedestrian and cyclist bridge across Hawthorne Canal could require some deeper excavations and therefore may result in the exposure of potential ASS.

Operation

Erosion may occur during the operation of the project due to increased run-off from new hard surfaces, namely the GreenWay shared path and other access paths and stop platforms, and/or as a result of the presence of exposed surfaces (such as embankments).

17.4.3 Management of impacts

Construction

Construction impacts to topology, geology and soils are expected to be adequately managed through applying standard management measures. Measures would include:

- Erosion and sedimentation controls would be installed, maintained and managed before and during construction in accordance with the construction compounds and ancillary facilities plan (Section 19.2.2), the earthworks management plan (Section 19.2.5) and the principles in *The Blue Book —Managing Urban Stormwater*: *Soils and Construction* (Landcom 2004). The control measures would apply the principles of:
  - minimising the area and duration of soil disturbance
  - early and effective revegetation of cleared areas
  - retaining natural vegetation, as much as practicable, to act as buffer zones to minimise erosion and sedimentation
  - using straw bales, siltation fences and other filtering devices to restrict sediment movements to within the work sites and to prevent any movement of sediment off-site
  - regular maintenance of all erosion and sedimentation devices so they operate effectively.
- Detailed geotechnical investigation to guide the detailed design and construction of the project.

Acid sulfate soil

The presence of ASS along the remainder of the project alignment would be confirmed through intrusive testing of soils in areas conducive to environments where ASS is likely to occur. Should ASS be identified during intrusive investigations at any section along the project, an ASS management plan would be required for the construction phase of the project in these areas.

The ASS management plan should outline procedures for the safe handling, treatment and transport of potential/actual acid sulfate soils excavated during construction or maintenance works and identify management measures, including:

- excavation procedures
- spoil storage and treatment
- dewatering and groundwater management
- bunding and measures to protect surrounding areas and waterways from the potential risk of acid contamination.

The objective of the ASS management plan would be to comply with all statutory requirements and implement all environmental controls to minimise and manage impacts to the environment from the disturbance of potential or actual ASS.

Detailed design would consider the potential impacts on elements that are buried or in contact with identified ASS and determine mitigation measures for minimising impacts.

Operation

Should ASS be identified during intrusive investigations, an ASS management plan would be required for future maintenance works in these areas. Embankments stabilisation treatments would require maintenance during the operation phase of the project to ensure functionality.

17.5 Contaminated land

17.5.1 Assessment approach

A phase 1 environmental assessment was undertaken for the project to determine the potential for existing contamination within the existing rail corridor and along the alignment of the GreenWay from past and present land uses. The phase 1 environmental assessment identifies the need for further investigation before construction begins and determines mitigation measures for any contamination issues.

During the preparation of the Phase 1 environmental assessment a number of sources of available information were reviewed to assess the potential contamination of the project area. An assessment of the following information sources was undertaken to assist with identifying potential issues that may impact on construction and operation of the light rail and GreenWay:

- aerial photographs
- *1:100,000 Geological Series Sheet and Notes of the Sydney Area*, Department of Mineral Resources (C Herbert, 1983)
- *1:100,000 Soil Landscapes Sheet and Notes of the Sydney Area*, Soil
- RailCorp's contamination assessment of the disused Rozelle goods line corridor between Dulwich Hill and Lilyfield undertaken by Pells Sullivan Meynink in July 2010 of behalf of RailCorp (PSM 2010).

17.5.2 Existing environment

A review of past and present aerial photography identified the disused Rozelle goods line was operating from the early 1900s. It is understood the portion between Lilyfield and Dulwich Hill ceased operation by 2009.

The aerial photography identified that the area surrounding the rail corridor, including the proposed GreenWay location, had a history of predominantly low to medium density residential, with some commercial and industrial sites.

Based on the historical review and a site inspection in August 2010, the most likely sources of contamination within the project area would be associated with imported fill, operation of the former goods rail line and nearby industrial sites.

Potential identified sources of concern are presented in Table 17.4. The locations of these areas of concern have been identified in Figure 17.6a to Figure 17.6e including the risk of contamination within and surrounding light rail and the GreenWay shared path.

Table 17.4 Potential contaminant sources

Area	Rationale/details	Potential contaminants	Risk of contamination		
			Light rail alignment	Stops/access	GreenWay shared path
Open space/parks	▪ Uncontrolled fill ▪ Spraying for weed and pest control ▪ Use of fertilisers	▪ Total petroleum hydrocarbons (TPH) ▪ Benzene, toluene, ethyl benzene and xylenes (BTEX) ▪ Polyaromatic hydrocarbons (PAHs) ▪ Nutrients ▪ Heavy metals ▪ Organochlorine pesticides (OCP) ▪ Organophosphate pesticides (OPP) ▪ Asbestos	Low	Low	Moderate to high
Rail corridor (including embankments)	▪ Fill and ballast material ▪ Asbestos fibres from train brakes ▪ Spraying for weeds and pest control ▪ Fuels, oils and greases ▪ Asbestos and lead paint residues from former buildings ▪ Electrical transformers	▪ Total petroleum hydrocarbons (TPH) ▪ Benzene, toluene, ethyl benzene and xylenes (BTEX) ▪ Polyaromatic hydrocarbons (PAHs) ▪ Phenols ▪ Heavy metals (including chromium IV) ▪ Organochlorine pesticides (OCP) ▪ Organophosphate pesticides (OPP) ▪ Polychlorinated biphenyls (PCB) ▪ Asbestos	High	High	High
Service station and workshop located on corner of Wardell Road and Riverside Crescent Service station and workshop located on the corner of Smith Street and Carlton Crescent Auto Workshop located at 230 Denison Road, Dulwich Hill	▪ Fuels, oils, waste oil and greases ▪ Spraying for weeds and pest control	▪ Total petroleum hydrocarbons (TPH) ▪ Benzene, toluene, ethyl benzene and xylenes (BTEX) ▪ Polyaromatic hydrocarbons (PAHs) ▪ Phenols ▪ Heavy metals ▪ Organochlorine pesticides (OCP)	Low	Low	Moderate to high

Area	Rationale/details	Potential contaminants	Risk of contamination		
			Light rail alignment	Stops/access	GreenWay shared path
Electricity substation located on Smith Street, Lewisham Electricity substation located on the corner of Brown and Barker Street, Lewisham	▪ Fuels, oils, greases ▪ transformer oil, metal corrosion	▪ Total petroleum hydrocarbons (TPH) ▪ Benzene, toluene, ethyl benzene and xylenes (BTEX) ▪ Polyaromatic hydrocarbons (PAHs) ▪ Heavy metals ▪ Polychlorinated biphenyls (PCB)	Low	Low	Moderate to high
Flour Mills	▪ Fuels, oils and greases associated with ▪ Asbestos and lead paint residues in buildings ▪ Rail sidings ▪ Weed and pest control	▪ Total petroleum hydrocarbons (TPH) ▪ Benzene, toluene, ethyl benzene and xylenes (BTEX) ▪ Polyaromatic hydrocarbons (PAHs) ▪ Heavy metals ▪ Organochlorine pesticides (OCP) ▪ Organophosphate pesticides (OPP) ▪ Polychlorinated biphenyls (PCB) ▪ Asbestos	Moderate	Moderate	Moderate
Former industrial building, 7 Darley Road, Leichhardt	▪ Fuels, oils and greases ▪ Asbestos and lead paint residues in building ▪ Rail siding	▪ Total petroleum hydrocarbons (TPH) ▪ Benzene, toluene, ethyl benzene and xylenes (BTEX) ▪ Polyaromatic hydrocarbons (PAHs) ▪ Heavy metals ▪ Organochlorine pesticides (OCP) ▪ Polychlorinated biphenyls (PCB) ▪ Asbestos	Moderate to high	Moderate to high	Low
Hawthorne Canal	▪ Reclaimed (disturbed) land, contaminated water and sediments, illegal dumping, contaminated stormwater, acid sulfate soils	▪ Total petroleum hydrocarbons (TPH) ▪ Benzene, toluene, ethyl benzene and xylenes (BTEX) ▪ Polyaromatic hydrocarbons (PAHs) ▪ Phenols ▪ Heavy metals ▪ Organochlorine pesticides (OCP) ▪ Polychlorinated biphenyls (PCB) ▪ Asbestos ▪ Acid sulphate soils	Low	Low	Moderate

Area	Rationale/details	Potential contaminants	Risk of contamination		
			Light rail alignment	Stops/access	GreenWay shared path
Rozelle Goods Yard	▪ Fuels, oils and greases ▪ Asbestos and lead paint residues in buildings ▪ Rail siding ▪ Weed and Pest control ▪ Metal corrosion	▪ Total petroleum hydrocarbons (TPH) ▪ Benzene, toluene, ethyl benzene and xylenes (BTEX) ▪ Polyaromatic hydrocarbons (PAHs) ▪ Heavy metals ▪ Organochlorine pesticides (OCP) ▪ Organophosphate pesticides (OPP) ▪ Polychlorinated biphenyls (PCB) ▪ Asbestos	Moderate to high	Moderate to high	Moderate to high
Roads and road reserves	▪ Bitumen, fuels, oils and greases ▪ Spraying for weeds and pest control along road reserves ▪ Uncontrolled fill material ▪ Metal abrasion and corrosion	▪ Total petroleum hydrocarbons (TPH) ▪ Benzene, toluene, ethyl benzene and xylenes (BTEX) ▪ Polyaromatic hydrocarbons (PAHs) ▪ Phenols ▪ Heavy metals (particularly copper, lead and zinc) ▪ Organochlorine pesticides (OCP) ▪ Organophosphate pesticides (OPP) ▪ Asbestos	Low	Low	Moderate

Light rail alignment
City West Link rail corridor tunnel
Local government area boundary
Existing light rail stop
Proposed light rail stops
Areas of conern

Figure 17.6a Potential sources of contamination

Note: Indicitive only, subject to detail design.

Light rail alignment
Proposed light rail stops
Local government area boundary
Watercourse
Existing GreenWay shared path (upgraded)
New GreenWay on-street cycle path
New GreenWay shared path (at-grade)
New GreenWay shared path (elevated)
Potential bushcare/landscaping
Areas of conern

Figure 17.6b Potential sources of contamination

Note: Indicitive only, subject to detail design.

Figure 17.6c Potential sources of contamination

Note: Indicitive only, subject to detail design.

Light rail alignment
Proposed light rail stops
Local government area boundary
Watercourse
Existing shared path (upgraded)
New GreenWay shared path (at-grade)
New GreenWay shared path (elevated)
New GreenWay on-street cycle path
Existing bushcare site
Potential bushcare/landscaping
Areas of conern

Figure 17.6d Potential sources of contamination

Note: Indicitive only, subject to detail design.

Light rail alignment
Proposed light rail stops
Local government area boundary
Watercourse
Existing shared path (upgraded)
New GreenWay shared path (at-grade)
New GreenWay shared path (elevated)
New GreenWay on-street cycle path
Existing bushcare site
Potential bushcare/landscaping
Areas of conern

Figure 17.6e Potential sources of contamination

Note: Indicitive only, subject to detail design.

17.5.3 Potential impacts

Construction

The following potential impacts may occur as a result of the project with regards to contaminated land during the construction phase of the project:

- Disturbance of ground surface in contaminated areas could disperse contaminated materials into the surrounding receiving environment, including air and water.
- Demolition of structures could disperse hazardous materials to the receiving environment, particularly the former industrial building off Darley Road, Leichhardt, which would be demolished as part of the project.
- Construction activities associated with spills and leaks of potentially contaminating materials could contaminate soil and or water.

Operation

Operational impacts relating to contamination are not considered significant. Some potential impacts relating to the contamination have been identified for the operational phase of the project, including ballast cleaning within the rail corridor when the light rail is operating.

It is not anticipated the project's operation would result in any further contamination of the local area.

No impacts relating to contamination have been identified with relation to the operation of the GreenWay.

17.5.4 Management measures

Construction

Measures to mitigate potential impacts from contaminated soil during construction are as follows:

- Develop and implement a waste management plan (WMP) as part of the CEMP for managing possible contaminated materials.
- The project earthworks management plan (refer to Section 19.2.5) would detail appropriate procedures for the assessment, handling and stockpiling of potentially contaminated materials before and during the works. The earthworks management plan would also include a contingency plan for unexpected hazards that may be encountered during site works.
- All waste would be managed in accordance with relevant legislation.
- A hazardous materials survey should be made of the building located at 7 Darley Road, Leichhardt before demolition works, and to schedule any existing signal huts or structures within the site area as hazardous materials for removal. In the event any asbestos is identified in these structures, an asbestos management plan would be developed and implemented.

It is recommended that additional intrusive (Phase 2) works be carried out to identify/characterise the following during detailed design of the project. This study would build on the findings of the Phase 1 assessment and would include the following assessment:

- depending on depth of excavations near Hawthorne Canal (GreenWay shared path bridge construction), potential for contaminated groundwater infiltration into excavations, dewatering and waste management
- categorisation of contamination/waste in accordance with the NSW DECC (2008), *Waste Classification Guidelines Parts 1 and 2*.

Some assessment may be required along the route of the GreenWay shared path to help manage any wastes and minimise the risks from unknown contamination during construction.

Operation

Measures to mitigate potential impacts from onsite contamination during the operational phase would include any:

- maintenance works requiring excavations or contact with potentially contaminated material would take place in accordance with the operator's environmental management system (EMS)
- ongoing asbestos issues following the construction phase of the project would be identified in an asbestos management plan
- ballast cleaning on the line during operation would be done in accordance with RailCorp procedures.

17.6 Air quality

17.6.1 Assessment approach

A desktop assessment of the existing environment and anticipated construction and operational impacts from the project was undertaken.

17.6.2 Existing environment

Sensitive receivers

Potentially affected receivers near the project include residential properties, childcare centres, aged care facilities and schools. People who are considered to be particularly sensitive are the young and elderly. The nearest potentially affected receivers include the following:

- local residents, particularly those located within streets next to the light rail corridor, as well as residents located within streets that provide access for construction vehicles to the proposed construction sites
- various parklands and sporting facilities surrounding the corridor, particularly Blackmore Oval, Richard Murden Reserve, Hawthorne Canal Reserve, Lambert Park, Hoskins Park, Johnson Park and Jack Shanahan Park

- childcare centres close to the corridor, such as Explore and Develop on Old Canterbury Road, Kegworth Out Of School Hours Care, Bambini of Lilyfield and Early Achievers Child Care Centre
- nursing homes located on Old Canterbury Road and Marion Street
- schools, such as Dulwich Hill Preschool and Dulwich Hill Public School
- local businesses, particularly those located near the proposed construction compounds and construction vehicle access points, including Lilyfield Road, Darley Road, Marion Street, Parramatta Road, Brown Street, Nelson Street and Hercules Street.

Background air quality data

The existing air quality for the study area is considered to be characteristic of a suburban and light commercial environment. The surrounding air shed contains key pollutants potentially harmful to human health, such as total suspended particles (TSP) including fine particulates less than 10 and 2.5 micrometers in diameter (PM_{10} and $PM_{2.5}$ respectively), oxides of nitrogen (NO and NO_2), carbon monoxide (CO), sulphur dioxide (SO_2), Volatile organic compounds (VOCs), ozone (O_3). Local air quality is mainly influenced by emissions from major arterial roads running through the study area, as well as other influences from the wider Sydney airshed, such as dust and bushfires. Beyond traffic no major pollutant generating facilities are located within the immediate locality.

Air quality monitoring data from the Department of Environment Climate Change and Water (DECCW) Rozelle and Chullora air monitoring stations is considered representative and therefore adopted to estimate existing background levels at the study area.

Rozelle and Chullora air monitoring stations

The Rozelle air quality monitoring station is located in the grounds of Rozelle Hospital, off Balmain Road, Rozelle at an elevation of 22 metres. The Chullora air quality monitoring station is located at the South Sydney TAFE College on Worth Street Chullora at an elevation of 10 metres. Both are situated within DECCW's Sydney region. The results for the key air pollutants for the years 2000 to 2009 are shown in Table 17.5. There were no recorded results for SO_2 at the Rozelle station and for most years at the Chullora station. $PM_{2.5}$ or VOCs were not recorded at either station from 2000 to 2009.

The air quality assessment criteria have been adopted from the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC 2005). The measured air quality for air pollutants NO_2 and CO was below the adopted criteria for all years measured. Ozone (O_3) was generally below the criteria with the exception of 2001 (11.5 pphm at Rozelle), 2005 (11.7 pphm at Chullora) and 2009 (17.1 pphm at Chullora). PM_{10} was the only pollutant to regularly exceed the 50 µg/m^3 criterion. Rozelle recorded exceedances in 2004 (54.1 µg/m^3), 2006 (50.3 µg/m^3) and 2007 (54.4 µg/m^3). Chullora recorded exceedances in 2003 (213 µg/m^3), 2004 (55.8 µg/m^3), 2005 (50.7 µg/m^3), 2006 (66.1 µg/m^3) and 2007 (66.5 µg/m^3). It is expected the elevated PM_{10} concentrations are a result of the stations' closeness to major arterial roads, such as Victoria Road at Rozelle, and Liverpool and Rookwood Roads at Chullora. Both stations recorded abnormally high PM_{10} concentrations in September 2009 due to a dust storm.

Table 17.5 Summary of background levels at Rozelle and Chullora air monitoring stations

Year	SO_2 (pphm)		NO_2 (pphm)		O_3 (pphm)		PM_{10} (µg/m3)		CO (ppm)	
	Rozelle	Chullora	Rozelle	Chullora	Rozelle	Chullora	Rozelle	Chullora	Rozelle	Chullora
	Max 1-hour average						Max 24 hour average		Max 8 hour average	
DECCW criterion	20		12		10		50		9	
2000	ND	ND	7	ND	8	ND	ND	ND	4.5	ND
2001	ND	ND	6.6	ND	**11.5**	ND	ND	ND	3.2	ND
2002	ND	ND	8.6	ND	10	ND	ND	ND	2.8	ND
2003	ND	ND	5.2	6.6	8.3	8.4	ND	213.7	2.2	ND
2004	ND	ND	6.4	5.6	9.4	**10.5**	**54.1**	**55.8**	2.2	3.4
2005	ND	ND	5.2	6.4	8.1	8.6	46.8	**50.7**	2.1	2.8
2006	ND	ND	5.7	6.6	9.3	**11.7**	**50.3**	**66.1**	2	2.3
2007	ND	ND	5	4.9	8.8	8.8	**54.4**	**66.5**	1.8	1.8
2008	ND	2.1	4	4.4	5.6	8	43.1	44.3	1.5	1.6
2009	ND	2.9	4.9	5.2	8.3	**17.1**	**1562.83**	**1474.73**	2.3	2.6

Note 1: Carbon monoxide (CO), nitrogen dioxide (NO_2), PM_{10}: particulate matter with an aerodynamic diameter of less the 10 microns, ozone (O_3)
Note 2: Bold indicates an exceedance of the DECCW air quality goals
Note 3: Concentration affected by the Sydney dust storm September 2009
$\mu g/m^3$ = micrograms per cubic metre, ppm = parts per million, pphm = parts per hundred million
ND: denotes no data available

17.6.3 Potential impacts

Construction impacts

Dust

Anticipated sources of dust and dust-generating activities from the project include:

- operation of bulldozers, scrapers, graders, loaders and excavators across the entire project area, particularly along the GreenWay shared path and stops
- excavation and fill transfer works associated with the GreenWay shared path underpasses at Longport Street, the Inner West rail line, Old Canterbury Road, Davis Street, Constitution Road, New Canterbury Road and Hercules Street
- construction works for GreenWay shared path bridge and raising the rail bridge over Parramatta Road
- demolition of the existing warehouse facility on Darley Road near the Leichhardt North stop
- dust loading and transfers from aggregate material on trucks, loaders and excavators
- emissions of dust from the movement of vehicles on unsealed roads
- wind erosion from exposed surfaces at disturbed areas.

The total amount of dust generated depends on the properties of the soil material (silt and moisture content), the techniques adopted during excavation, demolition, grading and transfer of soils, and the prevailing meteorological conditions. The dispersion of the dust relates to the quantity and drift potential of the particles. Larger particles generally settle out near the source, whereas fine particles (generally referred to as particulate matter or PM_{10}) can be dispersed over greater distances from the source.

Typically the impacts on nearby sensitive receivers decrease significantly with increased distance from the source. Receptors greater than 200 metres from construction works are anticipated to experience negligible dust impacts. During unfavourable meteorological conditions, such as dry and windy conditions, dust emissions could be higher. The response and procedure for dealing with dust management would be detailed as part of the CEMP as described further in Section 17.6.4 and Section 19.2.5. The closeness of sensitive receptors, such as residential properties, recreational facilities, schools and care facilities for the young and aged would drive the implementation of various dust control measures. Major points of construction, demolition and associated works would be the focus of these measures.

The implementation of best practice management and mitigation measures, as discussed in Section 17.6.4, would minimise impacts on the local air quality and nearest potentially affected receptors.

Other

Emissions of CO, NO_x, SO_2, PM_{10}, VOCs, and PAH compounds are associated with the combustion of diesel fuel and petrol from construction plant and equipment.

Emission rates and impact potential would depend on the number and power output of the combustion engines, the quality of the fuel and the condition of the combustion engines. Poor maintenance of construction machinery and vehicles would result in inefficient fuel use and increased emissions, particularly of CO and particulate matter. The implementation of the mitigation measures discussed in Section 17.6.4 would minimise emissions from construction vehicles and plant and would not result in significant air quality impacts.

The construction contractor(s) and site managers would be required to check all equipment for best possible performance and that it does not release smoke in contravention of the *Protection of the Environment Operations Act 1997* and/or the *Clean Air (Plant and Equipment) Regulation 1997*. Good site practices would minimise emissions of combustion gases so they would not have any impact on the nearest sensitive receptors.

Operational impacts

The project introduces light rail traffic along the disused Rozelle goods line corridor, which has been disused for two to three years. There would be emissions to air associated with the light rail component of the project, namely:

- maintenance using diesel vehicles
- maintenance and operation of staff vehicle emissions.

Light rail vehicles

Electric light rail vehicles operating on the project would operate from a nominal 750 volt direct current (DC) overhead power reticulation system. As such, there would be no point source emissions from the vehicles, with the exception of minor dust and particulate emissions from brake pads and lubricating oils. As light rail emits less of these pollutants than road vehicles and heavy rail, no significant air quality impacts are likely to result from the operation of the project.

Maintenance using diesel vehicles

The project would also generate air pollution emissions through using diesel vehicles during the periodic maintenance of stops, trackwork and associated infrastructure.

It is not expected that these activities would generate a significant increase in air quality impacts and emissions.

17.6.4 Mitigation measures

Construction phase

Air quality management measures would be included as appropriate within the construction compounds and ancillary facilities management plan, construction traffic management plan (CTMP) and earthworks management plan (as detailed in Sections 19.2.2, 19.2.4 and 19.2.5). The following mitigation measures would be included, as a minimum, to minimise the potential for dust migration from the site, emissions from on-site machinery and traffic, and from construction traffic using public roads:

- all plant machinery would be regularly maintained and would comply with all applicable standards and guidelines

- all equipment would be inspected before use to ensure the best possible performance and to prevent the release of excessive emissions in contravention of the NSW *Protection of Environment Operations Act 1997* and the *Protection of the Environment Operations (Clean Air) Regulation 2002*
- all plant and machinery would be used for the appropriate tasks to prevent excessive engine stress on each unit
- all site vehicles and machinery would be switched off when not in use to eliminate the generation of any unnecessary emissions
- where feasible, the extent of sealed surfaces on construction sites would be maximised
- site speed limits would be implemented to prevent any unnecessary generation of fugitive dust emissions
- site movements would be kept to a minimum
- all vehicles transporting material to and from sites would be covered immediately after loading to prevent fugitive emissions and spillages
- tailgates would be securely fixed before loading and immediately after unloading
- stockpiles would be located away from sensitive receptors where possible
- unconsolidated stockpiles not used for extended periods would be covered or enclosed on three sides using covers or spray grass or watered and kept moist
- exposed surfaces would be kept to a minimum or consolidated through using staged excavation or applying spray grass
- appropriate dust control measures, such as water cart rotations and misting systems, would be applied as required to minimise dust dispersion beyond construction areas
- multiple activities occurring close to each other that would generate dust would be minimised
- handling dust generating materials would be minimised and drop heights to trucks and/or skips would be kept to a minimum
- on-site burning of waste at any of the construction sites, depots or pre-cast yards would not be permitted
- all odours arising from activities or materials on-site would be managed in accordance with section 129 of the *Protection of the Environment Operations Act 1997*
- all construction sites and exposed areas would be appropriately rehabilitated once construction works are complete.

Construction procedures would be modified during periods of high wind and in dry conditions. As such, local meteorological conditions would be observed on a daily basis during construction. Mitigation measures that would be used during adverse weather conditions include:

- Increased use of a mobile dust suppression system to dampen unsealed surfaces, such as access roads and unpaved areas. The extent and frequency of application would depend on the prevailing weather conditions.
- Activities that could generate high levels of dust may be curtailed, suspended or postponed in situations where the wind direction and speed may cause adverse impacts on nearby sensitive receptors.

Communities that could be affected would be consulted throughout the project's construction. Newsletters and other communications tools would be used to distribute information to the community about work progress, consultation activities, upcoming works and all project contact points.

Operational phase

Plant, equipment and vehicles used for maintenance would not be left running or idling when not in use. Plant, equipment and vehicles would be fitted with appropriate emission controls and would undergo periodic and regular maintenance to reduce exhaust emissions.

17.7 Utilities and services

17.7.1 Existing utilities and services

Preliminary investigations have identified the following utilities within or near the project corridor:

- electrical cables (of varying size and voltage)
- telecommunication cables
- a stormwater drain on the eastern side of the rail corridor alignment from Dulwich Grove stop to Dulwich Hill Interchange
- a cess drain at the Leichhardt North stop
- various cross-drainage and sewerage structures within the project corridor, including the Lewisham Sewage Aqueduct which has been identified as a heritage item (refer to Section 12.1.1).

Further study of the locations and structures in this area would be conducted as part of the detailed design of the project.

17.7.2 Potential impacts

Construction

Construction impacts with respect to services and utilities could include the potential for damage to services and utilities as well as injury to persons (construction workers or the community) in the unlikely event that cables, mains or pipelines are accidentally damaged during excavation, plant movement or general civil works.

Transmission of large electrical currents through the ground (known as 'earth potential rise') could potentially occur as a result of damaged power cables or mains. In the unlikely event that an existing electrical cable is damaged during construction, this could have the potential to injure construction workers and members of the community standing close to the damaged power utility. This potential hazard is highly unlikely to occur due to the management measures proposed as part of the project. Damage to other mains (such as gas, water or sewer) could also result in injury to construction workers and community members. Users may also experience short disruptions to telecommunication connections, street lighting or water, wastewater and gas mains if these services are required to be relocated as part of the project.

Investigations would be carried out during the detailed design phase of the project to ensure that all appropriate measures are in place to minimise the potential risks to existing utilities and services prior to commencement of construction works.

Operation

The operation of the light rail would require an additional draw of power to run the light rail vehicle (LRVs) and electrical equipment at each of the stops (such as lighting, lifts, and emergency help points). This would require an additional level of power to be supplied over the existing amount supplied for the local area.

The project would therefore include the installation of two substations within the rail corridor to augment the local power systems and provide the required level of power required to operate the light rail network extension.

17.7.3 Management measures

Construction

Management of construction works

The project would aim to minimise and manage any hazards or risks of working in close proximity to existing utilities. The construction contractor(s) would be required to check the locations of existing underground utilities and services prior to commencing construction works (including a detailed dial-before-you-dig search). This would be undertaken through pot-holing and/or hand-digging and in accordance with guidelines provided by the relevant utility authority.

Should the location of any utilities be identified to be in conflict with the project, a formal review of the proposed works at these location(s) would be undertaken in consultation with the construction contractor. Alternative arrangements would then be determined to provide the most beneficial outcome for the community, service provider and project in terms of safety and constructability.

In addition, all works would be carried out in accordance with the following guidelines:

- AS4799-2000 *Installation of Underground Utility Services and Pipelines Within Railway Boundaries*
- RailCorp Standard G5000-G5007-2001 *Management Systems for Pipe, Electrical Telephone Crossings Under and Over Railway Property*
- RailCorp Standard ESC540 v1.1 *Utility Service Crossings*.

Consultation with utility owners and service providers

During detailed design and construction, all appropriate service utility providers (e.g. electricity, communication and water services) would be consulted.

Prior to the commencement of construction works, consultation would be undertaken with affected utility owners, including (but not limited to) Energy Australia, Telstra and Sydney Water and AGL. Services or utilities that may be impacted by the project (as outlined in Section 17.7.1) would be protected and/or relocated. This would include protection of the Sydney Water Corporation sewer and water mains, Telstra cables and other existing services where they cross the rail corridor or may be impacted by the construction of the GreenWay shared path.

It is not anticipated that services such as power poles, existing street lighting or other such services would require relocation or replacement as part of the project. This would be confirmed during detailed design of the project. However, if required, the construction contractor would identify any potential disruptions to existing utilities and key stakeholders would be notified in the event of a disruption.

Operation

The project would be designed to operate in the most energy efficient manner possible with minimum drawdown on local power. However, the operation of the project would require the installation of two substations within the rail corridor to augment the local power systems and provide the level of power required to operate the LRVs. The substations would be located so that they minimise amenity impacts on nearby sensitive receivers. Impacts would be minimised by:

- locating the substations away from sensitive receivers where possible (e.g. within industrial areas)
- planting appropriate vegetation around the substations to minimise visual impacts for adjoining properties.

Existing access tracks would still need to be maintained to allow for access during routine maintenance operations by relevant services providers.

17.8 Resource and waste management

This section addresses the non-energy-consuming resources that would be required during construction and operation of the project and the likely streams of waste that would be generated by the project.

17.8.1 Overview

The consumption of resources and production of waste are inherently linked. By minimising resource consumption, waste production is typically reduced as is the resultant impact on the environment. In NSW, resource and waste management is prioritised under the *Waste Avoidance and Resource Recovery Act 2001* according to the resource management hierarchy. The hierarchy is as follows:

- avoidance of unnecessary resource consumption
- resource recovery (including reuse, reprocessing, recycling and energy recovery)
- disposal.

The project has the potential to utilise a range of different resources and generate a number of different types of waste throughout its construction and operational phases. The construction of the project would require the use of resources such as electricity, water, fuel, concrete and paving materials (such as asphalt for stop platforms and the GreenWay shared path). Other resources would be required for infrastructure such as signals, signage, fit out of the stops, landscaping and retaining walls.

The maintenance and occasional repair of project infrastructure during operation would require resources. However, it is not anticipated that these activities would place a significant demand on resources.

Potential sources of waste during construction would include earthworks, vegetation clearing, drainage works, demolition, equipment maintenance, road infrastructure upgrades, waste concrete, wood and metal, materials packaging and worksite office activities.

Typical wastes during operation are minimal and would potentially maintenance waste from rolling stock and trackwork. These would require various management measures and disposal processes in accordance with relevant State legislation and government policies.

17.8.2 Potential impacts

Construction resource and waste management

Demand on resources

While the construction of the project would increase demand on local and regional resources, the development of the project alone would not result in any resource becoming scarce or in short supply within the Sydney or greater regional area.

Resource requirements — particularly for water and general construction materials — would be determined during the detailed design and construction phase.

Waste

The construction of the project would generate various types of wastes, which would be managed in accordance with *the Waste Avoidance and Resource Recovery Act 2001*, including:

- demolition waste from existing structures (including concrete, bricks and steel)
- construction waste materials (including packaging, concrete, bricks, crushed rock, steel and timber)
- liquid wastes (including waste fuels, paints, oils and chemicals)
- surplus materials used during site establishment (including safety fencing and barriers, which may include plastics and metals)
- cleared vegetation
- wastewater (including site run-off and water used to control dust)
- domestic wastes (including food scraps and putrescible wastes, aluminium cans, glass bottles, plastic and paper containers used by construction workers)
- sewage from construction site facilities
- possible contaminated materials (including materials from the disused warehouse building adjacent to the Leichhardt North stop).

Hazardous waste arising from the construction phase of the project would also be removed and disposed of in accordance with the relevant guidelines, including the DECCW *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes* (Environment Protection Authority 1999).

As identified in Section 17.5, a hazardous materials survey would be undertaken at detailed design to determine the presence of contaminated materials on the site.

Operational resource and waste management

Demand on resources

It is not anticipated that maintenance and occasional repair of project infrastructure would place a significant demand on resources.

Waste

Only a relatively small quantity of waste would be generated by the project and would primarily relate to the maintenance and repair activities associated with the light rail. These wastes would potentially include wastewater from ballast cleaning and replacement, oils and other materials used during track maintenance, and trimmed vegetation from remnant vegetation and landscaped areas to maintain a clear corridor for operation of LRVs.
Rail users may also generate small amounts of general waste and litter at stops. Additionally, wastewater would be generated from cleaning trains at the stabling and maintenance depot.

Some minor amounts of waste may also be generated from the maintenance of the GreenWay shared path. Some vegetation trimmed from remnant vegetation and landscaped areas on either side of the GreenWay shared path may be generated on a periodical basis in order to maintain an appropriately cleared corridor for pedestrians and cyclists or repair damaged sections of the GreenWay shared path. Waste generated by the operation of the GreenWay shared path would be managed by each of the local councils.

17.8.3 Management of impacts

Construction

A waste management plan (WMP) would be prepared as part of the CEMP prior to construction works commencing. The plan would detail standard environmental management measures to manage resource consumption and to avoid, re-use and dispose of waste during construction. These measures would include:

- investigating opportunities to maximise the re-use of construction spoil on the project, including cut/fill balance during design (detailed in Chapter 7)
- investigating opportunities to re-use or recycle other construction and demolition waste
- applying the waste hierarchy (avoid, minimise, re-use/recycle, dispose) during construction
- preparing and maintaining a waste management system on site (including recycling)
- treating any wastewater collected prior to discharge, in accordance with current standards
- chipping leaf material and small branches of native vegetation for use as mulch in revegetation or landscaping works
- disposing all other green waste from vegetation removal to a green waste recycling facility
- maintaining work sites in a tidy state, and appropriately disposing of all general litter (including food scraps, plastics, glass bottle)
- manage and classify waste for disposal in accordance with the *Waste Classification Guidelines Parts 1 and 2* (DECC, 2008), the *Waste Avoidance and Resource Recovery Act 2001* and other relevant policies and guidelines
- using a licensed contractor to remove contaminated waste, under current WorkCover NSW and DECCW guidelines.

Operation

To minimise and manage the operational waste produced on site, rubbish bins would be provided for passengers and users of the GreenWay shared path to appropriately dispose of any general or putrescible wastes.

Waste generated by the operation of the GreenWay shared path would be managed by each of the local councils.

17.9 Hazards and risks

17.9.1 Hazards and risks during construction

Hazards and risks associated with the construction phase of the project can be broadly categorised into the following three areas:

- environmental hazards — including potential discharge of potentially hazardous or other materials to the environment
- occupational health and safety hazards — including any activity or outcome that may affect the health and/or safety of site personnel and visitors that may arise due to the failure to implement health and safety procedures on site
- construction hazards — these hazards could result from the materials required to complete construction of the project, and materials required to maintain plant and machinery during the operation of the project (generally associated with the light rail component).

These three areas are discussed in more detail below.

Environmental hazards

Environmental hazards associated with construction of the project could arise during the transport, use and storage of hazardous materials on site, as well as the unearthing of contaminated soils/groundwater and their subsequent disposal during construction activities.

During construction, potentially hazardous materials that are required for construction works would be stored on site at the identified construction compounds (discussed in Chapter 7 and shown in Figures 7.1a to 7.1f) in accordance with the relevant legislation. The refuelling and maintenance of construction plant and equipment would be undertaken within designated areas at these construction compounds. These operations would be undertaken using specialised refuelling contractors equipped with appropriate spillage response equipment and training.

The types of potentially hazardous materials that may be required to be stored and used on site during the construction of the project are shown in Table 17.6. All cylinders, small containers and drums would be consolidated in designated areas.

Table 17.6 Hazardous materials potentially located on site during construction

Potentially hazardous material	Likely method of storage on site
Diesel	20-litre drums and carry cans
Lubricating oil	20-litre drums
Oxy-acetylene	Cylinders (up to 55 kilograms) in rack
Petrol	20-litre drums
Cement	Bags/pallets (in container)
Premix concrete	Bags/pallets (in container)
Concrete curing compounds	20-litre drums
Epoxy (plumbers') glue	Small containers
Acid Sulphate Soils	Stored in lined bins and kept moist or removed from site directly
Contaminated waste	Stored in bunded area or removed from site directly
Paint	20-litre drums

Potentially hazardous materials would also be required to be transported to and from construction sites on public roads. Spills and leaks during transportation could result in the contamination of land and waterways outside of the project area. It is expected that this would be managed through the existing management measures implemented by the delivery contractors of these materials.

Sensitive environmental receivers such as watercourses, water bodies and flora and fauna may be impacted by any potentially hazardous materials used during construction of the project if appropriate environmental management measures are not implemented. Potential discharges to the environment from the construction phase would be managed or eliminated by the implementation of environmental management measures during the construction phase of the project.

By eliminating and controlling these potential environmental hazards, the construction phase of the project is not considered to be a 'potentially hazardous industry' under the definition of *State Environmental Planning Policy 33 — Hazardous and Offensive Developments*.

Occupational health and safety hazards

Occupational health and safety hazards could result from construction activities and could potentially affect the health and safety of site personnel and any other persons visiting the construction site, as well as members of the public in close proximity to the construction site or on roads used for construction access. A health and safety plan would be prepared prior to commencement of construction on the site and would require induction of each of the personnel working on the site at any given time.

Occupational health and safety hazards associated with the project would include:

- undertaking construction works adjacent to roads and the operational Bankstown Line rail corridor
- undertaking construction works and associated truck movements on the local road network. Risks associated with the movement of vehicles would include the potential for injury as a result of collision with other vehicles, site workers or the community. In addition, other risks may include noise, dust or flying debris if loads are not covered appropriately
- moving plant, equipment and material-delivery vehicles into and out of the site (at the nominated site access points) could pose health and safety risks to construction workers and members of the public
- lifting heavy structural components or products, which could pose manual handling risks to construction workers
- demolishing existing structures, which could result in construction workers being exposed to hazardous materials
- slipping and tripping on uneven surfaces within work sites (e.g. sleepers, rail and ballast may present trip hazards)
- coming into contact with overhead wires and subsurface utilities (gas, water, electrical and sewer mains) within the vicinity of the project corridor — the management of utilities and services is discussed in Section 17.7

- using plant and equipment during site works, for example excavators, piling rigs, Hi-rail vehicles, cranes, etc
- working on embankments or within cuttings, or on overbridges, may present a risk of site personnel falling or having loose items or tools fall on them.

Construction hazards

Contaminated materials may potentially be found during construction of the stops and the GreenWay shared path. These could result in health impacts to construction workers, the environment and members of the community that come into contact with such materials. Contamination of land and waterways outside of the project area (such as Iron Cove, the Cooks River or Hawthorne Canal) could result from spills or accidents during the transportation of contaminated materials from the construction site or through the implementation of inadequate management measures to manage stormwater run-off or dust generation.

The management of contaminated land has previously been discussed in Section 17.5.

The demolition of the existing warehouse building at 7 Darley Road Leichhardt (the Leichhardt North stop) may involve the removal of asbestos containing materials. This activity would be carried out by a licensed contractor who has current WorkCover NSW accreditation in asbestos removal and would be undertaken in accordance with the relevant guidelines, including the DECCW *Waste Classification Guidelines: Part 1* (DECC 2008) (Environment Protection Authority 1999). Waste management has previously been discussed in Section 17.8. As identified in Section 17.5, a hazardous materials survey would be undertaken at detailed design to determine the presence of contaminated materials on the site.

Overhead wires and subsurface utilities could also present construction hazards to site workers and the environment once these have been installed. Damage to any existing utilities within the project corridor (such as high-pressure gas pipes, electricity cables, etc) could potentially result in injury to site workers and/or members of the community.

The management of utilities and services has previously been discussed in Chapter 7.

17.9.2 Operation hazards and risk

The main hazards that would be associated with the operation of the project include:

- pedestrian incidents (e.g. at pedestrian crossings at each stop, on-street sections, and at-grade road crossings along the GreenWay shared path)
- a light rail vehicle accident (including derailment, collision, fire or impact)
- collisions between cyclists and pedestrians on the GreenWay shared path
- natural events (including flooding and storms resulting in trees or overhead wires falling on the light rail or GreenWay shared path)
- external events (events occurring at adjacent facilities such as industrial facilities adjacent to the rail corridor)

- utility failure (power, signalling or communication failure)
- structural failure (bridge or pedestrian overpass collapse).

Passenger safety and vehicle accidents are addressed in more detail in Chapter 14.

17.9.3 Management of hazards and risks

Construction

Construction hazards and risks associated with the project would be addressed through the implementation of risk and opportunity management measures, which would be developed by the construction contractor prior to construction as part of the overall CEMP. The CEMP would include the following measures to minimise hazards and risks:

- potential environmental hazards and risks associated with construction activities would be identified prior to construction
- standard management measures and contingency plans would be implemented during construction through the project CEMP
- the storage of hazardous materials, and refuelling/maintenance of construction plant and equipment would be undertaken in clearly marked and bunded areas within the construction site that are designed to contain spills and leaks in accordance with Australian Standards and DECCW guidelines
- hazardous materials would not be stored below the 1 in 20 year average recurrence interval (ARI) flood level
- chemical spill kits would be readily available and accessible to construction workers. Kits would be kept at site compounds and on specific construction vehicles and all hazardous materials spills and leaks would be reported to site managers and actions would be immediately taken to remedy spills and leaks
- construction sites adjacent to public areas may be screened to minimise the risks of injury as a result of unsecured debris, tools and other objects
- where work would be undertaken adjacent to the road (e.g. new stops) it is recommended that the local speed limit be reduced to 40 kilometres per hour in accordance with the requirement of the Roads and Traffic Authority's (RTA's) *Traffic Control at Work Sites Manual* (RTA, 2003). This measure would be detailed in traffic specific management plans (as part of the overall CTMP) to be developed prior to commencement of construction.

Occupational health and safety hazards during construction would be managed by:

- requiring all workers to have a valid rail safety induction certificate
- preparing and implementing a site-specific safety management plan and safe work methods statements for the project. The safety management plan would include
  - procedures to comply with all legislative and industry standard requirements for the safe handling and storage of hazardous substances and dangerous goods

- procedures for manual handling of heavy loads
- procedures for blasting activities (if required)
- procedures for operating and maintaining site plant

- identifying hazards associated with work on the site and hazard control measures to ensure that people are adequately protected from risks.

Operation

The project would be designed to achieve operational safety, signalling and operating procedures that currently apply to the existing section of the light rail network.

Incidents involving spills/leaks of hazardous materials, fire or potential electrical hazards arising from crashes or other incidents during operation would be managed in accordance with established operational safety guidelines and practices for hazards and risks.

Commuter and pedestrian safety during operation would be managed through the following mitigation measures:

- operational hazards would be managed through established procedures for hazards and risks that are currently in place across the existing light rail network
- the stops and access paths would have a high degree of visibility (particularly at pedestrian crossings), and the stops would have appropriate lighting to discourage acts of crime, violence and vandalism
- warning signs and line markings would be provided along the GreenWay shared path and shared zone to warn users or upcoming stops and to slow down prior to the stop locations.

17.10 Cumulative impacts

17.10.1 Assessment approach

While this environmental assessment (EA) focuses on the potential environmental impacts of this project, it is important these potential impacts are considered in their wider contextual surroundings. The Director-General's Requirements require assessment of *the potential impacts (direct, indirect and cumulative) as a result of the project at both construction and operation stages in accordance with relevant policies and guidelines, and how the project has been designed to minimise these impacts* ('General Requirement 3').

This chapter discusses the potential cumulative impacts that may arise as a result of the construction and operation of the project, and the interaction of these impacts with other major developments within the local area. It also identifies how these potential cumulative impacts would be minimised through the consideration of a range of management and mitigation measures.

Cumulative impacts are those that may not be considered significant on their own but that may be more significant when considered in association with other impacts. Cumulative impacts may occur as the result of the interaction of impacts within a single project or due to the combined effects of a number of projects occurring simultaneously in a given area. These impacts may be caused by past, present or reasonably foreseeable future developments. When considered in isolation from one another, the environmental impacts of an individual project upon any single receiver, resource other individual project may not be significant. However, significant effects may arise when individual impacts are amalgamated, either as part of the same project or jointly between different projects.

The consideration of the project's cumulative impacts has included a review of existing developments that the project may affect. Future developments within the local area have also been identified through searches of local council and NSW Government websites (refer to Section 17.10.2).

17.10.2 Potential developments

Construction of the project would include activities occurring at a number of locations along the rail corridor and nearby land. These could generate a cumulative impact in the area surrounding the project corridor, which would mainly be related to factors such as noise, air quality and traffic during the construction phase of the project. Some visual impacts may also occur during the construction phase and once the project begins to operate.

A number of existing and proposed projects and activities near the project could have a cumulative impact resulting from interactions with its construction and operation.

Future developments

To find out the probability of any future developments occurring near the project, the NSW Department of Planning, Ashfield, Leichhardt and Marrickville Council websites were searched to identify if any applications were under consideration, or have recently been approved nearby the project, which would have a potentially significant impact.

A search of the Department of Planning's 'Major Project Assessments Register' (August 2010) indicated there are a number of potential major projects located close to the project. Those that may provide or result in cumulative impacts include:

- mixed use development at 78–90 Old Canterbury Road, Lewisham (next to Lewisham West stop)
- Summer Hill Mills site (former Mungo Scott Mills) mixed use development
- development of a cruise passenger terminal at White Bay
- redevelopment of the Sydney Super Yacht Marina, Rozelle Bay
- Inner West Busway project along Victoria Road
- M4 east expansion
- Harold Park urban renewal development.

Details of each of these projects are outlined below.

Mixed use development — 78–90 Old Canterbury Road

A recent development application has been made to build on former industrial land bounded by Old Canterbury Road, Longport Street and the existing rail corridor. The Department of Planning issued Director-General's Requirements for this project on 16 March 2010. Detailed construction timing and details of this project are not available.

Indicative plans for the proposed development include the following components:

- five residential towers located above retail podiums between six and 14 storeys high
- basement level car parking across the site of about one to two levels.

The mixed use residential/retail development would be located directly next to the proposed light rail corridor at the Lewisham West stop. The site redevelopment may provide beneficial opportunities between the light rail component of the project and the mixed used development in the long term through the two land uses integrating and interacting.

However, some negative cumulative impacts may be experienced in the short term if both projects were to be under construction at the same time. Cumulative impacts that may occur include increased noise for local residential and commercial receivers and an increased number of truck and vehicle movements along the local road network.

A similar type of development is planned for the adjoining Summer Hill Mills (former Mungo Scott Mills) building on the opposite side of the existing rail corridor. Planning for this site is not as complete as the Canterbury Road site. It is anticipated this site would also support a mixed use development of a similar scale to that proposed for the Canterbury Road site.

Summer Hill Mills site (former Mungo Scott Mills) mixed use development

Planning for the redevelopment of the former Summer Hill Mills (former Mungo Scott Mills) site is under way. The redevelopment of the site (in its current form) is anticipated to include approximately 300 dwellings, 2,500 square metres of retail space and 4,000 square metres of commercial space.

This development is in the master planning phase. The current master plan was presented to Ashfield Council in August 2010. The final design and scale of the development is ongoing.

Cruise passenger terminal — White Bay

The Sydney Ports Corporation is proposing to construct and operate a new purpose-built cruise passenger terminal at White Bay. The Department of Planning issued its Director-General's Requirements for this project on 7 June 2010.

The preliminary EA for the project (JBA May 2010) notes that it would include (but not be limited to):

- berthing lengths for two cruise ship vessels
- construction of new buildings, including arrivals hall, customs hall, cargo facilities and other offices
- covered set down and pick up points and coach queuing areas

- parking for approximately 200 vehicles inside the terminal precinct
- demolition of some existing structures.

The site is located about two kilometres to the east of the existing Lilyfield stop. Cumulative impacts that may be experienced if the project and the potential White Bay development were to occur concurrently would largely relate to traffic impacts along the main arterial roads within the local area, including Victoria Road, the City West link and Parramatta Road.

No indication of when construction would begin, or its likely duration has been provided for the proposed development.

Sydney Super Yacht Marina, Rozelle Bay

Sydney Super Yacht Marine Pty Ltd is proposing to construct a new yacht marina facility at the existing Rozelle Bay Super Yacht Marina. The Department of Planning issued Director-General's Requirements for this project on 5 November 2009. The preliminary EA for the project (Sydney Super Yacht Marine Pty Ltd 2009) notes the project would generally include (but not be limited to):

- two buildings of 2,100 and 1,400 square metres respectively, each over two levels approximately 8.5 metres high
- parking for 100 cars on grade.

The site is located about 1.3 kilometres to the east of the existing Lilyfield stop. Cumulative impacts that may be experienced if the project and the potential Sydney Super Yacht Marina development were to be constructed concurrently would be similar to the proposed White Bay development, and would generally relate to traffic impacts and some potential noise impacts on common sensitive receivers within the area west of Rozelle Bay.

No indication of when construction would begin or its likely duration has been provided for the proposed development.

Inner West Busway along Victoria Road

The Inner West Busway along Victoria Road project is under construction— it was approved by the Minister for Planning on 9 April 2009. The project consists of duplicating the Iron Cove Bridge as well as other road works along Victoria Road between Drummoyne and Rozelle. The road works include developing improved pedestrian and cycleways within this area.

A Part 3A modification is under consideration by the Department of Planning to modify the approved project to improve pedestrian and cyclist safety, in particular around the White Bay end of Victoria Road.

The site is located about two kilometres to the north-east of the existing Lilyfield stop. Cumulative impacts that may be experienced if the project was to begin construction while the Inner West Busway along Victoria Road was still under construction would generally relate to traffic impacts and impacts on amenity, and pedestrian access for local residents using Hawthorne Canal and the Bay Run as well as pedestrians and cycle paths.

The Inner West Busway is considered to have an overall beneficial impact on the light rail project. Additional pedestrian and cycling infrastructure along Victoria Road would create an additional potential link with the proposed GreenWay shared path between the Cooks River and Iron Cove. When combined with the existing local and regional cycle network within the Inner West (described further in Chapter 10), the project and the Inner West Busway along Victoria Road are anticipated to result in a positive cumulative impact.

The target date for substantial completion of this project is December 2010. The proposed modification works are anticipated for completion in April 2011.

M4 East expansion

The NSW Government is investigating the potential extension of the existing M4 motorway, which runs from Penrith to Concord. Preliminary investigations into the proposed extension indicate the M4 East expansion project would involve building a new tunnel, which would extend from its current end point at North Strathfield to one of the following three locations

- the Anzac Bridge
- Port Botany and Sydney Airport
- Victoria Road east of Gladesville Bridge.

The M4 east expansion project is still in the initial planning and investigation stages and has not yet been fully developed for assessment or construction. Given the anticipated timeframe to complete the project's construction by the first quarter of 2012, and that the proposed M4 east expansion would generally be located underground if constructed, it is not anticipated the current project would result in any significant cumulative impacts. It is also assumed that any environmental assessment of the expansion of the M4 would include a cumulative impact assessment of the project as part of its environmental impact assessment report.

Harold Park urban renewal development

The City of Sydney Council is in the process of preparing draft planning development controls for the potential urban renewal and redevelopment of the Harold Park site in Glebe. The draft planning controls are yet to be released for public exhibition, however, the council recently (26 July 2010) resolved to endorse the draft planning controls for Harold Park for public exhibition, subject to an offer of a planning agreement from the site owner.

The draft urban design study for the redevelopment of the site proposed it could accommodate approximately 900 new dwellings, which would be result in a total increased population of approximately 1,700 new residents.

As the redevelopment of Harold Park is still in the initial planning and investigation stages and has not yet been released for public comment, it is not anticipated the current project would result in any significant cumulative impacts at this stage. The Harold Park urban renewal development project would, however, provide a potential long-term benefit to the project in increased population within the local area that would likely use the proposed (and existing) light rail network.

It is assumed that any environmental impact assessment of the redevelopment would include a cumulative impact assessment of the project as part of its environmental impact assessment report.

17.10.3 Construction-specific cumulative effects

During the project's construction, the locations that would be most at risk from cumulative impacts would be those close to construction activities or those that occurred at the same or similar times. Cumulative effects arising from construction activities would mainly relate to noise and vibration, traffic and access, dust, visual amenity and air quality impacts.

The severity of cumulative effects would depend on:

- the type of work
- the duration of the work
- the sensitivity of the surrounding land uses
- the visible presence of the work.

Direct cumulative construction impacts that may be experienced from the project include:

- increased construction vehicle traffic on public roads causing congestion and delays, increased air pollution and noise for local residents
- cumulative noise impacts associated with multiple construction works, particularly during the night
- disturbance to existing and future land use and access
- changes to water quality of nearby waterways from stormwater run-off from multiple construction sites
- changes to the visual amenity of the area.

Although projects may not necessarily overlap in terms of construction programs, there may still be a cumulative effect resulting from an overall increased duration of disturbance, which, in the long term, could result in an adverse cumulative effect. This effect is often termed 'construction fatigue' and is common in communities where long-term or multiple construction projects are under way.

Specific direct cumulative construction impacts that may be experienced as a result of the project are described below.

Construction traffic

A traffic and transport study (PB 2010 Technical Paper 1 in Volume 2) has assessed the impact of construction traffic on existing and anticipated traffic levels near the project and surrounding roads. Recommendations have been developed to minimise impacts on traffic. These are presented in Section 10.6 and 10.7.

To avoid construction traffic and construction sites, drivers may choose to travel through local road networks rather than along arterial roads. This could result in minor indirect impacts to air quality and noise and generate vibration impacts on local communities.

A construction traffic management plan (CTMP) to minimise potential impacts and conflicts would be developed for the project in consultation with the RTA. It would provide a coordinated approach to traffic management throughout the construction phase and would take into account the potential impacts of other major projects within the local area. The CTMP would be implemented during the construction phase of the project.

Construction noise and vibration

Potentially sensitive receivers likely to experience noise and vibration impacts as a result of the construction of the project have previously been discussed in Chapter 11. Sensitive receivers would include existing residents, businesses and commercial offices. There could be cumulative impacts if additional nearby construction occurs simultaneously with the project or in a short period of time before or after the project is constructed.

Potential cumulative impacts associated with noise and vibration would include:

- additional periods of construction noise
- potential for increased overall noise levels above those predicted for an individual project.

The noise and vibration generated by the various construction activities within the project would be the subject of overall management via a construction noise and vibration management plan (CNVMP). Construction of the project (and the other projects in the area) would be required to adhere to relevant construction noise guidelines. The CNVMP (and similar plans for additional projects) would minimise cumulative noise impacts as far as possible.

Impacts on existing and future land use and access

The overall impact of the project on existing and future land use has been detailed in Chapter 9. The existing rail corridor acts as a barrier between the existing communities to the east and west of the corridor alignment. The project, and in particular the corridor crossing points at each of the nine stops, would introduce connectivity between the communities on the eastern and western sides of the existing rail corridor.

Construction compounds have been identified throughout the project corridor. Two sites (Richard Murden Reserve and the existing RailCorp site at Darley Road) are outside the existing rail corridor alignment. Temporary worksites may also be required to be established outside of the construction corridor for short periods of time (as discussed in Section 7.9). The project would generally be constructed within the disused Rozelle goods line corridor and would not require privately-owned land outside the corridor for construction. The project's cumulative impact on existing land use and access is considered to be minimal.

17.10.4 Operational-specific cumulative effects

Cumulative impacts as a result of the operation of the project may include:

- increased vehicle traffic associated with commuters travelling to and from the stops combined with increased traffic from new residential development in the area
- changes to the visual amenity of the area as a result of the new stops, GreenWay shared path and associated infrastructure.

When the project starts to operate it may generate an increase in traffic on the local road network around the new stops as a result of the expected patronage of the new light rail line. However, in the long term, the project is expected to provide for and generate a mode-shift from private cars to public transport, which would benefit regional traffic within the Inner West, in particular along arterial roads, such as New Canterbury Road, Old Canterbury Road, Parramatta Road and Marion Street.

The project would create an opportunity for public and active (cycling and walking) transport options to become more attractive to the community by providing a new light rail service and allowing for the greater integration of other modes of public transport, in particular bus and heavy rail opportunities.

17.10.5 Strategic assessment

To comprehensively assess the cumulative impact of projects that would be taking place in the same area or at the same time, it is important to take account of the interactions between the social, economic and biophysical factors identified during the EA process. These factors have been explored in a strategic assessment of the likely cumulative impacts of the project and are provided in Table 17.7.

Table 17.7 Strategic assessment of overall cumulative impacts

Interaction	Assessment
Social environment ▪ changes to visual amenity ▪ historic heritage ▪ public access and community disruption ▪ public safety	The cumulative impact of a number of the developments (discussed above) within the Inner West of Sydney would result in changes to the social amenity in the region, such as altered local and regional landscape character. The development of the new stops associated with the light rail and the integration of the GreenWay shared path is expected to result in some positive visual impacts to the local amenity of the area. The scale of these facilities and urban design treatments could result in the overall impact being minimal. Developments within the Inner West of Sydney could result in some cumulative loss of historic heritage. The project is not anticipated to significantly contribute to this cumulative impact. Temporary impacts may be experienced around existing heritage items where construction sites have been established during the project's construction phase. Impacts may occur near Parramatta Road as a result of the project. These impacts would be minimised as far as practical. Mitigation measures have previously been identified in Chapter 12. In terms of cumulative construction effects, works may cause temporary disruption to the community, including local access to areas such as open space and parklands, particularly when the GreenWay shared path component of the project is built. After construction the disruption from the project would cease. The cumulative impact of development during the construction phase could result in increased risk to public safety from construction traffic in the local areas. This impact would not continue once the project's construction was complete.
Economic environment ▪ demand for resources	The project's contribution to increased demand for resources is expected to be minimal, as the GreenWay shared path and proposed stops comprise a minimalist design with limited construction materials required. The operation phase of the project would also have, with the exception of electricity demand, minimal ongoing resource requirements. As a result the project would not have a significant cumulative impact. The project would involve the re-activation of the disused Rozelle goods line corridor and would not involve a requirement to acquire private lands.
Biophysical environment ▪ loss of biodiversity ▪ change in scenic quality ▪ waste production	The cumulative impact of development within inner western Sydney in combination with the development of the project would lead to cumulative loss of biodiversity, change in scenic quality and increased greenhouse gas emissions. Given the disused nature of the existing Rozelle goods line corridor, the overall cumulative impact resulting from the project on the biophysical environment is not considered to be significantly adverse. The incorporation of the GreenWay, shared path and bushcare components is considered to provide an overall benefit to the local area with respect to biodiversity and scenic quality. The cumulative impact of development within inner western Sydney combined with the development of the project would lead to increased waste production (i.e. new residential developments). The project would not, however, significantly contribute to waste production.

17.10.6 Mitigation measures

Construction

The potential cumulative construction impacts associated with the project would be further considered as detailed design is developed. Mitigation measures would be developed and implemented as appropriate during the project's construction. Mitigation measures during the project's construction would include, but not be limited to:

- preparation of the following management plans as part of the project CEMP to mitigate potential impacts:
  - CTMP
  - CNVMP
  - construction compounds and ancillary facilities management plan (Section 19.2.2) and earthworks management plan (Section 19.2.5), which would include measures to manage water quality, including natural waterways and stormwater run-off.
- where they are visible from the public domain, construction compounds would be screened using appropriate mesh fencing and/or other similar materials to reduce changes to the visual amenity of the area.

Operation

The potential adverse cumulative impacts associated with the project's operation are expected to be manageable, as the light rail would be considered in future planning for the area (such as urban renewal sites at Lewisham West). The delivery of the project before designs for these sites were finalised would maximise the opportunity to integrate these projects.

Mitigation measures during operation of the project would include:

- finalising a traffic parking study (discussed in detail in Chapter 10), which would be implemented during the project's operation to help mitigate its potential on-going traffic and transport impacts

preparing an urban and landscape strategy during the project's detailed design that would take into account the existing urban environment.

18. Environmental risk analysis

This chapter provides an environmental risk analysis for the project in accordance with the project Director-General's Requirements (DGRs).

DGRs	Where addressed in the EA
Environmental risk analysis	
Notwithstanding the above key assessment requirements, the EA must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional environmental impact must be included in the EA.	Chapter 18

18.1 Overview

Environmental risk analysis identifies potentially significant environmental effects associated with development projects. Evaluating the project's construction and operating characteristics, and the baseline environment, helps in deriving important information on potential issues, and further assessment needs.

The analysis for the project examined the following three key elements:

- environmental issues, including key issues in the DGRs and any other issues
- potential impacts and proposed mitigation measures in relation to the identified issues
- potential residual impacts after application of mitigation measures.

18.1.1 Key issue identification

During the project application and preliminary environmental assessment (PEA) phase of the project, an initial risk assessment of environmental issues identified key issues for further, more detailed assessment. These were documented in the PEA (Transport NSW 2010a) and are presented in Table 18.1.

Table 18.1 Summary of key environmental issues identified in the PEA

Key environmental issues	Construction	Operation
Ecology	√	√
Visual impacts		√
Noise and Vibration		√
Land use and property		√
Historic heritage	√	
Traffic, transport, parking and access		√

After the Department of Planning assessed the PEA, the 'key issues' identified in the DGRs issued for the project (refer Appendix A) included:

- land use and transport integration
- operational noise and vibration
- historic heritage
- ecology
- design, sustainability and amenity.

The 'key issues' identified in the DGRs have been discussed in further detail in relevant sections of Part C1 (EA — Key issues). Other 'non-key' issues have been discussed in Part C2 (EA — Non-key issues).

18.2 Risk analysis methodology

Before detailed assessment, an environmental risk category was assigned to each environmental aspect, based on the likelihood and consequence of potential impacts (identified as the initial risk category in Table 18.3). This allowed any matters that might be considered as additional key issues to be identified, and established the basis for an appropriately detailed assessment of those additional key issues to be included in this EA.

The environmental risk categories assigned to each impact are described in Table 18.2.

Table 18.2 Risk category descriptions

Risk category	Description
A	Project may have a medium to high level impact. Investigations are required to determine the level of potential impact and to identify appropriate measures to manage the effects.
B	Project may have a low to medium level of impact. However, the environmental impacts can be reduced to an acceptable level through using standard or identified management measures.
C	Project would have a low level impact manageable through using standard measures.

The preliminary environmental analysis in the project application and supporting PEA (Transport NSW 2010a) was used as the basis for the environmental risk analysis of the project. The environmental risk analysis has automatically allocated a risk category of 'A' to all key issues identified in the DGRs.

Following detailed assessment of the key and non-key issues, as detailed in Part C1 (EA — Key issues) and Part C2 (EA — Non-key issues), the risk categories were reviewed and revised to present the 'residual' risk, that being the risk likely to remain after mitigation measures were applied. This process included a qualitative analysis of the recommended mitigation and management measures, and their potential effectiveness, to determine the extent to which the proposed measures would reduce the risk of the potential impact.

18.3 Environmental risk analysis

The environmental risk analysis is summarised in Table 18.3.

Table 18.3 Environmental risk analysis

Issue	DGRs — key issue?	Potential impacts	Initial risk category	Analysis — proposed mitigation and effectiveness/residual impacts	Residual risk	EA reference
Land use integration	Yes	No private property acquisition would be required. Temporary land take of some government land would be required to facilitate construction. Construction impacts on adjacent land uses include amenity impacts, such as noise and air emissions, traffic congestion on surrounding roads, and impacts to visual amenity. Some government-owned land would be required for the project — these areas would generally be secured by easements or rights of way. The project would not restrict future development within the area and would enhance existing land uses and anticipated urban redevelopment within Sydney's Inner West by improving connectivity, accessibility and amenity along the corridor.	A	These issues are considered to be manageable with the effective implementation of standard construction and operational environmental management measures.	C	Chapter 9 (Land use)
Construction traffic and transport	Yes	Traffic and access impacts during construction are associated with heavy vehicle traffic, increased traffic on local roads, potential traffic diversions and full and partial road closures, in particular the potential partial closure of Parramatta Road during construction activities associated with raising the Parramatta Road underbridge. The project could also require partial road closures during ground improvement works for underpass excavations through bridge abutments for the GreenWay shared path.	A	While these impacts are considered manageable with the effective implementation of standard mitigation measures, including preparing specific construction traffic management plans (CTMP) and consultation with the community, the partial closure of Parramatta Road and other roads in the study area would still disrupt road users.	A	Chapter 10 (Traffic and transport) Technical Paper 1 (Traffic and transport)

Issue	DGRs — key issue?	Potential impacts	Initial risk category	Analysis — proposed mitigation and effectiveness/residual impacts	Residual risk	EA reference
Operational traffic and transport	Yes	During the operational phase there would be impacts on local resident parking associated with commuters driving their vehicles to light rail stops and parking on nearby local streets, with an estimated demand of up to 121 parking spaces at the light rail stops in 2016. The signalised intersection at Marion stop could provide minimal impact to the traffic performance on Marion Street. The project would result in local benefits by providing alternative and active transport options for the Inner West, including interchanges with other existing transport modes.	A	A draft commuter parking strategy has been developed to manage the potential parking impacts around the light rail stops. The strategy does not recommend the provision of park-and-ride spaces to encourage the use of more sustainable travel modes, as this would be inconsistent with state or local policies. As such, there is likely to be a minor impact on residential parking around light rail stops. Kiss-and-ride spaces have been recommended at light rail stops as an alternative to park-and-ride.	B	Chapter 10 (Traffic and transport) Technical Paper 1 (Traffic and transport)
Construction noise and vibration	Yes	Short-term impacts would be associated construction activities and construction traffic. Night works are required for some construction activities associated with the Parramatta Road underbridge and underpass excavation works for the GreenWay shared path. Exceedances of the human comfort criteria for vibration are anticipated for the closest sensitive receivers and potentially for the closest structures.	A	Construction noise and vibration impacts would largely be manageable using standard noise mitigation measures and developing a construction noise and vibration management plan (CNVMP). However, based on worst case construction scenarios (e.g. some piling and earthworks close to sensitive receivers) significant exceedances of construction noise goals could occur at some receivers. These impacts would be expected to be short-term in duration.	A	Chapter 11 (Noise and vibration) Technical Paper 1
Operational noise and vibration	Yes	The operation of the light rail would provide an increase above current levels at adjacent land uses, with seven receivers predicted to exceed the noise goals by up to 4 dB during the evening and night. The light rail's operation would be quieter than the previous use of the corridor as a goods line. Two residential receivers have been identified as potentially exceeding the vibration design goal when a light rail vehicle (LRV) passes by.	A	Proposed measures to mitigate operational noise impacts could include a range of at-source, noise path and at receiver mitigation measures. Appropriate mitigation for each receiver would be determined on the basis of attended measurements after operations start.	B	Chapter 11 (Noise and vibration) Technical Paper 1

Issue	DGRs — key issue?	Potential impacts	Initial risk category	Analysis — proposed mitigation and effectiveness/residual impacts	Residual risk	EA reference
Historic heritage	Yes	The project may result in damage to existing local and State-listed heritage items near the rail corridor during the project's construction phase, including: • The siting and construction of the GreenWay shared path could impact on the State heritage listed Lewisham railway viaduct and Lewisham sewage aqueduct. • Construction works associated with raising the s.170 listed Parramatta Road underbridge may have a significant impact on the fabric and historic significance of the bridge. • There is a potential for direct and indirect impacts to the s.170 listed Hawthorne Canal during construction.	A	Heritage impacts would be managed through preparing a heritage management plan (HMP) to provide specific measures to mitigate impacts to identified heritage items. Heritage items, such as bridges and Hawthorne Canal, would be considered during detailed design and engineering to avoid, or minimise, potential impacts. Despite the consideration of impacts to heritage during design development and construction planning, works associated with raising the Parramatta Road still present a potentially significant risk to the original fabric and historic significance of this item.	B	Chapter 12 (Historic heritage) Technical Paper 3

Issue	DGRs — key issue?	Potential impacts	Initial risk category	Analysis — proposed mitigation and effectiveness/residual impacts	Residual risk	EA reference
Ecology	Yes	The construction of the light rail stops and portions of the GreenWay shared path would require approximately 1.82 hectares of broad-scale fauna habitat to be removed, including: • 1.7 hectares of dense weed growth that provides potential suitable habitat for the Long-nosed Bandicoot • 0.05 hectares of foraging habitat for the Grey-headed Flying-fox, Eastern Bentwing-bat, Swift Parrot, and Little Lorikeet • potential fragmentation impacts for clearing at stop locations and construction work sites. The project is not considered to cause a significant impact on any threatened species or endangered population. Other potential impacts during construction include weed proliferation and noise and other human disturbance. Operational impacts to biodiversity near the light rail corridor include noise disturbance from LRV passbys, particularly to the Long-nosed Bandicoot and Eastern Bentwing-bat, lighting at stops and along the GreenWay shared path, and potential for fauna to collide with LRVs. The retention of existing bushcare sites and provision of new sites would be a positive impact for biodiversity and the community.	A	Biodiversity impacts during construction are considered to be manageable with the effective implementation of standard environmental management measures, to be included in a flora and fauna management plan (FFMP). This would include clearly identifying and protecting vegetation that is to be retained, progressive revegetation of cleared areas, and measures to control weeds and their dispersal. The provision and ongoing maintenance of new and existing bushcare sites would enhance the functioning of the GreenWay as a wildlife corridor and improve its value as habitat for native fauna.	B	Chapter 13 (Ecology) Technical Paper 4

Issue	DGRs — key issue?	Potential impacts	Initial risk category	Analysis — proposed mitigation and effectiveness/residual impacts	Residual risk	EA reference
Visual impact, landscaping and urban design	Yes	The main visual impacts would be associated with constructing the new light rail stops and GreenWay shared path, which would create some additional visual built elements within the existing urban environment. These may affect views from residential areas. These impacts are not likely to be significant given the highly disturbed and urbanised environment in which they would be constructed. During operations, there are potential issues relating to passenger and pedestrian safety, mainly at on-street sections, including the signalised crossing of Marion Street and the on-street GreenWay shared path sections on Weston Street and south of Dulwich Hill Railway Station. Some residential properties next to the light rail corridor may experience a loss of privacy due to the presence of light rail and GreenWay shared path users.	A	Visual impacts would be managed through design development by applying standard construction environmental management measures and through urban design and landscape management measures. The safety and security of passengers and GreenWay shared path users has been considered during design development and incorporated into the design of the light rail stops and the GreenWay shared path. CPTED principles would be fully assessed during detailed design. Vegetation screening or additional urban design elements would be considered to minimise the visual intrusion and mitigate privacy impacts.	B	Chapter 14 (Visual impact, landscaping and urban design) Technical Paper 5
Energy demand and greenhouse gases	Yes	There would be a temporary increase in energy use and greenhouse gas emissions during construction of the project. During the operational phase there would be a positive impact on greenhouse gas emissions by encouraging a mode shift from private cars to public transport and more active (walking and cycling) transport alternatives.	A	A sustainability management plan (SMP) would be developed, which would include a series of initiatives aimed at reducing energy usage and GHG emissions during the project's construction and operation.	C	Chapter 15 (Energy demand and greenhouse gases

Issue	DGRs — key issue?	Potential impacts	Initial risk category	Analysis — proposed mitigation and effectiveness/residual impacts	Residual risk	EA reference
Climate change adaptation	Yes	An assessment of potential climate change scenarios identified possible climate change risks to the project, including the following high risk scenarios: • more frequent and severe heat waves resulting in potential impacts upon passenger comfort and increased risk of rail line buckling • multiple severe weather events resulting in higher than forecast passenger numbers and resulting increase in operating costs and reduced service level.	A	Further analysis and determination of adaptation measures would take place during detailed design and project risk assessment.	C	Chapter 16 (Climate change adaptation)
Socio-economic	No	Potential socioeconomic impacts during construction are mainly related to amenity, including noise and visual impacts and increased traffic around construction sites. Some amenity impacts can also be expected during the operational phase, including from visually intrusive components of the light rail and GreenWay shared path and noise from LRVs. On completion, the project would provide social and economic benefits, including increased connectivity between communities and to recreational land uses, more reliable public transport services within the Inner West, and increases in trade to local businesses.	B	These issues are considered to be manageable with the effective implementation of standard construction and operational environmental management measures.	C	Section 17.1 Technical Paper 6
Aboriginal heritage	No	Potential disturbance of previously unidentified Aboriginal objects and places may occur as a result of the project.	C	If any Aboriginal objects are exposed during construction activities, works in the area should cease and further advice would be sought from relevant stakeholders and the Department of Environment, Climate Change and Water (DECCW).	C	Section 17.2 Technical Paper 3

Issue	DGRs — key issue?	Potential impacts	Initial risk category	Analysis — proposed mitigation and effectiveness/residual impacts	Residual risk	EA reference
Hydrology and groundwater	No	Much of the existing rail corridor is located next to Hawthorne Canal and is subject to flooding, particularly near Lewisham West stop. There are also some minor flooding issues in the corridor between Lilyfield stop and Leichhardt North stop. As the project is located close to Hawthorne Canal, the Cooks River and Iron Cove, there could be water quality impacts during its construction. Potential interception of groundwater may occur in some excavations during construction.	B	A detailed flood study and development of a flood management plan (FMP) would investigate and manage flooding issues associated with Hawthorne Canal, in particular at the Lewisham West stop. In other areas flooding and impacts to water quality and groundwater would be managed with the effective implementation of standard construction environmental management measures.	B	Section 17.3
Topography, soils and geology	No	Soil erosion and sedimentation of nearby waters (such as Hawthorne Canal) could occur during construction. Acid sulfate soils could be encountered within the project corridor.	C	These issues are considered to be manageable with the effective implementation of standard construction and operational environmental management measures.	C	Section 17.4
Contaminated land	No	Contaminated land could be uncovered during the project's construction, in particular within the boundaries of the disused Rozelle goods line corridor. Hazardous materials (asbestos) have been identified in the disused warehouse at Leichhardt North stop, which would be demolished as part of the project.	C	A phase 2 contamination investigation would be carried out during detailed design to further identify contamination and categorise for spoil/waste disposal. A hazardous materials survey should made of the disused warehouse at Leichhardt North stop before demolition and, if required, an asbestos management plan prepared.	C	Section 17.5
Air quality	No	Construction of the project would be result in a temporary increase in air pollution (including dust) and greenhouse gas emissions. When the project is operating, air quality could improve as the project would encourage a mode shift from private cars to public transport and active (walking and cycling) transport alternatives.	C	These issues are considered to be manageable with the effective implementation of standard construction and operational environmental management measures.	C	Section 17.6

Issue	DGRs — key issue?	Potential impacts	Initial risk category	Analysis — proposed mitigation and effectiveness/residual impacts	Residual risk	EA reference
Utilities and services	No	There are a number of existing services that currently cross the rail corridor and proposed GreenWay shared path route. Consequently, damage could occur to existing services/utilities during the project's construction, which could disrupt services, inconvenience or lead to hazardous situations through potential occupational health and safety risks.	C	Test pitting and a dial-before-you-dig investigation would take place during the detailed design to confirm the location of services and utilities near the project. Utility and service relocations would be considered during detailed design.	C	Section 17.7
Waste management	No	The project would generate some waste and require the use of various resources during its construction. Minimal amounts of on-going waste may also be generated by its operation.	C	A waste management plan (WMP) would be prepared detailing standard environmental management measures to manage resource consumption and to avoid, re-use and dispose of waste during construction.	C	Section 17.8
Hazards and risk	No	Hazards and risks would be mainly associated with the project's construction phase, particularly within the rail corridor, including storing and using potentially hazardous materials, heavy machinery and the potential interaction with existing services and utilities. Some hazards may also exist to the local community during the project's construction, including vehicle movements within local streets while accessing the site, and potential debris, dust or other impacts nearby the project during construction. Hazards and risks during the project's operation include potential collision between GreenWay shared path users and passengers and LRV's (when crossing) and LRV accidents (e.g. derailment, electrical fire).	C	Management of construction hazards and risks would be addressed through implementing risk and opportunity management measures, developed by the construction contractor before construction as part of the overall construction environmental management plan (CEMP). Operational hazards would be managed through standard procedures for hazard and risk that are currently in place across this network.	C	Section 17.9

18.4 Risk analysis conclusions

This risk assessment for the project, undertaken in accordance with the DGRs, has identified key issues that present a medium to high perceived or actual risk:

- land use and transport integration
- operational noise and vibration
- historic heritage
- ecology
- design, sustainability and amenity

These key issues have been the focus of the EA for the project (refer to Chapters 9 to 16). The level of assessment undertaken for the identified key issues has determined the likely extent of impacts and recommended appropriate management to abate the risk.

No additional key issues have been identified that would result from the project.

Following detailed assessment and consideration of the effectiveness of the proposed mitigation and management measures, the residual risk of some issues was considered to be less than the initial risk category assigned, including:

- land use (revised from risk category A to C)
- operational traffic and transport (revised from risk category A to B)
- operational noise and vibration (revised from risk category A to B)
- historic heritage (revised from risk category A to B)
- ecology (revised from risk category A to B)
- visual impact, landscaping and urban design (revised from risk category A to B)
- energy demand and greenhouse gases (revised from risk category A to C)
- climate change adaptation (revised from risk category A to C)
- socio-economic (revised from risk category B to C).