CHAPTER 7
Soils, topography and contaminated land
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7. Soils, topography and contaminated land

This chapter assesses potential impacts on soils and topography including contaminated land. It describes soils, topography and existing contaminated sites along the alignment and assesses potential impacts of Brisbane Metro’s construction and operation. Measures for managing potential impacts are also identified.

7.1 Assessment methodology

The study area for this assessment is described in Chapter 1 and includes the Brisbane Metro alignment with a 250-metre buffer on either side of the alignment. As much of the alignment will not be affected by construction, this assessment particularly focuses on properties within or adjacent to the Brisbane Metro alignment that are expected to be subject to major construction works (e.g. metro depot, Buranda station, Cultural Centre precinct and North Quay and Adelaide Street).

This assessment is based on a desktop review of existing information. It involved:

- describing existing soil conditions and topography within the study area, based on the review of existing available information and data (e.g. previous studies, spatial data and information)
- identifying existing sites potentially affected by contamination based on:
  - review of publicly available information and data, including previous environmental studies (e.g. CRR Environmental Impact Statement (EIS)\(^1\), BaT project EIS\(^2\), Northern Busway Royal Children’s Hospital to Kedron Concept Design and Impact Management Plan\(^3\)); spatial data and information; and Council spatial information and contaminated land records
  - targeted searches of the Queensland Government Environmental Management Register (EMR) and Contaminated Land Register (CLR) of properties at Buranda, South Brisbane and the CBD that are expected to be subject to, or adjacent, significant below ground excavation
- review of current and historical aerial photography (from 1946 to 2017) of sites within or adjacent to the alignment to identify current or historical uses that have potential to cause contamination
- identifying and assessing potential impacts or risks for soils, topography and contaminated land associated with Brisbane Metro’s construction and operation, including potential for contaminated land to be encountered by proposed excavation works
- identifying measures to manage potential risks related to soils, topography and contaminated land including through further environmental investigations.

Detailed contaminated land investigations will be undertaken during the detailed design phase in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM) and the Queensland Auditor Handbook for Contaminated Land, Module 5: Contaminated Land Investigation Documents, auditor certification and compliance assessment\(^4\).

This assessment does not consider in detail risks associated with asbestos containing materials in existing service trenches, service lines, buildings or infrastructure to be modified or demolished for Brisbane Metro. An assessment of potential asbestos risks will be undertaken during the detailed design phase.

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1 SKM-Aurecon CRR JV (2011), Cross River Rail EIS, July 2011, prepared for TMR
2 TMR (2014) BaT project EIS, August 2014, prepared by Jacobs AECOM JV
3 SKM Connell Wagner JV (2007), Northern Busway Royal Children’s Hospital to Kedron Concept Design and Impact Management Plan, May 2007, prepared for TransLink and Queensland Transport
7.2 Legislative and policy context

Legislation, policy and guidelines relevant to land contamination in Queensland (excluding asbestos related contamination) include:

- *Environmental Protection Act 1994 (Qld) (EP Act)*
- Planning Act and associated regulation
- *International Erosion Control Association 2008 Best Practice Erosion and Sediment Control (Volumes 1-6)*
- ASC NEPM

These are summarised in the following sections. Further information on legislation relevant to Brisbane Metro is provided in Chapter 22.

7.2.1 Environmental Protection Act

The disturbance of dispersive, slaking or contaminated soils or acid sulfate soils and the resultant impacts of disturbing these soils (e.g. sedimentation of the receiving waters), are currently regulated by the EP Act. The EP Act (Chapter 7, Part 8) details matters relating to the investigation and management of contaminated land. State appointed environmental auditors for contaminated land may need to be appointed to independently evaluate contaminated land investigation documents and certify that the document meets the regulatory requirements.

Activities that have been identified as likely to cause land contamination are referred to as notifiable activities by the DES. Notifiable activities are defined in Schedule 3 of the EP Act. Land parcels that have been historically or are currently used for notifiable activities are reported and recorded on the EMR. Inclusion of a land parcel on the EMR does not necessarily mean that the land is contaminated. Sites that have been demonstrated to pose a risk to human health and/or the environment are included on the CLR. Land parcels are recorded on the CLR when an investigation has identified that contaminants are present at concentrations that represent a risk to human health and, as such, action is required to remediate or manage the land to prevent adverse environmental and human health impacts.

7.2.2 National Environmental Protection Measure

The National Environmental Protection Council prepared national guidelines for contaminated land matters in the ASC NEPM. The purpose of the ASC NEPM is to establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community which includes regulators, site assessors, contaminated land auditors, land owners, developers and industry.

7.2.3 Technical guidelines

The primary erosion and sediment control guideline applying in Queensland is the IECA 2008. The IECA 2008 provides information relevant to planning and implementing best practice erosion and sediment control measures at construction sites. Achieving compliance with the IECA 2008 forms part of demonstrating the general environmental duty under the EP Act, although does not guarantee compliance with the EP Act.

The Queensland Acid Sulfate Soil Technical Manual encompasses four individual guidelines: a legislation and policy guide, laboratory methods guidelines, soil management guidelines, and guidelines for sampling and analysis of lowland acid sulfate soils. The manual intends to offer technical and procedural advice to avoid

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environmental harm in achieving best practice environmental management. Achieving compliance with the manual may form part of achieving compliance with the general environmental duty under the EP Act.

7.3 Existing environment

This section describes existing soils and topography values and contaminated land risk in the study area.

7.3.1 Soils and topography

The study area contains an undulating terrain that varies from 0 metres to 77 metres AHD. The study area commences at Rochedale at approximately 40 metres AHD, rising to approximately 77 metres AHD at Griffith University Mt Gravatt and then generally declines until it reaches the Brisbane River. North of the River, the topography rises to approximately 33 metres AHD at Herston and then generally declines to the north.

The study area contains a variety of mapped soil types (refer to Figure 7.1). Those relevant to erosion and sediment control include rudosols, hydrosols, podosols, sodosols and dermosols. These soils have a medium to high propensity for erosion, particularly the sodosols, which are highly erodible if the exchangeable sodium percentage is greater than 14\(^2\). Soil landscapes in the study area are summarised in Table 7.1.

Table 7.1: Geology and soil landscapes along the study area

<table>
<thead>
<tr>
<th>Geology</th>
<th>Soil landscapes</th>
<th>Dominant soil groups</th>
<th>Landscape and parent rock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunnybank formation Quaternary alluvium</td>
<td>Birkdale</td>
<td>Krasnozems, prairie soils</td>
<td>Low hills of weathered basalt</td>
</tr>
<tr>
<td>Quaternary alluvium Sunnybank/Corinda formation</td>
<td>Sunnybank</td>
<td>Lateritic red earths with some lateritic podzolic soils</td>
<td>Undulating plateau and slopes on tertiary sediments</td>
</tr>
<tr>
<td>Woogaroo subgroup Sunnybank formation Cainozoic sand deposits Quaternary alluvium</td>
<td>Coopers Plains</td>
<td>Red-yellow podzolic soils, lateritic podzolic soils</td>
<td>Dissected plateau edge, on sandy clays and sandstones</td>
</tr>
<tr>
<td>Quaternary alluvium</td>
<td>Woongoolba</td>
<td>Humic gleys, peaty gleys and solonchaks</td>
<td>Low coastal plains and narrow valley floors of alluvium</td>
</tr>
<tr>
<td>Neranleigh-Fernvale beds Cainozoic sand deposits Quaternary alluvium</td>
<td>Pullenvale</td>
<td>Lithosols with thin red-yellow podzolic soils</td>
<td>Low hills of greywackes, shales, phyllites etc.</td>
</tr>
<tr>
<td>Neranleigh-Fernvale beds Quaternary alluvium</td>
<td>Beenleigh</td>
<td>Red-yellow podzolic soils, with lithosols, some gleyed podzolic soils</td>
<td>Low hills of greywackes, phyllites, shales etc.</td>
</tr>
<tr>
<td>Aspley formation Quaternary alluvium</td>
<td>Woodridge</td>
<td>Red-yellow podzolic soils, with gleyed podzolic soils and lateritic podzolic soils</td>
<td>Low hills of sandstones and shales</td>
</tr>
<tr>
<td>Quaternary alluvium Neranleigh-Fernvale beds Brisbane tuff</td>
<td>Chermside</td>
<td>Lithosols with shallow podzolic soils</td>
<td>Low hills of rhyolitic tuff</td>
</tr>
<tr>
<td>Quaternary alluvium Holocene alluvium Bunya phyllite</td>
<td>Brisbane River</td>
<td>Prairie soils, with some sandy alluvial soils</td>
<td>Low undulating plain and terrace remnants of sandy alluvium</td>
</tr>
<tr>
<td>Neranleigh-Fernvale beds Bunya phyllite Quaternary alluvium</td>
<td>Toowong</td>
<td>Red podzolic soils with lithosols</td>
<td>Low hills of phyllite</td>
</tr>
<tr>
<td>Quaternary alluvium Neranleigh-Fernvale beds Moggill Creek</td>
<td>Peaty gleys and humic gleys</td>
<td>Depression on low coastal plains of sandy and clayey alluvium</td>
<td></td>
</tr>
<tr>
<td>Quaternary alluvium</td>
<td>Logan</td>
<td>Alluvial soils, some humic gleys</td>
<td>Low terraces and flood plains of river sediment</td>
</tr>
</tbody>
</table>

\(^{2}\) Northcote, K and Skene, J (1972) *Australian soils with saline and sodic properties*, CSIRO Publishing, Australia
Figure 7.1A: Soil landscapes

Key
- Study area
- Stations
- Metro depot
  - Station modifications
  - Station upgrades

Soil landscapes (Brisbane City Council 2016)
- PULLENALE
- RUNCORN
- SUNNYBANK
- WOODRIDGE
- WOONGOOLBA
- BEENLEIGH
- BIRKDALE
- CHERMSIDE
- COOPERS PLAINS
- MT COTTON
- MT COTTON
Figure 7.1B: Soil landscapes

Key

- Study area
- Stations
  - New station
  - Station modifications
  - Station upgrades

Soil landscapes (Brisbane City Council 2016)
- BEENLEIGH
- BRISBANE RIVER
- CARBROOK
- CHERMSIDE
- CLAYFIELD
- LOGAN
- MOGGILL CK
- NUNDAH
- PULLENVALE
- TOOWONG
- WOORIDGEE
- WOOGOOOLBA

Notes:
- BEENLEIGH
- BRISBANE RIVER
- CARBROOK
- CHERMSIDE
- CLAYFIELD
- LOGAN
- MOGGILL CK
- NUNDAH
- PULLENVALE
- TOOWONG
- WOORIDGEE
- WOOGOOOLBA
Acid sulfate soils are a characteristic feature of low-lying coastal environments in Queensland, particularly where landform elevations are less than five metres AHD. Acid sulfate soils are generally present within the sub-surface profile in an undisturbed anaerobic environment. When undisturbed they have a pH of neutral or slightly alkaline and are referred to as potential acid sulfate soils.

Actual acid sulfate soils are the oxidised form. When the iron sulfides are oxidised, sulfuric acid is produced and the soil becomes strongly acidic. Oxidation may occur as a result of disturbance from changes in groundwater levels and/or when potential acid sulfate soils are exposed to air. Under these conditions, metal contaminants, if present, can be mobilised. Runoff or drainage water from uncontrolled or poorly managed acid sulfate soils has the potential to reduce the life of infrastructure and impact on sensitive receiving environments. The locations of potential acid sulfate soils near to new or modified infrastructure are shown in Figure 7.2.

Rochedale to Upper Mt Gravatt

The metro depot site has a topography that slopes downward over 150 metres (approximately four per cent gradient) from School Road towards a vegetated swale adjacent to the Pacific Motorway on-ramp. Overall, the topography of the site presents a moderate risk of erosion.

Eight Mile Plains station has a relatively flat topography and permanent drainage infrastructure is in place. The existing Upper Mt Gravatt station is located at approximately 60 metres AHD at the highest point within the sub-catchment. The area is highly developed with a large percentage of impervious groundcover such as concrete and buildings with permanent drainage infrastructure in place. This section of the study area contains four soil landscapes including Sunnybank, Birkdale, Coopers Plains and Woongoolba (refer to Figure 7.1). A range of particle sizes (sand, silt, clay) are likely to be present due to the landscape and parent rock types.

Mt Gravatt to Greenslopes

The existing busway stations in this section of the study area are located in areas that have a relatively flat topography, with permanent drainage infrastructure in place. The proposed bus turnaround and layover area at Griffith University station is situated on land that has a slightly sloping topography with a risk of erosion. This section of the study area contains seven soil landscapes including Sunnybank, Birkdale, Coopers Plains, Woongoolba, Pullenvale, Beenleigh and Chermside (refer to Figure 7.1). A range of particle sizes (sand, silt, clay) are likely to be present due to the landscape and parent rock types.

Woolloongabba to St Lucia

Existing busway stations in this section of the study area are located in areas that have a relatively flat topography, with the exception of O’Keefe Street adjacent to Buranda station, which slopes gently to the east. The existing busway stations have permanent drainage infrastructure in place. The proposed construction laydown at Hanlon Park has a flat topography, but is situated near a drainage channel that leads to Norman Creek.

This section of the study area contains five soil landscapes including Brisbane River, Woongoolba, Woodridge, Beenleigh and Chermside (refer to Figure 7.1). A range of particle sizes (sand, silt, clay) are likely to be present due to the landscape and parent rock types. Soils around Norman Creek in the vicinity of The Gabba stadium and south across Stanley Street to Ipswich Road are mapped with a low risk of potential acid sulfate soils. Soils associated with the Brisbane River near the alignment at St Lucia also contain a low risk of potential acid sulfate soils (refer to Figure 7.2).
Figure 7.2: Potential acid sulfate soils in northern study area

Key
- Study area
- Stations:
  - New station
  - Station modifications
  - Station upgrades

Risk of acid sulfate soils (Brisbane City Council 2016)
- Low
- Medium
- High

Figure 7.2: Potential acid sulfate soils in northern study area
South Brisbane

The existing Mater Hill and South Bank stations are located in areas with a relatively flat topography, with permanent drainage infrastructure in place. Victoria Bridge spans the Brisbane River and steep banks are present at the bridge abutments.

This section of the study area contains four soil landscapes including Brisbane River, Woongoolba, Toowong and Chermside (refer to Figure 7.1). A range of particle sizes (sand, silt, clay) are likely to be present due to the landscape and parent rock types. Soils associated with the Brisbane River at South Bank between the Maritime Museum and the Cultural Centre precinct have predominately low risk of potential acid sulfate soils (refer to Figure 7.2), although some medium to high risk areas are found close to the riverbank.

Brisbane CBD

North Quay area is situated within and above the steep northern bank of the Brisbane River, while Adelaide Street is in a relatively flat area. The existing King George Square station is located underground and the Roma Street station is located in an area that has a relatively flat topography.

This section of the study area contains three soil landscapes including Brisbane River, Beenleigh and Moggill Creek (refer to Figure 7.1). A range of particle sizes (sand, silt, clay) are likely to be present due to the landscape and parent rock types.

Kelvin Grove to Herston

The alignment in this section of the study area is located in areas that have a relatively flat topography, with permanent drainage infrastructure at all existing bus stations. This section of the study area contains three soil landscapes including Logan, Beenleigh and Chermside (refer to Figure 7.1). A range of particle sizes (sand, silt, clay) are likely to be present due to the landscape and parent rock types. Soils in the area of Enoggera/Breakfast Creek – north of Butterfield Street are predominately medium and high risk of containing potential acid sulfate soils (refer to Figure 7.2).

7.3.2 Contaminated land

This section describes details of contamination or potential contamination sites identified within the study area.

Rochedale to Upper Mt Gravatt

A review of Council’s contaminated land mapping identified potentially contaminated sites near to works for the station modifications in this area. These include:

- Eight Mile Plains station, including the adjoining park ‘n’ ride
- the existing Mt Gravatt bus depot
- Garden City Shopping Centre
- sections of the South East Busway
- service station at the corner of Kessels Road and MacGregor Street
- South East Freeway/Klumpp Road/University Road/Mains Road intersection.

Historical aerial imagery shows that this section of the study area comprised mostly greenfield land until the late 1960s/1970s, when areas were developed for residential use. The Pacific Motorway was constructed in the late 1970s and Miles Platting Road was upgraded in the 1990s. A review of historical aerial imagery indicates that the Eight Mile Plains station site was previously used for a landfill until the late-1990s.
Mt Gravatt to Greenslopes

Council’s contaminated land mapping identified a number of potentially contaminated sites near the alignment in this section, including at Greenslopes station and the surrounding Ekibin Park, and the Pacific Motorway (Tarragindi to Greenslopes). These sites were previously used for landfill. Aerial imagery shows the construction of the South East Freeway in the late-1970s. Prior to this, land use along the corridor was predominately residential land, uncleared land and agricultural uses. A large area of ground disturbance and open excavation was located at the site of Greenslopes station from 1946 until the area was revegetated before 1997.

It is anticipated that potential or actual contamination encountered in the South East Busway corridor was managed during construction of the South East Busway.

Woolloongabba to St Lucia

Targeted searches of the EMR and CLR were conducted for properties surrounding Buranda station that will be subject to, or adjacent to, below ground excavation (refer to Figure 7.3). Two potentially contaminated sites were identified through the searches of the EMR and CLR (refer to Table 7.2). Site management plans or remediation action plans have not been prepared for any of these sites. Buranda station was opened in 2001 as part of the South East Busway development. This included construction of the existing below ground station.

Table 7.2: EMR records – Buranda station

<table>
<thead>
<tr>
<th>Land parcel (Lot and plan)</th>
<th>EMR listing (including notifiable activity)</th>
<th>CLR listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot 113, Lot 114 and Lot 115 RP12003</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 20 SP229927 (this site has been subdivided from Lot 1291 SL8160)</td>
<td>Yes – Lot 1291 SL8160 is listed for railway yards</td>
<td>No</td>
</tr>
<tr>
<td>Lot 10 SP149640 (this site has been subdivided from Lot 1291 SL8160)</td>
<td>Yes – Lot 1291 SL8160 is listed for railway yards</td>
<td>No</td>
</tr>
</tbody>
</table>

Other potentially contaminated sites were identified in this section of the study area through the review of Council’s contaminated land mapping and previous environmental assessments undertaken for the proposed CRR project. These include the South East Busway, Cleveland railway corridor and Woolloongabba station and former GoPrint site and the PA Hospital. Aerial photography confirms that the rail line and siding have been present in the Boggo Road area since prior to 1936 with some disturbed areas near the cemetery. The Eastern Busway between Eleanor Schonell Bridge and Buranda station opened in 2009.

The area around existing UQ Lakes station has been subject to historical flooding and potentially filling activities. As such, there is the potential for uncontrolled fill materials to be present across the general vicinity of the site.

It is assumed that potential or actual contamination encountered in the existing South East Busway and Eastern Busway corridors was managed during construction of those. However, the current status of contaminated sites will be confirmed during the detailed design phase where ground disturbance is required for the construction of Brisbane Metro.

South Brisbane

Targeted searches of the EMR and CLR were conducted for properties at the Cultural Centre precinct that will be subject to, or adjacent to, below ground excavation (refer to Figure 7.4) for Brisbane Metro. These identified a number of potentially contaminated sites near to proposed excavation works. EMR and CLR searches (refer to Table 7.3) identified that a site management plan and remediation action plans have been prepared for Lots 103-105 SPS107441. Site management plans or remediation action plans have not been prepared for other sites.

8 SKM-Aurecon CRR JV (2011)
Figure 7.3: EMR listings - Buranda busway station

Key
- Brisbane Metro alignment

Stations
- Station modifications

EMR listing notifiable activity (DEHP 2017)
- Railway yards
Table 7.3: EMR records – Cultural Centre precinct

<table>
<thead>
<tr>
<th>Land parcel (Lot and plan)</th>
<th>EMR listing (including notifiable activity)</th>
<th>CLR listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot 103 to Lot 105 SPS107441 (South Brisbane railway station) (this site has been subdivided from Lot 103 SPS107067)</td>
<td>Yes – Lot 103 SPS107067 is listed for railway yards; hazardous contaminant (lead, benzo-a-pyrene, polycyclic aromatic hydrocarbons, heavy metals); service station</td>
<td>No</td>
</tr>
<tr>
<td>Lot 933 RP896477 (Cultural Centre intersection with Stanley Street)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 934 SP251794 (South Bank Parklands) (amalgamation of Lot 6 SP102571; Lot 802 SP127970; Lot 912 RP844987; Lot 21 RP899090)</td>
<td>Yes – Lot 6 SP102571 is listed for railway yards, Lot 802 SP127970 is listed for landfill</td>
<td>No</td>
</tr>
<tr>
<td>Lot 700 SP273957 (QPAC and Queensland Museum) (subdivided from Lot 912 RP844987)</td>
<td>Yes – Lot 912 RP844987 is listed for service station</td>
<td>No</td>
</tr>
<tr>
<td>Lot 934 SSP107067 (BCEC) (amalgamation of Lot 3 RP861515; Lot 912 RP844987; Lot 21 RP899090)</td>
<td>Yes – Lot 21 RP899090 is listed for hazardous contaminant (heavy metals), Lot 3 RP861515 is listed for railway yards and hazardous contaminant (lead, benzo-a-pyrene and polycyclic aromatic hydrocarbons)</td>
<td>No</td>
</tr>
</tbody>
</table>

Lot 103 on SPS107067 (and reciprocated on Lots 104 and 105 on SPS107067) includes the property at 125 Grey Street located at the corner of Grey and Melbourne Streets. This site (associated with the South Brisbane railway station) is partially vacant with some car parking for Queensland Rail staff and utilities. The site management plan for this site\(^9\) indicates that the land parcel is contaminated by numerous ‘hazardous contaminants’. These include polycyclic aromatic hydrocarbons, recoverable hydrocarbons, asbestos (bonded and friable) and metals at concentrations which may pose an unacceptable risk to human health and/or the environment. A sewer pump station is also located within the site.

Other potentially contaminated sites near to the Brisbane Metro alignment were also identified through Council’s contaminated land mapping including parts of the existing Mater Hill station, railway corridor, and BCEC, and existing South East Busway (South Bank station).

Aerial imagery confirms that past industrial/transport (railway) land uses were present in this area from 1946 to the late-1970s, when the industrial land was redeveloped as part of the Queensland Cultural Centre and Expo 88 redevelopments. Development of the South Bank precinct occurred in 1990, while a significant portion of the former railway yard was redeveloped for the BCEC, which opened in 1995. Former land parcels at QPAC and Queensland Museum were historically listed on the contaminated site register for ‘hazardous waste – landfill’ and were removed from the register on 6 February 1996.

**Brisbane CBD**

Targeted searches of the EMR and CLR were conducted for properties in the CBD that will be subject to, or adjacent to, below ground excavation for Brisbane Metro (refer to Figure 7.5). These identified a number of potentially contaminated sites near proposed excavation works. The searches indicated that site management plans or remediation action plans have not been prepared for any of these sites (refer to Table 7.4).

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\(^9\) Queensland Government (2015), Annexure 1 – Site management plan, Lot 103, Plan SPS107067, File Ref 101/14057
Figure 7.4: EMR listings - South Brisbane

Key
- Brisbane Metro alignment
- Railway yards, hazardous contaminants
- Railway yards, hazardous contaminants, service station
- Petroleum product or oil storage
- Service station

Stations
- New station
- Station upgrades

EMR listing notifiable activity (DEHP 2017)
Figure 7.5: EMR listings - Brisbane CBD

Key
- Brisbane Metro alignment
- Railway yards
- Petroleum product or oil storage

Stations
- Station modifications
- Station upgrades

EMR listing notifiable activity (DEHP 2017)
- Service station
Table 7.4: EMR Records – CBD

<table>
<thead>
<tr>
<th>Land parcel (Lot and plan)</th>
<th>EMR listing (including notifiable activity)</th>
<th>CLR listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot 12 SP192709 (Brisbane Square)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 10 B32361 (old Queensland Courts site)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 28 RP170279 (239 George Street)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 20 SP198665 (building adjacent to Brisbane City Hall) (amalgamation of Lot 1 and 2 RP52036; Lot 1-3 RP57137; Lot 3-4 RP90089; Lot 17 RP90508, Lot 28 B11823)</td>
<td>Yes – Lot 1 and Lot 2 RP52036, Lot 1-3 RP57137, Lot 3-4 RP90089, Lot 17 RP90508 and Lot 28 B11823 are listed for petroleum product or oil storage</td>
<td>No</td>
</tr>
<tr>
<td>Lot 101 SP102966 (Brisbane City Hall)</td>
<td>Yes – petroleum product or oil storage</td>
<td>No</td>
</tr>
<tr>
<td>Lot 1 RP748 (27 Adelaide Street)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 1 RP749 (31 Adelaide Street)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 1, 2 and 3 RP747 (41, 43 and 45 Adelaide Street)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 2 RP886308 (59 Adelaide Street)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 29 RP219956 (63 Adelaide Street)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 6 RP732 (69 Adelaide Street)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lot 1 RP110131 (89 Adelaide Street)</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

The listings were compared to the Council flammable/combustible goods licenses, which identified that listings in the CBD section of the study area (including those around King George Square and Adelaide Street) were generally associated with lower risk generators and/or aboveground storage tanks. A review of Council records undertaken for this assessment indicated that there may be some underground storage tanks in this area, including a 10,000 litre underground storage tank in City Hall.

Other potentially contaminated sites were also identified in this section of the study area through the review of Council’s contaminated land mapping and previous environmental assessments undertaken for the proposed CRR project\(^\text{10}\) including the Roma Street precinct and Inner Northern Busway. A review of the aerial imagery confirmed that land use in the CBD section of the study area has consistently been commercial/industrial since prior to 1946. Progressive redevelopment has occurred over time, with a noticeable increase in high rise developments since the 1990s. The Roma Street precinct was used for transportation/railway uses since prior to 1946 and has been previously identified as potentially contaminated. A portion of the former rail yards was under redevelopment in 1997 and is now used for high-density residences and parkland.

**Kelvin Grove to Herston**

Aerial imagery has confirmed that general land uses in this section of the study area have been primarily commercial/industrial since prior to 1946. The redevelopment of buildings and the progressive expansion of the RBWH have continued over time (including supporting busway infrastructure). The land immediately adjacent to Breakfast Creek appears to have been used for timber processing until before 1978, when it was cleared and remained vacant until the construction of ‘Ernie’s Roundabout’ before 2017. A review of Council mapping and previous environmental assessments undertaken for other projects in this section of the study area identified potentially contaminated sites within the RBWH and at Ernie’s Roundabout.

It is assumed that potential or actual contamination encountered in the Inner Northern Busway corridor was managed during construction of that project.

\(^\text{10}\) SKM-Aurecon CRR JV (2011)
7.4 Construction impacts

7.4.1 Soils and topography

Brisbane Metro is not expected to impact soils and topography where it utilises existing infrastructure, with potential impacts related to soils and topography from the construction of Brisbane Metro limited to those areas of new or modified infrastructure. Potential impacts will generally be associated with:

- erosion and mobilisation of sediments – land disturbance activities during construction may result in soil erosion and releases of sediment-laden or turbid water to natural drainage systems or land areas
- disturbance of acid sulfate soils and/or potential acid sulfate soils – excavation of soil may result in disturbance of acid sulfate soils and/or dewatering resulting in oxidation.

Erosion and sediment

Several factors contribute to the erosion risk of a construction area, including the area and duration of bare soil exposure, rainfall erosivity, soil type, slope length and gradient and cover and management variables. In general, the potential for erosion and sedimentation impacts from construction are considered to be low to moderate due mainly to the topography of the construction areas (zero to five per cent gradient slopes), and the nature of the works to be carried out. Potential risks will mainly be associated with construction areas that involve large areas of disturbance and/or excavations or bulk earthworks. These locations include:

- the metro depot at Rochedale
- bus turnaround and layover facility at Griffith University station
- Buranda station
- Cultural Centre precinct, including the underground station and transition structure
- North Quay and Adelaide Street transition structure and tunnel.

There are expected to be no or low impacts along other sections of the existing busway.

Acid sulfate soils

Disturbances to acid sulfate soils during construction may result from direct excavation of acid sulfate soils material, or indirectly through groundwater drawdown and loading pressure on unconsolidated sediments from stockpile placement. Potential impacts associated with disturbance of acid sulfate soils and the resultant accelerated oxidation of acid sulfate soils and uncontrolled release of acid leachate include:

- increased acidity of soils which may result in subsidence and damage to existing infrastructure
- mobilisation of contaminants including aluminium, iron, manganese and arsenic
- changes to water chemistry and aquatic ecosystem values of receiving waters.

Construction activities are considered unlikely to disturb potential acid sulfate soils along most of the alignment. Areas where disturbance of potential acid sulfate soils may occur during construction include areas of excavation work for the new underground Cultural Centre station and transition structure.

7.4.2 Contaminated land

During construction, potential risks associated with contaminated land will generally be limited to those areas of new or modified infrastructure involving excavation. In particular, risks are expected to mainly be associated with:

- disturbance of potentially contaminated material – construction activities that involve the excavation of soil or land disturbance have the potential to intercept contaminated material on previously identified potentially contaminated sites (i.e. sites listed on the EMR) or on sites where contamination was not identified.
• spread of contamination from/to adjacent sites – contamination on adjacent sites may result in the production of contaminated dust, groundwater or noxious or harmful gases (ground gas) which may pose a risk to human health or the environment including potentially explosive atmospheres
• disturbance of asbestos – asbestos may be encountered during demolition or land disturbance works, which may pose a risk to human health
• contamination of land – accidental spills or leaks of hazardous materials could occur at construction worksites and laydown areas.

These risks will be managed through implementation of management measures to reduce risk to workers, environment from contamination and measures to reduce risk of gas ingress into excavations, structures during construction. Contaminated material from excavation will be disposed off-site to a licensed landfill facility under a DES-issued disposal permit.

Where properties within the construction worksites are listed on the EMR, further investigation will be undertaken as part of the detailed design phase to determine the nature and extent of contamination and to inform the construction methodology and ongoing operational requirements. Additionally, properties that have a site management plan will require further review to identify potential implications for Brisbane Metro’s design and construction. The management of contamination through the detailed design and construction phases will be considered in detail with oversight and guidance from a suitably qualified person and in consultation with an environmental auditor (contaminated land). This will include consideration of the need for contaminated sites to be remediated prior to construction works commencing.

Detailed investigations will be undertaken through the detailed design phase where subsurface structures are proposed to determine the need for management measures to be incorporated into the design to manage the potential influence of any volatile substances in the ground profile (e.g. petroleum hydrocarbons, landfill gasses).

The influence of potential groundwater drawdown (if any) will also be considered through the detailed design phase where dewatering activities are proposed, in the context of mobilising existing off-site contamination. In particular, construction activities will need to account for any change to existing contamination in those areas surrounding the alignment and include provisions for any influence that could potentially accelerate or promote contamination migration.

An audit of buildings and structures to be demolished will be conducted by a suitably qualified and licensed asbestos contractor prior to demolition or service replacement works commencing. Any asbestos found will be removed prior to demolition in accordance with relevant processes and procedures.

Rochedale to Upper Mt Gravatt

No contamination was identified at the metro depot site through this desktop assessment, however, potential impacts may be associated with unforeseen contamination. Construction of the depot will require the demolition of existing residential and commercial buildings on the site. There is the potential for disturbance of asbestos during demolition of these buildings. An audit of the buildings will be conducted prior to demolition to determine if asbestos is present.

Brisbane Metro will primarily reuse existing busway infrastructure in this section of the study area, with minor works and platform extensions proposed to Eight Mile Plains and Upper Mt Gravatt stations. The sites accommodating these stations are currently listed on the EMR and works involving ground disturbance have the potential to disturb contaminated land as part of these works. Potential risks will be managed through the design and implementation of appropriate management measures.

Mt Gravatt to Greenslopes

A new bus turnaround and layover facility is proposed north of the existing Griffith University station. Elsewhere in this section of the study area, Brisbane Metro will primarily use existing busway infrastructure, with minor works proposed to existing stations and platform extension at Griffith University station.
No contamination was identified through this desktop assessment near to proposed works at Griffith University or Holland Park West stations and potential risks from contaminated land at these locations are expected to be low.

Land surrounding Greenslopes station was identified as potentially contaminated. Works at this station will involve minor station modification only and minimal ground disturbance, if any. Potential risks from contaminated land at this location are expected to be low.

Woolloongabba to St Lucia

Modification of the Buranda station platforms will require the demolition and reconstruction of the existing plaza and busway tunnel and excavation works to widen the existing tunnel. As indicated in section 7.4.2, part of this site is listed on the EMR for railway yards and there is potential to disturb contaminated land as part of these works. Further investigation of potential contaminated land risks will be conducted through the detailed design phase to determine required management measures.

Elsewhere within this section of the study area, Brisbane Metro will mainly use the existing busway infrastructure, with minor works proposed at the existing stations and for bus layovers or turnarounds at Boggo Road, UQ Lakes and Woolloongabba stations. These works are expected to involve minimal land disturbance and potential impacts are expected to be low.

South Brisbane

Works at Mater Hill station will involve the extension of the existing platforms, requiring some ground disturbance. Part of this site is listed on the EMR for petroleum product or oil storage and land contamination and the excavation and removal of material during construction will require management. Works at South Bank station will involve minor station modifications only. While this site is identified as being potentially contaminated, the existing station is elevated and potentially contaminated land are not expected to be disturbed.

The construction of the new underground Cultural Centre station and underpass of the railway corridor, including associated surface works, will require excavation and removal of large quantities of material. As indicated in section 7.3.2, the South Brisbane railway station, QPAC, Queensland Museum and BCEC are listed on the EMR, including for railway yards, hazardous contaminants and service station. Excavation within and near to these sites has the potential to disturb contaminated material (including contaminated groundwater). Further assessment within this area is required to facilitate design and construction works, including the disposal of contaminated material to landfill under a disposal permit. Detailed investigations will be undertaken through the detailed design phase, in consultation with an environmental auditor to confirm potential risks and identify the required management measures.

Brisbane CBD

A new tunnel will be constructed under Adelaide Street connection to the existing King George Square station in this section of the study area. This will require the excavation and removal of a large volume of material. As indicated in section 7.3.2, a number of these sites are listed on the EMR for petroleum product or oil storage and may be contaminated. There is potential for the disturbance of contaminated material (including contaminated groundwater) during excavation of the tunnel, which will require management.

Works at Roma Street station will require extension to the existing platform involving modification of the existing Brisbane Transit Centre building. Part of this site has been previously identified for potential contamination associated with railway yards. Management of land contamination will be required should ground disturbance works be required.

Kelvin Grove to Herston

Existing stations in this section will have minor works, i.e. modifications to passenger information displays and ticketing, within the existing busway and are not expected to have contaminated land impacts.
TransLink are currently in the process of procuring the construction of a bus layover facility at Ernie’s Roundabout. Works at this location will involve the modification to the layover area. As indicated in section 7.3.2, this site is identified as being subject to potential contamination. Works at this location are expected to involve minimal ground disturbance, if any, and potential risks from contaminated land at this location are expected to be low.

7.5 Operational impacts

7.5.1 Soils and topography

Potential impacts on soil during operation will be managed in accordance with existing busway or Council procedures. This includes regular inspection and maintenance of drainage infrastructure and landscaped areas.

7.5.2 Contaminated land

Potential impacts associated with contaminated land during operations mainly relate to the mismanagement of contamination during construction activities and any ongoing requirements as well as spills or leaks of hazardous materials.

The metro depot at Rochedale will provide stabling for metro vehicles, a maintenance garage (for major and minor works) and fuel storage. It will also have drainage and bio-retention basin infrastructure. The detailed design will incorporate appropriate hazardous material measures for the proposed end use of the area. These are expected to include, as a minimum:

- appropriately designed hardstanding and pavement incorporating drainage interceptors as a mitigation for potential fuel leaks
- bunded areas for containment of fuel
- bunded areas for storage of chemicals including waste oils chemicals.

The design of the new underground Cultural Centre station and associated underground spaces will consider measures for managing gases if further investigation identifies the potential for soil gas accumulation in subsurface structures.

7.6 Mitigation and management measures

The management of impacts to soils, topography and contaminated land during construction will be documented in the CEMP and relevant sub-plans (e.g. Contaminated Land Management Plan, Acid Sulfate Soil Management Plan and Erosion and Sediment Control Plan). These will outline standards to be applied during the construction phase; management strategies and control measures; and regular monitoring and reporting processes. Plans will be developed and include measures specific to each construction area.

Potential impacts on soils, topography and contaminated land during operation will be addressed through design and planning and under existing processes and operating procedures for the busway and Council bus depots with updates for the new metro vehicles and infrastructure, as required.

7.6.1 Soils and topography

Mitigation measures for erosion and sediment control during the planning and construction phases include:

- establish no-go zones where soil disturbances is to be avoided and minimise the extent, area and duration of soil disturbances
- install appropriate drainage controls to divert waters around areas of exposed soil, where possible and maintain separation of clean and dirty water flows
- control the release of turbid and/or sediment-laden waters through appropriate sediment controls
control dewatering activities through the implementation of procedures for releasing water (i.e. recovery of the water with vacuum trucks for disposal/reuse or the installation of water quality treatment devices).

The management of potential and actual acid sulfate soil materials will be undertaken in accordance with the relevant guidelines. Mitigation measures:

- limit interception of potential and actual acid sulfate soil materials through avoiding known areas of potential and actual acid sulfate soil, where practicable
- minimise the exposure/oxidation of potential and actual acid sulfate soil materials through appropriate construction methodologies and site management practices
- avoid stockpiling potential and actual acid sulfate soil materials onsite and in locations where runoff could directly or indirectly enter the storm water system, through exposure to rainfall or surface water flows.

The management of potential impacts during operation will be conducted in accordance with existing busway or Council procedures. This includes regular inspection and maintenance of drainage infrastructure and landscaped areas.

### 7.6.2 Contaminated land

Detailed contaminated land investigations including preparation of a contaminated land investigation document will be undertaken to support the design process and construction planning. This will identify specific measures for the management of contaminated land and include measures relating to:

- management of contaminated dust generation during earthworks, including monitoring at adjacent properties and nearby sensitive receptors
- implementation of erosion and sediment control measures to assist with the control of water and dust and staging of off-site activities to minimise the extent of disturbed area and the potential run-off of contaminated material
- minimising exposure of humans and the environment to potentially contaminated soils during excavation activities
- controls for material haulage, such as covering loads or wetting material to reduce airborne dust emissions and documentation of all contaminated material during transport operations
- management of contaminated groundwater, including disposal by a liquid waste contractor
- management of asbestos
- management of ground gas accumulation in underground infrastructure
- prevention and management of spills and leaks of hazardous materials
- appropriate workplace health and safety procedures including use of personal protective equipment
- off-site disposal of contaminated material would be to a licensed landfill facility under a DES-issued disposal permit.

A suitably qualified person is required to prepare all contaminated land investigation documents and waste disposal permit documentation as construction activities impact EMR-listed properties and subterranean habitable space is proposed. An environmental auditor (contaminated land) is also required to review and certify contaminated land investigation documents and compliance permits to facilitate regulator sign off (as appropriate), and to provide input into the design of all sub-surface publicly accessible space.

During construction, management of contaminated land on some land parcels will be required. This may be limited to disposal of materials to landfill under a disposal permit, or could extend to remediation and/or ongoing monitoring during construction and early operational phases of Brisbane Metro. The requirement for remediation at individual land parcels will be confirmed as part of the detailed design.
It is not anticipated that contamination will require ongoing management during operations, provided the Brisbane Metro design sufficiently addresses all risks associated with in situ contamination. However, should some residual contamination remain in situ and not be remediated during construction, a site management plan may be required for respective land parcels. The site management plans will stipulate ongoing requirements for management and any maintenance works. The conditions of the site management plan are specific to a proposed development on the site, however they provide insight into the likely constraints imposed to redevelopment of the land parcel as part of any development. These include:

- all works which involve the breaking of ground on the site must be overseen by a suitably qualified person in consultation with an auditor
- the design of any structures on the site would require consultation with and sign off by an auditor
- the site must not be used for a more sensitive land use until groundwater and soil have been remediated in full, in accordance with the remediation action plan
- groundwater is to be disposed by a licenced liquid waste contractor.

7.7 Summary

Soils, topography and contaminated land are unaffected along the majority of the alignment as Brisbane Metro makes extensive use of existing busway infrastructure. Potential impacts associated with soils, topography and contaminated land for the construction of Brisbane Metro would generally be limited to areas of new or modified infrastructure. The risks presented by soils and topography are expected to be low if best practice erosion and sediment control measures are implemented.

The highest risk areas associated with land contamination are expected to be at Buranda station, Cultural Centre precinct and Adelaide Street due to the disturbance of land during excavations and bulk earthworks in the construction phase. Potential risks will be managed through detailed design and the CEMP. A summary of construction contaminated land risks and mitigation is presented in Table 7.5.

Table 7.5: Summary of contaminated land risks during construction

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disturbance of potentially contaminated soils on land parcels intersected by Brisbane Metro or immediately adjacent</td>
<td>Exposure of workforce to potentially contaminated soils during construction</td>
<td>CEMP would incorporate measures to reduce risk to workers from known and unforeseen contamination</td>
</tr>
<tr>
<td></td>
<td>Mobilisation of contamination to the receiving environment during construction</td>
<td>CEMP would incorporate measures to reduce risk to the environment from known and unforeseen contamination</td>
</tr>
<tr>
<td>Disturbance, drawdown and/or migration of potentially contaminated groundwater</td>
<td>Exposure of workforce to potentially contaminated waters during construction</td>
<td>CEMP would incorporate measures to reduce risk to workers from known and unforeseen contamination</td>
</tr>
<tr>
<td></td>
<td>Mobilisation of contamination in groundwater to the receiving environment during construction</td>
<td>CEMP would incorporate measures to reduce risk to the environment from known and unforeseen contamination</td>
</tr>
<tr>
<td></td>
<td>Mobilisation of contamination in groundwater from adjacent properties during construction</td>
<td>CEMP would incorporate measures to reduce risk associated with contaminated groundwater in areas of subterraneous structures</td>
</tr>
<tr>
<td>Soil gas accumulation in subsurface structures or service lines</td>
<td>Exposure of workforce to soil gas during construction (including explosive risk, suffocation risk)</td>
<td>Design would incorporate measures to reduce risk of gas ingress into excavations, structures during construction</td>
</tr>
<tr>
<td>Disturbance of asbestos containing materials</td>
<td>Exposure of workforce to soil contaminated by asbestos</td>
<td>CEMP would incorporate measures to reduce risk to workers from known and unforeseen contamination</td>
</tr>
<tr>
<td>Aspect</td>
<td>Impact</td>
<td>Mitigation</td>
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<tr>
<td>Exposure of public to soil contaminated by asbestos</td>
<td>CEMP would incorporate measures to reduce risk to workers from known and unforeseen contamination</td>
<td>CEMP would incorporate measures to reduce risk of land contamination (drum stands, waste oil capture systems, bunding etc)</td>
</tr>
<tr>
<td>Contamination of land through spills and leaks at worksites or maintenance yards</td>
<td>Mobilisation of contamination to the receiving environment during construction</td>
<td>CEMP would incorporate measures to reduce risk of land contamination (drum stands, waste oil capture systems, bunding etc)</td>
</tr>
</tbody>
</table>