

16. Groundwater, soils and contamination

16.1 Existing environment and background

This chapter draws on information from Appendix O (Soil and contamination assessment).

16.1.1 Policy and planning setting

The assessment considered the following relevant policies and guidelines:

- *NSW Contaminated Land Management Act 1997*
- *NSW Protection of the Environment Operations Act 1997*
- *NSW Waste Avoidance and Resource Recovery Act 2001*
- Guidelines for the Assessment and Management of Groundwater Contamination (NSW Department of Environment and Conservation, 2007)
- *NSW Contaminated Land Management Amendment Act 2008*
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (National Environment Protection Council, 2013)
- Waste Classification Guidelines and Addendum, Part 1 Classifying Waste (NSW EPA, 2014)
- Guidelines for the NSW Site Auditor Scheme (3rd edition, NSW EPA, 2017b)
- Guidelines for Consultants Reporting on Contaminated Land (NSW EPA, 2020).

16.1.2 Soils and geology

The geology within the project area is underlain by Ashfield Shale, which is characterised by black to dark grey shale and laminate (fine layers) with sandstone beds.

The project area is underlain by two soil types:

- Residual soils (that is, those created from weathering of rocks and what remains): Blacktown group, which are located across western and southern parts of the project area. These soils are characterised by gently undulating rises on Wianamatta Group shales. Soils typically comprise shallow to moderately deep hard setting/low permeability clays with mottled texture contrast, red brown podzolic soils on crests grading to yellow podzolic soils on lower slopes. There is poor drainage of these soils.
- Alluvial soils (that is, loose clay, silt, sand, or gravel that has been deposited by running water): Deep Creek group, which are located across northern and eastern parts of the project area. These soils are characterised by gently undulating alluvial floodplain draining the Hawkesbury Sandstone. Soils typically comprise deep podzols on well-drained terraces, siliceous sands on current floodplains and humus podzols in low lying areas. Limitations include flooding, extreme soil erosion hazard, sedimentation hazard, localised very low fertility and permanently high-water tables.

Soil sampling and analytical programs have been completed as part of a previous study carried out at Central Station as part of Sydney Metro (Aurecon Australasia Pty Ltd and GHD Pty Ltd (AGJV), 2019). The areas investigated included the Sydney Metro Station Box (20 metres southwest of the project area), Central Walk East (75 metres southwest of the project area) and Sydney Yard (within the construction compound area), as shown in Figure 16-1. The soil layers observed in the boreholes at these locations generally comprise:

- Fill extending from surface to depths ranging between 0.3 to 3.9 metres below ground surface consisting of brown/grey gravels, sand, and gravelly clays, with inclusions that comprised sandstone fragments, bricks, bitumen, ash, and coal.
- Natural alluvium/residual soils encountered below the fill at depths ranging typically between 0.3 to 9.6 metres below ground surface, which generally comprised orange-brown sands/clayey sands, and orange-brown/grey sandy gravelly clays with ironstone gravel inclusions.
- Bedrock, typically from depths ranging between 1.4 to 6.5 metres below ground surface. In one location bedrock was not encountered at a depth of about 17 metres below ground surface.

16.1.3 Acid sulfate soils

There are five acid sulfate soils (ASS) classes based on the likelihood of presence in particular areas and at certain depths. Based on [ASS mapping](#), the project area falls in the lowest classification (Class 5), where there is a low likelihood of ASS being present (State Government of NSW and Department of Planning and Environment, 2018). If ASS is encountered, the acid and metals released can pose a risk to water quality, cause corrosion of concrete iron and steel and kill plants.

16.1.4 Salinity

A review of the [eSPADE](#) (State of NSW and Department of Planning and Environment, 2022) database which provides access to soil profile and soil map information confirms that the project area is not located within a soil salinity risk area.

16.1.5 Groundwater

Data reviewed as part of the [previous study](#) carried out at Central Station (AGJV, 2019), indicated that groundwater appears to have been encountered in two separate underlying aquifers. A shallow aquifer within the alluvium and residual landscape soil profiles, followed by a deeper aquifer in the Hawkesbury Sandstone bedrock profile.

The project area is situated at an elevation between 16 metres Australian Height Datum (AHD) on the eastern side and 20 metres AHD on the western side. The shallow aquifer was noted to range between 14.725–19.785 metres AHD (3.05–10.685 metres below the top of well casing, as measured at locations about 170 metres south-east and 135 metres south of the project area) while the deeper aquifer ranged between 2.68–3.02 metres AHD (17.15–17.92 metres below the top of well casing, as measured at locations about 40 and 230 metres south of the project area). Given the depth to groundwater and proposed shallow excavations, there is potential that groundwater may be encountered or require management during construction.

Groundwater flow direction for the shallow groundwater aquifer was inferred to be generally in a north-western direction based on the available data.

16.1.6 Historical aerial imagery

A review of available historical aerial photographs identified the following land uses that have activities that present a contamination risk. In general, Central Station has been used for railway activities (that is, station platforms and railway corridors) for over 100 years. The surrounding areas have been used for mixed commercial, industrial (for example, ex-railway gasworks) and residential. A tunnel and a station box were built for eastern suburban trains in 1979 known as platforms 24 and 25.

Based on the historical site activities, the potential sources of contamination include:

- On-site activities associated with railway use and activities, which includes fuel and hazardous building materials, fill beneath platforms and ballast as fill along the rail lines
- Historical gas works activities immediately southwest of Platforms 14 and 15, adjacent to the Sydney Yard construction compound (see Figure 16-1). However, given the avoidance of ground disturbing works within the construction compound, the risk of encountering contamination associated with the gas works at this location is unlikely
- Historical potentially contaminating activities and businesses identified to have been in operation on neighbouring properties within 200 metres of the project at various times since at least 1930s. These included namely dry cleaners, motor garages, petrol and service stations, printing, and photography as well as textile and tannery manufacturing premises.

16.1.7 NSW EPA database search

A review of the NSW EPA database was carried out for the project. Reviewed information also included records relating to any known Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Investigation & Management Programs within the area.

Several records were identified for properties roughly within one kilometre of the project area. These included two service station sites (about 330 metres to the south-east and 690 metres to the west), a drycleaner (about 820 metres to the north-east), an Ausgrid Road Reserve (about 145 metres to the south-east), a shopping village (about 980 metres to the south-east) and a property associated with the chemical industry (about 440 metres to the south-west) which is currently regulated under the *Contaminated Land Management Act 1997*.

Based on the distance of the above properties from the project area and the anticipated maximum depth of proposed excavations, it is unlikely that these would present a contamination risk to the project.

16.1.8 Previous investigations

A [contamination assessment](#) prepared in relation to the Sydney Metro Central Station Main works project (AGJV, 2019) was reviewed. This provided a summary of existing contamination data at Central Station. The assessment targeted three distinct areas of anticipated works located within the railway corridor southwest of the Sydney Terminal Building as shown in Figure 16-1.

The assessment concluded:

- Elevated levels of contaminants of concern were mainly identified within shallow fill material
- Asbestos was encountered within fill
- There was the risk of metals, cyanide, low pH (acidic), nitrogen, ammonia, phosphate, and benzene in groundwater
- Groundwater within the Sydney Metro Station Box generally met Sydney Water's acceptance standard for trade wastewater except for low pH (acidic) in groundwater and zinc concentrations in seep water
- There is potential for direct contact or inhalation of vapours from contaminated shallow soil or groundwater.

16.1.9 Areas of potential environmental concern

Potential contamination risks and areas of potential environmental concern are summarised in Table 16-1 below. These have been identified from the above records, data, and information.

The areas mainly relate to past and present activities at Central Station and in the immediate surroundings and areas of potential historical uncontrolled fill or ground disturbance.

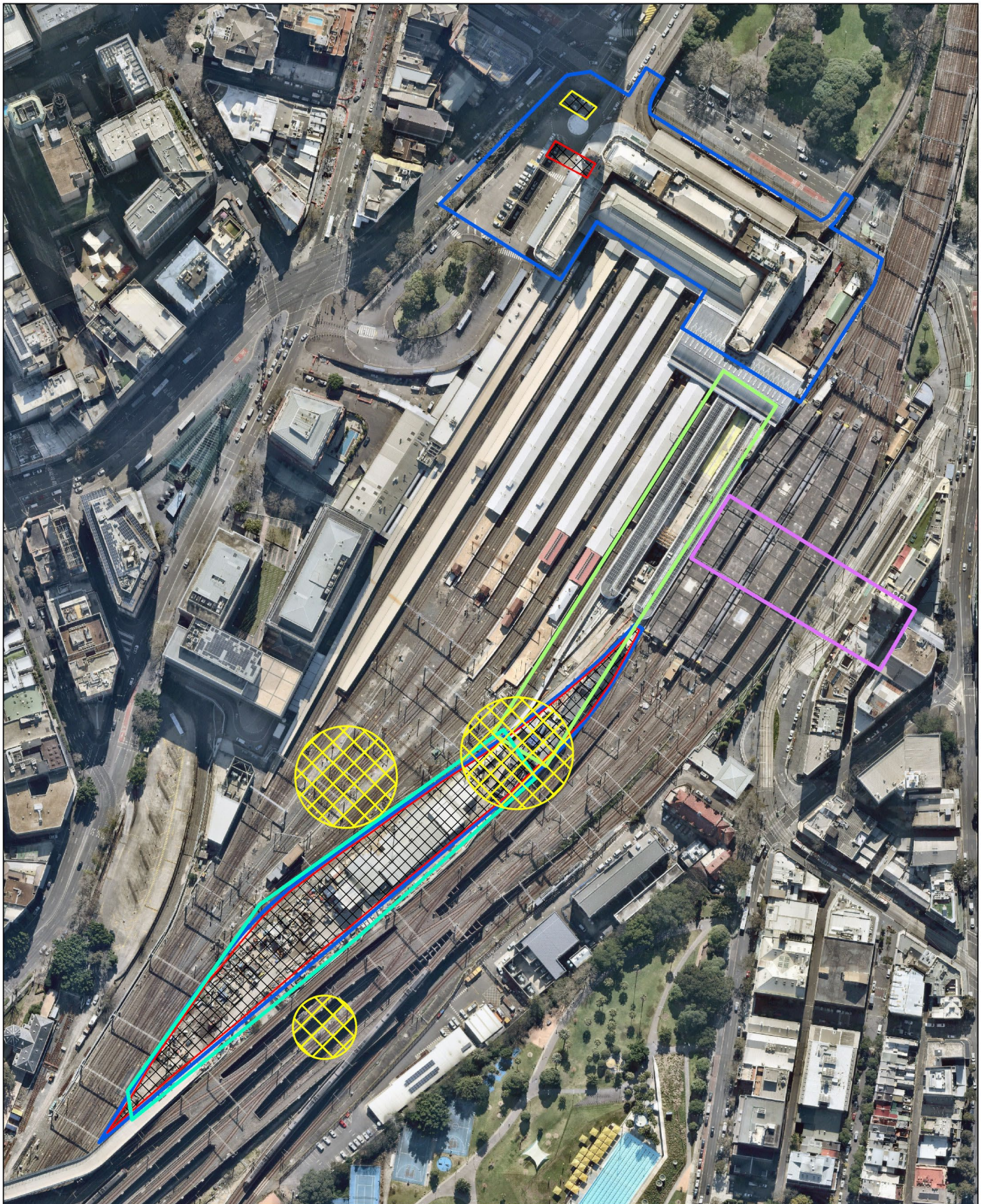
These areas of potential environmental concern and associated contaminants of potential concern were identified which may pose a potential risk from contamination during construction activities (land disturbance) and potentially during operation (maintenance) of the project, without mitigation measures in place.

Table 16-1: Areas of potential environmental concern

Area of potential environmental concern	Potential contamination source	Contaminants of potential concern ¹
Fill material below Sydney Terminal Building	Fill material encountered throughout the project area. Uncontrolled and potentially contaminated fill material may have been imported/placed as part of various activities in and around project area as a foundation to build the existing roads and buildings.	Heavy metals, hydrocarbons (TRHs, BTEXN, PAHs, PCBs), pesticides (OCPs, OPPs) and asbestos.
Sydney Terminal Building	Hazardous building materials may potentially be present in fill material below the Sydney Terminal Building because of poor demolition practices on properties in the immediate surroundings that may have resulted in impacts to surficial shallow soils.	Asbestos, lead, and hydrocarbons (PCBs).
Diesel generator within the western loading dock	Fuel storage.	Hydrocarbons (TRHs, BTEX) and heavy metals.
Transformer room in the western loading dock	Current and former electrical equipment and other equipment using coolants containing PCBs including potential localised PCB-containing oil spills or leaks.	Hydrocarbons (PCBs and TRHs)
Railway station platforms and railway corridor adjoining the project area to the south	Railway related activities.	Heavy metals, hydrocarbons (TRHs), nitrates, ammonia, phenolics, and asbestos.

Area of potential environmental concern	Potential contamination source	Contaminants of potential concern ¹
Current and historical potentially contaminating activities on neighbouring properties within 200 metres of the project	<p>Potentially contaminating activities including former gasworks, motor garages, petrol and service stations, dry cleaners, printing and photography, textile, and tannery manufacturing.</p> <p>The potential for exposure pathways to contamination sources listed above is low given the anticipated depth of proposed excavations as part of the construction.</p>	<p>Heavy metals and hydrocarbons (TRHs, BTEXN, PAHs)</p> <p>Related to gasworks only: ammonia, cyanide, nitrate, sulfide, thiocyanate, phenolics, heavy metals (including aluminium, antimony, barium, iron, manganese, selenium, silver, and vanadium) and coke.</p>

1. Contaminants of potential concern: Benzene, toluene, ethyl benzene, xylene and naphthalene (BTEXN), total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), Heavy Metals (arsenic, cadmium, chromium, copper, lead, nickel, mercury and zinc), organochlorine pesticides (OCPs), organophosphate pesticides (OPPs), herbicides (phenoxy), polychlorinated biphenyl (PCBs), per- and poly-fluoroalkyl substances (PFAS), asbestos containing materials (ACM), Perchloroethylene (PERC), trichloroethylene (TCE), Vinyl chloride (VC).



Coordinate System: GDA2020 MGA Zone 56



Metres
0 30 60
Scale at A4
1:3,000

Esri Community Maps Contributors, Geoscape, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, © 2022 Microsoft Corporation © 2022 Maxar © CNES (2022) Distribution Airbus DS, Sources: Esri, Airbus DS, USGS, NASA, GGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodaststyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, AGVJ, 2019

Prepared by: MD
Checked by: CS
Approved by: CS

Legend

- ▬ Construction footprint
- ▬ Metro Box
- ▬ Central Walk
- ▬ Sydney Yard
- ⊗ Area of Suspected Former Gasworks

Indicative construction compound

- ⊗ Grand Concourse level
- ⊗ Ground level

Sydney Terminal Building Revitalisation Project

Figure 16-1: Areas previously investigated as part of Sydney Metro Central Station Main works project

Project Number: 287415

Drawings / Design Prepared By

ARUP

Client

NSW
GOVERNMENT

Transport
for NSW

16.2 Assessment of potential impacts

16.2.1 Construction

The project includes excavation to around two metres below the surface and as such it is likely that uncontrolled fill material will be encountered. The uncontrolled fill material may present a potential human health risk during the construction phase of the project because of the potential presence of contaminants of concern (see Table 16-1). As described in Chapter 19 (Resource efficiency), about 1,100 cubic metres of excavated material will require management during the construction phase.

During construction, workers carrying out associated activities and the public may potentially become exposed to contaminated soil. Activities where workers could encounter contaminated soil include, but not limited to piling, trenching, excavations, and installation of services.

Uncontrolled release of impacted soil and/or groundwater could also pose a potential risk if entering stormwater.

Given the depth to groundwater and proposed shallow excavations, there is potential that groundwater may be encountered and require management during construction. There is also the potential risk for contaminants to mobilise and enter groundwater.

To manage these potential risks further assessment via intrusive methods and analysis of samples is proposed across the anticipated areas of excavation (see Section 16.3). The results of the investigation will be used to further evaluate potential existing risks to human health and/or the environment prior to construction works taking place. The analytical data would also provide information supporting the indicative waste classification of soils proposed to be excavated and to develop soil management practices.

There are potential health risks associated from direct contact or inhalation of vapours from contaminated shallow soil or groundwater where work is taken place in confined areas in the Sydney Terminal Building. This presents a risk to the workforce and other people who would continue to routinely work in these buildings. Chapter 20 (Hazard and risk) discusses these risks in detail.

Finally, there is the potential for accidents and incidents to occur during construction, as is typical of any works. While uncontrolled this could result in a discharge to any exposed soils, it would be managed through adopted measures that are proven in being effective in managing spills and avoiding impacts to the surrounding environment (see Section 16.3).

16.2.2 Operation

Central Station has been an operating piece of rail infrastructure for over 100 years. The impacted fill material, that is not encountered during the construction phase of this project, will remain in-situ. These areas have, and will, remain under hardstand removing any ongoing pathway or exposures to any contaminants of potential concern. In this case, ongoing monitoring programs will not be required following the completion of the project. During operation, there is still however the risk of fuel and chemical spills which could enter stormwater drains. Ongoing dewatering is not required for the project, precluding the need for future sampling or management practices.

16.3 Environmental management measures

Groundwater, soil and contamination impacts will be addressed in the form of management measures. Measures to minimise impacts relating to surface water, hazards and waste are addressed in other impact chapters and have not been included here. Table 16-2 lists the measures to manage groundwater, soil and contamination impacts specifically.

Any soil that does not meet relevant land use criteria and/or is surplus to development requirements will require management in accordance with the hierarchy for reuse, recycling or disposal of spoil produced during construction as outlined in Chapter 19 (Resource Efficiency). The classification to facilitate any offsite disposal of waste, if required, will be carried out in accordance with the NSW EPA [Waste Classification Guidelines: Classifying Waste \(Parts 1 to 4\)](#).

Table 16-2: Environmental management measures – soil and contamination

Ref	Impact/ uncertainty	Environmental management measure	Timing
GSC01		<p>A Soils and Water Management Plan (SWMP) will be developed and implemented as part of the CEMP. The sub-plan will include detailed soil and erosion sediment control plans consistent with the requirements of The Blue Book: Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2 (Landcom, 2004). The SWMP will:</p> <ul style="list-style-type: none"> HSC02Identify all reasonably foreseeable risks relating to soil erosion, soil contamination, asbestos and acid sulfate soils associated with carrying out the activity 	Pre-construction

Ref	Impact/ uncertainty	Environmental management measure	Timing
		<ul style="list-style-type: none"> Describe how these risks will be managed and minimised including the management of potential acid sulfate soils and potential contamination Include the required processes/procedures for excavation, handling, storage, and transport of sediment and arrangements for managing pollution risks associated with spillage or contamination Relevant control measures required during dewatering activities including PPE, monitoring and/or licencing requirements for water discharge will be included in the SWMP. 	
GSC02	Uncertainty Contaminated soil	Further investigation and analysis across the anticipated areas of excavation will be carried out to evaluate risks to human health and/or the environment and recommend any additional management measures prior to excavation works taking place.	Pre-construction
GSC03	Uncertainty Unexpected conditions	Management of contaminated soil identified during construction will be carried out in accordance with an Unexpected Finds Protocol (UFP). The UFP should specifically outline management procedures that should be carried out if indicators of contamination (for example, asbestos, stained or odorous material) are identified during construction activities.	Construction
GSC04	Uncertainty Acid sulfate soils	Where soil requires excavation beyond the underlying groundwater level, testing will be carried out to determine the presence of actual and/or potential acid sulfate soils. If acid sulfate soils are encountered, they will be managed in accordance with the <u>Acid Sulfate Soil Manual</u> (Acid Sulfate Soil Management Advisory Committee, 1998).	Construction