SYDNEY METRO - WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

St Marys Station
Detailed Site Investigation

Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works

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Abbreviations

Abbreviation	Definition
AHD	Australian height datum (0 AHD corresponds roughly to mean sea level)
AIP	NSW Aquifer Interference Policy
ARI	Average recurrence interval
BoM	Australian Bureau of Meteorology
bgs	Below ground surface
bgl	Below ground level
BTEXN	Benzene, toluene, ethyl-xylene, xylene, and naphthalene
BSF	Bringelly Service Facility
CMF	Claremont Meadows Service Facility
COPC	Chemicals of potential concern
CPBG	CPB Contractors Ghella
DCE	Dichloroethene
DDD	Dichlorodiphenyldichloroethane (organochlorine insecticide)
DPI	NSW Department of Primary Industries
DSI	Detailed site investigation
EC	Electroconductivity
EIS	Environmental Impact Statement
ENM	Excavated natural material
EPA	NSW Environment Protection Authority
EY	Exceedances per year
GDE	Groundwater dependent ecosystem
GDR	Geotechnical Data Report
GWMR	Groundwater Monitoring Report
GSW	General solid waste
m	Metre
mg/L	Milligram per litre
NSW	New South Wales
PAH	Polycyclic aromatic hydrocarbon
PCE	Perchloroethylene also called tetrachloroethylene

Abbreviation	Definition
PDS	Portal Dive Structure
PFAS	Per and polyfluoroalkyl substances
PMF	Probable maximal flood
SBT	Station Boxes and Tunnelling Works
SBT North	Area including STM, CMF and OHE
SBT South	Area including PDS, ATM, BSF and AEC
TBC	To be completed
TBM	Tunnel boring machine
TCE	Trichloroethylene
TDS	Total dissolved solids
TfNSW	Transport for New South Wales
TRH	Total Recoverable Hydrocarbons
TTMP	Tetra Tech Major Projects Pty Ltd (Coffey)
µg/L	Micro gram per litre
UST	Underground storage tank
VENM	Virgin excavated natural material
VC	Vinyl chloride
VWP	Vibrating wire piezometer
WAL	Water Access License
WSA	Western Sydney Airport
WSI	Western Sydney International (Airport)

1. Introduction

1.1. Project Overview

Sydney Metro has engaged the CPB Ghella Joint Venture (CPBG) for the design and construction of the Station Boxes and Tunnelling Works (SBT Works) of the Sydney Metro Western Sydney Airport project (the Project).

The SBT Works involves the construction and operation of a new 23 km metro rail line from the existing Sydney Trains suburban T1 Western Line (at St Marys) in the north and the Aerotropolis (at Bringelly) in the south. The Project includes tunnels and civil structures, including a viaduct, bridges, and surface and open-cut troughs between the two tunnel sections. Figure 1.1 shows the proposed alignment and key features of the Project.

The SBT Works are divided into two parts:

- SBT North: St Marys Station (STM) to Orchard Hills Station. St Marys Station is an existing heritage-listed suburban rail station. Orchard Hills is a new station for the Sydney Metro line and will include the portal dive structure. Claremont Meadows Services Facility (CMF) is included along this alignment.
- SBT South: Airport business park dive structure to the Western Sydney Airport Aerotropolis station. This section of work is largely greenfield, with construction both on and off-airport land. The Airport Terminal Station (ATM) and Bringelly Services Facility (BSF) are included along this alignment.

Key elements on the SBT Works include:

- Two sections of twin tunnels with a combined length of approximately 9.8 km, plus associated portal structures. This includes one section from St Marys to Orchard Hills and the other under Western Sydney International (WSI) airport to the new Aerotropolis Station.
- Excavations at either end to enable trains to turn back, and stub tunnels to enable future extensions.
- Station box excavations with temporary ground support for four new Metro stations at St Marys, Orchard Hills, Airport Terminal and Aerotropolis.
- Excavations for two intermediate services facilities, one in each of the tunnel sections at Claremont and Bringelly.

CPBG has engaged Tetra Tech Major Projects Pty Ltd (TTMP) to provide geotechnical, hydrogeological and contaminated land consultancy services associated with the design and construction of the SBT Works.

This document describes the Detailed Site Investigation (DSI) completed at the St Marys Station ("the site"). The extent of the site is shown in Figures 1 and 2 in Appendix 1.

Previous investigations have been conducted at the site (refer to Section 5) and have been limited in scope. Based on the potential for contamination from historical land use, further investigation was recommended to refine the understanding of potential contamination risks and to inform the design and construction proposed at the site.

Separate DSIs are being prepared for the tunnel, other station sites, BSF and CMF. This DSI is specific to the construction activities at the site described Section 4. Consideration to the use of the site post construction is outside the scope of the SBT Works.

Figure 1.1: Scope of SBT Works

The purpose of this DSI was to:

- Provide data to inform the management of spoil generated during construction for either on-site reuse and / or off-site disposal;
- Inform the required controls which need to be implemented during construction regarding the management of contamination in soil and groundwater; and
- Inform the requirement for remediation and / or management measures which need to be implemented for the design of the BSF.

This DSI was carried out in conjunction with geotechnical and hydrogeological investigations and relevant information from these investigations was included in this report.

The completion of this DSI was a requirement of the Sydney Metro - Western Sydney Airport Station Boxes and Tunnelling Works Design and Construction Deed Contract No: WSA-200-SBT. Under Section 12.19 of this Deed, objectives of the DSI included:

- Investigate areas of proposed excavation or disturbance;
- Investigate land within the construction site and / or surrounding the areas of proposed excavation or disturbance with respect to the potential migration of contamination via groundwater, ground gas and odour into the areas of excavation or disturbance; and
- Provide in-situ classification of solid waste (i.e., spoil).

1.2. Regulatory Framework

This DSI was prepared in general accordance with, the following legislation, industry standards, codes of practice, and guidance documents, where relevant:

- ANZG 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.
- Australian Standard (AS) 4482.1, *Guide to Investigation and Sampling of Sites with Potentially Contaminated Soil, Part 1: Non-volatile and Semi-volatile Compounds, 2005* (AS4482.1 – 2005)
- AS 4482.2, *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 2: Volatile Substances*, 1999 (AS4482.2-1999)
- *Contaminated Land Management (CLM) Act, 1997* (CLM Act 1997)
- CRC Care Technical Report No. 10, *Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, 2011* (CRCCARE 2011)
- Heads of EPAs Australia and New Zealand (HEPA). *PFAS National Environmental Management Plan. Version 2.0 – January 2020* (HEPA NEMP 2020)
- *Protection of the Environment Operations (POEO) Act 1997* (POEO Act 1997)
- *POEO (Underground Petroleum Storage Systems) Regulation 2019* (POEO UPSS Regulation 2019)
- *National Environment Protection Council (NEPC) Act 1994* (NEPC Act 1994)

- *National Environment Protection Council, National Environment Protection (Assessment of Site Contamination) Measure, 1999* (April 2013) (ASC NEPM 2013)
- NSW Department of Environment and Conservation (DEC), *Contaminated Sites Guidelines for the Assessment and Management of Groundwater Contamination, 2007* (DEC 2007)
- NSW EPA (1995) *Contaminated Sites Sampling Design Guidelines*
- NSW EPA (2014) *Waste Classification Guidelines Part 1: Classifying waste*
- NSW EPA (2014) *Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 - The excavated natural material order 2014*
- NSW EPA (2016) *Addendum to the Waste Classification Guidelines (2014) – Part 1: classifying waste*
- NSW EPA *Contaminated Land Guidelines: Assessment and management of hazardous ground gases, 2020* (NSW EPA 2020)
- NSW EPA (2020), *Contaminated Land Guidelines: Consultants Reporting on Contaminated Land, 2020*.

2. Scope of Work

The following scope of work was completed:

- Review of existing information including the previous Preliminary Site Investigation (PSI) and investigation reports.
- Complete a detailed site walkover to observe conditions within the site and surrounding land.
- Prepare Sampling Analysis and Quality Plan (SAQP) for investigations at the site to address data gaps/uncertainties. The SAQP was presented in the following report:
    - TTMP (July 2022); *St Marys Sampling Analysis and Quality Plan; Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works* (Ref: SMWSASBT-CPBG-SWD-SW000-GE-RPT-040503; Rev. B.01 dated 22 July 2022).
- Complete intrusive investigation over 39 days, which included drilling 40 boreholes to depths between 1.0m and 45.18m below ground surface (mbgs). Convert five boreholes into groundwater monitoring wells. Boreholes SBT-BH-1224 to SBT-BH-1227, SBT-BH-1229 to SBT-BH-1230 and SBT-BH-1342 are to be completed following the completion of demolition works at the St Marys Station Plaza.
- Analysis of soil and groundwater samples for contaminants of potential concern (COPC).
- Preparation of this report discussing the findings of the assessment.

Further detail is provided in Section 8.

3. Site Description

3.1. Site Setting and Features

The site is located at St Marys and is shown in Figures 1 and 2 in Appendix 1. Key attributes of the site are summarised in Table 1.

Table 1: Site Information

Attribute	Description
Address (centre of Site)	63 Station Street, North St Marys NSW 2760 (Approx. Chainage 17,300m to 17,900m, as shown in Figure 2 in Appendix 1)
Site Area	Approximately 3.9 Ha.
Title Identification Details	Part Lot 1 Deposited Plan (DP) 1040178 Lot 1 and Lot 2 DP1001735 Lot 1 DP1267484 Lot 7 and Part Lot 8 DP734738 Part Lot 9 DP840717 Lots 175, 176, Part 177 and Part 210 DP26908 Lots 4, 5 and Part 6 DP18072 Lot 3A DP397002 Part Lot SP12965 Road Reserve for Station Street, West Lane
Current Land Use	Station Box and Surface Works Construction Area • St Marys Bus Interchange • Bus Driver Rest Compound east of bus interchange • Cleared land within the rail corridor • Station Street • St Marys Station Plaza (commercial/retail centre) Tunnel Section Station Box to Chainage 17,900m (refer to Figure 2 in Appendix 1) • St Marys Bus Interchange • Commercial land use between Harris Street and West Lane (Tattoo parlour, and vacant buildings) • Public car park and residential house between West Lane and Carinya Avenue
Current Land Zoning	Land zones SP2 Railway, B4, R4 and IN1 under the Penrith Local Environment Plan 2010
Adjoining Land Uses	**North:** St Marys Train Station and Railway. North of the rail corridor is the St Marys Commuter Carpark (surface and multistorey carpark) in the north-east, and commercial/light industrial (warehouse) activities in the northwest (Showerama, Evolution Windows System, Wilkins Windows). In the far north-western corner (and north of the rail corridor) is a substation. In the far north-eastern corner is the Australian

Attribute	Description
	Reinforcing Company (ARC) manufacturing facility (west of Forrester Road) who supply steel reinforcement to the construction industry. Land use along the northern side of Harris Street includes a range of commercial / light industrial activities (smash repairs, automotive mechanic, veterinary laboratory, agricultural chemical warehouse, timber yard, commercial cleaning, driving school, vehicle inspection service, motorhome yard). The EIS technical report reports that the two of the facilities (Vetlab and Autopak Formulations) are licenced under the POEO Act to undertake activities including: chemical production, storage, and waste generation; pesticide production, waste storage, pharmaceutical and veterinary product production, and non-thermal treatment of hazardous and other waste. **South:** South of site and east of Gidley Street is a residential area with a mixture of single detached houses and units / apartments. South of site and west of Gidley Street are commercial / retail activities, the car park for St Marys Station Plaza, and other public car park facilities. **East:** Glossop Street. East of Glossop Street is a residential area south of the rail corridor, and a commercial / industrial area north of the rail corridor. **West:** West of the site include the car park for the St Marys Station Plaza, commercial / retail premises between Gidley Street and Carinya Avenue, and a residential area west of Carinya Avenue.

3.2. Environmental Site Setting

Table 2 presents a summary of the environmental setting of the site.

Table 2: Site Environmental Setting

Aspect	Description
Topography	A review of the topographic map of NSW indicates the site is situated at an elevation of approximately 36 m to 50 m Australian Height Datum (AHD). The land slopes down in a westerly direction towards South Creek located approximately 900 m west of the site.
Geology	A review of the Penrith 1:100 000 scale geology map[1] indicates that the site is underlain by Bringelly Shale of the Wianamatta Group which was deposited in a deep marine environment of the Middle Triassic. The Bringelly Shale is described as shale, carbonaceous claystone, laminite, lithic sandstone, with rare coal. A geotechnical cross-section of the site is included in Appendix 2. Based on previous investigations (refer to Section 5) the geology of the site is expected to be comprised of fill material (0.5 – 2.1 m thick) and underlain by residual soils comprised of Silty Clay to Clayey Silt. Alluvium is present at the western end of the site. The thickness of soils varies along the alignment and is approximately 3 m below ground surface (bgs) in the eastern end and 10 m bgs at the western end of the site. Soils are underlain by the Bringelly Shale.

[1] Geological Survey of Penrith 1991. Surface geology of New South Wales - 1:1 100 000 map. Geological Survey of New South Wales, NSW Department of Primary Industries, Maitland, Australia

Aspect	Description
Hydrology and Hydrogeology	There are no surface water bodies within the site. The nearest surface watercourses to the site include a minor, unnamed tributary of South Creek present approximately 420m to the north, and South Creek which is located approximately 800m to the southwest (at its nearest point). The existing groundwater level at the site within the Bringelly Shale is assessed to be 33 m AHD (TTC, 2022a[2]), although a shallow, perched waterbody is expected at the soil/rock interface. Groundwater is expected to flow in a westerly direction towards South Creek (TTC, 2022[3]).
Registered Groundwater Bores	The nearest licensed groundwater bores (GW112625, GW112626 and GW112627) are located approximately 750 m northwest of the site and are located on residential properties (previously a service station). All three bores were installed as monitoring wells to 6 m below ground surface (bgs).
Salinity	A review of the map indicates that the site is mapped as having moderate salinity.
Acid Sulfate Soils	The Atlas of Australian Acid Sulfate Soil (ASS) compiled by CSIRO[4] was reviewed to assess the probability of occurrence of ASS within the site. The ASS risk plan indicates that the site is located in an area with Extremely Low Probability of Occurrence of ASS.
List of Contaminated Sites Notified to the EPA	A search of the List of NSW Contaminated Sites Notified to NSW EPA[5] (as of 8 March 2022) was carried out on 13 April 2022. Two properties are recorded on the register, and include the following: • NS1513: 1 to 7 Queen Street (Former dry cleaner that is now vacant). This site is located above the Tunnel from approximately Chainage 17,800 to 17,850 (refer to Section 5.3 for further information on this site). • NS1189: 76 Glossop Street (Service station) located approximately 300 m north of the site.
NSW EPA Contaminated Land Public Record	A search of the NSW EPA Contaminated Land Public Record was carried out on 13 April 2022 for declaration notices, orders made by the EPA under the CLM Act 1997, voluntary management proposals approved under the CLM Act 1997, and site audit statements relating to significantly contaminated land. The search of the database revealed that the site, or properties within 250 m of the site, are not listed on the contaminated land public record.

3.3. Site Description

An inspection of the site including St Marys Plaza and 1-2 Station Street (bus drivers compound) was undertaken on the 14 and 15 March 2022. Site Photos from this inspection are presented in Appendix 2.

[2] TTC (2022a) *Western Sydney Airport Station Boxes and Tunnels Tender, Groundwater Monitoring Plan*
[3] TTC (2022) *Western Sydney Airport Station Boxes and Tunnels Tender, Hydrogeological Interpretative Report.*
[4] http/www.asris.csiro.au/
[5] https://www.epa.nsw.gov.au/your-environment/contaminated-land/notification-policy/contaminated-sites-list

3.3.1. St Marys Plaza

St Marys Plaza comprises a vacant, commercial shopping centre. The shopping centre comprises one above-ground level and single level basement car park that is accessed from Station Street. No generators were observed on-site, and the property manager indicated that the centre did not have one. The below-ground car park was surfaced with hardstand pavement in good condition.

Minor oil staining from motor vehicles was present on the hardstand and a small area used for the storage of cleaning chemicals was observed. Risk to underlying soil materials where these observations were made is considered to be low based on the integrity of the hardstand observed.

A car wash with an oil separator and sub-surface drainage was present in the car park. It was assessed that there was the potential for contamination of soil materials beneath the car wash if leakage from the oil water separator and / or sub-surface drainage features occurred.

There is a potential for some fill to be present in the exterior portions of this area of the site most notably in the northern portion of the property along Station Street.

3.3.2. 1-7 Station Street

Inspection of 1-2 Station Street was undertaken to determine whether an Underground Storage Tank (UST) was potentially present. However, at the time of the inspection, the property was being used as a stockpiling area and the ground surface could not be inspected. Anecdotal information provided by Sydney Metro staff indicated that a building had previously been situated there but had been removed to facilitate usage of the area for stockpiling and placement of some portable site offices. Sydney Metro personnel indicated that they were not aware that a UST may have existed on this property, and no records or anecdotal reporting were provided to Sydney Metro that a UST had been found or removed when the building was demolished. Sydney Metro provided a photograph of a gatic, or lid shown within the interior of the former building which may have been indicative of a possible UST, however the photograph was inconclusive. No information was provided indicating what the UST may have been present. This portion of the alignment was elevated approximately 10 m above the track line.

Heading east of this area, Station Street began to slope upwards towards the intersection with Chesham Street. On the northern side of Chesham Street (east of the intersection with Station Street), the area was being used as a construction compound. The compound was surrounded by a chain-link fence and was surfaced with either gravel or bare soil. Several portable site offices and amenities were situated in this area.

3.3.3. St Marys Station Commuter Car Park located north of the STM site

The commuter car park is not part of the STM construction site but is located north of the existing St Marys railway station. The location of the former wrecking yard (now St Marys Station Commuter Car Park) was inspected which was previously reported have a UST situated there. Inspection of the outdoor, on-grade area to the east of the multi-story car park identified a rectangular cut-out that had been resurfaced in the bitumen which may be indicative of a potential UST. Fill may have been present in the southern portion of this area adjacent to the rail line.

3.4. Site History

The history of the site is described in *Sydney Metro - Western Sydney Airport Technical Paper 8 Contamination (*M2A, 2020) ("the EIS Technical Paper") which is a supporting document to the Sydney Metro – Western Sydney Airport Environmental Impact Statement (Sydney Metro, 2020). The EIS Technical Paper provides a Preliminary Site Investigation (PSI) of the Project footprint, and a detailed summary of the site history and existing data available when the EIS was prepared was included in Section 1, Appendix C of this document. This section and the supporting figures have been included in Appendix 3.

The following information summarises relevant historical information included in the EIS Technical Paper which was supplemented by a review of historical aerial imagery available through the NSW Government Historical Imagery portal[6]. Historical aerial photography is provided in Appendix 4.

In 1943 historical aerial imagery shows the site comprised of St Marys Station, a rail line / siding, and low density residential housing surrounding the station. A rail siding is present south of the station (what is now the St Marys Bus Interchange) and the siding appears to have been in place through to the 1990s when it was redeveloped into the bus interchange.

Land between the rail siding and Station Street appeared to have been cleared in 1943. At the time land in this area appeared to be disturbed and used for the stockpiling of materials. Within this area buildings were added in the 1980s (now the Bus Driver Rest Compound). The configuration of these buildings changed between the 1980s through to 2013. A single building and shed remained in this area in 2013 to the present day. It is understood that this area is currently used as a rest area for bus drivers.

A former Girl Guides building was constructed in the 1970s at the eastern end of the site between the rail line and Chesham Street. The building was demolished between 2009 and 2011. Anecdotal records indicate that remediation works were completed, which included excavation and off-site disposal of asbestos impacted soils, and reinstatement of remedial excavation with clean fill. The works were reportedly validated by an environmental consultant, although no formal documentation has been provided to Sydney Metro, CPG or TTMP for review.

From 1943 to the present day land south of Station Street and east of Gidley Street the density of residential housing increased, and units / apartments were also developed. St Marys Station Plaza was developed in the late 1980s. During this time period, land west of Gidley Street and south of the rail line was developed for commercial use. Several service stations, motor vehicle service centres and dry cleaning facilities were also located in this area between the 1950s and 1990s (refer to Section 5.3).

Land north of the rail line was progressively redeveloped into commercial / industrial use between 1943 and 1965. The commuter car parks for the rail line were developed in the late 1970s and early 1980s, and the multi-storey carpark developed between 2009 and 2010.

3.5. AEC Sites

Historical activities with the potential for contamination (referred to as Areas of Environmental Concern (AEC)) were identified in the EIS Technical Paper. The location of the AEC are shown in Appendix 3 and are summarised in the following table.

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[6] Historical Imagery (nsw.gov.au)

For the purpose of the SAQP the AECs and other sites identified in the EIS Technical Paper have been assigned a reference number (DSI ID). These numbers are shown in the following table and have also been added to the figure in Appendix 3.

Table 3: Supplementary Historical Aerial Photograph Review

DSI ID	EIS Reference	Activity Description
01	AEC1	Site Summary • AEC1 is located at the St Marys Station Commuter Car Park. This area includes the potential for former fuel, oil and chemical storage and use associated with historical industrial land use including wreckers' yard within the 1970s and adjacent former bus depot. Previous Investigation Summary • No previous investigation data is available.
02	AEC2	Site Summary • AEC 2 includes the St Marys rail corridor and bus interchange area. • Potential former fuel storage within Sydney Trains Emergency Response Depot (now bus driver rest compound), former railway siding activities (spills, stockpiling, and filling) and up-gradient sources of groundwater contamination (dry cleaners and service station). Previous Investigation Summary • AEC2 is within the footprint of the station box which have been subject to previous investigations (refer to section 4). Potential UST located in the area.
03	AEC3A	Site Summary • Former Girl Guides Hall with potential for contamination (asbestos and lead) associated with the demolition of this building. Previous Investigation Summary • No previous investigation data is available.
04	AEC3B	Site Summary • The EIS Technical Report that the St Marys Station Plaza may contain chemical storage for back-up generators and air conditioning units. Back up generators were not observed during site walkover however a chemical storage area and car wash facility was observed. There is also potential for contamination in association Historical demolition of former buildings containing hazardous building materials. Previous Investigation Summary • No previous investigation data available

DSI ID	EIS Reference	Activity Description
05	1-7 Queen St (Dry Cleaner)	Site Summary • Environmental Strategies (2015) reported that Argus undertook a preliminary site investigation (PSI) of the site in 2015. The PSI found that there were vent pipes and vent stacks above the tailoring shop. There was no other evidence that dry cleaning had occurred based on historical titles, dangerous goods records, anecdotal information, and observations from the site. Previous Investigation Summary • This site has been subject to previous investigations which are summarised in **Section 4.3**.
06	Corner of Harris Street and Forrester Road	Site Summary • The EIS Technical reports former UST are present on the corner of Harris Street and Forrester Road. The subject land appears to be located topographically down-gradient and therefore unlikely to be a potential contamination source to the St Marys construction footprint Previous Investigation Summary • No previous investigation data is available.
07	1 Station Street (Bus Driver Compound)	Site Summary • Former Sydney Trains Incident and Emergency Response Depot. The EIS Technical reports notes that this site formally had hazmat signage for petroleum hydrocarbon storage, and the site may had either USTs or Aboveground Storage Tanks (AST). Previous Investigation Summary • No previous investigation data is available.
08	59 Queen St (corner of Belar St and Queen Street)	Site Summary • The site was potentially used as a workshop/service station from the 1950s to the 1970s. Previous Investigation Summary • No previous investigation data is available.
09	47 Phillip St	Site Summary • The site was potentially used as a service station in the 1980s. Previous Investigation Summary • No previous investigation data is available.
10	51 Phillip St	Site Summary • The site was potentially used as a dry cleaners in the 1990s. Previous Investigation Summary • No previous investigation data is available.
11	Sydney Trains Substation	Site Summary • The site is an existing substation. Previous Investigation Summary • No previous investigation data is available.

DSI ID	EIS Reference	Activity Description
12	Former Bus Depot	Site Summary • The site is a former bus depot (1940s to 1980s) with the potential for USTs. Previous Investigation Summary • No previous investigation data is available.
13	Former Ammunition and Locomotive Factory	Site Summary • The EIS reports the site was formerly used for the manufacturing of munitions, and then locomotives. Previous Investigation Summary • No previous investigation data is available.
14	Industrial Area North of railway	Site summary • The EIS reports hundreds of historical businesses associated with industrial activities north of the rail line such as chemical and industrial manufacturing, mechanical repairs, textile manufacturing, depots, and yards. Previous Investigation Summary • No previous investigation data is available.
15	43 Queen Street	Site summary • The EIS reports this site was previously used for waterproofing. Previous Investigation Summary • No previous investigation data is available.

4. Project Description

4.1. Construction

The proposed layout of the site during construction is provided in Figure 2 in Appendix 1.

In summary the construction activities to be undertaken at the site include:

- Demolition of existing commercial / industrial premises including St Marys Station Plaza.
- Establishment of temporary offices, amenities, car parking and access roads for construction purposes.
- Bulk excavation up to 6 m bgs within land south of the station box, and west of St Mary Station Plaza and the use of excavated material as fill within the St Marys Station Plaza, where such material is assessed to be suitable from a contamination and geotechnical perspective.
- Piling and station box excavation using rippers and rock hammers. The station box will be excavated to approximately 20 m bgs (i.e., 19 m AHD). Excavation of the station box is expected to generate approximately 172,000 m^3 (as an in-situ volume) of spoil which requires disposal off-site.
- Stub tunnel excavation east of the station box using road headers.
- Tunnel boring west of the station box, and retrieval of the Tunnel boring machine (TBM) within the station box.

For the SBT Works, the station box, along with the tunnels and associated cross passages and sub tunnels will be constructed as undrained (tanked) structures.

4.2. Dewatering

An assessment of potential groundwater inflow during construction is reported in TTC (2022) ("the HIR") and summarised in the Groundwater Monitoring Plan (TTC, 2022) ("the GMP"). The following is a summary from the GMP.

The existing groundwater level at the station in the main aquifer is assessed to be 33 mAHD. This level was adopted for the assessment of drawdown impacts associated with construction. A higher level of 34m AHD was adopted for the assessment of potential sustained groundwater inflow due to periods of sustained high rainfall.

For construction groundwater assessment, it is assumed that groundwater level will be controlled to 18.5 m AHD within the excavation allowing for excavation to facilitate foundation preparation and casting of the base slab.

Based on the previous borehole logs, Bringelly Shale is interpreted to be present at the bulk excavation level over the lower 16 m of the excavation. Perched groundwater (at the shallow level than the recorded groundwater level within shale) is anticipated in the shallow soil profile at higher elevations than the main aquifer. The groundwater inflow assessment assumed that such shallow groundwater would be address separately by surface drainage or cut-off trenching.

A sustained inflow of 0.2 L/s is estimated for the completed excavation. Higher inflow may occur initially depending upon the rate of excavation. Drawdown associated with the excavation is assessed to occur up to a distance of 420 m from the excavation. As a result, the excavation is considered unlikely to significantly influence the nearby watercourses.

4.3. Re use of Excavated Material within the larger Airport Site

Suitable material that is excavated from the site will be used to fill the footprint of the former St Marys Plaza. Surplus excavated material will be transported for reuse as fill within the larger Western Sydney Airport (designated the 'FS01 site'), where such materials meet the requirements set out under the Airport Environment Protection Regulations 1997 (AEPR) (refer Table 7.3; Appendix 7).

It should be noted that CPBG will need to ensure relevant regulatory requirements (e.g., Protection of the Environment Operations (Waste) Regulation 2014 and Protection of the Environment Operations Act 1997) and / or the Federal Material Import and Reuse Procedures included in Appendix 3 are complied with.

Material which cannot be re-used will be disposed off-site as waste.

5. Summary of Previous Investigations

The site has been subject to previous preliminary intrusive investigations of soil and groundwater. Data from these investigations is presented within the following reports:

- Cardno (Nov, 2021); *Contamination Assessment Report – Phase D/E, Sydney Metro Western Sydney Airport* (Ref: 80021888; RevB, dated 22nd November 2021)

- Cardno (May, 2021); *Contamination Assessment Report, Sydney Metro Western Sydney Airport* (Ref: 80021888; dated 5th May 2021)
- Golder & Douglas Partners (Feb 2021); *Factual Contamination Report – Preliminary Site Investigation* (Ref: 19122621-003-R-Rev3; Rev3; dated 19th February 2021).

Previous investigations have also been undertaken at 1-7 Queen Street St Marys (former dry cleaners).

5.1. Soil

Analytical data from previous investigations has been collated by TTMP and is provided in Appendix 5.

The scope of these previous assessments has been summarised in Table 4 and the results summarised in following sub-sections for fill and natural materials. The investigation sampling locations are presented in Figure 3C in Appendix 1.

Table 4: Summary of Previous Soil Assessments

Report	Scope of Investigation Relevant to the site
Factual Contamination Report (Golder & Douglas Partners, Feb 2021)	• Thirteen boreholes (SMGW-BH-A001, SMGW-BH-A002, SMGW-BH-A002S, SMGW-BH-A004, SMGW-BH-A100 - SMGW-BH-A102, SMGW-BH-A102L, SMGW-BH-A201, SMGW-BH-A202, SMGW-BH-A251, SMGW-BH-A252 and SMGW-BH-A300) were drilled and sampled.
Contamination Assessment Report (Cardno, May 2021)	• Three boreholes (SMGW-BH-A302, SMGW-BH-A321 and SMGW-BH-A321S) were drilled and sampled. • One test pit (SMGW-TP-A302) was excavated and sampled.
Contamination Assessment Report – Phase D/E (Cardno, Nov 2021)	• Three boreholes (SMGW-BH-A360, SMGW-BH-A361 and SMGW-BH-A362) were drilled and sampled.

Sampling has mainly been limited to the collection of soil samples in fill materials, and natural from selected boreholes (BH-A002, BH-A101, BH-A201, BH-A202, BH-A302, BH-A321, BH-A360, BH-A361 and BH-A362).

5.1.1. Fill Materials

Fill material was observed in all previous investigation intrusive locations over the site. Review of the logs from previous investigations indicates the depth of fill ranged between 0.2 m and 1.2 m bgs.

Fill was largely described as a brown, low plasticity sandy clay fill with roots. Visual/olfactory signs of contamination such as soil staining and hydrocarbon odours were not reported in the logs.

A summary of analytical results for fill materials screened against health-based guidelines is provided in Table 5.

Table 5: Analytical Results - Fill Samples

Analyte (mg/kg unless shown)	No. Samples / No. Detects	Minimum Value	Maximum Value	Commercial/ Industrial Health Guidelines (Note 1)	No. of Samples Exceeding Commercial/ Industrial Health Guidelines
Arsenic	27 / 22	<2	273	3000	Nil
Cadmium	27 / 0	<0.4	<1	900	Nil
Chromium (III+VI)	27 / 27	6	76	3600	Nil
Copper	27 / 26	<4	489	240000	Nil
Lead	27 / 27	5	259	1500	Nil
Mercury	27 / 2	<0.1	0.2	730	Nil
Nickel	27 / 26	<3	81	6000	Nil
Zinc	27 / 26	<5	330	400000	Nil
pH (aqueous extract)	9 / 9	5.9	8.9		-
TRH C6 - C10 Fraction F1	27 / 0	<10	<25	260	Nil
TRH C6 - C10 Fraction Less BTEX F1	27 / 0	<10	<25	260	Nil
TRH >C10 - C16 Fraction F2	27 / 0	<50	<50	20000	Nil
TRH >C10 - C16 Fraction Less Naphthalene (F2)	17 / 0	<50	<100	20000	Nil
TRH >C16 - C34 Fraction F3	27 / 2	<100	230	27000	Nil
TRH >C34 - C40 Fraction F4	27 / 1	<100	110	38000	Nil
TRH C10 - C40 Fraction	27 / 2	<50	340		-
Benzene	27 / 0	<0.1	<0.2	3	Nil
Toluene	27 / 0	<0.1	<0.5	99000	Nil
Ethylbenzene	27 / 0	<0.1	<1	27000	Nil
Xylenes (m & p)	27 / 1	<0.2	1		-
Xylene (o)	27 / 0	<0.1	<1		-
Xylenes (Total)	27 / 1	<0.3	1	81000	Nil
Naphthalene	27 / 0	<0.1	<1	11000	Nil
PAHs (Sum of total)	27 / 2	<0.05	7.4	4000	Nil
Benzo(a)pyrene TEQ (Calculated)	16 / 3	<0.172	1.2	40	Nil
Total Halogenated Phenol*	6 / 0	<1	<1		-
Total Non-Halogenated Phenol*	6 / 0	<20	<20		-
Perfluorooctanesulfonic acid (PFOS)	22 / 12	<0.0001	0.0032		-
Perfluorohexanoic acid (PFHxA)	22 / 0	<0.0001	<0.005		-
Sum of PFHxS and PFOS (lab reported)	22 / 12	<0.0001	0.0032	20	NIL
Sum of PFASs (n=28)	19 / 5	<0.0002	0.0034		-
PCB (Sum of Total-Lab Reported)	15 / 0	<0.1	<0.5	7	Nil

Note 1: Commercial / industrial guidelines include the NEPM HIL-D and HSL, PFAS NEMP, and the CRC Care (2011) petroleum hydrocarbon HSLs for direct contact for commercial industrial workers

In summary, the fill material reported analytes (potential contaminants) with concentrations which were below the adopted commercial industrial health guidelines. Trace concentrations of perfluoroalkyl and polyfluoroalkyl substances (PFAS) were reported in fill materials over the site.

Asbestos containing materials (ACM) were reported in the log for BH-A321S. Sixteen samples of fill material were screened for asbestos including the fill material from BH-A321S. No positive detection of asbestos was reported; however, potential ACM may occur from the demolition and removal of the buildings within the construction footprint of the site.

5.1.2. Natural Materials

A summary of analytical results of the natural material is provided in Table 6.

Table 6: Analytical Results - Natural Samples

Analyte (mg/kg unless shown)	No. Samples / No. Detects	Minimum Value	Maximum Value	Commercial/ Industrial Health Guidelines (Note 1)	No. of Samples Exceeding Commercial/ Industrial Health Guidelines
Arsenic	40 / 33	<2	74	3000	Nil
Cadmium	40 / 1	<0.4	6	900	Nil
Chromium (III+VI)	40 / 37	<2	94	3600	Nil
Copper	40 / 39	<4	72	240000	Nil
Lead	40 / 40	6.4	26	1500	Nil
Mercury	40 / 0	<0.1	<0.1	730	Nil
Nickel	40 / 32	<2	46	6000	Nil
Zinc	40 / 38	<5	230	400000	Nil
pH (aqueous extract)	27 / 27	5.2	9.7		-
TRH C6 - C10 Fraction F1	33 / 0	<10	<25	260	Nil
TRH C6 - C10 Fraction Less BTEX F1	33 / 0	<10	<25	260	Nil
TRH >C10 - C16 Fraction F2	35 / 0	<50	<50	20000	Nil
TRH >C10 - C16 Fraction Less Naphthalene (F2)	26 / 0	<50	<100	20000	Nil
TRH >C16 - C34 Fraction F3	35 / 1	<100	120	27000	Nil
TRH >C34 - C40 Fraction F4	35 / 0	<100	<100	38000	Nil
TRH C10 - C40 Fraction	35 / 1	<50	120		-
Benzene	35 / 0	<0.1	<0.2	3	Nil
Toluene	35 / 0	<0.1	<0.5	99000	Nil
Ethylbenzene	35 / 0	<0.1	<1	27000	Nil
Xylenes (m & p)	35 / 0	<0.2	<2		-
Xylene (o)	35 / 0	<0.1	<1		-
Xylenes (Total)	35 / 0	<0.3	<3	81000	Nil
Naphthalene	35 / 0	<0.1	<1	11000	Nil
PAHs (Sum of total)	34 / 0	<0.5	<0.5	4000	Nil
Benzo(a)pyrene TEQ (Calculated)	24 / 13	<0.5	1.2	40	Nil
Total Halogenated Phenol*	8 / 0	<1	<1		-
Total Non-Halogenated Phenol*	8 / 0	<20	<20		-
6:2 Fluorotelomer Sulfonate (6:2 FtS)	35 / 1	<0.0005	0.0006		-
Perfluorobutane sulfonic acid (PFBS)	35 / 2	<0.0001	0.0002		-
Perfluorooctanesulfonic acid (PFOS)	35 / 4	<0.0001	0.0006		-
Perfluorooctanoate (PFOA)	35 / 1	<0.0001	0.0009	50	Nil
Perfluorohexanoic acid (PFHxA)	35 / 0	<0.0001	<0.005		-
Sum of PFHxS and PFOS (lab reported)	35 / 4	<0.0001	0.0006	20	Nil
Sum of PFASs (n=28)	31 / 2	<0.0002	0.0006		-
PCB (Sum of Total-Lab Reported)	5 / 0	<0.1	<0.5	7	Nil

In summary, the natural material reported COPC below the adopted commercial industrial health guidelines. Trace concentrations of PFAS compounds have been reported in some of the samples of natural materials analysed.

Two samples of natural soil materials were screened for asbestos. No positive detection of asbestos was reported.

Based on the available data (and current site conditions) natural material was assessed to be provisionally classified as either GSW, Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM).

It was assessed that further investigation was required to characterise spoil material to be generated during the construction of the Project infrastructure as the site.

5.2. Groundwater

Eight monitoring wells and six vibrating wire piezometers (VWP) have been installed at the site and the location of these are shown in Figure 3C in Appendix 1. Well construction details for these wells are summarised in Table 7.

Table 7: Groundwater Monitoring Wells

Monitoring location	Surface Level (m AHD)	Screen Level (m AHD)	Unit	Typical Water Level (m AHD)	Water Level Range (m AHD)
SMGW-BH-A001-1	34.4	VWP 26.4	Residual Soil	34.1	32 to 36.1
SMGW BH A001-2	34.4	VWP 16.4	Interbedded Siltstone and Sandstone	32.4	31.5 to 33.3
SMGW-BH-A001-3	34.4	VWP 8.4	Siltstone	29.6	28.1 to 31
SMGW-BH-A001-4	34.4	VWP 3.4	Siltstone	27.3	26.7 to 27.8
SMGW-BH-A002	36.2	8.2 to 14.2	Interbedded Siltstone and Sandstone	32.49	32.3 to 32.5
SMGW-BH-A102	36.8	28.8 to 33.8	Residual Soil	32. 5	32.3 to 32.6
SMGW-BH-A103	31	7 to 16	Siltstone	24.9	24.5 to 25.5
SMGW-BH-A202	35.53	26.03 to 28.03	Siltstone	Information not available	
SMGW-BH-A302	35.81	VWP 25.61	Weathered Sandstone / Siltstone	32.2	32 to 32.4
SMGW-BH-A302	35.81	21.31 to 15.31 (30.21 to 24.21)*	Interbedded Siltstone and Sandstone	23.8	23.81

Monitoring location	Surface Level (m AHD)	Screen Level (m AHD)	Unit	Typical Water Level (m AHD)	Water Level Range (m AHD)
SMGW-BH-A321	41.66	25.66 to 19.66 (38.66 to 32.66)*	Interbedded Siltstone and Sandstone	Information not available	
SMGW-BH-A321	41.66	32.16 to 32.16	Siltstone / Sandstone	Information not available	
SMGW-BH-A321S	41.65	VWP 32.15	Siltstone	31.9	31.9
SMGW-BH-A321S	41.65	38.15 to 32.15 (38.65 to 32.65)*	Interbedded Siltstone and Sandstone	35 Note 1	>35
BH1	35.5	35.5 to 35.5 (32.5 to 29.5)*	Information Not Available	29.7 Note 2	29.7

Notes:

* Construction details are shown in Table 3.1 (Monitoring Well Summary) contained in the Groundwater Monitoring Report (Cardno 2021) where these differ from the construction logs.

(1) May represent perched water table.

(2) Located west of the station location, used for info only.

The existing groundwater level at the station in the bedrock is assessed to be 33 m AHD (TTC, 2002a[7]). Groundwater is expected to flow in a westerly direction towards South Creek.

Groundwater sampling has been undertaken from the following monitoring wells during previous investigations:

- SMGW-BH-A202
- SMGW-BH-A302
- SMGW-BH-A102
- SMGW-BH-A002
- SMGW-BH-A321
- SMGW-BH-A321S
- SMGW-BH-A103.

Analytical data from the previous investigations is provided in Appendix 5.

For preliminary screening purposes the analytical data was compared to Toxicant default guideline values (DGVs) present in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2000). Freshwater guidelines with 95% species protection were selected based on South Creek being located in a modified, freshwater ecosystem.

A summary of the laboratory analytical data is provided in the Table 8.

[7] TTC (2022a) *Western Sydney Airport Station Boxes and Tunnels Tender, Groundwater Monitoring Plan*

Table 8: Groundwater Summary Table

Analyte	Units	No. Samples / No. Detects	Minimum Value	Maximum Value	ANZG (2018) Freshwater 95% toxicant DGVs	No. of Samples Exceeding ANZG (2018) Freshwater 95% toxicant DGVs
Magnesium (Filtered)	mg/L	18 / 18	5	812		-
Aluminium (Filtered)	mg/L	25 / 15	<0.01	0.18	0.055	5
Arsenic (Filtered)	mg/L	26 / 19	<0.001	0.01		-
Beryllium	mg/L	24 / 11	<0.001	0.012		-
Beryllium (Filtered)	mg/L	24 / 10	<0.001	0.01		-
Boron (Filtered)	mg/L	25 / 11	<0.05	0.12	0.37	Nil
Cadmium (Filtered)	mg/L	25 / 4	<0.0001	0.0008	0.0002	2
Chromium (III+VI) (Filtered)	mg/L	25 / 2	<0.001	0.002		-
Cobalt (Filtered)	mg/L	26 / 24	<0.001	0.17		-
Copper (Filtered)	mg/L	26 / 11	<0.001	0.022	0.0014	7
Iron (Filtered)	mg/L	26 / 22	<0.05	25		-
Lead (Filtered)	mg/L	25 / 5	<0.001	0.004	0.0034	1
Manganese (Filtered)	mg/L	26 / 26	0.002	6.4	1.9	2
Mercury (Filtered)	mg/L	24 / 0	<0.0001	<0.0001	0.0006	Nil
Molybdenum (Filtered)	mg/L	24 / 18	<0.001	0.018		-
Nickel (Filtered)	mg/L	26 / 26	0.002	0.056	0.011	14
Selenium (Filtered)	mg/L	25 / 1	<0.001	0.004	0.011	Nil
Strontium (Filtered)	mg/L	25 / 25	0.081	16.8		-
Tin (Filtered)	mg/L	/				
Vanadium (Filtered)	mg/L	23 / 1	<0.005	0.019		-
Zinc (Filtered)	mg/L	25 / 17	<0.005	0.112	0.008	15
Electrical Conductivity @ 25C (lab)	µS/cm	19 / 19	615	23000		-
pH (lab)	pH_unit	18 / 18	6.19	8.51		-
Alkalinity (total as CaCO3)	mg/L	25 / 25	60	715		-
Bicarbonate Alkalinity as CaCO3	mg/L	24 / 24	60	715		-
Carbonate Alkalinity as CaCO3	mg/L	23 / 1	<1	6		-
Hardness as CaCO3	mg/L	23 / 23	40	5850		-
Ammonia as N	mg/L	26 / 24	<0.01	2.96	0.9	11
Nitrite + Nitrate as N	mg/L	23 / 11	<0.01	3.43		-
Nitrate (as NO3-N)	mg/L	26 / 11	<0.01	3.43		-
Nitrite (as NO2-N)	mg/L	25 / 5	<0.01	0.1		-
Nitrogen (Total)	mg/L	19 / 11	<0.2	3.8		-
Total Dissolved Solids @180oC	mg/L	16 / 16	316	13600		-
Perfluorooctanesulfonic acid (PFOS)	µg/L	13 / 11	<0.0002	0.0019		-
Perfluorooctanoic acid (PFOA)	µg/L	13 / 5	<0.0006	0.016		-
Sum of PFASs (n=28)	µg/L	13 / 6	<0.005	0.0312		-
Benzene	µg/L	4 / 0	<1	<1	950	Nil
Toluene	µg/L	4 / 1	<1	2		-
Ethylbenzene	µg/L	4 / 0	<1	<2		-
Xylene (o)	µg/L	4 / 0	<1	<2	350	Nil
Xylene (m & p)	µg/L	4 / 0	<2	<2		-
Xylene Total	µg/L	4 / 0	<2	<3		-
F1 (C6 - C10)	µg/L	4 / 0	<20	<20		-
F1 (C6 - C10) less BTEX	µg/L	4 / 0	<20	<100		-
F2 (C10 - C16)	µg/L	4 / 1	<50	50		-
F2 C10 - C16 (minus Naphthalene)	µg/L	4 / 1	<50	50		-
F3 (C16 - C34)	µg/L	4 / 1	<100	300		-
F4 (C34 - C40)	µg/L	4 / 0	<100	<100		-
C10 - C40 (Sum of total)	µg/L	4 / 1	<100	350		-
PAHs (Sum of total)	µg/L	6 / 2	<0.01	0.23		-

Analyte	Units	No. Samples / No. Detects	Minimum Value	Maximum Value	ANZG (2018) Freshwater 95% toxicant DGVs	No. of Samples Exceeding ANZG (2018) Freshwater 95% toxicant DGVs
4,4-DDE	µg/L	6 / 1	<0.01	0.15		-
b-BHC	µg/L	6 / 1	<0.01	0.22		-
chlordane	µg/L	6 / 1	<0.01	0.06	0.08	Nil
DDD	µg/L	6 / 2	<0.01	0.01		-
DDT	µg/L	5 / 0	<0.01	<2	0.01	Nil
Endrin	µg/L	6 / 0	<0.01	<0.5	0.02	Nil
g-BHC (Lindane)	µg/L	6 / 0	<0.01	<0.5	0.2	Nil
Heptachlor	µg/L	6 / 0	<0.01	<0.5	0.09	Nil
Methoxychlor	µg/L	6 / 2	<0.01	0.15		-
Toxaphene	µg/L	5 / 0	<0.1	<1	0.2	Nil
Methane	µg/L	3 / 0	<0.05	<0.05		-

Groundwater monitoring from these wells has detected a range of COPC in groundwater including metals, ammonia, PFAS, petroleum hydrocarbons, PAH and organo-chlorine pesticides (OCPs).

Metals and ammonia were the only COPC reported at concentrations exceeding the corresponding DGV.

Chlorinated hydrocarbons have also been reported in groundwater associated with a former dry cleaner site (refer to Section 5.3).

The drawdown associated with the construction of St Marys Station is predicted to extend approximately 420 m out from the excavation for an assumed period of two years. Based on the available historical and project specific information, the COPCs in groundwater in the vicinity of the St Marys station construction area are petroleum hydrocarbons, chlorinated hydrocarbons, metals, OCPs, PAHs and PFAS.

Known or suspected areas and sources of existing groundwater contamination in the vicinity of the station area which may potentially be influenced by dewatering are shown in Appendix 3.

5.3. Former Dry Cleaner – 1-7 Queen St, St Marys

The tunnel passes beneath a former dry cleaning facility located at 1-7 Queen Street St Mary's (refer to Appendix 3). A review of the available site investigation data for this site and its potential implications for the SBT Works is provided in TTC (2021) and as part of the HIR (TTC, 2022).

The following is a summary of information included in these documents.

- Chlorinated hydrocarbons including tetrachloroethene (PCE) was detected in monitoring well locations MW01 and MW02 in 2015 (ES, 2015), and in monitoring in 2019 (Golder Douglas Partners, 2019).
- The PCE concentration reported (13,000µg/L in 2015 and 3,290 µg/L in 2019) exceeds the 95% ANZECC criteria for freshwater ecosystems (70 µg/L), and the adopted USEPA human health screening criteria for tap water (41 µg/L) which is protective of children exposed via direct contact and inhalation pathways.
- The presence of PCE was confirmed in both soil and soil vapour samples.

- One or more soil vapour samples also exceeded the health investigation levels for commercial / industrial land use (HIL-D, ASC NEPM 2013) for PCE breakdown products; trichloroethene (TCE), cis 1, 2 dichloroethene (cis 1,2 DCE) and vinyl chloride (VC).
- The maximum concentration of PCE in groundwater at the site is unknown, however the reported concentrations indicate that PCE may be present as a dense non-aqueous phase liquid (DNAPL).

1-7 Queen Street is:

- Approximately 120 m west of the station box and within the predicted extent where dewatering of up to 5 m may occur during construction; and
- Directly above the proposed tunnel alignment. The depth to the top of the tunnel at this site is approximately 17.5 m bgs.

It is currently not known whether contamination at this site extends to design tunnel depth, and to what extent contamination from this site could be drawn into the Station Box during excavation for the SBT Works.

5.4. Other Potentially Contaminated Sites Nearby

Numerous potentially contaminated sites have been identified outside the site, with the potential to cause contamination in groundwater which could be subsequently drawn in the station box during the SBT Works. These offsite potential sources of contamination are summarised in Appendix 3.

There is currently no previous investigation data for these sites. The following is presented for consideration, based on the site history review completed.

Harris Street Commuter Car Park (SAQP ID 01[8])

The commuter car park north of the station includes a former wreckers and associated workshop, a plastics manufacturing site, and bus depot and associated fuel storage.

Groundwater flow direction in this area is unknown, however, based on topography is expected to be to the west toward South Creek.

There are no groundwater monitoring wells within or downgradient of the suspected source areas. UST fill points and pumps were identified in 2019 on the northeast corner of Harris and Forrester Street which is 150 m from the station excavation area where there is predicted to be 5 m of groundwater drawdown during construction.

[8] Figure showing the location of the SAQP ID references have been included in Appendix 3.

Industrial area – Queen and Phillip Streets (SAQP ID 09,10, 15)

Historical business records indicate that the industrial area to the south of the station where groundwater drawdown is predicted to be >1 m includes a number of current and former businesses where activities may have resulted in groundwater contamination. The businesses include a former service station (47 Phillip Street; SAQP ID 09), a former dry cleaner (51 Phillips Street, SAQP ID 10) and a Waterproofer (43 Queen Street, SAQP ID15). The COPC associated with these sites includes petroleum hydrocarbons, chlorinated hydrocarbons and PFAS.

Groundwater flow direction in the area is suspected to be to the west, toward South Creek, and so there are no existing monitoring wells within or downgradient of the suspected source areas.

St Marys Plaza (SAQP ID 04)

St Marys Plaza on Station Street is directly to the south of the station excavation, and within the area of maximum predicted drawdown. There is limited information on previous site use before the development of the Plaza in 1994 and chemical storage areas and a car wash was observed in the site walkover.

Groundwater flow direction in the area is suspected to be to the west, toward South Creek, and there are no existing monitoring wells within or downgradient of the area.

Former Depot (SAQP ID 07)

A former depot with the potential for a UST is located within the station box. Previous investigations did not provide positive confirmation of the presence of a UST and potential contamination associated with a potential UST has not been completed.

6. Preliminary Conceptual Site Model and Data Gaps

6.1. Preliminary Conceptual Site Model

Based on the findings of previous investigations completed, the following Preliminary Conceptual Site Model (PCSM) was developed for the Site, as presented in Table 9.

Potential **primary sources** of contamination which have been identified within the site include uncontrolled fill material, demolition materials from historical buildings, historical activities with the potential for contamination including bus depots, USTs, rail siding and activities associated with the operation of the railway.

Other potential **primary sources** of contamination which have been identified in proximity to the site include previous commercial / industrial businesses surrounding the area such as a dry cleaner, service stations, depots containing USTs, wreckers, vehicle workshops, and manufacturing / industrial facilities.

Contamination present in soil and other environmental media including groundwater as a result of the primary source are considered as a **secondary sources of contamination**.

Once in soil, contamination has the potential to be distributed through **transportation pathways** such as erosion and deposition (wind and water), volatilisation/vapour ingress, the leaching / migration of contaminants in groundwater and surface water, and construction activities which involve the movement of soil materials during the construction of the project.

Transportation pathways can also be considered as secondary sources of contamination (e.g., contamination in groundwater). During construction within the site, contamination in groundwater has the potential to be drawn into the station box and tunnel which requires management during construction including the management of vapours released from contaminated groundwater (if present).

The station box and tunnels are to be undrained (tanked) which will mitigate groundwater ingress during operation.

Receptors could potentially be exposed to contaminants derived from the disturbance of contaminants present in within soil and groundwater.

Potential receptors considered applicable during construction works at the site include:

- Workers involved with the site construction work;
- General public including persons who could be subject to contaminated media generated during redevelopment (e.g., dust, vapours);
- Ecological receptors including terrestrial flora and fauna; and
- Groundwater and surface water receptors.

Post-completion of the Project the site will be used as rail station. Potential receptors which may be exposed to contaminants post-redevelopment include:

- General public accessing the rail station;
- Workers involved with maintenance of the rail infrastructure;
- Persons who could be subject to contaminated media generated from the site (e.g., vapours); and
- Groundwater and surface water receptors.

Table 9: Preliminary Conceptual Site Model

Potential Contamination Source	Contaminants of Potential Concern and Affected Media	Plausible Exposure Pathways & Transport Mechanisms	Receptors
Uncontrolled Fill Material	TRH, BTEX, heavy metals, PAH, pesticides (OCP/OPP), PCB and asbestos	Inhalation of soil and fibres Ingestion of soil Dermal contact Plant Uptake Infiltration Lateral Groundwater Migration Surface Water Flow	Workers involved with the site construction work and maintenance of the rail infrastructure; General public including persons who could be subject to contaminated media generated during redevelopment, including those accessing the station Ecological receptors including terrestrial flora and fauna Groundwater and surface water receptors.
Demolition materials form Previous Buildings and Structures	Asbestos and lead (lead-based paint)	Inhalation of soil and fibres Ingestion of soil Plant uptake	
Existing commercial / industrial land use on-site and Previous commercial / industrial land use businesses in the surrounding area (Dry cleaners, service stations, depots containing USTs, wreckers, vehicle workshops, and manufacturing / industrial facilities).	TRH, BTEX, heavy metals, PAH, pesticides (OCP/OPP), PCB, chlorinated hydrocarbons, PFAS and asbestos	Inhalation of dust, vapour and fibres Ingestion of soil Dermal contact Plant Uptake Infiltration Lateral Groundwater Migration Surface Water Flow	

Notes:
OCP: organochlorine pesticides
OPP: organophosphate pesticides
Heavy metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.
TRH: Total Recoverable Hydrocarbons.
BTEX: Benzene, Toluene, Ethylbenzene, Xylene.
PAH: Polycyclic Aromatic Hydrocarbons.
PCB: Polychlorinated Biphenyls.

6.2. Data Gaps Identified

Based on the observations made during the site walkover and the information reviewed, the data gaps and uncertainties are considered to comprise:

- Previous investigations have collected soil samples from within the SBT site. Further investigation is required to investigate areas of the site which were not previously investigated and are to be disturbed during construction in both fill and natural materials.

The investigation is required to determine appropriate management requirements during construction and determine whether the excavated material can potentially be re-used on-site or off-site or requires off-site disposal to landfill.

- There is a potential UST associated with SAQP ID 07 (refer to Appendix 3). An investigation is required to establish whether a UST is potentially present which needs to be removed during construction and whether contamination associated with the UST requires management during construction.
- Potential exists for ACM to be present on the site in association with the demolition of historical structures. Further investigation is required to assess the presence and potential risk of ACM in fill at the site.
- Fill material has been observed on the site and potential exists for uncontrolled fill materials of unknown origin / quality to have been historically used at the site. Fill material requires further investigation to establish whether contamination in fill is present.
- There is currently limited groundwater data for the site and surrounding areas where historical activities have been identified with the potential for contamination. Further investigation is required to investigate groundwater quality. Groundwater surrounding the station box has the potential to be drawn into the construction area which requires management including the potential volatilisation of volatile contaminants present in groundwater. Additional groundwater sampling should be collected from monitoring wells installed on the site.

7. Adopted Assessment Criteria

7.1. General

To assess the significance of contaminant concentrations in soil, reference was primarily made to NEPM 2013, specifically ‘Schedule B1 Guideline on Investigation Levels for Soil and Groundwater’ (Schedule B1) for assessment criteria, where available. Schedule B1 provides a framework for the use of investigation and screening levels based on human health and ecological risks. In the absence of relative criteria in NEPM 2013, reference was made to other appropriate state, national or international guideline.

Schedule B1 states that ‘*the selection and use of investigation levels should be considered in the context of the iterative development of a Conceptual Site Model*’. Based on the information and drawings provided, and preliminary CSM presented in Section 6, TTMP has considered that the development of the site will include a number of different receptor groups, including:

- Workers involved with the site construction work and maintenance of the rail infrastructure;
- General public including persons who could be subject to contaminated media generated during redevelopment, including those accessing the station
- Ecological receptors including terrestrial flora and fauna
- Groundwater and surface water receptors.

Given the proposed use of the site, commercial / industrial land use criteria and intrusive maintenance workers was adopted.

7.2. Soil

7.2.1. Health Based Criteria

Soil health investigation levels (HILs) and soil health screening levels (HSLs) for vapour intrusion (where applicable) were adopted from Schedule B1 of NEPM 2013 while Direct Contact criteria for petroleum hydrocarbons was adopted from CRC CARE 2011.

Human health-based guidance values for direct contact were adopted from PFAS NEMP (HEPA, 2020).

7.2.2. Asbestos

For asbestos in soil, a screening level of 0.1g/kg (0.01 % w/w equivalent) was adopted based on the laboratory detection limit for analysis of asbestos in non-homogenous samples using the methodology outlined in Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples (AS4964-2004). Furthermore, where trace analysis was carried out during analysis, an assessment criterion of ‘no respirable fibres’ was adopted; a detection of respirable fibres would indicate an exceedance of the assessment criteria.

7.2.3. Management Limits

In accordance with Section 2.9 of Schedule B1 of the ASC NEPM, consideration of Management Limits for petroleum hydrocarbons was also considered where appropriate. The Management Limits consider the potential for accumulation of explosive vapours, the potential risk to buried infrastructure, or the formation of phase separated hydrocarbons (PSH).

7.2.4. Ecological Criteria

To assess the impact on site vegetation and animals from contamination within the upper 2 m of the subsurface, ASC NEPM Schedule B1 presents ecological investigation levels (EILs) and ecological screening levels (ESLs) for different settings (e.g., areas of ecological significance, urban residential / public open space and commercial).

Section 3.5.1 of Schedule 5a of NEPM states that the aim of the EILs is that varying levels of protection will be provided to the following ecological receptors at all sites:

- ‘Biota supporting ecological processed including microorganisms and soil invertebrates’
- flora and fauna, including transitory and permanent wildlife.

Consideration was given to the commercial / industrial ecological investigation levels (EIL) and Ecological Screening Levels (ESL) where appropriate.

Generic EILs were adopted for lead, arsenic, DDT and naphthalene while site specific EILs for copper, chromium, nickel and zinc were calculated using an average of relevant soil parameters. The derivation of the specific EIL is resented in Appendix 7.

TTMP conducted a review of the background documents used to derive the ecological screening levels (ESLs) for benzo(a)pyrene as prescribed in Schedule B1 of the ASC NEPM 2013. The review identified that the ESLs were heavily based on the 1999 Canadian Soil Quality Guideline (SQG) values (Warne, 2010). Due to the availability of a significant amount of new toxicity data, the

Canadian values were revised in 2010 (CCME, 2010), however these revisions were not considered in the ASC NEPM 2013.

As such, TTMP considers that the low reliability ESLs prescribed in Schedule B1 of the ASC NEPM 2013 are now outdated and as such the Canadian Soil Quality Guidelines for Environmental Health (SQGE) have been adopted (CCME, 2010) for this assessment. The Canadian SQGEs for B(a)P (72 mg/kg) for commercial / industrial land use) has been derived based on a similar methodology to that prescribed in Schedule B5b of the ASC NEPM 2013 (i.e., based on the species sensitivity distribution approach).

The ecological exposure criteria for intensively developed sites was adopted for PFOS from the PFAS NEMP (HEPA, 2020).

The EIL and ESL values are shown on Table 7.3 in Appendix 7.

7.2.5. Aesthetic Considerations

The following characteristics are considered indicative of soil materials that would have the potential to present unacceptable aesthetic impacts:

- Surface soil materials that exhibit heavy staining or emit hydrocarbon odours that are perceptible within 2 m of the soil investigation area;
- Anthropogenic wastes in near-surface soil material onsite; and
- Visible hydrocarbon sheens on groundwater.

7.2.6. Material Classification Criteria

7.2.6.1. NSW EPA Waste Classification Criteria

Concentrations of chemical analytes tested were compared against contaminant threshold (CT) values, specific contaminant concentration (SCC) values and TCLP test values presented in *Waste Classification Guidelines Part 1: Classifying Waste* (NSW EPA, 2014) and *Addendum to the Waste Classification Guidelines (2014) – Part 1: Classifying Waste* (NSW EPA, 2016).

These criteria are considered relevant for waste spoil which is disposed of at landfill in NSW.

Asbestos is pre-classified as Special (Asbestos) Waste under the NSW EPA Waste Classification Guidelines.

7.2.6.2. Virgin Excavated Natural Material (VENM)

The Protection of the Environment Operations Act 1997 defines VENM as:

‘natural material (such as clay, gravel, sand, soil or rock fines):

(a) that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities, and

(b) that does not contain any sulfidic ores or soils or any other waste.

and includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved for the time being pursuant to an EPA Gazettal notice.'

To facilitate assessment of natural soil as VENM, concentrations of metals for natural soil samples were compared with the following ambient background concentrations (ABC), adopted from Schedule B5b of the amended ASC NEPM 2013[9]:

- Zinc: 60 mg/kg
- Arsenic: 18 mg/kg
- Copper: 40 mg/kg
- Lead: 30 mg/kg
- Nickel: 55 mg/kg
- Chromium: 160 mg/kg.

Concentrations of organic compounds and asbestos should be less than the standard limit of reporting (LOR) for natural spoil to be considered VENM.

7.2.7. Off-Site Material Reuse

Consideration was also be made in regard to the classification of natural soil material as VENM and / or the management to natural soil materials under a Resource Recovery Order (RRO).

It is anticipated that separate material classification / resource recovery / exemption reports will be prepared for soil to be re-use or disposed off-site.

7.3. Re-Use within Larger Airport Site and Import Material

Material for potential re-use within the larger Western Sydney Airport Site (FS01) and import material were assessed against the criteria specified in Airport Environmental Protection Regulations 1997 (AEPR) and those for a future commercial / industrial land use, as shown in the result tables in Appendix 7.

7.4. Groundwater

The groundwater data is likely to be compared to appropriate guidelines including, not limited to:

- ANZG (2018) Freshwater Ecosystems guideline for 95% species protection level default guidelines values.
- ANZECC/ ARMCANZ (2000) guideline values for physical and chemical stressors;
- HEPA (2020) PFAS National Environmental Management Plan, Version 2.0, and 99% protection level considering bioaccumulation; and

[9] National Environment Protection Council (2013); *National Environment Protection (Assessment of Site Contamination) Measure, 1999* (the 'ASC NEPM').

- NHMRC (2022) Australian Drinking Water Guidelines 6 2011, Version 3.7 (ADWG)[10].

8. Sampling Methodology

8.1. Overview

The sampling locations (boreholes and groundwater monitoring wells) at the site are shown in Figures 3, 3A, 3B and 3C and 4 in Appendix 1.

The sampling strategy for the site was established with consideration of the guidance provided in the ASC NEPM (NEPC, 2013) and the NSW *Contaminated Sites: Sampling Design Guidelines* (NSW EPA, 1995) (NSW Sampling Guidelines) and in consideration of existing information (Section 5) and data gaps / uncertainties identified (Section 6).

This DSI was undertaken with input from three main work packages which included:

- Geotechnical/Hydrogeological intrusive investigation locations being undertaken by TTMP for CPBG (Geotechnical Program); and
- Contaminated land intrusive locations being undertaken by TTMP for CPBG (Contaminated Land Program).

This section summarises the sampling undertaken by TTMP to support the preparation of this DSI. Further detail is presented within the SAQP (TTC, 2022b).

8.2. Soil

The site construction footprint (not including potential temporary stockpile areas) is shown in Figures 1 to 3 and 3A, 3B and 3C in Appendix 1.

Station Box

The station box has an area of approximately 0.8 ha. For a 0.8ha site the NSW Sampling Guidelines recommend 19 sampling points for the detection of circular hotspot of 24.2 m with 95% confidence based on adopting a systematic sampling grid.

In summary the DSI involved sampling from 23 new locations within or in close proximity the station box using approximate grid based locations.

Excavation area outside the Station Box

The excavation area outside of the station box has an area of approximately 0.9 ha. For a 0.9 ha site the NSW Sampling Guidelines recommend 20 sampling points for the detection of circular hotspot of 25 m with 95% confidence based on adopting a systematic sampling grid.

[10] Groundwater is not being used for potable water supply at St Marys. The ADWG has been adopted as a conservative screening criteria to infer whether there is a potential risk via the vapour inhalation pathway.

In summary the DSI involved sampling from up to 20 new locations within or in close proximity to the excavation area. Outside of the station box the majority of cut material is derived from natural soil materials at the eastern end of the STM site.

St Mary Plaza Potential Fill Area

The St Mary Plaza area which will potentially be used for a fill area for spoil won from the excavation area outside the station box has an area of approximately 1.1 ha. For a 1 ha site the NSW Sampling Guidelines recommend 21 sampling points for the detection of circular hotspot of 25.7 m with 95% confidence based on adopting a systematic sampling grid.

In summary the DSI involved sampling from 14 new locations within this area using a combination of grid based and targeted locations.

Tunnel Spoil

Spoil generated from the construction of the tunnels is to be stockpiled and sampled ex-situ to determine off-site disposal / off-site reuse requirements. Ex-situ sampling and testing of tunnel spoil was described in the SAQP for tunnels and will be reported separately.

The soil sampling locations are shown in Figures 3, 3A, 3B, 3C and 4 in Appendix 1 and are summarised Table 10.

The logs presented in Appendix 6 are currently in draft or field log format and subject to change.

Table 10: Test Locations

Borehole ID	Date Completed	Depth (m bgs)
SBT-GW-1001	4 - 6 May 2022	35.00
SBT-BH-1003	11 – 13 May 2022	27.09
SBT-BH-1004	9 – 11 May 2022	34.00
SBT-BH-1005	18 August 2022	25.00
SBT-BH-1006	18 – 21 July 2022	45.18
SBT-BH-1007	17 – 18 May 2022	45.07
SBT-BH-1009	1 – 3 June 2022	43.05
SBT-BH-1010	7 – 12 July 2022	44.40
SBT-BH-1011	1 August 2022	25.00
SBT-GW-1018	10 June 2022	14.0
SBT-GW-1019	10 June 2022	19.10
SBT-CM-1020	9 June 2022	12.5
SBT-CM-1022	14 July 2022	9.05
SBT-BH-1200	7 – 9 June 2022	25.0
SBT-BH-1201	23 - 27 June 2022	20.0
SBT-BH-1202	10 – 16 June 2022	25.0
SBT-BH-1203	21 – 22 June 2022	25.0
SBT-BH-1204	4 May 2022	4.2
SBT-BH-1205	5 May 2022	9.0
SBT-BH-1206	5 May 2022	6.0

<table>
<tr><th>Borehole ID</th><th>Date Completed</th><th>Depth (m bgs)</th></tr>
<tr><td>SBT-BH-1207</td><td>To be confirmed</td><td>6.0</td></tr>
<tr><td>SBT-BH-1208</td><td>11 May 2022</td><td>4.0</td></tr>
<tr><td>SBT-BH-1209</td><td>5 May 2022</td><td>9.0</td></tr>
<tr><td>SBT-BH-1210</td><td>5 May 2022</td><td>7.0</td></tr>
<tr><td>SBT-BH-1211</td><td>15 July 2022</td><td>6.0</td></tr>
<tr><td>SBT-BH-1212</td><td>15 July 2022</td><td>6.0</td></tr>
<tr><td>SBT-BH-1213</td><td>13 July 2022</td><td>6.0</td></tr>
<tr><td>SBT-BH-1214</td><td>15 July 2022</td><td>6.0</td></tr>
<tr><td>SBT-BH-1215</td><td>7 June 2022</td><td>6.0</td></tr>
<tr><td>SBT-BH-1216</td><td>12 May 2022</td><td>5.0</td></tr>
<tr><td>SBT-BH-1217</td><td>4 May 2022</td><td>6.0</td></tr>
<tr><td>SBT-BH-1218</td><td>4 May 2022</td><td>6.0</td></tr>
<tr><td>SBT-BH-1219</td><td>5 May 2022</td><td>9.0</td></tr>
<tr><td>SBT-BH-1220</td><td>23 May 2022</td><td>1.0</td></tr>
<tr><td>SBT-BH-1221</td><td>23 May 2022</td><td>1.0</td></tr>
<tr><td>SBT-BH-1222</td><td>23 May 2022</td><td>1.0</td></tr>
<tr><td colspan="2">SBT-BH-1224 to SBT-BH-1227</td><td rowspan="2">To be completed following demolition of plaza</td></tr>
<tr><td colspan="2">SBT-BH-1230, SBT-BH-1342</td></tr>
<tr><td>SBT-BH-1232</td><td>15 June 2022</td><td>2.0</td></tr>
<tr><td>SBT-GW-1233</td><td>20 June 2022</td><td>10.0</td></tr>
<tr><td>SBT-GW-1234</td><td>17 June 2022</td><td>10.0</td></tr>
<tr><td>SBT-BH-1342</td><td colspan="2">To be completed when access is permitted</td></tr>
<tr><td>SBT-BH-1345</td><td>12 May 2022</td><td>10.0</td></tr>
<tr><td colspan="2">Total Boreholes</td><td>43</td></tr>
</table>

Sampling Density

The area of the station box was estimated to be approximately 8,100 m^2 in size, assuming an average thickness of fill 1.2 mm equates to approximately 10,000 m^3 of material. To date 48 primary samples have been collected from fill materials within and/or in close proximity to the Station Box which equates to an equivalent sampling density of 1 sample per 210 m^3 of this material within the station box.

Approximately 162,000 m^3 of natural soil or rock requires excavation from the Station Box. To date 210 primary samples have been collected from natural materials within and/or in close proximity to the Station Box which equates to an equivalent sampling density of 1 sample per 210 m^3 of this material within the station box.

Overall, TTMP considers that the number of test locations completed satisfies the SAQP requirements.

8.3. Sampling Methodology

8.3.1. Soil

The sampling methodology undertaken is presented in Table 11.

Table 11: Sampling Methodology

Activity	Detail / Comments
Below Ground Service Clearance and ground penetrating radar (GPR)	Dial-Before-You-Dig (DBYD) service plans and information provided by CPBG for the site and surrounding area was reviewed prior to commencement of intrusive investigation works. Investigation locations were scanned by a suitably qualified and experienced underground services clearance sub-contractor using an electromagnetic detector and ground penetrating radar to check for buried services.
Drilling method	**Intrusive Locations to Target Depth of 1 m and 2 m bgs** Intrusive locations to a target depth of 1 or 2 m bgs were carried out using a Geoprobe drill rig with either a push tube or solid flight auger attachment. **Intrusive Locations Completed in Geotechnical Works Program** The boreholes completed as part of the Geotechnical Work Program were drilled using a drill rig and soil samples were collected from a driven split tube or solid flight auger. **Membrane-Interface and Hydraulic Profiling Tool (MIP)** A MIP survey was completed at eight locations at 1-7 Queen Street St Marys with depths ranging from approximately 4 to 9 m bgs (refer to Appendix 11 for further information).
Sampling Frequency	Samples were collected from near surface 0-0.2 m bgs, and then 0.5 m intervals in fill material, and natural materials at the natural material interface directly underlying fill materials, and then 1 m intervals in natural to the target depth in the Contaminated Land Works program. Soil samples were collected at approximately 1 m intervals in the Geotechnical Works Program unless there was a requirement for geotechnical testing. Discrete soil samples were also collected where there were visual or olfactory signs of potential contamination.
Soil Sampling Containers	Soil samples were placed in clean acid washed glass jars supplied by the laboratory and sealed with a Teflon-lined lid. The laboratory provided 500 g sample bags for soil samples for asbestos analysis in fill materials. Soil samples for PFAS analysis were placed in PFAS specific sample containers provided by the laboratory.
Sample collection	Each soil sample was collected with new nitrile gloves to reduce the potential for cross contamination.
Soil Logging	Soil samples were logged by a suitably qualified and experienced TTMP scientist in accordance with TTMP's relevant Standard Operating Practice (SOP), Field Description of Soils, in Schedule B2 of the ASC NEPM (2013). Where applicable, signs of potential contamination or anthropogenic material recorded on the borehole logs.
Soil Screening	Soil samples were screened in the field for the presence of ionisable volatile organic compounds (VOCs) using a Photoionization Detector (PID) fitted with a 10.6eV lamp. The PID underwent a fresh air calibration at the beginning of each day of sampling. Calibration certificates provided by the equipment supplier are provided in Appendix 8. Headspace screening results were recorded on the logs.

Activity	Detail / Comments
	It is noted that some of the draft logs provided in Appendix 6 are missing some of the PID data. These results will be included in the final logs.
Sample Handling and Transportation	Sample collection, storage and transport was conducted in general accordance with TTMP's SOP. Soil samples were placed into laboratory prepared and supplied glass jars, fitted with Teflon lined seals to limit possible volatile loss. Sample jars were filled to minimise headspace. Separate samples for asbestos analysis were collected and placed in double zip lock bags. The samples were placed into ice chilled coolers and dispatched to NATA accredited laboratories for analysis under chain of custody (COC) control. PFAS sample jars were stored in a separate esky from the glass jars and ziplock bags. Furthermore, the PFAS sample jars and bottles (for rinsate blanks) were separated from ice bricks in the esky with a sampling bag to minimise the risk of teflon contamination for PFAS.
QA/QC Samples	To measure the accuracy and precision of the data generated by the field and laboratory procedures for this assessment, TTMP collected and analysed quality assurance / quality control (QA/QC) samples in accordance with the DQI's set forth in Appendix 9.

Samples were analysed by laboratories holding accreditation to ISO 17025 General requirements for the competence of testing and calibration laboratories and using National Association of Testing Authorities (NATA) accredited methods (Eurofins and Australian Laboratory Services).

Soil samples were analysed for a range of potential COPC as summarised in the Table 12.

Table 12: Soil Laboratory Analysis

Analyte	Fill	Natural
Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc)	Representative samples	Representative samples
Total Recoverable Hydrocarbons (TRH), and benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN)	Representative samples or where visual / olfactory signs of hydrocarbon are present	Representative samples or where visual / olfactory signs of hydrocarbon are present
Polycyclic Aromatic Hydrocarbons (PAH)	Representative samples or where visual / olfactory signs of hydrocarbon are present, or materials containing combustion by-products (e.g., ash, coke, slag) are observed	Where visual / olfactory signs of hydrocarbon are present
Phenolic Compounds	Representative samples or where visual / olfactory signs of hydrocarbon are present	Where visual / olfactory signs of hydrocarbon are present
Organochlorine Pesticides (OCPs) and Organophosphate Pesticides (OPPs)	Representative samples	Natural materials at interface of fill / natural materials
Volatile organic compounds (VOC) including chlorinated hydrocarbons and Semi-Volatile Compounds (SVOC)	Where visual / olfactory signs of hydrocarbon are present, and targeting the former dry cleaner (1-7 Queen Street)	
PFAS Extended Suite	Representative samples	Representative samples

Analyte	Fill	Natural
Polychlorinated Byphenyls (PCBs)	Representative samples	Where visual / olfactory signs of hydrocarbon are present
Asbestos	Representative samples or where ACM or demolition materials (e.g., building rubble) is observed	-
pH	-	Representative samples
Other	Other analyte as required based on site observations.	Other analyte as required based on site observations.

Representative soil samples were also analysed for particle size, pH, and cation exchange capacity (CEC) (mainly natural materials) to enable calculation of NEPM ecological investigation levels (EILs) for commercial / industrial land.

Toxicity Characteristic Leaching Procedure (TCLP) leachability tests were undertaken on selected soil samples for waste classification purposes.

Australian Standard Leaching Procedure (ASLP) tests with a pH neutral buffer were also undertaken on selected soil samples to consider the risk of potential contaminants leaching from rainwater, if retained on-site for reuse.

Selected samples were tested for TCLP or ASLP for PFAS and metals with the aim being to provide leachability data for representative samples.

Representative samples were also tested for Total Organic Carbon (TOC) to facilitate risk assessment

The asbestos sampling outlined in the SAQP (2022b) was not completed. The SAQP stated that bulk 10 L samples would be collected for subsequent screening and analysis where visible ACM was observed. Samples were collected and analysed for asbestos identification in accordance with AS4964.

Bulk samples were not collected in the fill where potential ACM fragments were observed (SBT-GW-1018 and SBT-GW-1019) as these locations are positioned adjacent to the former dry cleaner and this material is not proposed to be excavated as part of the proposed works.

8.3.2. Groundwater

At the time this version of this report was prepared, the installation of monitoring wells and groundwater sampling activities proposed in the SAQP is ongoing. Groundwater monitoring well locations are shown in Figure 4 and Figure 4A in Appendix B.

Table 13 provides a summary of the groundwater installations which have been installed, installed but in a different location to that proposed in the SAQP due to site access constraints, or have been substituted with an existing monitoring well, and/or is to be installed pending resolution of land access and/or other site access constraints such as buried services.

Table 14 summarises the monitoring wells installed in previous investigations which have been sampled for the DSI at the time of writing.

In summary the monitoring wells which have been sampled include the following.

- St Marys
    - SBT-GW-1232
    - SBT-GW-1234
    - SMGW-BH-A302
    - SMGW-BH-A321
    - SMGW-BH-A321-S
    - SMGW-BH-A401
    - SMGW-BH-A402
- 1-7 Queen St St Marys (former dry cleaners)
    - GW01
    - GW02
    - MW1 (EMW1)
    - SBT-BH-1018
    - SBT-BH-1019
    - SBT-CM-1020

Monitoring wells which are to be sampled (pending site access, refer to Table 13) include the following:

- SBT-GW-1002
- SBT-GW-1021
- SBT-GW-1005
- SBT-GW-1015
- SBT-GW-1016
- SBT-GW-1017

The groundwater sampling locations are shown in Figure 4 and 4A in Appendix 1 and are summarised in Table 13 and Table 14. The sampling methodology is summarised in Table 15, and laboratory analytical data is summarised in Table 16.

Table 13: Summary of Groundwater Monitoring Wells Installed for the DSI

Location ID	Rationale	Ground Level (m AHD)	Proposed Well Installation (Screened Interval m AHD)	Well Screen Interval		Comment
				m bgs	m AHD	
SBT-GW-1001	Monitoring well south east of the station box to provide information on water levels and groundwater quality in this area.	49.16	41 to 47	2 to 8	41.16 to 47.16	-
SBT-GW-1002	Monitoring water quality downgradient of former industrial sites and sub station on south of Harris Street within drawdown zone	Note 1	36 to 42	2 to 8	Note 1	The proposed location for SBT-GW-1002 was located west of the sub-station. Permission to install the MW was not granted by the landowner or from the landowner further to the west. The installed location of the MW was the only viable location north east of the station box / train line. Based on the HIR groundwater has been interpreted to be flowing in a west-south-west direction towards South Creek. The existing MW SMGW-BH-A321-S was sampled and is down-gradient of the substation based on this flow direction. SMGW-BH-A320, and SMGW-BH-A321 were also sampled however these are deeper monitoring wells and may not be representative of near shallow groundwater conditions which was to be targeted in SBT-GW-1002.
SBT-GW-1005	Monitoring water quality at the water table to the southeast of the station within the drawdown zone.	Note 1	36 to 42	2 to 8	Note 1	-

Location ID	Rationale	Ground Level (m AHD)	Proposed Well Installation (Screened Interval m AHD)	Well Screen Interval		Comment
				m bgs	m AHD	
SBT-GW-1008	Water quality monitoring downgradient of former industrial sites on south of Harris Street, to north of station and within drawdown zone.	N/A	28 to 34	N/A	N/A	SBT-GW-1008 was not completed. Sampling was undertaken from SMGW-BH-A401 which was completed by GHD in October 2021. SMGW-BH-A401 is located in a similar location to SBT-GW-1008 as was installed at a similar depth (27-33 m AHD, see Table 15).
SBT-GW-1021	Water quality monitoring downgradient of former industrial sites on southern side of Harris Street within predicted drawdown zone	~ 35 (Note 2)	27 to 33	2 to 8	27 to 33 (Note 2)	-
SBT-GW-1022	Monitoring downgradient of Dry Cleaner to inform attenuation for modelling predictions.	~ 34 (Note 2)	22 to 25	2 to 7	27 to 32 (Note 2)	-
SBT-GW-1020	Monitoring downgradient of Dry Cleaner.	~ 35 (Note 2)	24 to 27	1.5 to 7.5	27.5 to 33.5 (Note 2)	-
SBT-GW-1018	Multi-level well to assess lateral/vertical migration of chlorinated hydrocarbon impact.	~ 35 (Note 2)	22 to 25	10 to 13	22 to 25 (Note 2)	The location of SBT-GW-1018 and SBT-GW-1019 was informed by a MIP survey. Eight (8) grid-based MIP locations were used to assess

Location ID	Rationale	Ground Level (m AHD)	Proposed Well Installation (Screened Interval m AHD)	Well Screen Interval		Comment
				m bgs	m AHD	
SBT-GW-1019	Multi-level well to assess lateral/vertical migration of chlorinated hydrocarbon impact.	~ 35 (Note 2)	17 to 20	16 to 19	16 to 19 (Note 2)	for the vertical and lateral presence of volatile compounds in the sub-surface at the rear of the building (refer to Appendix 11). Strong PID and XSD signals, which indicate the presence of chlorinated hydrocarbon impact, were identified in two locations close to the rear wall of the building (MIP05 and MIP06), with signal strength decreasing with distance from the building. The maximum depth of the MIP assessment was 8.8 mbgl before material was too hard for the probe to achieve the specified 'push rate'. Vertical data therefore does not extend to tunnel depth. While MIP signals cannot be used to provide quantitative data, the assessment results provide a strong line of evidence that significant chlorinated hydrocarbon impact is present, and impact is greatest close to the building in the vicinity of existing shallow MW01. The MIP results confirm that additional groundwater monitoring in the area at depth is required to understand if impact is present at tunnel depth, and that collection of soil samples throughout the profile to bedrock is required to assess where impact is likely to be intersected by the TBM.

Location ID	Rationale	Ground Level (m AHD)	Proposed Well Installation (Screened Interval m AHD)	Well Screen Interval		Comment
				m bgs	m AHD	
SBT-GW-1012	Monitoring well between Dry Cleaner and Station to monitor contaminant mobilisation due to Station excavation.	Note 3	29.5 to 34.5	Note 3	Note 3	MWs to be installed. Installation subject to permission from landowner. Potential MW locations further east towards the station box have been considered and are not viable due to site access constraints.
SBT-GW-1013	Monitoring well between Dry Cleaner and Station to monitor contaminant mobilisation due to Station excavation.		29.5 to 34.5			
SBT-GW-1014	Monitoring well between Dry Cleaner and Station to monitor contaminant mobilisation due to Station excavation.		29.5 to 34.5			
SBT-GW-1015	Sentinel well immediately to east of Dry Cleaner to monitor contaminant mobilisation due to Station excavation, and compare to predictions.	Note 3	26 to 32	Note 3	Note 3	Location subject to site access, and service clearance. Location may not be possible to complete due to site access constraints.
SBT-GW-1016	Monitoring to assess changes in water quality downgradient of former drycleaner and service station within predicted station drawdown zone.	Note 3	27 to 32	Note 3	Note 3	Location has moved approximately 30 m to the east due to site access constraints and is to be installed near the corner of Queen St and Philip St. Location is subject to approval from Penrith City Council. Proposed

Location ID	Rationale	Ground Level (m AHD)	Proposed Well Installation (Screened Interval m AHD)	Well Screen Interval		Comment
				m bgs	m AHD	
SBT-GW-1017	Water quality monitoring downgradient of USTs and fill points, and within drawdown area.	Note 3	25 to 31	Note 3	Note 3	Location not permissible in the location proposed in the SAQP. Multiple alternative locations have been considered and it is not possible to locate the MW within the road corridor due to services. A private property on the eastern side of Forrester Road is currently being considered. If this location is not permissible it may not be possible to install this monitoring well. Groundwater sampling has been undertaken from SMGW-BH-A402 located approximately 40 m south of the location proposed for SBT-GW-1017 in the SAQP. The installation depth is similar
SBT-GW-1232	Shallow monitoring wells within in vicinity of a former potential USTs.	39.85	25 to 31	6 to 9	30.85 to 33.85	The presence of a UST could not be identified in an underground survey and the location of the MWs were installed in the locations proposed in the SAQP.
SBT-GW-1233		39.89	25 to 31	6 to 9	30.89 to 33.89	
SBT-GW-1234		40.04	25 to 31	6 to 9	31.04 to 34.04	

Notes:

1) Survey of location is to be completed.

2) Ground elevation based on existing elevation data; ground elevation to be confirmed following completion of survey.

3) Location to be completed and is subject to site access. Site access and/or other constraint may prevent completion of the proposed location.

Table 14: Existing Groundwater Monitoring Wells Sampled for the DSI

Location ID	Installation		Comment
	m bgs	m AHD	
SMGW-BH-A401	3 to 9	27.51 to 33.51	Monitoring well installed in 2021 by GHD for Sydney Metro. Sampling from this monitoring well was completed as a substitute for SBT-GW-1008
SMGW-BH-A402	1.5 to 7.5	27.15 to 33.15	Monitoring well installed in 2021 by GHD for Sydney Metro. Sampling from this monitoring well was completed on the basis that it is in the vicinity of SBT-GW-1017. Site access to install SBT-GW-1017 is pending.
SMGW-BH-A302	14.5 to 20.5	15.2 to 21.2	Sampling from this monitoring well was included in the SAQP.
SMGW-BH-A321	16 to 22	19.66 to 25.66	Sampling from this well was undertaken for the DSI to provide further information at the station box.
SMGW-BH-A321S	3.5 to 9.5	32.15 to 38.15	This monitoring well is potentially down-gradient of the sub-station proposed to be investigated through SBT-GW-1002. Installation of the SBT-GW-1002 at the location proposed in the SAQP could not be completed (refer to Table 13 for further information).
GW01	4.5 to 7.5	27.62 to 30.62	Additional monitoring well sampled at 1-7 Queen St (former dry cleaner).
GW01	5 to 8	27.39 to 30.39	
BH1/MW1	4.3 to 7.3	28.2 to 31.2	
EW1 (EMW1)	No data	No data	

Table 15: Groundwater Installation and Sampling Procedure

Activity	Detail / Comments
Well Installation	The installation of the monitoring wells was completed in general accordance with Coffey's SOPs and with relevant parts of Section 8 and 9 of Schedule B2 in the ASC NEPM (2013). The wells were installed as follows: • Established in a 125 mm diameter boring by a mechanical drill. • 50 mm diameter Class PN18 uPVC casing with a slotted screen interval upward from the base of the well. The depth and length of the screened interval was confirmed in the field based on site observations. • 2 mm poorly graded sand backfill around and 0.5 m above the screened interval. • 500 mm thick layer of hydrated bentonite above the top of the sand backfill / well screen. • Backfilled with bore cuttings or concrete from the top of the bentonite to finish flush with the ground surface. • A gripper / cap was installed on top of the well string to minimise the potential for infiltration of water and other foreign matter into the well. • The monitoring well was finished with a monument or flush-fitted gatic cover. Wells were developed using a dedicated disposable bailer (or pump) to remove excess sediment introduced during drilling and improve connection with the surrounding water bearing zone. Well development was ceased when water was visibly cleared, or physio-chemical parameters had stabilised. The relative elevation of the top of monitoring well casing was recorded using a Real-time Kinetic GPS equipment with a vertical accuracy of +/-10mm. The casing elevations were used to assess groundwater flow conditions and relate standing water level measurements to a relative elevation. Representative samples of materials used in well construction (bentonite, sand, concrete) and uPVC casing (as a rinsate sample) were collected for laboratory analysis. *The results of this analysis will be reported separately*.
Sampling Methods	Where groundwater was present in the monitoring well, a groundwater sample as collected using a Hydrasleeve. Approximately one week following deployment, the hydrasleeve was retrieved for sampling. HDPE sleeves were used in all monitoring wells with the exception of 1-7 Queen St where LDPE sleeves were used. Field parameters (pH, electrical conductivity (EC), redox potential (Eh), dissolved oxygen (DO) and temperature) were recorded for each intake depth. Samples proposed for dissolved metals analysis were filtered in the field using 0.45um disposable filters. Prior to retrieval of the hydrasleeve, the wells were also dipped with a dual-phase interface probe (IP) to assess the standing water level (SWL) and presence / absence of Light Non-aqueous phase liquids (LNAPL). Groundwater samples collected also included QA/QC samples as detailed in Section 8.7 and Appendix 9. Sampling field records include the following: • Unique sample location identifier • Weather conditions • Water colour, turbidity, odour, present of surface layer

Activity	Detail / Comments
	• Other observations as considered relevant for the location Field measurements will include: • Time and date • Gauged depth prior to sampling • Water Quality parameters: pH, ORP, EC, DO and temperature • Depth of water sample

Table 16: Groundwater Laboratory Analysis

Analyte	Groundwater Samples
Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc)	All samples
Total Recoverable Hydrocarbons (TRH), and benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN)	All samples
Polycyclic Aromatic Hydrocarbons (PAH)	All samples
Phenolic Compounds	All samples
Organochlorine Pesticides (OCPs) and Organophosphate Pesticides (OPPs)	All samples
Volatile organic compounds (VOC) and Semi-Volatile Compounds (SVOC)	All samples
PFAS Extended Suite	All samples
Polychlorinated Byphenyls (PCBs)	All samples
Cation and anions	All samples
Nutrients	All samples

8.4. Decontamination procedures

The drill rigs were inspected to confirm that the equipment had been cleaned prior to the commencement of drilling. A rinsate sample was collected from the auger immediately prior to the commencement of drilling.

Where applicable, the following procedures were applied for the decontamination of sampling equipment.

- Re-useable equipment (e.g., auger) was decontaminated prior to the first use each day at each site, and between each sampling location or at an increased frequency to provide a satisfactory level of decontamination suitable to meet the project requirements / site conditions.
- Disposable (single use) equipment such as nitrile gloves were disposed of appropriately following each use. This equipment was not re-used and therefore did not require decontamination.
- Care was taken at all times to handle the cleaned equipment and samples only with clean disposable nitrile gloves. Equipment was stored after decontamination and prior to use, in clean polypropylene bags, to ensure the cleaned equipment did not come into contact with anything that may introduce contamination to the equipment.

- Care was taken to ensure that the decontamination process did not contribute to the spread of contamination of the site, stormwater or off site locations.

The procedure noted below was followed as a minimum when decontaminating reusable equipment used to sample soil, sediment and groundwater at the site.

- For equipment used to sample solids, all adhered materials (such as soil, vegetation) were removed from the sampling equipment by gloved hand, paper towel or scrubbing brush.
- The equipment was washed in a bucket of potable water with Liquinox detergent.
- The equipment was rinsed thoroughly in a second bucket containing deionised water.
- The equipment was spray rinsed with potable water.
- The decontaminated equipment was dried with disposable paper towels or air dried on a surface that would not result in re-contamination of the equipment.
- Where equipment was being temporarily stored between sample locations (i.e., where another round of decontamination washing is not being undertaken) the equipment was stored in clean polypropylene bags, to prevent re-contamination prior to its next use.

8.5. Management of excavated materials

Excavated soil from boreholes less than 6 m and test pits were backfilled in order of excavation, where practicable. Excavated soil from boreholes greater than 6 m was retained on-site and drums for off-site disposal and / or on-site reuse pending the results from analytical testing.

Liquid materials captured during non-destructive drilling, drilling, and groundwater well development and sampling were retained on-site in bulk containers for off-site disposal and / or on-site reuse pending the results from analytical testing.

8.6. Drilling Additives

Drilling additives (e.g., muds and lubricants) proposed to be used by drillers were reviewed to confirm that the additives used were unlikely to result in false positives. Representative samples of drilling additives used was undertaken and analysed for the potential contaminants tested in this DSI. The results of this testing will be included in a separate QA/QC report to be prepared for the Project Site.

8.7. Data Quality Assessment

A standalone data quality assessment is presented in Appendix 9. This assessment concluded that the field and laboratory data collected from this investigation is of suitable quality to assess potential contamination risks from this site.

9. Investigation Results

9.1. Ground Conditions

Ground investigations encountered comprised a thin layer of fill overlying residual soils and Bringelly Shale bedrock.

Fill materials, including topsoil, were typically to depths of between 0.2 m and 1.5 m. Deeper fill was encountered in SBT-BH-1200 to a depth of 2.5 m.

Fill material encountered to a depth of 0.1 m in SBT-BH-1215 included brick fragments which can be attributed to the hardstand at the surface which was comprised of brick pavers. With the exception of the brick fragments, no other indications of potential contamination were noted in this borehole.

Fill material encountered in SBT-GW-1018 and SBT-GW-1019 to depths of between 0.3 m and 0.9 m included brick, terracotta a tiles and potential ACM. It is noted that locations SBT-GW-1018 and SBT-GW-1019 were positioned adjacent to the former dry cleaner and this material will not be excavated as part of the proposed works. For this reason, confirmatory analysis of potential ACM was not completed. Elevated PID readings and hydrocarbon odours were not observed during drilling of SBT-GW-1018 and SBT-GW-1019.

Asphalt was encountered in SBT-CM-1022 and SBT-BH-1220 to SBT-BH-1222 to depths of between 0.05 m and 0.2 m, and in SBT-BH-1232 to a depth of 0.45 m.

Concrete was encountered in SBT-BH-1007, SBT-BH-1200 and SBT-BH-1202 to depths of between 0.1 m to 0.25 m.

Groundwater was encountered in SBT-GW-1019 at a depth of 0.7 m during drilling, which is consistent with the gauged groundwater level of 0.65 m bgs in existing adjacent monitoring well MW01.

Residual soils encountered beneath the fill were described as silty clay with sandy clay from 6.5m depth, and increasing sand from 14m to 16m. Below 16m a three metre thick band of siltstone interbedded with clay was encountered, with bedrock (assumed siltstone) from 19 m bgs.

The Bringelly Shale Formation within the site was described as a distinctly bedded, inter-laminated siltstone and sandstone. Based on the cross-section presented in Appendix 2, and the Bringelly Shale Formation was encountered at approximate elevations of 42m AHD in the east of the site (Chainage 17,300m) reducing to approximately 23m AHD in the west of the site (Chainage 17,900m).

MIP Survey at 1-7 Queens Street

A report on the MIP survey is included in Appendix 11. Key findings of the MIP survey include:

- the survey suggested the presence of chlorinated hydrocarbons and the highest readings were reported closest to the building. The highest reading was reported at MIP-06 at 0.95 m bgs.
- the survey did not identify signs of NAPL within the strata investigated (to approximately 9 m bgs).
- the electrical conductivity (EC) measurements as part of the hydraulic profiling tool indicated the presence of clay. Silty and sandy clays were observed on the site during the drilling of SBT-GW-1018 and SBT-GW-1019.

9.2. Groundwater

As noted in Section 8.3.2 at the time of writing the installation and sampling from the groundwater which were proposed to be installed in the SAQP is ongoing. Groundwater monitoring well locations are shown in Figure 4 and Figure 4A in Appendix B.

Groundwater sampling field sheets are presented in Appendix 6, and field parameters are summarised in Table 15.

At the time of writing groundwater sampling was completed between 26 July and 4 August 2022.

Groundwater levels reported ranged between approximately 31 m AHD and 34 m AHD. Groundwater levels and flow direction at St Marys have been interpreted in the HIR as flowing in a west-south-west direction towards South Creek. Figure 5, Appendix 1 shows the groundwater flow direction presented in the HIR. Groundwater level data is currently being collected at St Marys from vibrating wire piezometers (VWPs) and will inform future updates of the HIR.

Groundwater field parameters were recorded as follows:

- Dissolved oxygen: 0.70 mg/L and 4.99 mg/L;
- Electrical conductivity: 580 µS/cm and 25,086 µS/cm;
- pH: 4.83 pH units and 8.29 pH units;
- Redox potential: -168.9 and 198.8 (Ag/AgCL 3.5M); and
- Temperature : 13.4°C and 21°C.

Electrical conductivity ranged from fresh to brackish/saline water. Variations in conductivity are potentially attributed to freshwater recharge (i.e. in response to rain) and/or leakage from water pipes.

Groundwater samples collected from GW01, SBT-GW-1232, SMGW-BH-A302 and A321S had a mild sulfur odour. Hydrocarbon odours were observed in BH1/MW1 and SBT-GW-1018 however LNAPL was not reported in the monitoring wells. This is consistent with the finding of the MIP survey.

Table 17: Groundwater Field Parameters

Area	Well ID	Water Level (mBTOC)	Water Level (m AHD)	Toal Depth (mBTOC)	Screen (m bgs)	Sample depth (mBTOC)	Date Measured	Dissolved Oxygen (mg/L)	Electrical Conductivity (µS/cm)[1]	pH	Redox Potential (Ag/AgCL 3.5M)	Temperature (°C)	Comments
1-7 Queen St, St Marys	SBT-CM-1020	1.358	~ 34 (Note 1)	8.153	1.5 to 7.5	3.0	26/07/2022	2.55	4,710	6.89	167.0	19.1	Slightly cloudy pale brown, no odour
						5.0	26/07/2022	2.84	4,766	6.50	127.5	17.0	Slightly cloudy pale brown, no odour
						7.0	26/07/2022	1.07	6,184	6.45	89.0	16.7	Slightly cloudy pale brown, no odour
	SBT-GW-1018	4.033	~ 31 (Note 1)	18.430	10 to 13	15.4	26/07/2022	0.38	2,577	7.17	-168.9	19.1	Slightly cloudy dark grey, moderate hydrocarbon and sulphur odour
						17.4	26/07/2022	0.52	17,289	6.53	-117.4	18.7	Slightly cloudy dark grey, moderate hydrocarbon and sulphur odour
	SBT-GW-1019	2.364	~ 33 (Note 1)	14.532	16 to 19	11.5	26/07/2022	1.65	22,678	6.47	86.3	18.5	Slightly cloudy pale brown, no odour
						13.0	26/07/2022	1.15	23,559	6.25	69.4	18.7	Slightly cloudy pale brown, no odour
	EW1 (EMW1)	1.744	~ 33 (Note 1)	8.014	no data	3.0	26/07/2022	4.99	1,384	7.73	28.4	17.7	Slightly cloudy pale brown, no odour
						5.0	26/07/2022	3.66	3,910	6.72	65.4	17.9	Slightly cloudy pale brown, no odour
						7.0	26/07/2022	1.22	12,572	5.53	201.4	18.2	Slightly cloudy pale brown, no odour
	BH1/MW1	0.357	~ 35.1	7.268	4.3 to 7.3	2.0	26/07/2022	0.55	1,567	6.96	-103.4	16.5	Slightly cloudy pale brown, mild hydrocarbon odour
						4.0	26/07/2022	1.21	1,019	7.24	-62.4	17.3	Slightly cloudy pale brown, mild hydrocarbon odour
						6.0	26/07/2022	0.67	1,042	7.14	-45.6	17.8	Slightly cloudy pale brown, mild hydrocarbon odour
	GW01	1.467	~ 33.7	7.493	4.5 to 7.5	5.3	29/07/2022	3.15	1,800	5.20	89.7	13.7	Clear, mild sulphur odour
						6.5	29/07/2022	1.86	2,303	4.83	164.6	13.9	Clear, mild sulphur odour
	GW02	2.155	~ 33.2	7.316	5 to 8	5.3	29/07/2022	2.71	6,029	5.22	146.7	16.1	Clear, no odour
						6.5	29/07/2022	1.71	6,178	5.40	141.0	15.8	Clear, no odour
St Marys	SBT-GW-1232	8.445	~ 31.4	10.028	6 to 9	8.5	4/08/202	3.44	19,008	6.11	133.5	19.2	Cloudy pale brown, mild sulphur odour
	SBT-GW-1233	N/A	N/A	N/A	6 to 9	N/A	26/07/2022	N/A	N/A	N/A	N/A	N/A	Insufficient water for sampling
	SBT-GW-1234	7.741	~ 32.3	9.726	6 to 9	8.5	26/07/2022	3.21	33,081	5.69	40.8	21.0	Slightly cloudy pale grey, no odour
	SMGW-BH-A302	3.207	~ 32.5	21.003	14.5 to 20.5	9.0	1/08/2022	2.63	15,521	6.86	-102.5	18.1	Clear, mild sulphur odour
	SMGW-BH-A321	8.420	~ 33.2	10.372*	16 to 22	9.0	1/08/2022	2.81	580	7.63	-24.0	17.9	Clear, no odour
	SMGW-BH-A321S	7.886	~ 33.8	10.442*	3.5 to 9.5	9.0	1/08/2022	0.70	16,073	6.23	-150.5	18.8	Clear, mild sulphur odour
	SMGW-BH-A401	3.834	~ 32.7	8.933	3 to 9	4.0	27/07/2022	2.75	24,670	4.84	198.8	16.8	Cloudy pale brown, no odour
						6.0	27/07/2022	2.07	25,086	6.60	148.5	17.7	Cloudy pale brown, no odour
	SMGW-BH-A402	0.385	~ 34.3	7.953	1.5 to 7.5	2.5	1/08/2022	1.76	1,012	8.08	-92.4	13.4	Slightly cloudy pale brown, no odour
						6.0	1/08/2022	0.91	716	8.29	-133.7	14.9	Slightly cloudy pale brown, no odour

Notes:
1) Elevation of monitoring well casing has yet to be surveyed. Water levels in m AHD estimated from ground elevation.
2) survey data for the majority of monitoring wells has been measured from ground level. A survey is to be undertaken to measure the top of casing from monitoring wells installed in the DSI, and well as monitoring wells installed in previous investigations for the Groundwater Monitoring Plan (GMP).

9.3. Discussion of Analytical Results

9.3.1. General

The following tables provided in Appendix 7 present a comparison of the analytical results and the adopted assessment criteria:

- Soil:
  - Table 7.1 – Comparison against health investigation levels;
  - Table 7.2 – Comparison against Airport Regulations;
  - Table 7.3 – Comparison against ecological investigation and screening levels;
  - Table 7.4 – Comparison against waste classification criteria.
- Groundwater:
  - Table 7.5 – Groundwater Analytical Results

The laboratory analytical certificates and associated chain of custody records are presented in Appendix 10.

The following sections present a discussion of analytical results and their relevance to the investigation objectives.

9.3.2. Soil

9.3.2.1. Human Health

Analysis of soil samples collected from this investigation did not report concentrations of COPC above the adopted health assessment criteria.

Suspected ACM was noted in samples of fill collected from SBT-GW-1018 and SBT-GW-1019, which requires further consideration within the CSM.

It is noted that samples collected from soil boreholes SBT-GW-1018 and SBT-GW-1019 that were drilled directly adjacent to the former dry cleaning facility detected Tetrachloroethene (PCE) and Trichloroethene (TCE) in samples from near surface to 2.0-2.1mbgs. Soil and rock samples from deeper depths are to be collected in a subsequent borehole to be completed (refer to Section 9.3.4). Concentrations of PCE ranged from 1.1mg/kg at surface to 333mg/kg at 2.0-2.1mbgs. Concentrations of TCE ranged from <0.5mg/kg at surface to 1.8mg/kg at 2.0-2.1mbgs. Other chlorinated hydrocarbons including degradation biproducts of PCE including cis-1,2-dichloroethene (DCE) and Vinyl Chloride (VC) were not detected at concentrations above the LOR at these locations. Samples collected from depths below 2.1mbgs were not collected for analysis from these boreholes, indicating the base depth of this impact was not delineated. Analysis of soil leachate sample from BH SBT-GW-1019 at 1.0-1.1mbgs reported a PCE concentration of 145ug/L.

Data from previous investigations reported concentrations of PCE in BH1/MW01 installed in this area ranged from 37mg/kg at 0.5mbgs to 120mg/kg at 3mbgs. Other chlorinated hydrocarbons were reported below the LOR during the previous investigation.

There is no generic health investigation level that allows for the direct comparison of PCE and TCE concentrations measured in soil within the Schedule B1 of the ASC NEPM (NEPC, 2013). It is noted that the highest concentrations of PCE detected in soil at this location exceeds the USEPA Regional Screening Level (RSL) of 100mg/kg for Industrial Soil. The reported maximum concentration of TCE did not exceed the RSL of 6mg/kg for Industrial Soil. On this basis, it is assessed that TCE in soil requires further consideration in the CSM.

9.3.2.2. Ecological Receptors

Analysis of soil samples collected from this investigation reported concentrations of COPC below the adopted ecological assessment criteria with the exception of zinc in SBT-GW-1019 / 0.1-0.2, The zinc concentration was reported at 1,200 mg/kg and its duplicate sample reported at 1,800 mg/kg. Both samples exceeded the EIL of 1,100 mg/kg.

SBT-GW-1019 was drilled directly adjacent to the former dry cleaning facility. Given that this soil will remain undisturbed, and likely paved at this location which will restrict terrestrial ecology interacting with this soil. As such, this exceedance does not require further consideration within the CSM.

9.3.2.3. Management Limits

Analysis of soil samples collected from this investigation did not report concentrations of TRH above the adopted Management Limits. As such, it is considered that TRH reported in soil presents a low risk to buried services and is highly unlikely to result in the formation of observable NAPL or pose fire / explosive hazards.

9.3.2.4. Aesthetic Issues

The investigation did not encounter soil conditions that are considered to pose aesthetic issues in the context of the proposed use of the site for construction or future rail infrastructure setting.

9.3.2.5. Preliminary Waste Classification & Beneficial Reuse

The results from the investigation indicate the fill soils would be preliminarily classified as General Solid Waste (non-putrescible), with the exception of fill collected from SBT-GW-1018 and SBT-GW-1019, where potential ACM was noted. These samples were not analysed for asbestos as these soils are not expected to be excavated as part of the development works.

The investigation indicates that natural residual soil and Bringelly Shale would provisionally classify as VENM with the exception of natural materials which contain a contaminant of anthropogenic origin which would preclude classification of the material as VENM.

Organics (TPH/TRH, xylene, phenanthrene and naphthalene) which have been reported in the Bringelly Shale within the Station Box have been inferred to be naturally occurring based on information presented in TTMP (2022) *Aerotropolis Detailed Site Investigation, 13 September 2022* and the following lines of evidence:

- confirmed anthropogenic sources of contamination which have resulted in gross contamination within the Station Box have not been identified
- hydrocarbon contamination in groundwater which would result in contamination of the Bringelly Shale within the Station Box has not been identified in the DSI
- drilling additives are considered to be an unlikely cause of the false positives (particularly BTEX and PAHs) (drilling additives used in the DSI investigation are discussed in the Aerotropolis DSI report).

- the Bringelly Shale contains organic matter which can transform into hydrocarbons. Naturally occurring hydrocarbons including PAHs have been identified in similar shale deposits in Sydney (Ashfield Shale)
- review of chromatograms from St Marys have similar compounds to those reported at Aerotropolis including: methyl butane, pentane, hexane, heptane, octane, methyl pentane, methyl hexane/heptane, cyclohexane, methylcyclohexane, dimethyl cyclohexane, trimethyl benzene, ethyl methyl benzene and cyclopentane.
- the low concentrations of hydrocarbons reported in this investigation including BTEX and PAHs can form in shale.

The mean concentrations of Arsenic, Copper, Total Chromium, Lead, Nickel and Zinc in natural soil materials were below the generic background concentrations in the NEPM.

Where natural soil and the Bringelly Shale cannot be considered as VENM alternative management strategies will be considered including management under a Resource Recovery Order (RRO), and/or classification of the material as ENM (note classification of material as ENM would be subject to further assessment to comply with the Excavated Natural Material Order 2014.

The investigation results suggest the fill and natural soils sampled would be suitable for reuse at the FS01 site, although furthermore detailed checks would need to be undertaken to confirm such material does not contain asbestos. All results were within the AEPR and those for a future commercial / industrial land use, as shown in Tables 7.1 and 7.2 in Appendix 7.

It is noted that the above comments are preliminary and require confirmation as detailed in Section 11.

9.3.3. Groundwater

Tabulated groundwater monitoring results for the groundwater samples which have been collected at the time of writing are provided in Appendix 7.

At the completion of the groundwater monitoring program, a Groundwater Assessment Report will be prepared which is an Addendum to this DSI report to inform management and mitigation measures required to address contamination that poses unacceptable risks.

The following provides a summary of the groundwater monitoring results for the monitoring wells that have been installed and sampled to date.

9.3.3.1. Metals

Dissolved phase metals including arsenic, cadmium, chromium, copper, nickel, mercury and zinc were generally within the background ranges reported in groundwater monitoring from previous sampling events with the exception of arsenic, nickel and zinc from monitoring wells located at located at 1-7 Queen St, St Marys.

Gross areas of elevated concentrations of metals of concern in soil have not been identified from the DSI and previous investigations. Metals in groundwater are likely to be attributed to a combination of natural and urban/industrial sources in the area.

9.3.3.2. Hydrocarbons

1-7 Queen Street (former dry cleaner)

Elevated concentrations of hydrocarbons in the F1 (C6-10) fractions were reported in groundwater samples collected from 1-7 Queen St (former dry cleaners). The hydrocarbons reported are predominately made up of the chlorinated hydrocarbon PCE and to a lesser extent DCE, vinyl chloride, and TCE[11]. The maximum concentration of PCE reported was 24.5 mg/l from SBT-BH-1018. The maximum concentration of vinyl chloride reported was 0.32 mg/l from BH1/MW1.

The maximum concentrations of chlorinated hydrocarbons reported are higher than those reported in previous investigations and is the result of the installation and sampling of deeper groundwater monitoring wells within the site, and the location of monitoring wells

Phenolic compounds were also detected in SBT-BH-1019.

The implication of the results for 1-7 Queen St are discussed further in Section 11.6.2.

AEC2 Former Fuel storage within Sydney Trains Emergency Response Depot

Hydrocarbons in the F2 (C10-C16) and/or F3 (C16-C34) fractions were reported in groundwater samples from SBT-GW-1232, SBT-GW-1234, and SMGW-BH-A321. A low concentration of toluene was also reported in SBT-GW-1232.

SBT-GW-1232 and SBT-GW-1234 are located in the vicinity of a potential former UST. From a review of the chromatograms the laboratory has advised that source of SBT-GW-1234 is potentially weathered diesel and heavy oil, and SBT-GW-1232 is carbocyclic acid. Carbocyclic acid can be naturally occurring or anthropogenic in origin.

Hydrocarbon odours were not observed during the sampling of these monitoring wells. An additional sampling event is recommended for these wells and SMGW-BH-A321 including the analysis of TRH with silica gel cleanup and GCFID[12] finger print analysis to check for the potential for false positives and/or assist with the identification of the source of hydrocarbons. The finding may indicate a potential source of hydrocarbons in groundwater (and potentially soil) which requires management during construction.

SMGW-BH-A321 is located east of SBT-GW-1232 and SBT-GW-1234. Hydrocarbons were reported in SMGW-BH-A321 and were non-detect in SMGW-BH-A321s and SMGW-BH-A302. These finding in combination with SBT-GW-1234 indicate the potential for a minor source of hydrocarbons within the STM site.

SMGW-BH-A401 and SMGW-BH-A402

Hydrocarbons were not detected in groundwater samples collected north of the STM site at SMGW-BH-A401 and SMGW-BH-A402.

9.3.3.3. BTEX, PAH, Phenols, OCP/OPPs, PCBs

With the exception of SBT-GW-1232, BTEX were not detected in the groundwater samples analysed.

PAH, OCP/OPPs were not detected in the groundwater samples analysed.

With the exception of SBT-BH-1019, Phenolic compounds were not detected in the groundwater samples analysed.

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[11] TCE, DCE and vinyl chloride are breakdown products of PCE.
[12] Gas Chromatography With Flame Ionization Detection

PCBs were not detected in the groundwater samples tested and in groundwater samples from previous investigations.

9.3.3.4. PFAS

Positive detection of PFAS were reported in the majority of samples collected. Higher concentrations of PFAS were reported in monitoring wells from the former dry cleaners 1-7 Queen St. The highest concentration of PFOS reported from groundwater monitoring wells was 1.07 µg/l which exceeded the Freshwater Guidelines with 95% species protection[13]. Dry cleaners are known potential sources of PFAS. Groundwater samples also exceeded drinking water guidelines in the PFAS NEMP for PFHxS + PFOS.

The maximum concentration of PFOS reported at St Marys was 0.0076 µg/l. PFAS in groundwater exceeded the PFAS NEMP Freshwater Guidelines with 99% species protection. The maximum concentration of PFAS reported at St Marys in previous investigations was 0.019 µg/l.

PFOA was detected in groundwater samples however the concentrations were below the adopted guidelines.

A broad range of other PFAS analytes were detected including:

- Perfluorobutane sulfonic acid (PFBS)
- Perfluoropentane sulfonic acid (PFPeS)
- Perfluorohexane sulfonic acid (PFHxS)
- Perfluoroheptane sulfonic acid (PFHpS)
- Perfluorobutanoic acid (PFBA)
- Perfluoropentanoic acid (PFPeA)
- Perfluorohexanoic acid (PFHxA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorooctanoic acid (PFOA)
- Perfluorononanoic acid (PFNA)
- Perfluorodecanoic acid (PFDA)
- Perfluorooctane sulfonamide (PFOSA)
- 6:2 Fluorotelomer sulfonic acid (6:2 FTS)

9.3.3.5. Nutrients

Elevated concentrations of nitrate and ammonia which exceed the ANZG 95% freshwater quality guidelines were reported at 1-7 Queen St. Maximum concentrations reported were ammonia 42.5 mg/l and nitrate 4.5 mg/l. Ammonia could derived biological process and leakage from a sewer.

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[13] LDPE hydrasleeves were used in the monitoring wells at 1-7 Queen St and HDPE sleeves were used in all other monitoring wells. LDPE hydrasleeves have the potential to absorb PFAS however it is considered unlikely that the deployment of these hydasleeves would have changed findings which have reported elevated concentrations of PFAS at this site. HDPE hydraleelves will be deployed in future sampling events.

Ammonia may have also been used historically at the dry cleaners but is considered unlikely to be the cause of ammonia reported in groundwater.

Ammonia marginally exceeded the ANZG 95% in monitoring wells sampled at St Marys. The range of concentrations reported at St Marys are generally consistent with previous investigations.

10. Conceptual Site Model

10.1. Contamination Sources

The investigations completed within the site has not identified significant or widespread contamination across the site. However, the following sources of contamination were identified that requires further consideration:

- Suspected ACM observed in fill material encountered at sampling locations SBT-GW-1018 and SBT-GW-1019.
- Former dry-cleaning activities at 1-7 Queen Street. Concentrations of PCE recorded in soil encountered at sampling location SBT-GW-1019 and BH1/MW01. As noted in Section 5.3, previous investigations have identified PCE in groundwater at concentrations significantly exceeding ecological and human health screening criteria. PCE and its degradation biproducts were also recorded in soil vapour samples exceeding human health screening criteria. Recent groundwater monitoring confirmed the presence of chlorinated hydrocarbons in groundwater in the area of the former dry cleaners. Elevated concentrations of ammonia and PFAS have also been reported at this location.
- PFAS compounds detected in all groundwater samples above the NHMRC (2022) Australian Drinking Water Guideline / HEPA (2020) PFAS NEMP for drinking water. Further investigation is considered warranted.
- Potential source of hydrocarbons near SBT-GW-1232, SBT-GW-1234, and SMGW-BH-A321 which is to be further investigated through supplementary groundwater sampling and analysis (refer to Section 11.6.2).

10.2. Receptors

The following sources were considered relevant to the sources of contamination identified:

- Workers involved with the site construction work and maintenance of the rail infrastructure;
- General public including persons who could be subject to contaminated media generated during redevelopment, including those accessing the station;
- Ecological receptors including terrestrial flora and fauna; and
- Groundwater and surface water receptors.

10.3. Exposure Scenario & Risk Evaluation Discussion

10.3.1. Suspected Asbestos Impacts in Fill

Fibre cement debris, suspected of containing ACM, was observed in fill material encountered in sampling locations SBT-GW-1018 and SBT-GW-1019. This debris is assessed to relate either to the fill present within this area of the site and/or hazardous building materials within nearby structures.

As the material was observed from a borehole, limited information was collected to describe the condition of the debris. As boreholes are less conducive to identifying ACM in soil, there remains some uncertainty regarding the extent of potential asbestos impacts. However, as the fill currently remains beneath ground surface materials which will limit the potential for exposure. Further, given that the Project does not propose to disturb fill materials in this area, the risks associated with ACM in fill at this location is assessed to be low.

10.3.2. Chlorinated Hydrocarbons in Soil & Groundwater

Investigation data, including recent groundwater monitoring, recorded the presence of chlorinated hydrocarbons in soil, soil vapour and groundwater in an area relating to the former dry cleaning facility at 1-7 Queen Street. Elevated concentrations of PFAS and ammonia have also been reported at the 1-7 Queen Street.

It is assessed that chlorinated hydrocarbons in soil have the potential to pose health risks to occupants of existing structures on 1-7 Queen Street via the vapour ingress/indoor inhalation pathway. Such vapours would sufficiently attenuate within an outdoor environment, and hence would not pose unacceptable health risks to the general public accessing the station infrastructure to the east.

Available data indicates that chlorinated hydrocarbons have infiltrated the ground surface with the highest concentrations recorded in the deepest samples collected from SBT-GW-1018, SBT-GW-1019 and BH1/MW01. Available data in this area has reported significant impacts in groundwater. The lateral migration of impacted groundwater has the potential to result in an extensive plume although some attenuation would occur limiting it’s potential to impact aquatic receptors within South Creek, some 800m west.

This area is located approximately 120m west of the station box and within the drawdown zone influenced by construction dewatering. Impacted groundwater has the potential to be drawn into the station box during construction. This area is also located directly above the proposed tunnel alignment. Vertical migration of impacted groundwater and DNAPL has the potential to enter the tunnel dive immediately west of the station box. Both contaminant transport mechanisms have the potential to introduce impacted water within an enclosed environment, potentially posing health risks to subsurface construction workers via the vapour inhalation pathway.

10.3.3. PFAS Compounds in Groundwater

Groundwater monitoring indicated PFAS at levels above the NHMRC (2022) Australian Drinking Water Guideline / HEPA (2020) PFAS NEMP for drinking water in all groundwater samples. Elevated concentration of PFAS have also been reported at 1-7 Queen Street.

As in the case of the chlorinated hydrocarbons in groundwater, the PFAS in groundwater has the potential impact aquatic receptors within South Creek, some 800m west. The impacted groundwater is also within the within the drawdown zone influenced by construction dewatering. This also has the potential to preferentially draw impacted groundwater into drained construction excavations as discussed in Section 11.6.2.

10.3.4. Nutrients in Groundwater

Elevated concentrations of nutrients including ammonia have been reported at 1-7 Queen St in groundwater which exceed ANZG 2018 guidelines.

In high enough concentrations ammonia can be toxic to aquatic organisms and an irritant to humans. Based on the proximity of this site to South Creek (approximately 800 m away) it is considered unlikely that the ammonia present would pose an unacceptable risk to aquatic receports.

During construction ammonia in groundwater has the potential to migrate to the station box and trigger the requirement for management during dewatering. This is discussed further in Section 11.6.2

11. Conclusions and Recommendations

TTMP conclude that the site can be made suitable as per the requirements of *State Environmental Planning Policy (Hazards and Resilience) 2021*. The investigation has identified areas within the site that are affected by contamination that warrant further assessment to determine the need for and scope of remediation. This contamination is summarised in the following sections.

11.1. Chlorinated Hydrocarbons at 1-7 Queens St

Given the results of this DSI, it is considered that there is a potentially complete exposure pathways in relation to chlorinated hydrocarbons in soil and in groundwater. The recent investigation results also confirm the presence of chlorinated hydrocarbons in soil and groundwater in the area related to the former dry cleaning facility at 1-7 Queen Street. Elevated concentrations of PFAS and ammonia have also been reported at this site.

The levels of chlorinated hydrocarbons (PCE, TCE and VC) detected in the groundwater in the area of the former dry cleaner exceed the respective Australian Drinking Water Guideline.

It is considered that a site-specific risk assessment is required to assess:

- Potential risks to workers during the proposed construction works; and
- Effect of construction dewatering on contaminant fate and transport/migration.
- Potential implications for the design and operational / maintenance phases of the SBT Project.

The results of the site-specific risk assessment would then be used to inform the need for a Remedial Action Plan (RAP) to mitigate the potentially unacceptable risks identified.

Given the known contamination status of the groundwater quality within the Project corridor and the proposed dewatering, CBPG should give consideration on whether these conditions trigger the need to notify the NSW EPA, under the Duty to Report requirements set out under section 60 of the Contaminated land Management Act 1997.

Pre-construction groundwater contamination from 1-7 Queen Street would be migrating in a westerly direction to South Creek. Assessment of the risk from groundwater contamination from this site to non-Project related receptors is outside the scope of the DSI.

During construction and dewatering groundwater will migrate from 1-7 Queen Street towards the station box.

Potential also exists for contamination in materials to be intersected by the TBM at and in the vicinity of 1-7 Queen St.

11.2. Suspected Asbestos Impacts in Fill at 1-7 Queens St

Suspected ACM was observed in fill material encountered in sampling locations SBT-GW-1018 and SBT-GW-1019. The fill currently remains beneath ground surface materials which will limit the potential for exposure. Given that the Project does not propose to disturb fill materials in this area, the risks associated with ACM in fill at this location is assessed to be low. These risks would change where the Project proposes to disturb fill in this part of this site.

11.3. Groundwater contamination at other potential source areas

At the time of writing the installation and sampling from the groundwater which were proposed to be installed in the SAQP is ongoing. Groundwater sampling has confirmed the presence of PFAS in groundwater at the St Marys site.

Hydrocarbons have been reported in two monitoring wells located at AEC2 Former Fuel storage within Sydney Trains Emergency Response Depot. From a review of the chromatograms the laboratory has advised that source of SBT-GW-1234 is potentially weathered diesel and heavy oil, and SBT-GW-1232 is carbocyclic acid. Carbocyclic acid can be naturally occurring or anthropogenic in origin.

Hydrocarbon odours were not observed during the sampling of these monitoring wells. Additional sampling is recommended including the use of TRH with silica gel cleanup and GCFID finger print analysis is check for the potential for false positives and/or assist with the identification of the source of hydrocarbons. The finding may indicate a potential source of hydrocarbons in groundwater (and potentially soil) which requires management during construction.

11.4. Soil and rock material within STM disturbance footprint and station box

Based on review of the field observations, logs, and soil analytical results, TTMP considers that the soil within the STM site poses a low risk of contamination given that no widespread gross[14] contamination was identified in soils within the STM site. Within the STM site soil/rock materials investigated in the DSI and previous investigations, samples collected did not report concentrations of contaminants of potential concern above the adopted health assessment criteria for commercial/industrial use.

Potential exists for minor areas of contamination in association with hydrocarbons, and contamination has been identified within fill materials. Potential also exists for minor contamination to be present in soil/rock material beneath the groundwater table based on the presence of contaminants in groundwater (mainly hydrocarbons and PFAS).

AEC 2 includes an area with potential USTs. The presence of the USTs was not identified in underground survey of this area using non-intrusive methods by CPBG. Boreholes completed in the vicinity of the USTs did not observe visual/olfactory signs of contamination during the excavation of these intrusive locations, and soil samples from these locations did not report hydrocarbon contamination. Hydrocarbons were reported in groundwater samples from groundwater monitoring wells installed at these locations (refer to Section 11.3).

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[14] Gross contamination is considered to be an area of wide-spread contamination which exceeds relevant commercial/industrial health guidelines triggers a requirement for remediation to mitigate contamination impacts that are over and above the standard construction practices to make the site suitable for commercial / industrial use.

Condition E92 of *Sydney Metro Western Sydney Airport – Conditions of Approval (SSI 10051)* requires the undertaking of a DSI prior to construction which would result in disturbance to moderate (Medium) and high risk contaminated sites identified in the EIS Technical Paper.

Proposed mitigation measure SC2 in the EIS Technical Paper includes the following: "*if a medium or high risk area of environmental concern is reassessed as low, the site would be managed in accordance with the Soil and Water Management Plan. This would typically occur where there is minor, isolated contamination that can be readily remediated through standard construction practices such as excavation and off-site disposal.*"

This mitigation measure was identified in a meeting with Sydney Metro on the 31 May 2022 as a mechanism for re-assessing sites identified as Medium or High risk in the EIS Technical Paper as Low Risk.

Based on the findings of the DSI soil material within AEC2 (station box) would be considered 'Low Risk' on the basis that these materials can be managed through standard construction practices such as excavation and off-site disposal. However, AEC2 (station box) was also assessed as medium risk in the EIS Technical Paper based on the potential for the migration of contaminated groundwater into the station box during construction and operational phases of the SBT Project. Consideration to groundwater related risks needs to be completed following the completion of the groundwater investigation and this is discussed further in Section 11.6.

Asbestos was not detected in any of the samples tested. However, it is noted that a limitation of the investigation was a constraint to use boreholes rather than the completion of test pits and based on the depth of fill and location of the site with an urban area/rail corridor there is the potential to uncover fill materials containing asbestos during construction. It should be noted that any fill which is excavated which contains ACM must be managed as Special Waste (Asbestos Waste).

The results suggest the fill soils would be preliminary classified as General Solid Waste (non-putrescible).

Results suggest natural soils would be preliminary classified as VENM, with the exception of samples where the metal concentrations exceed the ambient background concentrations adopted from Schedule B5b of the amended ASC NEPM 2013[15] and where concentrations of organic compounds are more than the limit of reporting, in which case, the soils would be preliminary classified as General Solid Waste (non-putrescible). Some exceptions may apply where the natural samples exceed both the background concentrations and CT1.

Results suggest the soils sampled would be suitable for reuse at the FS01 site. All results were within the AEPR and those for a future commercial / industrial land use.

11.5. Unforeseen contamination

Unexpected contamination, if identified during future works, can be managed through implementation of an Unexpected Contaminated Finds Protocol included in the Project construction environmental management plan (CEMP).

[15] National Environment Protection Council (2013); *National Environment Protection (Assessment of Site Contamination) Measure, 1999* (the 'ASC NEPM').

11.6. Preparatory Works and Initial Bulk Excavation Above the Groundwater Table

Based on the findings of the DSI, construction activities that do not result in groundwater drawdown which would result in the mobilisation of contamination in groundwater from confirmed and potentially contaminated sites in the vicinity of the station box (and subject to investigation in the DSI) are considered to be low risk, and would not be considered as 'remediation'. Remediation is considered to be a management measure which is required to make the site suitable for commercial/industrial use.

Construction activities which are considered low risk and are not considered to be 'remediation' include:

- Preparatory works: Site levelling (cut and fill), importation of fill for a piling platform, and piling
- Bulk Excavation above the groundwater table.

To satisfy the requirements of the Deed an Interim Remediation Action Plan (RAP) has been prepared for the aforementioned activities. The Interim RAP describes the controls to be implemented in regard to the management of spoil during preparatory and bulk excavation works above the groundwater table, and the importation of material.

11.7. Bulk Excavation Below the Groundwater Table

Bulk excavation below the groundwater table within the Station Box is to be undertaken following the completion of the following:

1) Completion of the groundwater monitoring program, and reporting of groundwater data collected post completion of this DSI report in a Groundwater Assessment Report (GAR). The GAR will be prepared an Addendum to this DSI report to inform management and mitigation measures required to address contamination that poses unacceptable risks to construction and operation and maintenance phases of the project.
2) Completion of the Risk Assessment described in Section 11.8.2.
3) Preparation of an Addendum RAP based on the findings of the DSI and the outcomes of 1) and 2) above.
4) Submission and endorsement of the above by the Site Auditor.

11.8. Recommendations

The following recommendations have been made.

11.8.1. Spoil Management

- CPG engage a competent person during disturbance of topsoil/fill materials to visually monitor for signs of potential contamination and potential ACM. If evidence of potential ACM or other indications of potential contamination are noted (e.g., stained or odorous soils, buried wastes, etc) work should cease pending further investigation of this material by TTMP. The competent person must be experienced in the undertaking excavation/remediation works and have the necessary experience to identify soil materials containing ACM and unforeseen contamination.

- Topsoil (fill) materials are stockpiled separately to natural soils, and stockpiles are managed in accordance with the requirements of the CEMP.
  - Fill material excavated from AEC 3A and a surrounding buffer area (as shown in Figure 3C in Appendix 1) be segregated from fill materials won from elsewhere during the Preliminary Works.
  - No soil materials shall be removed from the site without a Waste Classification Report and/or a Material Classification Report.

11.8.2. 1-7 Queens Street Risk Assessment and Supplementary Groundwater Assessment Report

Site Specific Risk Assessment 1-7 Queen Street

Based on the findings in soil and groundwater at 1-7 Queen Street, TTMP recommends that a Site Specific Risk Assessment (SSRA) is completed for the purpose of assessing potential risks associated with the drawdown of groundwater from 1-7 Queen Street during construction, and potential implications for operational and maintenance phases of the Project. The SSRA will include the following main tasks:

- additional sampling at SBT-GW-1018, SBT-GW-1019, MW1 at multiple depths to confirm chlorinated concentrations and groundwater chemistry
- Drilling an additional borehole near SBT-GW-1019 to refine vertical extent of chlorinated hydrocarbon and PFAS impact in soil and rock. This will include soil headspace screening and collection of soil samples at approximately 0.5 m intervals to characterise chlorinated hydrocarbon and PFAS contamination along the soil profile to the base of the tunnel depth.
- aquifer testing for estimating transmissivity
- preparation of an analytical model to model time for contaminated groundwater from 1-7 Queen St to migrate to the station box during excavation
- if the analytical model predicts that contaminated groundwater will be drawn into the station box during construction, completion of human health risk assessment to consider potential vapour intrusion risk to station (based on modelled groundwater concentrations) and worker health during tunnel construction
- preparation of a report on the above including a refined CSM, model results, HHRA, and mitigation options assessments.

Supplementary Groundwater Assessment Report (SGAR)

Following sampling from the remaining monitoring wells and resampling of monitoring wells within St Marys where positive detection of hydrocarbons have been reported[16], a supplementary

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[16] . An additional sampling event is recommended for SBT-GW-1232, SBT-GW-1234 and SMGW-BH-A321 including the analysis of TRH with silica gel cleanup and GCFID finger print analysis to check for the potential for false positives and/or assist with the identification of the source of hydrocarbons.

groundwater assessment report will be prepared which summarises the groundwater data collected for the DSI, and mitigation measures for construction and operational maintenance phases. This report will exclude reporting on 1-7 Queen St which will be reported in the SSRA.

Timing of SSRA and SGAR

The SSRA and SGAR will be completed during construction activities with the exception of bulk excavation beneath the groundwater table. Bulk excavation work beneath the groundwater table will not be undertaken until the SSRA and SGAR have been approved by the Site Auditor.

11.9. Investigation locations at St Mary Plaza

The St Mary Plaza site is currently being demolished. Following demolition, the plaza site is to be backfilled with site won natural material sourced from the eastern end of the STM site. The following investigation locations are to be completed within the footprint of the plaza site: SBT-BH-1224 to SBT-BH-1227, SBT-BH-1229 to SBT-BH-1230 and SBT-BH-1342. Contamination of concern has not been reported in investigation locations completed along the northern frontage of plaza site and eastern side of the plaza. At the completion of demolition the remaining boreholes will be completed and the findings reported to the Site Auditor in an addendum letter report prior to the commencement of filling of the plaza site.

11.10. Project Operational and Maintenance Phases

Sydney Metro has advised that the station box is to be an undrained (tanked) structure, and therefore groundwater inflow into the station box would expected to be minimal.

Based on the findings of the SSRA and SGAR described in Section 11.6 recommendations will be made in regard to potential risks and mitigation measures which need to be considered in operational maintenance phases, and whether a risk assessment specific to Project operational and maintenance phases is required.

Completion of the St Marys Sydney Metro Station is outside the scope of the SBT Works and is to be completed under the Stations Systems Trains and Operations and Maintenance (SSTOM) works package.

If a risk assessment specific to Project operational and maintenance phase is required, it will need to be completed by the Contractor responsible for the SSTOM works package. The completion of this risk assessment will need to be specific to the design and construction methodology of the St Marys Sydney Metro Station which is outside the control of the SBT Contractor.

The DSI has assumed that the Project will be a commercial site which is predominately covered in hard landscaping with minimal soft landscaping (e.g. garden bed in a car park). The conclusions and recommendations in the DSI are specific to this landuse and development scenario.

12. References

ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000*

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018*

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Environmental Strategies (2015) *Detailed Site Assessment (Phase 2) 1-7 Queen Street, St Marys NSW, 11 November 2015. Ref 15175.*

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Golder & Douglas Partners (Feb 2021); *Factual Contamination Report – Preliminary Site Investigation (Ref: 19122621-003-R-Rev3; Rev3; dated 19th February 2021)*

NEPC (2013); National Environmental Protection (Assessment of Site Contamination) Measure 1999 (the 'ASC NEPM')

NSW EPA (1995); Sampling Design Guidelines

HEPA (2020) *PFAS National Environmental Management Plan (PFAS NEMP) 2.0, 2020*.

M2A (2020) *Sydney Metro - Western Sydney Airport Technical Paper 8 Contamination*

TTC (2021) *Contamination at 1-7 Queen Street, St Marys*

TTC (2022) *Western Sydney Airport Station Boxes and Tunnels Tender, Hydrogeological Interpretative Report*, *Rev B.02*

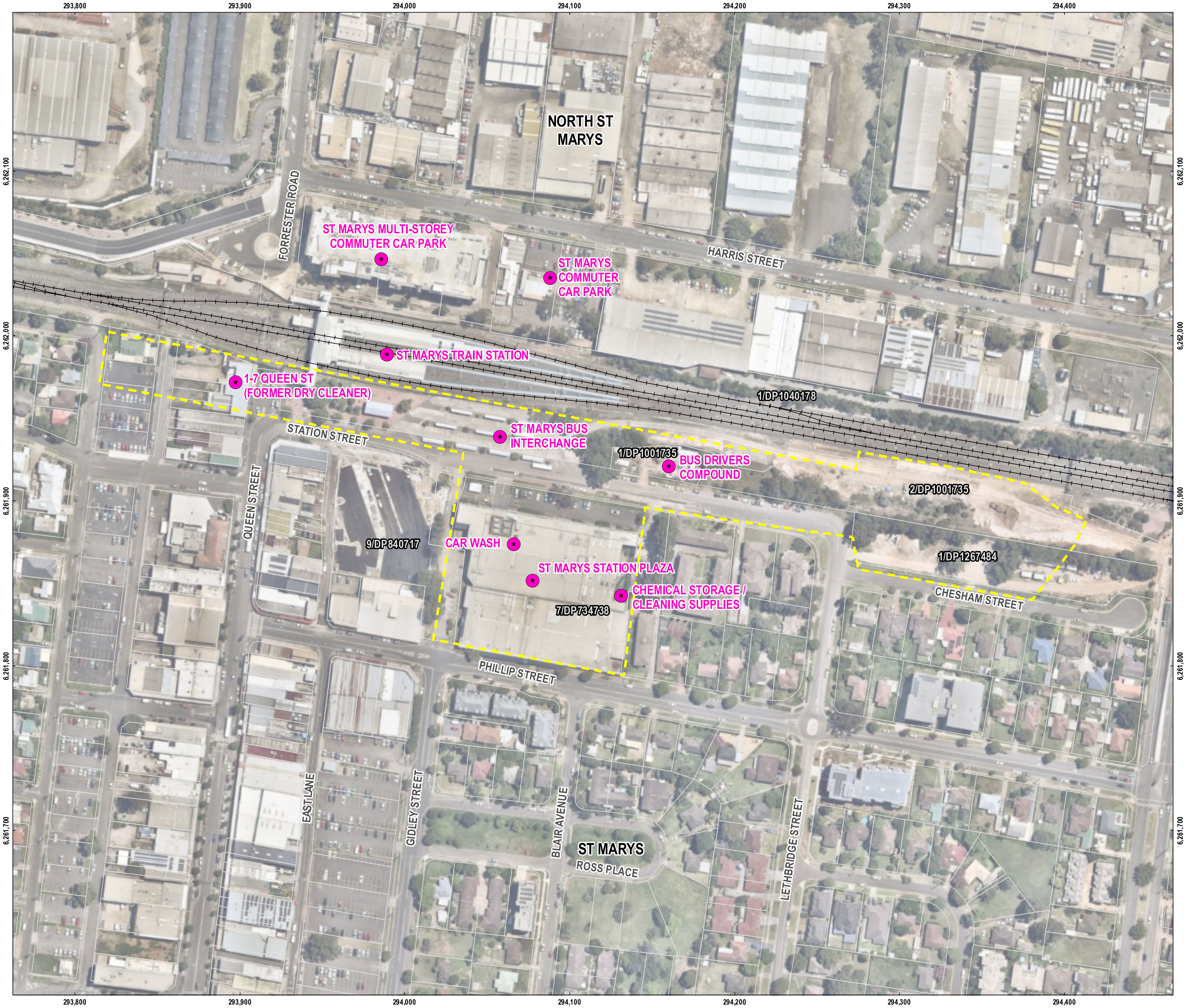
TTC (2022a) *Western Sydney Airport Station Boxes and Tunnels Tender, Groundwater Monitoring Plan*.

TTC (2022b) *Western Sydney Airport Station Boxes and Tunnels Tender, Sampling and Analysis Quality Plan*

TTC (2022c) *Western Sydney Airport Station Boxes and Tunnels Tender, Material Classification Assessment, Preliminary Works, St Marys*

TTC (2022d) *Technical Memorandum: Preliminary Soil Results Eastern Portion of St Marys*

APPENDIX 1 Figures



CPB CONTRACTORS

Ghella 1894 5 Generations of Tunnelers

LEGEND

- Existing Site Feature
- Railway
- Cadastral Boundary
- SMS Site Boundary

SOURCE
Existing site features, site layout and boundary from Tetra Tech Coffey.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 18-02-2022).

N

0 30 60 m

SCALE 1:2,250
PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 1

Site Location Plan
St Marys Station

TETRA TECH COFFEY

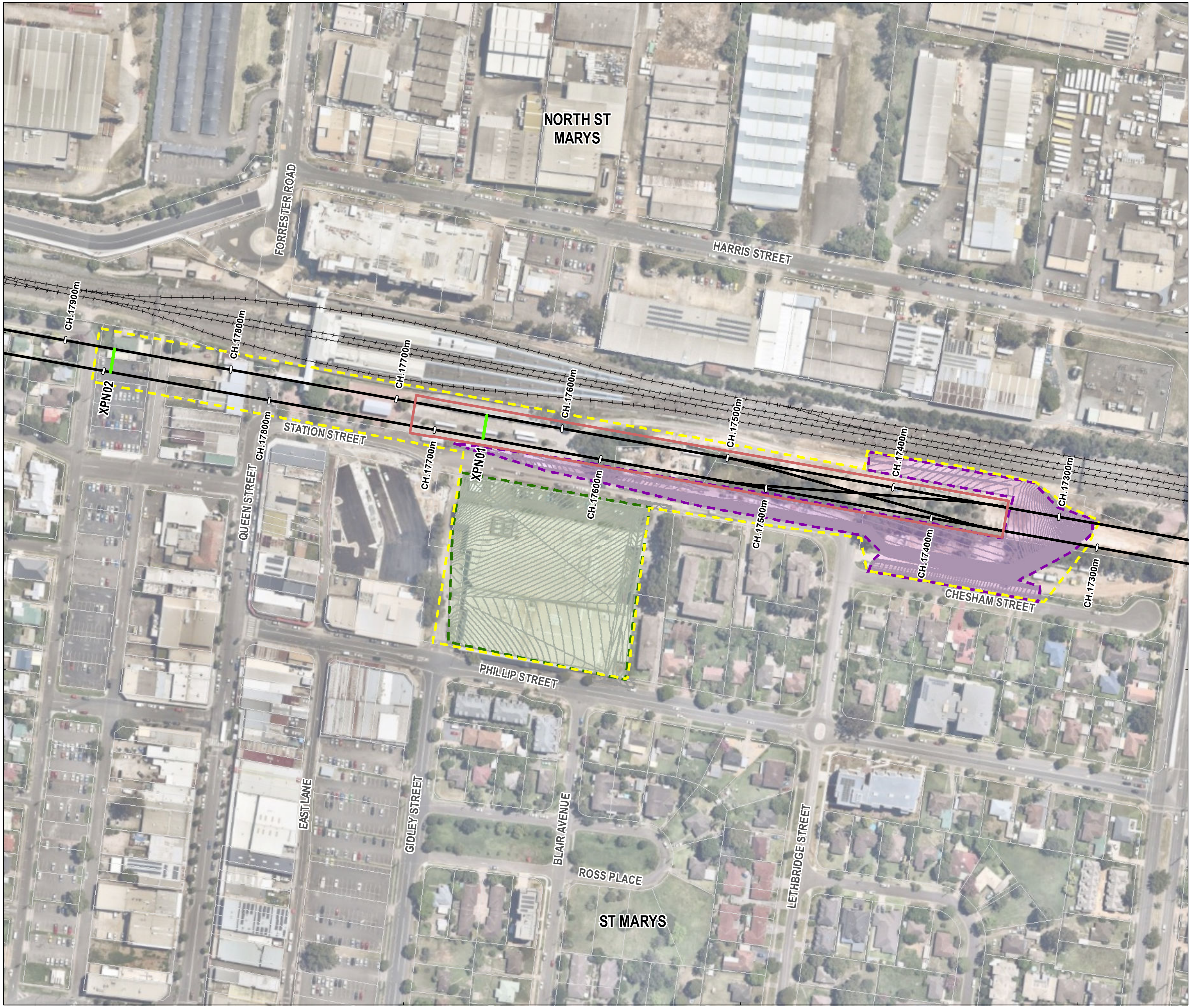
DATE: 23.08.22 PROJECT: 754-SYDGE292575 FILE: 292575_SAQP_SM_F001_GIS

SAVED BY: EAMMON.MARHA 23.08.22 12:40:45 PM

DOC REFERENCE: \\TT.LOCAL\COFI\S72\S\GIS\286919_SYDGE_CPBG_WSASBT\CPBG_WSASBT_GIS\MXD\SYDGE292575_SAQP\REV8\292575_SAQP_SM_GIS001_REV8.MXD_2

CPB CONTRACTORS

Ghella 1894 5 Generations of Tunnelers



LEGEND

- Tunnel Alignment
- Tunnel Alignment - Chainage
- Tunnel Alignment - Cross Passage
- St Marys Station Site Layout
- Railway
- Cadastral Boundary
- Surface Works Cut Area
- Surface Works Fill Area
- STM Site Boundary
- St Marys Station Box

SOURCE
Existing site features, site layout and boundary from Tetra Tech Coffey.
Alignment supplied by CPBG.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 18-02-2022).

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0 30 60 m

SCALE 1:2,250
PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 2

Project Footprint
St Marys Station

TETRA TECH COFFEY

DATE: 21.04.22 PROJECT: 754-SYDGE292575 FILE: 292575_SAQP_SM_F002_GIS

SAVED BY: EAMMON.MARHA 21.04.22 10:05:10 AM

DOC REFERENCE: \\TT.LOCAL\COF\S72\S\GIS\286919_SYDGE_CPBG_WSASBT\CPBG_WSASBT_GIS\MXD\SYDGE292575_SAQP\REV8\292575_SAQP_SM_GIS002_REV8.MXD_1

CPB CONTRACTORS

Ghella 1894 5 Generations of Tunnelers

LEGEND

Additional Contaminated Land Location
- Borehole

Additional Geotechnical/Hydrogeological Location
- Borehole

Existing Investigation Location
- Borehole
- Test Pit
- Tunnel Alignment
- Tunnel Alignment - Chainage
- Tunnel Alignment - Cross Passage
- St Marys Station Site Layout
- Railway
- Cadastral Boundary
- SMS Site Boundary
- Station Box / Shaft

SOURCE
Contaminated land locations, additional investigations, site boundary, and hand samples from Tetra Tech Coffey.
Existing investigations, site layout, station box and alignment supplied by CPBG.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 14-06-2022).

0 50 100 m

SCALE 1:2,750
PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 3

Investigation Locations St Marys Station

TETRA TECH COFFEY

DATE: 08.08.22 PROJECT: 754-SYDGE292575 FILE: 292575_DSI_SM_F003_GIS

SAVED BY: EAMMON.MARHA 08.08.22 10:47:59 AM

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LEGEND

Additional Contaminated Land Location
- Borehole

Additional Geotechnical/Hydrogeological Location
- Borehole

Existing Investigation Location
- Borehole
- Tunnel Alignment
- Tunnel Alignment - Chainage
- Tunnel Alignment - Cross Passage
- St Marys Station Site Layout
- Railway
- Cadastral Boundary
- SMS Site Boundary
- Station Box / Shaft

SOURCE
Contaminated land locations, additional investigations, site boundary, and hand samples from Tetra Tech Coffey.
Existing investigations, site layout, station box and alignment supplied by CPBG.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 14-06-2022).

0 20 40 m

SCALE 1:1,100
PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 3A

Investigation Locations
St Marys Station

TETRA TECH COFFEY

DATE: 10.08.22 PROJECT: 754-SYDGE292575 FILE: 292575_DSI_SM_F003A_GIS

SAVED BY: EAMMON MARHA 10.08.22 10:55:25 AM

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CPB CONTRACTORS

Ghella 1894 5 Generations of Tunnelers

LEGEND

Additional Contaminated Land Location
- Borehole

Additional Geotechnical/Hydrogeological Location
- Borehole

Existing Investigation Location
- Borehole
- Tunnel Alignment
- Tunnel Alignment - Chainage
- Tunnel Alignment - Cross Passage
- St Marys Station Site Layout
- Railway
- Cadastral Boundary
- SMS Site Boundary
- Station Box / Shaft

SOURCE
Contaminated land locations, additional investigations, site boundary, and hand samples from Tetra Tech Coffey.
Existing investigations, site layout, station box and alignment supplied by CPBG.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 14-06-2022).

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0 20 40 m

SCALE 1:1,000
PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 3B

Contaminated Land Locations St Marys Station

TETRA TECH COFFEY

DATE: 08.08.22 PROJECT: 754-SYDGE292575 FILE: 292575_DSI_SM_F003B_GIS

SAVED BY: EAMMON.MARHA 08.08.22 10:45:17 AM

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CPB CONTRACTORS

Ghella 1894 5 Generations of Tunnelers

LEGEND

Additional Contaminated Land Location
- Borehole

Additional Geotechnical/Hydrogeological Location
- Borehole

Existing Investigation Location
- Borehole
- Test Pit
- Tunnel Alignment
- Tunnel Alignment - Chainage
- St Marys Station Site Layout
- Railway
- Cadastral Boundary
- SMS Site Boundary
- Station Box / Shaft

SOURCE
Contaminated land locations, additional investigations, site boundary, and hand samples from Tetra Tech Coffey.
Existing investigations, site layout, station box and alignment supplied by CPBG.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 14-06-2022).

0 20 40 m

N

SCALE 1:1,000
PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 3C

Contaminated Land Locations
St Marys Station

TETRA TECH COFFEY

DATE: 08.08.22 PROJECT: 754-SYDGE292575 FILE: 292575_DSI_SM_F003C_GIS

SAVED BY: EAMMON.MARHA 08.08.22 10:44:13 AM

DOC REFERENCE: \\TT.LOCAL\COFFEY\72\SIGIS\289919_SYDGE_CPBG_WSASBT\CPBG_WSASBT_GIS\MXD\SYDGE292575_DSI\292575_DSI_SM_GIS004_REVA.MXD_1

CPB CONTRACTORS

Ghella 1894 5 Generations of Tunnelers

LEGEND

DSI Investigation Locations

- Groundwater Quality Well
- Monitoring Well

Previous Investigation Locations

- Monitoring Well
- Tunnel Alignment
- Tunnel Alignment - Chainage
- Tunnel Alignment - Cross Passage
- St Marys Station Site Layout
- Railway
- Cadastral Boundary
- SMS Site Boundary
- Station Box / Shaft

SOURCE
Investigation locations and boundary from Tetra Tech Coffey.
Existing investigations, site layout, station box and alignment supplied by CPBG.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 14-06-2022).

N

0 50 100 m

SCALE 1:2,250
PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 4

Groundwater Investigation Locations St Marys Station

TETRA TECH COFFEY

DATE: 25.08.22 PROJECT: 754-SYDGE292575 FILE: 292575_DSI_SM_F004_GIS

SAVED BY: EAMMON.MARHA 25.08.22 4:34:40 PM

DOC REFERENCE: \\TT.LOCAL\COFS\S72\S\GIS\286919_SYDGE_CPBG_WSASBT\CPBG_WSASBT_GIS\MXD\SYDGE292575_DSI\292575_DSI_SM_GIS005_REVA.MXD_2

CPB CONTRACTORS

Ghella 1894 5 Generations of Tunnelers

LEGEND

DSI Investigation Locations

- Groundwater Quality Well
- Monitoring Well

Previous Investigation Locations

- Monitoring Well
- Tunnel Alignment
- Tunnel Alignment - Chainage
- Tunnel Alignment - Cross Passage
- Railway
- Cadastral Boundary
- SMS Site Boundary

SOURCE
Investigation locations and boundary from Tetra Tech Coffey.
Existing investigations, site layout, station box and alignment supplied by CPBG.
Cadastre from DFSI.
Aerial imagery from Nearmap (capture date 14-06-2022).

N

0 10 20 m

SCALE 1:500
PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 4A

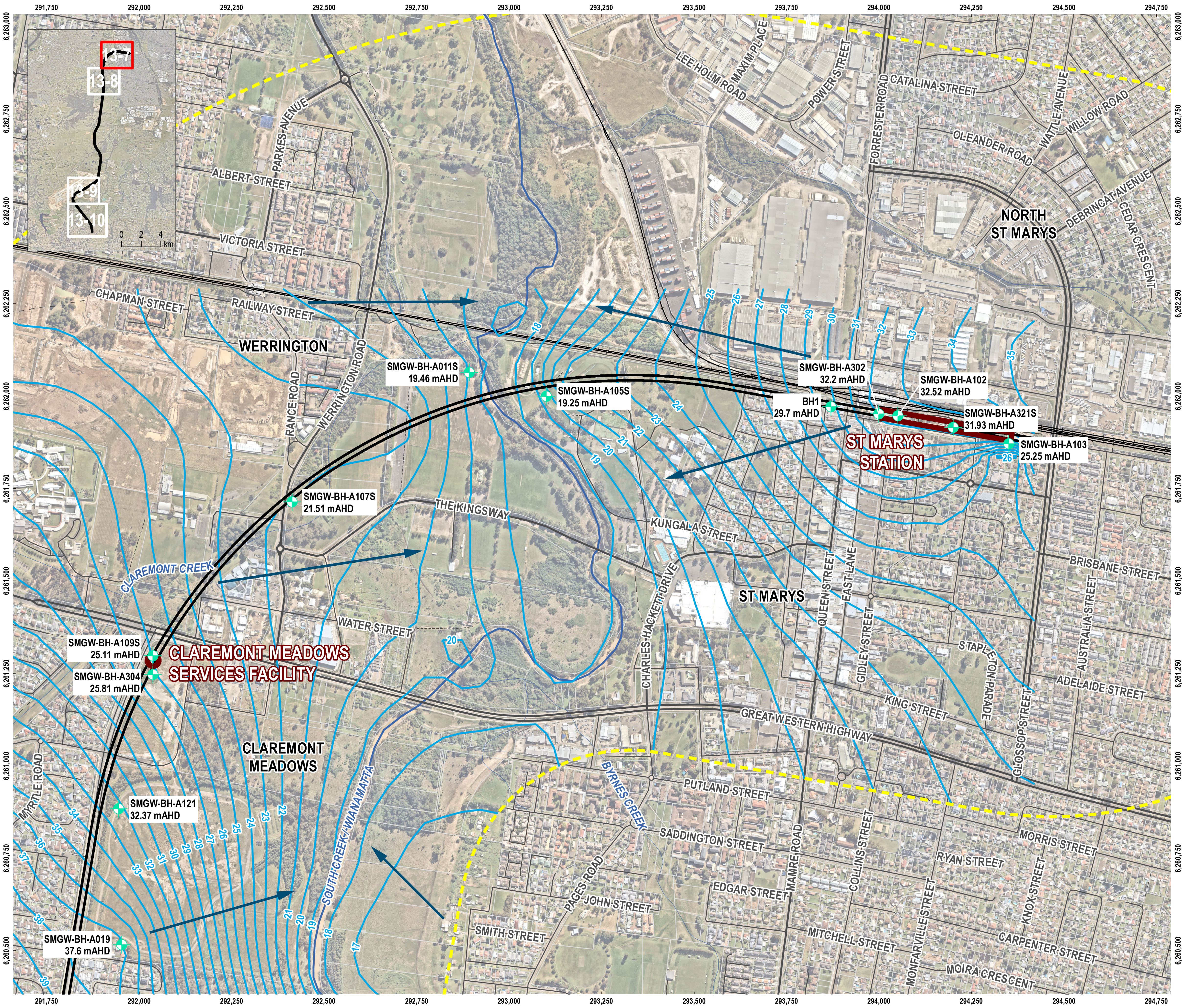
Groundwater Investigation Locations 1-7 Queen Street

TETRA TECH COFFEY

DATE: 25.08.22 PROJECT: 754-SYDGE292575 FILE: 292575_DSI_SM_F004A_GIS

SAVED BY: EAMMON.MARHA 25.08.22 4:36:03 PM

DOC REFERENCE: \\TT.LOCAL\COFS\72\SG\GIS\286919_SYDGE_CPBG_WSASBT_GIS\WSASBT\CPBG_WSASBT_GIS\MXD\SYDGE292575_DSI\292575_DSI_SM_GIS006_REVA.MXD_2



SAVED BY: TAUHIDUL.ISLAM 24.06.22 12:41:08 PM

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CPB CONTRACTORS

Ghella 1894 5 Generations of Tunnelers

LEGEND

- Selected Groundwater Monitoring Well
- Project Alignment
- Project Alignment - Structure
- Railway
- Major Road
- Minor Road
- Track
- Path
- Perennial Watercourse
- Non-perennial Watercourse
- Groundwater Elevation Contour (mAHD)
- Groundwater Flow Direction
- Cadastral Boundary
- Project Alignment Buffer (1 km)

SOURCE

Groundwater monitoring wells compiled by Tetra Tech Coffey.
Groundwater contours, groundwater flow direction, and alignment buffer from Tetra Tech Coffey.
Alignment supplied by CPBG.
Cadastre, roads, rail, and watercourses from DFSI.
Aerial imagery from Nearmap (capture date April, 2022).

N

0 200 400 m

SCALE 1:10,000
PAGE SIZE: A3
PROJECTION: GDA2020 MGA Zone 56

CPB - GHELLA

WESTERN SYDNEY AIRPORT
STATION BOXES AND TUNNELLING WORKS

FIGURE 5

Groundwater Level Contours

TETRA TECH COFFEY

DATE: 24.06.22 PROJECT: 754-SYDGE292575 FILE: 292575_HIR_F013-7_GIS_REVC

Appendix 2 Geotechnical Cross Section and Site Photos

LEGEND

- CORE LOSS
- ASPHALT
- CH - High Plasticity CLAY
- CH-MH - High Plasticity CLAY to High Plasticity SILT
- CI - Medium Plasticity CLAY
- CI-CH - Medium to High Plasticity CLAY
- CL - Low Plasticity CLAY
- CL-CI - Low to Medium Plasticity CLAY
- CL-ML - Low Plasticity CLAY to Low Plasticity SILT
- CLAYSTONE
- CONCRETE
- CONGLOMERATE
- FILL
- GW - Well Graded GRAVEL
- INTERBEDDED SILTSTONE & SANDSTONE
- MH - High Plasticity SILT
- ML - Low Plasticity SILT
- Organic
- OL - Low Plasticity ORGANIC CLAYS and SILTS
- SANDSTONE
- SC - Clayey SAND
- SHALE
- SILTSTONE
- SILTSTONE & SANDSTONE
- SM - Silty SAND
- SP - Poorly Graded SAND
- SP-SC - Poorly Graded SAND to Clayey SAND
- SW - Well Graded SAND
- SW-SC - Well Graded SAND to Clayey SAND
- SP - Poorly Graded SAND
- GP - Poorly Graded GRAVEL

LEGEND

- EXISTING GROUND SURFACE
- – –?– – INFERRED GEOLOGICAL BOUNDARY
- APPROXIMATE INTERFACE BETWEEN SH-V & SH-IV

SOIL CONSISTENCY/RELATIVE DENSITY

VS	- VERY SOFT
S	- SOFT
F	- FIRM
St	- STIFF
Vst	- VERY STIFF
H	- HARD
Fb	- FRIABLE
VL	- VERY LOOSE
L	- LOOSE
MD	- MEDIUM DENSE
D	- DENSE
VD	- VERY DENSE

PROJECT UNITS

T	- TOPSOIL
T/F	- TOPSOIL/FILL
F	- FILL
A	- ALLUVIUM
R	- RESIDUAL SOIL
SS & SHS (Class #)	- LOCAL SANDSTONE CLASSIFICATION
SH (Class #)	- LOCAL SHALE CLASSIFICATION

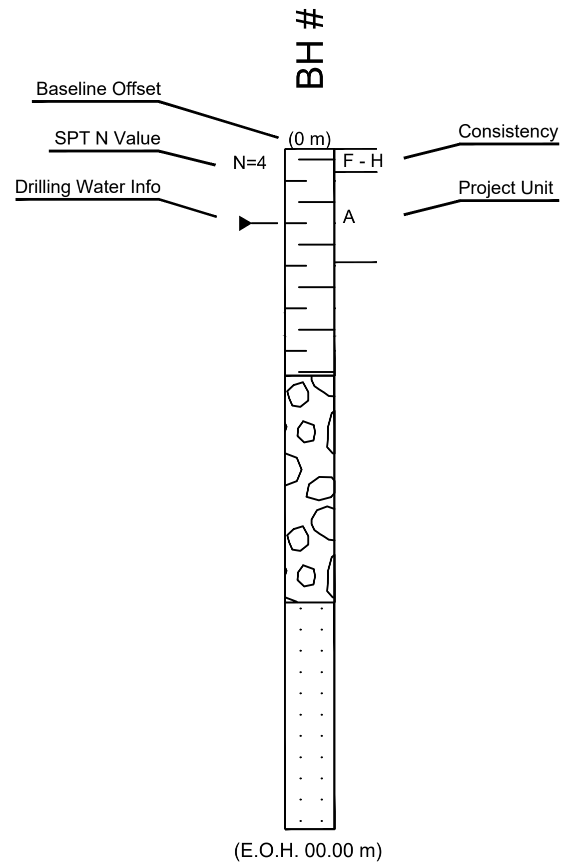
SOIL LEGEND

- S1 - FILL
- S2 - ALLUVIUM
- S3 - RESIDUAL SOILS

ROCK LEGEND

- R1 - TYPICALLY CLASS V/IV BRINGELLY SHALE
- R2 - TYPICALLY CLASS III BRINGELLY SHALE
- R3 - TYPICALLY CLASS II OR BETTER BRINGELLY SHALE

POST LEGEND



1. SITE-SPECIFIC INVESTIGATION DATA IS INCOMPLETE AND PROVIDED IN DRAFT FORMAT FOR SOME LOCATIONS.
2. NO GUARANTEE CAN BE GIVEN AS TO THE VALIDITY, NATURE AND CONTINUITY OF THE VARIOUS SUBSURFACE FEATURES SHOWN.
3. INFERRED SUBSURFACE CONDITIONS BETWEEN BOREHOLES HAVE BEEN CREATED FROM 3D INTERPOLATION AND/OR EXTRAPOLATION OF DISCRETE TEST HOLE DATA. AS SUCH THE CONDITIONS SHOWN ARE AN INTERPRETATION AND MUST BE CONSIDERED AS A GUIDE ONLY.
4. LOCAL VARIATIONS OR ANOMALIES IN GROUND CONDITION CAN OCCUR IN THE NATURAL ENVIRONMENT, PARTICULARLY BETWEEN DISCRETE TEST HOLE LOCATIONS.
5. FOR DETAILS AND PRECISE LOCATIONS OF PARTICULAR BOREHOLES, REFERENCE SHOULD BE MADE TO THE ORIGINAL LOGS FROM SOURCE DOCUMENTS.
6. GROUND SURFACE SHOWN IS BASED ON THE LIDAR PROVIDED ON FOUNDATION SPATIAL DATA (ELVIS) FROM GEOSCIENCE AUSTRALIA (2019) WITH THE EXCEPTION OF THE WSI AREA WHICH IS BASED ON CLIENT PROVIDED DATA.
7. THE BEDROCK HAS GENERALLY BEEN CATEGORISED BASED ON A SIMPLIFIED VERSION OF THE PELLS (2019) METHOD. HERE CLASS V AND IV HAVE BEEN COMBINED IN A SINGLE ROCK UNIT AND CLASS I AND II HAVE ALSO BEEN COMBINED AS A SINGLE UNIT.
8. ROCK ZONES ARE DENOTED AS "TYPICALLY CONTAINING...". DESIGNERS SHOULD NOTE THAT EACH ROCK ZONE MAY CONTAIN AREAS OF HIGHER AND LOWER ROCK CLASSIFICATION AND ACCOUNT FOR SUCH VARIATION IN THEIR DESIGN.
9. POSITIONS OF TUNNELS, STATION BOXES, DIVE STRUCTURES AND SERVICE SHAFTS ARE INDICATIVE ONLY.
10. FOR GEOTECHNICAL CROSS-SECTIONS, POSITION “0” ON THE X-AXIS REFERS TO DISTANCE FROM THE SOUTHBOUND TUNNEL ALIGNMENT.
11. DISTANCE BELOW BOREHOLE INDICATES APPROXIMATE OFFSET FROM SECTION LOCATION IN METRES.

Cad File: \\tts779fs1.tt.local\Data\1. Projects\4. SYD-GEOTECHNICS\13. SYDGE290000\SYDGE292575 WSA SBT\04_CAD\SMWSASBT-CPG-SWD-SW000-GE-DRG_040305_A.dwg
Plot Date: 24/03/22 - 09:48
100mm AT FULL SIZE

REV.	BY	DATE	DESCRIPTION	APPD.
A	AW	25/03/2022	DEVELOPED CONCEPT DESIGN	VN

SCALES

NOTE:
PLEASE REFER TO NOTES ON THE LEGEND PAGE.

CLIENT

SERVICE PROVIDERS

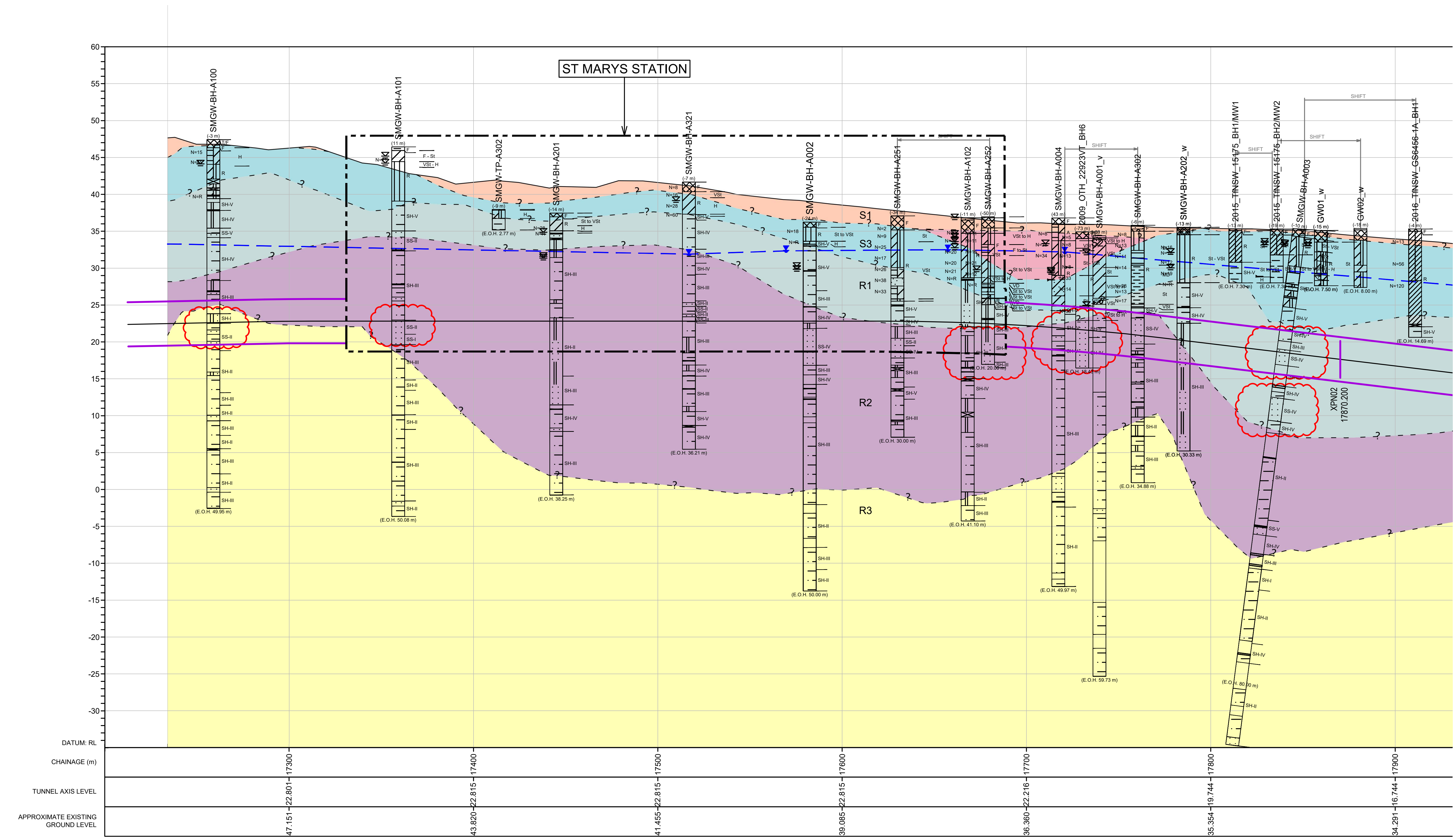
DRAWN	Annette Wilson	25 Feb 2022
DESIGNED	Viet Nguyen	25 Feb 2022
DRG CHECK	Troy Credlin	25 Feb 2022
DESIGN CHECK	Ching Dai	25 Feb 2022
APPROVED	Troy Credlin	25 Feb 2022

Sydney Metro Western Sydney Airport SBT
SBT North and SBT South
GEOTECHNICAL
GENERAL NOTES AND LEGEND
PROJECT WIDE

STATUS: FOR INFORMATION | SHEET 01 OF 01 | ©

DRG No. SMWSASBT-CPG-SWD-SW000-GE-DRG-040305 | REV. A

A3 Original | Co-ordinate System: Zone 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing. | ALT. DRG No. Alternate Document Number



ESTIMATED PERCENTAGE OF ROCK CLASS AT TUNNEL LEVEL	50% CLASS III, 50% CLASS >II	NOT APPLICABLE	80% CLASS IV/V, 20% RS	
APPROXIMATE RQD AT TUNNEL LEVEL	80 - 100%	NOT APPLICABLE	0 - 100%	
APPROXIMATE UCS RANGE AT TUNNEL LEVEL	17 - 9 MPa	NOT APPLICABLE	2.5 MPa	
ESTIMATED ABBRASIVITY AT TUNNEL LEVEL	MEDIUM	NOT APPLICABLE	LOW TO VERY LOW	

REV.	BY	DATE	DESCRIPTION	APPD.
T	AW	29/07/2021	FOR REVT SUBMISSION	TC
B	AW	5/07/2021	FOR REVB SUBMISSION	TC

SCALES

SCALE 1:2000 AT A3 SIZE (0 10 20 30 40 50 60m)

SCALE 1:500 AT A3 SIZE (0 2.5 5.0 7.5 10 12.5 15m)

NOTES:
REFER TO NOTES ON THE LEGEND PAGE.

CLIENT

CPB CONTRACTORS · Ghella

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SERVICE PROVIDERS

GEODATA · PB&E · TETRA TECH COFFEY · PSM · Robert Bird Group · ARCADIS

DRAWN	Annette Wilson	5 July 2021
DESIGNED	Wendy Weng	5 July 2021
DRG CHECK	Troy Credlin	7 July 2021
DESIGN CHECK	Ching Dai	7 July 2021
APPROVED	Troy Credlin	7 July 2021

Sydney Metro Western Sydney Airport SBT

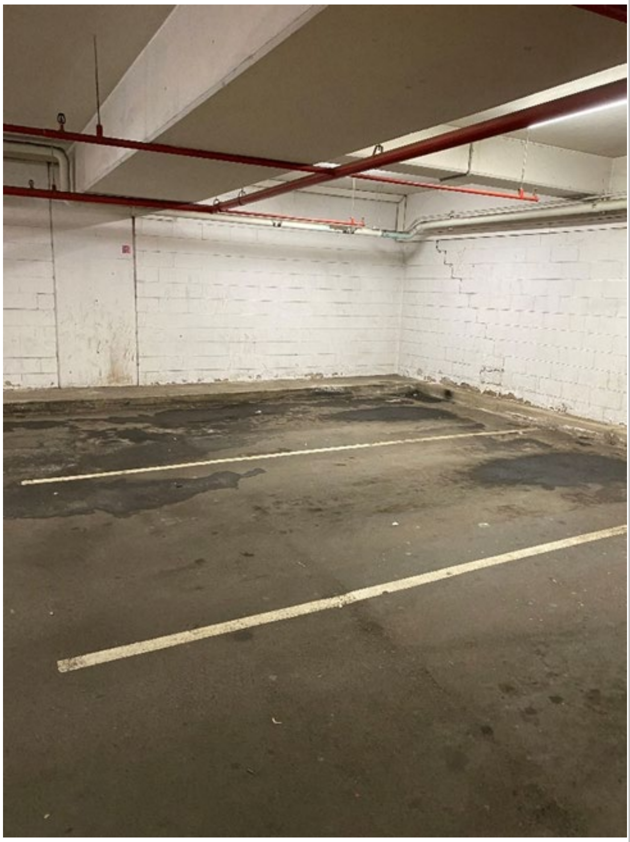
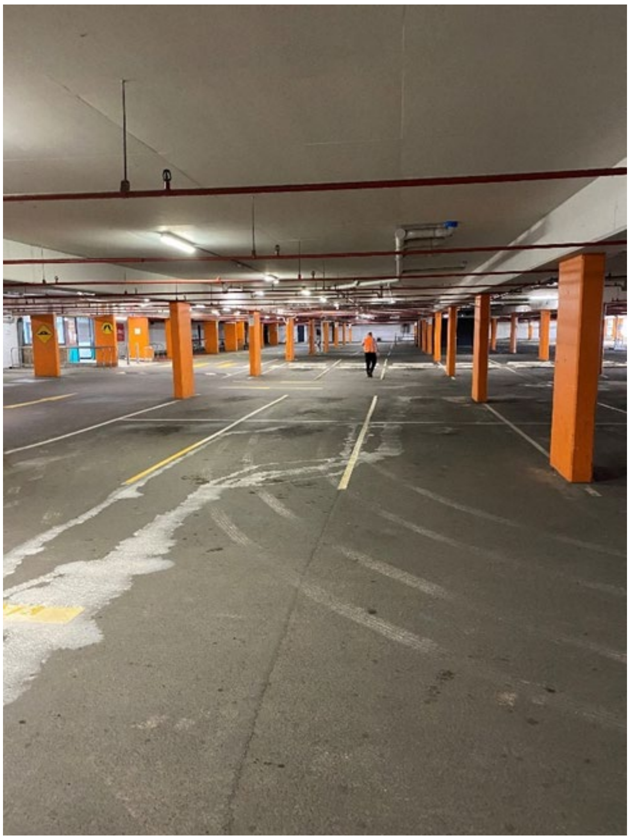
SBT North
GEOTECHNICAL
NORTHERN LONG SECTION
CH17243 - CH22500

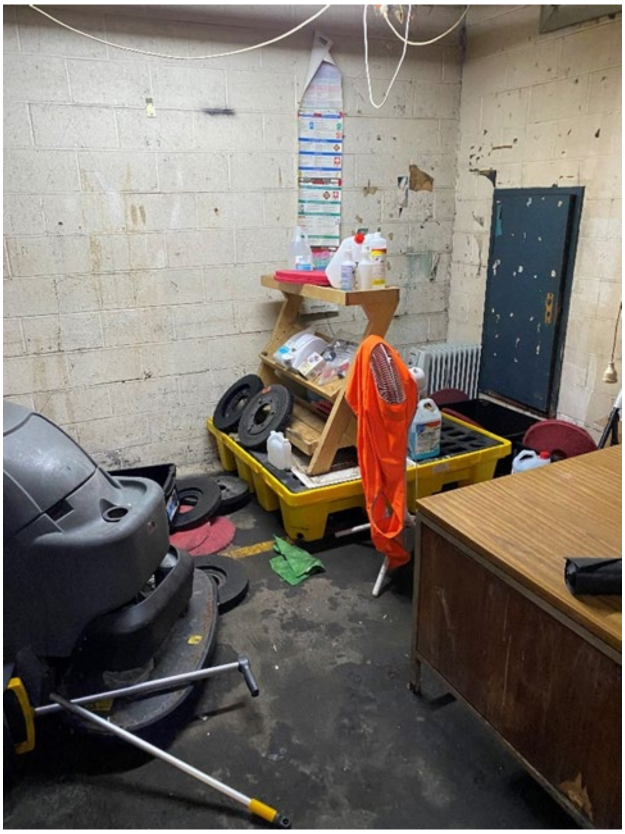
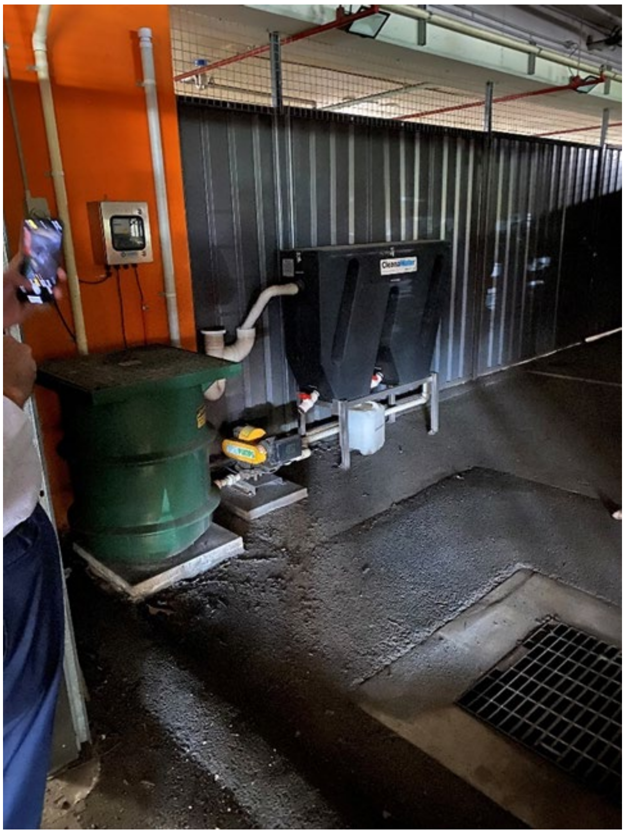
STATUS: FOR TENDER SUBMISSION | SHEET 01 OF 09

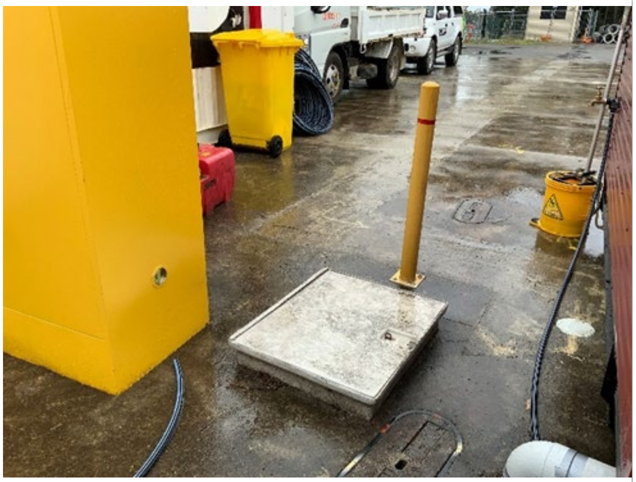
DRG No. WSASBTT-0111-006-DRG-COFF-GE-0002 | REV. RevT

A3 Original | Co-ordinate System: Zone 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing. | ALT. DRG No. Alternate Document Number

Site Walkover Photographs

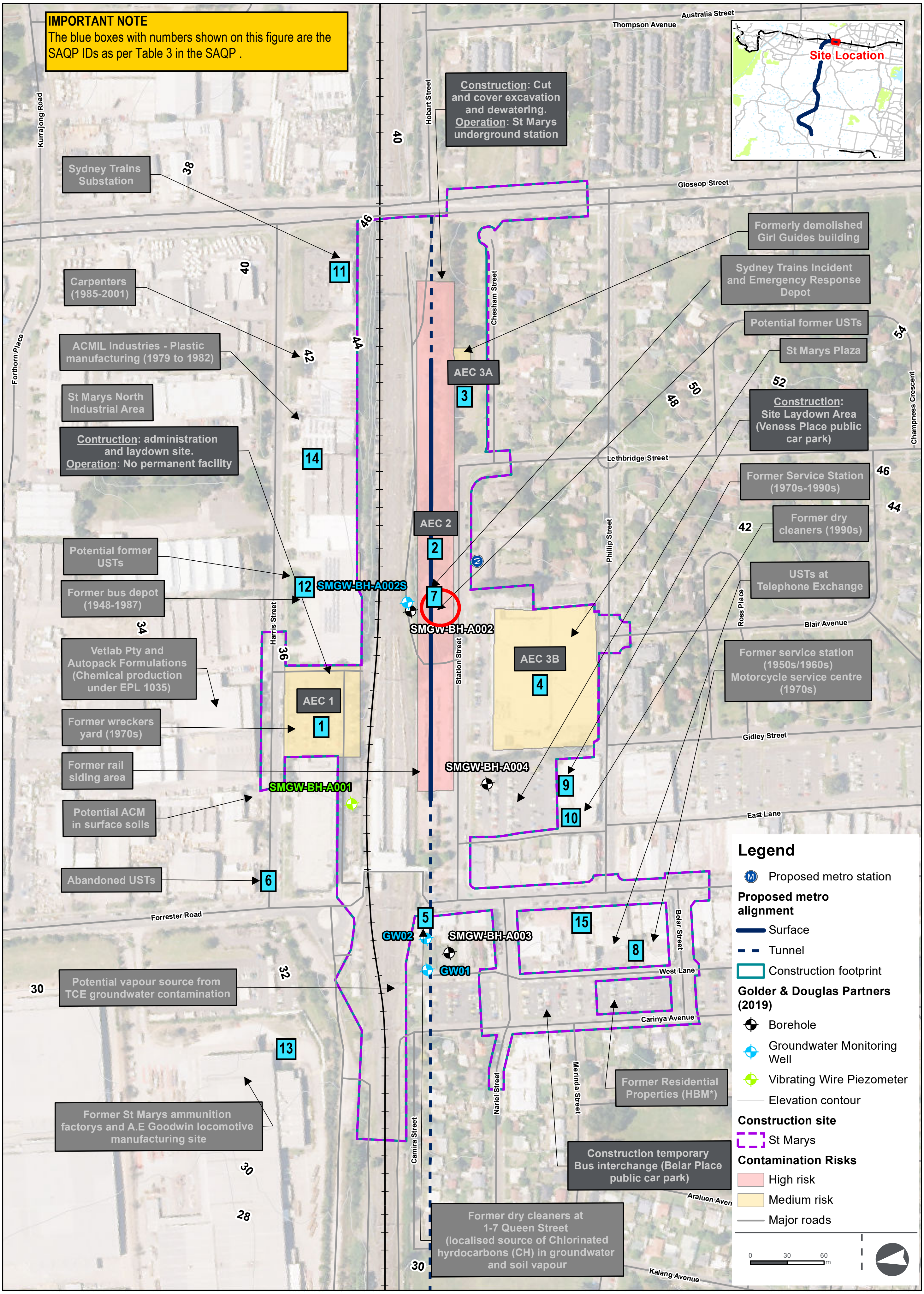
	
St Marys Plaza Underground Carpark oil staining	St Marys Plaza underground carpark

	
St Marys Plaza carpark cleaning chemicals storage area	St Marys Plaza carpark cleaning chemicals storage area

	
Rear of 1-7 Queens Street (Former Dry Cleaners); photograph taken from West Lane	1-2 Station Street: Potential underground storage tank (UST) located in bus drives compound. Photograph provided by Sydney Metro of an area which has now been decommissioned.
	
1-2 Station Street (bus drivers compound)	1-2 Station Street (bus drivers compound)

	
Potential Former UST Location, St Marys Station Commuter Car Park	

Appendix 3 Relevant Information from EIS Technical Paper St Marys and Federal Material Import and Reuse Procedures



Australian Government NSW GOVERNMENT sydney METRO

Sydney Metro – Western Sydney Airport

*HBM - Potential hazardous building materials

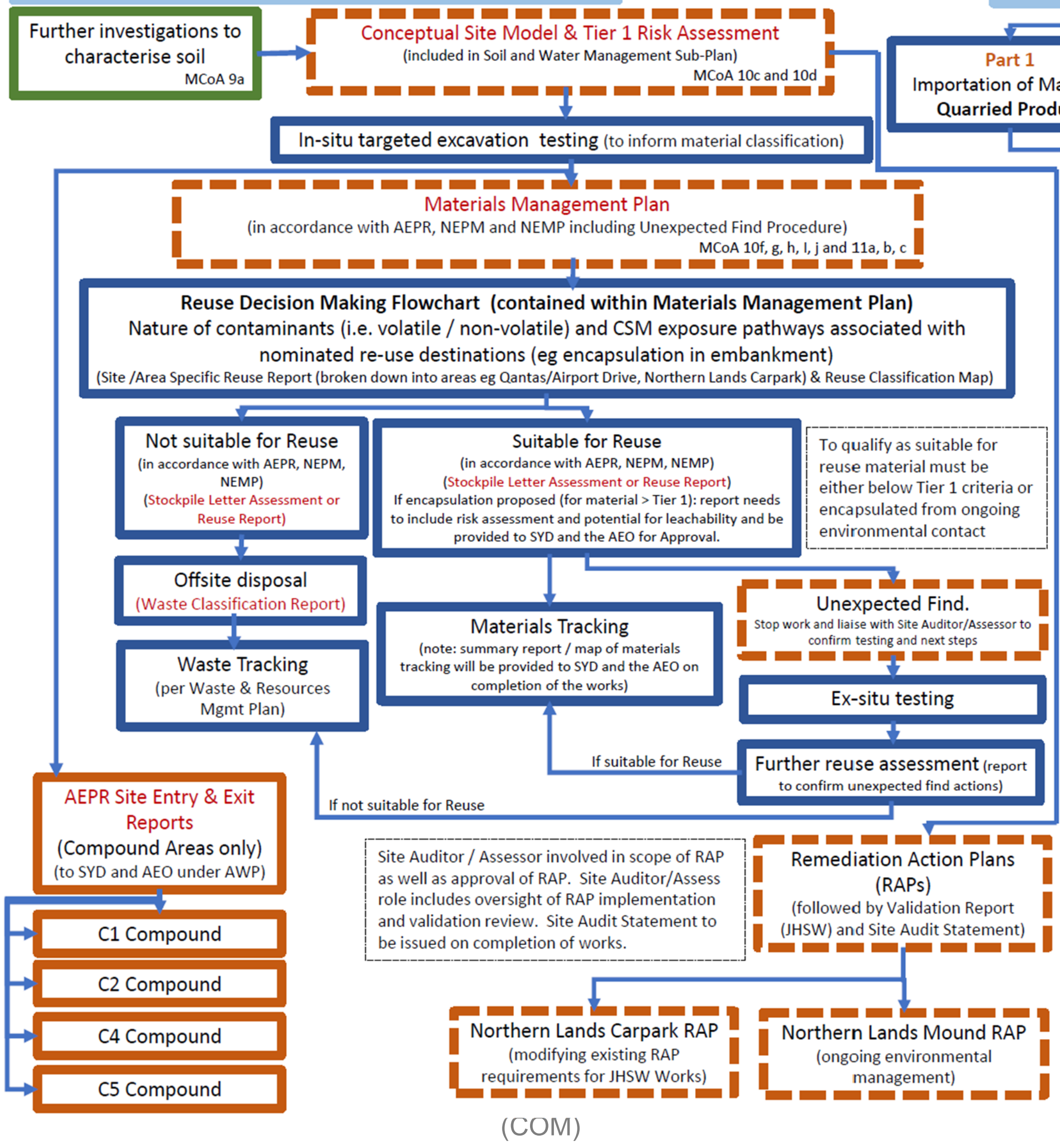
Indicative only, subject to design development

St Marys contamination sources and risk ranking

Figure A1

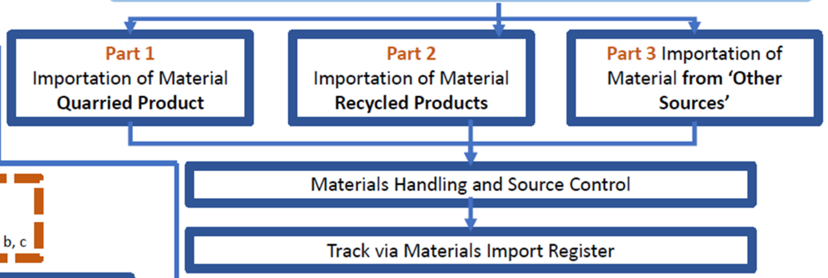
Materials Reuse and Importation Procedure

Materials Reuse & Management



Materials Importation & Management

Refer to page 2 & 3 for detailed process



The importation of material into Commonwealth Land can be categorised into three areas:

1. **Part 1-** Importation of Quarried Products
2. **Part 2-** Importation of Recycled Products
3. **Part 3** – Importation of Materials from 'Other Sources'

This flowchart sets out the requirements for each of these material types listed above and details the process for testing and importation of materials for the Sydney Gateway Road Project.

The requirements of the AEPR and PFAS NEMP are considered to only be relevant for Part 3 of this Materials Importation & Management process on the basis that Part 1 and Part 2 relate to natural materials or materials subject to a Resource Recovery Order in accordance with the Protection of the Environment (Waste) Regulation 2014.

Updated Mitigation Measure (UMM) CS16 makes allowance for this importation under the EIS/MDP Approval.

KEY:

Action complete

Action ongoing (managed through commitments in Mgmt Plan)

Action involves approval from Site Auditor/Assessor

Action requires further documentation through AWP

AEPR - Airport (Environment Protection) Regulation

MCoA- Commonwealth Minister's Condition of Approval

NEPM-National Environmental Protection Measure

NEMP-National Environmental Management Plan (PFAS NEMP 2.0, 2020)

SYDNEY GATEWAY

A Joint Venture Project JOHN HOLLAND SEYMOUR WHYTE

Refer to key on page 1

Materials Reuse and Importation Procedure

SYDNEY GATEWAY

A Joint Venture Project JOHN HOLLAND SEYMOUR WHYTE

Materials Importation & Management

Part 1
Prior to importation of material - **Quarried Product**
(for example- aggregates (non recycled), natural materials)

Materials Handling and Source Control
No testing required.
Evidence from Supplier confirming material is natural.
Visually verification to confirm material is consistent with supplier documentation.

Part 2
Prior to importation of material - **Recycled Products**

Materials Handling and Source Control
- Supplier to provide evidence of sampling and / or notification in accordance with the Resource Recovery Order (RRO).
- JHSW to ensure compliance with Resource Recovery Exemption (RRE) and approve material for import.
- Visually verification to confirm material is consistent with supplier documentation.

Part 3 Prior to importation of material - from 'Other Sources'
(for example tunnel spoil or similar from other road projects)

The importation of material into Commonwealth Land from 'Other Sources' requires JHSW to demonstrate compliance with UMM CS16, being the PFAS NEMP and the AEPR.

Sampling frequency and analytes are detailed on Page 3
Updated Mitigation Measure (UMM) CS16 makes allowance for this importation under the EIS/MDP Approval.

Compliance with UMM CS16
Any material imported and used within Sydney Airport land will be tested prior to use to ensure it does not exceed the acceptable limits in the PFAS National Environmental Management Plan (HEPA, 2018) and Schedule 3 of the Airports (Environment Protection) Regulations 1997.

Material analysis to confirm analytes below Tier 1 criteria (NEPM, NEMP and AEPR)
(Import Certificate / Analytical Report)

State Requirements

EPA agreement accepting material moving from State land to Federal Land
(EPA agreement)

Material classification prior to removal from State land.

Confirmation on 'State' requirement for lawful acceptance of material (JHSW to obtain from AEO)

If PFAS not detected in sampling (No Risk)
- Sampling Density per Page 3 of 4
- Risk assessment confirms low risk from origin of material (documented risk assessment, available to be audited by SYD/AEO)

If PFAS detected > LOR and < 0.14mg/kg PFOS (Indirect Ecological Criteria [1]) (Low Risk)
- Sampling Density per Page 3 of 4
- Risk assessment confirms low risk from origin of material
- Leachability testing (ASLP- 0.07ug/L) on 10% of samples.
- Document where the material is going to be placed to confirm to confirm leaching potential.

If PFAS is detected > 0.14mg/kg PFOS and /or analytes are above AEPR criteria (High Risk)
- Import cannot proceed without risk assessment and Site Auditor Approval (HOLD POINT)
- Risk assessment to be done in accordance with Figure 5 of the PFAS NEMP to confirm decision making process.
- Site Auditor approval of risk assessment required.

Report to confirm Sampling Density and Waste Characterisation compliance with AEPR. Environment Team to provide approval to Import
(available to be audited by SYD/AEO. Auditor not required as below PFAS NEMP)

Importation to be tracked in Material Tracking Register
(available to be audited)

Records of Material Importation to be provided to SYD/AEO/ABC on Completion

KEY:
- Action complete
- Action ongoing (managed through commitments in Mgmt Plan)
- Action involves approval from Site Auditor/Assessor
- Action requires further documentation through AWP
- AEPR - Airport (Environment Protection) Regulation
- MCoA- Commonwealth Minister's Condition of Approval
- NEPM-National Environmental Protection Measure
- NEMP-National Environmental Management Plan (PFAS NEMP 2.0, 2020)

Note: no testing required for concrete, bitumen, stabilised sand, and asphalt (commercially supplied new products)

1. Reference Table 3 Ecological Criteria PFAS NEMP

(COM)

Refer to key on page 1

Materials Reuse and Importation Procedure

SYDNEY GATEWAY
A Joint Venture Project
JOHN HOLLAND SEYMOUR WHYTE

Materials Importation & Management

Analytes to be sampled to confirm compliance with AEPR Schedule 3 Criteria

Item no.	Substance	Accepted limit/trigger Level (mg/kg)
1	Aldrin (including aldrin and dieldrin in combination)	50
2	Arsenic (total)	500
3	Benzo (a) pyrene	5
4	Beryllium	100
5	Cadmium	100
6	Chlordane	250
7	Chromium (III)	600,000
8	Chromium (VI)	500
9	Copper	5,000
10	Cyanides (complexed)	2,500
11	Dieldrin (including dieldrin and aldrin in combination)	20
12	DDT	1,000
13	Heptachlor	50
14	Lead	1,500
15	Manganese	7,500
16	Methyl mercury	50
17	Mercury (inorganic)	75
18	Nickel	3,000
19	Polycyclic aromatic hydrocarbon	100
20	PCB (total)	50
21	Phenol	42,500
22	Zinc	35,000
23	Total petroleum hydrocarbon — fuel (C_6–C_9 fractions)	800
24	Total petroleum hydrocarbon — mineral oil (>C_9 fractions)	5,000
25	Benzene	1
26	Ethylbenzene	50
27	Toluene	130
28	Xylene	25

NEPM Screening Criteria

Health Investigation Levels in Soil – Commercial Industrial (HIL D)

Use NEPM criteria for all AEPR Analytes. Where no NEPM criteria exists for AEPR Analyte- use AEPR as criteria. Where there are criteria for the same analyte in both AEPR and NEPM, the most conservative criteria applies.

Table 1A(1) Health investigation levels for soil contaminants

Chemical	Health-based investigation levels (mg/kg)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial/ industrial[1] D
Metals and Inorganics				
Arsenic[2]	100	500	300	3 000
Beryllium	60	90	90	500
Boron	4500	40 000	20 000	300 000
Cadmium	20	150	90	900
Chromium (VI)	100	500	300	3600
Cobalt	100	600	300	4000
Copper	6000	30 000	17 000	240 000
Lead[3]	300	1200	600	1 500
Manganese	3800	14 000	19 000	60 000
Mercury (inorganic)[5]	40	120	80	730
Methyl mercury[4]	10	30	13	180
Nickel	400	1200	1200	6 000
Selenium	200	1400	700	10 000
Zinc	7400	60 000	30 000	400 000
Cyanide (free)	250	300	240	1 500
Polycyclic Aromatic Hydrocarbons (PAHs)				
Carcinogenic PAHs (as BaP TEQ)[6]	3	4	3	40
Total PAHs[7]	300	400	300	4000
Phenols				
Phenol	3000	45 000	40 000	240 000
Pentachlorophenol	100	130	120	660
Cresols	400	4 700	4 000	25 000
Organochlorine Pesticides				
DDT+DDE+DDD	240	600	400	3600
Aldrin and dieldrin	6	10	10	45
Chlordane	50	90	70	530
Endosulfan	270	400	340	2000
Endrin	10	20	20	100
Heptachlor	6	10	10	50
HCB	10	15	10	80
Methoxychlor	300	500	400	2500
Mirex	10	20	20	100
Toxaphene	20	30	30	160
Other Organics				
PCBs[8]	1	1	1	7
PBDE Flame Retardants (Br1–Br9)	1	2	2	10

(9) To obtain F1 subtract the sum of BTEX concentrations from the C_6-C_{10} fraction.

(10) To obtain F2 subtract naphthalene from the >C_{10}-C_{16} fraction.

Table 1A(3) Soil HSLs for vapour intrusion (mg/kg)

CHEMICAL	HSL A & HSL B Low - high density residential				HSL C recreational / open space				HSL D Commerc[illegible]al				Soil saturation concentration (Csat)
	0 m to <1 m	1 m to <2 m	2 m to <4m	4 m+	0 m to <1 m	1 m to <2 m	2 m to <4 m	4 m+	0 m to <1 m	1 m t[illegible] <2 m	2 m to <4 m	4 m+	
SAND													
Toluene	160	220	310	540	NL	NL	NL	NL	NL	NL	NL	NL	560
Ethylbenzene	55	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	64
Xylenes	40	60	95	170	NL	NL	NL	NL	230	NL	NL	NL	300
Naphthalene	3	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	9
Benzene	0.5	0.5	0.5	0.5	NL	NL	NL	NL	3	3	3	3	360
F1(9)	45	70	110	200	NL	NL	NL	NL	260	370	630	NL	950
F2(10)	110	240	440	NL	NL	NL	NL	NL	NL	NL	NL	NL	560

Asbestos: compliance with NEPM (2013) for HIL D criteria

- Bonded ACM - 0.05%
- Friable asbestos - 0.001%
- All forms of asbestos – no visible asbestos for surface soil

ENM Sampling Density

Note- refer to RRO/RRE requirements for testing density for recycled products (as per Page 2 of 4 of this flowchart)

Stockpiled Material

Table 1

Sampling of Stockpiled Material		
Column 1	Column 2	Column 3
Quantity (tonnes)	Number of samples	Validation
<500	3	Required
500 – 1,000	4	
1,000 – 2,000	5	
2,000 – 3,000	7	
3,000 – 4,000	10	

In Situ Sampling of Material

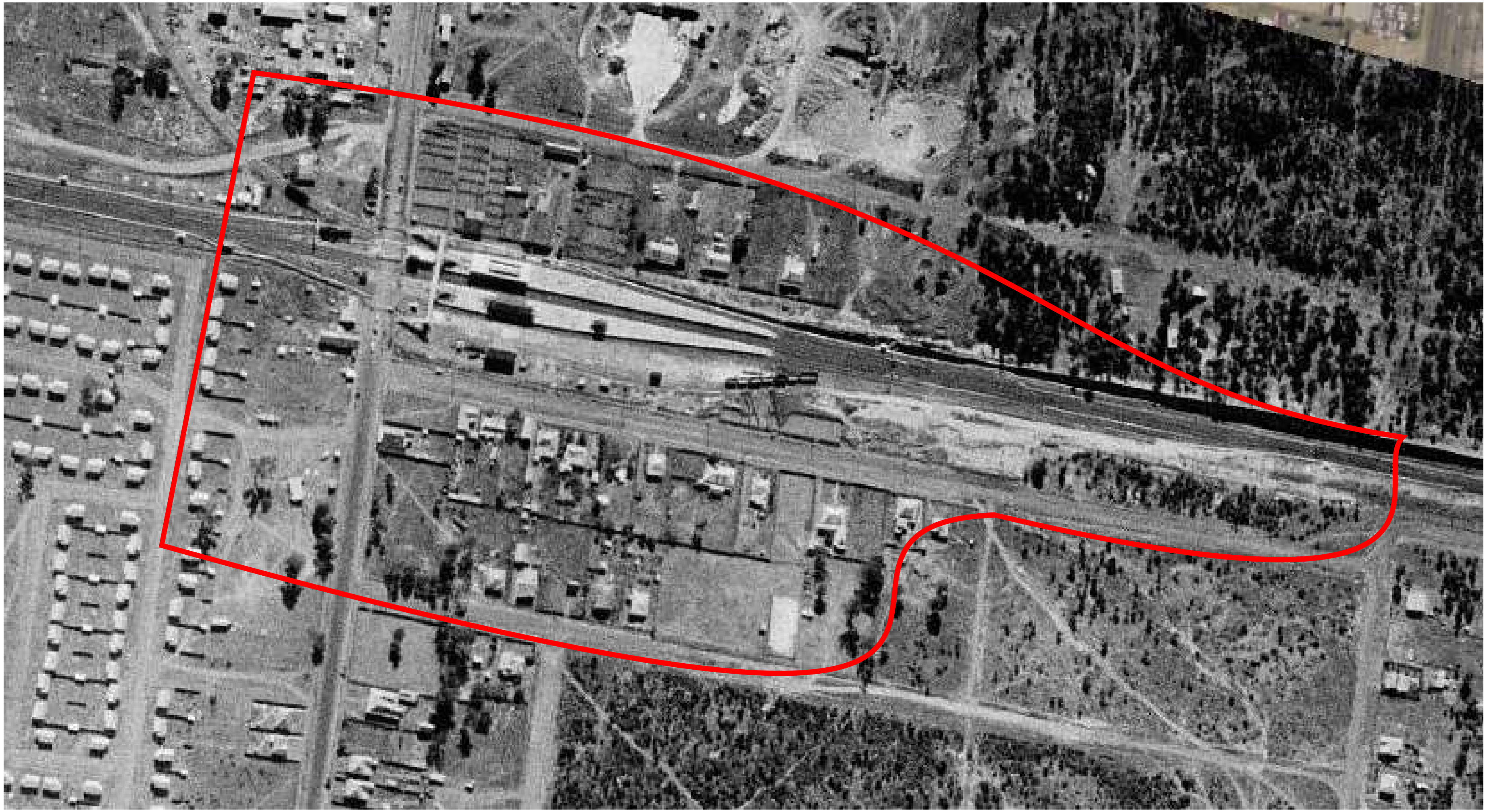
Table 2

In Situ Sampling at surface				
Column 1	Column 2	Column 3	Column 4	Column 5
Size of *in situ* area (m^2)	Number of systematic sampling points recommended	Distance between two sampling points (m)	Diameter of the hot spot that can be detected with 95% confidence (m)	Validation
500	5	10.0	11.8	Required
1000	6	12.9	15.2	
2000	7	16.9	19.9	
3000	9	18.2	21.5	
4000	11	19.1	22.5	
5000	13	19.6	23.1	
6000	15	20.0	23.6	
7000	17	20.3	23.9	
8000	19	20.5	24.2	
9000	20	21.2	25.0	
10,000	21	21.8	25.7	
15,000	25	25.0	28.9	
20,000	30	25.8	30.5	
25,000	35	26.7	31.5	
30,000	40	27.5	32.4	
35,000	45	27.9	32.9	
40,000	50	28.3	33.4	
45,000	52	29.3	34.6	
50,000	55	30.2	35.6	

Table 2 has been taken from NSW EPA 1995, *Contaminated Sites Sampling Design Guidelines*, NSW Environment Protection Authority.

Appendix 4 Historical Aerial Photographs

St Marys

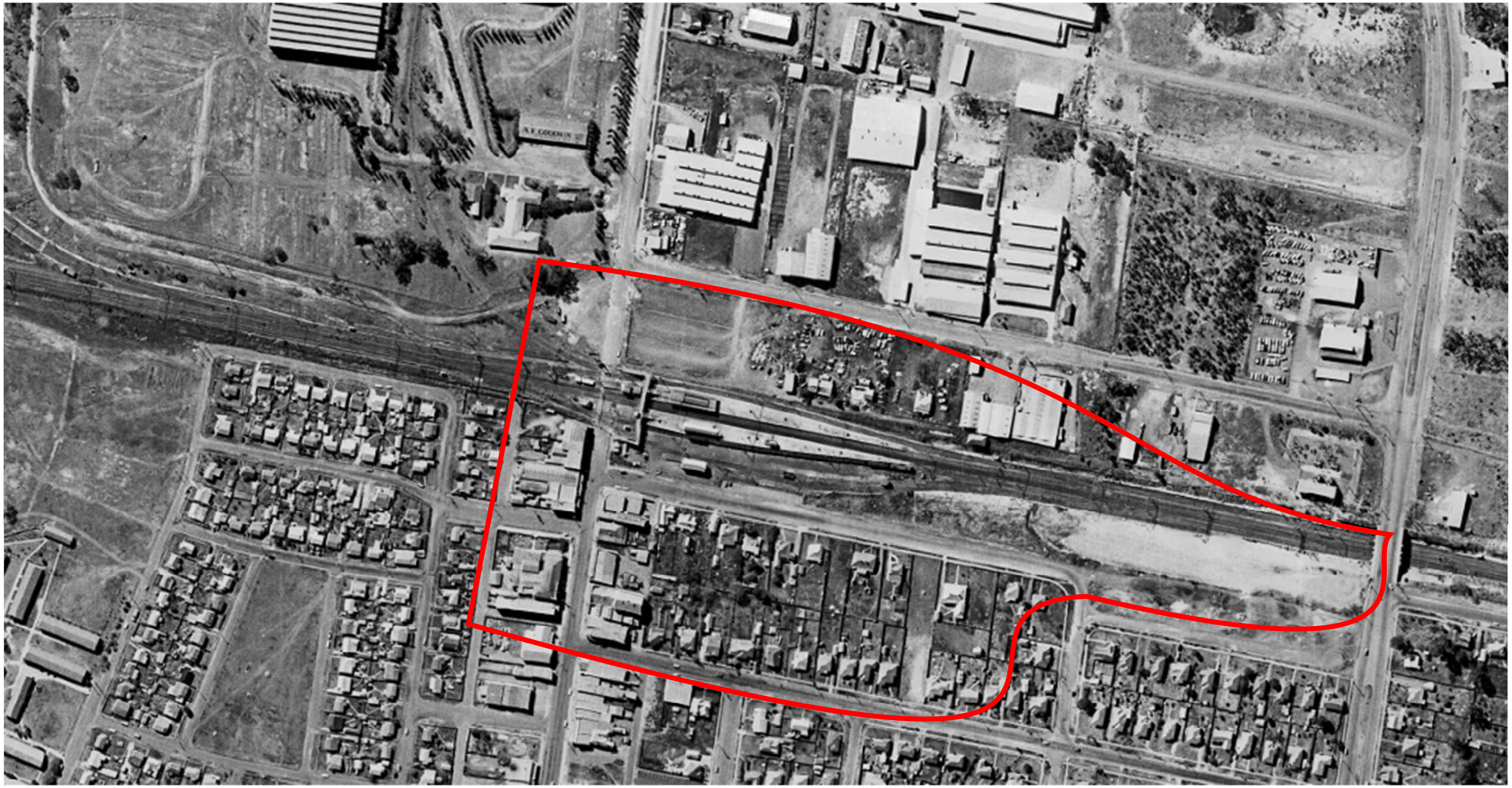


(Image source: https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery)

1943

Site Boundary (approximate)

St Marys



(Image source: https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery)

1965

Site Boundary (approximate)

St Marys

(Image source: https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery)

1975

Site Boundary (approximate)

St Marys

(Image source: https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery)

1978

Site Boundary (approximate)

St Marys

(Image source: https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery)

1984

Site Boundary (approximate)

St Marys

(Image source: https://www.spatial.nsw.gov.au/products_and_services/aerial_and_historical_imagery)

1986

Site Boundary (approximate)

St Marys

(Image source: Nearmaps)

1991

Site Boundary (approximate)

St Marys

(Image source: Nearmaps)

1998

Site Boundary (approximate)

St Marys

(Image source: Nearmaps)

2013

Site Boundary (approximate)

Appendix 8 Equipment Calibration Certificates

27/04/2022

PID Calibration Certificate

Instrument PhoCheck Tiger
Serial No. T-113994

airmet

Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments			
Battery	Charge Condition	✓				
	Fuses	✓				
	Capacity	✓				
	Recharge OK?	✓				
Switch/keypad	Operation	✓				
Display	Intensity	✓				
	Operation (segments)	✓				
Grill Filter	Condition	✓				
	Seal	✓				
Pump	Operation	✓				
	Filter	✓				
	Flow	✓				
	Valves, Diaphragm	✓				
PCB	Condition	✓				
Connectors	Condition	✓				
Sensor	PID	✓	10.6ev			
Alarms	Beeper	✓	Low	High	TWA	STEL
	Settings	✓	50ppm	100ppm	N/A	N/A
Software	Version	✓				
Data logger	Operation	✓				
Download	Operation	✓				
Other tests:						

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Calibration gas and concentration	Certified	Gas bottle No		Instrument Reading
PID Lamp		93ppm Isobutylene	NATA	SY361		92.8ppm

Calibrated by: [redacted]

Calibration date: **27/04/2022**

Next calibration due: **24/10/2022**

2/05/2022

PID Calibration Certificate

Instrument PhoCheck Tiger
Serial No. T-113967

airmet

Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
	Recharge OK?	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
Pump	Operation	✓	
	Filter	✓	
	Flow	✓	
	Valves, Diaphragm	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	PID	✓	10.6 ev
Alarms	Beeper	✓	Low: 50ppm; High: 100ppm; TWA: ; STEL:
	Settings	✓	
Software	Version	✓	
Data logger	Operation	✓	
Download	Operation	✓	
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Calibration gas and concentration	Certified	Gas bottle No		Instrument Reading
PID Lamp		93ppm Isobutylene	NATA	SY361		93.2

Calibrated by: [redacted]

Calibration date: 2/05/2022

Next calibration due: 29/10/2022

27/04/2022

PID Calibration Certificate

Instrument PhoCheck Tiger
Serial No. T-114174

Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments			
Battery	Charge Condition	✓				
	Fuses	✓				
	Capacity	✓				
	Recharge OK?	✓				
Switch/keypad	Operation	✓				
Display	Intensity	✓				
	Operation (segments)	✓				
Grill Filter	Condition	✓				
	Seal	✓				
Pump	Operation	✓				
	Filter	✓				
	Flow	✓				
	Valves, Diaphragm	✓				
PCB	Condition	✓				
Connectors	Condition	✓				
Sensor	PID	✓	10.6 ev			
Alarms	Beeper	✓	Low	High	TWA	STEL
	Settings	✓	50ppm	100ppm		
Software	Version	✓				
Data logger	Operation	✓				
Download	Operation	✓				
Other tests:						

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Calibration gas and concentration	Certified	Gas bottle No		Instrument Reading
PID Lamp		93ppm Isobutylene	NATA	SY361		92.8ppm

Calibrated by: [redacted]

Calibration date: 27/04/2022

Next calibration due: 24/10/2022

KENNARDS HIRE

EQUIPMENT CERTIFICATION REPORT

PGN9003871 WATER QUALITY METER – MULTIFUNCTION

Plant Number: 1082473

SENSOR	CONCENTRATION	SPAN 1	SPAN 2	TRACEABILITY	PASS
pH	pH 7.00 / pH 4.00	7.00 pH	4.00 pH	384001 371300	☑
Conductivity	2.76 mS/cm @ 25°C	2.76 mS/cm	12.88	381242	☑
Dissolved Oxygen	Sodium Sulphite / Air	0.0% in Sodium Sulphite	% Saturation in Air	11897	☑
ORP	240mV @ 25°C	240mV	Zobell Part A	Zobell Part B	☑

Battery Status 100 %	Temperature 19 °C
	Electrodes Cleaned and Checked

Note: Calibration solution traceability information is available upon request.

Please clean/decontaminate instrument and accessories before returning. A minimum 'Cleaning Fee' $55.00 (Inc GST) may apply if instrument is returned contaminated.

Checked By: [redacted] Date: 14/7/22 Signed: [redacted]

Accessories List:

User's Manual & USB	pH Sensor	Conductivity Sensor
Dissolved Oxygen Sensor with Wetting Cap	Redox (ORP) Sensor with Wetting Cap	Flow Cell 500ml
Comm Cable	Testing Cap	Storage Cap

KENNARDS HIRE

EQUIPMENT CERTIFICATION REPORT

PGN9003871 WATER QUALITY METER – MULTIFUNCTION

Plant Number: ______________________

SENSOR	CONCENTRATION	SPAN 1	SPAN 2	TRACEABILITY	PASS
pH	pH 7.00 / pH 4.00	7.00 pH	4.00 pH	# 371300 384001	☑
Conductivity	2.76 mS/cm @ 25°C	2.76 mS/cm		#381242	☑
Dissolved Oxygen	Sodium Sulphite / Air	0.0% in Sodium Sulphite	% Saturation in Air	#11897	☑
ORP	240mV @ 25°C	240mV	Zobell Part A #375760	Zobell Part B # 374424	☑

Battery Status 100 %	Temperature 18·2 °C
	Electrodes Cleaned and Checked

Note: Calibration solution traceability information is available upon request.

Please clean/decontaminate instrument and accessories before returning. A minimum 'Cleaning Fee' $55.00 (Inc GST) may apply if instrument is returned contaminated.

Checked By: [redacted] Date: 08 / 07/ 22 Signed: [redacted]

Accessories List:

User's Manual & USB	pH Sensor	Conductivity Sensor
Dissolved Oxygen Sensor with Wetting Cap	Redox (ORP) Sensor with Wetting Cap	Flow Cell 500ml
Comm Cable	Testing Cap	Storage Cap

Appendix 9 DQO, DQI and QA/QC Report

APPENNDIX 9

1. Data Quality Objectives

As stated in Section 18 Appendix B of Schedule B2 of the National Environment Protection (Assessment of Site Contamination) Measure 1999 ('ASC NEPM') (NEPC, 2013), the DQO process is a seven-step iterative planning approach used to define the type, quantity and quality of data needed to support decisions relating to the environmental condition of a site.

The seven-step DQO process adopted for assessment of soil and groundwater are provided in **Table 1.**

Table 1: Data Quality Objectives

1. State the problem	The site contains potential sources of contamination which may pose a constraint during construction and operation of the project. There is currently insufficient information to characterise the contamination which may be present at the site and may impact the project activities. Construction of the site has the potential to require the excavation of contaminated soil which requires disposal off-site or re-use on-site. This DSI is required to characterise the soil materials which are to be disturbed during construction to develop appropriate management requirements. Construction at the site has the potential to draw in groundwater which may be potentially contaminated from on-site and off-site sources during construction. This DSI is required which includes the investigation of groundwater quality to inform appropriate management requirements. An assessment of groundwater inflow is required to assess the extent to which groundwater will potentially be drawn into the site during construction[1].

[1] Note this assessment is being completed as part of a hydrogeological assessment.

2. Identify the decision	The key decisions include: • Is soil and groundwater contamination present at the site in consideration of the data gaps / uncertainties identified? • Is groundwater contamination present in the vicinity of the site which may be drawn into the excavation during construction? • Are volatile contaminants present in groundwater which require management during construction? • If contamination is present how likely is it to be disturbed during construction works? • Are potential sources of contamination identified likely to represent a constraint to the project with respect to construction and spoil management in relation to contamination? • Are remediation actions or management measures required to manage risks to human health and the environment related to contamination? • Is asbestos present which requires management during construction? And if asbestos is present, what is the condition of the material (i.e., bonded and / or friable)? If asbestos in soils is identified, is additional investigation required to assess potential risks to human health during construction, or can risks be controlled through implementation of an asbestos management plan and procedures outlined in SafeWork NSW codes of practice for asbestos related works?
3. Identify inputs to the decision	The primary inputs to assessing the above include: • Previous investigations (where applicable) • Information from CPBG to confirm the presence/location of the UST with the Bus Driver Rest Compound in the Station Box • Field observations including the presence of visual / olfactory indicators of contamination • Analytical data of sample media, and quality assurance / quality control (QA/QC) samples • Outcome of QA/QC samples • Nominated investigation levels / assessment criteria (refer to Section 7).
4. Define the boundaries of the study	The boundaries for the DSI are identified as follows: • Spatial Boundaries: The locations at which the soil samples are collected from (shown on Figures 1 to 3, Appendix 1) including the area of potential drawdown which is estimated to be up to 420 m surrounding the station box excavation. • Temporal boundaries: The status of the sampling points at the time of the investigation. • Constraints to the investigation will be considered and discussed in this DSI Report. • The vertical study boundary will be groundwater quality in the top two metres of groundwater below the water table. Soil materials were investigated to a maximum depth of 45 m bgs (refer to Section 8).

5. Develop a decision rule	The decision rules to be applied to this DSI include: • If the concentrations of analytes are below the adopted assessment criteria for samples representative of the exposure pathway, then the risk to human health and/or the environment can be considered to be acceptable for the intended land use. • If the concentrations of analytes are above the adopted assessment criteria for samples representative of the exposure pathway, then further assessment is required which may include the following: – review of the results in-conjunction with a refined CSM to consider if exposure pathways and associated representative concentrations represent an unacceptable risk to potential receptors for the intended land use. – completion of further investigations to refine the understanding of extent and magnitude of contamination. – use of statistics in the assessment of data to develop relevant exposure concentrations. – completion of a site-specific risk assessment to refine assumptions of intake to relevant specific site pathways and indicate whether the contamination poses an unacceptable risk to receptors. If the completion of the above determines there is an unacceptable risk to receptors, appropriate remediation and / or management actions would be developed to make the site suitable for its intended use. • The comparison of analytes concentrations with regulatory waste acceptance criteria to determine off-site transport and disposal requirements.

6. Acceptable limits on decision error	Decision errors are incorrect decisions caused by using data that is not representative of site conditions due to sampling or analytical error, or by assessing data against incorrect criteria. As a result, in this DSI a decision may be made that remediation / management is not needed when it is (false negative), or vice versa (false positive). There are three identified sources of decision error: • Sampling errors, which occur when the samples collected are not representative of the conditions within the investigation area. Sampling errors are reduced by collecting samples using industry standard methods, across material types and depths and ensuring a spatial distribution that will identify hot-spots of meaningful size. • Measurement errors, which occur during sample collection, handling, preparation, analysis and data reduction. Measurement errors are reduced by following industry standards (QA practices) and conducting quality control assessment (QC analysis). • Assumption errors, which occur when the assumptions that are used to develop assessment criteria do not accurately reflect the site setting, migration pathways or receptor behaviours. False negative assumption errors are typically reduced by using conservative assumptions in the initial data review, and then false positive errors are reduced by conducting refined risk assessment. To consider the potential for decision errors to have been made, an assessment of data quality indicators will be undertaken as described in Section 8.7 (including a QC assessment of the data collected). The closeness of the data to the assessment criteria will also be considered and the results presented in this Appendix.
7. Optimise the design for obtaining data	The methodology and rationale for obtaining relevant data for this DSI is described in Section 8 of this report. The methodology and analytical plan will be reviewed during the DSI based on site constraints, visual observations and interim review of results, in consultation with CPG.

2. Data Quality Indicators

Data Quality Indicators (DQIs) were used to show that the DQOs have been met. DQIs for the project were based on the field and laboratory considerations in Section 19.6 of ASC NEPM Schedule B2 Appendix B, which include:

- Completeness – a measure of the amount of useable data (expressed as %) from a data collection activity.
- Comparability – the confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event.
- Representativeness – the confidence (expressed qualitatively) that data are representative of each media present on the Site.
- Precision – a quantitative measure of the variability (or reproducibility) of data.
- Accuracy – a quantitative measure of the closeness of reported data to the true value; and
- The QA review included a check of performance against the DQIs.

The DQIs adopted for this investigation and means by which the were assessed is discussed in the following tables.

Table 2: DQI : Completeness

DQI	Field Considerations	DQI Criteria	Laboratory Considerations	DQI Criteria
Completeness	Critical locations sampled	Samples were collected from nominated locations with no deviation from the sampling plan, without reasonable justification.	Critical samples were analysed according to sampling plan.	Samples were analysed for COPCs described in Sections 6.1 and 8.3.
	Samples collected	Samples were collected in accordance with TTC's SOPs during the assessment.	Identified COPCs included.	As above.
	Standard Operating Procedures (SOPs) appropriate and complied with	No departure from TTC SOPs without reasonable justification.	Appropriate methods and LORs	Samples were analysed by NATA accredited laboratories, for the analyses to be performed and appropriate methods were used. LORs were less than assessment criteria.
	Experienced sampler	Experienced TTC Environmental Scientists conducted the sampling.	Sample documentation complete	Chain of custody's (COCs) were returned, signed and dated by laboratory. NATA endorsed laboratory certificates were completed in accordance with Schedule B3 of the ASC NEPM. Field logs were completed in accordance with TTC SOPs.
	Documentation correct	Samples were handled and transported under appropriate chain of custody (COC) documentation. TTC kept the original COC documentation. Sample Receipt Notifications (SRN) from the laboratory	Sample holding times were complied with.	Samples were analysed within holding times specified in Schedule B3 of the ASC NEPM.

DQI	Field Considerations	DQI Criteria	Laboratory Considerations	DQI Criteria
		were reviewed to assess that samples were received cool and in good condition. Current calibration certificates for the PID, & WQM were provided and the PID instrument was fresh air calibrated on a daily basis.		

Table 3: DQI Comparability

DQI	Field Considerations	DQI Criteria	Laboratory Considerations	DQI Criteria
Comparability	Same SOPs used on each occasion	TTC SOPs were implemented.	Same sample analytical methods were used.	The same NATA accredited laboratories were used to undertake analyses of primary, duplicate and triplicate samples collected for this study. The laboratories used the same analytical methods for each sample for each analytical parameter.
	Experienced sampler	Experienced TTC Environmental Scientists conducted the sampling.	Same sample LORs	As above
	Climatic conditions (temperature, rainfall, wind etc.)	TTC attempted to sample in similar climatic conditions, where practicable	Same laboratories and analytical methods were used	As above
	Same types of samples collected	Samples were collected in the appropriate laboratory supplied container specific to the analyses performed.	Same units	As above

Table 4: DQI Representativeness

DQI	Field Considerations	DQI Criteria	Laboratory Considerations	DQI Criteria
Representativeness	Appropriate media sampled according to sample plan	Samples were collected and analysed in accordance with TTC's SOPs.	Appropriate media sampled according to the endorsed SAQP.	Collected samples were analysed by NATA accredited laboratories.
	All media identified in sample plan	Samples were collected and analysed in accordance with TTC's SOPs.	-	-
	SOPs appropriate and complied	TTC's SOPs were implemented.	Analysis of field duplicates	Laboratory duplicates were analysed in general accordance with ASC NEPM. Duplicate and triplicate samples for both soil and groundwater were analysed.

Table 5: DQI Precision

DQI	Field Considerations	DQI Criteria	Laboratory Considerations	DQI Criteria
Precision	Appropriate SOPs were complied with	TTC's SOPs were implemented.	Analysis of laboratory duplicates	Relative Percent Differential (RPD) values for laboratory duplicates and recovery of matrix spikes were within acceptable ranges, with exceptions. Refer to tables attached in this Appendix.
	Analysis of field duplicates	As for laboratory considerations	Analysis of field duplicates	Duplicates were analysed at a frequency of greater than: • 1 intra laboratory duplicate and 1 inter laboratory triplicate sample per 20 primary samples. RPDs were calculated and compared to relevant acceptance criteria.

DQI	Field Considerations	DQI Criteria	Laboratory Considerations	DQI Criteria
				TTC adopted 30% for concentrations more than 10 times the LOR and 50% for concentrations less than 10 times the LOR (Standards Australia 1997)

Table 6: DQI Accuracy

DQI	Field Considerations	DQI Criteria	Laboratory Considerations	DQI Criteria
Accuracy	SOP appropriate and complied with	TTC SOPs were implemented	Same sample analytical methods were used.	The same NATA accredited laboratories were used to undertake analyses of primary, duplicate and triplicate samples collected for this study. The laboratories used the same analytical methods for each sample for each analytical parameter.
	Trip blanks	Trip blank samples were collected using laboratory supplied distilled water.	Field blanks	A laboratory prepared trip blank was included for each sample set (i.e., esky) where volatile compounds are requested for analysis (as defined in AS4482.2-1999 and Schedule B2 in the ASC NEPM). Analysis of the trip blank included TRH F1 and BTEX.
	Trip Spikes	Trip spikes were prepared by the laboratory and were carried into the field and transported with samples to the laboratory.	Method blank	Method blanks were analysed as recommended in Schedule B3 of the ASC NEPM. Results were less than LOR. Where method blanks were in excess of the LORs, justification for the use of such data was required or additional analysis was considered.
	Rinsate sample	Where reusable sampling equipment was utilised, a rinsate sample was collected using laboratory supplied distilled water. If rinsate sampling was not completed as part of	Rinsate sample	Where volatile compounds were requested for analysis (as defined in AS4482.2-1999 and Schedule B2 in the ASC NEPM, analysis of the trip blank included TRH F1 and BTEX.

DQI	Field Considerations	DQI Criteria	Laboratory Considerations	DQI Criteria
		the assessment, justification was provided.		
	-	-	Laboratory duplicate and Matrix spike	RPD values for laboratory control duplicates and recovery of matrix spikes were within acceptance limits.

Quality Assurance / Quality Control Report

1.1 INTRODUCTION

The sampling and analysis process (collection, transport and analysis) was guided by the sampling and analysis quality plan and conducted according to standard operating procedures (SOPs) in the field and in the laboratory as part of the quality assurance process, in order minimise the effect of natural and inherent variability and extraneous factors on data quality.

To measure the effectiveness of the quality assurance process, quality control (QC) samples are part of the field and laboratory procedures to assess both the accuracy and the precision of the results produced.

- Measures of ACCURACY are indicative of how close the reported results are to the true result. For practical reasons, measures of accuracy are usually confined to the laboratory procedures.
- Measures of PRECISION provide information on the variability in the results. Precision can be assessed as:
  - "repeatability" or intra-laboratory variation – the degree of variation in a result when the same laboratory analyses a sample (or blind replicate) several times, and;
  - "reproducibility" or inter-laboratory variation – the degree of variation in a result when a different laboratory separately analyses a sample.

The quality control was based on guidelines presented in:

- NEPC (2013); National Environment Protection (Assessment of Site Contamination) Measure 1999
- AS4482.1 Guide to the sampling and investigation of potentially contaminated soil, Part 1: Non-Volatile and Semi-volatile Substances.

The outcome of the Field and Laboratory quality control are presented in this Quality Assurance / Quality Control report.

1.2 FIELD QUALITY CONTROL

With reference to the Field Data Quality Indicators established for the project, TTMP note the following:

- Investigations were completed at all locations identified within the SAQP.
- Samples collected during the investigation were done so in general accordance with methods described within the SAQP and TTMP's Standard Operating Procedures (SOP). The SOPs were not modified during the investigation. Soil samples were collected directly off the auger flight. Given the predominant rural-residential land use setting, and the lack of field indicators to suggest volatile organic compounds were present (i.e., low soil headspace readings, no visual / olfactory indications of potential contamination), this minor deviation in the sampling method was unlikely to affect the data quality.
- The investigations were co-ordinated and implemented using consultants from TTMP who hold experience in conducting geo-environmental investigations, including procedures for collecting samples for chemical analysis. These consultants received a briefing in relation to the sampling procedures documented in the SAQP. These consultants also hold experience in the identification of materials suspected to contain asbestos.

- All samples were collected in clean containers supplied by the laboratory. The investigation collected soil samples from topsoil / fill and natural soils and weathered bedrock relative to the depth of excavation proposed for this project.
- Samples were stored in chilled, insulated containers and dispatched to the primary laboratory with chain of custody documentation. Scheduling of laboratory analysis was subsequently confirmed by the TTMP Field Manager / Contamination Lead.
- Equipment used in the field included Photo-ionisation Detectors (PID), which were calibrated by the equipment supplier at the commencement of the investigation. Each PID was fresh-air calibrated at the commencement of each day prior to use. Calibration records are provided in Appendix 8.

Field quality control samples were collected as outlined in the SAQP. The field QC included:

- Inter and Intra laboratory duplicates at a minimum frequency of one sample per twenty samples collected (5%). Repeatability will be assessed by calculating the relative percentage difference (RPD) between the primary and duplicate results. Tetra Tech has adopted the following acceptance criteria for RPD results on replicate samples:
    - 0-30% for concentrations more than 20 times the laboratory limit of reporting (LOR),
    - 0-50% for concentrations between 10 and 20 times the laboratory limit of reporting (LOR), and;
    - No limit for concentrations less than 10 times the LOR.
- Rinsate Blanks were prepared to check field decontamination procedures. Rinsate samples were collected and analysed for each day of field work carried out, where non-disposable sampling equipment was used. Results to be below the laboratory LOR for all analytes.
- Trip Blanks prepared by the laboratory were used to check on potential sample contamination arising from sample transport, shipping and site conditions. A trip blank will be used and analysed for a batch of samples released to the laboratory. Results to be not above the laboratory LOR for all analytes.
- Trip spikes prepared by the laboratory were used to check adequacy of sample preservation methods for volatile analytes. Trip spikes will be used at a rate of 1 sample per week during soil sampling/drilling if a source of hydrocarbons was observed on the site and when undertaking groundwater sampling

1.3 LABORATORY QUALITY CONTROL

Laboratory analysis was performed at laboratories with National Association of Testing Authorities (NATA) accredited procedures for the respective analysis. NATA accreditation demonstrates the ability of the lab to produce reliable, repeatable results for a range of parameters within a range of sample matrices against recognised benchmarks.

Each laboratory method used undergoes a validation process establishing the precision and accuracy of the method before it is adopted by the laboratory and accredited by NATA.

Laboratories conduct and report a range of internal quality control testing to indicate their performance on each reported batch of samples including lab duplicates, method blanks, control and matrix spikes and surrogates. The results of this testing are assessed against established acceptance criteria.

Laboratory quality control testing is described below:

- Laboratory duplicates are randomly selected intra-laboratory split samples that provide information regarding method precision and sample heterogeneity and are assessed by RPD according to:
    - 30% where the concentration is >20 x the laboratory limit of reporting (LOR);
    - 50% where the concentration is 10-20 the LOR; and
    - no limit where the concentration is <10 x the LOR.

- Method Blanks refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation to monitor potential laboratory contamination during analysis
- Laboratory control samples are certified refence materials spiked with target analytes to monitor method precision and accuracy independent of sample matrix
- Matrix Spike is an intra-laboratory split sample spiked with a representative set of target analytes to monitor potential matrix effects on analyte recoveries
- Surrogates are isotopically labelled analogues of target analytes used as internal standards are added to the sample container to be analysed and processed through the analytical process. The amount of spiked material is measured as the recovery of the added amount reported in the final result.

Schedule B(3) of the National Environment Protection Measure (NEPM) for contaminated sites states that, in general, at least 70% recovery should be achievable from a reference method. Additionally, standard methods prepared by international agencies such as the US EPA and APHA, frequently have performance data such as expected spike recovery incorporated within the method. Where these vary from the 70% figure indicated in the NEPM Schedule, they are noted in the discussion of results which follows this introduction.

Based on the above, Tetra Tech has adopted 50% - 150% as the default acceptable range for spike recovery and surrogates spike recovery results, and as the default acceptance limits for the difference between analysis results and the expected result for reference materials.

2. SAMPLING QC PROGRAMME

2.1 PRECISION / ACCURACY

	Yes	No (Comment below)
1. Was a NATA registered laboratory used?	☒	☐
2. Did the laboratory perform the requested tests?	☒	☐
3. Were the laboratory methods adopted NATA endorsed?	☒	☐
4. Were the appropriate test procedures followed?	☒	☐
5. Were the reporting limits satisfactory?	☒	☐
6. Was the NATA Seal on the reports?	☒	☐
7. Were the reports signed by an authorised person?	☒	☐

2.2 COMMENTS

Nil

Precision/Accuracy of the Laboratory Report	☒ Satisfactory ☐ Partially Satisfactory	☐ Unsatisfactory

2.3 SAMPLE HANDLING

	Yes	No (Comment below)
1. Were the sample **holding times** met?	☐	☒
2. Were the samples in **proper custody** between the field and reaching the laboratory?	☒	☐
3. Were the samples **properly and adequately** preserved? *This includes keeping the samples chilled, where applicable.*	☒	☐
4. Were the samples received by the laboratory in good condition?	☒	☐

2.4 COMMENTS

Sample Handling

A summary of issues identified with sample handling is presented below.

- 890462 - Samples not received: SBT-BH-1216_5.9-6.0 and SBT-BH-1216_6.9-7.0.
- ES2219959 - TRH/BTEX & 8 metals analysis was not added to sample 36 as the correct bottles was not received.
- ES2220621 - TRH/BTEX & 8 metals analysis was not added to sample 36 as the correct bottles was not received. Asbestos bag not received.
- ES2221024 – Sample Trip Blank-HK-14062022 was not received
- ES2222322 – TRH/BTEX/8Metals, PAH/Phenols was not done for sample 15 as incorrect sample jars provided for this batch.

Holding Times

Breaches of holding times were reported in the following lab reports as follows:

- Holding time breaches were reported in 890542 and relate to samples collected at Orchard Hills and not St Marys. The holding time breaches are discussed in the DSI report for Orchard Hills.
- 887346.
  - Three soil samples exceeded holding times for VOCs by 7-days. This are considered to be minor breaches based on no visual/olfactory signs of hydrocarbon contamination being observed in samples and PID screening data.
  - Holding times for TRH/BTEX, PAH/Phenols, and OCP/OPP, and SVOC exceeded holding times by 1-day and is considered to be a minor breach
  - Trip Spike included for batches 887346 had recoveries within acceptance criteria.
- 890081 is a re-batch with additional analysis for TRH/BTEX and PAH analysis of 887346. Holding times were exceeded by 16-days for TRH/BTEXN analytes and 9 days for PAH/Phenols. Holding breaches for TRH/BTEXN are considered unlikely to have affected the validity of the results

based on no visual/olfactory signs of hydrocarbon contamination being observed in samples and PID screening data. PAH/Phenol holding time exceedance are considered to be minor for similar reasons. Trip Spike included in batch 890081 had recoveries within acceptance criteria.

- 888591
  - Holding times were exceeded by 5 days for VOC analytes in 1 soil sample. This is considered to be a minor breach noting that no visual/olfactory signs of hydrocarbon contamination were observed and PID screening data.
  - Holding time breaches greater than >7 days were reported for TRH/BTEX in the rinsate sample.
- 890462
  - Holding times were exceeded by 5 days for VOC analytes in 3 soil samples. This is considered to be a minor breach noting that no visual/olfactory signs of hydrocarbon contamination were observed and PID screening data.
- 890019
  - Holding times were exceeded by 6 days for VOC analytes in 1 soil samples This is considered to be a minor breach noting that no visual/olfactory signs of hydrocarbon contamination were observed and PID screening data.
  - Holding times were exceeded by 3 days for TRH/BTEX and is considered to be a minor breach.
- 890608
  - Holding times were exceeded by 9 days for VOC analytes in 5 soil samples, and TRH/BTEX and PAH/Phenols by 6 days. These are considered to be minor breaches noting that no visual/olfactory signs of hydrocarbon contamination were observed. Results for semi-volatile PAH compounds (excluding naphthalene) are unlikely to have been affected.
  - Holding times for OCP/OPPs were exceeded by 2-days in soil samples and is a minor breach.
  - Holding times were exceeded by 7-days in the TRH/BTEX, PAH/Phenols, OCP/OPPs in the water (rinsate samples).
  - Trip Spike included in batch 890608 had recoveries within acceptance criteria.
- 890542
  - Samples were collected on the 17/5 and an analytical schedule submitted on the 19/5. Holding times were exceeded by 16 days for VOC analytes in 24 soil samples. TRH/BTEX and PAH/Phenols, and OC/Ops and SVOCs by 9 days. Results for semi-volatile PAH compounds (excluding naphthalene), OCP/OPPs are unlikely to have been affected. Noting that no visual/olfactory signs of hydrocarbon contamination were observed and no elevated PID readings were reported these exceedances are considered unlikely to have affected the validity of the results.
  - Rinsate sample exceeded holding times by 3-days for TRH/BTEX and is considered to be a minor breach
- 896807
  - PFAS exceeded holding time by 13 days and is considered a minor breach
  - Chromium VI exceeded holding time by 13-days and 6-days in two samples and is considered to be a minor breach based on this analyte not being a contaminant of concern.
  - The laboratory incorrectly tested a sample for TRH and exceeded holding times.
- 900266 and 907116
  - Holding times for BTEX, TRH, SVOCs were exceeded (>14 days) by 3 days and for VOCs (>7 days) by 10 days. This affected only two interlab QC samples.
- 904101, 904106 and 914623

  - Were for follow up TCLP analysis and were outside holding time. TCLP analysis was only for metals or PFAS, so this is not expected to affect results
- 905539
  - Samples analysed for the NEPM screen as follow up analysis. Holding times were exceeded for the determination of physical parameters. This is not expected to affect interpretation of results.
- 906170
  - Holding times were exceeded by 1 day for BTEX, TRH, PAH and Phenols, OPP/OCPs and PCBs. This is considered a minor breach and affected only an interlab triplicate sample.

- ES2217772 - PCBs, OPPs, OCPs, Phenols, PAHs, TRH/TPH 1 days overdue for extraction and is considered to be a minor breach.
- ES2218225 (inter-laboratory duplicates for 890542)
  - Fumigants, Halogenated Aliphatic Compounds, Halogenated Aromatic Compounds, Trihalomethanes, Sulfonated Compounds 9 - 10 days overdue for extraction and analysis
  - Phenols, PAHs, Phthalate Esters, Nitrosamines, Nitroaromatics and Ketones, Haloethers, Chlorinated Hydrocarbons, Anilines and Benzidines, Organochlorine Pesticides, Organophosphorus Pesticides 1 -2 days overdue for extraction and is considered a minor breach.
  - TRH,TPH, BTEXN 1 - 3 days over for extraction and /or analysis and is considered a minor breach.
- ES2218744 - TPH/TRH 3 days over for extraction and is considered to be a minor breach.
- ES2219634 –
  - Monocyclic Aromatic Hydrocarbons, Oxygenated Compounds, Sulfonated Compounds, Fumigants, Halogenated Aliphatic Compounds, Halogenated Aromatic Compounds, Trihalomethanes, 10 days overdue for extraction and 11 days for analysis
  - Phenols, PAHs, Phthalate Esters, Nitrosamines, Nitroaromatics and Ketones, Haloethers, Chlorinated Hydrocarbons, Anilines and Benzidines, Organochlorine Pesticides, Organophosphorus Pesticides 3 days over for extraction and is considered to be a minor breach.
  - TRH,TPH, BTEXN 3 days over for extraction and is considered to be a minor breach
- ES2219959 –
  - Monocyclic Aromatic Hydrocarbons, Oxygenated Compounds, Sulfonated Compounds, Fumigants, Halogenated Aliphatic Compounds, Halogenated Aromatic Compounds, Trihalomethanes,1 day exceedance for extraction and is considered to be a minor breach
  - Soil pH 2-day exceedance for extraction 1 days for analysis
- ES2220387 –
  - Oxygenated Compounds, Sulfonated Compounds, Fumigants, Halogenated Aliphatic Compounds, Halogenated Aromatic Compounds, Trihalomethanes,2-day exceedance for extraction is considered to be a minor breach
  - TPH/TRH 1 day over for extraction
- ES2220621 –
  - Soil pH 1:5 3-day exceedance for extraction 1 days for analysis
  - Monocyclic Aromatic Hydrocarbons, Oxygenated Compounds, Sulfonated Compounds, Fumigants, Halogenated Aliphatic Compounds, Halogenated Aromatic Compounds, Trihalomethanes, 3 days overdue for extraction and is considered to be a minor breach.
- ES2221024 –

  - Acidity suite (Actual acidity, potential acidity, ANC, retained acidity, ABA 9 days over for extraction (note these holding times are for acid sulfate soil and not the rock samples collected. Holding times for these tests will be discussed in a separate report.)
  - Total Sulfur 3-day exceedance for extraction (note these holding times are for acid sulfate soil and not the rock samples collected. Holding times for these tests will be discussed in a separate report.)
  - Monocyclic Aromatic Hydrocarbons, Oxygenated Compounds, Sulfonated Compounds, Fumigants, Halogenated Aliphatic Compounds, Halogenated Aromatic Compounds, Trihalomethanes, 2-day exceedance for extraction and is considered to be a minor breach.
- ES2221376 –
  - Acidity suite (Actual acidity, potential acidity, ANC, retained acidity, ABA 10 days over for extraction
  - Total Sulfur 1 day exceedance for extraction
  - Note these holding times are for acid sulfate soil and not the rock samples collected. Holding times for these tests will be discussed in a separate report.
- ES2221560 – Soil pH 1:5 1 day overdue for analysis
- ES2222045 –
  - Soil pH and EC 1:5 2 day overdue for analysis
  - Acidity suite (Actual acidity, potential acidity, ANC, retained acidity, ABA 13 days overdue for extraction (note these holding times are for acid sulfate soil and not the rock samples collected. Holding times for these tests will be discussed in a separate report.)
  - Total Sulfur 6 days exceedance for extraction (note these holding times are for acid sulfate soil and not the rock samples collected. Holding times for these tests will be discussed in a separate report.)
  - Monocyclic Aromatic Hydrocarbons, Oxygenated Compounds, Sulfonated Compounds, Fumigants, Halogenated Aliphatic Compounds, Halogenated Aromatic Compounds, Trihalomethanes, 6 day exceedance for extraction. This sample was from rock and visual/olfactory signs of contamination were not observed in the sample.
- ES2222322 - Soil pH and EC 1:5 4 day overdue for analysis
- ES2222608 –
  - Acidity suite (Actual acidity, potential acidity, ANC, retained acidity, ABA 9 days overdue for extraction
  - Total Sulfur 2 days exceedance for extraction
  - Note these holding times are for acid sulfate soil and not the rock samples collected. Holding times for these tests will be discussed in a separate report.
- ES2223290 - ZHE TCLP Leach 18 days overdue for extraction. Rebatch of samples for follow up TCLP
- ES2224284 – NEPM Screen Rebatch of existing samples
  - Soil pH 1:5 - 4 -47 days overdue for extraction and 2 days over for analysis of some samples
  - Moisture Content 5 - 36 days overdue for analysis
  - Exchangeable Cations on Alkaline Soils 5-6 day exceedance for extraction 5-6 days for analysis
  - Exchangeable Cations 3 and 26 days overdue for extraction and analysis
  - Organic Matter 1 and 23 days overdue for extraction and analysis
- ES2225339 - Non-Volatile Leach 16 days overdue for extraction. Rebatch of samples for follow up TCLP
- ES2224077 - Soil pH 4 days overdue for analysis. This is considered a minor breach.

- ES2224460 and ES2224655 - Acidity suite (Actual acidity, potential acidity, ANC, retained acidity, ABA 9 and 7 days overdue for extraction respectively (note these holding times are for acid sulfate soil and not the rock samples collected. Holding times for these tests will be discussed in a separate report.)
- ES2224899 and ES2225177 - Soil pH 1 days overdue for analysis. This is considered a minor breach.
- ES2225851 –
  - Acidity suite (Actual acidity, potential acidity, ANC, retained acidity, ABA 13 days overdue for extraction
  - Total Sulfur 2 days exceedance for extraction
  - Note these holding times are for acid sulfate soil and not the rock samples collected. Holding times for these tests will be discussed in a separate report.
- ES2226430 – Nitrogen and Phosphorus analyses 4 -10 days overdue for extraction and/or analysis
- ES2226605 - Nitrogen and Phosphorus analyses 4 - 5 days overdue for extraction and/or analysis
- ES2226987 - Nitrogen and Phosphorus analyses 2 - 3 days overdue for extraction and/or analysis
- ES2229520 – Analysis 1 day overdue for TOC analysis. This is considered a minor breach

Summary

- The above sample handling breaches do not impact the overall integrity of the analytical results of this investigation for following reasons:
  - Field data was found to correlate with laboratory results (e.g., no detect volatile organics correlate reasonably well with field data such as a lack of staining/odours and low soil headspace readings).
  - there was at least 1 duplicate in 10 primary samples; and
  - RPDs were generally within the acceptance criteria.

Sample Handling was:	☒ Satisfactory	☐ Unsatisfactory
	☐ Partially Satisfactory	

3. FIELD QA/QC

3.1 FIELD QC SAMPLE SUMMARY

	Soil	Water
Number of Primary samples analysed	270	30
Number of days sampling	36	
Field Duplicates / Triplicates (at least 1 in 20 samples)	34/21	2
Trip Blanks/Field Blanks (at least 1/day or sampling event)	25	21

Trip Spikes	2	1
Rinsate Blanks (at least 1/day/matrix/equipment)	-	43

Duplicate / Triplicate samples were collected at the required rate of 1:10 in soil and 1:30 in water[1]. In some cases the triplicate samples were also submitted to the primary lab and were considered as duplicate samples.

The field program for St Marys was delivered as part of a larger field program for the SBT Project. Trip blanks and/or field blanks were generally included with each batch of samples submitted each day from the field program. Trip Blanks were not collected on the 12/05/2022, 07/07/2022 and the 13/07/2022. The trip blank collected for the 9/05/2022, 3/06/2022 and the 20/06/2022 were not received at the lab.

With consideration to ground investigation findings (through visual, olfactory and PID head space analysis) greater emphasis was placed on the collection and analysis of blank samples for PFAS. PFAS is present at St Marys and other project sites within the SBT Project footprint.

Three trip spikes were collected during the field program and recoveries were within acceptable limits. However, as no source of hydrocarbons was observed on the site trip spikes were subsequently omitted from the program.

3.2 FIELD DUPLICATES

	Yes	**No** (Comment below)
A. Were an <u>Adequate Number</u> of field duplicates analysed?	☒	☐
B. Were RPDs within Control Limits? (30 % if >20 x LOR, 50% if 10-20 LOR)	☒	☐

Comments:

- Where RPDs were outside the acceptable range, sampling procedures, laboratory analytical methods, laboratory results were investigated. The results of this review are presented in Table 3.1 below.
- RPDs have not been listed below for concentrations less than 10 times the LOR.

Table 3-1: RPDs outside acceptance criteria

Primary Sample	Field / Inter- Lab Duplicate	Laboratory	Analyte	RPD	Explanation
SBT-BH1204_0.5-0.6	QC5-DW-04052022	Eurofins	Copper	57	2
			Nickel	122	2
			Zinc	139	2
SBT-BH1204_0.5-0.6	QC6-DW-04052022	ALS	Nickel	58	2

1

			Zinc	66	2
SBT-BH1207_0.5-0.6	QC7-DW-04052022	Eurofins	Zinc	43	3
	QC8-DW-04052022	ALS	Zinc	38	3
SBT-BH1205_0.5-0.6	QC1-SY-05052022	Eurofins	Arsenic	73	2
			Chromium	98	2
SBT-BH1208_0.5-0.6	QC22-JY-11052022	ALS	Chromium	67	2
			Copper	57	2
			Nickel	51	2
SBT-BH-6230_0.0-0.1	QC26-JY-16052022	ALS	Copper	62	2
			Nickel	67	2
			Zinc	55	3
SBT-BH-1007_0.2-0.4	QC3-RF-17052022	Eurofins	Nickel	76	2
	QC4-RF-17052022	ALS	Zinc	53	3
SBT-BH-1220_0.0-0.1	QC70-DW-23052033	Eurofins	Copper	80	2
SBT-BH-1009_3.0-3.1	QC8-PD-01062022	Eurofins	Arsenic	120	2
			Chromium	63	2
			Zinc	123	2
SBT-CM-1020_0.1-0.2	QC43-JY-09062022	ALS	Nickel	44	2
SBT-GW-1019_0.10-0.2	QC46-JY-10062022	Eurofins	PFOS	33	2
SBT-BH-1233_0.50-1.0	DUP2006-1233-2-JB20062022	Eurofins	Chromium	114	2
			Copper	110	2
			Nickel	169	2
SBT-BH-1213_0.00-0.2	QC2-PK-13072022	ALS	Chromium	67	3
SBT-CM-1022_0.00-0.05	QC2-PK-14072022	Eurofins	Chromium	56	2
		ALS	Lead	43	2
SBT-BH-1211_0.30-0.5	QC6-PK-15072022	ALS	Chromium	57	3
	QC5-PK-15072022	ALS	Chromium	57	3
SBT-BH-1212_0.00-0.2	QC4-PK-15072022	ALS	Chromium	60	3
	QC3-PK-15072022	ALS	Chromium	36	2
			Lead	135	3
			Nickel	96	2
MW1_2.00-0.0	26722-T	Eurofins	Perfluoroheptane sulfonic acid (PFHpS)	64	3

1. RPDs have not been considered for results that are combinations of multiple analytes (e.g., TRH C6 C10 minus BTEX, Sum of PFAS).
2. The duplicate/split result has reported a higher concentration for an analyte where both results are below the adopted criteria. The variance in the results is considered to be due to the nature and heterogeneity

of sample matrix. As the presence of impact has been identified with other analytes the overall outcome is unchanged.

3. The primary result has reported a higher concentration for an analyte where both results are below the adopted criteria. As the presence of impact has been identified with other analytes the overall outcome is unchanged.

RPDs for all other analytes were within the acceptable range.

3.3 TRIP BLANKS

	Yes	No (Comment below)
A. Were an <u>Adequate Number</u> of trip blanks collected?	☒	☐
B. Were the Trip Blanks free of contaminants? (If no, comment whether the contaminants present are also detected in the samples and whether they are common laboratory chemicals.)	☒	☐

Field QA/QC was:	☒ Satisfactory	☐ Unsatisfactory
	☐ Partially Satisfactory	

Comments:

Trip Blank were used for each batch of samples submitted to the lab. No target analytes were reported above the LOR for Trip Blank samples.

3.4 FIELD BLANKS

	Yes	No (Comment below)
A. Were an adequate number of Field Blanks collected?	☒	☐
B. Were the Field Blanks free of contaminants? (If no, comment whether the contaminants present are also detected in the samples and whether they are common laboratory chemicals.)	☒	☐

Field QA/QC was:	☒ Satisfactory	☐ Unsatisfactory
	☐ Partially Satisfactory	

Comments:

With consideration to ground investigation findings (through visual, olfactory and PID head space analysis) greater emphasis was placed on the collection and analysis of blank samples for PFAS. PFAS is present at St Marys and other project sites within the SBT Project footprint.

3.5 EQUIPMENT RINSATE SAMPLES

	Yes	No (Comment below)
A. Were an adequate number of Rinsate Samples collected?	☒	☐
B. Were the Rinsate Samples free of contaminants? (If no, comment whether the contaminants present are also detected in the samples and whether they are common laboratory chemicals.)	☐	☒

Field QA/QC was:	☒ Satisfactory ☐ Partially Satisfactory	☐ Unsatisfactory

Comments:

Rinsates were collected during sampling where equipment was reused (Auger, Hammer, Tube). Several rinsate samples reported relatively low concentration of the metals Chromium, Lead, Copper, Nickel and Zinc (<0.15mg/l). Arsenic was reported at very low concentrations (<5 µg/l) in 6 samples and cadmium (<0.0004 mg/l) in two samples.

Metals in the rinsate samples is potentially attributed to the rinsate water provided by the laboratory rather than decontamination procedures based on the analytical results for PFAS and/or may reflect minor residue on equipment after decontamination.

Five rinsate samples reported low concentrations of TPH/TRH (0.06 - 0.2mg/l), which was reported in some of the soils sampled and may reflect minor residue on equipment after decontamination.

One rinsate sample reported low concentrations of trans-1,2-dichloroethene (15 µg/L), which was not reported in the analysed primary samples. One rinsate sample reported low concentrations of OCPs Heptachlor (0.2 µg/L) and Methyl parathion (2 µg/L) and only one QC sample reported concentrations of OCPs in analysed primary samples.

One rinsate sample collected before augering related to lab report ES2226806 reported Chlorinated Hydrocarbons Bromodichloromethane (12 µg/L) and Chloroform (50 µg/L), which may reflect residual contamination on the auger or were potentially sourced from the rinsate water (these compounds are also biproducts of chlorination).

One rinsate sample related to batch ES2220621 reported a low concentration Tetrachloroethene (15 µg/L)
One rinsate sample reported the presence of PFOS at 0.0011 µg/l, which was related to lab report ES2226605 .

The above results are not considered to have affected the validity of the site investigation results.
PFAS was not detected in the rinsate samples collected.

The above results are not considered to have affected the validity of the site investigation results.

3.6 LABORATORY QUALITY CONTROL PROCEDURES

As noted in Section 1.3, laboratories conduct their own quality control testing to indicate their performance on each reported batch of samples. The following section assesses the adequacy of these procedures.

	Yes	No (Comment below)
1. Were the laboratory blanks/reagents blanks free of contamination?	☐	☒
2. Were the spike recoveries within control limits? • Eurofins:Organics (70% to 130%), Phenols (25%- 140%), PFAS (50 – 150%) and metals (80% to 120%) • ALS: control limits vary by specific compound	☐	☒
3. Were the RPDs of the laboratory duplicates within control limits?	☐	☒
4. Were the surrogate recoveries within control limits?	☐	☒

3.7 COMMENTS

Lab Blanks

890608 - Perfluoropropanesulfonic acid (PFPrS) 0.1µg/kg. Some PFAS detections were in samples were 0.1 µg/kg.

Lab control spikes

The following were reported outside the lab control limits:

ES2218225

- 3-nitroaniline (31.5 - 93.7) 94.2%

ES2219959

- 4-(dimethylamino) azobenzene(48 -108) 110%
- 1-naphthylamine(18 - 112) 119%
- Benz(a)anthracene(59 - 115) 118%
- Chrysene(61 - 117) 126%
- Fluoranthene(58 - 114) 116%
- Pentachlorophenol(12 - 76) 81.8%
- Endosulfan II(65 - 115) 118%

- Ethion(62 - 118) 119%
- Chlorobenzilate(57.4 - 112) 114%
- Butyl benzyl phthalate(62 - 116) 120%
- Bis(2-chloroethyl)ether(69 - 112) 66.6%
- Methapyrilene(23.3 - 125) 14.8%
- 2,4-Dimethylphenol(50 - 94) 41.1%
- 2-Picoline(41 - 109) 37.5%

ES2220387
- 2-nitroaniline(52-112) 118%
- 3-nitroaniline(31.5-93.7) 95.6%
- Acenaphthylene(56-114) 117%
- 2,6-dinitrotoluene(58-118) 121%
- 2,4,5-Trichlorophenol(49-107) 108%
- 2,4,6-Trichlorophenol(49-109) 110%
- Dimethyl phthalate(60-118) 120%

ES2220621
- 3-nitroaniline(31.5-93.7) 94.7%
- 2,4-Dichlorophenol(47-105) 106%

ES2221024
- Dimethoate(63-119) 47.7%
- Bis(2-ethylhexyl) phthalate(69-133) 63.9%
- 4-Nitroquinoline-N-oxide(40-96) 98.4%
- Bis(2-chloroethyl)ether(69.1-112) 62%
- Methapyrilene(23.3-125) 21.6%
- 2,4-Dimethylphenol(50-94) 33.8%

ES2221376
- Bis(2-chloroethyl)ether(69.1-112) 65%
- Methapyrilene(23.3-125) 23.2%
- Phenacetin(57.8-101) 109%

ES2221560

- 2-(acetylamino) fluorene(58-114) 52.8%
- 4-Nitroquinoline-N-oxide(40-96) 103%
- Nitrobenzene(68.3-112) 67.6%
- 2,4-Dimethylphenol(50-94) 20.8%

ES2222045

- Phenacetin(62-114) 115%
- 3-nitroaniline(31.5-93.7) 94.5%

ES2224460 - Di-n-octyl phthalate (62 - 124) 60.2%.

ES2226430 –
- Pentachlorophenol (12.8 - 95) 96.5%.
- 1-naphthylamine (104 - 46.8) 102%.

ES2226605
- Bis(2-chloroethyl) ether (69.1-112%) 68.9 %

ES2226974 –

- 2,4-Dimethylphenol (13.7 - 108) 114%
- 2-nitroaniline (52 – 112) 118%
- 3-nitroaniline (31.5 - 93.7) 95.7%
- 4-nitroaniline (42-112) 117%
- 4-Nitroquinoline-N-oxide (10- 87) 92.2%

ES2226987 - Bis(2-chloroethyl) ether (69.1-112%) 68.9%

Matrix spikes

887346

- Recovery of Mevinphos (OPP) 160%. Lab explanation Q08 - The matrix spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference. OPPs were < LOR in samples.

890019

- Recoveries of Benz(a)anthracene 57% Lab explanation Q08 - The matrix spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference.

890462

- Recovery of N-Methylperfluorooctanesulfonamidoethanol (N-MeFOSE) 53%. Low PFAS concentrations detected in samples.

890608

- Recovery of Dimethoate (OPP) 62%. Lab explanation Q08 - The matrix spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference. OPPs <LOR in samples.

907116

- Recovery of Copper (62%) was below limit. Lab explanation Q08 - The matrix spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference.

ES2216436, ES2218225, ES2226974

- Perfluorooctane sulfonic acid (PFOS) MS recovery not determined, background level greater than or equal to 4x spike level.
-

ES2221560

- PFAS compounds "MS recovery not determined, background level greater than or equal to 4x spike level.

ES2224899

- Mercury (70.0-130%) 59%. Recovery less than lower data quality objective. Poor matrix spike recovery was obtained for Mercury on sample ES2221268 # 5. Confirmed by re-analysis. Mercury was below LOR in analysed samples.

ES2226430, ES2226605 and ES2226987

- Recoveries were not determined for Sulfate and Chloride as background level greater than or equal to 4x spike level.

ES222950

- Recoveries were not determined for Chloride, Ammonia, Total Kjeldahl Nitrogen, Total Phosphorus, Reactive Phosphorus and Methane as background level greater than or equal to 4x spike level.

The following lab duplicates reported RPDs above the criteria.

Batch	Analyte	RPD
ES2221560	Zinc	27.7%
	Copper	70%
	Lead	58%
	Zinc	41%
	Azinphos-methyl	200%
	Chromium	46%
	Zinc	36%
	TRH C6-C9	54%
	TRH C6-C10	53%
890542	TRH C29-C36	42% Q15
	TRH >C34-C40	57% Q15
	Perfluorooctanesulfonic acid (PFOS)	54% Q15
	TRH C10-C14	200% Q15
	TRH C15-C28	170% Q15
	TRH >C10-C16	200% Q15
	TRH >C34-C40	150% Q15
887346	Zinc	32% Q15
888591	TRH C29-C36	54% Q15
	Arsenic	46% Q15
	Zinc	44% Q15
890019	Chromium	78% Q15
	Arsenic	45% Q15
	Chromium	32% Q15
890462	TRH C29-C36	54% Q15
	Chromium	32% Q15
891496	TRH C10-C14	64% Q15
	TRH C15-C28	54% Q15
	TRH >C10-C16	67% Q15
	TRH >C16-C34	41% Q15
900266	Arsenic	31% Q15
905539	Total Organic Carbon	200% Q15
907116	Lead	35% Q02
ES2225179	Lead	25.3%
ES2225407	Zinc	29.8%

ES2226987	Chromium	39.7%
	Zinc	47.4%

The Eurofins note Q15 applied to the RPD exceedances above as indicated. Q15 notes the RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria. The Eurofins note Q02 applied to the RPD exceedances above indicates that further analysis identified sample heterogeneity as the cause.

RPD results that are outside recommended control limits (0-30%) are considered acceptable as they meet the guidelines outlined in Australian Standard AS 4482.1 – 2005 and section 1.2 of this report.

Surrogate

Lab reports indicated that no surrogate recovery outliers occurred for ALS reports.

Some phenol and OCP compounds reported recoveries slightly above or below the limits in Eurofins batches. PFAS surrogates were sometimes reported outside the limits of 50 – 150%, however as surrogate recoveries are used to correct PFAS these do not affect interpretation of the data.

QC Control sample frequency outliers

Some outliers were identified (<5% or <10%) for TRH, PFAS, PAH, metals and phenols and other VOCs, in laboratory duplicates and matrix spikes in some batches, however, are not considered a significant issue.

5. The laboratory internal QA/QC was:	☒ Satisfactory	☐ Unsatisfactory
	☐ Partially Satisfactory	

4. DATA USABILITY

Data Directly Usable ☒

Data Usable with the following corrections/modifications (see comment below) ☐

Data Not Usable. ☐

In summary a number of non-conformances were identified in the QA/QC data. These however are not considered to preclude the use of the analytical data for this investigation.

Appendix 11 MIP Survey Locations and Report

FIELD DATA ACQUISITION

WITH DIRECT SENSING TOOLS

Site:

1 Queen Street, St Marys, New South Wales 2760

Prepared by:

Legion Drilling Pty Ltd (trading as Numac)

For:

Tetra Tech Coffey

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Email: info@numac.com.au Website www.numac.com.au Ph: 1300 131 019

DOCUMENT CONTROL SHEET

Project Number:	SYDGE292575
Client:	Tetra Tech Coffey
Report Title:	Field data acquisition with direct sensing tools
Report Author:	[redacted]
Report Reviewers:	[redacted]
Project Summary:	This report presents the results of an investigation using the Membrane-Interphase & Hydraulic Profiling Tool at a site located 1 Queen Street, St Marys, New South Wales.

Document preparation and distribution history

APPROVAL RECORD			
Issue No:	**Name**	**Date**	**Position Title**
Prepared By:	[redacted]	**20/06/2021**	**Direct Sensing Manager and Field Technician**
Reviewed By:	[redacted]		**Direct Sensing and Remediation Technician**
Approved By:	[redacted]		**Managing Director**

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ABBREVIATIONS AND SYMBOLS

Term	Definition
EC	Electrical Conductivity
FID	Flame Ionisation Detector
GC	Gas Chromatograph
HPT	Hydraulic Profiling Tool
HRSC	High-Resolution Site Characterisation
LIF	Laser-Induced Fluorescence
MiHPT	Membrane-Interface & Hydraulic Profiling Tool
MIP	Membrane-Interface Probe
MTBE	Methyl Tert-Butyl Ether
mBGL	Metres Below Ground Level
NAPL	Non-Aqueous Phase Liquid
PCB	Polychlorinated Biphenyl
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PID	Photoionisation Detector
Q/P_{inj}	Ratio between HPT flow rate and injection-induced pressure
QA/QC	Quality Assurance/Quality Control
SOPs	Standard Operating Procedures
SP16	Screen Point 16
TCE	Trichloroethylene
UVOST	Ultra-Violet Optical Screening Tool
VOCs	Volatile Organic Compounds
XSD	Halogen Specific Detector

1 INTRODUCTION

1.1 Background

Tetra Tech Coffey engaged Legion Drilling Pty Ltd (Numac) to investigate the subsurface conditions at a site located 1 Queen Street in St Marys, New South Wales.

The direct sensing campaign was conducted between 7 and 8 June 2022 after completing the plant assessments on 6 June 2022. A total of eight locations were probed using the Membrane-Interface & Hydraulic Profiling Tool (MiHPT) to depths ranging from 3.98 to 8.84 metres Below Ground Level (mBGL). A Geoprobe® 7720DT direct-push rig was used to advance the MiHPT at all locations.

From the information provided by Tetra Tech Coffey, the site was potentially affected by chlorinated compounds and the subsurface materials primarily comprised sedimentary deposits with high content of clay. The water table was shallow and the ground was relatively level in the area investigated.

1.2 Purposes

The purposes of this investigation using MiHPT included:

- Obtaining data relating to the vertical and lateral delineation of any Volatile Organic Compounds (VOCs);
- Providing an additional line of evidence supporting the presence or absence of Non-Aqueous Phase Liquid (NAPL) in the subsurface; and
- Acquiring additional data for the characterisation of the hydrostratigraphic profile.

2 SITE ACTIVITIES

2.1 Tasks

The tasks undertaken by Numac were as follows:

- Mobilisation of MiHPT equipment, Geoprobe® drill rig, and associated crew to site;
- Advancement of site/Numac work safety induction processes;
- Setup of the MiHPT equipment and subsequent Quality Assurance/Quality Control (QA/QC) probe sensor response testing;

- Hand augering the top soil when required;
- Probing and real-time logging of the MiHPT sensor outputs at eight locations; and
- Post-logging data review and reporting.

2.2 Work Procedures

MiHPT logging was performed in accordance with the following Standard Operating Procedures (SOPs):

- HPT MK3137 SOP (2015); and
- MIP MK3010 SOP (2021).

It is noted that all logging locations were selected and approved by Tetra Tech Coffey representatives and discussed with Numac personnel. All work performed by Numac personnel was completed under the supervision of Tetra Tech Coffey representatives.

3 DIRECT SENSING TECHNOLOGY FOR HIGH-RESOLUTION SITE CHARACTERISATION

3.1 Investigation Technology

Numac provides an array of technology that can assist in the effective characterisation of sites by way of High-Resolution Site Characterisation (HRSC). Numac's direct sensing tools for HRSC consist of an Ultra-Violet Optical Screening Tool (UVOST) using Laser-Induced Fluorescence (LIF) technology and a MiHPT system combining a Membrane-Interface Probe (MIP) and a Hydraulic Profiling Tool (HPT).

3.2 MIP: Membrane-Interface Probe

MIP is used for real-time detection and delineation of VOCs such as halogenated solvents and petroleum compounds.

The MIP probe includes a heating block, which is heated to 100–120 °C to induce volatilisation of organic chemicals present in the formation. This facilitates VOCs to move across a semi-permeable membrane into the probe and be transported through the trunkline with nitrogen as an inert carrier gas (as illustrated in **Figure 1**). The trunkline is attached to a Gas Chromatograph (GC) located up hole which is combined with several detectors to discriminate between different contaminants. In general, the probe is advanced in increments of 0.3 m to ensure proper heating of the formation and thus collect more representative VOC measurements.

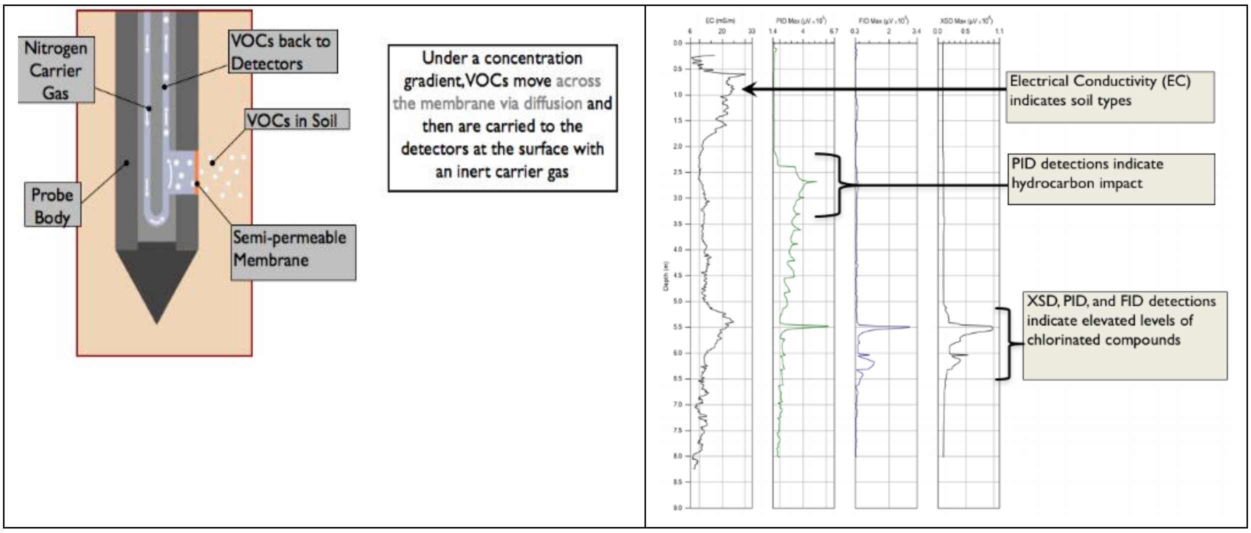


Figure 1. MIP tool and data output sample.

The three detectors installed in our MiHPT system are:

- Photoionisation Detector (PID), which uses ultraviolet radiation and detects aromatic hydrocarbons and double-bonded chlorinated compounds (e.g., Trichloroethylene—TCE) when used with a 10.6 eV lamp;
- Flame Ionisation Detector (FID), which uses a hydrogen/air flame and can detect any VOCs (including alkanes such as methane), although its sensitivity is relatively low; and
- Halogen Specific Detector (XSD), which relies on oxidative chemistry and detects halogenated compounds only.

Consequently, the type of contaminant may be inferred depending on the responses obtained. For instance:

- Petroleum hydrocarbons generate a response in PID and FID logs but not in XSD, unless there are scavenger additives such as 1,2-Dichloroethane;
- The presence of aromatic compounds in fresh petrol typically leads to stronger responses in the PID than in the FID, which may be reversed in the case of weathered fuels due to the greater abundance of alkanes with high ionisation potential;
- When logging high contaminant concentrations, the detectors could max out depending on the GC gain settings. The FID signal typically reaches values over 10 V when NAPL is encountered;

- The presence of natural gas or methane in the absence of aromatic hydrocarbons is captured in the FID log only. In such cases, PID readings may fall below the baseline recorded in the initial response test;
- Halogenated (e.g. chlorinated, brominated) substances are detected with the XSD as well as the PID if they are alkenes. Halogenated alkanes only appear in the XSD log;
- Other compounds like Methyl Tert-Butyl Ether (MTBE) and especially 1,4-Dioxane typically present high detection limits in part due to their high solubility in water; and
- Unfortunately, Polychlorinated Biphenyls (PCBs), Perfluorooctane Sulfonate (PFOS), and Perfluorooctanoic Acid (PFOA) cannot be detected with MIP because they are too large molecules and have too high boiling points. In these cases, the application of HPT followed by the collection of discrete samples with tools such as the SP16 groundwater sampler from Geoprobe® (able to expose a screen as little as 0.1 m) could be considered.

Note that the MIP results (given in volts) are qualitative/semi-quantitative in nature since they are influenced by factors such as the sediment type, the probe heating process, and the transport mechanisms related to the migration of VOCs through the membrane and trunkline.

3.3 HPT: Hydraulic Profiling Tool

The HPT system is used for hydrostratigraphic characterisation purposes, including identification of preferential migration pathways, detection of confining layers, and estimation of water-saturated hydraulic conductivity values.

As depicted in **Figure 2**, the HPT probe comprises two tools:

- an electrical conductivity (EC) sensor (in the form of a dipole or Wenner array); and
- a continuous, direct-push injection logging system.

As the HPT probe advances into the subsurface, water is injected through a screen port at a monitored flow rate (generally 200–300 mL/min). The pressure resulting from injecting water at this rate into the medium is logged with an in-line sensor. The ratio between flow rate and injection-induced pressure (Q/P_{inj}) can be used as a proxy of water-saturated hydraulic conductivity under certain conditions, being the limits of quantification typically in the range 0.03–25 m/day.

HPT reference tests are completed at every logging location as a QA/QC measure and to correct atmospheric pressure effects. In addition, dissipation tests may be conducted by ceasing the water injection in the saturated zone and waiting for the pressure to dissipate. Dissipation tests can be used to correct hydrostatic pressure effects and estimate the potentiometric surface elevation.

In the absence of reliable dissipation tests (for instance due to the presence of fine-textured materials impeding full pressure dissipation in a reasonable timeframe), the elevation of the potentiometric surface dipped in adjacent wells can be used to correct hydrostatic pressure effects if the specific weight of groundwater is known (9.81 kPa/m for fresh water at 4 °C). If multiple aquifer units and/or vertical hydraulic gradients exist, they should be incorporated into the calculations as well.

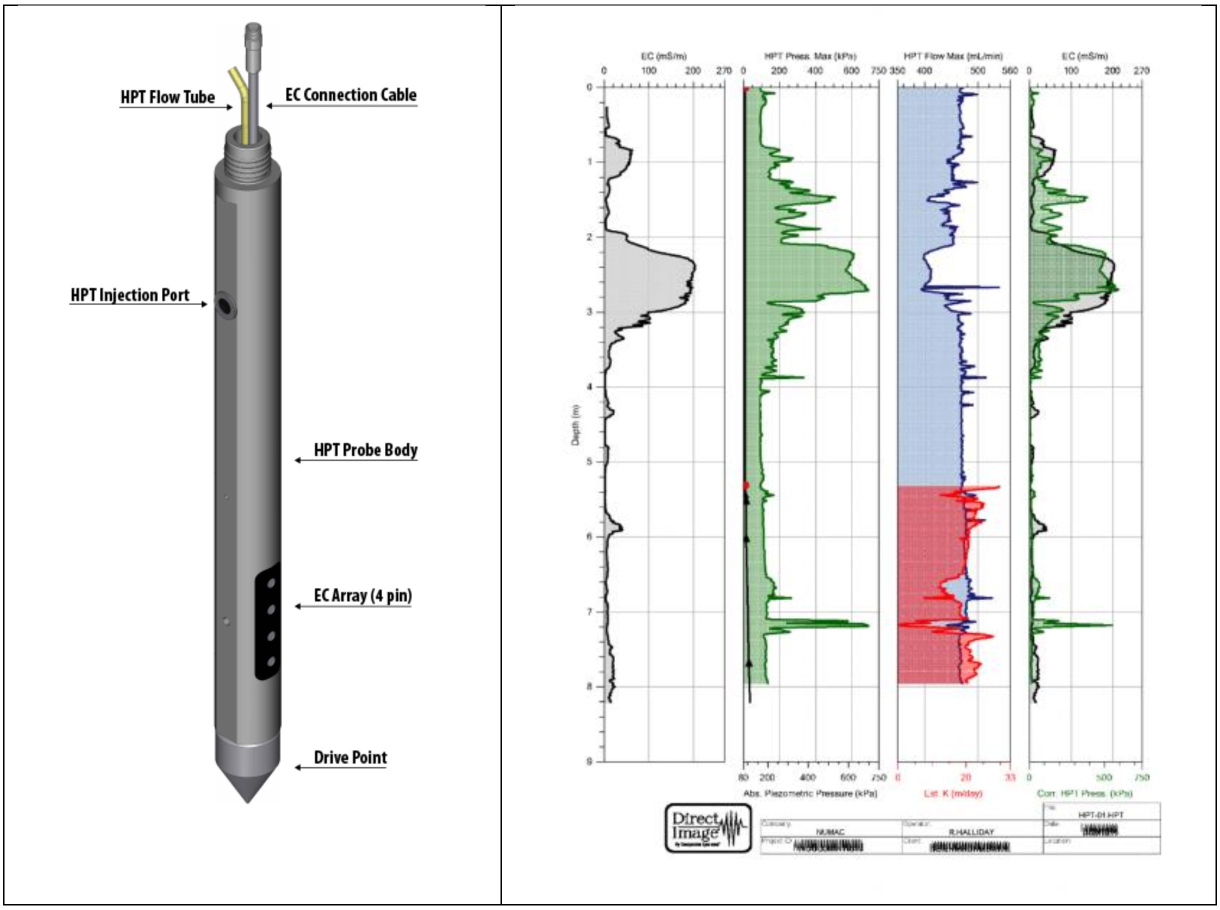


Figure 2. HPT tool and data output sample.

In general, regarding the interpretation of HPT logs:

- LOW flow rate and HIGH injection-induced pressure correspond to less permeable materials;
- HIGH flow rate and LOW injection-induced pressure correspond to more permeable materials; and
- High EC values may be a sign of fine-textured materials, particularly clay-rich sediments (typically over 50 mS/m).

Therefore, Q/P_{inj} and EC profiles frequently exhibit opposite trends. Nevertheless, there are exceptions to this rule:

- Clays such as kaolinite have a lower cation-exchange capacity than smectite and montmorillonite and may be more difficult to detect through EC logging;
- Fine sands, silts and cemented materials may significantly increase Q/P_{inj} but not EC;
- The presence of chloride ions or remediation amendments may affect EC but not Q/P_{inj};
- The transition between saturated and unsaturated zones may induce a step increase in EC, especially in coarse-textured materials due to the abrupt change in moisture content; and
- In sites contaminated with weathered petroleum hydrocarbons, high EC values may reflect NAPL presence due to microbial activity and chemical alteration of the pore solution.

3.4 Visualisation via cross sections and three-dimensional models

The analysis of cross sections and three-dimensional models can provide further insight into the subsurface characteristics. For this purpose, it is strongly encouraged to level survey each direct sensing location. Numac can assist in the presentation of data in cross sections and three-dimensional models upon request. Cross sections can be built with the DI Viewer software provided by Geoprobe®:

https://geoprobe.com/direct-image/software/direct-image-viewer

4 RESULTS

The output logs of the MiHPT for each location advanced at the site are collated in **Appendix A**.

Basic information of the MiHPT logs is summarised in **Table 1**.

It is Numac's view that the MiHPT logs collected suggested some of the following outcomes. However, from Numac's perspective, the correct interpretation of MiHPT data and assessment of subsurface conditions should consider multiple lines of evidence and all relevant information available. The correct interpretation of the data, and any decision based on such interpretation, is the responsibility of the Client in its entirety.

- All MiHPT logs exhibited positive chemical responses at a broad range of depths between 0.2 and 8.2 mBGL;
- The XSD logs supported the existence of halogenated compounds in the subsurface;

Table 1. Details of the MiHPT logs. 'Total depth' refers to final depth of the EC dipole.

Log ID	Date	Total depth [mBGL]	Comments
MIP01	07-Jun-22	6.233	On site since 6:45.
MIP02	07-Jun-22	6.111	
MIP03	07-Jun-22	7.437	
MIP04	07-Jun-22	4.557	Crew left site around 16:15.
MIP05	08-Jun-22	8.397	On site since 6:45. Top soil was hand augered.
MIP06	08-Jun-22	6.355	GC gain settings for PID and FID changed from 'high' to 'medium' for this log only. Top soil was hand augered.
MIP07	08-Jun-22	3.978	The heating system stopped working at 3.261 mBGL and the rods were pulled out to fix the probe.
MIP08	08-Jun-22	8.839	Crew left site around 16:30.

- In general, there was good consistency between PID and XSD profiles, thus suggesting the presence of halogenated alkenes (single-bounded chlorinated compounds have ionisation potentials over 10.6 eV). **Figure 3** compares the PID and XSD profiles at multiple locations;
- The maximum PID, FID, and XSD reading were obtained at MIP05, where the PID maxed out (5 V at high gain settings) and the FID rose to 1.05 V at 1.86 m BGL. The maximum XSD response was 0.84 V at 0.95 mBGL. Given the high signals from the detectors (especially the PID), the MIP pressure was set at a higher value to reduce the amount of VOCs migrating through the MIP membrane and prevent the saturation of the system at this interval. Once the PID, FID, and XSD signals decreased, the MIP pressure was set back at the original value. Similarly, MIP06 exhibited high PID, FID, and XSD signals of 2.69 V (2.29 mBGL), 0.42 V (4.90 mBGL), and 0.80 V (1.72 mBGL), respectively. High FID responses of 0.46 V and 0.52 V were also measured at MIP02 (4.62 mBGL) and MIP03 (4.18 mBGL), respectively;
- There were no clear signs of NAPL in the locations investigated. NAPL commonly results in FID signals over 10 V and similarly high PID values; and
- Comparison of PID, FID, and XSD logs with EC, HPT pressure, and HPT flow logs repeatedly supported that contaminant transport was in part governed by subsurface features such as preferential migration pathways and low-permeability zones (which may also act as capillary barriers and storage zones). In general, increases in the response from chemical detectors could be associated to preferential pathways (as indicated by decreases in HPT pressure and/or EC or increases in HPT flow) within low-permeability intervals as depicted in **Figure 4**.

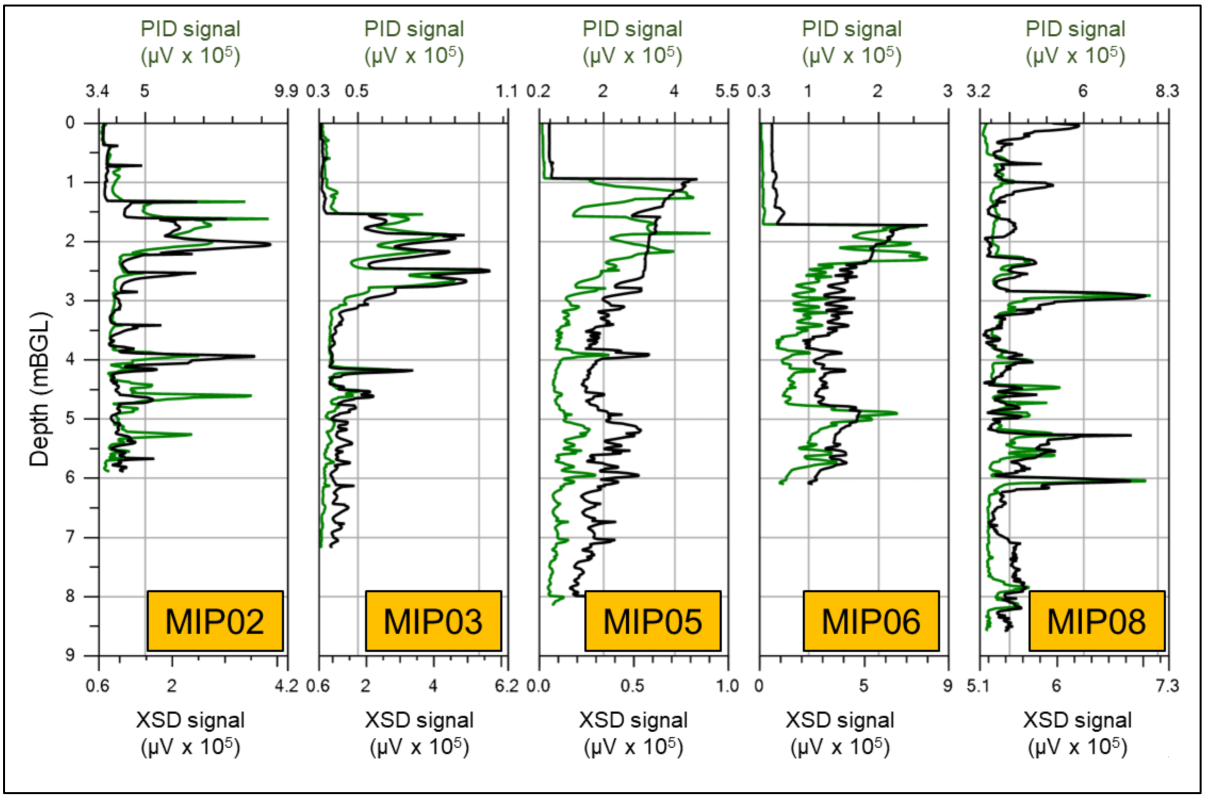


Figure 3. Consistency between PID (green line) and XSD (black line) profiles at several locations.

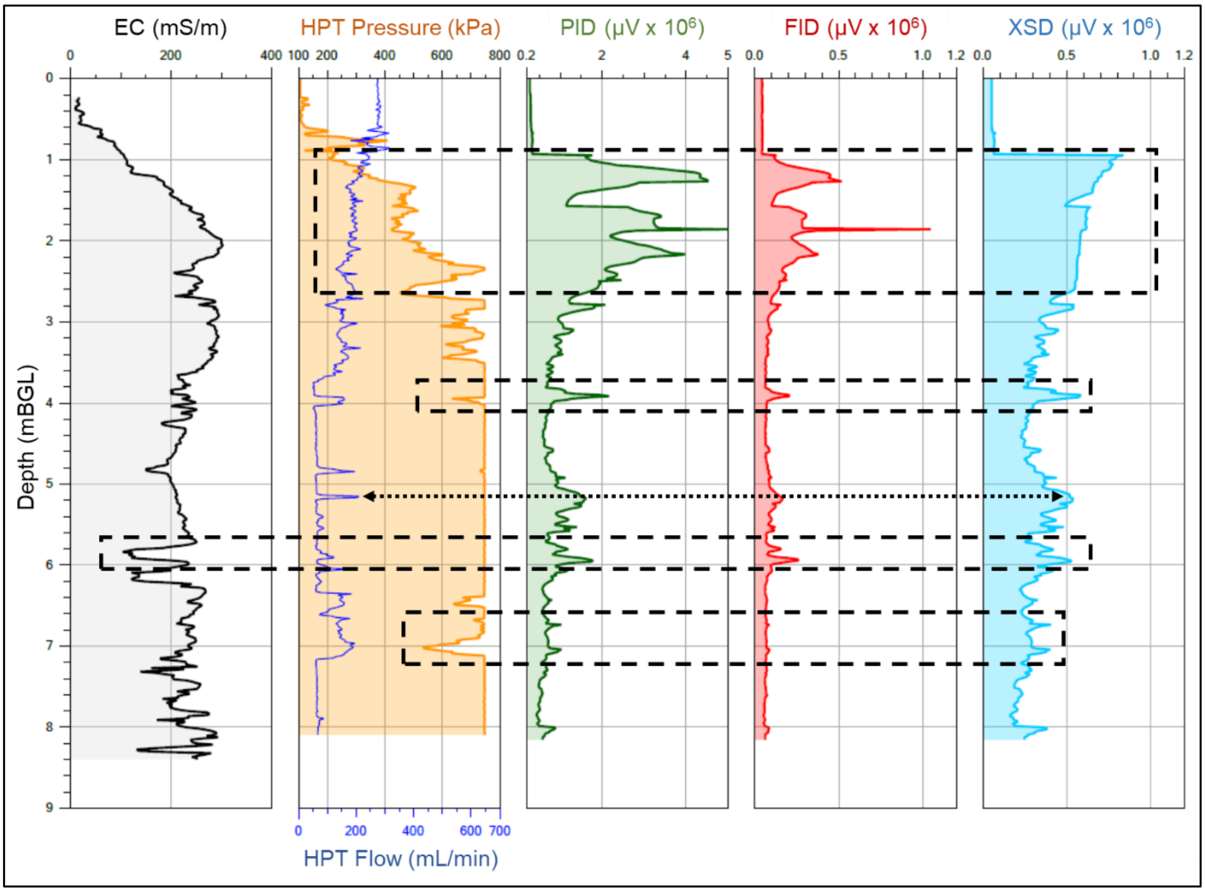


Figure 4. Correlation between chemical responses (PID in green, FID in red, XSD in cyan), HPT pressure (in orange), HPT flow (in blue), and EC (in black) at MIP05. The black dashed rectangles and dotted arrows highlight intervals of interest.

5 QUALITY ASSURANCE AND QUALITY CONTROL

The entire MiHPT system undergoes numerous QA/QC checks to ensure the highest possible data quality. Many parameters, such as nitrogen flows and pressure measurements, are checked and recorded throughout the day to ensure system stability and consistency. Response tests are performed using specific compounds designed to evaluate the sensitivity of the probes, transfer lines, and detector suites being utilised. The resulting values are recorded and compared to predetermined values. Parameters are also measured and recorded throughout the logging process to confirm MiHPT system performance and data quality.

Some aspects recorded during this fieldwork that should be considered for the proper interpretation of the logs include:

- The daily production rate was relatively low due to the hard materials encountered in the subsurface. In general, push rates below 0.3 m/min are considered refusal. However, as depicted in **Figure 5**, the probe was advanced even at lower rates to manage to go through the formation. This did not avoid a shallow refusal at MIP04 (4.56 mBGL);

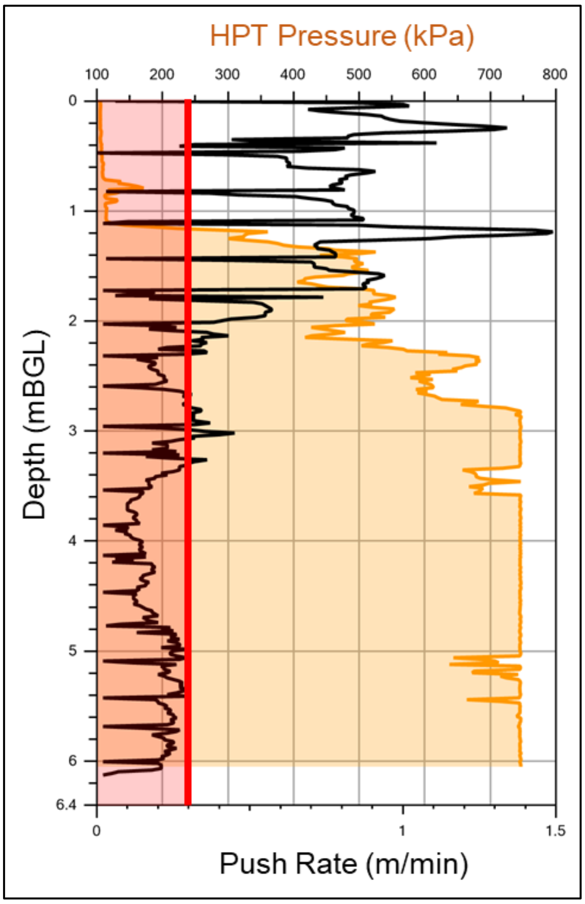


Figure 5. Push rate (in black) and HPT pressure (in orange) at MIP06. Geoprobe typically considers refusal when the push rate is lower than 0.3 m/min (indicated by the red line). Note how the probe was stopped every ~0.3 m to heat up the formation.

- High temperatures were sometimes recorded when pushing the probe through these hard materials at MIP01. Accordingly, the probe temperature was set at lower values (105–115 °C instead of 120 °C) while keeping good sensitivity in the response tests. Eventually, the heating system stopped working while logging MIP07 (being the MIP membrane at 3.261 mBGL). The rods were pulled out of the ground to fix the probe before logging MIP08;
- The MIP results (given in volts) are qualitative/semi-quantitative in nature since they are influenced by factors such as the sediment type, the probe heating process, and the transport mechanisms related to the migration of VOCs through the membrane and trunkline. The baselines and sensitivity of the chemical detectors can vary after logging contaminated locations, which may require extended waiting periods to return to the original baseline values. It was agreed to proceed with the works when the baselines and signal-to-noise ratio were relatively stable. **Figure 6** shows the post-log response tests at MIP04 and MIP08 when 1, 5, and 10 ppm of TCE were used. Note the limited ability of the XSD to detect TCE at 1 ppm or less. Windy conditions caused noise in some response tests performed during the direct sensing campaign;
- Given the high PID, FID, and XSD signals recorded at MIP05, the MIP pressure was set at a higher value to reduce the amount of VOCs migrating through the MIP membrane and prevent the saturation of the system at this interval, which could have compromised the ability of the equipment to log the next locations. Once the PID, FID, and XSD signals decreased, the MIP pressure was set back at the original value; and

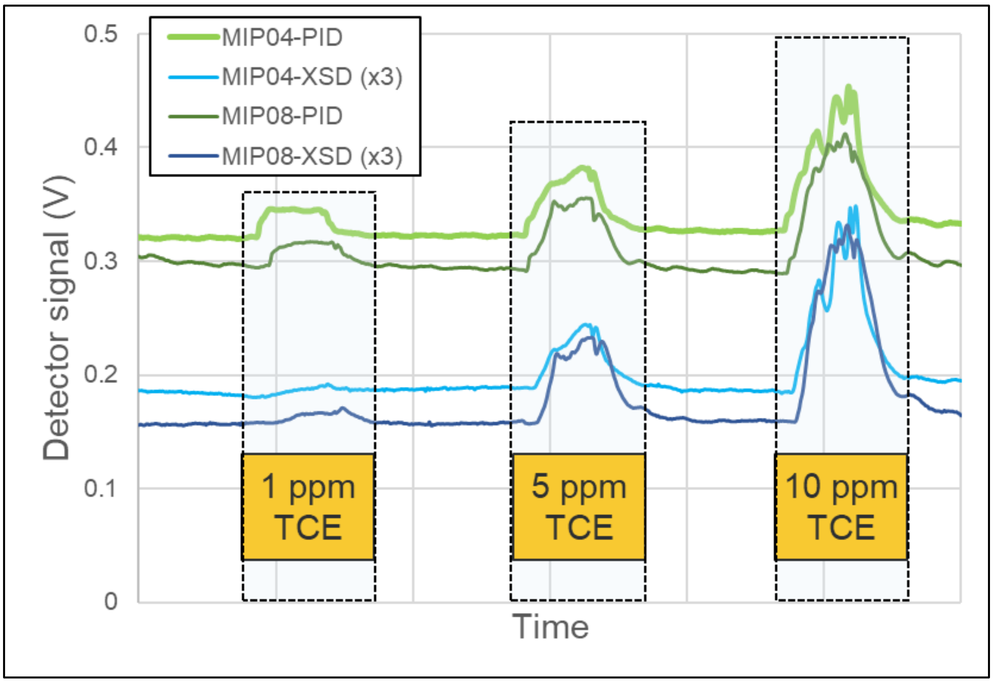


Figure 6. Post-log response tests at MIP04 and MIP08. For illustrative purposes, XSD signals are multiplied by three and PID and XSD peaks are aligned.

- Carryover effects can occur due to sorption and desorption cycles of VOCs in the MIP membrane and transfer lines. In general, the FID is less prone to carryover effects than the other detectors, so its interpretation may help to better infer the vertical distribution of VOCs. For instance, the high XSD values recorded between 0.95 and 2.59 mBGL at MIP05 (see **Figure 4**) may have been partly due to carryover effects.

6 LIMITATION/DECLARATION

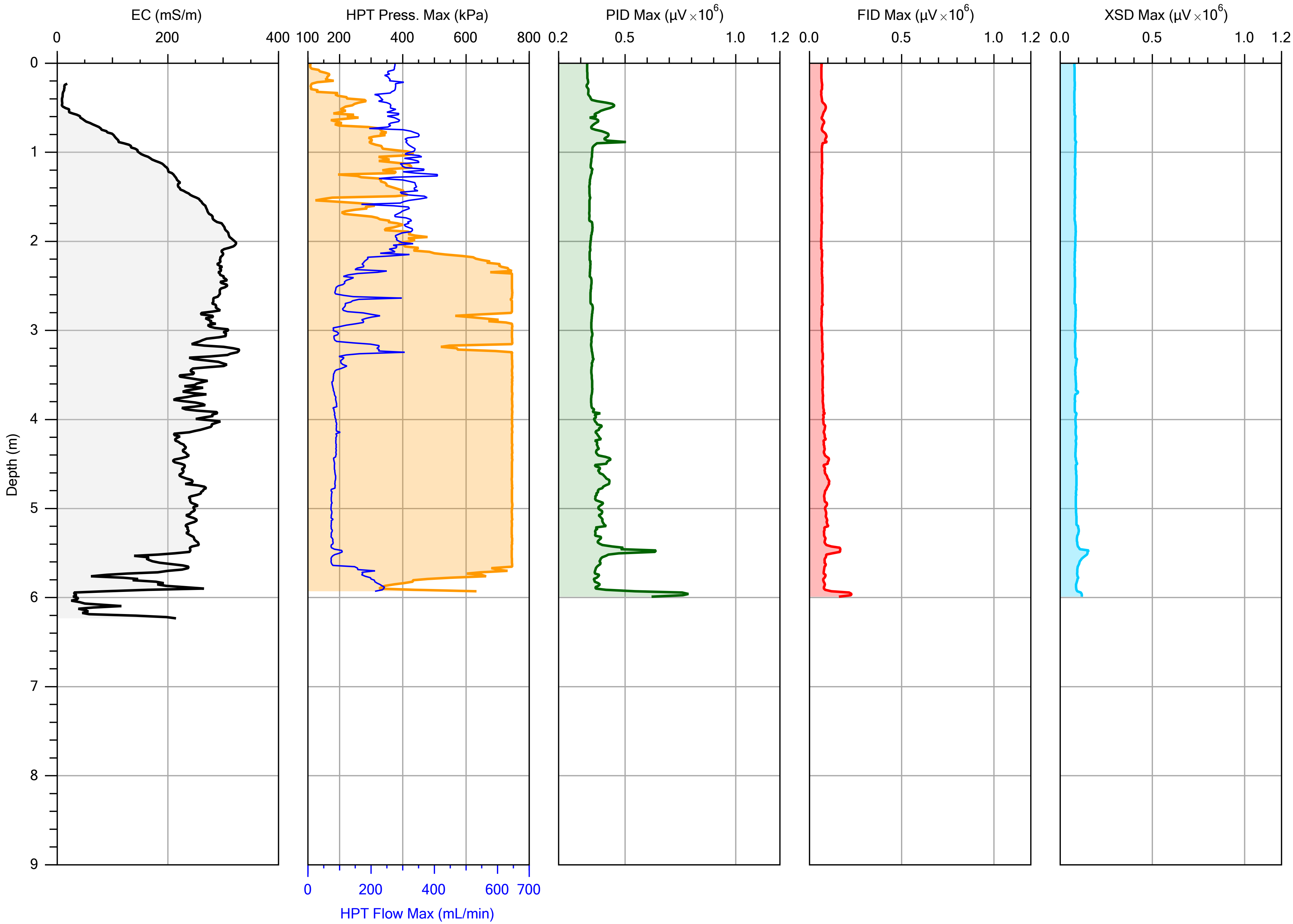
This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only and has been based in part on information obtained from and directions provided by the client. The correct interpretation of the data, and any decision based on such interpretation, is the responsibility of the Client in its entirety. The information herein relates only to this project and all results should be reviewed by a competent person with experience in environmental investigations before being used for any other purposes.

The correlation between MiHPT responses and laboratory sample results can be investigated but should not be assumed to be necessarily linear. MiHPT data and laboratory results are collected, analysed, and reported in different units, by different procedures, and in different locations. Subsurface conditions between investigation locations may vary, and this should be considered when interpolating direct sensing data between logging locations.

While direct sensing tools are designed to provide high-resolution data of subsurface properties, they are not designed to be used as stand-alone tools for site characterisation purposes. Collection of multiple lines of evidence is normally suggested (e.g., analytical data from physical samples for contaminant identification and mass quantification).

Result outputs are based on the equipment operation, interaction with the subsurface, and the sensor performance detailed in this report. Further characteristics or categories of chemicals not identified in this investigation may exist at the site. Changes to the subsurface conditions may occur subsequent to the investigations described herein through natural processes or through the intentional or accidental release of contaminants. The results provided in this report are based on the information obtained at the time of the investigations. This report does not provide a complete assessment of the subsurface conditions of the site, and it is limited to the scope defined herein.

APPENDIX A: MIHPT LOGS



numac GEOTECHNICAL I ENVIRONMENTAL

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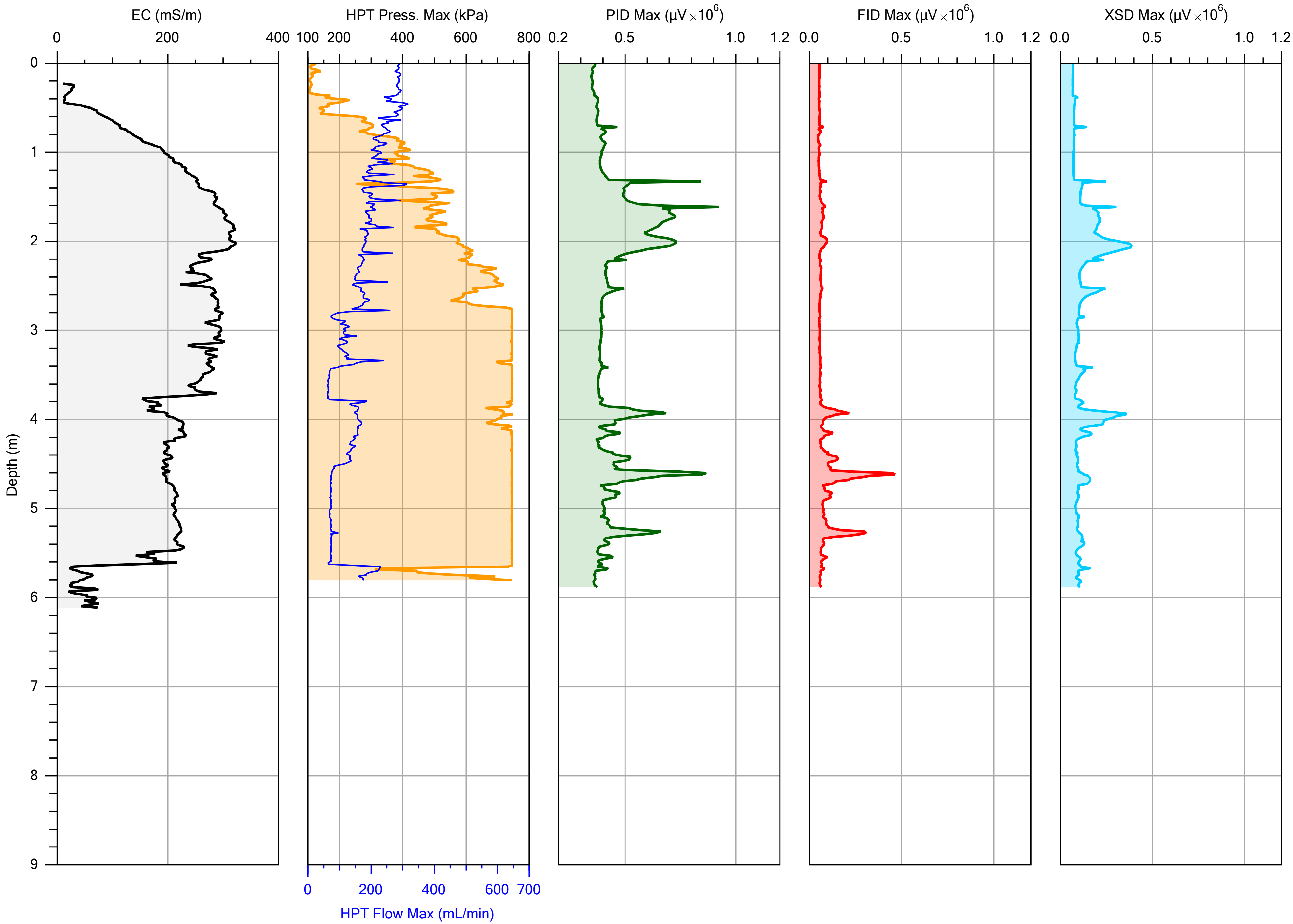
Project ID: SYDGE292575	Client: Sydney Metro	Location: St Marys, NSW



numac
GEOTECHNICAL | ENVIRONMENTAL

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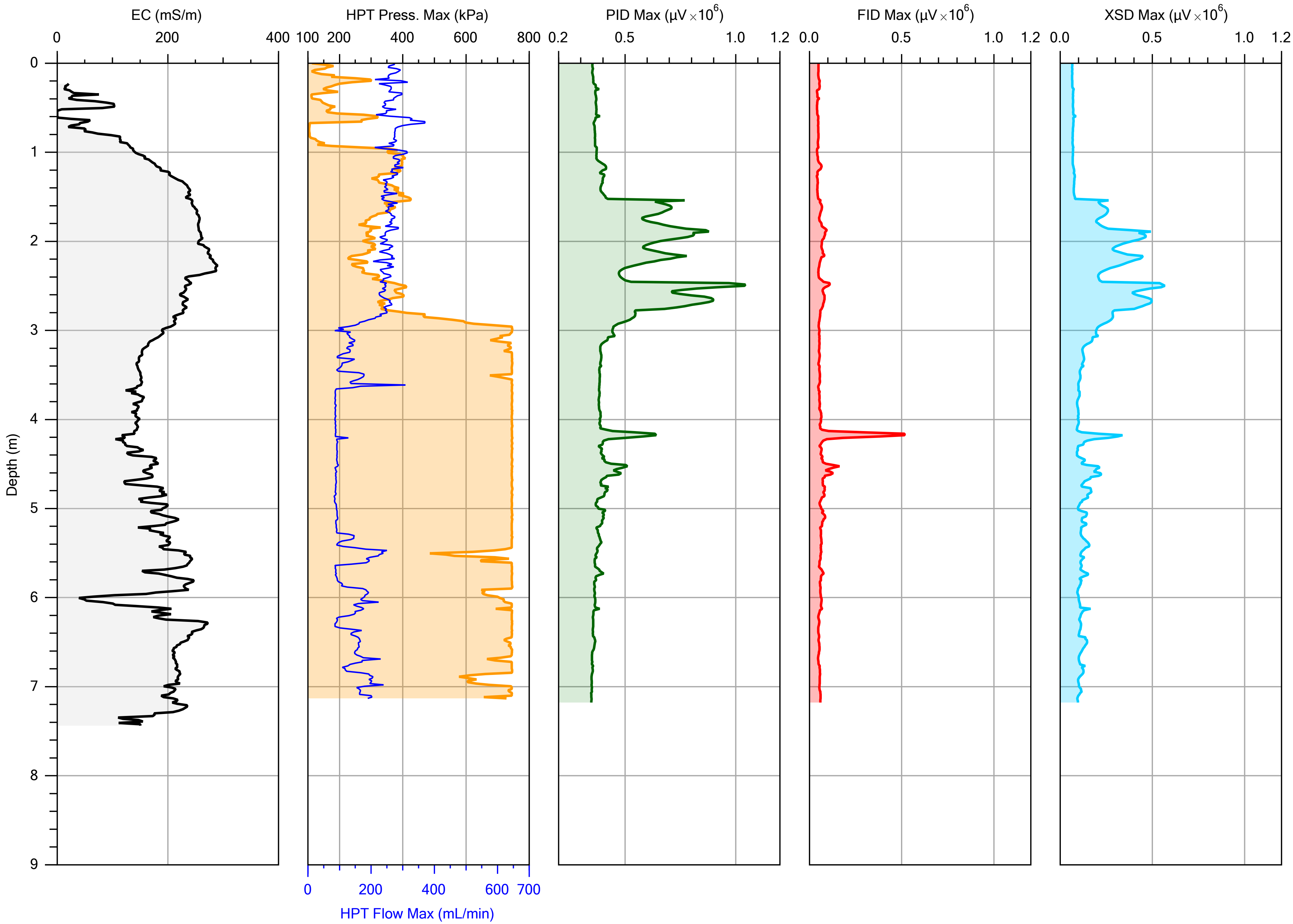

numac

GEOTECHNICAL | ENVIRONMENTAL

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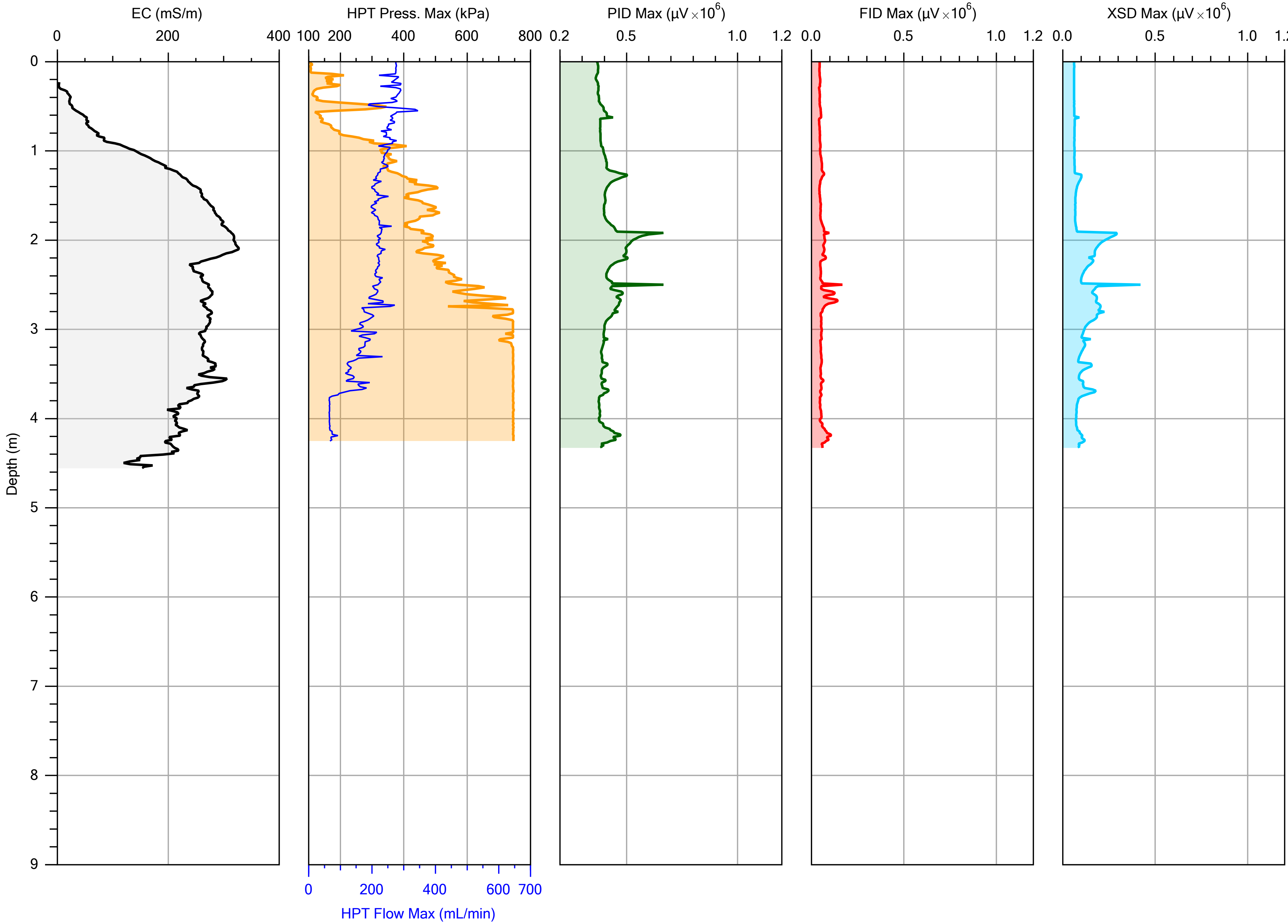

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GEOTECHNICAL | ENVIRONMENTAL

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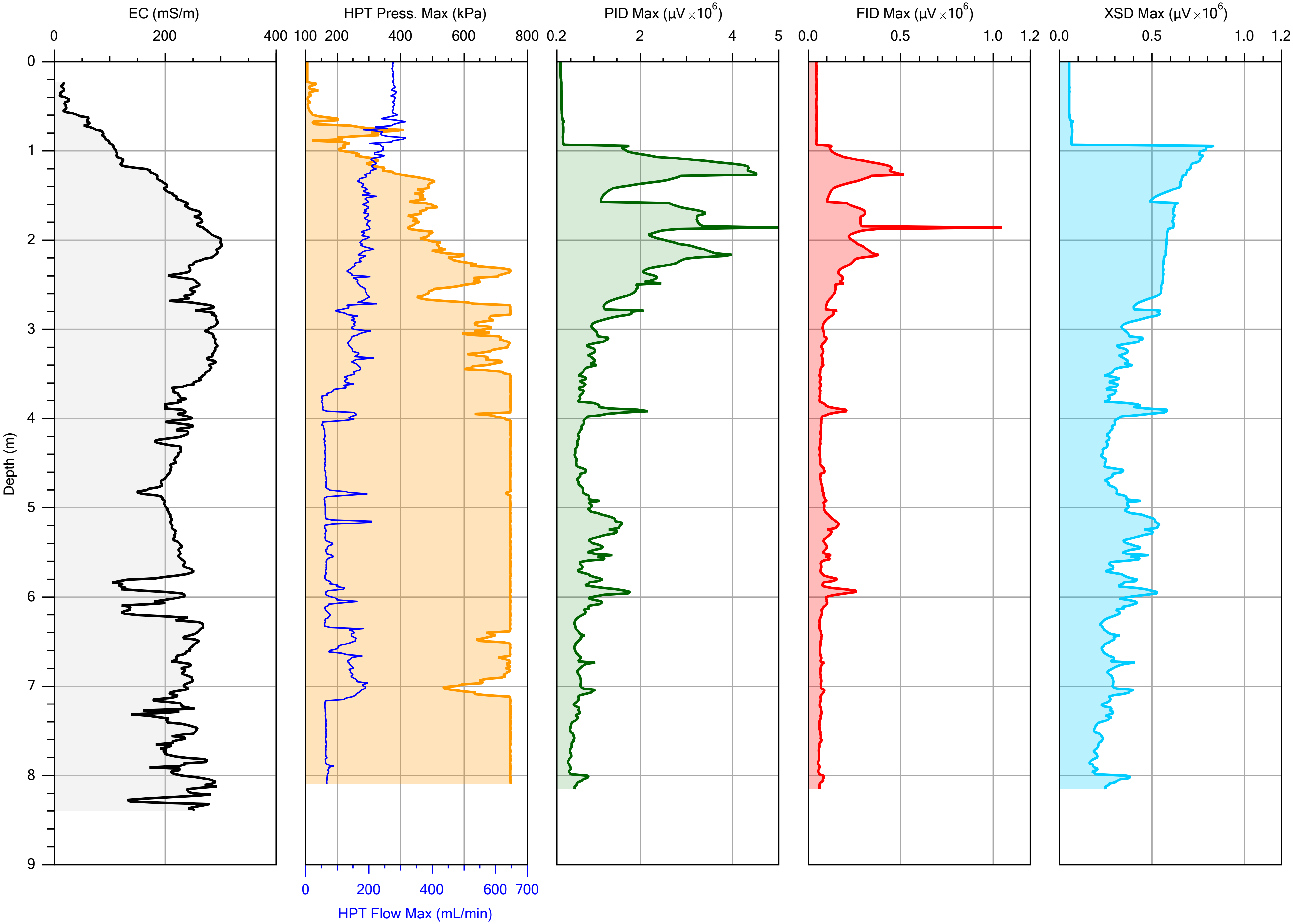

GEOTECHNICAL I ENVIRONMENTAL

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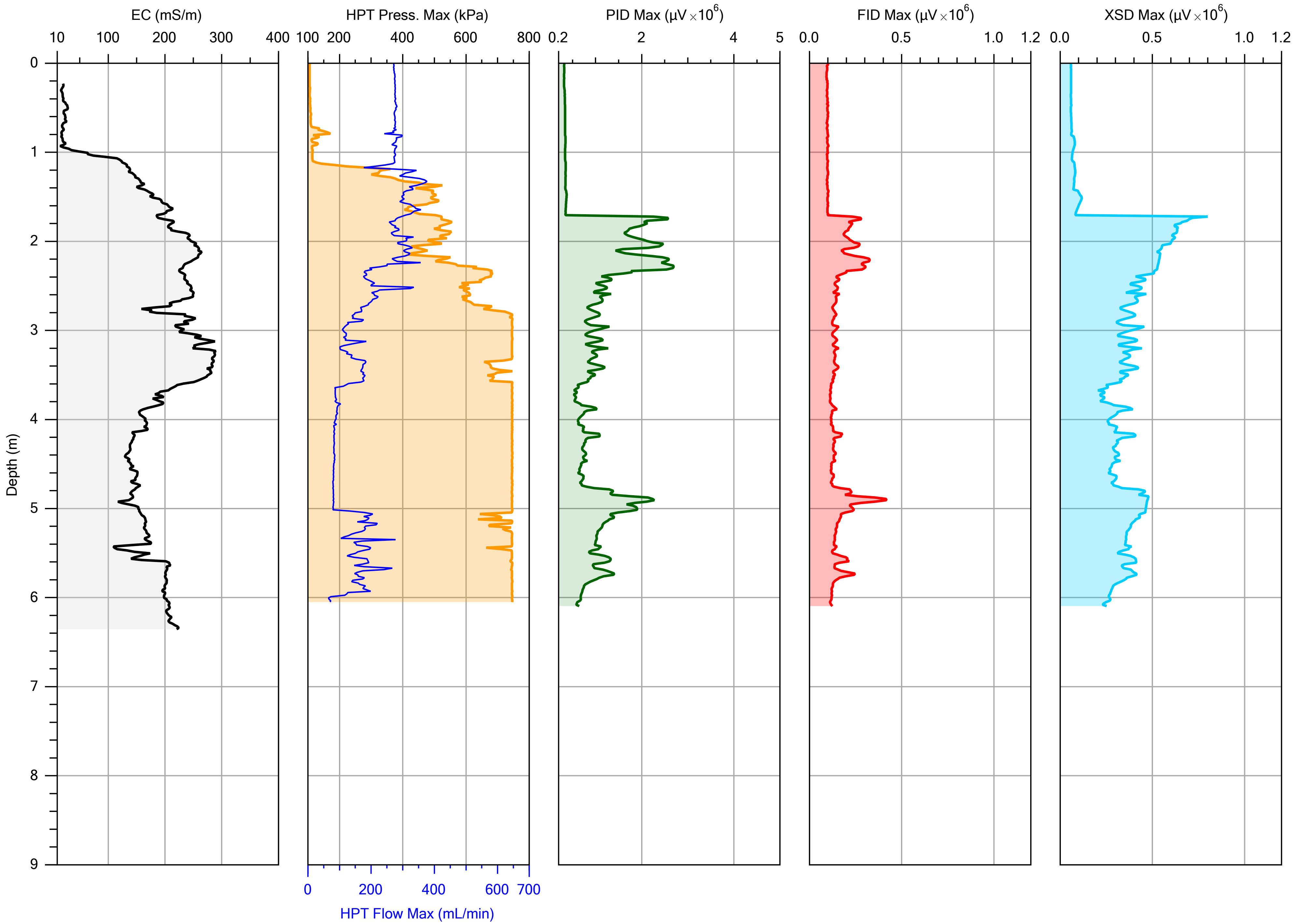

numac
GEOTECHNICAL | ENVIRONMENTAL

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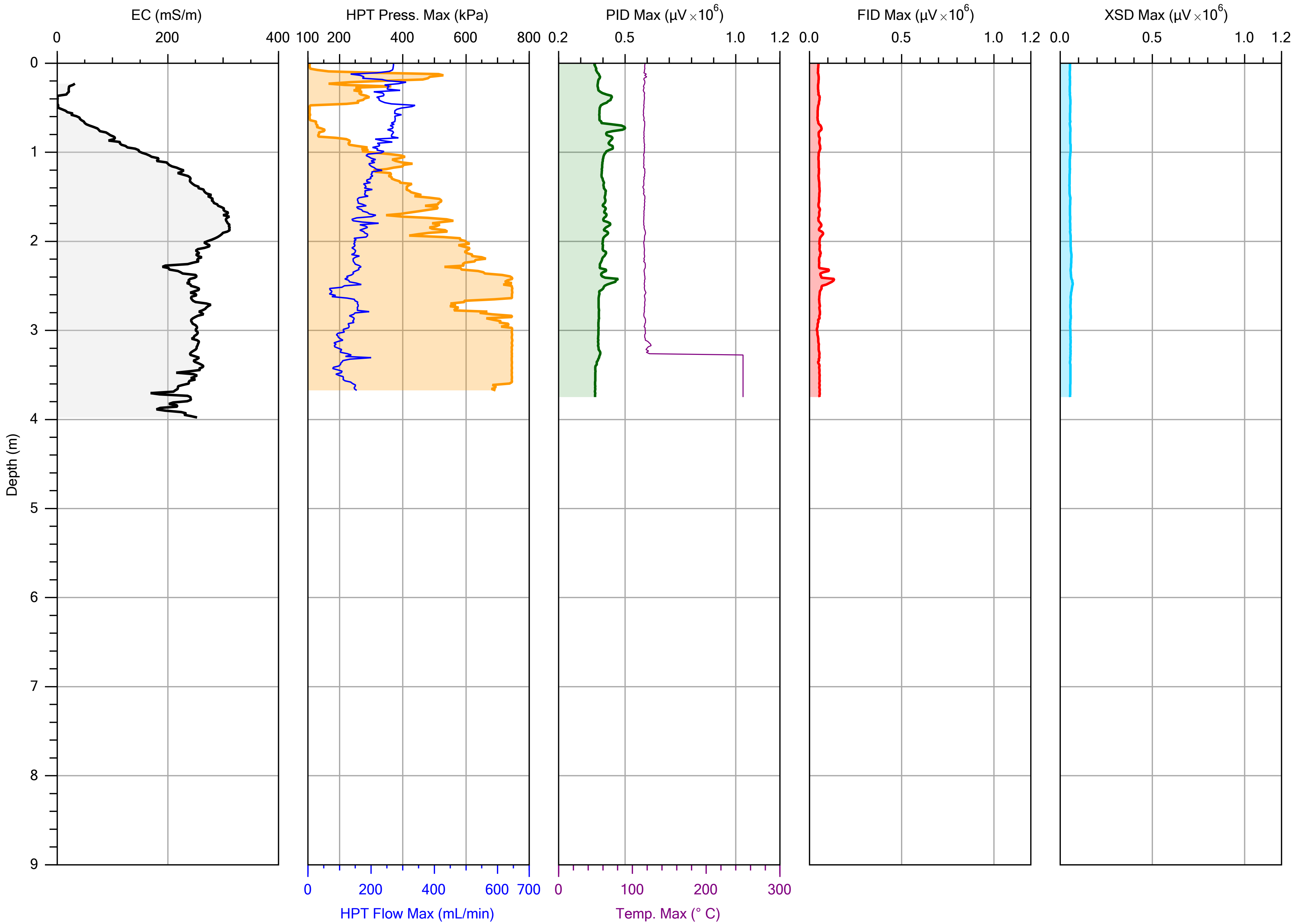

numac
GEOTECHNICAL | ENVIRONMENTAL

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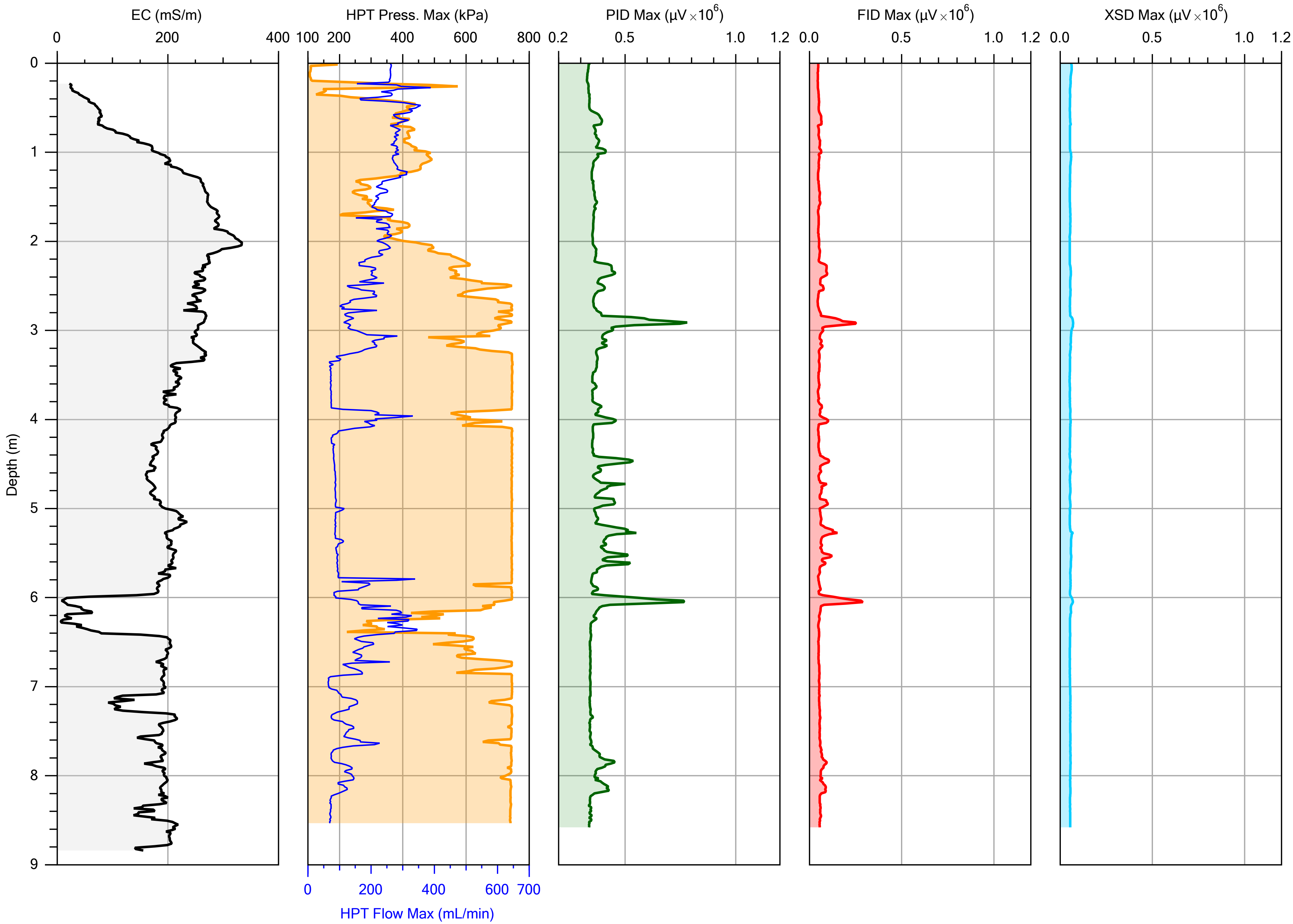
Project ID: SYDGE292575	Client: Sydney Metro	Location: St Marys, NSW



		File: MIP08.MHP
Company: Tetra Tech Coffey	Operator: JGR	Date: 8/06/2022
Project ID: SYDGE292575	Client: Sydney Metro	Location: St Marys, NSW

SMGW-GW01
MW2
MIP04
MIP08
MIP03
MIP06
MW1
MIP07
MIP02
MIP05
MIP01
7 Queen St
BH1