338 Pitt Street, Sydney

Geometrical Desktop Study Report

PSM3102-006R 28 October 2019

PSM Consult Pty Limited ABN 47 134 739 496

Table of Contents

1. Introduction 3

2. Proposed Development 3

3. Available Information 4

4. Existing Site Geometry 4

4.1 Site Surface Geometry 4

4.2 Adjacent Buildings 4

4.3 Adjacent Subsurface Infrastructure 5

5. Preliminary 3D Geometrical Model 5

5.1 Model Development 5

5.2 Basis of Geometrical Model 6

6. Discussion and Preliminary Commentary on Impacts 6

6.1 Future Sydney Metro City & South West Tunnels 6

6.1.1 Rail Protection Reserves 6

6.1.2 Construction Restrictions on Protection Reserves 7

6.2 Existing City Circle Rail Tunnels 7

6.3 Telstra Tunnel 8

6.4 Potential Future CBD Rail Link (CBDRL) Corridor 8

6.5 Adjacent Buildings 8

6.6 RMS Roads 9

6.7 Others 9

6.8 Summary of Geometrical Implications for Excavation Shoring Design 9

List of Tables

Table 1 - Geometrical Model Basis 6

List of Figures

Figure 1A: Site Plan – Above Ground Interfaces

Figure 1B: Site Plan – Underground Interfaces

Figure 2: Section A

Figure 3: Section B

Figure 4: 3D Model Perspective View

Figure 5: Zoomed in - 3D Model Perspective View

1. Introduction

This report presents the results of a desktop study completed by PSM for the proposed development at 338 Pitt Street, Sydney (The Site). This work has been undertaken in accordance with our proposal PSM3102-004L dated 13 August 2019. The site location is shown in Inset 1 below.

Inset 1: Aerial photo of the site

The purpose of this study is to consider the currently available information to identify interfaces for the proposed development. Specifically, the following scope has been completed and reported:

1. Collation and review of available information regarding rail infrastructure adjacent to the Site.
2. Development of a preliminary geometrical model based on the available information (includes adjacent basements, rail infrastructure etc) to allow visualisation of interfaces for the proposed development.
3. Preliminary (qualitative) assessment of interaction with:
   a. Sydney Metro City & South West Tunnels in accordance with the Transport for New South Wales (TfNSW) standard *Sydney Metro Underground Corridor Protection*[1] (**the Sydney Metro Standard**)
   b. Existing City Circle Rail Tunnels in accordance with the Transport for New South Wales (TfNSW) standard *Development Near Rail Tunnels*[2] (**the TfNSW Standard**).
4. Provision of preliminary commentary on impacts on adjacent infrastructure which is to be further explored in future work.
5. Implication of geometrical constraints on excavation shoring design.

2. Proposed Development

Based on recent communications and draft basement plan drawings from FJMT, we understand the following about the development:

- The proposed development is situated at 338 Pitt Street, Sydney and comprises mixed-use high-rise development
- Demolition of existing low-rise buildings and basements within the site boundary will be required
- The design is yet to be developed in detail, but the current drawings show four basement levels extending down approximately 20 m below Pitt Street to approximately RL 0 m

[1] TfNSW Sydney Metro – Technical Services, NWRLSRT-PBA-SRT-TU-REP-000008, Sydney Metro Underground Corridor Protection – Technical Guidelines, Revision 1, 16/10/17

[2] TfNSW Asset Standard Authority (ASA) Standard, T HR CI 12051 ST, Development Near Rail Tunnels, Version 2.0, 15/11/18

- Column loads are up to 60 MN
- Uplift loads are up to 10 MN.

3. Available Information

The geometrical desktop study was based on information supplied by Hans Sydney (The Client) and its consultants which includes drawings from Sydney Metro and drawings of nearby buildings, as well as drawings extracted from PSM's database. These include the following which are relevant to the Site:

- Site basement layout drawings from FJMT (Ref. FJMT, Draft Basement Plan, dated 5 September 2019)
- Drawings of future Sydney Metro City & South West infrastructure – plan and longitudinal section from Sydney Metro (Ref. Sydney Metro, Alignment GA Plan and Longitudinal Section, SMCSWTSE-JAB-TPW-AL-DRG-505112, DRG 212, dated 9 January 2018), supplied by Touchstone Partners
- As-built drawings for the 255 Castlereagh St building from City of Sydney (Ref. City of Sydney, 255-255A Castlereagh Street Sydney.zip, dated 16 September 2019), supplied by FJMT
- Survey of the Telstra tunnel along Pitt Street and Liverpool Street, received from ARUP
- Site ground surface survey – extracted from the FJMT overlay drawing with Telstra tunnel (Ref. LTS Surveyor, Plan of Detail and Levels Over Lot 3 In DP1044304 At 233 Castlereagh St Rev C, Sydney, dated 4 July 2016)
- Orthophotomap Sydney U1845-13 New South Wales, Australia (Ref. u184513.jpg, dated 1978)
- Adjacent site basements (approximate) from the PSM database
- Telstra tunnel geometry (approximate) from the PSM database
- Geometry of existing City Circle Rail Tunnels and Eastern Suburb Rail Tunnels (approximate) from the PSM database.

4. Existing Site Geometry

4.1 Site Surface Geometry

From the 2016 LTS survey of the site and the draft basement plan we understand the following regarding the existing site geometry:

- The site is currently occupied by several low-rise and high-rise buildings (varying from single storey to 24 levels above ground level)
- The surface level at Castlereagh Street is approximately at RL 22.7 mAHD
- The surface level at Pitt Street is approximately at RL 19.5 mAHD.

4.2 Adjacent Buildings

The Site is bounded by the following existing buildings:

- South East boundary: 255 Castlereagh Street building with one basement level to approximately RL 17.5 m AHD
- North boundary: 310 – 322 Pitt Street, 30-storey building with one basement level to approximately RL 17.0 m AHD
- North boundary: 225 - 227 Castlereagh Street with 8-storeys and up to one basement level (RL is unknown)

The adjacent building basements and footing plan are to be confirmed. The building at 225 - 227 Castlereagh Street is a heritage listed building as listed by the NSW government – Office of Environment & Heritage.

Other buildings in the vicinity of the Site with significant basements include:

- South West corner: World Square building at 644 George St with basement levels extending to approximately RL -6 m AHD
- North East boundary: 255-269 Elizabeth Street with up to 3 basement levels to approximately RL 14.5 m AHD

- North West corner: 343-357 Pitt Street with basement levels extending to approximately RL 7.0 m AHD.

Figure 1A presents the Site plan with the 'above ground interfaces' (i.e. adjacent buildings)

4.3 Adjacent Subsurface Infrastructure

The following subsurface infrastructure are adjacent to the Site:

1. Sydney Metro City & South West: The project is still under construction with 2 single track running tunnels traversing under Pitt Street and Castlereagh Street. There is also a cross passage tunnel connecting the 2 running tunnels under Liverpool Street. These tunnels are closely adjacent to the proposed basement excavation.
2. Telstra Tunnel: the tunnel running along Pitt Street and Liverpool Street.
3. Existing City Circle Rail tunnels (4 single track tunnels) to the South West and East of the Site.
4. Underground services (locations unknown at this time).
5. Adjacent building basements as listed in Section 4.2.
6. CBD Rail Link (CBDRL) protection corridor (i.e. not yet physical infrastructure). We do not currently have any information on this.

Figure 1B presents the Site plan with 'underground interfaces' (i.e. subsurface infrastructure).

5. Preliminary 3D Geometrical Model

5.1 Model Development

Based on the currently available information together with some assumptions, a preliminary three dimensional (3D) geometrical model was developed. It is intended that this model is sufficiently detailed to allow visualisation of interfaces and to provide inputs to preliminary analysis to be completed for initial assessment of effects on adjacent buildings and subsurface infrastructure. The following existing structures have been included in the 3D model:

- Existing building basements within the site boundary
- Proposed basement excavation at the Site
- Sydney Metro City & South West Running Tunnels and Cross Passage Tunnel
- Adjacent building basements as outlined in Section 4.2
- Telstra Tunnel
- City Circle Rail Tunnels:
  - Preliminary 3D geometrical models for the 4 single track rail tunnels that go from Central station to Townhall Station
  - 2D outlines of rail tunnel alignment in plan for the 2 single track rail tunnels that go from Central station to Museum station.
- Eastern Suburbs Rail Tunnels.

Figure 1 presents a locality plan of the Site with:

- Figure 1A: 'Above ground interfaces' (i.e. adjacent buildings)
- Figure 1B: 'Underground interfaces' (i.e. subsurface infrastructure).

Figure 2 and 3 present Cross Sections A to B through the Site.

Figure 4 and 5 presents the 3D model as a series of oblique views.

The geometrical model present is not to be used for detailed geometry or set out.

5.2 Basis of Geometrical Model

Table 1 presents the basis of the preliminary geometrical model

Table 1 - Geometrical Model Basis

Structure	Basis	Information Gaps/ Discrepancies
Proposed Basement Excavation	Draft Basement Plan Drawing from FJMT	Revised Basement Plan to be sent to PSM once available
255 Castlereagh St	As-built drawings from City of Sydney	
Sydney Metro City & South West Tunnels	Assured For Construction (AFC) drawings from Sydney Metro	The 3D model of Sydney Metro Tunnels is based on the AFC drawings with some assumptions about the lining thickness to calculate the excavation line geometry
Telstra Tunnel	Survey of Telstra tunnel along Pitt Street and Liverpool Street received from ARUP and from PSM database	• Exact tunnel geometry is unknown • Details of Telstra Easement Zone shown in LTS survey is unknown at this stage • Geometry of the Telstra New City South Exchange Cable Chamber is indicative.
CBD Rail Link (CBDRL) Corridor	Not yet in model	Alignment is unknown at this stage
255 Castlereagh St	As-built drawings from City of Sydney	
310 – 322 Pitt St	Basement level obtained from PSM database	• Exact basement geometry is unknown • Footing layout is unknown
225 – 227 Castlereagh St	Not yet in model	• Basement RL level is unknown • Exact basement geometry is unknown • Footing layout is unknown
Adjacent Utilities	Not yet in model	Details of adjacent utilities are unknown at this stage
Existing Site basement	Selected drawings from PSM Database	
City Circle rail tunnels	Selected drawings from PSM Database	
Eastern Suburbs rail tunnels	Selected drawings from PSM Database	

6. Discussion and Preliminary Commentary on Impacts

6.1 Future Sydney Metro City & South West Tunnels

For the future Sydney Metro City & South West rail tunnels, the Sydney Metro Standard sets out the requirements to assess the impacts on existing rail tunnels due to the proposed development.

6.1.1 Rail Protection Reserves

The Standard (Cl. 4.1) defines the rail protection reserves (First Reserve and Second Reserve) for the protection of the new Sydney Metro tunnels. The extent of the protection reserves is largely dependent on the geometry (width and height) of the existing tunnel being assessed.

The first protection reserve around the tunnels have been assessed and presented in plan and section (Figures 1 to 3). As the proposed excavation is relatively close to the new Sydney Metro Tunnels, parts of the excavation that are outside the first protection reserve will still be within the second protection reserve as this zone extends laterally more than 30 m from the boundary of tunnel excavation. Figure 1B presents the extent of the first protection reserves in plan relative to the Site and boundary. It can be seen that the first protection reserve extents overlap the proposed site excavation boundary on the south east boundary. We understand that the current basement geometry is still under design and will be finalised at a later stage to comply with the Sydney Metro standard.

We have also reviewed and compared the definition and extent of rail protection reserves between the Sydney Metro Standard and the TfNSW Standard; the following are noted:

- The Sydney Metro Standard was issued in 2017 and found to be similar to the TfNSW Standard Version 1.0 issued on 14 November 2016. The latest version of the TfNSW Standard is V2.0 issued on 15 November 2018. However, the first protection reserve calculated using the Sydney Metro standard is about 1.5m wider and higher than the TfNSW Standard. This is appeared to be the reason that the currently proposed basement geometry extends into the first protection reserve as shown in this report.
- The Sydney Metro Standard does not state which tunnel geometry the protection reserves are calculated from (i.e. from excavation line or from the intrados of tunnel). The TfNSW Standard Figure 2 shows the tunnel excavation line to be used for determination of the rail protection reserve, we have assumed this is also applied in the Sydney Metro Standard.

6.1.2 Construction Restrictions on Protection Reserves

The Sydney Metro Standard states the construction restrictions that are applied to each protection reserve in Table 4.5 of Cl. 4.4 reproduced as Inset 2. It is clear from the Standard that construction is not allowed within the First Reserve with the exception of investigation holes and installation of instrumentation (and even these are subject to assessment). Note this restriction also precludes ground anchors (and presumably rock bolts), so an allowance should be made between the first reserve and the basement excavation face to allow the installation of support (if required)

Types of construction	First reserve	Second reserve
Excavation for basements, footings	Not allowed	▪ Excavations less than 2.0 m depth from surface level, assessment not required. ▪ Excavation greater than 2.0 m depth, assessment required.
Shallow footings or pile foundations	Not allowed	Allowed, subject to load restrictions. Assessment required.
Tunnels and underground excavations	Not allowed	Allowed, subject to assessment
Ground anchors	Not allowed	Allowed, subject to assessment
Demolition of existing subsurface structures	Not allowed	Allowed, subject to assessment
Penetrative subsurface investigations	Allowed away from support zone, Assessment required	Allowed, subject to assessment

Inset 2: Construction restrictions applied to each protection reserve

In the second protection reserves, the proposed excavation works are allowed subject to impact assessment. From our experience working with development near underground tunnels, the expected impact on tunnels is less critical when the base of the excavation is above the crown level of tunnels. The current basement excavation geometry is below the tunnel crown level (as shown in Figure 2 – Section A), this will have some potential impacts on the tunnels that need to be addressed especially if the excavation is in close proximity laterally to the first protection reserve. The potential impact on tunnels can be estimated following some initial analyses.

6.2 Existing City Circle Rail Tunnels

For the existing rail tunnels, the TfNSW Standard sets out the requirements to assess the impacts on existing rail tunnels due to the proposed development.

The Standard (Cl. 5) defines the rail protection reserves (First Reserve and Second Reserve) for the protection of existing rail tunnels. The extent of the protection reserves is largely dependent on the geometry (width and height) of the existing tunnel being assessed. For the case where the existing tunnels comprise a cluster of tunnels, as in the case of the City Circle rail tunnels crossing under George St adjacent to the Site, the total width of the cluster of tunnels is considered when assessing the protection reserves (Cl. 5.1 of the Standard), instead that of a single tunnel.

The second protection reserves around the City Circle rail tunnels at the South West of the Site have been assessed. Figure 1 presents the extent of the second protection reserves in plan relative to the Site boundary. It can be seen that the second protection reserve extents slightly overlap with the existing site boundary but is outside the extent of the current proposed excavation. It is likely that the proposed excavation will have minor or no impact on the existing City Circle Rail Tunnels.

The City Circle Rail Tunnels at the East of site going from Central station to Museum station are located at further distance compared to the above tunnels so excavation induced impact on these tunnels due to the proposed excavation is expected to be minor to no impact.

6.3 Telstra Tunnel

From reviewing the drawings from ARUP for the Telstra Tunnel and drawings from our database, we noted the following regarding Telstra Tunnel:

1. The tunnel traverses along Liverpool Street and Pitt Street. Along Pitt Street, the tunnel is adjacent to the proposed site excavation (approximately 1.5 m from the proposed excavation western boundary).
2. The Telstra tunnels are a network of tunnels carrying communication cables. These tunnels have apparently been constructed using a cut and cover methods with backfill placed around the tunnels for drainage.
3. The tunnels are lined with double bricks with a thickness of 230 mm and a concrete base slab founded on unreinforced concrete footings, usually on a sandstone base.
4. The Telstra New City South Exchange Cable Chamber is adjacent to the northern boundary of the site. The detailed geometry of chamber is not known to PSM at this stage.
5. The LTS detailed survey plan shows a Telstra Easement Zone within the site boundary. We assumed that the easement zone is only at the surface.

Due to the inferred “cut & cover” construction method for the Telstra Tunnel there might be localised fill around the tunnel along the Pitt Street boundary of the excavation (and potentially along Liverpool Street). The close proximity of Telstra Tunnel to the excavation boundary might obstruct or affect the use of temporary anchors/ rock bolts along the Pitt Street boundary.

6.4 Potential Future CBD Rail Link (CBDRL) Corridor

From the briefing documents, we understand there is a CBD Rail Link (CBDRL) protection corridor traversing under Pitt Street adjacent to the western boundary of the proposed excavation. PSM have not received any further documents to reliably assess the geometrical relationship between the CBD Rail Link and the proposed site excavation.

6.5 Adjacent Buildings

The adjacent buildings and basements to the site are listed in Section 4.2 of this report

Detailed impact assessments are recommended to assess the effect of the proposed excavation on the neighbouring structures. Given the close proximity of the proposed excavation relative to the neighbouring basements we expect that excavation induced impact (ground deformation due to rock mass stress relief and to a lesser extent shoring deflection) is essentially unavoidable and needs to be assessed and resolved appropriately. In order to perform the impact assessment, the following information is required:

- Number of basement levels of adjacent buildings
- Number of storeys
- Footing plan and levels

- Footing types and loads
- Tolerable movements of the buildings.

As built drawings of adjacent buildings and/or investigation would be required to obtained the above information.

The boundary adjacent to neighbouring building/basements may also impose some limitations on extent of anchoring or rock bolts.

Underpinning works or specific shoring design may be required where the excavation extends below the adjacent buildings. Such works may require permissions from the neighbouring owners.

6.6 RMS Roads

The proposed excavation is adjacent to major CBD roads (i.e. Pitt Street, Liverpool Street, Castlereagh Street) and will be subject to approval from RMS.

Impact assessment on ground deformation and excavation wall deflection need to be performed as outline in RMS Techincal Direction – Excavation adjacent to RMS infrastructure dated 27 April 2012. The shoring wall designer will need to confirm and ensure their design complies with the RMS requirements.

City of Sydney might have similar requirements regarding excavation and shoring design that need to be complied by the shoring designer.

6.7 Others

As the site is surrounded by number of existing utilities, an assessment of impacts on utilities due to the proposed excavation work may be required.

Also, the location, extent and depth of services pits (unknown at present) might impose some limitations on shoring design (e.g. anchors)

We recommend to conduct services searches like DBYD to establish the extent of services underground. Some intrusive investigation might be required at a later date.

6.8 Summary of Geometrical Implications for Excavation Shoring Design

This section summarises the implications of the above-mentioned geometrical constraints on the excavation shoring design:

1. The proposed extent of excavation will probably need some allowance between the Sydney Metro first protection reserve and the excavation face to install temporary anchors or rock bolts (if required).
2. The temporary anchors or rock bolts (if required) along Pitt Street will need to take into account the existing Telstra tunnel.
3. Shoring design along the boundary of adjacent buildings will need to take into account adjacent basement footing levels. Underpinning/shoring work may be required and may be subject to agreement with adjacent building owners. Rock bolts/ anchors across the boundary will also be subject to agreement.
4. The shoring design for excavation face adjacent to roads should comply with the RMS Technical Direction - Excavation adjacent to RMS infrastructure dated 27 April 2012. Permission will need to be sought for anchors/ rock bolts beneath road reserves.
5. The presence of underground utilities might affect the shoring design (e.g. anchor depths) and need to be taken into account.
6. City of Sydney might have some specific requirements regarding extent of temporary anchors/shoring under road reserves.

Should there be any queries, do not hesitate to contact us.

For and on behalf of
PELLS SULLIVAN MEYNINK

ANH DUC TRAN
SENIOR GEOTECHNICAL ENGINEER

JEREMY TOH
PRINCIPAL

Brisbane

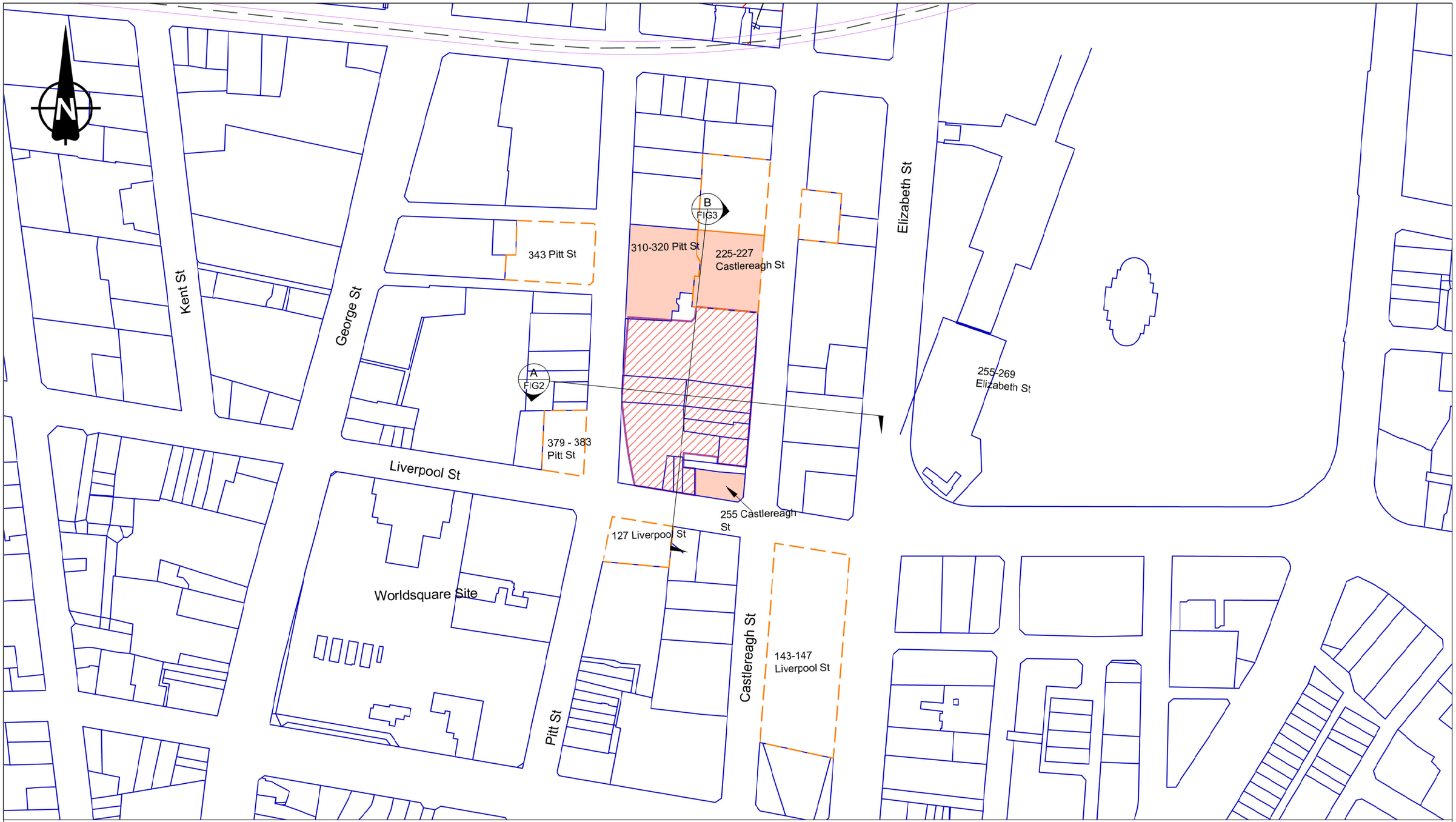
Level 6, 500 Queen Street
GPO Box 3244
Brisbane QLD 4000
+61 7 3220 8300

Sydney

G3-56 Delhi Road
North Ryde NSW 2113
+61 2 9812 5000

Perth

Level 3 22 Delhi Street
West Perth WA 6005
+61 8 9462 8400



LEGEND

- Proposed extent of basement at The Site (338 Pitt Street)
- Adjacent Buildings
- Heritage Listed

Notes:

1. Proposed site basement extent is taken from FMJT Drawing 190905_338 Pitt St - DRAFT Basement plan.pdf
2. Refer to geometrical study report (PSM3102-006R) for a full list of referenced documents
3. Heritage listed buildings are sourced from PSM previous projects and to be confirmed with relevant authority

0 40 80m
1 : 2000 At A3

Hans Sydney Pty Ltd
Hans 338 Pitt Street
Sydney

GEOMETRICAL DESKTOP STUDY
SITE PLAN - ABOVE GROUND INTERFACES

PSM3102-006R | FIGURE 1A

N

Approximate lateral extent of existing City Circle Rail Tunnels Second Protection Reserve

Kent St

George St

City Circle Rail Tunnels

B FIG3

A FIG2

Telstra Old City South Exchange Cable Chamber

Telstra New City South Exchange Cable Chamber (indicative)

Approximate lateral extent of Sydney Metro First Protection Reserve

Telstra Easment Zone from LTS Survey

Elizabeth St

ESR Tunnels

Liverpool St

Sydney Metro Cross Passage Tunnel

Worldsquare Site

Sydney Metro Running Tunnels

Telstra Tunnel

Castlereagh St

Pitt St

LEGEND

Proposed extent of basement at The Site (338 Pitt Street)

Available Basement Data

Notes:

1. Existing rail tunnels geometry is preliminary and to be confirmed by surveying and/or exact data.
2. Proposed site basement extent is taken from FMJT Drawing 190905_338 Pitt St - DRAFT Basement plan.pdf
3. Sydney Metro Tunnels are based on Drawing SMCSWTSE-JAB-TPW-AL-DRG-505112 and DRG-505212 from Sydney Metro
4. Refer to geometrical study report (PSM3102-006R) for a full list of referenced documents

0 40 80m

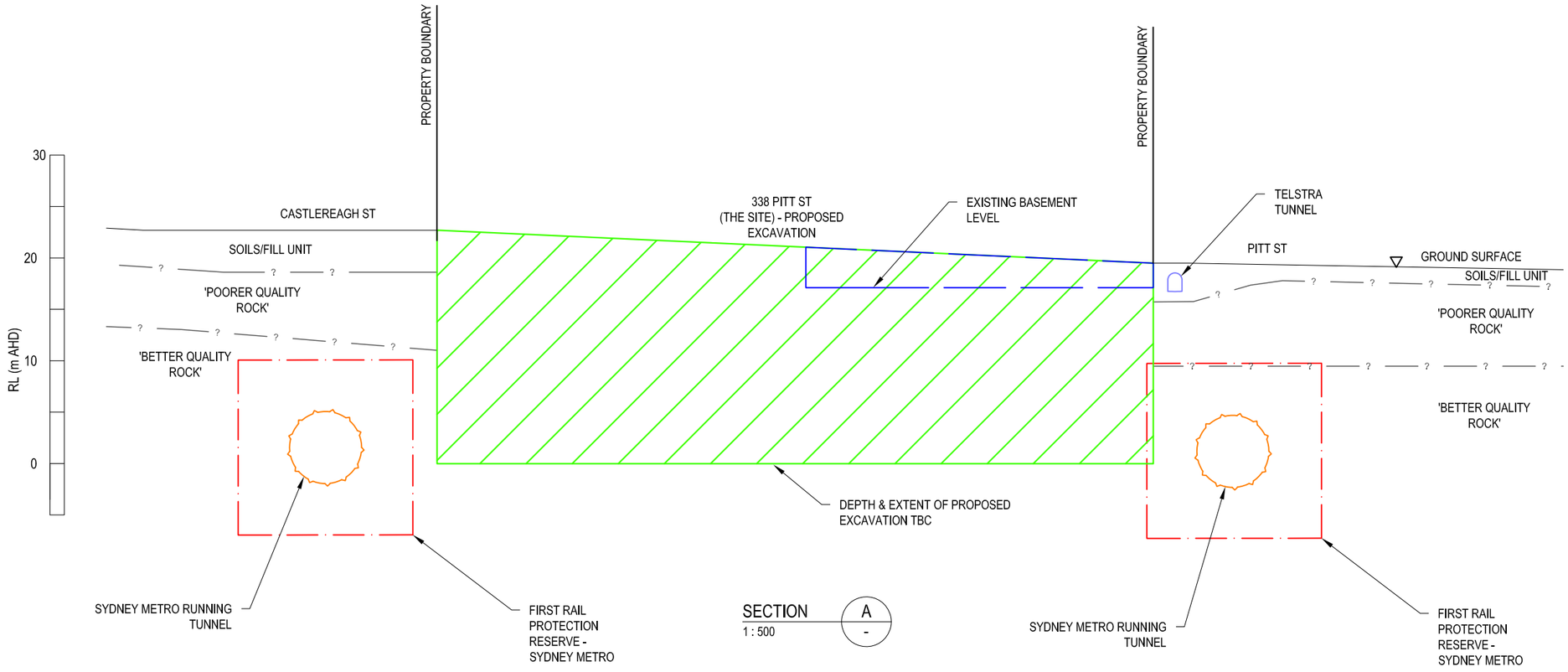
1 : 2000 At A3

P S M

Hans Sydney Pty Ltd
Hans 338 Pitt Street
Sydney

GEOMETRICAL DESKTOP STUDY
SITE PLAN - UNDERGROUND INTERFACES

PSM3102-006R | FIGURE 1B



NOTES:

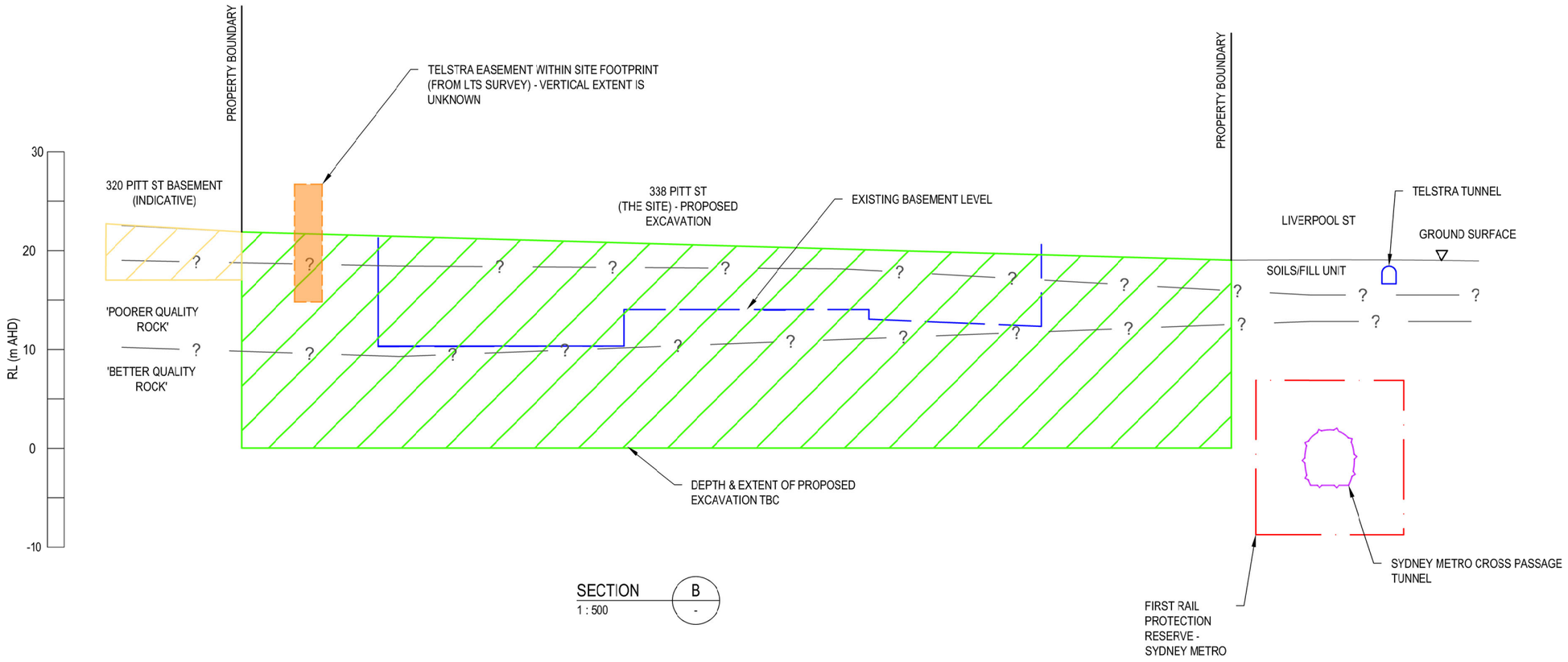
1. Extent of Rail protection reserves are assessed based on the TfNSW standard - Sydney Metro Underground Corridor Protection - Technical Guidelines dated 16 October 2017
2. Drawings are preliminary and subject to verification by survey
3. The ground model is indicative based on the desktop study previously undertaken by PSM (PSM3102-002L dated 3 August 2016) and will be revised in the geotechnical desktop study report & by further investigation. It does not explicitly consider local scale excavations and backfilling at this time.

0 10 20m
1 : 500

Hans Sydney Pty Ltd
Hans 338 Pitt Street
Sydney

GEOMETRICAL DESKTOP STUDY
SECTION A

PSM3102-006R | FIGURE 2



SECTION B
1 : 500

NOTES:

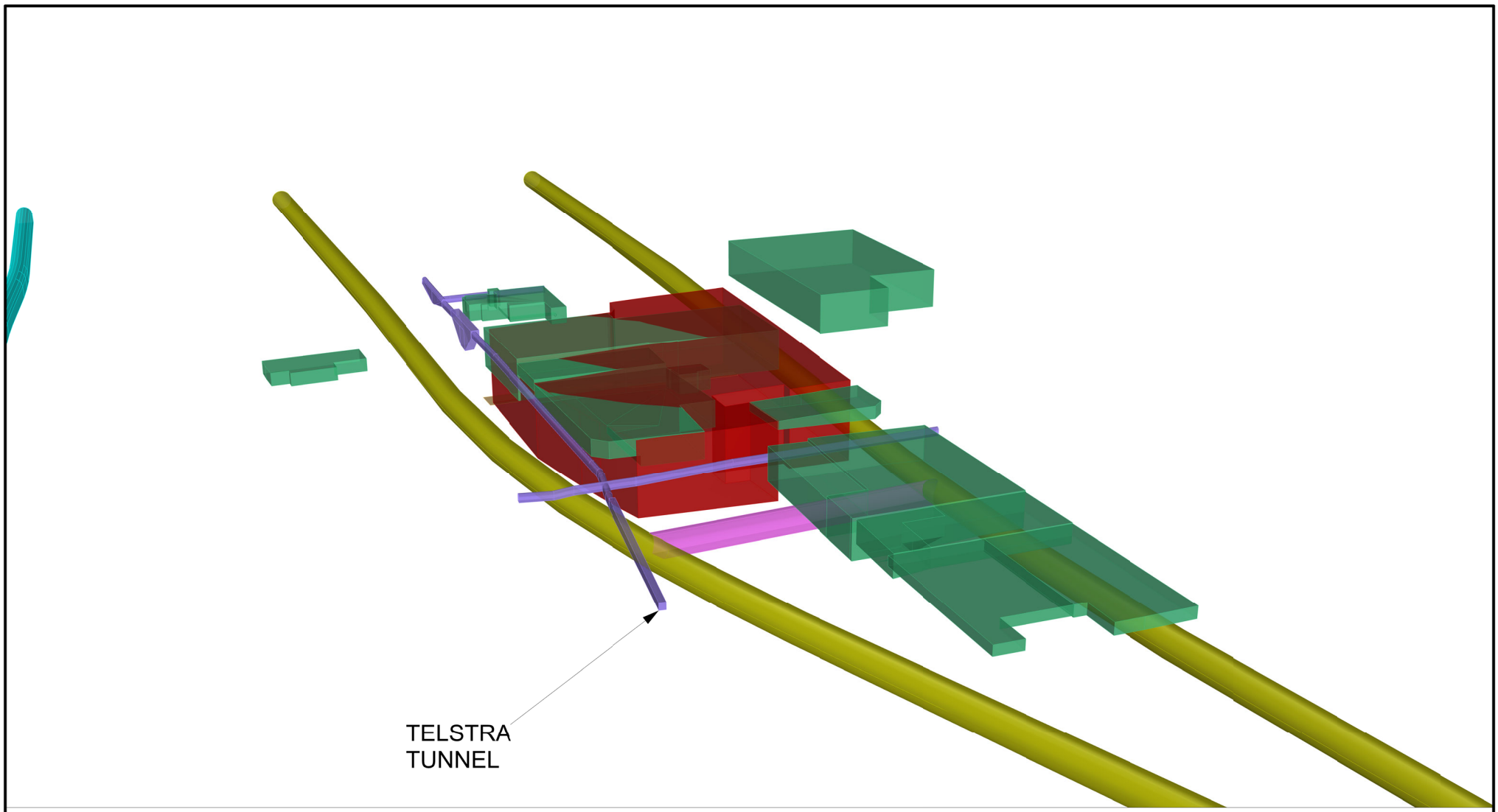
1. Extent of Rail protection reserves are assessed based on the TfNSW standard - Sydney Metro Underground Corridor Protection - Technical Guidelines dated 16 October 2017
2. Drawings are preliminary and subject to verification by survey
3. The ground model is indicative based on the desktop study previously undertaken by PSM (PSM3102-002L dated 3 August 2016) and will be revised in the geotechnical desktop study report & by further investigation. It does not explicitly consider local scale excavations and backfilling at this time.

0 10 20m
1 : 500

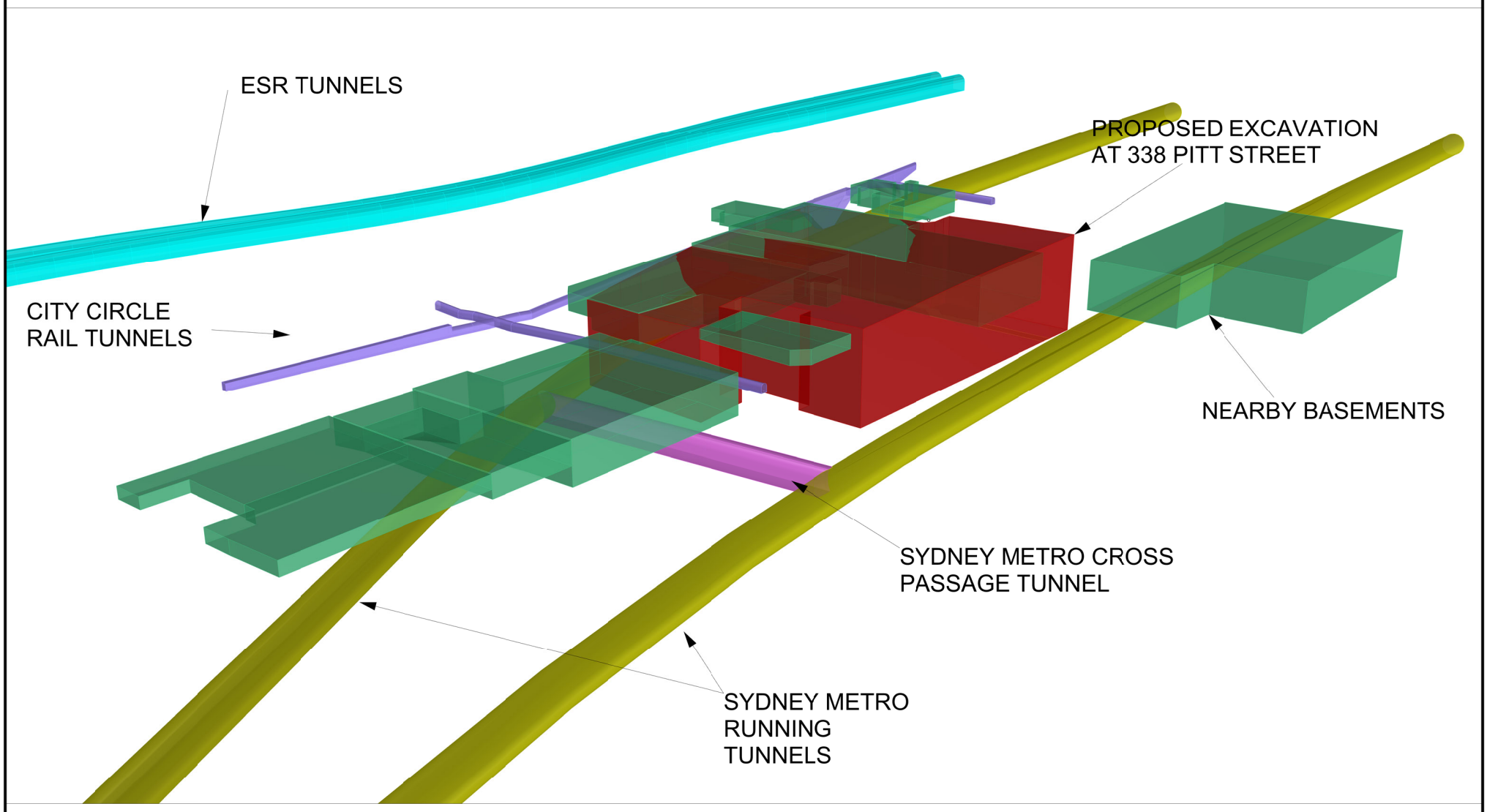
Hans Sydney Pty Ltd
Hans 338 Pitt Street
Sydney

GEOMETRICAL DESKTOP STUDY
SECTION B

PSM3102-006R | FIGURE 3



OBLIQUE VIEW 1: LOOKING NORTH EAST



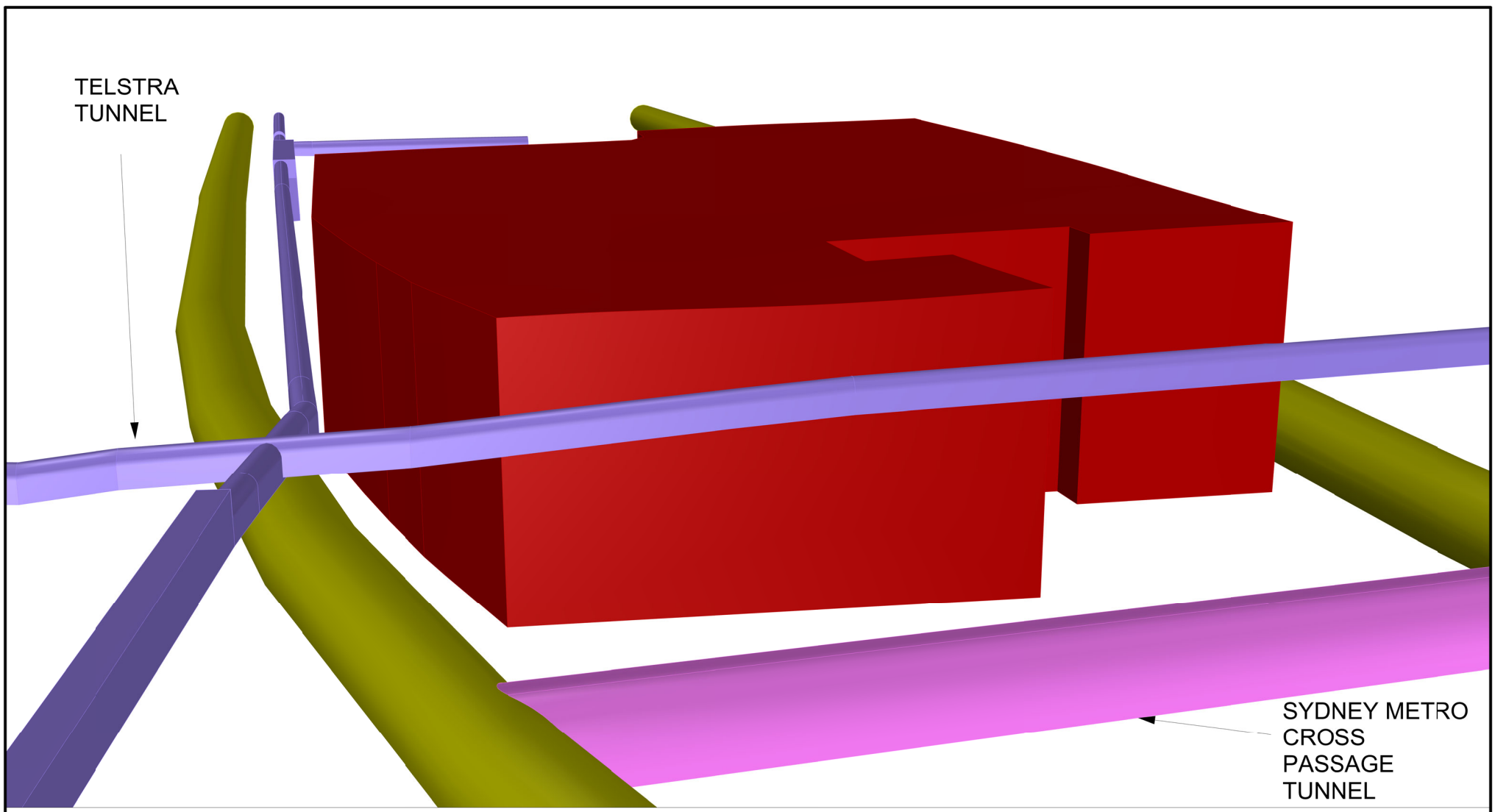
OBLIQUE VIEW 2: LOOKING NORTH WEST

NOTES:
1. Refer to report for information sources.
2. All information approximate only for illustrative purposes.

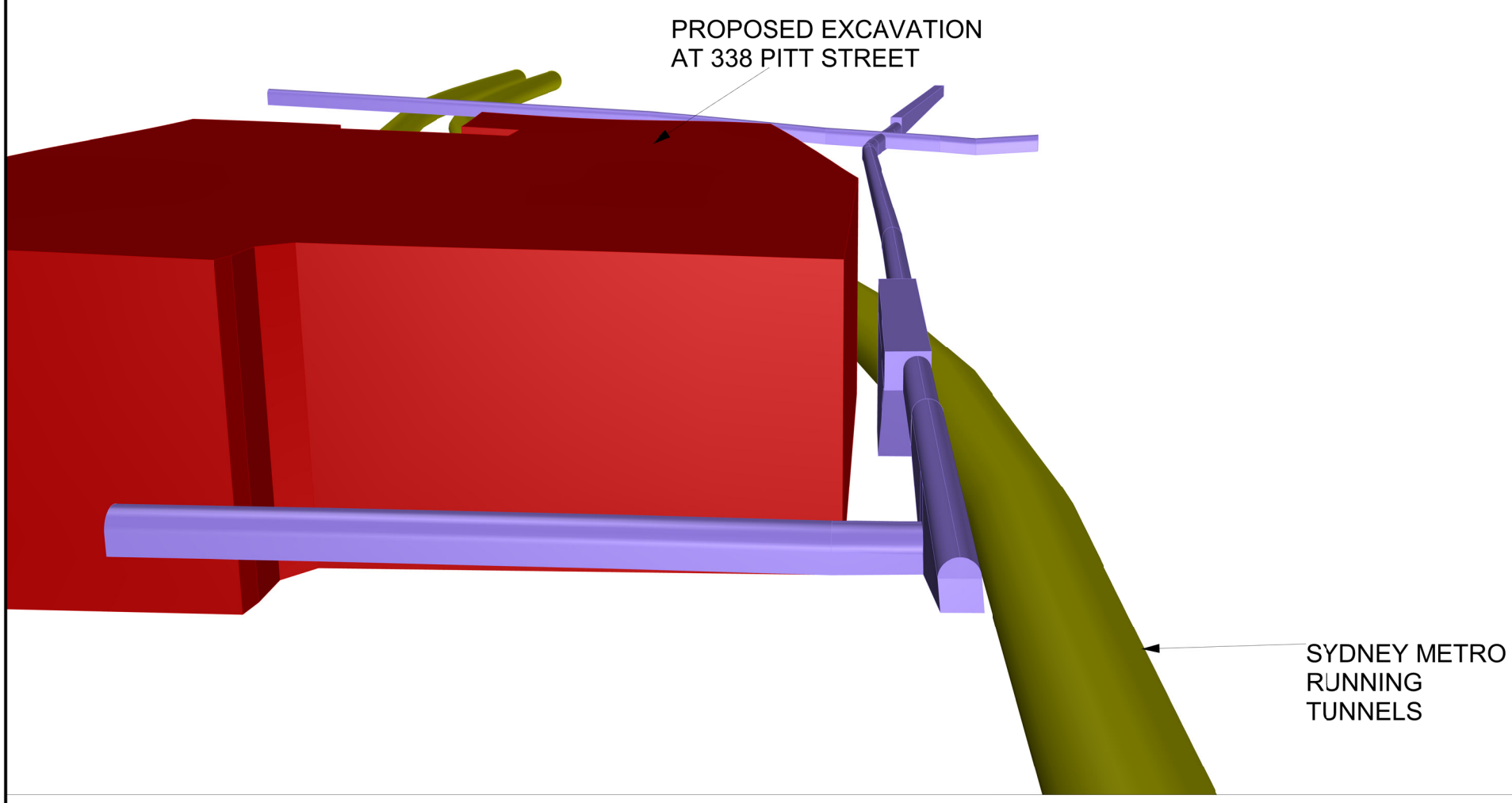
Pells Sullivan Meynink

Hans Sydney Pty Ltd
Hans 338 Pitt Street
Sydney
GEOMETRICAL DESKTOP STUDY
3D MODEL PERSPECTIVE VIEW

PSM3102-006R | Figure 4



OBLIQUE VIEW 3: LOOKING NORTH



OBLIQUE VIEW 4: LOOKING SOUTH

NOTES:
1. Refer to report for information sources.
2. All information approximate only for illustrative purposes.

Pells Sullivan Meynink

Hans Sydney Pty Ltd
Hans 338 Pitt Street
Sydney
GEOMETRICAL DESKTOP STUDY
ZOOMED IN - 3D MODEL PERSPECTIVE VIEW

PSM3102-006R | Figure 5