Building around existing tunnels
Seminar

City Shaping Infrastructure Projects: The Sydney Metro Corridor Protection Development Review Process

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ENGINEERS AUSTRALIA | AUSTRALIAN TUNNELLING SOCIETY 50 years 1972 - 2022 | AUSTRALIAN GEOMECHANICS SOCIETY

Disclaimer: The speakers are presenting their own personal views and are not expressing the view of ATS or AGS.

Acknowledgement of Country

Sydney Metro pays respect to Elders past and present, and recognises and celebrates the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands and waters of NSW.

The Sydney Metro network

Metro North West Line

Opened 26 May 2019

- 13 stations
- 4000 commuter car parks
- 36 kilometres

Sydney Metro City & Southwest

Opening 2024

- 18 stations
- New CBD connections
- 30 kilometres, including under Sydney Harbour

Sydney Metro West

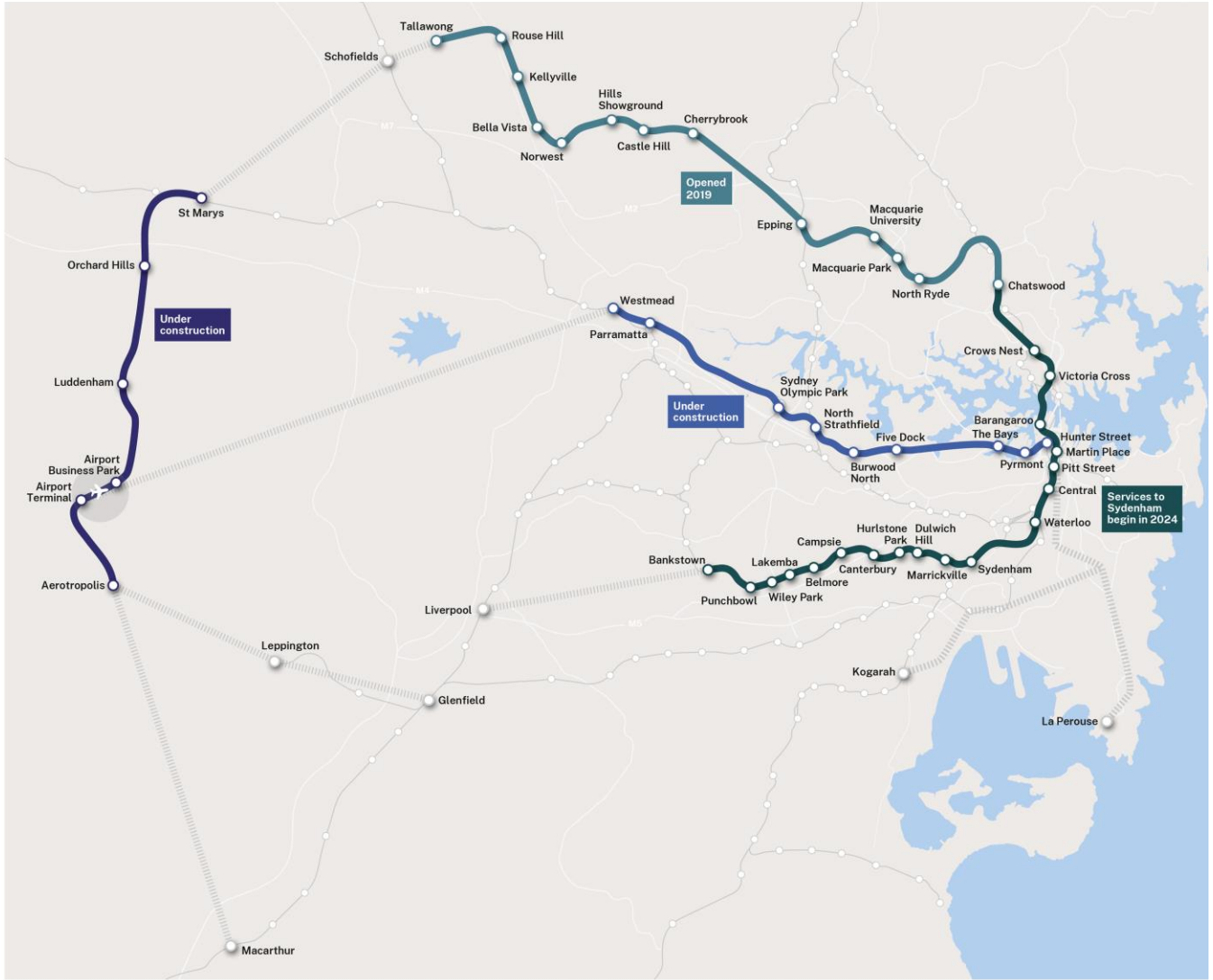
Construction started 2020

- Nine stations
- Connecting Greater Parramatta and the Sydney CBD
- Western Sydney population, 2036

Sydney Metro – Western Sydney Airport

Construction started 2020

- Six stations
- Connecting Western Sydney International Airport to the rest of Greater Western Sydney
- Servicing Greater Western Sydney



Sydney Trains suburban network

Future metro (subject to further investigation)

Legislative framework

- Legal framework through the *Environmental Planning and Assessment Act 1979*

- Sydney Metro - approved projects Critical State Significant Infrastructure or Interim Rail Corridors

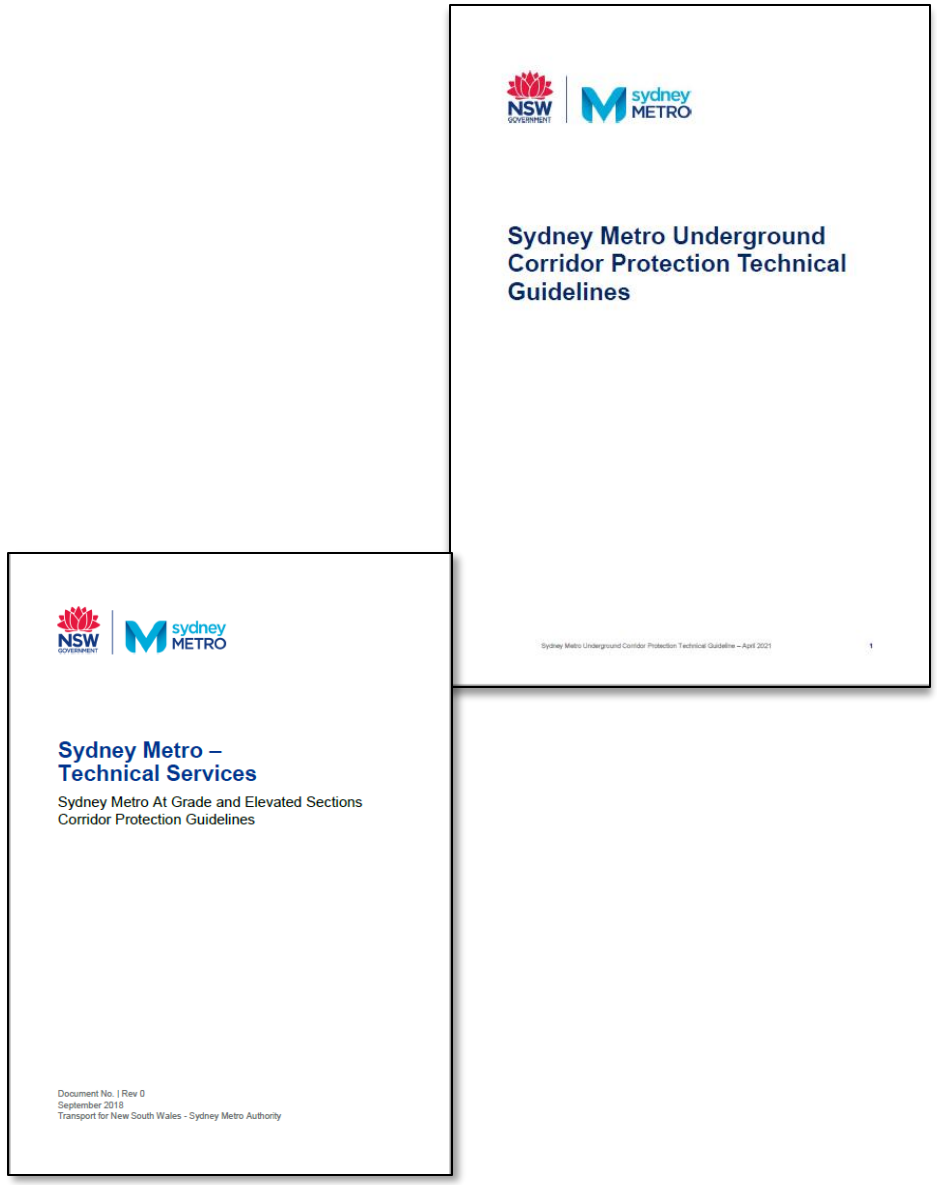
- *Transport and Infrastructure SEPP 2021* (former ISEPP)
  - Section 2.99 – Excavation in, above, below or adjacent to rail corridors
  - Section 2.98 – Development adjacent to rail corridors
  - Section 2.101 – Interim rail corridor
  - Section 2.48 – Electricity Transmission Network
  - Section 4.9 Future Major infrastructure corridors

- Review and assessment of State Significant Development proposals

- Rail corridor defined: that is owned, leased, managed or controlled by a public authority for the purpose of a railway or rail infrastructure facilities – includes stations, tunnels, caverns, viaducts, at grade, construction sites, sub stations, services facilities, electrical infrastructure

Approach to protecting Metro infrastructure

- Focus on protecting Metro assets and infrastructure
- Encourage development along Metro corridors and at station precincts
- Guidelines to assist developers and their technical teams
- Underground Guidelines – tunnel typologies and underground corridor
https://www.sydneymetro.info/sites/default/files/2021-09/SM-Underground-Corridor-Protection-Technical-Guidelines.pdf
- At Grade and Elevated Guidelines – viaduct and at grade sections
https://www.sydneymetro.info/sites/default/files/2021-09/Sydney_Metro_At_Grade_and_Elevated_Sections_Corridor_Protection_Guidelines.pdf



Assessing a development application or third party activity

- Pre DA – clarification of requirements, Guidelines, meeting if required, provision of Metro information if required
- Assessing lodged DA – review design, documents and impacts on Metro infrastructure
- RFI (if required) – Additional information to assist in review of proposal and its impacts on Metro infrastructure
- Concurrence outcome

Concurrence outcomes

When Sydney Metro receives a DA the following outcomes can be arrived at:

- Concurrence and consent with no conditions – nil impacts on Metro infrastructure
- Request for further information (RFI) – inadequate information provided and additional assessment required to assess impacts on Metro infrastructure
- Concurrence with conditions granted– acceptable impacts
- No concurrence granted – unacceptable impacts on Metro infrastructure

Development Application

Supporting documents

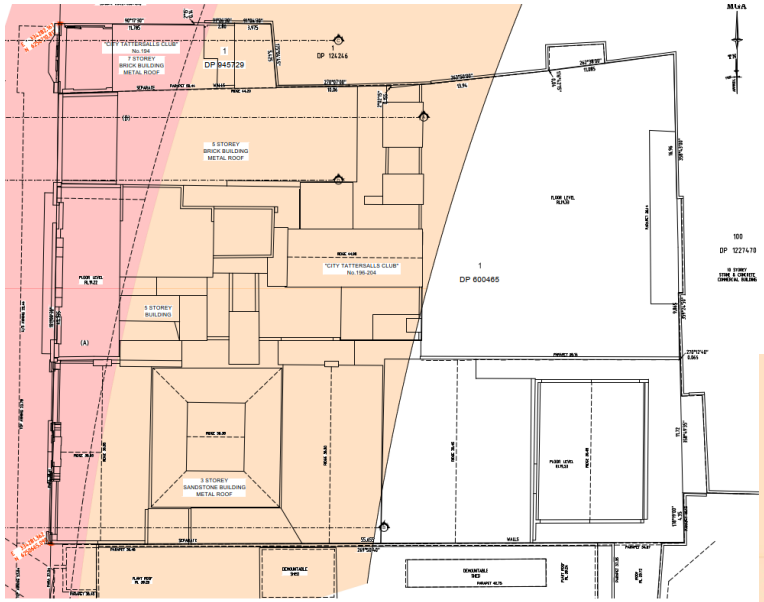
For detailed DAs, all the required documents must be submitted to an acceptable level of detail.

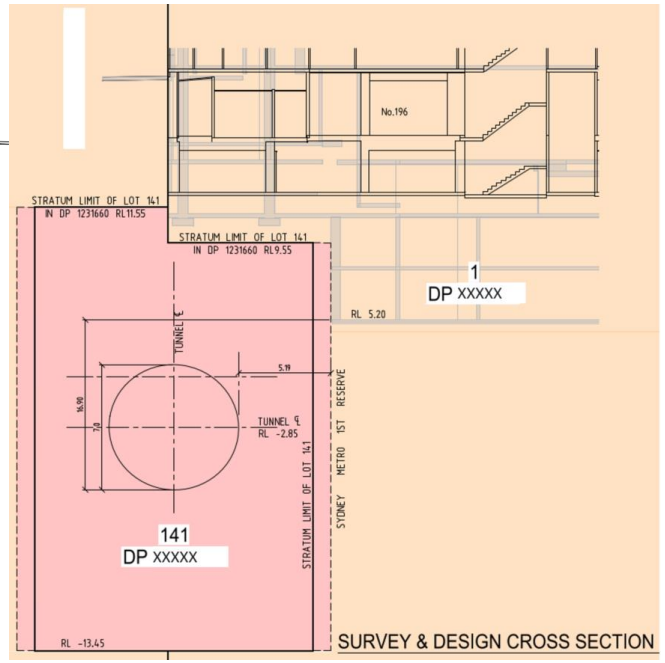
- Survey plans
- Cross sections
- Geotechnical investigation report
- Impact assessment report
- Risk assessment report
- Instrumentation and monitoring report (if required)
- Noise and vibration assessment
- Electrolysis assessment

Documents should adequately reflect the design intent and preliminary documents will not provide the level of detail required for review

Insufficient detail will likely extend the DA review process

Survey Plan and sections

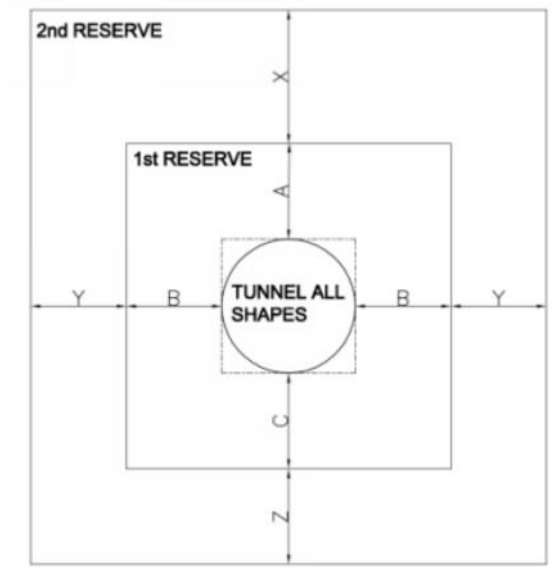




Must clearly show in plan and in section:

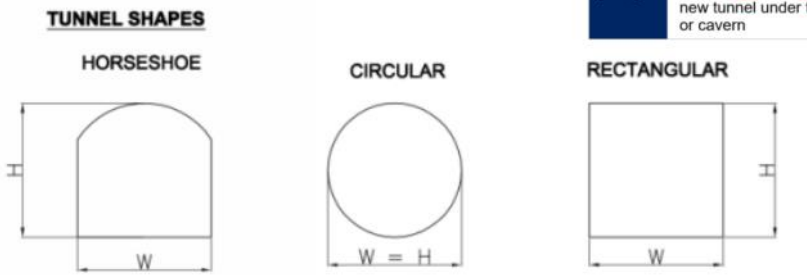
- 1st and 2nd reserves
- Current ground profile
- Proposed development

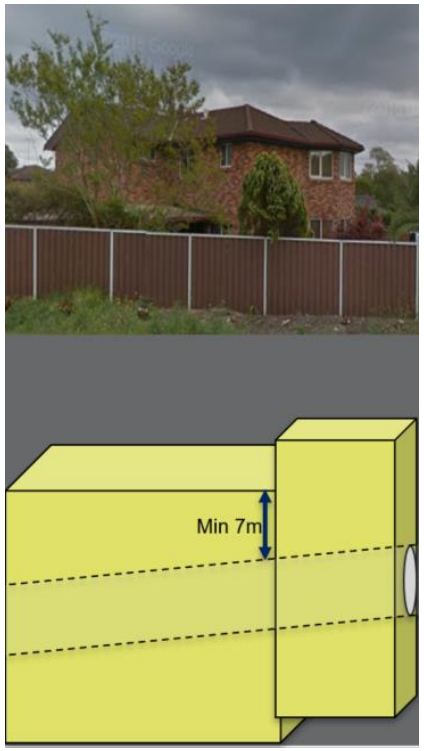
Survey Plan and sections



	First reserve dimensions (m)
Top (A)	The greater of the following: • 5 m from the crown of tunnel or cavern or • Support zone based on 1/3* tunnel width plus 1 metre (1/3*W+1) or • Extent of Sydney Metro substratum above crown
Side (B)	The greater of the following: • 5 m from side wall of tunnel or cavern or • Lateral extent of Sydney Metro substratum
Bottom (C)	The greater of the following: • 5 m below the invert of the tunnel or cavern or • Extent of Sydney Metro substratum below invert

	Second reserve dimensions (m)
Top (A+X)	The greater of the following: • 1.5 x (W+H) or • A + 25 or • Where 'W' and 'H' are width and height of the existing rail tunnel
Side (B+Y)	The greater of the following: • W or • B + 25
Bottom (C+Z)	C + 1.5 x (W_n + H_n) Where 'W_n' and 'H_n' are width and height of new tunnel under the existing metro tunnel or cavern





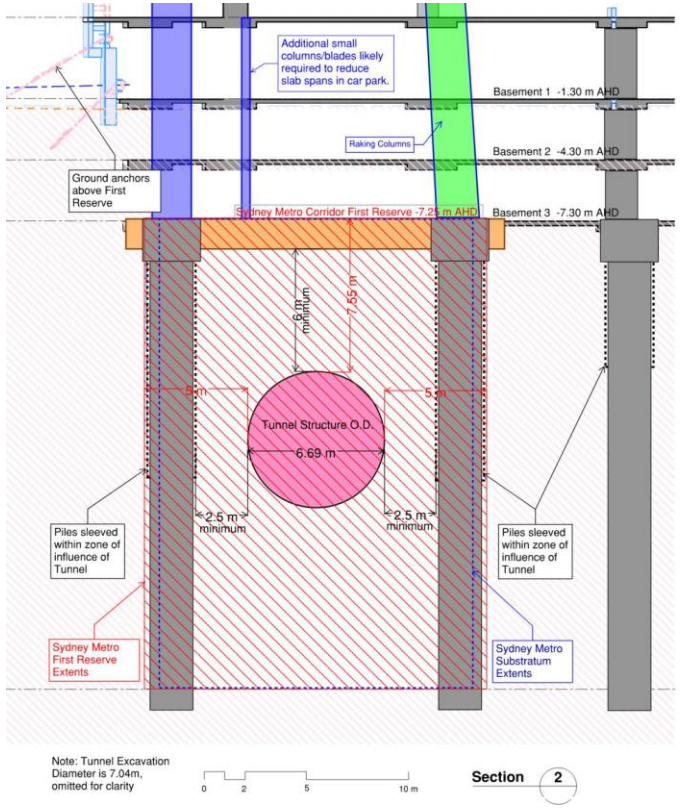
First reserve generally defined by sub-stratum

Sub-stratum information generally acquired by registered surveyor from the Land Registry Services

Impact Assessment Report

An impact assessment report will be required for developments or structural inclusions within the SM reserves

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 e.g. boreholes, instrumentation	Allowed away from support zone. Assessment required.	Allowed, subject to assessment (refer to Section 7.1 for requirements)

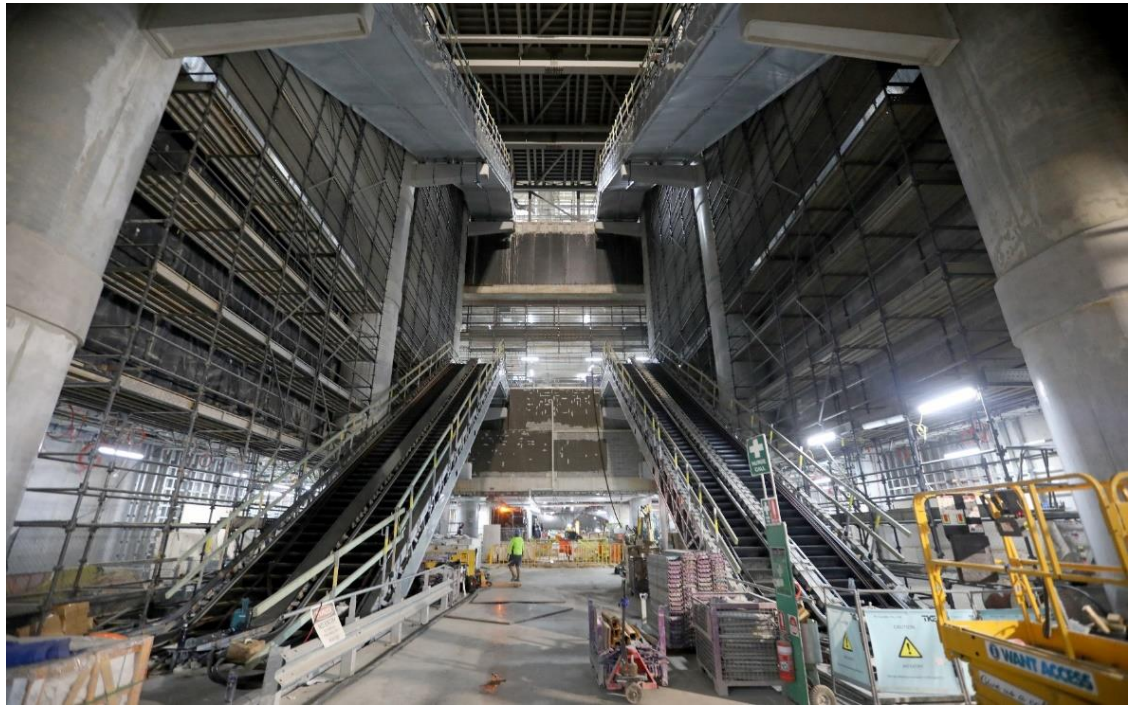


Impact Assessment Report

The purpose of the report is to quantitatively demonstrate there will be negligible impact to Sydney Metro infrastructure.

In addition the guidelines stipulate:

- Maximum total movement of 10mm
- No new visible cracking
- Existing cracks must not increase by:
  - more than 0.2 mm in width
  - more than 300 mm in length



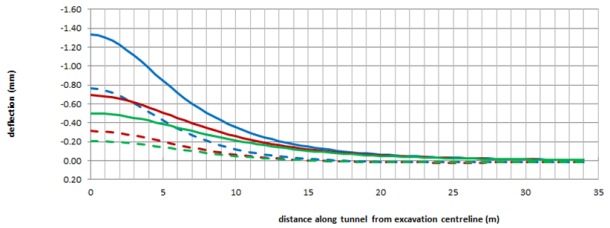
Impact Assessment Report

- The guidelines do not dictate the method of analysis
- Level of analysis detail to be determined by developer
- Structural elements define the durability and long-term performance of the asset and geotechnical analyses only may not be sufficient.
- Structural checks need to demonstrate that existing residual capacity of structural elements are not exceeded (using appropriate structural analyses which includes all relevant loads and load combinations and relevant factors)

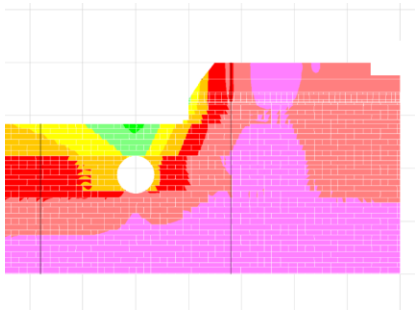
Geotechnical

Structural

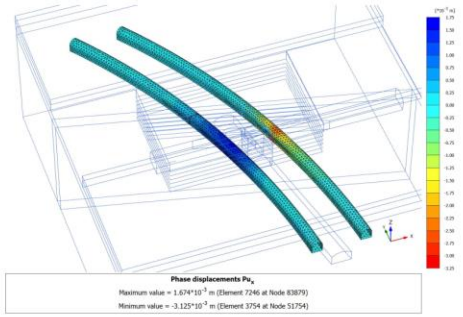
Elastic - Kirsch / Boussinesq

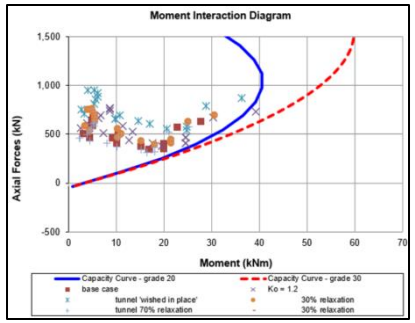


2D FE / FD / BE



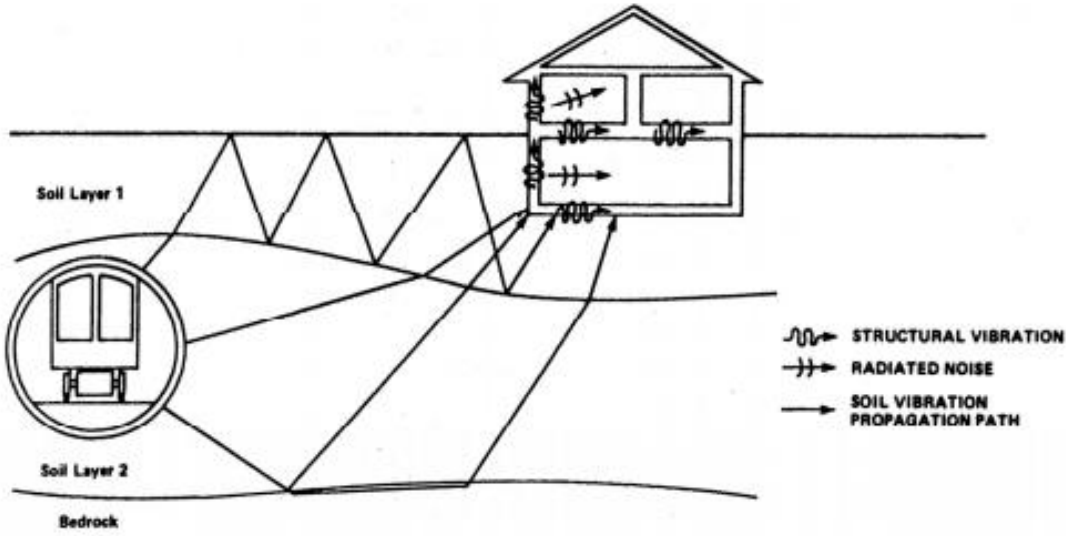
3D FE / FD / BE





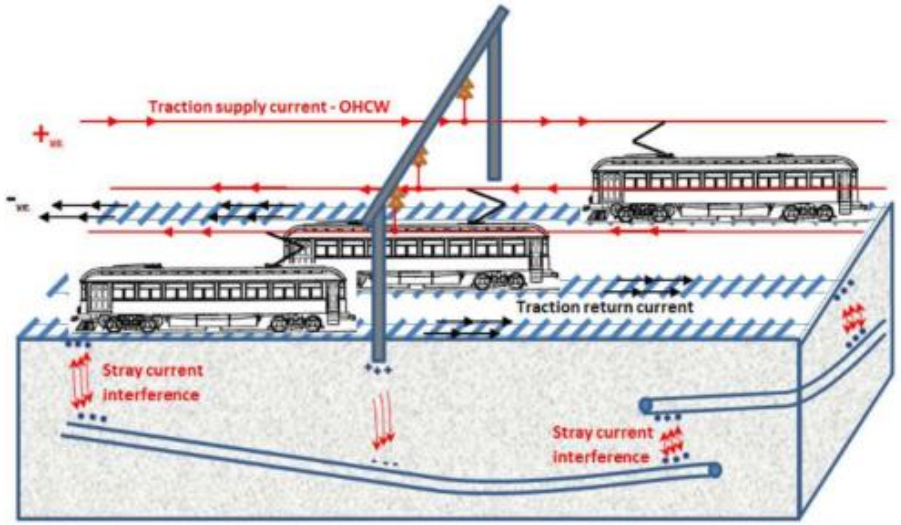
Noise and vibration

- Vibration radiates from tunnel, through the soil and into buildings
- Acoustic reports to assess for impacts of train induced vibration in terms of:
  - Human comfort
  - Ground-borne noise
- Acoustic reports to detail assumptions and methodology used in assessing noise and vibration impacts



Different propagation paths for train-induced vibrations (Remington et al., 1987).

Electrolysis



What causes electrolysis of metal structures?

- DC traction current returns to the source through the rail
- Rails being closer to the ground surface present a risk of DC current leaking through the ground
- This leakage current is called DC stray current
- This DC stray current causes electrolysis in metal which results in corrosion

What are the risks associated with electrolysis in a structure?

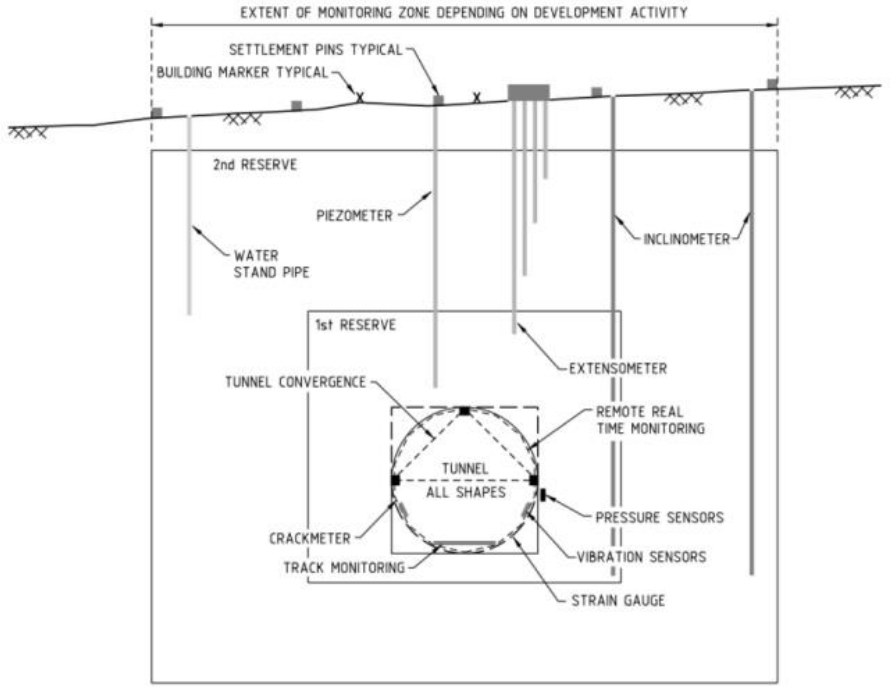
- Proximity to the rail system
- Structures with low electrical resistance (Presence of moisture, exposed metal work, etc)
- Low concrete strength

What are the recommended controls for limiting of DC stray currents?

- Moisture barriers to improve electrical resistance
- High concrete strength for piles and slabs
- Monitoring points
- Using insulated joints for services at entry/exit

Instrumentation and monitoring

- If deemed necessary an instrumentation and monitoring report will be required
- Proposed monitoring techniques and location to be proposed by developer
- Trigger limits to be based on analysis results



Dilapidation surveys

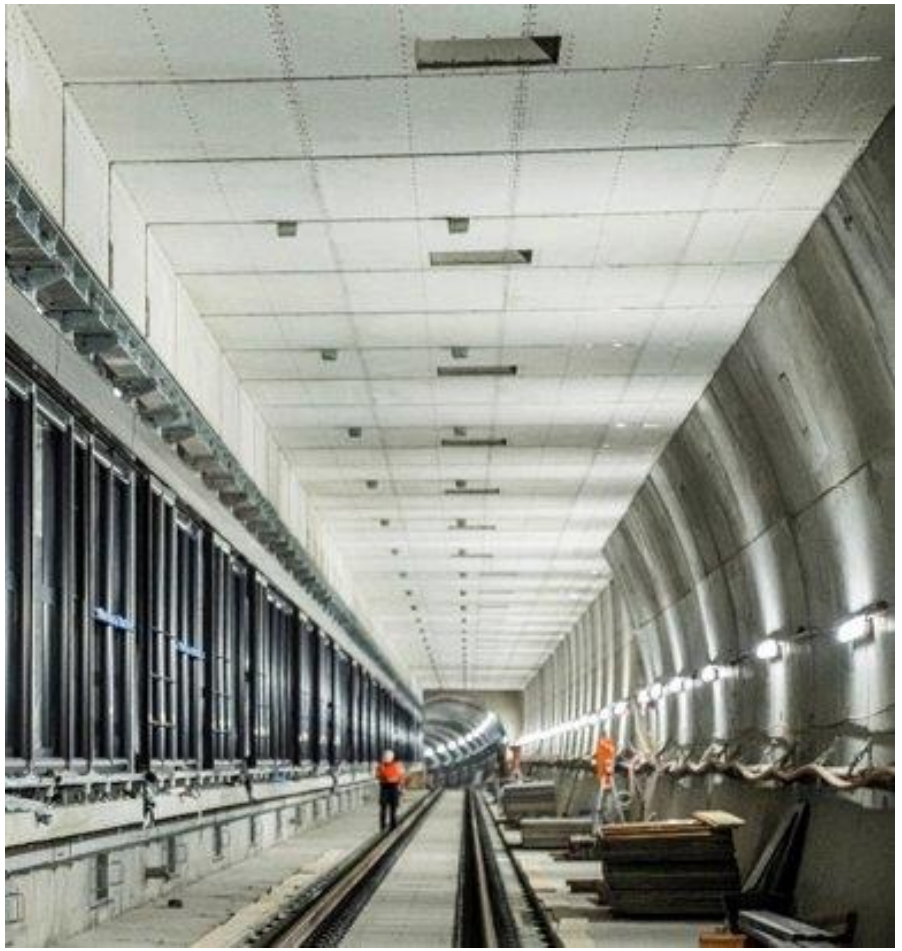
- If deemed necessary, pre and post dilapidation surveys will be required
- Intermediary surveys may also be required if deemed necessary
- All defects to be clearly marked on high quality photographic records
- Extent of survey to be agreed with Sydney Metro
- Full photographic record will assist demonstration that there has been no impact on the lining

Design changes and modifications

- Amendments – minor changes, some limited additional analyses may be required
- Modifications – significant change lodged to an approved DA. This will require a modified impact assessment to be submitted
- New DA – new project specific impact assessment to be submitted

Post DA approval

- Consolidated document package to address conditions for the relevant construction stage submitted to Sydney Metro via email
- SM technical team review and assesses compliance with conditions
- RFI required if necessary and design and documents submitted
- Sydney Metro review and internal consultation with relevant disciplines
- Technical team advises conditions have been met
- Sydney Metro letter advising relevant conditions have been satisfied
- Certifier issues construction or occupation certificate



- SydneyMetroCorridorProtection@transport.nsw.gov.au

Thank you

sydneymetro.info

NSW GOVERNMENT

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