



# A New Standard: Developments Near Rail Tunnels



**16<sup>TH</sup> AUSTRALASIAN  
TUNNELLING  
CONFERENCE 2017**

**30 OCT - 1 NOV 2017  
THE STAR SYDNEY**

**CHALLENGING UNDERGROUND  
SPACE: BIGGER, BETTER, MORE**

[www.ATS2017.com.au](http://www.ATS2017.com.au)

HOST	CO-HOSTED BY	SUPPORTED BY
		

**N. Loganathan<sup>1</sup>, S. Fernando<sup>2</sup>, R. Mahajan<sup>1</sup>, and R. Hitch<sup>2</sup>**

<sup>1</sup>WSP Australia

<sup>2</sup>Asset Standards Authority, Transport for NSW

## Background

- Lack of technical guidance/requirements
  - (*specially city circle tunnels*)
- Guidelines available for Airport Line (APL) and Epping to Chatswood Rail Line (ECRL)
- Lack of coherent approach to technical assessments
- Engage tunnelling SME
- Review of existing related documents/guidelines
- Stakeholder consultation

City underground rail system

Airport link tunnel

Epping to Chatswood tunnel

- City Circle tunnel
- Eastern Suburb Railway tunnel (ESR)

- Wolli Creek to Central

## Existing Documents (Before 2016)

### Regulations

#### *Legislative requirements*

- State Environmental Planning Policy (Infrastructure) 2007 – SEPP Reg 86
- Transport Administration Act 1998 provides statutory protections in respect of underground rail facilities

### Guidelines

#### *TfNSW Guidelines/requirements*

- ECRL underground infrastructure protection guidelines: 2008
- Guidelines for development within vicinity of the Airport line: rail Access Corporation: 2000

### Technical standards

T HR CI 12080 ST – External development

## Why New Standard?

- No guidelines or Standard for developments near City Circle Line and Eastern Suburban Railway Tunnels (ESR)
- Set same rules for all Sydney tunnels
- Combine Regulations and Guidelines
- Simplify development application document requirements

## Construction drill came from site above rail tunnel

🕒 27 March 2013 | London

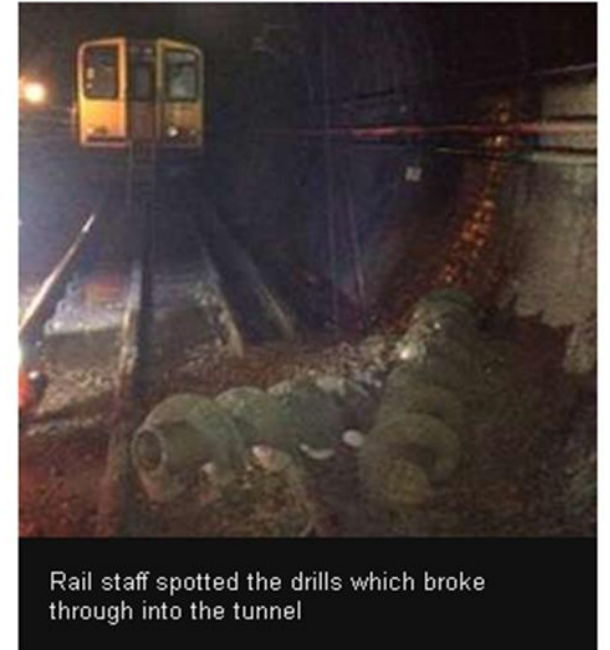
Sections of a drill which broke through the roof of a rail tunnel came from a construction site above the ground, accident investigators have found.

Staff spotted two broken parts near Old Street Station, east London, on 8 March after a passenger train driver reported water pouring on to the train's roof.

The metal drill parts, 2m (6.5ft) in length, were on the tracks.

Rail services on the busy First Capital Connect route were suspended for about three days as repairs were carried out.

A driver on the passenger train travelling from Moorgate to Welwyn Garden City reported muddy water pouring on to his train's roof near the station.



## Content of the New Standard

- Terms and definitions
- Protection reserves
- Load limits
- Construction requirements- Safety, environment, heritage, construction constraints, etc.
- Engineering assessment
- Design and performance requirements
- Construction requirements
- Appendix - Existing Sydney rail tunnel alignment and other project details

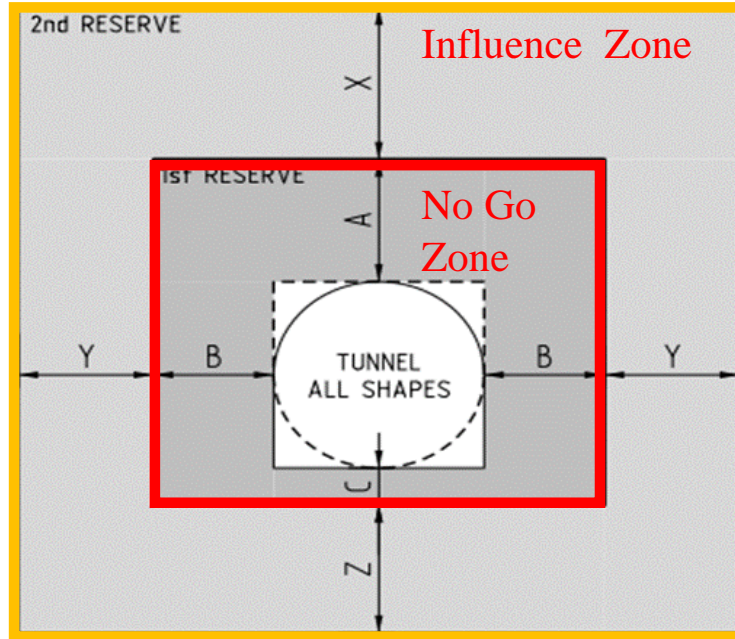
## Development Induced Impacts

- Loading from development
- Ground deformation resulting from excavations and external loading
- Induced vibrations during construction and operation
- Ground water leakages into tunnel

## How to Protect?

- Define Protection Reserves around the tunnel
- Design and performance requirements
- Construction requirements

# Protection Reserves



## 1st RESERVE

A: GREATER OF

- (1) 3m FROM THE CROWN OF THE TUNNEL.
- (2) ONE-THIRD OF TUNNEL WIDTH PLUS ONE METRE  $[(1/3) \times W + 1]$ .
- (3) EXISTING PRE-DEFINED EASEMENT HEIGHT.

B: GREATER OF

- (1) HALF OF TUNNEL WIDTH  $[(1/2) \times W]$ .
- (2) EXISTING PRE-DEFINED EASEMENT WIDTH.

C: GREATER OF

- (1) 1m FROM THE LOWEST TUNNEL INVERT INCLUDING CABLE AND DRAINAGE TRENCHES.
- (2) EXISTING PRE-DEFINED EASEMENT DEPTH.

W = EXISTING TUNNEL WIDTH

H = EXISTING TUNNEL HEIGHT

## 2nd RESERVE

A+X: GREATER OF

- (1)  $1.5 \times (W + H)$
- (2) A+25m

B+Y: GREATER OF

- (1) W
- (2) B+25m

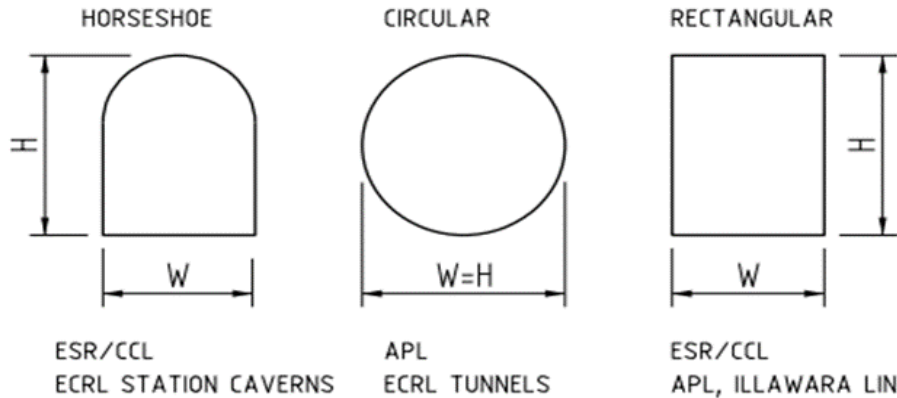
C+Z:  $C + 1.5 \times (W_n + H_n)$

W<sub>n</sub> = WIDTH OF NEW TUNNEL BELOW EXISTING TUNNEL

H<sub>n</sub> = HEIGHT OF NEW TUNNEL BELOW EXISTING TUNNEL

NOTE: ALL DIMENSIONS IN METRES

## TUNNEL SHAPES:



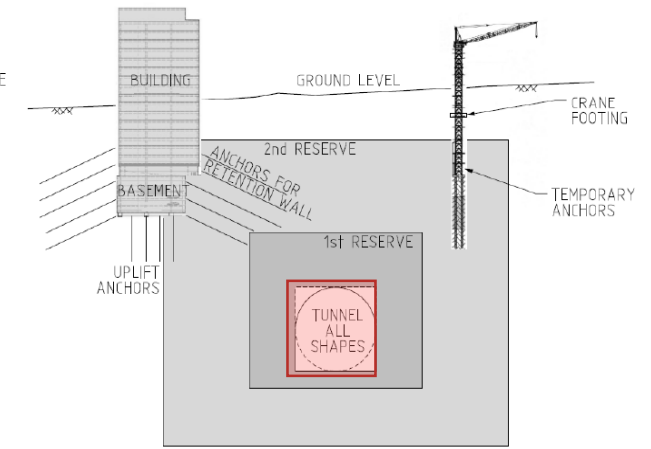
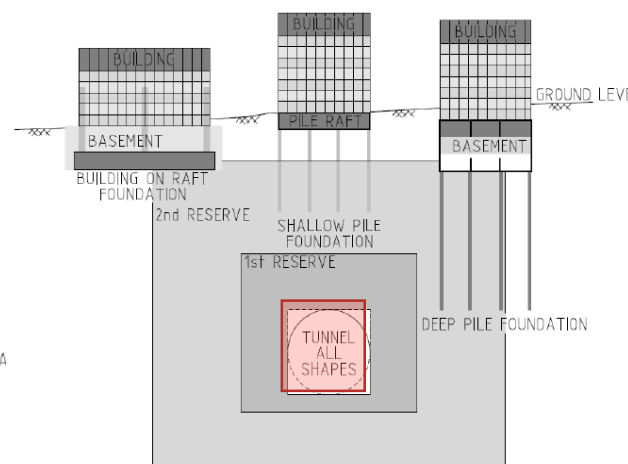
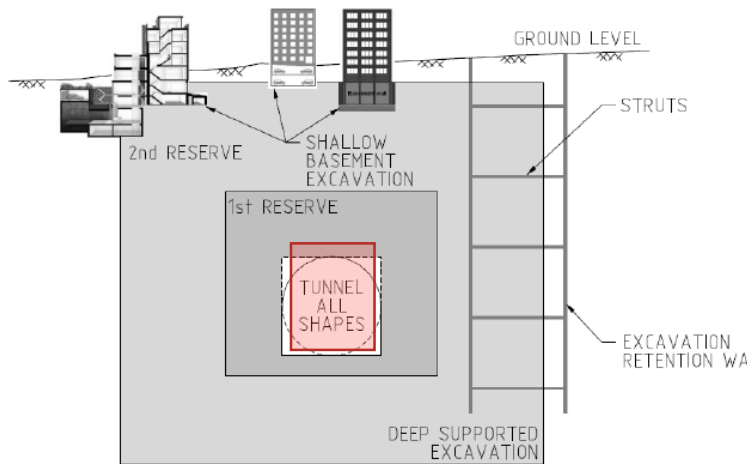
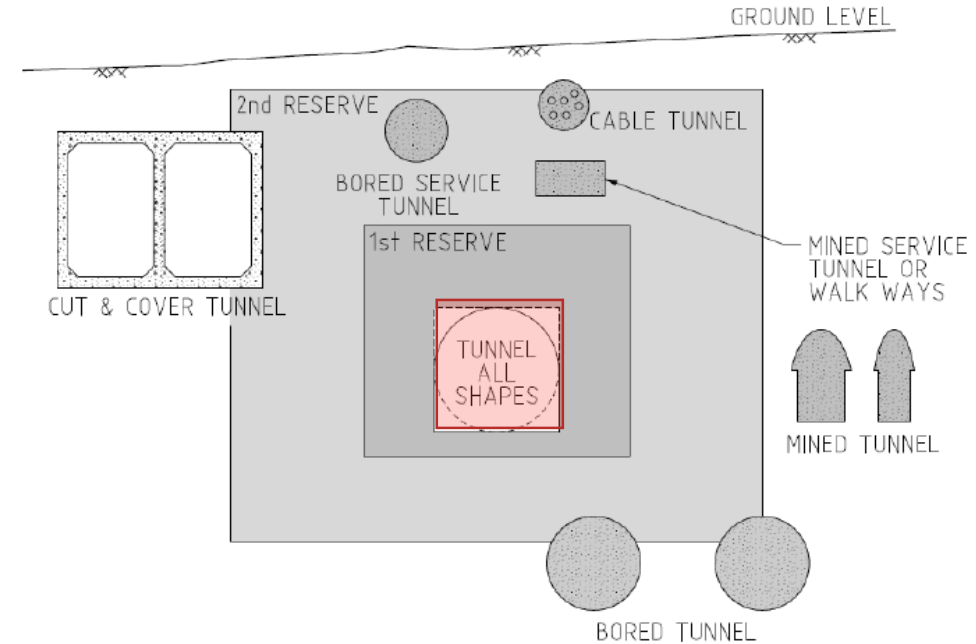
ESR/CCL  
ECRL STATION CAVERNS

APL  
ECRL TUNNELS

ESR/CCL  
APL, ILLAWARA LINE

# Typical Development Activities

- Open excavations
- Tunnels & underground excavations
- Foundations
- Ground anchors
- Temporary works
- Demolition of existing structures
- Site investigations & instrumentation holes





# Construction restrictions

	FIRST RESERVE	SECOND RESERVE
Excavations for basements, footings	Not Allowed	<ol style="list-style-type: none"> <li>Excavations less than 2.0m depth from surface level, assessment not required.</li> <li>Excavations greater than 2.0m depth, assessment required.</li> </ol>
Shallow footings or pile foundations	Not Allowed	Allowed subject to load restrictions. Assessment required.
Tunnels and underground excavations.	Not Allowed	Allowed subject to assessment.

# Construction restrictions

	FIRST RESERVE	SECOND RESERVE
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.



# Design and Performance Requirements

- Load limits in reserve zones for different tunnels
- Crack criteria
- Seismic effects
- Displacements
- Noise and vibration
- Temporary works
- Stray current and electrolysis

# Construction Requirements

- Dilapidation survey
- Rail related risk assessment and work method statement
- Demolition works
- Piling and excavation works
- Monitoring regime

# Documentation Requirements

- Minimum requirements at different stages
- Planning stage
- Design stage
- Prior to construction
- During construction
- After construction

## Engineering Assessment Report

- Geotechnical investigation report
- Verified survey plans with tunnel easements/protection zones
- Geotechnical model, parameters
- Predicted displacements, stresses at various stages
- Sensitivity analysis
- Assessment of likely effects on existing tunnel and infrastructure
- Assessment of effects of construction method
- Risk assessment
- Independent verification
- Certification stating that proposed development has no adverse impacts on existing rail tunnel

## After One Year

- Comments and clarifications from industry

## Technical Note - TN 026: 2017

Issued date: 13 July 2017

Effective date: 13 July 2017

**Subject:** *Amendments to T HR CI 12051 ST Development Near Rail Tunnels, version 1.0*

This technical note is issued by the Asset Standards Authority (ASA) to notify the amendments to T HR CI 12051 ST *Development Near Rail Tunnels*, version 1.0.

- **Section 6 Load limits**

If the guideline load limits **on tunnel reserve boundaries** are proposed to be exceeded, then an independent verification of the engineering analysis and impact assessment is required. Refer to Section 8.4 for information on independent verification.

## After One Year

- Section 6: Table 7 - Load limits on APL tunnels

Element	Description
Loading limit - soft ground tunnel	<p><i>If the applied pressure on the tunnel lining from foundation loads exceeds 10 kPa, but less than 30 kPa, then independent verification of the engineering analysis and impact assessment is required.</i> When the applied pressure on the tunnel lining exceeds 30 kPa, then the foundation loads shall be transferred past the tunnel.</p> <p>10 m minimum cover over tunnel to retain stability of the segmental concrete lining and to counter buoyancy effects. Load limits and associated ground movements shall not compromise the function of the waterproof gasket of the segmental lining. Gasket decompression assessment shall be performed based on the as-built details obtained from TfNSW.</p>



## After One Year

- Section 9.1.2- Crack Criteria

The following criteria shall be met for the cracking of tunnel lining and support structures as a result of the new development. The extent of cracking and crack criterion shall be confirmed for all stages of the development by engineering analysis and impact assessment.

The calculated maximum crack width shall be less than or equal to 0.3mm. Cracks with lengths exceeding 300mm and width exceeding 0.2mm shall be repaired by the developer.

## After One Year

- Section 9.5- Monitoring Plan

The monitoring requirements in this section are equally applicable for developments near or underneath existing dive structures

- Appendix A3- Airport Line

The soft ground tunnel is constructed as a circular bored tunnel supported by precast segments. There are eight 450mm thick segments forming each circular ring.

## Conclusions

- A New Standard is available for developments near existing rail tunnels



- Industry feedback is valuable