Tunneling Safety			
Business Name:		ABN:	
Business Address:			
Contact Person:	Phone:	Email:	

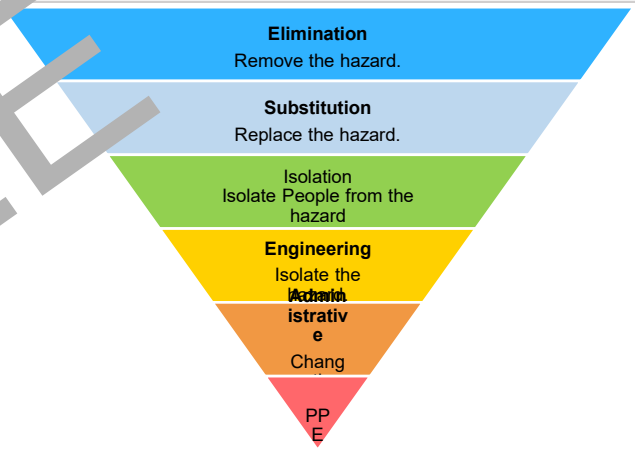
THIS RISK ASSESSMENT IS APPROVED BY THE PCBU OF THE PROJECT		
Under the Work Health and Safety Regulation (WHS Regulation), a person conducting a business or undertaking (PCBU) is required to ensure that a RISK ASSESSMENT is prepared before the proposed work starts.		
Full Name:		
Signature:	Title:	Date:

CLIENT OR PRINCIPAL CONTRACTOR DETAILS	
Client:	SCOPE OF WORKS
Project Name:	
Project Address:	
Project Manager:	
Contact Phone:	
Date Risk Assessment supplied to Project Manager:	

RISK MATRIX

LIKELIHOOD	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC	SCORE	ACTION
ALMOST CERTAIN	3 HIGH	3 HIGH	4 ACUTE	4 ACUTE	4 ACUTE		
LIKELY	2 MODERATE	3 HIGH	3 HIGH	4 ACUTE	4 ACUTE	4A ACUTE	DO NOT PROCEED
POSSIBLE	1 LOW	2 MODERATE	3 HIGH	4 ACUTE	4 ACUTE	3H HIGH	Rev before work
UNLIKELY	1 LOW	1 LOW	2 MODERATE	3 HIGH	4 ACU	2M MO RATE	Ensure control measures in place.
RARE	1 LOW	1 LOW	2 MODERATE	3 HIGH	3 H	1L LOW	Monitor and keep records.

HIERARCHY OF CONTROLS



Risk Rating & Required Action:

4A	Stop work. The risk is intolerable. E inate the hazar redesign the activity before proceeding. A Safe Work Method Statement (SWMS) or hi er-level authorisati is required.
3H	Review and approve additional c rols b ask arts. Senior supervisor sign-off needed.
2M	Ensure all nominated controls are in ace and effe ive. Proceed with caution; monitor conditions.
1L	Proceed, following standard operating procedures Monitor and keep records.

Consequence Scale:

Consequence	People (injury/illness)	Project / Assets	Compliance / Reputation
Catastrophic	Fatality or permanent total disability	project shutdown	Significant regulator intervention; criminal prosecution
Major	Serious injury/illness (hospital > 5 days)	critical delay	Improvement notice; major media coverage
Moderate	Medical-treatment injury; lost-time > 1 day	moderate delay	Minor breach; adverse client comment
Minor	First-aid only, no lost time	negligible delay	Isolated non-conformance
Insignificant	No injury	no schedule impact	Deviation caught and corrected on site

Notes on Hierarchy of Controls:
Remember to apply controls in the preferred order shown by the coloured pyramid:

1. **Eliminate**
2. Substitute
3. Isolate
4. Engineering
5. Administrative
6. PPE

Always document **why** a lower-order control is accepted if elimination or substitution is not reasonably practicable.

aligned with Safe Work Australia's Managing the risk of fatigue at work *(2023) and ISO 45001:2018 clauses 6–8.*

JOB STEP	POTENTIAL HAZARDS	IR	CONTROL MEASURES	RR
SPECIFIC WORK STEPS	HAZARDS THAT MAY ARISE	INITIAL RISK	SPECIFIC MEASURES TO BE PUT IN PLACE TO ELIMINATE OR CONTROL THE RISKS	RESIDUAL RISK
1. Governance, Legal Compliance & WHS Responsibilities	• Lack of clear PCBU and officer due diligence arrangements for tunnelling activities under WHS Act 2011 • Inadequate understanding of duty of care for designers, principal contractors and subcontractors in tunnelling environments • Failure to integrate tunnelling risk management with overall project WHS management system • Insufficient consultation with workers and health and safety representatives (HSRs) on tunnelling-specific risks • Failure to incorporate relevant Australian Standards, Codes of Practice and tunnelling guidelines into governance documents • Poor change management for design, equipment or methodology variations (e.g. switch between micro tunnelling, road header and TBM) • Inadequate incident notification and regulator liaison processes for serious tunnelling incidents and near misses	4A	• Establish a project-specific WHS management plan for tunnelling that clearly articulates duties under the WHS Act 2011 and WHS Regulation • Define and document officer due diligence activities specific to tunnelling (e.g. regular risk review meetings, site walks, verification of controls) • Integrate tunnelling risk management into the principal contractor's overarching WHS management system, including interfaces with other work fronts • Develop a legal and standards register covering relevant Codes of Practice, Australian Standards (e.g. AS 2865, AS 3735), and industry tunnelling guidelines and incorporate into procedures • Implement a structured consultation framework with workers and HSRs for tunnelling, including pre-start forums, toolbox talks and design review workshops • Introduce a formal management of change (MoC) procedure for any change in tunnelling method, equipment (TBM, road header, micro tunnelling plant), sequence or design • Develop incident notification and escalation procedures tailored to tunnelling (ground collapse, inundation, major plant failure) including regulator notification timeframes • Schedule periodic independent WHS audits of tunnelling governance arrangements and implementation effectiveness	3H
2. Design, Ground Investigation & Geotechnical Risk Management	• Inadequate geotechnical investigations prior to selection of tunnelling method (micro tunnelling, road header, TBM) • Uncertain ground conditions leading to unplanned ground movement, collapse or subsidence • Insufficient assessment of groundwater inflows and hydrostatic pressure affecting tunnel stability • Poor integration between design engineers, geotechnical specialists and construction team • Inadequate design factors of safety for tunnel support systems and lining based on assumed ground behaviour	4A	• Implement a geotechnical baseline investigation program including boreholes, test pits, laboratory testing and groundwater monitoring appropriate to tunnelling method • Establish a formal geotechnical risk register and Geotechnical Risk Management Plan covering all tunnelling stages and methods • Require independent design verification of tunnel support systems, lining, and excavation sequences against anticipated ground and groundwater conditions • Convene regular design coordination meetings between structural, geotechnical and construction teams to review emerging data and performance • Apply conservative design parameters and documented safety factors for support and lining, with allowances for variability and uncertainty in ground conditions • Develop and implement a ground and structure monitoring program (settlement markers, inclinometers, vibration monitoring, convergence monitoring) • Include hold points in the construction process to review monitoring data and adjust design or tunnelling parameters where trends indicate increasing risk	3H

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	• Lack of monitoring strategy for ground movement, settlement and support performance • Failure to consider interaction with existing services, utilities and nearby structures in design		• Map and verify existing services and adjacent structures and integrate clearance and protection requirements into design and method statements	
3. Tunnelling Method Selection & Integration (Micro Tunnelling, TBM, Road Header)	• Selection of inappropriate tunnelling method for ground, alignment, and environmental conditions • Fragmented planning when multiple tunnelling methods are used on the same project without clear interfaces • Underestimation of equipment capability limits and operating envelopes • Inadequate contingency planning for method changeover or equipment failure (e.g. TBM breakdown, micro tunnelling head retrieval) • Insufficient assessment of vibration, noise and settlement impacts from method selection • Lack of system-wide consideration of spoil management, ventilation, power and access requirements across methods	4A	• Conduct a formal options assessment comparing micro tunnelling, road header and TBM methods based on geotechnical data, alignment, access and risk profile • Develop an Integrated Tunnelling Execution Plan describing interfaces, transition points and responsibilities between different tunnelling methods • Define operational envelopes, limitations and technical specifications for all tunnelling equipment and embed these in procurement and operating procedures • Prepare contingency and recovery plans for key scenarios, including TBM stuck events, road header failure underground and micro tunnelling head retrieval • Undertake predictive modelling and assessment for vibration, noise, settlement and building impact for each tunnelling method and integrate into approvals • Coordinate systems planning (ventilation, power supply, spoil handling, water management, emergency access) to ensure compatibility across all methods • Implement periodic review of method performance against design assumptions, with triggers for re-assessment or method adjustment	2M
4. Plant Procurement, Engineering Controls & Maintenance Systems	• Procurement of tunnelling plant (TBM, road header, micro tunnelling rigs) without adequate WHS functional safety features • Lack of conformity assessment and commissioning checks for complex tunnelling plant and support systems • Inadequate preventive maintenance and inspection systems for critical safety components • Failure of emergency stop, isolation and braking systems due to poor maintenance or design • Incompatible or uncertified modifications to tunnelling plant and support systems	4A	[redacted]	2M

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SPECIFIC WORK STEPS	HAZARDS THAT MAY ARISE	INITIAL RISK	SPECIFIC MEASURES TO BE PUT IN PLACE TO ELIMINATE OR CONTROL THE RISKS	RESIDUAL RISK
	• Poor availability of spare parts and technical support leading to improvised repairs		[redacted]	
5. Ventilation, Atmospheric Monitoring & Hazardous Substances	• Inadequate ventilation design leading to build-up of diesel exhaust, dust, welding fumes or blasting fumes in tunnels • Failure of ventilation fans or ducting systems without appropriate monitoring or alarms • Lack of continuous atmospheric monitoring for oxygen levels, flammable gases and toxic contaminants • Poor management of shotcrete chemicals, grouts, resins and other hazardous substances used in tunnel support systems • Insufficient consideration of temperature and humidity leading to heat stress risk in confined tunnels • Uncontrolled use of diesel plant underground leading to elevated NOx, CO and particulate levels	4A	[redacted]	2M
6. Ground Support Systems & Tunnel Lining Management	• Inadequate system design, selection and verification of tunnel support systems (rock bolts, mesh, shotcrete, segmental lining) • Incorrect installation of support elements due to poor procedures or supervision • Failure to respond to observed ground deterioration, overbreak or convergence • Inadequate traceability of installed support (location, type, batch data, testing records) • Lack of systematic pull-testing, quality control and inspection of ground support installation	4A	[redacted]	2M

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	• Failure to integrate TBM segmental lining performance data into ongoing risk assessments		[redacted]	
7. Excavation Stability, Face Control & Inundation Risk	• Face instability during tunnelling with road header or TBM resulting in collapse or sudden ground loss • Uncontrolled water ingress or pressurised inflows leading to inundation or ground softening • Inadequate system to monitor and manage face pressure in pressurised TBM operations • Lack of contingency planning for rapid sealing of inflows, grout curtains or dewatering adjustments • Insufficient control of excavation advance rates and sequencing relative to ground conditions and support capacities • Poor communication of geotechnical hazard zones to operators and supervisors	4A	[redacted]	3H
8. Energy Isolation, Lockout/Tagout & Stored Energy Control	• Failure to isolate energy sources on TBM, road header, micro tunnelling rigs and associated plant during maintenance or blockages • Uncontrolled release of stored energy (hydraulic, pneumatic, electrical, mechanical, pressurised slurry) • Inadequate lockout/tagout systems and hardware to manage complex multi-energy systems • Poor coordination between contractors when multiple parties work on the same plant or system • Lack of clear isolation drawings, registers and procedures for tunnelling plant and services	4A	[redacted]	2M

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9. Emergency Management, Egress & Rescue Capability	• Inadequate emergency response planning for fire, explosion, ground collapse, inundation, medical events and plant failure underground • Insufficient egress routes, refuge chambers or safe havens within the tunnel • Poor communications systems for emergency notification and coordination in deep or long tunnels • Lack of specialised rescue capability for confined and complex underground environments • Inadequate integration of site emergency plan with external emergency services and local hospitals • Failure to consider staged commissioning and decommissioning of emergency systems as tunnelling advances	4A	[redacted]	2M
10. Traffic Management, Access & Interface with Surface Works	• Poorly controlled interaction between tunnelling logistics (spoil haulage, deliveries) and surface t[redacted] public roads • Inadequate sepa[redacted]tion of light v[redacted]icles, pedestrians and he[redacted] po[redacted] areas and shafts • Congestion or blocked access ro[redacted]s impacting emergency res[redacted] capability • Uncoordinated interface between tunnelling operations and adjacent construction activities • Insufficient controls for crane lifts, shaft access cages and man-riding systems at portal and shaft locations	3H	[redacted]	2M
11. Worker Competency, Training & Supervision for Tunnelling Operations	• Insufficient competency of operators, supervisors and engineers in specialised tunnelling equipment and methods	3H	[redacted]	2M

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SPECIFIC WORK STEPS	HAZARDS THAT MAY ARISE	INITIAL RISK	SPECIFIC MEASURES TO BE PUT IN PLACE TO ELIMINATE OR CONTROL THE RISKS	RESIDUAL RISK
	• Inadequate understanding of site-specific geotechnical and atmospheric hazards among workers • Poor supervision ratios and lack of experienced tunnelling supervisors for critical shifts • Lack of structured training on emergency procedures, isolation, confined space and ground support systems • Reliance on informal on-the-job learning without verification of skills		[redacted]	
12. Contractor Management, Procurement & Interface Control	• Engagement of tunnelling and specialist subcontractors without adequate WHS capability assessment • Inconsistent WHS standards and procedures between principal contractor and tunnelling subcontractors • Poor coordination of responsibilities f plant, maintenance, supervision and emergency response • Gaps in risk man ement where multiple contracto nterface el portals, shafts and d junctions • Inadequate pre-qualification and ongoing performance mo of contractors	3H	[redacted]	2M
13. Fatigue, Rostering, Psychosocial & Remote Work Risks	• Excessive work hours, night shifts and rotating rosters leading to fatigue-related errors in tunnelling operations • Monotonous or high-stress work environments contributing to psychosocial risks (e.g. isolated TBM cabins, confined spaces) • Inadequate management of remote or isolated work where tunnelling sites are distant from support services	3H	[redacted]	2M

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	• Poor reporting culture for fatigue, stress and mental health concerns among tunnelling workers • Insufficient rest facilities and break arrangements for long shifts underground		[redacted]	
14. Monitoring, Reporting, Audit & Continuous Improvement	• Insufficient monitoring of key WHS performance indicators for tunnelling operations • Under-reporting of incidents, near misses and unsafe conditions underground • Failure to learn from tunnelling incidents on the project or from external industry events • Infrequent or ineffective WHS inspections and audits of tunnelling works • Poor data integration [redacted] geotechnical monitoring, plant performance and WHS metrics	3H	[redacted]	1L

EMERGENCY RESPONSE – CALL 000 FOR EMERGENCIES

Ensure to have an Emergency Management Plan in place as well as adequate numbers of trained first aid staff with easy access to fully stocked first aid kits, rescue equipment, material safety data sheets, adequate access to emergency communication equipment and fire-fighting equipment suitable for all classes of fire and ignition sources.

LEGISLATIVE REFERENCES

RELEVANT LEGISLATION AND CODES OF PRACTICE. DELETE THE LEGISLATIVE REFERENCES FOR ANY STATE THAT ARE NOT APPLICABLE

Queensland & Australian Capital Territory
Work Health and Safety Act 2011
Work Health and Safety Regulations 2011
Legislation QLD: https://www.worksafe.qld.gov.au/laws-and-compliance/work-health-and-safety-laws
Codes of Practice QLD: https://www.worksafe.qld.gov.au/laws-and-compliance/codes-of-practice
Legislation ACT: https://www.worksafe.act.gov.au/laws-and-compliance/acts-and-regulations
Codes of Practice ACT: https://www.worksafe.act.gov.au/laws-and-compliance/codes-of-practice

New South Wales
Work Health and Safety Act 2011
Work Health and Safety Regulations 2025
Legislation NSW: https://www.safework.nsw.gov.au/legal-obligations/legislation
Codes of Practice NSW: https://www.safework.nsw.gov.au/resource-library/list-of-codes-of-practice

Northern Territory
Work Health and Safety (National Uniform Legislation) Act 2011
Work Health and Safety (National Uniform Legislation) Regulations 2011
Legislation NT: https://worksafe.nt.gov.au/laws-and-compliance/workplace-safety-laws
Codes of Practice NT: https://worksafe.nt.gov.au/forms-and-resources/codes-of-practice

South Australia
Work Health and Safety Act 2012 (SA)
Work Health and Safety Regulations 2012 (SA)
Legislation for SA: https://www.safework.sa.gov.au/resources/legislation
Codes of Practice for SA: https://www.safework.sa.gov.au/workplaces/codes-of-practice#COPs

Tasmania
Work Health and Safety Act 2012
Work Health and Safety (Transitional and Consequential Provisions) Act 2012
Work Health and Safety Regulations 2012
Work Health and Safety (Transitional) Regulations 2012
Legislation for TAS: https://worksafe.tas.gov.au/topics/laws-and-compliance/acts-and-regulations
Codes of Practice for TAS: https://worksafe.tas.gov.au/topics/laws-and-compliance/codes-of-practice

Details of permits, licenses or access required by regulatory bodies (add or delete as required):

- Permits from local council
- Authorisation to commence work
- Any required documents.

Victoria
Occupational Health and Safety Act 2004
Occupational Health and Safety Regulations 2017
Legislation VIC: https://www.worksafe.vic.gov.au/occupational-health-and-safety-act-and-regulations
Codes of Practice VIC: https://www.worksafe.vic.gov.au/compliance-codes-and-codes-practice

Western Australia
Work Health and Safety Act 2020
Work Health and Safety Regulations 2022
Legislation Western Australia: https://www.commerce.wa.gov.au/worksafe/legislation
Codes of Practice WA: https://www.commerce.wa.gov.au/worksafe/codes-practice

Safe Work Australia Links
Law and Regulation (All States): https://www.safeworkaustralia.gov.au/law-and-regulation
Model Codes of Practice: https://www.safeworkaustralia.gov.au/resources-publications/model-codes-of-practice

Model Codes of Practice

- Managing noise and preventing hearing loss at work
- Confined spaces
- Labelling of workplace hazardous chemicals
- Managing risks of hazardous chemicals in the workplace
- Welding processes
- First aid in the workplace
- Managing the risk of falls at workplaces
- Hazardous manual tasks
- Managing the risk of falls in housing construction
- Managing electrical risks in the workplace
- Demolition work
- Excavation work
- Work health and safety consultation, cooperation and coordination
- Managing the work environment and facilities
- How to manage work health and safety risks
- Managing risks of plant in the workplace
- Construction work