MASTER® BUILDERS SOLUTIONS

bluey

BluSeal Tunnel Liner

GROUND WATER INFILTRATION MANAGEMENT

Blu**Seal** Tunnel Liner
WATER INFILTRATION MANAGEMENT

WHAT IS IT?

Blu**Seal** Tunnel Liner is a system of product supply, project management, training and site support to ensure desirable ground water infiltration control.

Blu**Seal** Tunnel Liner
PRODUCT INFORMATION

Bluey are leading Australian tunnel waterproofing specialists with proven experience on leading infrastructure projects

WHERE DO WE USE BLUSEAL TUNNEL LINER?

Blu**Seal** Tunnel Liner is chosen where there is a need for 'dryness' in a tunnel.

There are 3 tunnel sealing and drainage systems that typically fall into the following categories:

Drainage Layer Linings

Spray-on Liquid Membrane Linings

Sheet Membrane Linings

WHY BLUSEAL TUNNEL LINER?

Water infiltration control

Easily applied spray on liquid membrane by roller, brush or spray methods

Proven large scale application and project management of major infrastructure projects

SHEET MEMBRANE TUNNEL LINING PROJECTS

Epping to Chatswood Rail Link, Sydney

Eastlink Project, Melbourne

Northern Gateway Project, Auckland (New Zealand)

City West Cable Tunnel, Sydney

NSBT Gibbon Street Shaft, Brisbane

Boggo Road Tunnel, Brisbane

Airport Link Project, Brisbane

Electrified Double Track Tunnel, Berapit (Malaysia)

City East Cable Tunnel, Sydney

T2E Tunnel, Byron Bay

North West Rail Link, Sydney

Waterview Tunnel, Auckland (New Zealand)

Norwest Rapid Transit, Sydney

NorthConnex, Sydney

West Connex, Sydney

SPRAY APPLIED LINING AND TUNNEL INJECTION SEALING PROJECTS

Cross City Tunnel, Sydney

North Kiama By-Pass, NSW

M5 East Tunnel Sealing, Sydney

Eastern Distributor Tunnel Sealing, Sydney

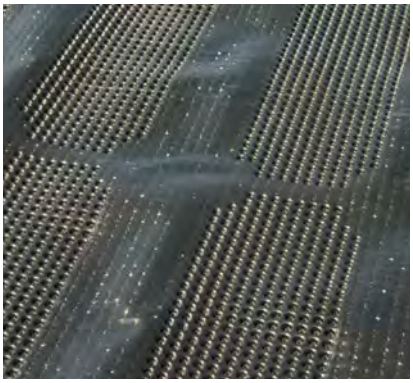
M2 Tunnel Widening, Sydney

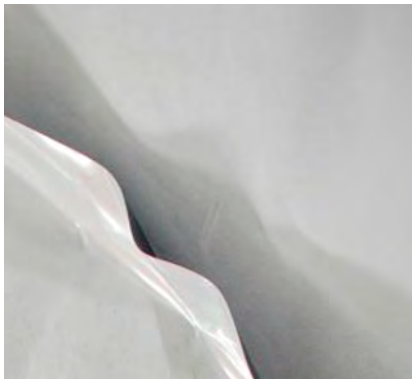
North West Rail Link, Sydney

Baragaroo, Sydney

Norwest Rapid Transit, Sydney

WestConnex, Sydney





BluSeal Tunnel Liner
EXPERIENCE

Bluey's four key offerings in major tunnel infrastructure projects, with proven experience and successful results

PROJECT MANAGEMENT ACTIVITIES

Selection and procurement of specialist membrane welding & testing equipment

Training and supervision of local installers to meet the demand of numerous concurrent waterproofing work fronts

Materials handling and delivery from abroad

Quality control of both material supply and site installation

General site management of the installation works

TRAINING

Bluey's Engineers specialise in onsite techniques to ensure that the Client, its designers and applicators receive full support during the entire material selection, installation and testing process. Bluey is able to offer training and quality inspections on site either directly or through third party trained specialists accredited by Bluey. For all of our products we are also able to recommend competent applicators who have experience in applying our range of products.

PRODUCT SUPPLY

When Bluey is engaged for work on your project, you can be sure that you will have access to the best value products around the World.

Due to our ongoing work on large projects in the region, we have a broad understanding of the most efficient manufacturers of each product depending upon the size, location and technical details of your underground structure.

Bluey will work through the design process and ensure that the right product is selected to give the best outcome. Consideration will be given to the local environment, tunnel methodology, installation techniques, and performance criteria. Bluey will also take care of some of the more complex logistical issues such as selection of membrane roll lengths to reduce wastage, roll widths, container packing methods and delivery schedules to keep ahead of construction activities.

SITE SUPPORT

Onsite, Bluey uses its experience in tunnel lining to ensure that waterproofing and drainage works are well managed so that you can get on with the more important task of building the tunnel.

We ensure that the design of gantries and membrane details are developed to ensure installation can keep ahead of concrete lining. Our role onsite extends beyond project management of membrane lining, for example, we will work together with shotcreting crews to ensure the quality is acceptable for membrane placement. Our experience will keep all parties satisfied that activities are being coordinated to ensure a good outcome for the Client.

Most importantly of all, we will develop systems of safe work in the tunnel environment to ensure that the waterproofing and drainage systems are installed without harm to others. We will take care of the procedures for handling and storage of plastic materials within the tunnel environment to significantly reduce manual handling requirements and also eliminate fire safety issues. Our experience in this field will prove to be a valued asset.

It is our job to plan every aspect of tunnel and drainage installation in your underground environment. Our Project Managers will guide you through the entire project to ensure that all aspects of the installation are considered and well planned for.

BluSeal Tunnel Liner
SYSTEM SELECTION

WATERPROOF LINING SYSTEMS

Tunnel sealing and drainage systems typically fall into the following categories:

Drainage Layer Linings

Spray-on Liquid Membrane Linings

Sheet Membrane Linings

ASSESSMENT

These systems have varying application benefits and limitations

The system will generally be designed around final tunnel requirements for 'dryness'

Within the framework of other considerations:

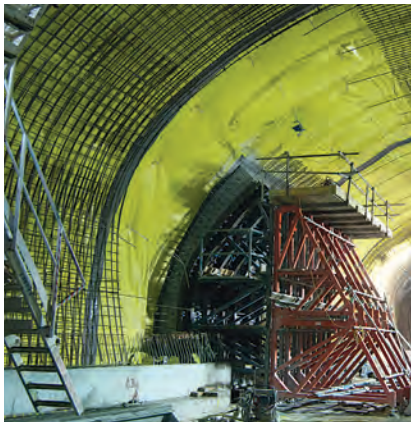
- Site Conditions
- Economic Implications
- Concrete Lining Methodologies and Program
- International Standards

SITE CONDITIONS

Ingress of water at the time of excavation and membrane application

Substrate preparations planned to be carried out

Underground access constraints



ECONOMIC IMPLICATIONS

Budget available

Constructors risk perception depending on previous experience (fix it later)

Not a budget priority to the contractor

CONCRETE LINING METHODOLOGIES AND PROGRAM

Insitu concrete

Shotcrete permanent lining systems

Planned sequencing of the works

INTERNATIONAL STANDARDS

Specification for tunnelling, British Tunnelling Society and The Institution of Civil Engineers, 3rd Edition 2010

DVS 2225 – Joining of Lining Membrane Made of Polymer Materials in Geotechnical and Hydraulic Engineering

International Association of Geosynthetic Installers – HDPE and LLDPE Geomembrane Installation Specifications

DS 853 - Deutsche Bahn AG - German Railway Standards

Blu**Seal** Tunnel Liner
SURFACE PREPARATION

SURFACE PREPARATION

INSPECTION & ACCEPTANCE OF SHOTCRETE / SUBSTRATE SMOOTHNESS

Maximum aggregate size 4 to10mm (depending on system)

Irregularities shall not exceed 200mm on any 1m curved edge

Cover or remove protruding objects such as rockbolts

Seal or divert running water

Maintain drainage prior to concrete pour

DRAINAGE LAYERS

DRAINAGE LAYER LININGS

Technically not a 'watertight' liner

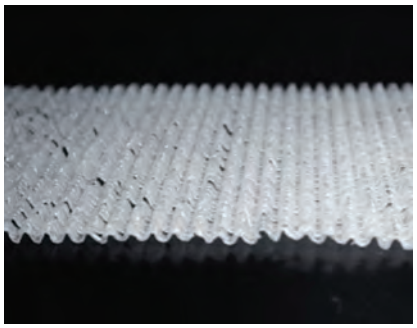
Provides an annulus drainage path

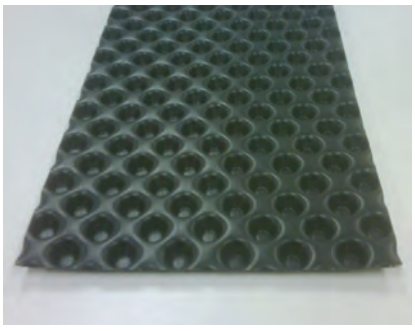
Alleviates the build up of external hydrostatic pressures on the structure

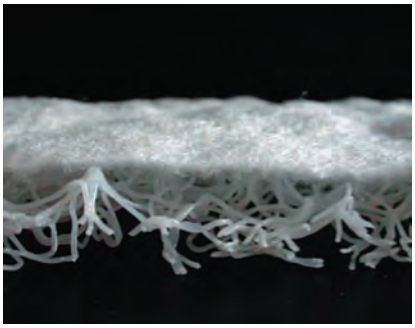
Typically used for tunnels constructed in good quality rock

DRAINAGE LAYERS

DRAINAGE MEDIUMS







BluSeal Tunnel Liner
SURFACE MEMBRANE

SPRAY APPLIED MEMBRANE

SPRAY-ON LIQUID MEMBRANE LININGS

Developed out of their similar use within the mining industry

Have only been used on a limited basis world-wide for waterproof of tunnels

Materials include: acrylics / bitumen / cement latex / polyurethane / polyurea

SPRAY MEMBRANE USES

Remediation of rock-face weathering

Management of minor water infiltrations

Waterproofing membrane in specifi cases

SPRAY-ON LIQUID MEMBRANE LININGS

Membrane can not be applied to damp or wet shotcrete surfaces

Consistent quality difficult to achieve in tunnel environment

Less durable than PVC or VLDPE sheet membranes

Generally not suitable for use in tanked tunnels

Blu**Seal** Tunnel Liner
SHEET LININGS

SHEET MEMBRANE LININGS

Most robust and watertight protection for a tunnel structural lining

Impermeable water barrier between concrete lining and surrounding strata

Internationally recognised as the most reliable method of tunnel waterproofing

Used as either:

- 'Umbrella', shedding water from the tunnel 'crown' down into an invert drainage.
- Fully 'encapsulated' or 'tanked' structural lining, which limits water ingress.

VARIATIONS IN SHEET MEMBRANE SYSTEMS

Material type and thickness

Drainage and protection layers

Welding and fixing methods

Secondary protection provisions

External compartmentalisation systems to maintain water tables

INSTALLATION OF GEOTEXTILE FLEECE

Installed as membrane protection or drainage

Generally non-woven 100% polypropylene

Minimum weight of 700 g/m^2

Flammability class B2

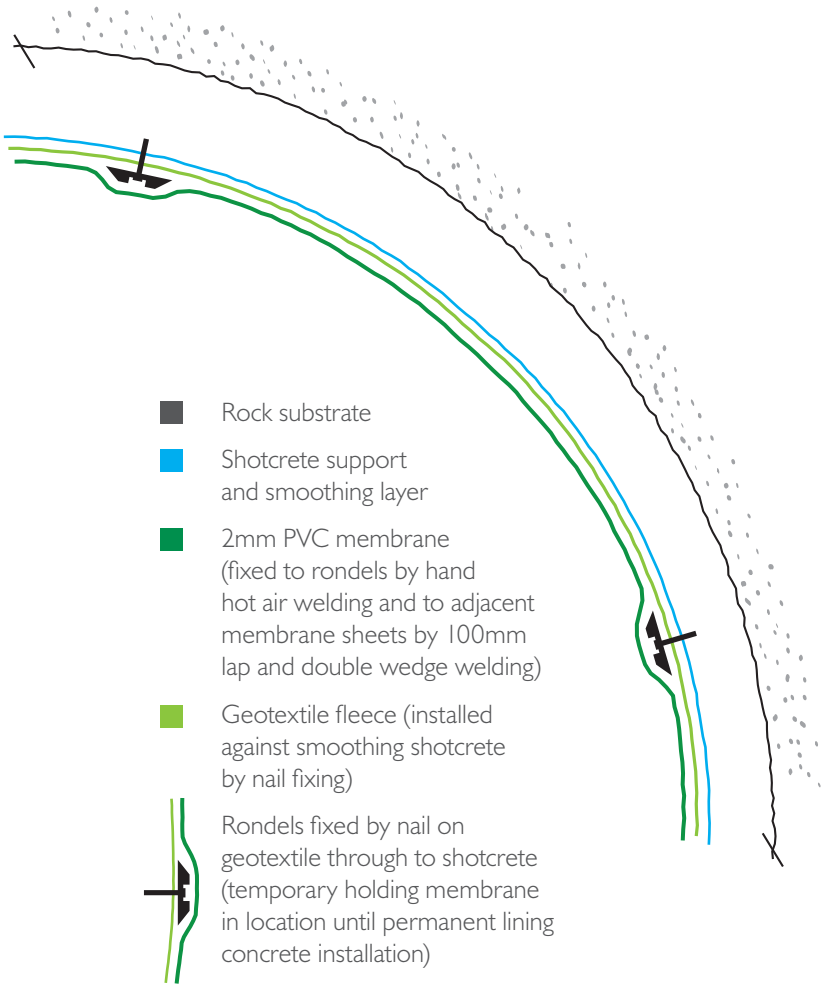
BluSeal Tunnel Liner
SHEET LININGS

INSTALLATION OF ROUNDELS (MEMBRANE FIXING DISCS)

Nail fixed through the geotextile fleece

Compatible for hot air (spot) welding to the sheet membrane

Fixed on an average of 1 per m^2 for walls and 2-3 per m^2 for crowns



INSTALLATION AND WELDING OF MEMBRANE SHEET WATERPROOFING

Drained tunnels shall generally be 2mm thick

PVC-P or VLDPE

The membrane shall have a 'signal' layer

Flammability class shall be appropriate for the site

Heat weld to previously installed roundel fixings

Install with sufficient slack to avoid potential overstressing

Install 'snug enough' to avoid folds developing during concrete placement

All seams are pressure tested

BluSeal Tunnel Liner
SHEET LININGS

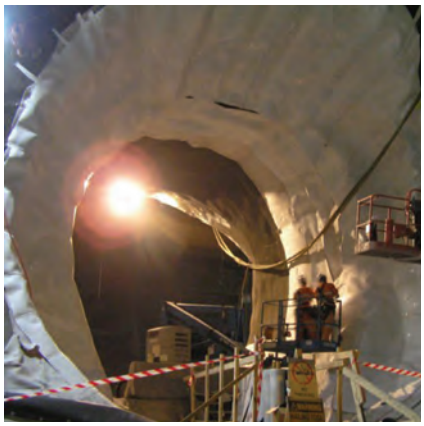
PORTALS AND CROSS PASSAGES

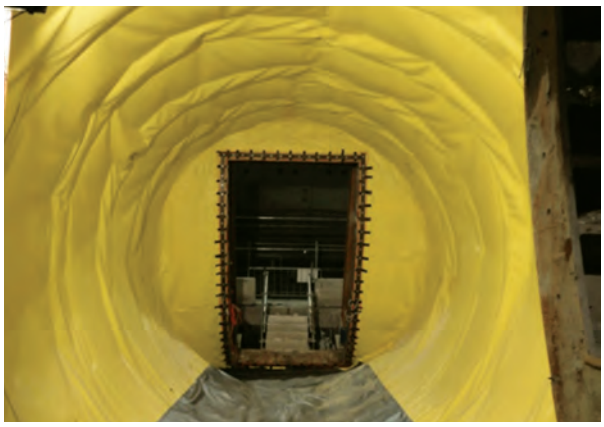
Three way curvature

Heavy reinforcement

TBM CROSS PASSAGES

Connection to precast segments

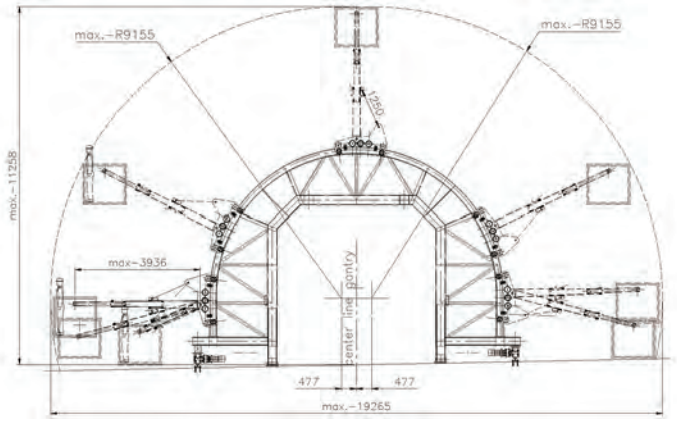




BluSeal Tunnel Liner
SHEET LININGS

INSTALLATION ACCESS EQUIPMENT

Fixed gantry, mobile or automated gantry



BluSeal Tunnel Liner
SHEET LININGS

TERMINATIONS

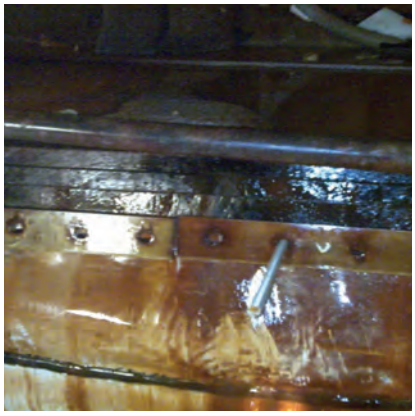
Pressure terminations

Epoxy tape terminations

PENETRATIONS

Through fixings (condom bolts)

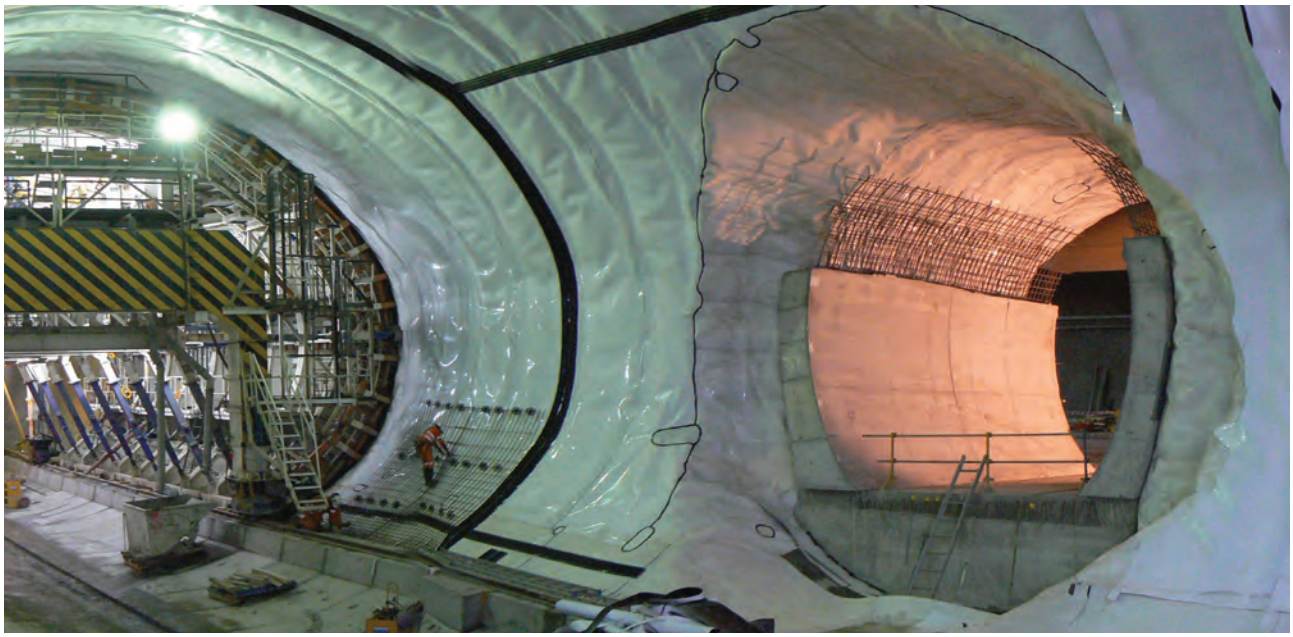
Drainage and grouting



WATERSTOPS

Compartmentalisation

Longitudinal and Radial



BluSeal Tunnel Liner
CASE HISTORIES

BRISBANE AIRPORT LINK PROJECT
Twin 5.1km tunnels connecting Brisbane city with the northern suburbs and airport precinct.

PROJECT DETAILS

Drained tunnel

TBM bored

Cast insitu concrete lining

1 litre/s/100m tunnel length inflow

No damp patches

SOLUTION

Bluey designed unique dimple sheet fixings

Materials selected to allow double seam welding and testing

Manufactured in Norway to Bluey specification

Bluey partnered German Installer Naue

Project complete with no damp patches

FEATURES

Drained and tanked tunnel profiles with associated groundwater drainage systems and external compartments between profiles

System compatibility for both insitu concrete and shotcrete permanently lined tunnels

Tanked connections between mined and TBM tunnels

BENEFITS

Tunnel functionality for high speed tollway traffic flows with no 'drips' from above or visible damp patches from below

Groundwater impacts minimised with tunnel inflows controlled and handled by the designed drainage and pumping systems

Blu**Seal** Tunnel Liner
CASE HISTORIES

MELBOURNE EASTLINK PROJECT
Twin 1.6km tunnels under the environmentally sensitive community parkland area of Mullum Mullum Creek

PROJECT DETAILS

Fully tanked tunnel lining

40m water head

13 cross passages

SOLUTION

International Standard waterproofing design conformance

2mm and 3mm membrane double seam welding

Radial waterstop at every block joint

Bluey DVS qualified supervision

Every membrane seam pressure tested and verified

FEATURES

150,000 square metres of 2mm LLDPE sheet membrane to both the invert and obvert (arch) of the tunnels

Waterstop joint protection and lining compartmentalisation

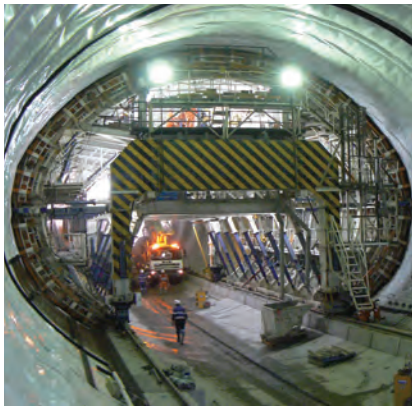
External lining z-profile compartments

Post completion injection systems

BENEFITS

Minimal long term environmental impact on the surrounding water tables with nil effects on the Mullum Mullum creek water levels above

Negligible water inflows that needed to be handled by operational drainage pumping systems for the life of the tunnels



BluSeal Tunnel Liner
CASE HISTORIES

WYNYARD WALK PROJECT
Pedestrian Tunnel, Shaft, and Bridge connecting Wynyard Station to the Barangaroo Precinct.

PROJECT DETAILS

Drained tunnel and shaft

Cast insitu concrete lining

Challenging design requiring installation of both VLDPE sheet membrane and HDPE cast in liner

SOLUTION

Bluey designed tunnel lining solution using our cast in liner (AKS) to deal with limited head clearances

Materials selected to allow compatibility of 2 lining systems

Pile terminations on bridge abutments

FEATURES

Combination of drained and tanked areas

Waterstop Joint Protection

BA Anchor system to facilitate reinforcing support

BENEFITS

Unique design using 2 lining systems allowed a free flowing continuous head clearance along the entire length of tunnel

BA Anchor system allowed for support penetrations to be made without compromising the waterproofing

Blu**Seal** Tunnel Liner
CASE HISTORIES

T2E PROJECT
Twin 434m tunnels under St Helena Hill near Byron Bay forms part of the Tintenbar to Ewingsdale Pacific Highway Upgrade.

PROJECT DETAILS
Tanked twin road tunnel

3 Cross Passages

Cut and Cover Sections at either end of the tunnels

SOLUTION
Installation of a fully welded PVC liner

Both internal and external compartments installed to eliminate longitudinal water flow

Membrane installed off custom built membrane gantry

FEATURES
Fully tanked design

Waterstop Joint Protection

Post-casting back grout injection ports installed

BENEFITS
Fully tanked system allowed existing water table level to be maintained

Blu**Seal** Tunnel Liner
CASE HISTORIES

NORTH WEST RAIL LINK PROJECT
New Metro Rail Line from Cudgegong to Existing Epping Station.

PROJECT DETAILS

20km of new rail system

8 New Stations and 2 Service Facilities

53 Cross Passages

SOLUTION

Installation of a fully welded VLDPE liner

Pressure terminations to seal to TBM tunnels in cross passages and stations

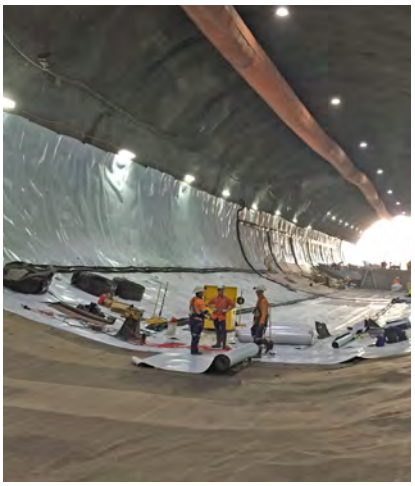
FEATURES

Fully tanked design

Waterstop Joint Protection

BENEFITS

Product selected to suit all project criteria including complex geometries including in cross passages and nozzles



Blu**Seal** Tunnel Liner
CASE HISTORIES

WATERVIEW TUNNEL PROJECT
Twin 2.4km TBM Tunnel (3 Lanes Each Way) in West Auckland.

PROJECT DETAILS

Twin TBM Tunnel

Longest Tunnel in NZ

16 Cross Passages

SOLUTION

Bluey designed unique dimple Installation of a fully welded PVC liner

Integrated Injection System

Protection Layer

FEATURES

Fully tanked design

Waterstop Joint Protection

Steel Set Cross Passages allowed stud welded termination plates

BENEFITS

Flexibility of PVC allowed complex cross passage contours to lined efficiently

Blu**Seal** Tunnel Liner
CASE HISTORIES

NORWEST RAPID TRANSIT PROJECT
Station Boxes and Service Facilities for Norwest Metro Line.

PROJECT DETAILS

20km of new rail system

8 New Stations

2 Service Facilities

SOLUTION

Installation of a fully welded VLDPE liner to connect with membrane installed during NWRL Project

Drained Stations and Fully Tanked Service Facilities

Developed System to effectively seal against tension piles

FEATURES

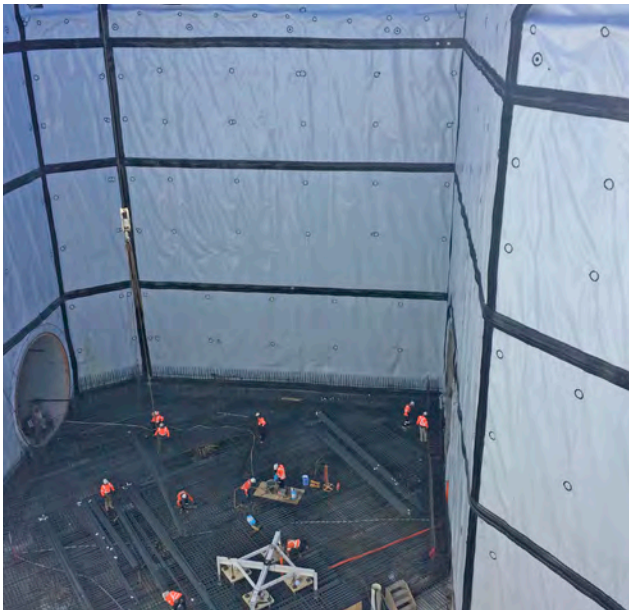
Tanked system due High water pressure in service facilities

Waterstop Joint Protection

BA Anchor system to facilitate reinforcing support

BENEFITS

Seamless integration with system installed during NWRL phase of project



BluSeal Tunnel Liner
CASE HISTORIES

NORTHCONNEX PROJECT
Road header Mined Tunnel connecting M1 and M2 Motorways.

PROJECT DETAILS

Drained dual mainline tunnels and 4 on/off ramps

Includes Cross Passages and Egress Points

Cast insitu concrete lining

SOLUTION

Fully welded sheet PVC membrane

Materials selected to allow integration with sections to have spray applied membrane

FEATURES

Drained waterproofing system installed including drainage pipe system

Epoxy terminations to facilitate overlap with spray membrane

BA Anchor system to facilitate reinforcing support and temporary ducting support

BENEFITS

System allowed for a certifiable overlap between the sheet and spray system

Epoxy termination to achieve termination of membrane back to substrate

BluSeal Tunnel Liner
CASE HISTORIES

EPPING TO CHATSWOOD RAIL LINK

12KM TWIN TUNNELS 7M DIAMETER

PROJECT DETAILS:

Drained tunnel

TBM bored

Cast in-situ concrete lining

1 litre/s/100m tunnel length inflow

No damp patches

SOLUTION:

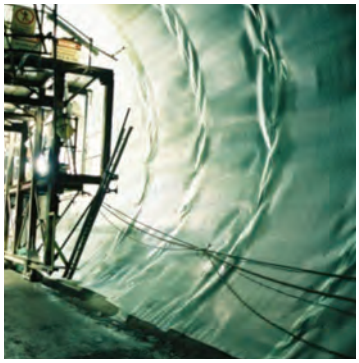
Bluey designed unique dimple sheet fixings

Materials selected to allow double seam welding and testing

Manufactured in Norway to Bluey specification

Bluey partnered German Installer Naue

Project complete with no damp patches



AUCKLAND NORTHERN GATEWAY PROJECT

300M TWIN TUNNELS DUAL CARRIAGEWAY ROAD TUNNEL

PROJECT DETAILS:

Drained tunnel lining

Environmentally sensitive

Cross passages

Road header excavation

Cast in-situ concrete lining

SOLUTION:

International Standard waterproofing design conformance

2mm and membrane double seam welding

Radial waterstop every 50m

Bluey DVS qualified supervision

Client supplied labour for installation

Every membrane seam pressure tested and verified

SYDNEY CITY WEST CABLE TUNNEL PROJECT

SHAFT, BACK DRIVE AND CAVERNS

PROJECT DETAILS:

Fully tanked lining

Aggressive ground water

Sensitive electrical equipment

Road header and hand excavation

Cast in-situ concrete lining

SOLUTION:

International Standard waterproofing design conformance

2mm and membrane double seam welding

Radial waterstop at every construction joint

Bluey DVS qualified supervision

Subcontractor labour for installation

Every membrane seam pressure tested and verified

Blu**Seal** Tunnel Liner
PRODUCT SUMMARY

SUMMARY

Australia is an international leader in tunnel waterproofing applications.

Work standards have improved significantly in recent years through training and partnering programs.

Contractors are saving time and money by engaging the right methods, equipment and people at the early phases of project planning.

There is now a rapidly growing list of successfully sealed tunnels completed in Australia in terms of cost, program and final outcome for water infiltration.

We are striving to improve this record by working together with industry, learning from our experiences and continuing to engage international expertise.

BluSeal Tunnel Liner
PRODUCT SUMMARY

We deliver...

- Products developed for civil engineering
- Product technical knowledge
- Site application knowhow
- A collaborative approach
- Economical solutions for large projects

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