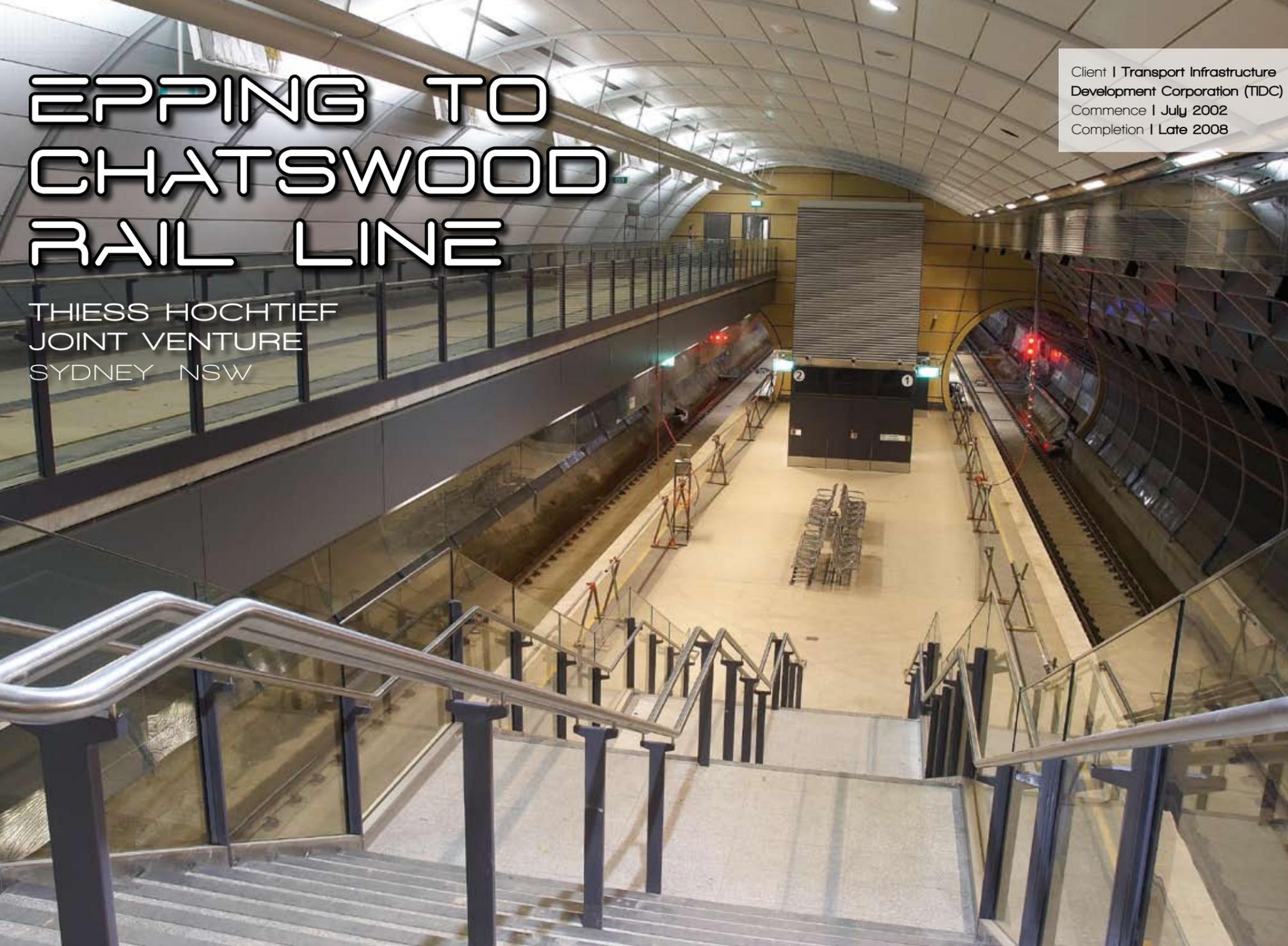


EPPING TO CHATSWOOD RAIL LINE

THIESS HOCHTIEF
JOINT VENTURE
SYDNEY NSW

Client | Transport Infrastructure
Development Corporation (TIDC)
Commence | July 2002
Completion | Late 2008



ON THE RIGHT TRACK

Tunnelling beneath the bustling streets and leafy parks of Sydney's North Shore the Epping to Chatswood Rail Line has progressed efficiently and quickly. The Thiess, Hochtief Joint Venture (THJV) Project is now nearing the final stages of construction and is on target for mid-2008 conclusion.

The 12.5 kilometre twin tunnels, are 7 metres in diameter and were excavated, along with the four new stations on the line, using a combination of TBM, road-header excavation, and cut and cover techniques. Two TBM were used, each weighing in at approximately 1100 tonnes, and 210 metres long. The TBM, each

with a 7 metre diameter cutting head, were assembled at the M2 worksite approximately half way along the proposed line. They then began tunnelling towards Epping using a relatively new system, which allowed them to pour the invert between the TBM head and the backup carriages. The spoil (primarily Hawkesbury Sandstone) was transported via a system of conveyer belts to the M2 site where it was stockpiled and a large percentage recycled for other uses.

On completion of the 6 kilometre run to Epping, the TBM were run into a pre-prepared chamber where they were partially disassembled

and pulled back through the tunnel to the M2 start point. They were then turned around, reassembled, and began work heading towards Chatswood, 5.2 kilometres in the opposite direction.

The cut and cover Lane Cove River tunnel section, in the Lane Cove National Park was excavated across the Lane Cove River using cofferdams to de-water half the river at a time whilst excavating, then flooding the completed half and following the same process on the second half. This technique was developed with regard to sensitive environment of the area and ensured the river maintained its flow during the works – the completed area of the National Park was reopened to the public in December 2005.

Once the TBM broke through at Chatswood they were dismantled inside a specially prepared chamber and then transported to the surface for removal from site. The combined average speed of the TBM on the project was a highly respectable 33 metres per day, with a best ever of 92 metres in 24 hours. The project holds the world record for the daily excavation rate for TBM of this size and class. Their weekly excavation rate missed the world record by only 4 metres coming in with 368 metres in one week.

The stations, tunnel declines and tunnel portals were excavated using road-headers, and then supported using rock bolting and shot-crete. In the final stages a waterproof membrane was used to seal the station cavern walls and another layer of shot-crete applied over this. Rock hammers were used to excavate service buildings and the station entrance shafts.

On completion of the tunnel boring six lining forms each 15 metres long (transported from Austria in 50 x 40-foot containers) were used to carry out the concrete lining of the tunnels. The three trains, two forms on each were used to lay in excess of 400 metres of concrete lining a week as they progress towards their completion target.

The smooth expedition of the new Epping to Chatswood Rail Line is in part, due to a level of flexibility within the THJV, whereby constant monitoring of progress and adjustment to procedures as required ensured that any delays or inefficiencies were minimised. This approach was evident in resolving initial teething problems with the conveyer system from the TBM's. The fact that public works of this scale are ongoing, without attracting any adverse attention is the clearest indication of overall success of such a project.

The value of the new rail line when completed and the addition to the Sydney network in the current climate of increasing oil prices may well be even timelier than was originally intended when the plan was conceived.

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A NEW BENCHMARK IN QUALITY RAIL INFRASTRUCTURE

The Epping to Chatswood Rail Line is the largest infrastructure project currently underway in NSW. The \$2.29 Billion scheme when completed in 2008 will provide the city with a major new rail path linking the North Shore Line from Chatswood to the Main North Line at Epping. The new 12.5 kilometre twin rail tunnels will serve three new stations and the redeveloped Epping Station. The new line will provide capacity for an extra 12,000 passengers a day on the CityRail network.

A W Edwards, a company that fully met the stringent requirements for this undertaking, carried out the mammoth task of coordinating the fit out works for the new stations and the construction works for the redevelopment of Epping Station.

Established in 1921, A W Edwards has grown from a small building operation to a multi-disciplined general building contractor with proficiency in all aspects of major construction

and development. The company now has divisions specialising in plumbing, joinery and metalwork and is accustomed to delivering projects using a variety of design and construct project delivery models.

On the Epping to Chatswood Rail Line project A W Edwards provided building services for the underground station fit-outs which included new underground platforms and major improvements to the existing above-

ground platforms at Epping and associated works. Edwards' scope of works also required the installation of 42 escalators and ten lifts throughout the new stations.

A significant contribution to the success of the project was the effective communication established by A W Edwards with the client, contractors, engineers and architects. This communication and coordination was paramount in the organisation of scheduled



works within the confines of the underground stations and station areas. Due to restrictions with regards to access and egress via the entrance tunnels, a significant proportion of the larger machinery and materials were delivered to the work site through the rail tunnels. In addition to this, specific organisational approaches were required to facilitate effective and efficient fit-out works within the high-vaulted caverns that form the stations.

Another feature of the project that required particular attention was the construction of the Epping Station aerial concourse. This was undertaken during the normal 'live-rail' operations of the station without disruption to regular rail services.

A W Edwards' success on complex projects of this nature demonstrates not only extensive expertise and experience, but also confidence in the abilities of its employees and management team to 'get the job done' well. A W Edwards

takes great pride in its management team's capabilities and workforce's skills. Constant attention to increasing existing skill levels is integral to the company's operations. This has delivered significant benefits for both clients and employees.

Amongst other projects, A W Edwards has recently completed the Campbelltown Private Hospital, the ResMed Innovation Centre at Norwest Business Park, diverse works for Qantas at Sydney Airport and the Alchemy

Apartments project in Lavender Bay. Edwards is currently in the early stages of delivering the prestigious new Norwest Private Hospital in Bella Vista.

Naturally the company's dedication to education and skills is carried over into OH&S procedures and operations. This attention to safety was recently recognised when A W Edwards won a Federal Safety Commissioners Award for their work on the Epping to Chatswood Rail Line Project. Notably, the

company's attention to their staff's well being and education results in a higher than average level of employee retention and significant benefits flow on to their clients in increased efficiencies and expertise.

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ONE STEP FOR WARDS

As would be expected for the 12.5 kilometre twin tunnels, three of the new stations, and the redeveloped Epping Station that make up the \$2.29 Billion Epping to Chatswood Rail Line, much of the construction work was undertaken below ground. The Thiess Hochtief Joint Venture (JHJV) was keen to ensure that the works progressed smoothly and with minimal disruption or delay. To this end they engaged the services of Ward Civil & Environmental Engineering Pty Ltd to oversee a large proportion of the earthworks, ground excavation, and associated civil works required for the tunnels and stations including the groundbreaking cut and cover tunnel section that passes through the environmentally sensitive Lane Cover National Park.

Best Practice and Reform (accreditation that Wards still holds to this day). The company is founded on a strong and vibrant culture of safety, respect, and communicative cooperation – and this culture is bound by ISO/AS internationally recognised management systems and systems that maintain the company's core focus on quality, the environment, and OH&S to the recognised levels.

Wards are proud to have been involved in NSW's expanding infrastructure. On this particular project, Wards were able to utilise its ground anchoring division and resources after the recent formation of Ward Ground Engineering. Wards is proud to offer innovative and efficient solutions to projects such as this to its clients and community via the expansion of the Ward Group.

The scope of works for Wards' involvement on the project covered works at over 12 different sections on the line. This included, bulk earthworks, road pavements and service installations, excavation of two declines in sandstone and shale, excavation of six 20m shafts in sandstone and shale, reinforced concrete works for the cut and cover section, excavation of tunnel cross passages, installation of temporary and permanent ground anchorages at over 750 locations, reinforced concrete capping beams, reinforced shot-crete and soil nails. As such it proved a complex and diverse challenge for the company and their involvement has lasted over two years.



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Wards is a company that stands by its exemplary record of successfully completed projects over the past 36 years. A recipient of the CASE Earth Awards on a number of occasions and projects during their time and also accredited by the NSW Government for

WORLDWIDE EXPERTISE

Hyder Consulting is an international engineering design company that seeks to generate a lasting legacy through its involvement with landmark projects around the world and be the first choice for its clients. Last year, the company celebrated its 150th anniversary and was awarded International Firm of the Year for recognition of growth and achievement in the international market at the 2007 New Civil Engineer, Association of Consulting Engineers Awards.

The proven philosophy behind Hyder's achievements is based on ideals and aspirations generated in the reality of 'day to day' operations. The company has long accepted the fact that lasting change and significant accomplishment result from thorough research, assessment, on the ground dedication and 'nuts and bolts' attention to detail. It is through the seemingly mundane process of getting the small things right that ensures Hyder's on-going success.

Hyder's work on landmark projects such as the Sydney Harbour Bridge and Centrepont Tower, London's Tower Bridge, Burj Dubai and Victoria's Eastlink tolled road project are evidence of its abilities and the high level of confidence that infrastructure decision-makers place in Hyder. Each of these projects reflects Hyder's ability to provide 'whole of life' advice and design solutions within a broad range of sectors.

Hyder Consulting provides planning, engineering design, management advisory and environmental services for both major infrastructure undertakings and construction development. The company offers a diverse range of in-house services including acoustics, building services, structures, civil works, environmental and water, facades, tourism and leisure events and transport.

Hyder was engaged on the Epping to Chatswood Rail Line project to provide independent verification of the multidisciplinary design and construction works. Their involvement began in the initial design and planning stages and continues right through to completion, commissioning and operation. There are few areas of the project that Hyder has not been involved with in some form or other.

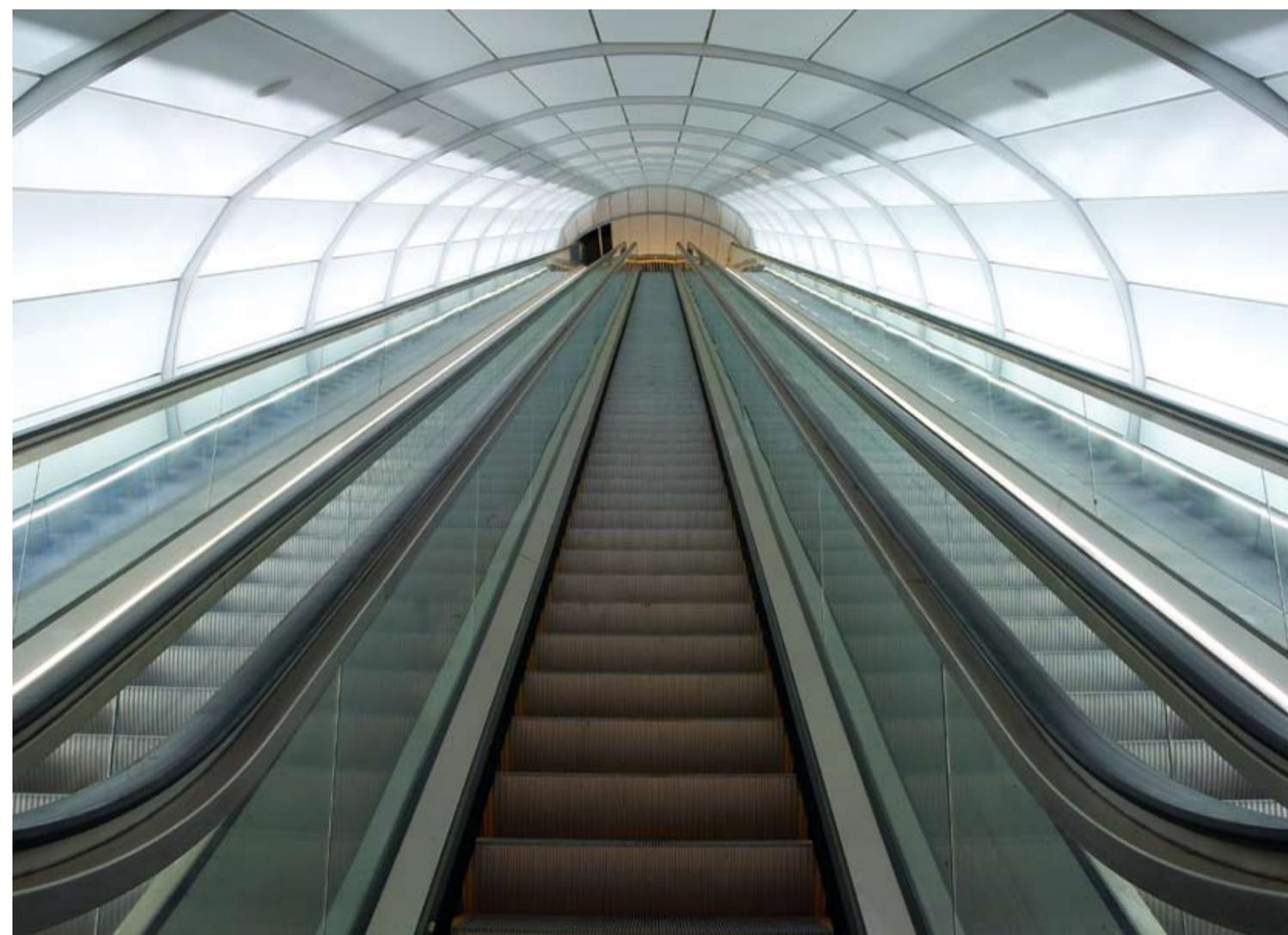
The \$2.29 Billion Epping to Chatswood Rail Line is the largest infrastructure project currently underway in NSW. When completed in late 2008, it will provide the city with a major new rail path linking the existing North Shore Line from Chatswood to the Main North Line at Epping. The 12.5 kilometre twin rail tunnels will have the capacity to add up to 12,000 passengers daily across the network. The new line will provide greater efficiencies across the whole network, reduce greenhouse gas emissions, relieve traffic congestion and improve amenities for commuters.

An example of the extreme importance Hyder placed on environmental management during the works is the complex cut-and-cover sections across the Lane Cove River, within the Lane Cove National Park. This section of the works was undertaken within the most stringent environmental guidelines. The river flow was maintained for the duration of the works, while constant monitoring and assessment of possible environmental impact ensured the river and the park remained in pristine condition.

Hyder is passionate about infrastructure solutions that really make a difference and improve people's lives. Its global capability and breadth of disciplines under-one-roof, position it at the forefront of infrastructure investment. Their involvement with the Epping to Chatswood Rail Line project provides ample demonstration of these ideals.



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DRAWING THE LINE

Parsons Brinckerhoff (PB) was engaged by the Thiess Hochtief Joint Venture (THJV) to perform the structural design of the three new underground cavern stations, another underground station at Epping, two running tunnels, and other features for the 12.5 km Epping to Chatswood Rail Line. The Epping to Chatswood Rail Line is one of the largest infrastructure projects ever undertaken in NSW with a total project value of \$2.29 billion. The new line, when completed, will provide a long-awaited 'missing link' connecting the main north shore line at Chatswood to the northern line near Epping. An anticipated 12,000 daily

commuters will benefit from the project's completion in late 2008. PB was responsible for the design of excavation and support for the three new cavern stations at Macquarie University, Macquarie Park, and North Ryde.

Macquarie Park Station is set in a platform cavern 14m high, 210m long, and 20m wide. The adjacent concourse cavern is 7.5m high, 70m long and 16m wide. Three 12m wide access-ways connect both caverns, and twin 39m long, 36m deep entry shafts connect the station to street level.

Macquarie Park Station was the first station to be completed, and as such it provided a blueprint for Macquarie University and North Ryde. The asymmetrical shape and size of the stations was a condition of the client's tender for the station design – it was required

that they be perfectly suited to the subsurface geology of the area. Through extensive numerical modelling, and both 2D and 3D modelling, excavation of the 'brain shape' of the station caverns was confirmed as feasible and appropriate. The design contained some of the largest spans ever used on this type of project in Sydney, and extensive controls and monitoring in addition to some detailed design work were required to ensure they remained feasible and safe. Confident of their design and after studying the results achieved at Macquarie Park, PB was able to use the data to complete the designs for the further two stations, making adjustments to accommodate each station's own particular geology.

At Epping station, the design and construction challenge involved rebuilding the existing station to accommodate the new line, while

maintaining a fully operational station and suburban rail line. This required close cooperation between the design and construction teams, to develop the most efficient and effective construction staging and sequencing, without compromising the overall station design philosophy.

The stations, tunnel declines and tunnel portals were excavated using road-headers, and then supported using rock bolting and shot-crete. The TBMs which excavated the running tunnels were also utilised in a unique way in the partial excavation of some of the stations. In the final stages a waterproof membrane was used to seal the station cavern walls and another layer of shot-crete was applied over this. Rock hammers were used to excavate service buildings and the station entrance shafts. The twin rail tunnels were excavated by TBM.

PB is at the forefront of global planning, environmental engineering, and project management and is one of the leading companies in this multi-disciplinary arena with over 11,000 dedicated staff operating from offices on six continents. The key to PB's success is encapsulated in the company's ability to combine global knowledge with local insight and to establish long-term relationships with clients while delivering 'best practice' design, planning and management.

In Australia and New Zealand the company employs over 1500 staff across a diverse range of specialised areas. Not only does this give PB the ability to deliver comprehensive project management services but also allows for a strong degree of flexibility and innovation to meet the specific challenges of each project.

PB is dedicated to the delivery of effective, functional and visionary infrastructure throughout the world. A key aspiration for PB is to enhance the communities in which the company provides its services. PB's involvement on the Epping to Chatswood Rail Line is a good example of delivering the company vision as a reality – the benefits to both the environment and the people of Sydney will be realised long into the future.

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· Roadheader excavation of the Chatswood soft ground tunnel.



· Macquarie Park Crossover during construction.

INTELLIGENT DESIGN

The Epping to Chatswood Rail Line is one of the largest infrastructure projects ever undertaken in NSW. With a total project value of \$2.29 Billion the 12.5 kilometres of new line will provide the ‘missing link’ for the Sydney rail network connecting the North Shore Line at Chatswood to the Main North Line near Epping. The Thiess Hochtief Joint Venture (THJV) design consists of twin bored tunnels, each 7 metres wide and separated by a central pillar with cross connecting access for emergency egress every 200 metres. The project also included the creation of three new stations, a major upgrade to the Chatswood transport interchange and station, and a cut and cover section of tunnelling that accommodated the environmentally sensitive needs of the Lane Cove River and surrounding National Park.

Pells Sullivan Meynink Pty Ltd (PSM) is a specialised consultancy that provides geotechnical and hydrological engineering, investigation and assessment services to a broad range of industries. Established in 1993 PSM has a team of geotechnical engineering specialists undertaking operations internationally and throughout Australia. With extensive experience in recent tunnelling projects both in Sydney and interstate the company was ideally suited to provide their expertise on the Epping to Chatswood Rail Line.

PSM was engaged by the THJV to provide dedicated monitoring and design services in three key areas: (i) the monitoring of ground deformation throughout all sections of the project as excavation works progressed; (ii) the development and implementation of a

methodology for assessing the groundwater inflow of the tunnels to enable selection of appropriate lining solutions, and (iii) the design responsibility for a 170 metre section of the twin tunnels that runs through weathered shale above the lower layer of sandstone as the tunnels rise towards the Chatswood end of the line to connect with the North Shore Line.

The subsurface geology of what has been termed the ‘Chatswood soft ground tunnel’ is a complex mix. The lower Hawkesbury and Mittagong sandstone formations are overlain by weak shale layers grading to residual shale clay soils at the surface. An added complication to the design and subsequent works was the current North Shore Rail line under which the new tunnels run. High frequency monitoring, minimisation of surface settlement during the

excavation process and the design efficiency of support systems and structures for the tunnels were of primary importance.

PSM conducted extensive computer modelling to assess the capacity for the tunnel lining to carry the overburden weight as required by contract. However this was deemed unsuitable due to the predicted settlement occurring between excavation and the installation of appropriate supporting structures. Further modelling of the stresses induced by the overburden and the effects this had on the tunnel crown and walls suggested that although the lining could be designed to accommodate the overburden weight, construction processes were required to maintain the integrity of the structure as it was excavated. Support was installed, close to the face as the road header

progressed, to carry a large percentage of the weight of the overburden as the tunnel advanced. This ensured there was minimal displacement. As the overburden geology varied, a range of support systems were used to cater for the changing conditions, these included canopy tubes, spiling bars, rock bolts, steel sets, and structural shotcrete. The permanent lining consists of a steel fibre reinforced shotcrete shell.

The successful excavation and stabilisation of the soft ground tunnel, was a highly complex undertaking. PSM were able to adapt their approach to the variable conditions encountered and through extensive modelling and strict monitoring required by the client to ensure the degree of support versus displacement was acceptable.

Although now hidden from view beneath the current North Shore Line, and soon to be ‘unnoticed’ by the thousands of daily passengers that will pass through it, the safety and integrity of the twin tunnels is a fine testament to the expertise and skill of PSM.



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SURVEYING THE SCENE

Geo-Metric Surveying (Geo-Metric) is an Australian-owned member of the international Geo-Metric Worldwide Consulting Group, and specialises in high end engineering, railway, tunnel, deformation and custom surveying projects. As such, it had much to offer the Thiess Hochtief Joint Venture (THJV) on the demanding Epping to Chatswood Rail Line.

Geo-Metric complemented THJV's internal surveying team, and was responsible for all surface monitoring, monitoring of the Lane Cove section of works (including the walls of the sheet pile cofferdams used to construct the cut-and-cover tunnel beneath the Lane Cove River in three sections), setting out of tracks and station cavern surveying.

Since then Geo-Metric has continued to develop its monitoring systems to the point where, when a parameter is exceeded, automated incident reporting can be provided via SMS, the internet or other communication means, as well as real time recording to a web page. This is accessible by authorised personnel (which can include selected community groups, to provide assurance and transparency). The Geo-Metric systems have temperature-controlled housings because observations can be temperature-sensitive.

The company's specialist expertise also came to the fore when setting out the tracks. Geo-Metric performed in-house modifications to a gantry-style rail surveying trolley that it used to accurately position the rails to meet gauge, grade and superelevation requirements. The rail set-out was done in two passes: the first to determine the gauge and the second to adjust the left and right track elevation. Geo-Metric also supplied qualified staff to man the trolley, and performed track recording with the trolley.

Geo-Metric's expertise, and familiarity with the project, was recognised when United

Group Infrastructure Pty Ltd (United), which is stringing the overhead power lines and installing the ventilation fans for the rail link, engaged the company to provide accurate survey information used in fabrication of brackets to support the overhead power lines and jet fans (for ventilation).

A United crew worked from a rail wagon, which doubled as a template to find the approximate centreline when attaching brackets to the roof of the tunnel at 25m intervals. The

brackets had a plate with a reference hole in it, and Geo-Metric was required to survey that hole with a high accuracy, so that brackets could be fabricated for each location, to hold the power line in the true centre track position.

Similar accuracy was required when surveying the location of rock bolts so that brackets could be individually designed and fabricated to support the jet fans, which were located at 75m intervals.

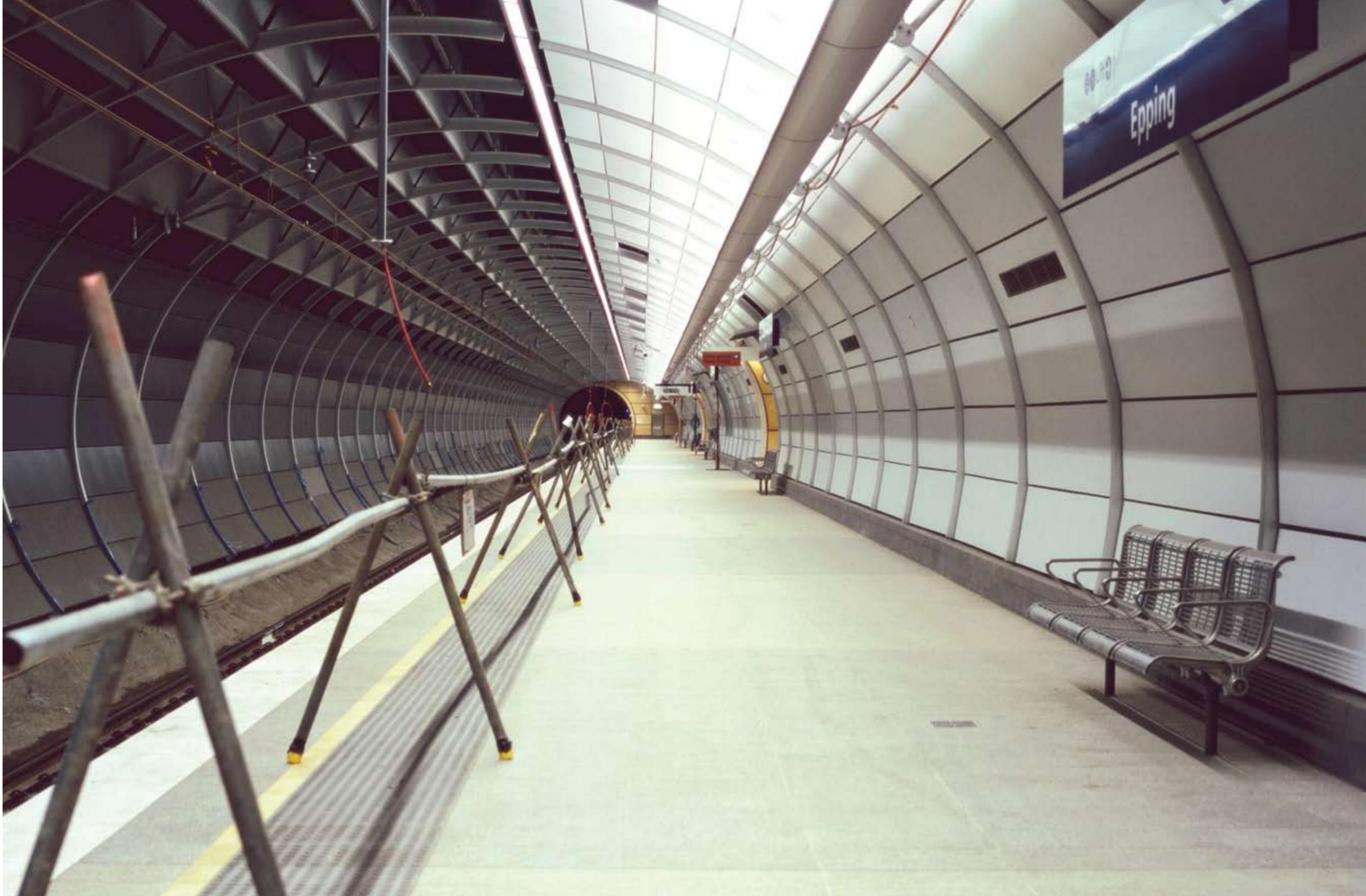
AW Edwards Pty Limited is performing that station fit-outs, and engaged Geo-Metric to survey the location of the rock bolts in the cavern walls. The profile of the station roof is significantly different from the shape of the shotcreted cavern, and steel brackets had to be fabricated to support glass and aluminium panels that formed the ceiling, barriers between the upper and lower concourses, and smoke baffles. The tight tolerances required to fit the panels made this a demanding surveying job.

Geo-Metric continues to specialise in surveying services for challenging civil projects, and is currently working in the North South Bypass Tunnel in Brisbane. It has offices in Brisbane and Perth to complement its head office in Sydney, and is able to develop unique solutions to meet any challenge.



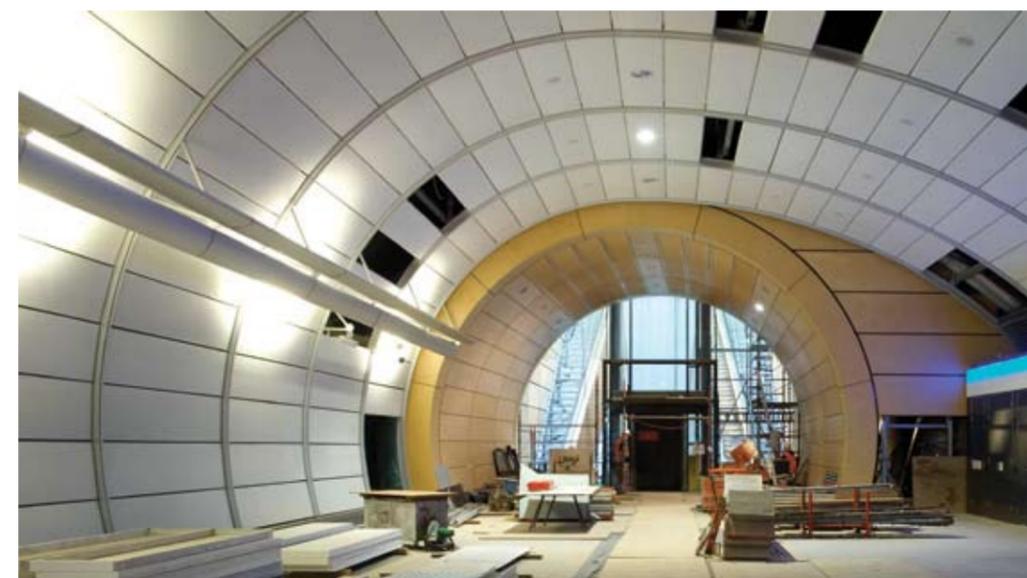
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GROUP DYNAMICS



On a project of the size and importance as the Epping to Chatswood Rail Line – being the largest infrastructure project currently underway in the state of NSW – efficiency of delivery of both design and practical operations was a prerequisite for any company involved.

The Townsend Group was engaged by A W Edwards to provide the design, production and installation of the cavern linings and associated systems for four new stations on the new line, Macquarie University, Macquarie Park, North Ryde and Epping. In meeting with the requirements of a large project of this nature, the company demonstrated the adaptability and innovative edge that they have become renowned for.

A significant and guiding standard adopted early on by Townsend was the KIS (Keep It Simple) principle. The company worked closely with HASSELL to create a design that met the desired criteria of providing a lining that accommodated the mechanical and electrical services between the cavern wall and the lining, whilst also creating an aesthetic and congruent visual structure to complete the station interior. Significant to the finished design was also the requirement for ease of transportation to the underground stations for installation and where possible the off site assembly to reduce on site time.

Bearing in mind these factors, the Townsend design incorporates a suspended panel system integrating vitreous enamel wall panels,

aluminium smoke baffles, suspended glass smoke curtains, and insulated ceiling panels that rise in an arcing curve from one side of the station to the other. Additional to the cavern linings was the requirement for the design production and installation of similar linings for the escalator shafts.

The Townsend Group is a privately owned company that has been creating engineered solutions for over 60 years. During this time they have learnt the value of collaboration and close communication to ensure delivery of the required results occur smoothly and without undue delay. To this end, during the tender stages of the project, Townsend worked closely with both HASSELL and Connell Wagner to ensure their proposal met the highest of

standards. The results of this collaborative process not only ensured their success in the early stages, but also ensured the smooth expedition of the required works due to the efficient design and installation methodology. With time, space and access at a premium on site, this efficiency was essential to successful completion of the works within budget and time constraints.

The suspension system for the lining is one of the real innovative successes of the project. The steel and extruded aluminium bracket system was designed to be highly adjustable, to accommodate the variance of the shotcrete cavern walls and to support the required load of the lining and associated services. In the largest of the platform caverns the ceiling

suspension system allowed for a ceiling measuring 186m in length and 12m wide to be positioned and installed across a curve incorporating 12 radii with a tolerance of 2mm.

In all, the Townsend Group supplied 8,000 perforated powder coated ceiling panels, 2,800 steel panels, 1,456 curved panels, 460 smoked glass panels and 300 inspection panels, plus the associated suspension systems and services. The innovative aspects of the project also included the design of transport systems to deliver components to the site locations, the design of mobile scaffold to install the panels and the coordination for delivery and installation within the required 'windows of opportunity' allowed for on the project. Townsend's philosophy of

keeping it simple proved an ideal attitude with which to approach the project and the success of the installation which has recently been awarded.....is testament to this.

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SAFE AND SECURE

Safety is of primary concern on any major development and especially so on a massive scale project such as the new \$2.29 Billion Epping to Chatswood Rail Line. Effective safety design has been a paramount consideration for the Thiess Hochtief Joint Venture (THJV). As part of the solution to the complex fire services required for the project THJV employed the assistance of Holland Fire Door Installations Pty Ltd.

Holland Fire Door Installations Pty Ltd is an Australian owned and operated company that specialises in the manufacture and provision of fire rated doors, fire rated glass, sliding fire doors and pressed metal and architectural frames. The company was established in 1983 to cater for both large and small scale construction projects by supplying high quality product to the industry manufactured at their own facility in Australia. Holland Fire Door Installations Pty Ltd is also a Pyropanel licensee – providing the company with access to the very latest in technological development and testing of fire rated products – Holland Fire Door Installations Pty Ltd's Pyropanel

products have consistently demonstrated properties that exceed the required Australian and New Zealand fire resistance criteria.

Holland Fire Door Installations Pty Ltd was engaged to provide metal jambs and supply and install hinged fire doors and sliding fire doors for the core works of the stations, service buildings and tunnels for the entire project. With much of the work taking place underground the company developed extensive procedures and plans to ensure effective and safe delivery and installation that integrated with the many other contractors and trades involved with the project. An extra level of communication was required to ensure expedient operations within the often confined and busy underground areas. A particularly interesting aspect of Holland Fire Doors involvement was the design and installation of special pressurised sliding fire doors for the cross passages. A total of 98 of these sliding doors were installed.

Holland Fire Door Installations Pty Ltd values experience and professionalism. The company

has established sound operational practices and provisions to ensure that not only is their staff highly trained, but also their retention rate is significant – this guarantees a continuity of experience and service that produces considerable benefits to their clients. Experience gained on numerous large and small projects over the years has enabled Holland Fire Door Installations Pty Ltd to streamline manufacturing operations, installation and delivery to a point where equality of service is guaranteed to their clients. This consistency of service and quality is one of the company's true hall marks.

Naturally, Holland Fire Door Installations Pty Ltd are honoured to have been involved with THJV on this landmark infrastructure project – they are also delighted to have been able to display their expertise in the provision of their services and products.

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THE HOLE SOLUTION

With a total project value of \$2.29 Billion, the 12.5 kilometres of the Epping to Chatswood Rail Link will provide significant benefits in efficiency for the Sydney Rail Network. The new rail line will connect the main North Shore Line at Chatswood to the Main North Line near Epping. The Thiess Hochtief Joint Venture (THJV) consists of twin bored tunnels each 7 metres in diameter and separated by a central pillar with cross connecting access for emergency egress every 200 metres.

A project of this nature incorporating extensive tunnelling and rock work was ideally suited to Charter Contracting Pty Ltd and their specialised talents. Following a successful submission the Company was engaged by THJV to complete the excavation of the cross connecting passages and the excavation of drainage sumps at the base of the passages.

Charter Contracting Pty Ltd provides detail rock excavation equipment and specialises in low noise and low vibration operations. With over 30 years of experience between the team

from Charter Contracting Pty Ltd allocated to the project, it soon became apparent that there were other areas of the works that they could provide their assistance with. These included the final trimmings of the tunnel wall after the final form machines had been through.

Trimming involved the rock grinding of "tights" or imperfection such as Fibre-Crete overspray left behind by the shot-crete machines. Being high strength (80MPa) this required specialised grinders that could perform under the required stresses. The company adapted one of their own grinders (with the assistance from Tallen Engineering) whilst a search was undertaken to locate a grinder that could handle the heavily abrasive Fibre-Crete. A suitable grinder was located in the Erkat ER 600 grinder and it was immediately employed in trimming up the rest of the Fibre-Crete tights and finishing of in the cross tunnels.

Charter Contracting Pty Ltd has been in operation for over 10 years and during this time they have been able to gather together a core of highly experienced professionals to

ensure the results and project delivery are of the highest standards. Logically, in the industry that Charter Contracting Pty Ltd is employed in attention to OH&S with regular training and information programmes is vital aspect of their operations. The Company prides itself on its operational safety.

The completion of their works for the Epping to Chatswood Rail Line also highlights Charter Contracting Pty Ltd unique adaptability and expertise in addressing complex excavation. Naturally extensive communication with the THJV and consultation during the project were integral to its overall success – and another significant aspect of the Company's operations.

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