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SCOPE OF PROJECT AND CONTRACT TYPE

Northern Expressway (NEXY) - This joint venture project between Fulton Hogan and York Civil designed and constructed the 23 km of a four lane divided expressway joining the Sturt Highway at the Gawler Bypass to Port Wakefield Road, north of Waterloo Corner. This \$370 million project is the largest road construction project in Adelaide since the 1960s and provided outstanding value for money.

To cater for a project of this scale, it was delivered by a collaborative team consisting of:

- Fulton Hogan York Joint Venture (joint venture) – head contractor for the design and construct contract. This was a 75/25 joint venture, with Fulton Hogan responsible for all aspect with the exception of structures and drainage.
- Smec Maunsell Joint Venture (design joint venture) – a 50/50 joint venture between the two design companies to collaborative manage the design process for NEXY.
- Department of Transport, Energy and Infrastructure (DTEI) – client accountable for the delivery of the expressway.

Earthworks

3.8 million cubic metres of earthworks, with significant ground improvement works on approximately half the alignment was completed in the first year of construction. Improvements involved ripping up approximately 500mm of the existing ground and incorporating imported lime grits to strengthen the existing material. A significant borrow pit was established to source approximately 80% of the required fill material. This minimised the need to transport material over the road network, reduced carbon emissions and contributed to strong relationships with the community.

Achieving a smooth road surface starts with the preparation of its base - a major innovation was the identification and modelling of the below sub-grade strata along the full road corridor and designing a system to stabilise those layers susceptible to expansion and contraction. Approximately 1 million cubic metres of earth was replaced and stabilised under the roadway to offset future movement of the road pavement during the wetting and drying of seasonal moisture levels below the road pavement.

Structures

The bridge construction schedule was crucial to the timely completion of the expressway as it formed pivotal links allowing the existing road network to operate concurrently with the construction of NEXY.

Over 24 months, 17 bridges were constructed, two of which span the Gawler River and two span railway crossings, while the remainder span existing roads. The first bridge was completed and ready for traffic in less than 11 months after contract award.

Close cooperation and coordination with local industry ensured that critical components such as the 204 precast concrete beams used on the project were delivered on time and to the strict quality requirements.

Asphalt production

The procurement of a new ASTEC mobile asphalt plant, with a lead time of more than seven months required early decisions on methods and production rates. Asphalt production commenced in March 2009 and continued unabated until 13 September 2010 when the expressway was opened to traffic.

All the asphalt was placed using a shuttle buggy to remix the asphalt prior to placement. This piece of equipment together with a unique paving design process that was approved by DTEI placed asphalt to thickness instead of levels and resulted in a very smooth surface.

Other changes to the DTEI specification saw the joint venture use non-standard mixes including the utilisation of A15E binder in the Stone Mastic Asphalt. With a ride quality of NAASRA 13, these improvements to state specifications will change quality standards for asphalt production in South Australia.

Stats at a Glance

- **Project delivered 3 months early, with the addition of a 25 percent increase in scope**
- **Mobilisation and the collaboration of a 3800 strong team that included the client, joint venture, designers and subcontractors**
- **Completion of over 3 million cubic metres of earthworks cut to fill in the first 12 months**
- **Construction of 17 bridges in 24 months**
- **Laying 460,000 tonnes of asphalt in 18 months to create Australia's smoothest road with a ride quality of National Association of Australian State Road Authorities (NAASRA) count 13**
- **750,000 native tubestocks propagated and planted**
- **Over 2 million manhours completed**
- **87 percent of people employed by project lived in South Australia**
- **Nil industrial action**
- **No legal or commercial disputes**

Type of Contract

Design and construct contract, with an early contractor involvement model used by DTEI to shortlist the tender proponents.

LEADERSHIP TEAM BIOGRAPHIES

Tony Carecos (Fulton Hogan)

Tony is Fulton Hogan's General Manager for Western Region which encompasses Western Australia, South Australia and Northern Territory surfacing, construction and maintenance operations. Tony has 20+ years experience in the civil contracting industry and has worked both in the public and private sector. For the past 10 years Tony has held senior roles in Fulton Hogan including delivering some of the company's most successful construction project. Tony was a member of the NEXY Joint Leadership Team.

Mike Kenealy (Fulton Hogan) - Project Manager

Mike has extensive construction and project management experience in both the private and public sectors –state and local government levels. Mike first dealt with Fulton Hogan on the Calder Freeway, Malmsbury to Faraday where he was the Client's Construction Manager. He subsequently joined Fulton Hogan for NEXY initially as Compliance Manager and then as Construction Manager. Both these projects were completed significantly ahead of schedule. Since the opening of NEXY, Mike has been appointed as Project Manager to oversee the finalisation of the contract. He was a member of the NEXY Joint Management Team.

Dallas Keane (York Civil) - Constuction Manager Structures and Drainage

Dallas has over 10 years experience in engineering design and construction having worked in Australia and international on major infrastructure project. Having joined York Civil in 2008, he was immediately imbedded into the Futon Hogan York Joint Venture to manage all aspects of the structures and drainage on the project. Dallas was a member of the NEXY Joint Management Team.

Stephen Healy (AECOM) - Design Team Leader

Thirty years in successful infrastructure ventures endows Stephen with a broad range of expertise in both engineering and management. Stephen has been responsible for management of major projects as well as AECOM's South Australian business unit giving him strong team and business development skills. Stephen was the Design Team Leader for both the tender design and the construction of NEXY where he was based onsite to ensure the highest level of collaboration between all parties.

Chris Yates (Fulton Hogan)- Design Manager

Chris has spent the majority of his career working for client organisations or their agents on alliancing contracts both in Australia and in the UK. His extensive alliance experiences and hands on project management experience enables him to make a significant contribution to any project he is involved with. As Design Manager on NEXY, Chris was responsible for coordinating specialist designers and consultants throughout the project whilst achieving the requirements of the specification and delivering value for money in a fast track design situation.

Kane Kowalczyk (Fulton Hogan) - Project Safety Manager

Since completing his tertiary qualification in OH&S 15 years ago, Kane has gained a range of experience in varied safety roles in the civil construction industry. Kane is the current Fulton Hogan Safety Manager for South Australia and the Northern Territory. A key highlight in Kane's career has been his involvement in NEXY where he helped create a culture where safety was more than talk. – it was a behaviour that everyone believed in. He was also a member of NEXY's Joint Management Team

Con Tsemtsidis (Fulton Hogan) - Compliance Manager

Con has over 10 years experience in the civil construction industry and has been involved in a number of significant projects where he developed and implemented robust quality and environmental control systems. On NEXY, Con was responsible for overseeing quality, environment and community engagement. In the later stages of the project, he also worked closely with the design team to resolve any outstanding issues. Con was a member of the Joint Management Team.

Margi Whitfield (Fulton Hogan) - Stakeholder and Community Engagement Manager

With over 25 years experience, Margi is widely recognised as a Community Engagement specialist in local government circles in South Australia and has a proven ability in working collaboratively and maintaining strong relationships with clients, the community and other stakeholders. On NEXY, Margi worked collaboratively with officers from DTEI to provide clear, accessible and timely information, always respecting the right of the community and stakeholders to have their say, and be heard.

Ken Little (Fulton Hogan) - Divisional Manager NEXY Asphalt

Ken has over 20 years experience in managing quarries and surfacing operations. During this time, Ken has been instrumental in delivering some of Australia's largest surfacing contracts, including EastLink where Fulton Hogan manufactured and placed over 640,000 tonnes of asphalt. More recently he managed the quarrying and asphalt activities associated with producing 460,000 tonnes of asphalt for NEXY, including Fulton Hogan's Waterloo quarry. Ken also oversaw the establishment of the \$15 million NEXY asphalt plant that was specially purchased for the project and his leadership and innovative thinking helped NEXY achieve the mantle of the smoothest road in Australia.

1.0 OUTCOMES ACHIEVED

The outcomes achieved by the Fulton Hogan York Joint Venture (joint venture) on NEXY heralds a new era for construction management in South Australia. Not only did the joint venture deliver the project ahead of schedule, they set new benchmarks for the state in terms of safety, quality and community engagement.

1.1. Safety

From the onset of the project, the joint venture was focused on creating substantial step change to how safety is managed on large construction projects in South Australia. As the largest road project since the 1960s, the joint venture knew that previous industry benchmarks were not acceptable and that the objectives needed to be clearly focused on zero harm.

To this end the NEXY team, including DTEI, established a set of robust key performance indicators (KPIs) to monitor and improve safety performance. These included:

- **Zero Harm – no injury is acceptable**
 - Create a system of OH&S inspections to ensure all hazards are identified and addressed with high level control measures
 - Engage with the broader workforce using toolbox meetings and ensure all actions are followed up and closed out
 - Capture all safety data to ensure continuous improvement
- **Culture – create a one-team safety culture that focused on encouraging positive behaviours and instilling safety responsibility across the whole team**
 - Safe Act Auditing – to ensure the safety culture onsite is maintained at a high standard
 - Actively involve senior managers in safety
- **Innovation – to lead the industry in continuous improvements**

1.1.1. Culture

The Fulton Hogan York Joint Venture, in collaboration with DTEI, worked to establish a safety culture that set about creating behaviours where the whole project team took ownership of safety.

Senior managers clearly “walked the talk” with 1197 Safe Act Audits completed over the life of the project to provide real-time indication of the safety climate onsite. These audits were undertaken on a daily basis and involved managers/engineers observing work crews and scoring their behaviours against site safety guidelines. If there was a below average level of compliance in a certain crew, the job would be stopped.

The Project Manager or Safety Manager would host a toolbox meeting to address the drop in compliance. This proactive ‘Stop for Safety’ approach meant that managers were identifying incidents and getting there before it even happened. It drove behaviours and no one would walk past an unsafe act.

“Everyone tapped each other on the shoulder and always looked out for one another. With the constant support of senior team, we sent a clear message with regard to safety leadership and what we were all about”

Kane Kowalczyk
Safety Manager

Induction also formed a key element in creating the projects safety culture with over 3800 people inducted onto site. To ensure no one was missed, attendance records at pre-start meetings were compared against induction records. If anyone was found to have entered site without the appropriate inductions, this was quickly addressed by the offending person being removed from site, pending induction.

1.1.2. Safety innovations

In addition to driving safety by creating a culture that encouraged safe behaviours, the joint venture also implemented a number of new measures that were a first for South Australia.

Personal Protective Equipment

The Personal Protective Equipment procedure required by all workers onsite to wear hard hats. This was a first for a road project in the state. Traditionally road projects in South Australia did not have this requirement, but in order to drive a consistent safety message, hard hats were compulsory for all activities, not just those that had the potential for head injuries.

Truck safety

The rollover of tip trucks and water carts is a major and recurring hazard in the civil construction industry. In conjunction with Sage Automation, a warning alarm system was deployed in semi trailer tip trucks and in water carts to minimise this risk.

Investigations from previous roll over incidents have identified that ground conditions have significantly contributed to poor weight distribution and therefore rollover of the vehicle. This system monitored and logged the lateral tilt angle of a water cart or tipper truck during operations, in order to warn the operator when the lateral angle becomes too extreme to allow safe operation. The meter measured an equivalent centrifugal force directly related to excessive vehicle speed on corners which is another major cause of truck roll (particularly in water carts).

The advantage of the system compared to products currently available on the market was that the Sage Automation device captures ‘data logs’ which can be downloaded and viewed as history. This device also has three separate functions, whereas other products simply have alarms or a stop function. These relate to three set points which can all be modified.

All three set points are logged on the system along with any time the truck is powered down, or if the sensor is unplugged. Thus, the system is not only useful as an audible alarm providing a warning to drivers before critical speeds or critical cross slopes are reached, it also allows driver behaviour to be continuously monitored and sets up the basis for reporting indicators in terms of driver behaviour. Risk-taking driver behaviour gets logged and reported as repeated infringements before critical tipping points are exceeded, allowing the joint venture to identify poor work practices and address these in advance.

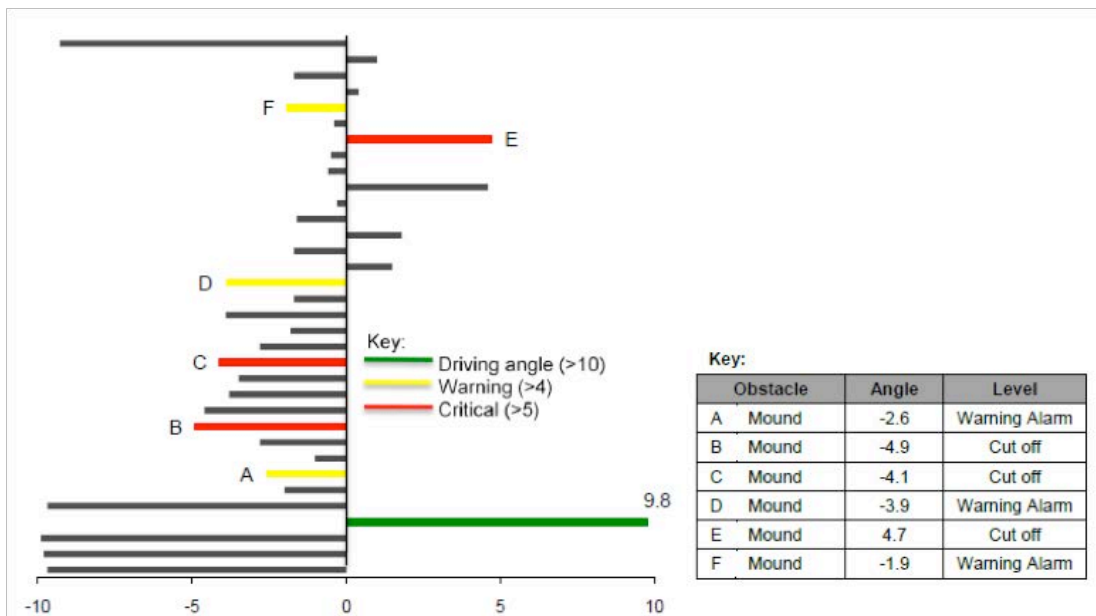


Figure 1. Results from recorded history on Chris Stephen's Semi-trailer 20/04/2010

"I was unloading at a paving site a while ago and the alarm went off so I stopped, even though the guys on site said I'd be ok to keep tipping. I wasn't going to risk it because the device is a more reliable way to measure the angles, and if I were to rollover, the records kept would show that I didn't stop when warned to..."

The alarm itself rarely goes off while I'm working, but when it does you can't ignore it, firstly because of the sound, and secondly because it holds you accountable while recording the history"

Chris Stephens
Driver, NEXY

1.1.3. Zero Harm

With over 2 million manhours worked on the project a strong culture of reporting all incidents onsite was instilled into the NEXY workforce, including subcontractors.

This focus, combined with other initiatives, resulted in three lost time injury over the life of the project and a 85 percent improvement in total injury frequency rates as demonstrated in Figure 2.

Creating this level of step change in injury rates for both direct and indirect employees required substantial focus by all involved in the project. Rigorous system requirements were implemented as well as:

- 521 JSEAs developed
- 3800+ personnel inducted
- 2000+ visitors inducted
- 2000+ driver delivery inductions
- 6600+ permits issued
- 14100+ pre-starts completed
- 600+ toolbox meeting held

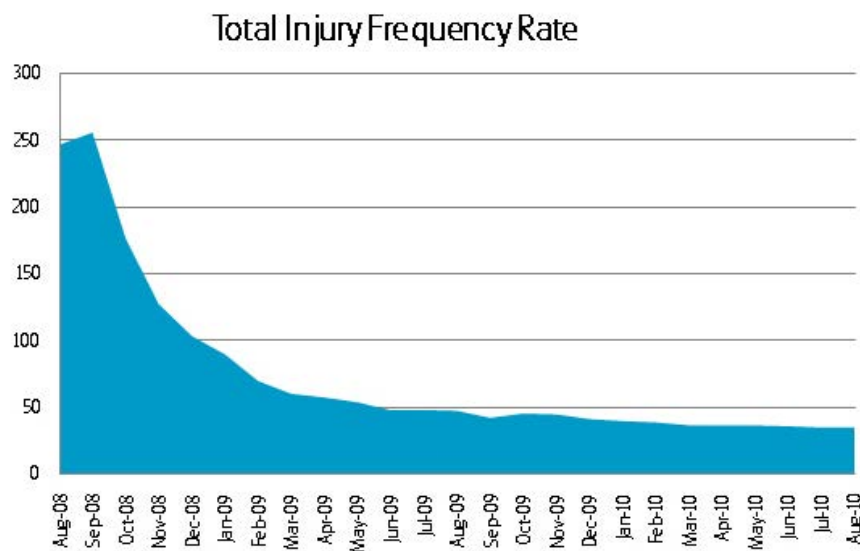


Figure 2. Demonstrates the 85 percent improvement in total injury frequency rates over the duration of the project.

“This project and the consistent efforts of everyone involved have established a new benchmark for working safely.

The safety record on this project is outstanding and testimony to an outstanding team.”

Luigi Rossi

Project Director – DTEI

1.2. Costs and time

The original completion date for NEXY was December 2010 and this was always considered a challenging, but achievable, timeframe by the client, DTEI.

During the early collaboration workshops held prior to the award of the contract, the joint venture identified an opportunity to improve on client expectations through an aggressive earthworks program and early programming of the Gawler River bridge and Gawler Bypass works. South Australia had been in a drought for a number of years and the winter of 2008 was certainly no different to the previous few years – dry, mild conditions that were conducive to delivering a project early if strong project management principles were applied.

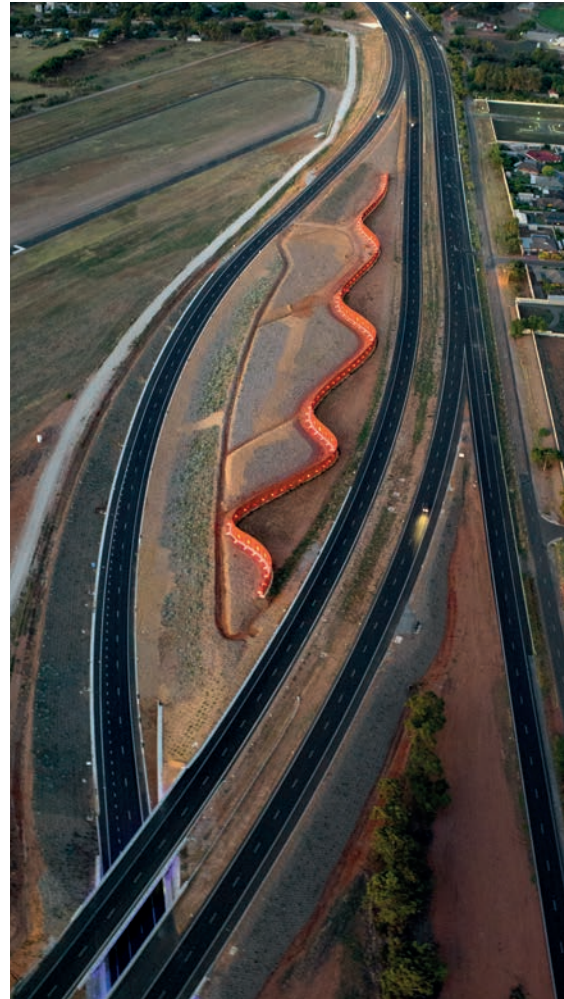
In order to achieve this, it was essential that right of entry to properties along the alignment was in place, however at the time of award DTEI only had 20 percent of the properties acquired. With this in mind, the joint venture had to plan the early earthworks and other preparatory works in a manner to cater for the limited access. We also worked hand-in-hand with the client to find alternative solutions that was compassionate to the local community needs.

For example, the joint venture worked with DTEI and local resident to address right of entry issues. The resident was extremely reluctant to move from his property, even though the house was in the middle of the alignment. As a result DTEI staff investigated a series of options to appease his needs, while catering for the joint ventures requirement for right of entry. The options considered included:

- relocation of the house on property adjacent to the alignment using “monster movers”
- eviction of the tenant and demolition of the house,
- provision of a temporary transportable dwelling for the resident

Through collaboration between all parties, DTEI was able to provide a transportable dwelling adjacent to his property that allowed for the joint venture to demolish the house in a way that enabled the resident to salvage all the bricks, and much of the frame from his residence. A “win-win-win” that allowed for joining up of the alignment south of the Gawler River!

Despite the drought conditions that South Australia had experienced, the winters of 2009 and 2010 were both very wet, with the latter being the wettest on record for 14 years. This slowed work significantly at the Gawler River bridges towards the later stages of the project, which had the potential to delay an early opening. However, due to the detailed programming undertaken on the project, resources were able to be reallocated to allow for a number of other bridges to be completed concurrently and then return to the Gawler River once water levels had subsided sufficiently to commence the piling works.



As the project developed, so too did DTEI's desire to maximise the scope of work on NEXY. The final project value exceeded the original contract sum by a little more than 25 percent with variations such as:

- grade separated interchange at Port Wakefield Road
- urban design enhancements
- scope changes on the Gawler Bypass to include an additional 1km of the freeway to match to recently completed widening and overlay works
- ITS modifications
- inclusion of a shared path along the length of the alignment within the existing corridor and an additional bridge to accommodate the path over the Gawler Road.

These variations were completed along with the contract works, three months earlier than the scheduled completion date, despite the additional work and resources required, resulting in a project that offered exceptional value for money.

In addition to increasing scope, while maintaining the original timeframes, the project was one of the few federally funded road projects to achieve forecast cash flows for the duration. The close collaboration on areas such as right of entry, design review, urban design and approvals for items such as vegetation removal and traffic management plans enabled this to be achieved.

1.3. Quality

1.3.1. Building the smoothest road in Australia

As the smoothest road in Australia, the commitment by the joint venture to 'getting it right the first time' set new industry quality standards for both South Australia and the industry has a whole.

NEXY holds the record of the smoothest road in Australia, having achieved an average NAASRA count of 13, despite the DTEI specification requiring a maximum NAASRA count of 40.

This outstanding result in rideability can be attributed to some initiatives lead by Fulton Hogan including:

- Application of learning's from EastLink, where Fulton Hogan manufactured and laid over 670,000 tonnes of asphalt on the southern end of the project and achieved the previous record for rideability with a NAASRA count of 19. This is a 25% improvement on any other large road project in the country.
- Incorporating Fulton Hogan's research and development knowledge into the pavement design. This saw the Stone Mastic Asphalt (SMA) layer being upgraded to A15E, a firmer binder than the grade 320 binder specified, to help achieve a high quality finish that surpasses other road projects.
- The seal under the binder was also polymer modified to reduce the likelihood of bleeding and flushing of the pavement. Fulton Hogan's technical experts had identified that bleeding of binder and a fatty finish on SMA has been a common issue in the past with other supplier's mixes in South Australia
- The ride quality on the project is excellent with a NAASRA count of 13 being achieved. The use of the shuttle buggy in both re-mixing the product and in avoiding delivery trucks from "bumping" the paver has been the main improver for ride quality. The lengths of paving runs on the top layers were also very long, with one up to 8km, resulting in less joints and a smoother ride. This superior outcome will allow intervention for maintenance at greater intervals, which in turn improves value for money for the client and community
- Establishment of South Australia's most advanced asphalt facility for NEXY. This involved Fulton Hogan investing more than \$15 million in new equipment which includes the 200 tonnes per hour plant, 450 tonne hot storage capabilities, and 4,000 tonne of storage of aggregate and sand, as well as extensive mobile plant equipment. The plant has full recycling capability, allowing asphalt from older roads to be fully reconstituted creating benefits in supply of raw products and storage of waste. The technology also includes a quality control system which guarantees the highest quality product is produced on start up of the plant, and emission control technology which recycles the blue smoke and also features bitumen tanks fitted with carbon filters. These emission controls eliminate odour for nearby residents, businesses and the public.

1.3.2 Architectural Features and Structures

In order to achieve outstanding quality on both the architectural details and structures the joint venture implemented a comprehensive strategy to ensure all parts of the works were controlled to achieve the best quality practicable. The structures that we refer to are those included in Section 1, and included those architectural features attached to these structures, such as LED lighting, folded pressed metal and cladding with supergraphics.

The client expressed a desire for design / finish that challenged the norm. Therefore the team sought to enhance typical features with high quality, visually attractive elements that could be functional but also aesthetically pleasing to motorists and neighbouring residents; in other words, a design legacy for Adelaide's largest infrastructure project.

Design

During design development the team reviewed each design, particularly reviewing the detailed elements, to ensure that the constructability issues were resolved prior to design being issued for construction. This took into account the method of construction and materials used so that the final product was not compromised by poor detailing. In particular the Folded Pressed metal features were designed to hide many of the fixings while meeting the fabrication and installation limitations. To this extent for each of the architectural features on the project a prototype was constructed to determine what the look of the feature was and resolve any design and constructability issues prior to final design. The benefit was to ensure that the final design was exactly what was expected and any issues that might compromise the technical or aesthetic aspects were resolved.

Offsite production

As offsite fabrication was recognised as a high risk area for the project, a specific team was established to ensure strong quality control measures were in place. With over 204 precast t-roff beams were required for the 17 bridges we needed to be guaranteed that our suppliers provided the safe quality outcomes as our onsite workforce. This saw each precast element inspected by the joint venture prior to and during casting for quality, aesthetic and durability.

This same approach was applied to the production of the architectural features and included reviewing and improving handling processes and fabrication techniques to ensure the highest quality outcome was achieved. Our seriousness to quality saw the first batch of an architectural feature being rejected by the joint venture and improvements made to the industry standard fabrication techniques.

Overall this level of inspection and control of all aspects of the fabrication process greatly enhanced the final product by making sure that no step compromised the overall finished product.

Construction

The site construction team was focussed on delivering an outstanding quality project to the client. To achieve this, an additional team was implemented to monitor the engineers in control of the structural works, to focus solely on the workmanship and quality of the works. This team was authorised to have complete control of ensuring the highest level of workmanship was achieved and was not compromised by unsuitable materials or techniques. This team consisted not only of dedicated site engineers but experienced industry recognised past professionals, to ensure all aspects were reviewed and implemented to achieve the best end result.

Prior to installation, all individual beams - with asbuilt measurements - were modelled by the site surveyors to allow for any issues to be identified prior to delivery to site. This ensured no last minute modifications occurred that could compromise quality.

The methodologies used by the construction team were chosen to increase the quality of the works. An example of this was the use of screed rails on all deck pours. This improved the quality of the deck finish, achieving a more consistent level, but more importantly gave a better durability as it ensured that cover was checked for the entire deck surface, not just at discrete locations, which is what would have been achieved if hand finishing with no screed rails were used.

Step-by-step inspections by the architect and DTEI were carried out to ensure that at each phase of production and installation the architectural features were inspected and modifications made to get the best outcome practicable. As an example, the supergraphic was inspected by the artist and architect at

design development, prototype development, during fabrication, following fabrication (prior to delivery), after installation of the first set of panels, following installation of 75 per cent of the panels, completion of the panel installation (prior to flashing installation) and following completion of the works.



1.4. Environment and sustainability

Sustainable construction processes was a priority for the joint venture. All parties knew that a key to proving real value to the community and DTEI was to create a design that minimised the projects footprint, while also incorporating sustainable construction processes that focused on recycling and reusing.

1.4.1. Gawler River borrow pits and wetlands

The establishment of the Gawler River borrow pit was just one example of how the joint venture maximised use of onsite material. With almost 3 million cubic metres of fill required for the project, Gawler River borrow pits provided approximately 80 percent of the required material. The largest borrow pit spanned a 300,000 m² metre area, and was up to 15 metres in depth in places.

As this was a substantial borrow pit, the joint venture recognised the opportunity to create a local amenity that was linked to the Gawler River to assist in flood mitigation and habitat creation.

Since the completion of the project, five local councils are now working together to gain an Australian Government grant to transform the Gawler River wetland into an aquifer storage and recovery (ASR) scheme. The scheme would harvest water from the river, filter it through a reed bed and then inject the water into deep aquifers for storage and future reticulation to the wider Gawler region - with the water available to open space, sports fields, schools, industry and local residents. The long term benefits of this scheme would help recharge the overdrawn T2 aquifer in the northern Adelaide plains.

This water harvesting opportunity is a direct result of economic and environmental decisions to source fill material from borrow pits adjacent to the Gawler River and construct a wetlands oasis.

1.4.2. Recycling of rail sleepers

In addition to recycling material that was sourced onsite, the joint venture also looked for ways to incorporate other recycled products into the project. The electrification of South Australia's rail network provided such an opportunity to reuse red gum rail sleepers containing low levels contaminants into the project that would have otherwise been sent to landfill. With the support of the Environment Protection Authority and DTEL, over 300 tonnes of sleepers were mulched and used for landscaping along the expressway corridor.

This initiative created a precedent in South Australia for the reuse of low level contaminated rail sleepers within road corridors, with all future waste sleepers produced by rail revitalisation projects to be used as mulch for other DTEL projects. It also demonstrates that by creating strong linkages within the industry that one project's construction waste can be a valuable resource for other infrastructure project.

1.4.3. Asphalt

As Fulton Hogan is Australia's largest asphalt and surfacing company creating sustainable asphalt designs that lead the industry is a priority. With South Australian roads experiencing significant issues due to the state's expansive soils, our technical experts recognized that the use of hydrated lime in all asphalt surface course mixes had the potential to create long term maintenance issues.

Fulton Hogan's technical leaders sourced a more suitable filler to incorporate into the Stone Mastic surface course mix that could be sourced locally from waste product. This saw the asphalt mix being altered to include up to 7% of waste kiln dust that was sourced from Adelaide Brighton. Kiln dust is a waste byproduct of cement and lime production processes.

In addition to incorporating kiln dust into the asphalt manufacturing process, approximately 18,000 tonnes of recycled materials were also used. This was sourced from the waste material created by the asphalt manufacturing process; from existing asphalt pavement removed to make way for new expressway; or from excess material such as concrete that was crushed onsite.



1.4.4. Sustainable design

The designers engaged by the joint venture effectively incorporated sustainable design principles into the project.

- LED and solar lighting where lighting was used to enhance the urban design aesthetic of the project – such as the banding on the bridge fascias and abutments and to light artistic installations including the steel snake wall – LED lighting was selected due to its low energy use and longevity. Blue solar powered beacons on tall poles were used to delineate the shared use path at night, and blue and orange solar bricks have been set into the pavement of the path to highlight access points to the local road network.
- Environmentally sensitive design (ESD), water sensitive design (WSD) and high-quality urban design are essential considerations throughout the project, starting at the planning and design review stages. Consequently wetlands and water detention basins are included along the alignment, serving the dual purpose of providing an additional source of fill for the project, while also improving the health of adjacent river systems and the rest of the local environment.
- Recycled asphalt incorporated into the asphalt design.
- Depressed carriageway at the Port Wakefield Road end of the alignment would have resulted in the road being constructed below existing ground level, creating long term dewatering issues and maintenance costs associated with the drainage sumps. Instead the joint venture raised the vertical alignment of the carriageway to negate the need for long term maintenance and energy requirements.

These simple, but effective, sustainable features create a long term benefit for the community in terms of reduced greenhouse emissions, reused existing materials and reduced maintenance costs.

1.4.5. Re-vegetation

Since European settlement, the northern Adelaide plains have been extensively cleared of remnant native vegetation. The Northern Expressway project presented an ideal opportunity to re-vegetate large areas of land with indigenous native plant species to improve and enhance biodiversity in the region.

To ensure that the small wild seed populations were not depleted as a result of the project, native seed collection occurred over a three year period. Some of this seed was used to establish a 0.5ha seed orchard which was irrigated with non-potable recycled water from the Bolivar waste water treatment plant. The orchard produced hundreds of kilograms of native grass and groundcover seed, which was used for direct seeding within the road corridor. Over 750,000 native tubestock plants were also grown to landscape the expressway corridor.

Together, the seed orchard and expressway landscaping provide a valuable resource for indigenous plant propagation material (seed, cuttings and divisions). This resource will be available for both community re-vegetation and biodiversity projects, as well as for the landscaping associated with the many new construction projects currently occurring in northern Adelaide.

1.5. Stakeholder satisfaction

Effective engagement and reporting of every aspect of construction was fundamental to the project establishing a reputation for outstanding project delivery outcomes within budget and ahead of time.

In addition to the usual stakeholders identified for any major road infrastructure project, the expressway passed through four local government areas and three Federal and State electoral boundaries, creating extra complexities for effective engagement.

The four Councils directly impacted by the NEXY were vocal in their opposition immediately following the announcement of this project for various reasons and the NEXY team worked consistently with each entity, individually and jointly, to ensure any issues were understood and rationales explained, or issues addressed.

The strategies used to achieve this included ensuring project staff were available to brief officers and elected members whenever required; ensuring council officers were regularly updated on progress and; including council officers in technical groups to address project elements including, drainage, landscaping, signage, employment, shared use path and local roads.



1.5.1. Property acquisitions

NEXY has always been promoted as “more than just a road”. This project involved the acquisition of more than 160 properties and effective consultation and engagement of the community through this process was crucial to achieving the project schedule. The project had the potential to significantly alter the character of a peri-urban region comprising horticultural properties and pockets of new and existing residential developments. Additionally noise modelling identified over 150 properties were impacted by noise and 14 local roads were closed.

The scale of acquisition required for this project was unprecedented in South Australia. Accommodation works for most of the properties required had only just commenced when the contract was awarded and this had an obvious influence on maintaining relationships with affected property owners and on the construction program.

Effective management of these relationships and flexibility and negotiation in programming activities to accommodate numerous sub-contractors and property owners’ requirements was crucial to maintaining the goodwill and successes achieved through the early planning phases of the project.

The land acquisition process in South Australia provides significant protections to ensure property owners are treated equitably and transparently, and at any stage any owner could have taken steps to delay or stop construction. In a design and construct environment the successful collaborative approach to all property issues and the ensuing early completion is testament to the success of the cooperation demonstrated by all parties to the contract.

This approach was infinitely valuable particularly with regard to significant scope changes to the project including the addition of an additional interchange at Port Wakefield Road. This scope change required the acquisition of more than 10 additional properties, and if the property owners maintained their right for the acquisition to occur within legislated time frames, construction in this area could have been delayed by more than 6-12 months.

DTEI and the joint venture worked diligently to accommodate the requirements of the affected property owners, more often than not working well outside their normal responsibilities. This included offering additional supports including counselling, sourcing real estate services to locate alternative accommodation, assisting with moving, fast tracking accommodation works and ensuring property owners had single points of contact that were able to make decisions and act immediately if required.

1.5.2. Supporting the local economy

Extensive and effective engagement throughout the planning phases of this project identified a diverse range of issues in an area of South Australia often characterised as one of the most socially and economically disadvantaged areas of the state. Seeking opportunities to support the local economy during construction was a key initiative in ensuring community and stakeholder satisfaction and providing a lasting community legacy.

DTEI identified and included targets and strategies in the contract to ensure the community benefits of the largest infrastructure project in South Australia for more than 50 years were realised locally. This included a target of 10 percent young and Aboriginal people to be employed. This type of target was a first for the state and required staff from both DTEI and the joint venture to work collaboratively to ensure that it was achieved.

Local employment, and the subsequent creation of employee and project advocates in the local community, was a key factor in the community acceptance of this project. The joint venture achieved an average of 13% of total construction hours in employment for young people and Aboriginal people during the project which amassed approx 2 million manhours in total.

The joint venture and DTEI believes this is the first project in Australia to commit to a comprehensive analysis of the economic benefits to the region and the state during construction. This involved the joint venture consulting extensively with all its suppliers and subcontractors to understand locations of businesses involved in NEXY. This information was then mapped to better describe how the 880 subcontractors and supplier involved in the project benefitted the local community.

In addition, as part of the induction process each person was also counted and their address mapped in order to demonstrate how jobs were created in the local area. More than 3800 people were inducted to work on the site and the mapping of their residential addresses, and sub-contractor mapping assisted us in demonstrating that over 87 percent of people employed on the project are from South Australia and 50 percent of these live north of Adelaide in close proximity to the project.

1.5.3. Involving and engaging with the community

In everything the NEXY project team did, they considered the local community and engaged with them prior to making any lasting decisions. While the community engagement team, consisting of the joint venture and DTEI, managed the implementation of specific strategies and initiatives these were only successful because of the strong support of the construction team. Some of the specific methods used to engage the community include:

- Full time Community Engagement Manager was appointed to proactively manage two-way communications with the community and key stakeholders
- A dedicated community room was established to display a range of specific materials developed for the project i.e. maps, interactive displays, fact sheets, brochures, posters, displays of equipment and materials, newsletter
- Project specific website including an interactive map advising of all traffic changes
- Webcam focusing on the construction of the bridge over Curtis Road
- Time lapse imagery used on the website for specific activities
- The establishment of a dedicated 1300 Information Line
- Site visits and tours undertaken by 2,790 people, using the community room as a base
- Two open days, with site tours conducted for 400+ visitors
- Specific tours for emergency service providers to ensure appropriate access for emergency vehicles both during and after construction
- Information and displays at local community events
- The provision of regular fortnightly email bulletins with project updates, particularly in relation to current traffic management and access arrangements. Bulletins were sent to local councils, local schools and colleges, emergency service providers, including police, the Metropolitan Fire Service, the Country Fire Service, St John Ambulance, the South Australian Road Transport Authority (SARTA), local businesses, community groups, resident associations and individual residents
- Involved the community in the celebrations of all milestones, including the opening of every bridge. The official opening of the expressway attracted between 5,000 – 7,000 people
- Integrated with the community by supporting local sporting clubs and charities. The joint venture approached two local women, recently unemployed due to the closure of a local business, to gauge their interest in establishing an onsite food van for the project. The van, supplied by the project, was a very successful business enterprise for its operators, as well as donating proceeds from the sale of coffee to needy community groups.



Curtis road interchange to open

TRINITY College students planted trees at the Curtis road interchange last Friday to mark the upcoming opening of the bridge as part of the Northern Expressway project.

The site was originally proposed as a partial interchange, but is now a full interchange at the outcome of community consultation.

Member for Light Tony Pizzullo said the bridge will improve road safety, and has been a job boost for the area.

"Curtis Road is a key route for vehicles travelling to the suburbs of Macdonald Park, Andrews Farm, Doreen Park, Southfield Plains and Manne Pass Downs," Mr Pizzullo said.

"The interchange has involved 17,000 hours of work, including the construction of the pedestrian walkway."

As part of the tree planting ceremony, the students also attended the onsite nursery where about 750,000 plants are being grown, to learn about landscaping and environmental aspects of the project.

The Curtis road interchange bridge comprises 750 cubic metres of concrete and 110 tonnes of reinforcing steel.



From left, Light MP Tony Pizzullo, Playford mayor Martin Lindhorst, Trinity students Bradley Pritchard and Dylan Hill, Federal MP Nick Champion, and students Jason Ashton, Daniel Fry and Katie Finney.

Tour focuses on emergency access

EMERGENCY access points were the focal point of a Northern Expressway tour on Friday, when emergency service representatives from local offices and stations were invited to tour the project.

The tour pointed out the new access points, and showed some of the project's safety features.

They included sealed road shoulders to minimise the occurrence of cars veering off the road, as well as long stretches of steel rope barriers to prevent vehicles from straying into oncoming lanes – which, according to member for Light Tony Pizzullo, were some of the key provisions.

Police officer for Wakefield, Nick Champion was also among the visiting party.

He commented on the features that will make it easier for emergency services vehicles to access the highway and adjacent areas, namely the number of access points along the route.

"By providing regular access points we can ensure that emergency vehicles can attend to any emergency without delay," Mr Champion said.

Gawler River CFS captain Stephen Meates said the

tour helped highlight the potential difficulties of the new roadway, and will allow emergency services to

visit these early so they don't become a problem.

"I think it's definitely a valuable thing to be done at all the different difficulties that the CFS – I can only speak about one – is going to have to contend with the Northern Expressway once it is up," he said.

"We have lost two of our crew members on the Gawler Expressway. Because of that, our response times will have to change."

"I think it will be really important now that we are

informed."

"I think the thing for me personally is the fact that we can now plan things before they even happen."

The tour gave emergency service representatives the chance to give advice on the most effective way to

disseminate the new information to all local services.

The Department for Transport, Energy and Infrastructure is now in the process of preparing detailed

plans to make sure that anyone responding to an incident understands how they can access the new road

and how traffic can be managed in an emergency.



From left, Light MP Tony Pizzullo, Playford mayor Martin Lindhorst, Trinity students Bradley Pritchard and Dylan Hill, Federal MP Nick Champion, and students Jason Ashton, Daniel Fry and Katie Finney.

Locals help keep expressway on target

By Jessica Magill

WITH more than one million cubic metres of soil and gravel, the Northern Expressway is a massive local job – a fact for a major new government contract.

In addition, almost half of the expenditure on services has been spent with firms north of Geelong.

NEXY project director Luigi

Rossi said the project had a "home" effect on local jobs, from

penetration to local services.

"For the first time in a major contract, we are 10 per

cent of the workforce had in,

he said, the project – so which

he was sub-contracted by the

Fulton Hogan Group (FHG) – has been successful, especially

because it is close to home.

"I'm involved from the

ground up with resources and

equipment – I make sure everyone

goes in the right position

and on placed correctly," Joe

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NEXY's employment of local

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"Fulton Hogan through its Community Engagement Manager has been very proactive with Xavier College and its Community in relation to the change in traffic conditions as a result of the Northern Expressway Project.

Through our discussions, the interaction has been positive and helpful"

Karl Barber

Business Manager – Xavier College

As well as information provision about the project itself, the community engagement team also sought to foster a greater understanding of the civil construction industry. Contact was made with schools and universities offering opportunities for site visits and tours designed with their specific requirements in mind. Career awareness and opportunities within the industry were the focus of high school student tours and work placements.

This level of engagement on a major infrastructure project was unique and clearly focused on creating strong links to the community and demonstrating the benefits that be gained by this type of infrastructure project in terms of both economic benefits, employment and skills development.

2.0 COMPLEXITY, DIFFICULTY AND OPTIMISATION OF CONSTRUCTION TASK

2.1. Construction challenges

One of the key challenges identified in the tender phase of the project was the need to build the expressway almost completely on fill and sourcing suitable fill material. Much time was spent in the planning stages to analyse materials around the Gawler River from potential borrow pits for their technical suitability, as well as the availability of suitable low cost imported material.

Early commencement and quick progress of the earthworks was necessary to maximise the use of material from borrow pits; construct bridges at key interchange locations, and; minimise disruption to the local community by separating local and construction traffic. From the beginning the joint venture's target completion date was 6 months prior to practical completion and this was seen as the key to meeting that date.

Utilising the material from the borrow pit allowed for the best productivity onsite and the engineering challenge was to produce a consistent quality Type A material from lower quality materials. Initial testing showed that a combination of the sands and gravels from the borrow pit along with a by-product imported from Penrice quarry allowed us to achieve the specification requirements. DTEI's specification requirement for settlement of the fills concentrated on the Weighted Plasticity Index (WPI) of the material and this testing required up to 5 days. Early work was focussed on limited areas, due to right of entry requirements, and this timeframe potentially meant waiting for test results before the placement of the subsequent layer and delays to the programme. Working with our geotechnical advisers we identified a simplified insitu test that proved to be a reliable indicator of the WPI and this allowed earthworks to continue at a rate to match our early completion deadline.

Transporting the volumes of material required also required some major planning and coordination. A limited number of 50 tonne dumpers were available for short hauls and much of the local road network could not be crossed along alignment until interchanges were completed. A combination of large dumpers and road registered vehicles, predominantly sidetippers, but also truck/trailer combinations, were utilised to maximise output. A large fleet of these vehicles was subcontracted for almost a 12 month period to complete the earthworks component. Generally these subcontractors were "one man shows" and needed to be provided some incentive to make themselves continuously available for our work. This was achieved by offering hire rates that provided a reasonable return, promoting a safe workplace, good conditions and getting "buy-in" from these subcontractors to work on South Australia's largest road project.

Subcontractors formed a large part of the workforce on the project and not all these contractors were controlled by the joint venture. Timely completion of service relocation work was critical for completion of many of the interchange bridges and the service authorities each had a number of contractors working at any one time. Coordination of these works and completion to meet the stretch programme was a major challenge. From the very beginning of the project the joint venture identified a protocol with DTEI for induction of all personnel and equipment to site. This led to some difficulties with service authorities who generally operated under their own standards and required concerted effort by the joint venture to reach mutual conditions that were consistent with the NEXY safety culture. Our cohabitation with DTEI on the project allowed the joint venture to provide a "united front" when planning and coordinating service authority activities.

Additionally, at the Gawler River and Diversion Channel Bridges, the design of these structures incorporated scour prevention for the embankments upstream and downstream of both bridges. To achieve better

economic results for the project, the joint venture decided that the material from the DTEI's unused Fords quarry at Kapunda would be suitable. Harnessing knowledge from Fulton Hogan's vertically integrated business model that includes quarrying an operation was quickly established to extract the material. This involved drill and blast, screening and rock breaking to produce the three different grades of material required for the scour prevention works.



2.2. Logistics

The split of scope within the joint venture was for York Civil to complete the structures and drainage and Fulton Hogan to complete earthworks, pavements and all other works required for the completion of the project. Despite these clearly delineated areas of responsibilities, the project was delivered as though there was only one contractor, using a single construction programme. This allowed for the coordination of all works, prioritisation of design components and the allocation of the necessary resources. This programme and resource planning was managed through a weekly coordination meeting for engineers and supervisors onsite with the Project Manager ultimately responsible for ensuring a best for project outcome.

At all stages of the work there was a link between earthworks/pavements and structures and the key interface areas were

- preparation of the abutments and construction of the Taylors Road Bridges
- drainage, abutments and bridges at Port Wakefield Road
- construction of the bridges over the Gawler River and the Gawler River Diversion Channel,
- connection of the Northern Expressway to the Gawler Bypass
- completion of the bridge decks in preparation for linking the asphalt surfacing over the bridges
- completion of roadside furniture elements on a newly surfaced asphalt pavement without damaging the surfacing.

In all these activities meeting the stretch programme was a key driver and the logistical requirements of

coordinating a 3000 plus strong team to achieve this was a major challenge.

An example of the logistical size of the challenge was arranging for the 880 subcontractors to be inducted into site without delaying progress. The engineers had to identify in advance when subcontractors were planning to enter the site and then liaise with the safety team to ensure they were included in the next induction programme. Inductions were not held daily, so forward planning was essential. Without this level of management NEXY would not have realised their safety objectives. In addition to inducting people, all plant and equipment had to be issued permits to work onsite – our people know that no permit meant no working.

Staging of the pavement works required the surfacing on the expressway to be progressively completed. This created the challenge of protecting the asphalt wearing course – critical to the client in terms of ride quality – from March to September 2010. This same period was the peak time for the installation of signs, guard rail, wire rope safety barrier and ITS components, as well as the landscaping. To mitigate any damage entry and exit points and defined routes were delineated along the project length. All the workforce were educated on these access points and constant monitoring ensured that the wearing course remained undamaged. The NAASRA count of 13 is, in part, testimony to the success of our coordination and management of these activities.

In addition to the logistical challenges presenting in sourcing material, coordinating works and subcontractors, the joint venture also had to deal some of Australia's most extreme weather conditions. During the earthwork phase, over 10 continuous days of 40 degrees Celsius was experienced. This was further compounded in the later stages of the project by the wettest winter in 14 years. Keeping staff motivated, interested and safe was during these periods was a priority for the joint venture. Many works needed to be reprogrammed to occur at different times, while at other points it was necessary to stop the job.

2.2.1 Bridges

Due to program constraints, namely design development, inclement weather and completion of earthworks, the project required 15 bridges be constructed simultaneously. Plant, labour and materials needed to be available at the same time to ensure that the program was met.



Labour

During the construction of NEXY, South Australia was experiencing a shortage of skilled formwork trades. To address this, early in the project the joint venture developed alternative methods to reduce the need for formwork trades. The strategy outlined labour resources required and the methods to access them. It also involved maximising the use of offsite precast concrete elements, use of a formwork panel systems which could be installed by labourers and not formworkers.

Part of the strategy was also to identify and train key personnel in specific tasks, for example precast barrier installation. These key personnel were then able to work with labourers across the multiple bridge sites and provide up-skilling support. Up to 35 labourers were engaged in this manner.

Materials

As the program required 15 bridges to be constructed concurrently sourcing material was a logistical challenge for the project, especially since the state was not geared up for large road project.

Sourcing and the delivery of the 204 t-roff beams required close cooperation and coordination with local industry. Not only did the joint venture need to ensure only high quality beams were produced, local precast yards could not be geared up to stockpile the high number of beams required – usually beams are delivered as required. This meant that the joint venture had to find a location along the alignment that the beams could be safely stored without disrupting construction work.

Additionally, any delay in the materials had the potential to impact on the bridge construction programme. This would have limited the joint venture's ability to source fill material from the Gawler River borrow pit, where approx 3 million cubic metres was to be sourced from, as the bridges formed the backbone of the haul routes.

Plant

Availability of specialised plant such as beam delivery and cranes was limited within the state and required detailed forward planning. Critical tasks could not occur concurrently and therefore accurate programming of key plant deliverables and their use was required to optimise the programme. An example of this was the use of the 500 tonne crawler crane for precast concrete t-roff beam erection. The crane moved seamlessly from one bridge to another due to the detailed programming undertaken by the joint venture.

2.2.2. Asphalt

Fulton Hogan is Australasia's largest surfacing company and as such brought extensive technical knowledge to the joint venture. Clearly focused on achieving the smoothest road in Australia, and laying 460,000 tonnes of asphalt in 18 months, construction techniques were optimised to provide best for project outcomes.

To this end, Fulton Hogan invested more than \$15 million in new equipment including the 200 tonnes per hour plant, 450 tonne hot storage capabilities, and 4,000 tonne of storage of aggregate and sand, as well as extensive mobile plant equipment for use on NEXY. With the project awarded in July 2008, the first batch of asphalt was produced some nine months later and continued unabated until 13 September 2010 when the expressway was opened to traffic.

All the asphalt was placed using a shuttle buggy to remix the asphalt prior to placement. This specialised piece of plant together with a unique paving design process approved by DTEI, placed asphalt to thickness instead of levels and resulted in a finished product that is unparalleled in South Australia.

Other changes to the DTEI specification saw the joint venture develop project specific mixes, in collaboration with DTEI, to achieve best for project pavement outcomes. This included utilising A15E binder in the Stone Mastic Asphalt.

Other initiatives implemented by Fulton Hogan to optimise pavement construction included:

Profilometer

A profilometer, a mobile laser survey system, was used by Fulton Hogan to gather profile data of the pavement surface to be paved. This data is then used to design the next layer of asphalt and to control the levelling mechanism of the paver. The design uses the existing surface as a reference point, from this reference point a design is produced to achieve minimum specified layer thickness and pavement profile to achieve outstanding ride quality while allowing for differential compaction.

A methodology to verify pavement thickness through survey determined locations and coring testing strategy was developed and approved. This methodology is a total departure from constructing everything to a reduced level, although the design is adjusted to match existing pavements or structures, a level of mutual trust and confidence in the contractor's ability is needed to achieve the outcomes.

The resultant pavement achieved an average NAASRA ride count of 13 for the main carriageway, the smoothest road in Australia. This ride quality will extend maintenance intervention levels for the expressway and heightened value for money.

Shuttle Buggy

The Shuttle Buggy is a materials transfer vehicle used as part of the asphalt paving operation and is not new technology in itself. Traditionally a buggy is used to achieve improved ride quality through allowing the asphalt paver to operate isolated from the delivery trucks, with continue asphalt supply to the paver hopper. However, Fulton Hogan took the use of a shuttle buggy to a new level on NEXY by extending the asphalt laying season beyond what was specified by DTEI.

Nuclear Density Testing

Nuclear density testing was used by Fulton Hogan during the paving operations to confirm rolling patterns meet the required density specification. This type of quality control is unusual for the industry and has been used in the past by Fulton Hogan on EastLink.

Process Control in Asphalt Materials Production

Although process control is a specification requirement, the application of process control in relation to asphalt production, materials testing, asphalt placement and testing ifor NEXY has delivered positive outcomes for all parties.

From the production of the asphalt aggregates through to completion of the asphalt works, all processes, product properties, testers and test procedures have been analysed. This was achieved by using experienced staff familiar with process control and an external consultant to facilitate the process.

The data and analysis has been shared openly with DTEI and the independent verifier. Early in the project there were a number of specified properties where erroneous results were recorded. The data was examined and discussed in a collaborative manner that allowed valid statistical methods to be applied, and not an approach where individual test results were the focus.

One of the first areas subject to discussion was the high level of variance in the Gyropac production air-voids. Although the gradings and bitumen contents were extremely stable and within specification, the voids were inconsistent. This prompted an investigation into the interface between the layers of asphalt in the pavement as a high percentage of air-voids could possibly lead to ingress of water. This was discussed with DTEI and resulted in the structural layers of asphalt having a reduced maximum stone size of 19 mm, instead of 26.5 mm. This avoided any possible pavement failures.

2.3. Interfaces

Service relocation is a key aspect of any large infrastructure project and NEXY was no exception. The size of the task was even further complicated by the seven significant interchanges in an area that had previously been agricultural and residential, issues with access to properties due to right of entry constraints and the requirements for relocation of existing service become critical to the progress of the project.

DTEI originally had responsibility for relocation of services effected by the expressway alignment and it became evident due to the nature of a D&C contract and scope changes, that this arrangement had the potential not to provide a best for project outcome.

This situation was further compounded by the extensive overhead electrical and Telstra service relocations required and that DTEI was working off a reference design, which was subject to change by the joint venture's detailed design. As such, the joint venture needed to ensure coordination between DTEI's service relocation program and the designers.

ETSA utilities relocations in particular required significant lead time for high voltage overhead and the presence of a "middleman" in the service relocations presented a significant risk. This was recognised early and a regular working group with representatives from ETSA, DTEI and the joint venture was convened to control and prioritise this work. This allowed the client to have control over the works and cost – a DTEI responsibility – and gave the joint venture the control over programme and the interface with ETSA subcontractors/ This allowed all relocations to be completed in line with our programme. A similar approach was adopted for Telstra, water, fibre optic and gas relocations

One of the key drivers for construction of the expressway was to take heavy vehicles off the arterial and local road network. Traffic management was identified as key to successful construction and also a key element of the community engagement responsibilities. To this end, weekly traffic coordination meetings were held to:

- keep up to date with the programme of works for the ensuing weeks
- outline the status for traffic plans and local traffic impacts
- advise on additional notification requirements in terms of advertising (print, radio etc)
- inform internal customers on works that might impact the surrounding community and roads.

An example of the benefit of the collaborative approach to traffic management was the staged opening of the Port Wakefield Road bridges at Easter 2010. Traditionally this section of Port Wakefield Road is clogged with holiday traffic on the Thursday prior to Easter and there was media attention that ongoing roadworks would seriously impact on this traffic peak. With planning and best for project approach to the task this section was opened on schedule and traffic flowed without delays.

Rail crossings at each end of the project introduced their own set of challenges particularly for access along the alignment. DTEI negotiated an arrangement with the track owner at the northern end of the works

that enabled the joint venture to arrange an extended closure to an infrequently used line. This was an excellent result and one which allowed work adjacent to the Gawler Bypass to be fast-tracked.

The rail crossing at the southern end of the works was the Adelaide-Perth rail line and was operated by Australian Rail Track Corporation (ARTC). Closure of the track was not an option and the design of the structure over this rail line had to ensure work could be achieved with minimum impact on rail operations. During the verification of preliminary designs for this structure an opportunity was identified to decrease the spans on the structure, therefore decreasing construction time and the rail closures. Early identification allowed for early consultation with ARTC. Due to the restrictions of the rail traffic, erection of the beams was carried out at night and, despite a number of nights being lost due to train timetable changes, the beam erection was completed in just over two weeks without incident.

2.4. Constraints

Design requirements provided many challenges for the project and this, combined with significant scope changes, created a number of constraints in the design process.

Timely design and verification is a key to early commencement of construction activities in a design & construct contract. The cohabitation of designers, contractor, client and verifier provided an environment where the design could be fast-tracked. Within one month of the team establishing on site, earthworks had commenced.

To maximise the outcomes in relation to urban design, the joint venture took the unusual step of allowing DTEI's urban design consultant to manage its designers directly. The high level of trust between parties created by the collaborative contracting approach facilitated this unorthodox approach.

The shared path provided a number of constraints to the formation and in particular the drainage design along the full alignment. The corridor acquired for NEXY was 70 metres in width, less than desirable to cater for a shared path. As such design modifications were required to provide for drainage, ITS systems and the shared path along the southbound carriageway of the expressway. Despite these complications and late changes to swale drains and ITS bays, the construction proceeded according to the joint ventures aggressive programme.

This aggressive programme was one of the benefits that the joint venture offered to DTEI as part of our overall package for the project. Targetting an early completion date forces people to think what can be achieved and the level of resources required for that particular outcome. Unless this type of forward planning and innovative thinking is adopted an early completion is not possible. DTEI was also focussed on early completion to demonstrate it's ability in managing this landmark project in South Australia.

A number of key modifications to the reference design were introduced by DTEI early in the construction phase and the most significant was at Port Wakefield Road. Initially the intersection of the Northern Expressway and Port Wakefield Road was to be a signalised T-intersection, however DTEI initiated a review. Concept designs were produced for a number of alternatives and the preferred design involved taking Port Wakefield Road over the future alignment and providing a ramp northbound onto the expressway and one southbound onto Port Wakefield Road. This option required additional land and DTEI had to negotiate the purchase of this land from an additional 10 adjacent landowners. The interchange concept introduced additional hurdles for the construction phase including:

- relocation of ETSA services in the Port Wakefield Road median and along the east side
- relocation of water services along both sides of Port Wakefield Road
- closure of 2 additional local roads and part closure of another

- a staged construction of the earth embankments for the structures due to delays in right of entry for all properties
- managing traffic on Port Wakefield Road (Perth-Adelaide Highway).

This scope change presented a significant scope change to the reference design and DTEI and the joint venture worked together to satisfy landowner requirements; provide for a staged construction programme, and; agree on a suitable commercial arrangement that reflected the challenges and costs associated with the scope change.

2.5. Community

There were a number of sensitivities in relation to community. In the first instance, the project did not have the support of the local council. Both the joint venture and DTEI worked incessantly to ensure that the council were well informed of project activity and that the council and its residents were able to express their views and concerns. Engaging the council directly through site visits, specific meetings both at the council itself and at the project site was beneficial, with the council eventually being an enthusiastic supporter of NEXY.

There was always the risk of the project schedule being interrupted by stakeholders with vested interests and specific issues of concern, particularly property. The provision of direct contact to the project through the 1300 Information Line was especially beneficial, allowing callers to air their concerns or questions and to receive the attention required from the relevant person from within the joint venture or DTEI. The website was an additional support for project updates and information, with the 1300 line allowing callers to gain specific information that was relevant to them in addition to general project information. Queries or complaints about dust, for example, could be quickly dealt with by a call to the 1300 line, with works called to a halt if required because of particular weather or environmental conditions.

A perception of NEXY being an “interstate project” due to Fulton Hogan’s involvement and taking jobs away from local people was eventually dispelled. The publication of employment data and research on local employment was managed by DTEI who also utilised the local press to present stories on local businesses and local people who were engaged with NEXY, as well as presenting local employment statistics to the wider media and industry bodies. Word of mouth by local subcontractors also helped to build a realistic and positive picture of NEXY as a boon for local employment and for up-skilling of existing workers involved in the civil infrastructure industry.

2.6. Environmental challenges

There were two sensitive environmental challenges on the NEXY project that required careful management and forward planning by the joint venture to avoid any issues.

The close proximity of NEXY to residential and agriculture areas coupled with the extensive earthworks program had the potential to cause issues relating to dust. With the majority of fill being sourced from the northern end of the alignment, and in some instances transported the whole length of the alignment, the joint venture needed to manage the potential issue proactively.

The dust mitigation strategy involved water carts and organic dust suppressant products being used to control dust across the project. In key locations, haul roads were also spray sealed. Calculations had

determined that the cost of sealing a haul road provided sound value for money outcomes as it diminished the need for haul road maintenance and extensive use of water carts.

The other sensitive environmental issue was water usage due to the ongoing drought and lack of water in the regional aquifer. From the outset, the joint venture was committed to being water-wise and no potable or river water was used for construction of NEXY, despite South Australian legislation allowing it. A quantity of reclaimed water was purchased from a local landholder to supplement groundwater and stormwater used for dust suppression and construction.

2.7 Heritage protection

The local region has both a rich Indigenous and European heritage which the joint venture was committed to protecting. As with any significant construction works there is a risk of damage to heritage sites and it was imperative that any locations of historical significance potentially impacted by the construction of the NEXY project be identified and protected.

A significant Indigenous heritage site was found adjacent to the Gawler river during pre-construction heritage surveys. The Indigenous heritage site was set aside as a 'Meeting Place' for the Kaurna Aboriginal community – the traditional owners of the land the expressway was built on and remains part of the Gawler River Wetland red gum habitat offset area

The deteriorating but heritage-listed Pise cottage and the historical Zoar cemetery were also identified directly adjacent to site, both of which were at risk of dilapidation from construction activities. Temporary supports were installed by DTEI on both Pise cottage and on the older and less stable headstones in the Zoar cemetery to reduce the potential impact of construction on these structures. In addition, the Pise cottage chimney was re-pointed to permanently stabilise it. No damage was recorded on either site as a result of the work undertaken by the joint venture.

2.8 Project initiation

2.8.1 Living together

DTEI had the vision that all parties involved with the delivery phase of NEXY should co-locate in a shared project office. This office was established by DTEI in the procurement phase of the project. This proactive and collaborative approach resulted in the office being available for use promptly after contract award and facilitated a rapid mobilisation of the wider project team, including the designers, who completed the majority of their design from this office.

Much of the outstanding success of the expressway can be attributed to the culture of the wider project team. The project that now benefits the people of South Australia is the result of the innovative vision, dedication and commitment of the client, contracting joint venture, design joint venture, and the Independent Verifier. All these organisations not only shared a common vision for the project, but shared office accommodation in a uniquely interactive manner that stripped away the usual barriers between participant organisations and allowed hugely successful interfacing between all parties. The office layout was based on project discipline and disregarded parent organisational boundaries. Each member of the project team were allocated desk space adjacent to the people they needed to work with, regardless of which organisation they were employed by. The result was that on entering the project office it was impossible to determine which organisation each member of the team worked for. Indeed, the culture was that we worked for the 'project' not our parent organisations!

This cohabitation engendered and cultivated a genuine best for project ethos throughout the entire project team that generated a uniquely open and transparent approach to the delivery of this competitively tendered design and construct project. Many project teams, particularly alliance projects, use phrases like “best for project” and “one team” but rarely are these principles applied with such commitment as exhibited on NEXY.

From the outset we all shared a vision that the project team should deliver outstanding performance whilst also enjoying the experience of working on the project. This vision was fully accomplished as evidenced by the commitment of the whole team, low staff turnover and delivery goals achieved. In short, the delivery of the ‘hard dollar’ design & construct contract benefited hugely from a delivery model that would be the envy of any Australian infrastructure alliance project. This was truly an innovative approach that sets new benchmarks for infrastructure project delivery in this country.

2.8.2. A problem shared is a problem halved

Inevitably, a project of this size and complexity will encounter problems during design and construction. One of the key benefits of the delivery model and office sharing is the early identification of problems and issues, whether they be design or construction related. The shared accommodation enabled the immediate communication of issues to all parties and responsibility for finding the best for project solution was shared with minimal formalities and maximum speed, thereby minimising impacts on project delivery.

Often, such as in the case of service relocations (a client responsibility and risk), the contractual risk/obligation allocation was set aside and resources applied from elsewhere in the project team to ensure task was completed on a best for project basis with minimal disruption or cost to the project. In the case of the service relocations, designer and contractor resources were assigned to assist the client’s services engineer to resolve problems to the satisfaction of all parties with minimal interruption to the project. Possible commercial opportunities that often arise from such situations were disregarded by the joint venture in favour of the best for project principles and outcomes that the team had committed to.

2.8.3. Shared systems and processes

In addition to procuring the project office accommodation the client also procured the Incite document management system to manage the huge volume of project documents and communications that would be produced throughout the life of the project. All parties to the project were given access to Incite and training in its use. It was decreed from the start of the contract that all communications and contract documentation would be distributed through, and managed by, Incite.

The Incite system has an ‘open architecture’ which enables the user to customise the system and embed bespoke workflows and controls within the system. This was used to great effect on the project, particularly with respect to the management of design documentation and design reviews. Over 2,850 design documents were produced and managed within the Incite system. In order to manage these documents in a manner that met the requirements of both the contract and the systems of the various participants, numerous project specific workflows were developed jointly by the client, the construction joint venture and the design joint venture for implementation by the software vendors. These systems ensured the timely and appropriate distribution of each design document at pre designated stages of its development. The achieved outcome was that design reviews were undertaken as programmed, were communicated to the right people and review comments were captured and responded to in a timely fashion. The end result was a streamlined and workmanlike management of the huge volume of design documentation.

3.0 LEADERSHIP AND MANAGEMENT

3.1. Project team relationship

The project relationships formed on NEXY were unique considering the hard dollar contract environment. Relationships between DTEI, the joint venture, designers and proof engineers was outstanding and a key factor in the success of the project.

From the onset of NEXY alliance principles were adopted by all – we all worked in one office, wore a common uniform, and were highly interactive with each other. Best for project was always at the front of mind.

When the contract was awarded, DTEI and the joint venture developed agreed alliance principles that governed the relationships on the project. These principles were championed by the Joint Leadership team and Joint Management team, with representatives from the client and all contracted parties. Additionally, KRAs and KPIs were also developed jointly to encourage shared ownership and responsibility.

The relationship contract approach ensured the project risks were minimised and opportunities and benefits were jointly shared. This approach would not have been possible without the genuine commitment to best for project outcomes for all parties. The service relocation challenges discussed earlier are an excellent example of this.

3.1.1. The Joint Leadership Team (JLT)

To create a collaborative environment from the top down, a JLT was established to provide cohesive governance to the project. The JLT consisted of senior executives from DTEI, the construction joint venture and the design joint venture who met monthly to review project progress and project team performance.

They also established clear objectives on the desired project culture, programme performance, quality outcome and community integration.

The openness and maturity of the JLT members was critical to its success, with all discussions focused on best for project outcomes, rather than individuals stubbornly defending their relative parties positions.

The value of the JLT was evidenced by the way in which significant variations to the contract were resolved. Over 160 variations to the value of over \$80M were agreed to with the help of the JLT, without any animosity between the parties. This could not have been achieved without the JLT members having total trust in each other. The key aspect of this process was that any issues identified by the team – such as failure of either party to provide prompt attention to key contractual or operational matters on the project – were discussed and resolved by each party providing direction and resources to their respective teams.

Particular areas addressed by the JLT included:

- safety – reviewing lead indicators (such as safe act audits and inductions)
- community and stakeholders – analysing the team's commitment, issue management and timeliness of all responses, senior management involvement and compliance with the overall plan
- budget – reviewing status of cost versus DTEI budget, final cost expectation, value adding potentials, risk allocations and cash flow projections
- time and programme – reviewing status of progress against contractual dates, project programme,

structures and pavements separately against programme and time innovations that reducing construction time

- quality and environment – addressed specification requirements and achievement, functionality of the associated systems, innovation implementation, percentage of recycled goods.

There were a number of elements attached to the JLT report including, the innovation register, audit schedules, program up dates, early completion milestones, as built drawing schedule and hold point tracking. All of which helped to focus the entire team on the elements which were going to deliver an outstanding result.

The JLT is clear evidence of the collaborative, relationship style approach adopted by all parties and another example of alliance principles being applied in a hard dollar contract environment

3.1.2. Joint Management Team

The Joint Management Team (JMT) included representatives from the joint ventures, designers and the client and enabled staff on the project to develop innovative solution. The JMT also acted as a conduit to the JLT to develop ideas for game breaking performance on the project.

During the winter of 2009, the first wet winter after many years of drought, it became evident that we needed to review our programme and methodology to achieve our early completion target. This wet weather throughout the winter had hampered our efforts particularly in relation to the connection of the Northern Expressway to the arterial network at each end of the job. An Early Completion Workshop was organised in August 2009 to investigate:

- the required strategies to get all parties geared up for an April 2010 completion
- opportunities to expedite an early finish
- understand roadblocks and how these might be mitigated
- methods to reinvigorate the team to deliver game breaking performance.

One of the “roadblocks” that was identified was the requirement to maintain two lanes of traffic in peak directions on the Gawler Bypass for the duration of works. This was a requirement of DTEI in their design brief and reference design, but investigation by the joint venture and preliminary discussions with client representatives at JMT level suggested that this was an opportunity to provide a game breaking performance. Traffic volumes on the Gawler Bypass were assessed to be at a level that could be catered for by one lane in each direction and the requirement for two lanes was considered over and above functional requirements. The joint venture developed a comprehensive business case for contra flow arrangements on the Gawler Bypass utilising first the southbound carriageway and then the northbound . DTEI approved the contra flow proposal, despite the contra flow traffic management being deemed as Non Conforming, on the basis that it was a best for project outcome with respect to providing timely completion within contractual timeframes.

This proposal required

- a significant traffic management component in terms of variable message signage and detour signage in and around the Gawler township
- installation of more than 2.5 kilometres of concrete new jersey barriers and the relocation of these for the change in carriageways
- consultation and regular information updates with local schools and the surrounding community with respect to closures and detour routes

- liaison with transport groups, bus companies and the travelling public
- installation of a camera to monitor traffic movements and a procedure to notify local tow truck operators in the case of a breakdown.

The approval for this relaxation of the specification requirements also considered the commercial implications and provided for some give and take from the joint venture and DTEI. This is a further example of the collaborative mindset that was developed and applied successfully on the Northern Expressway project

3.2. Legacy creation for the community and industry

DTEI promoted NEXY as being “more than just a road” and this concept was enthusiastically embraced by the joint venture partners.

From the outset, there was a commitment to seeking out and maximising opportunities to create an enduring legacy for industry and for the community. We knew that we needed to make the largest road project in South Australia recent history a success, at all levels.

3.2.1. Employment opportunities

Local employment was a key element of the NEXY engagement strategy, particularly as the media and community deemed Fulton Hogan as an outsider to the state, even though they had partnered with a local contractor – York Civil – to ensure local knowledge was harnessed and incorporated.

The joint venture recognised significant social and economic disadvantage of the region and saw an opportunity to stimulate the local economic through employment opportunities and purchasing locally.

More than 3800 people were inducted to work on the NEXY site and more than 130 local subcontracting firms were engaged. The residential addresses of those inducted onsite were mapped to demonstrate that the employment opportunities were maximised for local people.

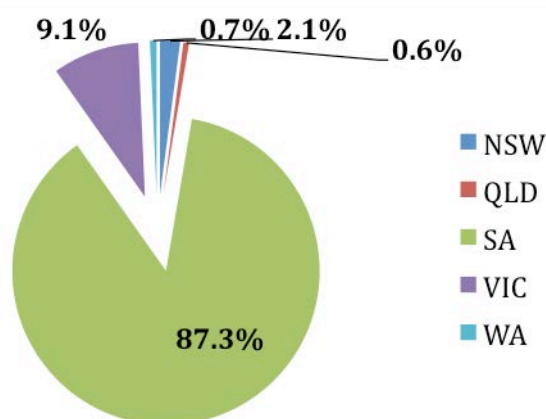


Figure 3. Over 87% of those inducted on site resided in South Australia.

In addition to creating employment and up-skilling opportunities for local people, a strong preference was placed on using local sub-contractors. This saw that of a total sub-contractor spend of \$33.45m, over 59 percent was re-invested in the South Australian economy.

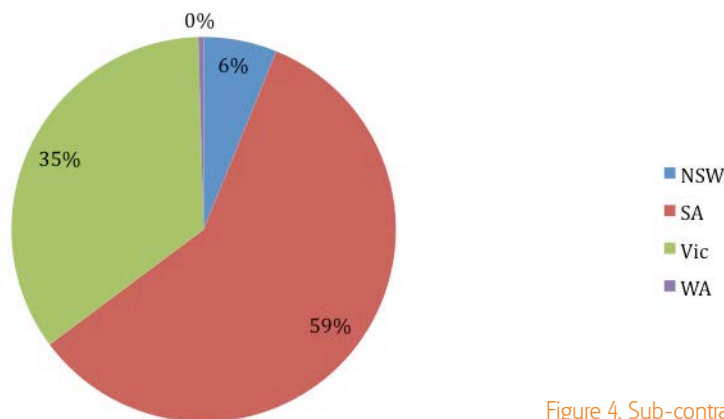


Figure 4. Sub-contractor spend by state.

This re-investment in local resources demonstrates the potential in the construction industry for stimulating local regional economies. The South Australian Premier Mike Rann, the Federal Minister for Infrastructure Mr Anthony Albanese, and Monsignor David Cappelletti, assisting the Premier on Social Inclusion have all presented NEXY as an example of best practice.

3.2.2. Indigenous and youth strategy

As part of the engagement process with the local community, NEXY helped generate employment opportunities for local youth and Indigenous workers and provided them with the opportunity to improve skills, while gaining hands-on experience.

It was a contractual obligation that 10% of the workforce employed by the joint venture were youth or indigenous workers, however we exceeded this target by 30%.

The process of exceeding the target by 30% was not easy. The joint venture needed to commit significant resources to the strategy.

The strategy was initiated at project commencement, with contact initiated with local employment brokers, particularly those who specialised in the employment of young people and Indigenous people. Ongoing contact was maintained with these brokers along with contact with the Land Management Corporation, which also included staff from the City of Playford's employment development staff with whom a pilot program for young women was later initiated.

Once the project was established and both young and Indigenous workers were employed on NEXY, the role of Indigenous Liaison Officer was initiated to support the retention and wellbeing of Indigenous employees.

Regular monthly contact was also made with subcontractors to ensure that they provided statistics about their own workforce in relation to the employment targets – ie how many young workers were employed in that month, how many workers were Indigenous, how many workers lived locally.

As a result of the joint venture's successful youth and indigenous employment initiatives on NEXY, the South Australian Government now mandates similar targets on all major construction projects in South Australia, which will create long legacy for the local community and the industry.

"I was never employed by a private company before, let alone a civil construction company.... I have been able to provide financial security for my family. A better quality of life. My employment with Fulton Hogan has enabled me to re-mortgage my house and undertake some much needed renovations. It has been busy. My immediate and extended family thinks it is cool and people are often amazed where I work. I would love to see more Nunga women, men and young people working in the industry. It is the first step of a rewarding career."

**Christina McMenamin,
Plant Operator and Indigenous Liaison Officer**

3.2.3. Premier's industry initiative

With the Northern Expressway being such an important project for South Australia it was imperative that the project contributed to the wider community in terms of education and training.

In an initiative, designed to foster greater understanding of career opportunities and career paths, four teachers were seconded through the Premier's Industry Initiative to develop new maths and science curriculum based on the project. The resulting curriculum in maths and science for upper primary, secondary and adult students was then made available on the Department of Children's Services website for use by all students and teachers in South Australia. Initial feedback indicates that the application of maths and science to project based activity gave a new thrust to how such subjects could be applied in real life and in career pathways.

In addition, the project encouraged school and university groups to visit NEXY, with tours tailored to suit the information requirements of students, whether they be postgraduate or primary level.

These initiatives providing a real life learning legacy for students as well as providing a new awareness of the practicalities of the applied learning involved in such a project as NEXY, contributing to industry awareness.



3.2.4. Young women in civil training program

In conjunction with the Land Management Corporation, the City of Playford and Civil Train, Fulton Hogan applied for funding to run two programs with young women interested in civil construction.

Twenty young women who were unemployed and interested in the civil construction industry were involved in the program. This involved them gaining real work experience on a construction site while completing a Certificate 2 in Civil Construction. The women also had the opportunity to discuss working in the construction industry with other young women employed on NEXY.

3.2.5. Landscaping and the seed orchard

More than 750,000 plants were planted as part of the project and most were propagated onsite in a purpose built nursery by the joint venture.

The specially constructed nursery - seed orchard - remains onsite for continued use by DTEI and the local community. This creates an ongoing legacy for the community and allows local people and school groups to learn propagation techniques.

3.2.6. Shared use pedestrian and cycle path

A shared use pedestrian and cycle path was included on the project requirements, despite the significant constraints imposed by land availability in some areas.

The joint venture recognised the need to provide this important community amenity and worked closely with community groups, DTEI and land owners to create the Stuart O'Grady Bikeway. Interpretive and directional signage has also been installed along the path to highlight important heritage listed sites and local flora and fauna.

3.2.7. Flood mitigation measures

NEXY was constructed across an area of the Adelaide Plains prone to flooding particularly around the Gawler River and Smith Creek. The design of NEXY sought to alleviate this flood risk through the creation of a diversion channel and wetlands adjacent to the Gawler River as part of the project. The creation of the Gawler River wetlands was achieved as a result of this area providing around 50 percent of fill material for the expressway.

Recent heavy winter rain in 2010 demonstrated the value of these flood mitigation works which alleviated flood conditions along the Gawler River, with the wetlands being filled and water retained without causing the flood damage of previous flood events in this area.

3.2.8. Gawler Airfield and the Adelaide Soaring Club

The Gawler Airfield accommodates the Adelaide Soaring Club who were significantly impacted by the expressway.

DTEI and the joint venture worked with the club and individual hangar owners to redesign and reconstruct runways and relocate all club facilities and individual owners' hangars. This was a significant project in its own right and the Soaring Club members are proud of their new facilities.

This site is now an important regional asset and has enabled the club to encourage use of their venues for events that would never have been considered previously, including local community functions and community celebrations.

3.3. Design process and contribution

3.3.1. Integrated design team & processes

From the outset it was decided that all key project activities should be conducted from a shared project office located on the site. The decision to integrate the design team with the construction team and co-locate them in an onsite office was instrumental in achieving the outstanding results realised on NEXY.

This integrated approach to design and construction planning, combined with co-location created an environment that could easily respond to, and accommodate changes to the client's project requirements and changes to the construction programme that arose through unexpected physical site conditions or land availability issues etc. A key example of this was the client's desire to change the route of the shared use path at the Gawler River. This change required the design and construction of an additional footbridge to accommodate the path. The solution was quickly workshopped and a preferred option for the footbridge decided upon and work instigated with little or no impact on the design or construction programmes.

As with any major infrastructure project numerous design challenges had to be identified and overcome. It was essential that the issues and their resolutions were identified as early as possible if we were to realise our goal of early completion within the project budget. Co-location, shared ownership, robust systems and processes and proactive bi-directional stakeholder engagement combined with a truly integrated design and construction team enabled early workshopping of the design issues to quickly gather all the design inputs and align on the best for project solutions.

At the beginning of the design process we established Technical Reference Groups (TRGs) for various aspects of the design such as drainage and services etc. These TRGs comprised the relevant designers, construction engineers, client representatives and stakeholders such as local council and services owners. The philosophy was that the TRG delegates were authorised to approve the resolutions, thereby eliminating referrals and the delays associated with them. We believe the level of coordination, collaboration and interaction on NEXY, through these TRGs, is unparalleled and was a key tool in ensuring a holistic approach to design with minimal impact on a challenging design programme.



3.3.2. Check it twice, check it thrice, build it once

Design packages completed by Maunsell AECOM were checked by SMEC and vice versa. Packages were also exported to Maunsell AECOM and SMEC offices external to, and independent of, the project design team for internal verification. This internal verification was additional to the client's independent verifier checks. This check it and check it again process ensured robust and reliable final 'for construction' design documents. In addition to the designers internal checks and verification each design package was subjected to client and construction team reviews at the 15%, 85% and 100% design stages. These reviews ensured the client's and construction team's requirements and views were captured, recorded and addressed.

This comprehensive review process was jointly designed by the construction joint venture, design joint venture, client and independent reviewer. Bespoke project specific systems were then built to accommodate these processes and incorporated into the Incite document management system to automate and manage the review process. It is our understanding that no other project has developed a document management system so comprehensively.

"The design management workflows developed by the team and built into Incite were cutting edge"

Claudelle Taylor

Product Manager of Nexus Point Solutions Pty (Incite Vendors).

Key features and project benefits

- high level of interaction between client, contractor, stakeholders and Independent Verifier
- rapid identification of design issues and interactive/joint resolution of issues.
- design program continually reviewed and adjusted to remain 'in tune' with construction program
- fully integrated design/construction/joint venture/client team giving rapid review and feedback.
- genuine shared ownership of issues and resolutions
- designers able witness/view site conditions and share in project 'ownership'
- designers more 'connected' to the project.
- ability to rapidly accommodate changing client and construction team requirements
- key design issues quickly identified and jointly workshopped.
- rapid collation of stakeholder requirements and inputs.

3.4. Planning and control of design and construction operations

The design and construction processes and programs were continually reviewed and coordinated to ensure alignment of the various design and construction teams.

Co-location of the design and construction teams enabled rapid and effective communication and coordination of design activities with the construction program and other project time constraints such as land acquisition and utility services relocation.

Incite, the web-based document control software package, was used to manage all forms of documentation (drawings, reports, memos, requests for information and all manner of contract correspondence). Key to the planning and control of the design process was the establishment of design lots and Incite workflows to distribute design documents and to receive traceable comments and approvals across all design packages.

3.4.1. Design

The planning and resourcing of the design was based on the geographic scope of work required and technical elements such as roadworks and bridgeworks.

Design lots

Design lots were established to suit the technical elements and construction sequencing required to suit seasonal constraints as well as the availability of acquired land and services relocations. For example additional design lots were created to allow immediate start north of the borrow pits while the Gawler River water levels subsided.

The design lots became the unit of measurement of progress by all parties involved from designers through to reviewers and the construction team. The design lots allowed work on the main expressway alignment to progress separately to the arterial and local road work to maximise flexibility in both design and construction programmes. The total project comprised 154 design lots, which contained over 2,850 design documents in total.

Design disciplines

Design disciplines each focused on project elements required as a priority for construction. DTEI had commenced detail design of priority locations to allow construction to proceed with the creation of overpass bridges to separate local traffic from the main alignment earthworks. The construction program focussed on completing all major earthworks in the initial summer, placing significant focus on the remaining investigations and geotechnical design of earthworks and bridge embankments. Key early packages were arranged around disciplines to allow the required construction priorities.

Roadworks, bridgeworks and temporary works were divided into 15 design disciplines to better coordinate the assembling and management of technical skills.

Design locale

Initial works were focussed on key interchanges at Angle Vale Road and Curtis Road. Significant amounts of the earthworks fill material was obtained from borrow pits at Gawler River. Prior to completing overpass structures to the south, initial works were focussed on the alignment to the north of Gawler River. The packaging of the design tasks allowed priority to be focussed in the area.

The project was divided into six sections, but this grew to nine sections, including the Port Wakefield Road and Gawler Bypass interchanges.

Design program

The design program tracked all the design packages required for the NEXY project. The program was tailored to meet construction priorities and also to meet the required design approval process. The design program was adjusted and summary design lot updates were presented at the regular design meetings held on site. The program tracked approximately 1000 activities that broke down the design packages into design development and design review tasks.

Design process

The project required systematic development of design packages through a nominal 35%, 85%, 100% and 'Issued For Construction' stage process. The design documentation was distributed to all relevant parties via Incite at each stage.

Regular reporting of the design lots phase and status was prepared on the basis of the Incite records and presented in graphical form as indicated in figure 5.

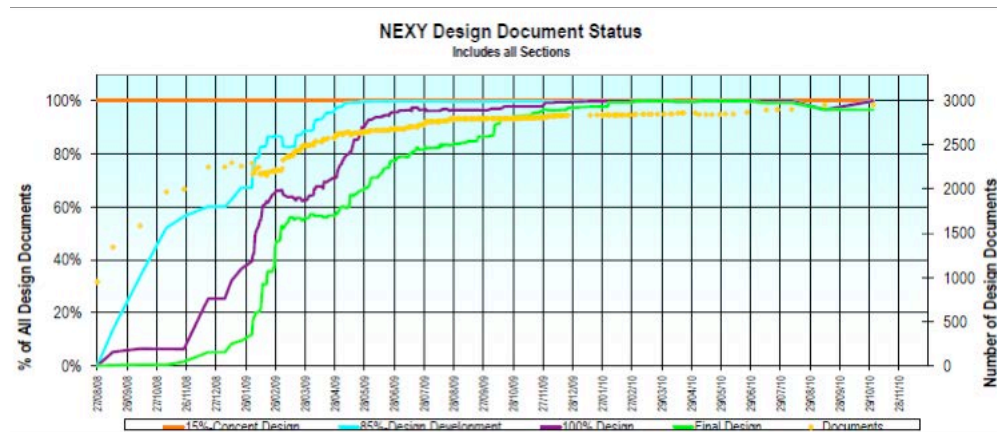


Figure 5. The status of the design lots phase was reported in graphical format.

With input from the construction and client review teams, the SMEC Maunsell joint venture design team, were responsible for the development and delivery of the NEXY project design. The design reports were prepared by the designers and then sent to the joint venture for submission to DTEI and the Independent Verifier.

Approximately 200 reports were produced. Each completed report contains all the design records for a package.

Inter-disciplinary reviews between design disciplines were conducted at key stages for each section of the works. The reviews were documented and the designs adjusted prior to the next formal review issue.

Design reviews

The design was continually reviewed at each stage through a number of different review processes - internal independent reviews; contractor reviews; and client and independent verifier reviews. Proof engineering checks were undertaken as stipulated in the contract, as well as third party road safety audits on all roadway and road side elements.

Control and reporting of the design lots review status was based on the Incite records.

Internal and independent reviews - Internal reviews were undertaken by the design team. Proof engineers and road safety auditors were independent of the design task.

These independent design reviews were tracked internally and reported via a standard reporting format that allowed the designers to incorporate their responses to issues raised. The reviewers then signed off the responses prior to including the completed form in the design report for the respective package. The complete reports were then uploaded for the contractor and independent verifier reviews.

Contractor reviews - Each package was provided for review by the relevant contractor personnel at each stage of the design development. These contractor reviews were tracked via Incite and reported back to the designers via a standard reporting format that allowed the designers to incorporate their response in the design report for the next issue of the respective package.

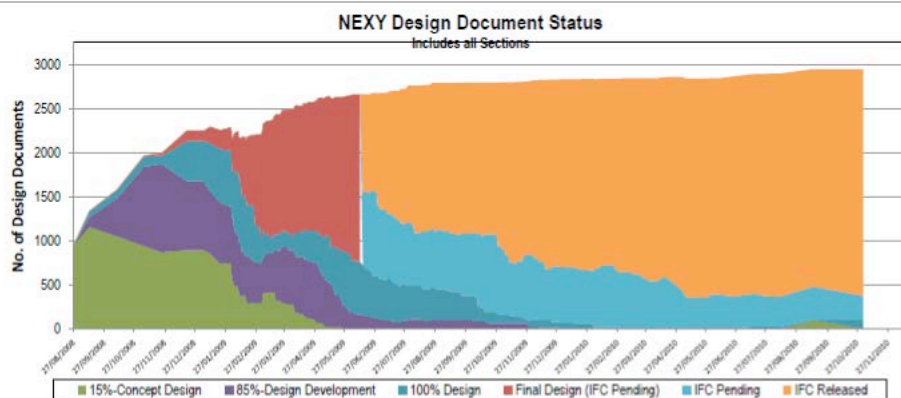


Figure 6. Graphical representation of the NEXY Design Document status

Client and verifier reviews – All design packages were provided for review to the client and independent verifier personnel at each stage of the design development. These client and independent verifier personnel reviews were tracked via Incite and reported back to the designers via a consolidated reporting format that allowed the designers to incorporate their response in the design report for the next issue of the respective package.

Once the design lot had successfully completed its development and review, the design lot Hold Point was released as 'Issue for Construction'. This step required a completed design report describing all design documents to be prepared and incorporated the independent and proof engineering certificate as well as agreed close out of all independent verifier comments.

Some 1,500 contractor and independent verifier reviews and 250 hold point release notifications were tracked via Incite.

3.4.2. Construction

Construction program

The construction program tracked all design construction lots required for the project according to the predetermined packages. The design program was tailored to meet construction priorities, according to the project construction program, as well as considering the required design approval process managed through INCITE. The construction program and the design program were synchronised on a monthly basis to ensure that the design program priorities were adjusted to suit construction priorities. It was very much a case of construction driving the design process to achieve the aggressive program schedule. In

cases where Issued for Construction (IFC) drawings were delayed or potentially going to delay particular construction activities, the joint venture Project Manager would discuss the opportunity and risk associated with proceeding with DTEI before making a decision. Such decisions were assessed on a case-by-case basis and were particularly important with lower layers of earthworks. The risk on proceeding with high embankment fills without IFC drawings was considered an acceptable risk to the project and agreement was generally reached on proceeding in these situations.

Construction support

Construction support services were provided by the designer to address requests for information and to clarify the design or seek input to proposed changes to the design. The designer was also requested to review suggested dispositions or resolve non conformances arising during construction.

A formal construction stage services process was established in Incite with workflows to distribute Request for Information (RFI) and Non Conformance (NCR) documents and to receive traceable designer comments and verifier approvals across all construction issues.

The workflows provided management control and allowed for the reporting of interactions between construction and design. Most importantly the workflows provided a fully traceable and consolidated record including all collated data of all requests and subsequent approvals.

Construction RFIs (Request for Information) - Some 300 requests for information were sent to the designers and the outcomes tracked via Incite. The RFI's included all supporting information to allow prompt assessments to be made.

Overall some 300 RFI's and 800 construction NCR's were sent to the designers and the outcomes tracked via Incite.



3.5. OH&S leadership and management

“One of the promises we made to DTEI was that we were going to implement safety procedures that lifted the standard in South Australia and set a benchmark for all future projects that are done here in terms of safety,”

Kane Kowalczuk
Safety Manager

From the outset it was an objective of the joint venture to create a culture on NEXY where safety was the number one priority. The joint venture, along with DTEI established key performance indicators to monitor and improve safety performance throughout the project, these were Zero Harm, creating a one team culture where everyone takes responsibility for safety and to lead the industry in continuous improvement.

Key to this was the role of management in leading by example and driving the safety message. This was achieved by creating a culture that was clearly focused on lead indicators, not the traditional lag indicator process.

To stay on the front foot, management lead by example through a number of initiatives. These included creating a safety culture, Safe Act Audits; investing in training and development of staff; creating an environment where new ideas were encouraged, and where possible, incorporated into safety systems and processes.

3.5.1. Safety culture

Safety was not a second thought on NEXY, it was at the front of mind for all people involved in the project, regardless of your role.

The safety culture for this new virtual organisation was not created instantaneously; it was the result of ongoing commitment and determination of senior management, which cascading through the entire project team.

In addition to monitoring the culture of the team in terms of safety behaviours, regular wellbeing and high performance team surveys were also conducted with the aim of creating a one-team environment. The joint venture, wanted to create an environment where people enjoyed going to work and this was evidenced by our extremely low unplanned turnover figures – less than 2 percent.



“My role as a Safety Officer meant that employees would usually contact me in the first instance when concerns for safety were identified. I would then attend the site, consider the issue via risk assessment and then consult with Supervisors to ensure the issues were rectified.

One such instance was during the construction of the Taylors Rd southern bridge abutment. A truck driver and an OHS Rep called me refusing to continue to dump fill in a particular location because the track that the trucks had to drive onto was elevated and too narrow and they felt that there was a high risk of truck rollover. I attended the site and got into the truck with that driver so that I could see from his point of view what the issues were. Having discussed the issue with the Supervisor, it was agreed by all parties that work could continue if the track was widened and compacted. A dozer and grader were brought in to achieve this and the trucks then continued tipping at this location.

This is just one example of many that occurred on the project where workers highlighted safety concerns due to our strong culture.”

Amber Dinevski

Safety Officer

3.5.2. Safe Act Audits

Safe Act Audits were used as a compass to indicate the trend of safety behavioural and enabled the joint venture to identify when attention to safety is dropping off. The joint venture could then take corrective measures to reduce the potential for incidents and reinforce the safety culture.

All managers and engineering staff were required to lead Safe Act Audits by completing a minimum of one each week. The audit process was kept simple, and designed to be random and spontaneous. This allowed the true safety culture to be assessed.

Any observed unsafe acts are rated according to severity and the audit is then scored as a percentage of the workforce displaying safe behaviours.

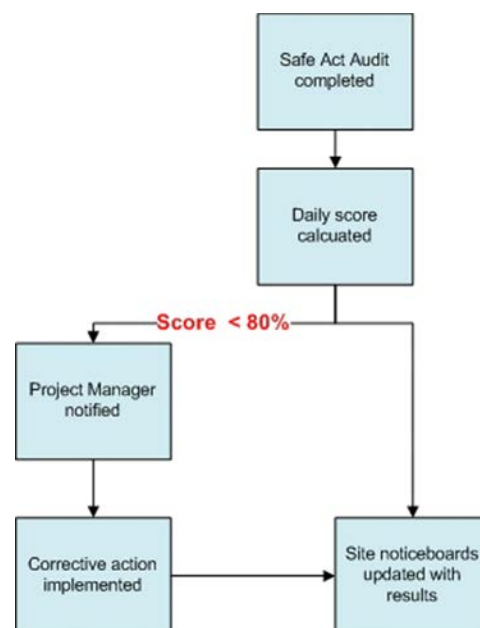


Figure 7. A simple process to identify when attention to safety is dropping off.

A drop in the index score is an indicator of a dangerous climate and requires immediate action (such as a toolbox meeting) to elicit a heightened safety focus within the workforce. The audit results in figure 8 show a decline in the rating scores immediately preceding an injury (red line) occurring. Where a decline

is shown with no subsequent injury line indicates that corrective action has been taken in time to prevent an incident occurring.

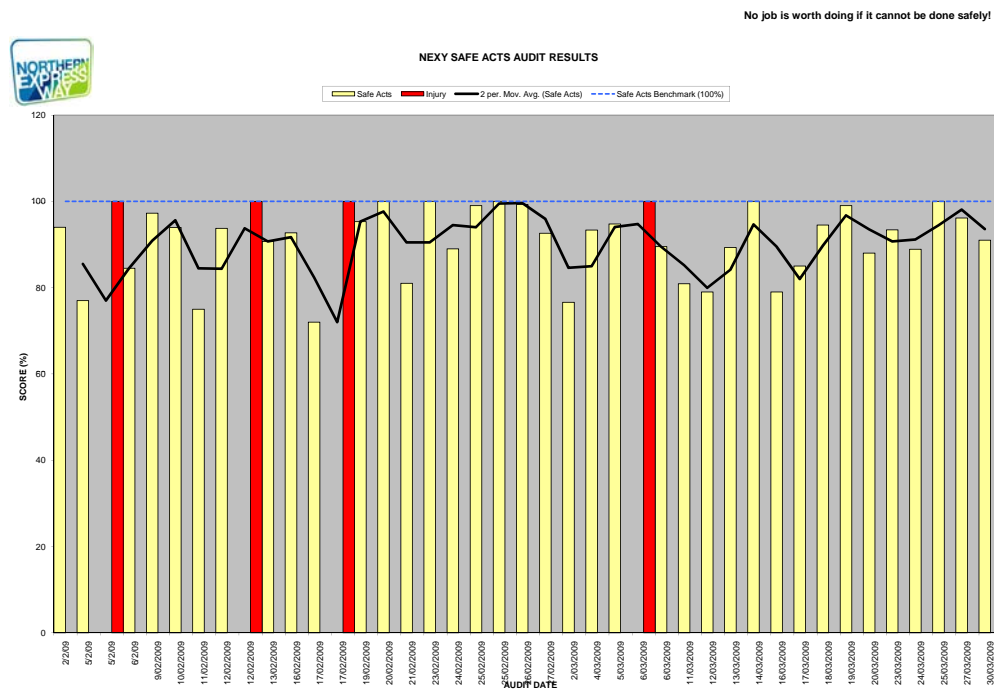


Figure 8. The results of the NEXY Safe Act Audits.

3.5.3 Safety training

During the NEXY project, a major transition occurred in the construction industry with the introduction of the National Construction Industry Induction scheme (White card).

Prior to 1 July 2009, different states had varying OH&S training requirements that any person doing construction work needed to complete prior to stepping onsite. To ensure that the NEXY was not delayed or impacted by these changes, a proactive approach to up-skilling workers was implemented and allowed all workers to transition over to the new requirements without delay.

In addition, to meet all statutory and contractual OH&S requirements, other training provided on NEXY included:

- OH&S for Supervisors
- Spotter training
- Crane awareness
- OH&S Representatives
- Manual Handling
- Earthmoving Tickets (Dozer, EWP's, Rollers, Scrappers, Dump Trucks, Excavators)
- Heat stress training
- Noise awareness
- Fire Wardens
- Fire Permits(CFS)
- Working at Heights
- Heavy Vehicle Driver Fatigue

3.5.4. Safety management systems

During the tender period the joint venture decided that the Fulton Hogan safety management system was best for project and was consequently adopted for NEXY. This required extensive training of all parties to engender awareness and compliance of the system requirements.

To ensure all hazards were identified and addressed with high level control measures the safety system included:

- inspections
- JSEAs
- work procedures reinforced with daily pre-start meetings- over 14,000 held over the duration of the project
- regular tool box meetings
- safety database
- audits
- 'Stop for Safety' preventative toolbox sessions

Management leadership of safety translated to real gains for the project in terms of safety outcomes. The system became more than words, it became part of the way the whole project team operated. For example, excavator operator would always stop work and wait for an excavation permit to be issued. They knew the system!

3.5.5. Safety database

A key performance indicator set by the joint venture and DTEI was for the NEXY project to lead the industry in continuous safety improvement. To ensure this continuous improvement, the joint venture elected to capture all safety data in a common safety database.

The NEXY safety database was invaluable tool in managing the large volume of data generated on a project of this size. It allowed for the timely tracking of inductions, pre-start data and JSEA signatories. It also served as the basis for the production of statistics such as manhours, inspections carried out and incident recording and tracking.

3.6. Environment leadership and management

As the largest infrastructure project in South Australia in 50 years, the joint venture and DTEI were fully committed to creating new benchmarks in all areas of the NEXY project, including environmental management.

As part of this, the joint venture provided an experienced full time Environmental Management Representative to be onsite for the duration of the project. The full-time availability of the joint venture's Environmental Management Representative and the consistent and dedicated collaboration with DTEI's own environmental representative facilitated a consistent environmental performance and a trusting and mutually productive relationship.



3.6.1. Training and awareness

Key staff members including site supervisors, foremen and engineers were put through several levels of environmental training throughout the project. Initially site staff attended the DTEI prescribed 'Environmental Awareness for Civil Construction (EACC) training course that outlined the basics of environmental management in earthworks and has a strong South Australian focus, covering relevant South Australian legislation, policies and operating procedures.

Following the first round of this training, it became apparent that many of the staff who attended the training were already aware of their environmental responsibilities, and practicing the course contents in the field. The joint venture's internal 'Working Green' training was later conducted, and was tailored to cover areas not included in the EACC course. The 'Working Green' training also provided more information on areas nominated by site supervisors as those that they lacked knowledge or experience in.

Environmental issues were also regularly covered at toolbox meetings and this provided an opportunity for the entire workforce to be reminded about their environmental obligations.

In addition, the Environmental Management Representative contributed to every JSEA by highlighting the key environmental aspects for each work task. The result was a workforce aware of its environmental obligations, and supervisors who knew what they should be doing, and, when they didn't know, who they should ask.

3.6.2. Landscaping

The landscaping contractor, Ecodynamics, was involved in all stages of the landscaping process from design through to installation and maintenance.

Their experienced supervisor had an office and nursery - seed orchard - set up adjacent to site, making

Ecodynamics more accessible to DTEI and providing the opportunity for onsite and design issues to be resolved quickly. Ecodynamics proximity to site also allowed a close interface with the joint venture supervisors, allowing them to receive their site preparation requirements in a timely fashion. Another benefit of Ecodynamics close proximity to site was it enabled them to engage with the local community - workshops and tree planting days were run with local schools and theseed orchard formed part of site tours.

3.6.3. Wetlands

Developed with the support of South Australian Department of Water, Land and Biodiversity Conservation, the Gawler River wetlands were a major environmental and landscaping achievement, combining flood mitigation with onsite vegetation offset. In total, 10 hectares of red-gum woodland has been created in an area that had been previously stripped by intensive agriculture and all that remained was a linear habitat alongside the Gawler River.

This will, over time, convert an otherwise unused parcel of agricultural land into valuable red-gum woodland habitat.

As part of the establishment of the red-gum woodland adjacent to the Gawler River, a 'Meeting Place' (camp site/cultural educational area) was to be constructed for the Kaurna Aboriginal community – the traditional owners of the land the Expressway was built on. Extensive design development took place in consultation with the Kaurna community to ensure the site met their requirements. The location earmarked for this Meeting Place was identified during pre-construction heritage surveys as a site of significance. This parcel of land, abutting the newly-established red-gum woodland, was to be purchased from the landholder for the purpose of constructing the 'Meeting Place' however the construction did not go forward due to lack of timely agreement on property acquisition issues.

3.7. IR leadership and management

South Australia is a 'quiet' state from an industrial relations viewpoint but still attracted interest from unions particularly with the large workforce onsite. No industrial disputes occurred on the project and no time was lost due to industrial relation matters.

From the beginning all subcontracts included requirements for subcontractors to understand and abide by the Code of Compliance required for federally funded projects. For many of the local subcontractors, and some of the engineering staff, this was unfamiliar.

The joint venture spent considerable time in assisting the subcontractors through the process, as well as training staff in right of entry requirements. During the course of the project union representatives visited the site on 12 occasions to hold discussions with members and prospective members. All visits to site were carried out in accordance with the right of entry requirements.

Australian Building Construction Commission audits were completed on both joint venture partners, Fulton Hogan and York Civil which also included a number of subcontractors working on the project.

The joint venture, in consultation with DTEI, decided early in the project to adopt a five day (50 hour) working week as a general rule.

By giving our people two full-consecutive days each weekend, instead of the industry standard of 1¹/₂ consecutive days off, was seen as a positive way to attract personnel to the project and to foster a culture of 'people wanting to work'. Compared to other projects undertaken by the joint venture parties, productivity improved under the five day working week and the project never fell behind schedule. Other initiatives adopted on NEXY included:

- Provision of water and ice on a daily basis to all work sites
- Managing activities/personnel likely to be effected by heat
- Controlling site activities to minimise dust on hot windy days including stopping work where necessary
- Random alcohol and drug testing (office as well as field personnel)
- Annual health checks and nutrition tips on display at all sites.



3.8. Leadership in innovative construction techniques

3.8.1. Leading specification change

Never happy with the status-quo the joint venture sought to challenge conventional ideas to ensure best for project outcomes were achieved. The collaborative relationships between parties enabled fruitful discussion on many standard specification clauses, resulting in significant changes to specifications, culminating in the construction of the smoothest road in Australia.

Asphalt

With significant technical knowledge on asphalt pavement design the joint venture challenged the norm. The trust developed between parties and alignment of common goals saw a number of deviations from the specifications. These included:

- asphalt was placed to thickness instead of levels. This approach has never been undertaken in Australia before.

- non-standard mixes including the utilisation of A15E binder in the Stone Mastic Asphalt and up to 7% of waste kiln dust that was sourced from Adelaide Brighton
- altering the maximum stone size from 26.5mm to 190mm to reduce air voids which had the potential to result in the ingress of water into the pavement.

Further details on these changes to specification can be found in Section 3.2.2.



3.9. Training and development initiatives

An ongoing focus for the joint venture was training and developing its workforce. This included:

- high performance team training
- project induction
- safety induction
- ongoing skill specific training
- first Aid
- recognition of prior learning and subsequent accreditation for those highly experienced workers without formal certification
- up-skilling
- graduate placement
- work experience placement

In the period August 2008 to June 2010, 1326 individuals were involved in training, with an average of 640 training days per month and 5,010 training hours per month during the project. Ensuring the development of skills through ongoing training and up-skilling benefitted both the project and the individual workers, helping to ensure a skilled, effective and productive workforce.

3.9.1. Mentoring approach

In addition to formal training and development, younger staff were assisted and mentored by supervisors and managers. A particular success was the mentoring undertaken by an Indigenous employee specifically for other Indigenous employees, particularly in the field. This Indigenous Liaison Officer also provided cultural-specific advice to the joint venture as required, ensuring that any cultural sensitivities were recognised and understood.

3.9.2. Youth and Indigenous

As part of an initiative to provide local employment for young people and Indigenous people, the NEXY project was particularly successful, consistently exceeding the designated 10% employment target for these groups. This was a result of engagement with local training providers and employment brokers, particularly those which had successfully worked with Indigenous people.

Over the life of the project, young people and Indigenous people provided an average of 13% of the total manhours worked on the project. As a result of NEXY's success in meeting these employment targets, a target of 15% employment for young people and Indigenous people has been set for future State Government infrastructure projects so that employment benefits continue to be focused on these particular target groups.

3.9.3. DTEI graduates

DTEI graduates were seconded to Fulton Hogan as part of the NEXY project, offering them an unprecedented opportunity to hone their study with practical experience in the largest civil infrastructure project in South Australia for decades. Working with experience senior engineers and project teams, the DTEI graduates have significantly embellished their future career opportunities within the civil infrastructure industry and given them first hand experience of the numerous technical , commercial and relationship challenges that a contractor must deal with in completing such a project.