

# ACAA Awards Submission Stage 2 Technical Document

The Newcastle  
Light Rail project

February 2020



Newcastle Light Rail

## Scope of work

The NLR project was part of the Revitalise Newcastle program initiated by the NSW Government. Revitalising Newcastle is a \$510 million-dollar infrastructure program focused on transforming Newcastle's city centre by strengthening connections between the city and waterfront and delivering attractive public spaces with accessible transport, including a light rail commuter option.

Downer EDI Works achieved the successful on-time delivery of the NLR and the wider road network upgrades, providing a frequent and reliable travel option throughout the city centre, a greater connection of key activity precincts, reinvigorated city streets and assisting urban renewal opportunities.

Key project features:

- The NLR is the first full catenary-free (wire-free) system in the southern hemisphere
- Housing an on-board energy storage system with rapid charge systems at each of the light rail stops
- NLR is 2.7km in length, running from the Newcastle Interchange at Wickham to Newcastle Beach
- The NLR follows the old rail corridor for approximately one-third of the route before moving onto Hunter and Scott Streets
- Removal of the existing rail infrastructure (track, overhead wiring and structures) and full site remediation of the former rail corridor
- Six stops located at Newcastle Interchange, Honeysuckle (near Hunter Street TAFE), Civic, Crown Street, Queens Wharf and Newcastle Beach
- A light rail vehicle maintenance facility.

### Wider road upgrades

Downer worked closely with Transport for NSW (TfNSW), Newcastle City Council and Main Roads and Maritime Services to deliver a number of traffic improvements along and around the light rail route. These intersection/road upgrades were designed to improve traffic flows through the city centre with the introduction of light rail.

The project included the reconfiguration of 11 key intersections, upgrades to surrounding roads, and changes to inner city bus and parking arrangements to allow traffic to move more efficiently on the completion of the light rail. The road upgrades were located within the existing road corridors surrounding Stewart Avenue, Hannell Street, Parry Street, Hunter Street, King Street, Steel Street and Darby Street, and involved detailed planning and complex traffic management.

### Newcastle Light Rail track

The innovative NLR helps to reduce city centre congestion and provides a frequent, reliable and comfortable travel option through the city centre.

NLR is 2.7 kilometres of light rail track from the new transport interchange at Wickham to Pacific Park. There are six stops along the way, starting at the transport interchange, Honeysuckle (near Hunter Street TAFE), Civic, Crown Street, Market Street and Pacific Park. The project also includes a stabling and maintenance facility, road works and associated precinct works and all systems required to operate and maintain the light rail network.



## Newcastle Light Rail Network



The NLR route has three types of alignment configuration, including:

- Segregated track—typically throughout the existing heavy rail corridor
- Separated track—typically along Hunter Street, where general road traffic only enter the Light Rail Vehicle (LRV) transit space when their route ahead is blocked
- Mixed track—typically along Scott Street, where the LRV and road vehicles share the east and west bound lanes, due to limitations in existing road width.

## Project background

In December 2012, the NSW Government announced the Newcastle Urban Renewal Strategy, a 25-year plan to revitalise Newcastle by 2036. To achieve this goal the Newcastle Urban Transformation and Transport Program (NUTTP) was developed, consisting of a combined urban revitalisation and integrated transport improvement program.

In December 2013, the NSW Government announced the truncation of the Newcastle Line at Wickham, west of Stewart Avenue. Additionally, as part of the 2013/2014 budget, the introduction of light rail to the Newcastle city centre between Wickham and Newcastle Beach was announced, to be aligned with the planned truncation of the heavy rail line at Wickham Interchange.

On December 26, 2014 the heavy rail line was truncated at Hamilton to allow construction of the Newcastle Interchange. The construction of a fully-accessible transport interchange enables customers to easily connect with trains, light rail, buses, taxis and cars.

In April 2016, the Review of Environmental Factors (REF) went on public display and the community was invited to have its say on the NLR project.

In August 2016, TfNSW released the Submissions Report responding to community and stakeholder feedback on the REF, and its formal determination that the NLR project will proceed.

## General features of works

### 1. Complex staging of construction works

The NLR construction works were broken down into specific areas to optimise the program and staging, taking into consideration:

- Specific traffic conditions and the overall Newcastle traffic management strategy (23 road intersections across the entire length of the project)
- Minimising disruption to the community and local businesses
- Relocation of underground utility assets
- Other underground items such as heritage sandstone blocks and decommissioned utility assets (i.e. old fuel pipeline and tanks)
- Time optimisation and cost minimisation
- Light rail dynamic testing and commissioning requirements.

Due to the location in the Newcastle CBD, a critical part of construction works was in minimising disruption to traffic, the local community and businesses. To manage this, Downer produced Traffic Management Plans (TMPs) that covered intermittent stops, full road closures, general traffic control and pedestrian management.

The TMPs included provision for the safe movement of vehicle and pedestrian traffic, protection of workers from passing traffic, access to properties located within the limits of the worksite, traffic controllers and traffic control measures, installation of temporary signs and safety barriers as required. The TMPs also considered all the required construction activities and the safe dynamic testing and commissioning of the NLR infrastructure and rollingstock.

### 2. Earthworks

Key earthworks activities included:

- Utility trenches (i.e. water, communications, drainage, combined services routes and smart pole conduits)
- Footing excavations for traffic control signal (TCS) posts, smart poles, overhead lines and the depot substation
- Excavation and placement of the trackform, which is the structural concrete slab that houses the light rail system
- Deep sewer excavations
- Other utility excavations (water, gas, communications, drainage, electrical and smart pole conduits)
- Excavation for intersection roadworks.



*Trackform excavation in the Newcastle CBD undertaken as part of the works*

### 3. Aggressive unsuitable materials including acid sulphate soils

Downer developed and implemented a detailed process for dealing with contaminants such as Acid Sulphate Soils, which was outlined in the project's Soil and Water Management Plan. As expected, Potential Acid Sulphate Soils (PASS) were encountered during an excavation for the deep sewer works. This was alerted to the Environmental Advisor after encountering a sulphurous odour. The Unexpected Finds protocol was followed by the workers onsite and an exclusion zone was established. The Environmental Advisor and TfNSW were immediately notified and the material was placed on black plastic and covered with lime.

Lime was also added to the stockpiled material (in line with required liming rates) and it was kept wet to prevent oxidation. The material was analysed, classified and then disposed of at an appropriately licensed facility. This resulted in no oxidation or contamination and the material was managed in full compliance with legal requirements and best practice.

The discovery and removal of 78,726 tonnes of contaminated materials, including coal tar were encountered during road excavation. Downer developed a process for this (in line with RMS Technical Direction - Coal Tar), which was incorporated into the Soil and Water Management Plan, and engaged contamination consultants to analyse material and provide classifications. Given the extent of the material found, discussions were held with the EPA following sampling and it was agreed that much of the waste material could be classified as General Solid Waste as it was a) not leachable and b) embedded within a solid/cohesive matrix of road materials. This enabled an exemption which achieved several million dollars of additional offsite disposal savings.

Other coal tar asphalts encountered, which did not meet this criteria, were also disposed of at an appropriately licensed facility in full compliance with legislation. During excavation, air monitoring was undertaken on several occasions to ensure there was no risk to workers or the public, and on occasions, areas which emitted odour were covered with geofab and wet down (particularly on hot days).

There were a large and diverse range of contaminants and hazardous materials including asbestos (both expected and unexpected) that were all dealt with sustainably, legally and in a cost-effective manner with minimal onsite laydown areas. Early planning and effective management by the environmental team meant environmental risks and delays were mitigated and the Project was delivered on time and on budget.

### 4. Pavement

The pavement works included complete resurfacing works on all 23 intersections throughout the Newcastle city centre. The pavement profile (and materials) varied throughout the project, and included:

- Most commonly the profile for road pavement consisted of a subgrade, Select Material Zone (SMZ) or stabilised sand or DGB20, AC20 and AC14
- Track edge beams and track concrete infills consisted of lean mix or DGB, stabilised sand and reinforced concrete
- Footpath paving predominantly comprised of a subgrade, crushed rock base, reinforced concrete, grout bedding, and 40mm or 60mm bluestone pavers
- The Depot stabling yard's concrete base (EW001 only) comprised of a subgrade, DGB20, and reinforced concrete.

The pavement types applied for the project catered for the following scenarios:

- Re-surfacing of the existing pavement due to new pavement marking and kerb/widening works
- New full depth pavement construction for the areas where carriageway widening will be required
- Reconstruction of the existing pavement driven by vertical alignment changes or current performance of the existing pavement structure.



## Heavy duty asphalt pavements and large-scale concrete pavements

In areas of full pavement reconstruction, a full-depth asphalt pavement was applied. Rigid (concrete) road pavements were included within the 'shared running' areas along Hunter and Scott Streets, where vehicular traffic and the light rail operate within the same lanes. The lean-mix concrete subbase under the track slab extends underneath the new concrete base within the road cross section. Joints have been detailed and provided to be consistent with a mesh reinforced Plain Concrete Pavement (PCP-R) to RMS standards. It is also noted a section of track form and pavement crosses the alignment of the V8 super cars race track where both the track and pavement types needed to be constructed to strict tolerances and grades.



*Full-depth asphalt pavement adjacent to the light rail track*

## Drainage

The drainage scope included:

- Flood modelling and site investigations (i.e. CCTV & survey)
- Drainage design development in accordance with relevant standards
- Drainage construction including:
  - New proposed drainage
  - Relocation, augmentation or replacement of existing drainage
  - Remediation of exiting drainage assets
- Drainage testing and commissioning.

The road alignment design aimed, where possible, to minimise changes to kerb locations, drainage sub-catchment areas and cross falls. In the majority of locations, the impervious area did not increase, ensuring runoff volumes remained unchanged. Slight increases in runoff volumes occurred in localised areas where the road design resulted in minor changes to the drainage catchments.

Where the project works had little or no impact on the existing hydraulic regime, the design approach adopted was to retain the existing drainage infrastructure. Where kerb lines moved slightly, existing pits were modified to align to the new kerb line. Where the kerb line moved or the drainage catchment increased significantly, a new pit was added to the existing drainage line or a new pit and pipe network was added to connect to the existing system.

The proposed drainage was designed to connect into the existing network without attenuation, given that the increase in catchment area was minor relative to the total network catchment area.

It is noted that several old stone drainage culverts were discovered crossing the project alignment at a shallow level. Multiple culverts had to be reconstructed and protected due to the condition of the asset or its vertical alignment relative to the NLR infrastructure requirements.

### Arrangements for urban works

Installation of new required drainage assets and drainage upgrades took place throughout the majority of the urban intersections along the light rail alignment and also within the wider road network. Different hydraulic approaches were taken to identify drainage issues within certain intersections.

Drainage excavation and installation works were undertaken spanning more than 1.5km in length up Hunter and Scott Streets within the Newcastle CBD. In addition to the new and relocated drainage, specific rehabilitation or remediation works were undertaken on heritage-listed stormwater drainage culvers within several intersections.

## Miscellaneous

### Simple ITS arrangements

A simple ITS arrangement can be seen within the Pedestrian Countdown Timer (PCT) system situated at the Newcastle Interchange, which acts solely as a timer for the Tram Driver to commence movement through the Stewart Avenue intersection.

When the Tram is positioned over a balise, this omits a signal to the Traffic Control System (TCS), requesting a phase. When in phase, the timer (in view of the driver) will countdown to zero. A white “T” will then appear, indicating to the driver to commence movement.



## Permanent variable message signs and complex ITS arrangements

Permanent Variable Message Systems (VMS) are present at each of the stops in the form of Passenger Information Displays (PID). The PIDs are mounted at each stop and provide real-time information regarding tram positioning or cancellations. The real-time information is provided to the PID via a complex ITS system known as an Advanced Detection System (ADS). The ADS functions each time the LRV is detected on the balise. The balise provides the LRV position, advance-warning and operation of the Depot entry and exit points. Balises are located at various intersections, stops, and at the NLR Depot.

## Traffic management

### Complex staged traffic management in an urban environment

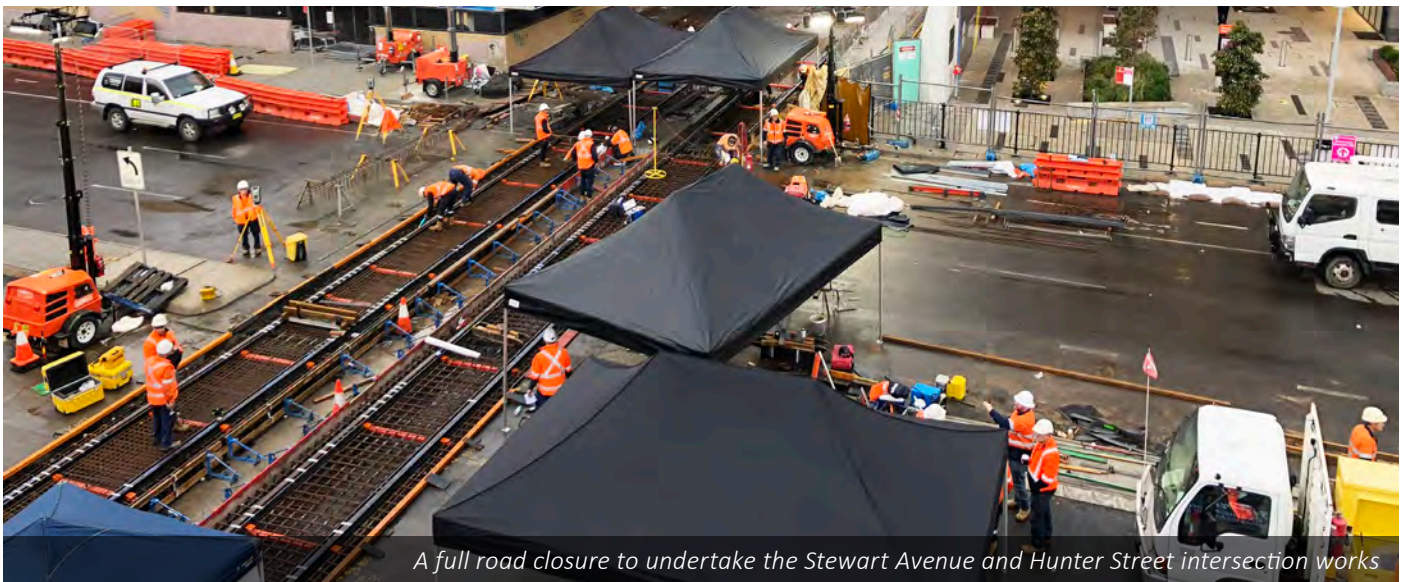
Complex traffic management staging was required during construction of the project in general, to maintain a minimum of three north/south connections at all times, however a particularly complex stage included the upgrade of King Street and Union Street in late 2018. The Traffic Control Plan (TCP) was implemented in four stages. In each stage, right turn lanes were closed, buses were diverted and pedestrians were shifted to opposing medians. Disruptions to the public, businesses and public transport were necessary across both night and day.

In addition to these works, traffic management staging was implemented at the adjacent intersection of King Street and Steel Street. Both were managed concurrently to minimise the impacts of disruption.

The staging proved to be a success given the positive and responsive nature of the public and vehicles. TCPs were applied correctly, local traffic control were receptive, and traffic flowed efficiently given the extent of changed traffic conditions.

Works were undertaken at the Stewart Avenue and Hunter Street intersection (refer below) along a major RMS road and one of Newcastle's busiest intersections, involving:

- Building demolition
- Construction of a wind wall with a large mural painting
- Installation of Smart Poles and TCS poles
- Major utility relocations (water, gas, electrical and communications including the construction of three manholes)
- Drainage upgrades
- Milling and re-sheeting of the intersection and the construction of a new slip lane
- Soft and hard landscaping.



*A full road closure to undertake the Stewart Avenue and Hunter Street intersection works*



## Multiple alignment changes

At the intersection of Honeysuckle Drive and Hannell Street, various line-marking stages took place over the course of six months, which saw the vehicle alignment adjusted multiple times.

Initially, the northbound lanes consisted of two through lanes and one right turn lane into Honeysuckle Drive. The next stage saw the introduction of a bus stop on a western-most northbound lane (originally a bike lane), which provided an alternate means of public transport. This resulted in an additional, temporary straight through lane.

Following the closure of the bus stop, the entire line-marking arrangement and lane alignments were re-marked permanently from Hunter Street to Honeysuckle Drive, which saw the introduction of an additional right turn lane, resulting in two straight through and two right turn lanes.

## Services

### Complex service relocations

Downer managed critical above ground and underground utility service relocations to enable the construction of both light rail specific infrastructure and wider road network works. This staged works was complex in itself and required close coordination and multiple approvals with 15 separate asset owners to integrate the service works with the main works.



*Identification and relocation of multiple utility services at Worth Place*



*Micro-tunnelling works and deep sewer relocation at Hunter Street*

## Key statistics:

**Identified more than 2,500 clashes of proposed NLR fixed infrastructure with both above ground and underground utility services, including:**

- Water
- Sewer
- Gas
- Electrical (low voltage and high voltage)
- Communications
- Stormwater drainage.

**Stakeholder management – more than 15 different utility asset owners, including:**

- Ausgrid
- Hunter Water Corporation
- Jemena
- Telstra
- Optus
- NBNCo
- Newcastle City Council
- RMS
- TPG
- Vocus.

## Approximately 200 utility relocations and adjustments

**Three different deep sewer main relocations consisting of:**

- Major relocations under two of the most important roads in the Newcastle CBD— Hunter and Scott Streets
- Existing 225mm VCP (vitrified clay pipe)
- Approximately 1,200m of relocated sewer main including the three packages
- Micro-tunnelling of approximately 600m
- Excavation over 6m in depth in some instances by means of sheet piles and shoring boxes
- Groundwater extraction from excavations and treatment in terms of PH, suspended solids and heavy metals
- Settlement surveying and modelling, dilapidation monitoring, vibration monitoring.

**Worth Place—most congested road and light rail alignment intersection. Relocation of the following utility assets:**

- High voltage cables (11kV) (Ausgrid)
- Low voltage cables (Ausgrid)
- Street lighting (Ausgrid & Newcastle City Council)
- Three medium pressure gas mains (Jemena)
- Two reticulation water mains (Hunter Water Corporation)
- One distribution water main (DN375mm) (Hunter Water Corporation)
- Multiple communication assets including relocation of fibre optic and main copper cables (Telstra, NBNCo, Optus, Vocus, TPG, AAPT).



## Multiple staging of coordination of utility services

Downer's dedicated in-house utility team worked with all asset owners on the critical timing and management of utility adjustments and protection. An example of multiple utility service relocations and coordination with several utility asset owners is at the intersection of Worth Place and Hunter Street in the heart of Newcastle. Multiple construction stages were required for utility service relocation and adjustment works. While this is the most complex example, this was also required in a number of other key Newcastle road intersections.

Utility works included the relocation of water (DN150 main), gas (210kPa & 30kPa), multiple communications cables (copper and fibre) from different asset owners, drainage and electricity cables (both high and low voltage). These works were also coordinated together with the required installation of the light rail specific Combined Services Route (conduits containing communications and low voltage cables), Traction Power (conduits containing low voltage cables), Newcastle City Council (NCC) smart infrastructure (including pits, conduits, footings, cables, electrical cabinets and required electrical connections) and TCS infrastructure (which includes pits, conduits, post footings and cabinets). It is also noted many of the existing utilities had become entangled in tree roots, taking up to a week to fully remove the roots at the worst locations.

As the utility services spanned each of the three crossings in the intersection, coordination of each service relocation was paramount to maintain construction access throughout the worksite. For example, the first stage of the relocations involved excavation across Worth Place (beneath the proposed NLR track). Conduits were installed, cutovers were complete, and backfilling occurred. Access via Worth Place was then made possible prior to commencing utility relocation works within the adjacent crossings.

## Subcontractors/consultants

Downer managed significant subcontracting, including complex consultant and design teams. The key subcontractors and consultants, with the scope of their works, are detailed below:

### **Robson Civil Projects Pty Ltd**

Scope: Civil works

### **North Construction & Building**

Scope: Construction of the depot facility and stops

### **Daracon Contractors Pty Ltd**

Scope: The Wider Road Network

### **4Tel**

Scope: Communications, Signalling & Controls

### **Drumderg Demolition**

Scope: Demolition works

### **Rhomberg Rail Australia**

Scope: Rail & Trackform

### **B&K Revegetation & Landscaping**

Scope: Soft landscaping works

### **Laing O'Rourke Australia Pty Ltd**

Scope: Overhead wiring



*The newly completed NLR has transformed the Newcastle CBD*

**Wilkinson Murray Pty Ltd**

Scope: Noise and vibration monitoring

**RPS Group**

Scope: Flora and fauna support services

**Monteath & Powys Pty Ltd**

Scope: Survey support

**Edge Environmental**

Scope: ISCA consultancy

**ERM Services Pty Ltd**

Scope: Contamination services

**EMC Services**

Scope: Electromagnetic field testing works

**Valley Civilab Pty Ltd**

Scope: Geotechnical services

## Stakeholder/project management

### Complex design management

Downer performed complex design management duties as part of Revitalising Newcastle. The design was carried out by a joint venture (JV) between WSP/Parsons Brinckerhoff and Aurecon (referred to as the Professional Services Contractor, or PSC), which itself engaged subconsultants for specialist design activities such as architecture, urban design, arborists works and site field investigations and surveying.

The design JV ramped up to more than 100 designers and engineers at its peak, with work being performed in multiple satellite offices located in Newcastle, Sydney and Brisbane. The design JV was structured into the 21 different design disciplines required to complete the NLR project.

Downer's team managed the design JV by engaging directly with the design managers and subconsultants. Design management extended to regular reviews of the design at each of the four design submission stages, reporting and assessment of design cost, program, resourcing and milestone management. In addition to the technical challenges, a huge focus was required in stakeholder and scope management with over 3,000 comments received through the design review process including many project stakeholders.

The NLR design needed to be coordinated with CAF, the supplier of the light rail vehicle. The NLR traction power supply system design (catenary-free) had a significant impact on the design of the LRV. Similarly, the design of the LRV traction power system in response to the catenary-free design introduced key design criteria for the fixed infrastructure to meet, for the system to operate safely and reliably. To minimise the overall cost of the charging system, the team developed a control system not used anywhere else in the world to limit the worst case charging occurrences while maintaining operational requirements and in turn reduce the overall volume of cables required within the ground by circa \$3 million. The innovative control system was installed, tested and commissioned successfully by the team.

The integrated system representing the light rail fleet and fixed infrastructure also had to comply with timetabling and operational constraints required by the light rail operator Keolis-Downer Hunter. CAF were based in Spain, creating a number of language barriers to be resolved, and the design management process included the TfNSW management team responsible for the delivery of the light rail fleet.

The design of the fixed infrastructure for NLR was also coordinated with numerous external stakeholders including Hunter Development Corporation, Roads and Maritime Services and Newcastle City Council. According to TfNSW protocol, the design for NLR was issued to these stakeholders for their review and comment. The design review process on NLR generated a total of 2,300 design comments, which were successfully closed out with these stakeholders.



Design management on NLR extended into the construction phase through technical RFI negotiation and resolution between the various stakeholders and the design JV. This was seen as a particular risk and challenge for the project and to mitigate the concerns a hand-picked team of designers were established onsite for the duration of the construction works.

#### Key statistics:

- 1,300 technical RFIs
- 1,600 AFC drawings
- 3,200 stakeholder comments addressed
- 250 post AFC design changes successfully managed and constructed.



#### More complex community and stakeholder interfaces

Downer's proactive approach to community engagement and implementation of effective, consultative and collaborative stakeholder strategies was key to the successful delivery of the NLR project.

Located within the heart of the Newcastle CBD, the project dealt with a wide range of stakeholders including Newcastle City Council, TfNSW, Office of Environment and Heritage, State and Federal Government MPs, Roads and Maritime Services, Hunter Development Corporation, more than 15 utility asset owners and 10 registered Aboriginal Land Councils. The project also directly engaged more than 2,700 businesses and residents along the alignment to highlight project benefits and promote awareness about upcoming construction activities. At peak construction the communications team issued 14,000 notifications per month.

All key stakeholders and interfaces were identified in the Community Liaison Management Plan (CLMP), which listed communications and engagement tools to be adopted throughout the project, highlighted potential risks and opportunities, and identified mitigation measures to be employed to reduce key risks.

The CLMP adopted a 'no surprises' approach, which aimed to engage the community and stakeholders early and regularly throughout the project, and implement issues-specific strategies for complex or high-risk activities. This helped achieve a positive community relationship that enhanced the reputation of our client by understanding local community issues and managing them effectively with tailored and targeted solutions.

Throughout this process, the Downer Community Engagement Team managed more than 600 complaints from various stakeholders between January 2016 and February 2019. The number of complaints per week reached 60 to 70 during peak construction periods. To ensure stakeholder issues were addressed and issues did not escalate, all complaints received by Downer were responded to within two hours of receipt from our client. Complaints and enquiries were used as an opportunity to obtain feedback from various stakeholders, identify sensitive issues and implement mitigation strategies to prevent reoccurrence.

The NLR project formed part of the overarching Revitalising Newcastle Program, which required an ongoing interface with key organisations including Newcastle City Council, Hunter Development Corporation and TfNSW. Regular meetings and briefings with representatives from each organisation ensured we were aligned and aware of other construction activities happening adjacent or close to our worksite. These meetings included both project management staff and communications staff, so work programs could be planned and communicated effectively.

A Traffic Liaison Group was formed and met fortnightly prior to and during peak construction to discuss upcoming work and impacts on traffic. This group included representatives from NSW Police, NSW Ambulance, NSW Fire Services, Roads and Maritime Services, Newcastle City Council, Ausgrid, Jemena, Supercars, bus service provider, taxi operators and other utility providers.

The project team also had to work closely with major event organisers to ensure events could proceed with minimal community and traffic impacts during construction.

The most notable event was the Supercars event in 2017 and 2018, which was held during construction. In particular, the overlap of construction activities between Supercars and NLR prior to the first event in 2017 presented a number of challenges given the workspaces overlapped and both projects used similar access throughout the city. The project team worked closely with the Supercars team to adjust the works program to ensure major excavation and construction near the Supercars track started after the first event, and was completed prior to the second event, while not impacting the overall delivery of the NLR project.

## Stakeholder communications

The following objectives provided the foundation for Downer's approach and delivery of communications and stakeholder engagement for the project.

Downer's commitment was to:

- Provide a safe workplace for our people, the community and our environment
- Build trust and confidence in the project by informing and engaging with business owners and residents in meaningful dialogue through a variety of proactive engagement and communication activities
- Minimise disruption to local communities and businesses by focusing on a 'no surprises' approach through early, regular and meaningful engagement
- Ensured timely responses (two hours) were given to issues and concerns raised by businesses and the community, and construction impacts on businesses and residents are effectively resolved
- Promote the benefits of the project to the community creating a sense of excitement and momentum, and empowering Novocastrians to choose public transport
- Capturing feedback from the community throughout the project to ensure we are always learning from our interactions.

A number of improvements were made to the NLR to incorporate this feedback put forward by the community and stakeholders, including:

- Revising the track alignment at Worth Place, and, adding a track-slab west of Worth Place instead of ballast so that light rail in this section is quieter, looks better and delivers more open space for walking and cycling, while delivering a smoother ride and faster journey time for commuters
- Future proofing the light rail by adding a second track across Stewart Avenue, to reduce construction and traffic disruption should future extensions be constructed
- Delivering a new pedestrian crossing over the light rail track at Cottage Creek, to improve pedestrian safety and access to the western Honeysuckle precinct.



### Key statistics:

- More than 600 complaints were received between January 2016 and February 2019. The number of complaints received per week reached 60 to 70 during peak construction periods
- To ensure stakeholder issues were addressed and issues did not escalate, all complaints received by Downer were responded to within two hours.

### Outstanding achievements:

- Development of the 'Ready-Set-Ride' Schools Program, which was designed to promote awareness about light rail safety and delivered to more than 6,000 students across the Hunter region
- Development and rollout of the 'My Newy Passport' campaign
- More than 1.18 million was spent on communications and engagement materials and activities within the local Newcastle area, contributing to our successful local participation rates
- Development of social media campaigns, which achieved a natural reach of up to 20,000 per post
- 180 social media posts provided during construction.

### Community events:

- Kids in Hi-vis 1 event at Wheeler Place - 1,500 attendees
- Kids in Hi-vis 2 event in Pacific Park - 2,500 attendees
- 27 street teams held in coordination with a local business to promote their product or service as part of our initiative to support local businesses during construction
- Free wellbeing events in collaboration with local providers to help promote increased footfall around construction zones
- Attended five Newcastle Now business group events to ensure local businesses remained informed about work and upcoming work in their area
- Held six community information sessions to discuss construction impacts.



*Downer's construction team at the Kids in Hi-vis 1 event*



*Kids in Hi-vis 2 event*

## Complex environmental risk management

Significant drainage improvements were made to Newcastle's road network as a result of NLR design. Several flood studies were carried out during the design phase and ensured that the asset not only reduced flooding risk during significant storm events (i.e. 1 in 100 ARI events), but also considered the increased impacts as a result of climate change.

The innovative ACO polycrrete (Kerbdrain QK200SF) was installed along certain high-risk areas along the road alignment to ensure drainage was further improved and to lengthen the lifespan of drainage assets. Climate change risk was also assessed and considered throughout the design and through various redesigns the project managed to scope out all high climate risks to the asset (sea level rise, heat stress, rainfall intensity etc). Certain aspects of the asset which were vulnerable to sea level rise (substations etc) were elevated higher to cope with the current trend of sea level rise.

It is also noted the project alignment had key interfaces with storm water drainage which interfaced directly with the harbour and sensitive estuary's. Significant efforts were made to ensure no site materials or contamination was able to impact any of the key water course/drainage interfaces, including during storm events.

## Cultural heritage and environmental management

During design and development of the NLR and wider road upgrades, Downer implemented a number of measures to not only ensure the project was environmentally compliant, but also to meet and exceed our sustainability targets.

Key target areas and outcomes included:

### 1. Material reductions

One of the largest opportunities to reduce embodied carbon emissions and project costs was through the reduction in material use. This was achieved through design interrogation and value engineering, which led to reduction in pavement thicknesses, reduction in track form, removal of overhead wiring from design (and associated concrete footings, steel, pavements etc) and through high rates of recycling. Concrete and asphalt mix designs included 25% supplementary cementitious material (fly ash/slag) and 20% Recycled Asphalt Pavement, respectively.



These measures combined led to a 21% reduction in greenhouse gases on NLR. During construction, cut-to-fill was regularly used, and tens of thousands of tonnes of excavated fill from the roadway were recycled and reused using our local recycling partners.

Low cost and RMS spec-compliant crushed glass was also used to back some trenches in the road network, making use of a local recycled material and further reducing the need to import materials.



## 2. Ecological improvements

Downer reduced the ecological impact of the project through direct mitigation measures during design and construction (installation of bird and bat boxes and retention of trees/vegetation wherever possible), and offsetting more than 500 trees in local rehabilitation areas (refer to photos below). All species planted along the improved road/light rail alignment are native and were selected on the basis of their resilience and low watering requirements. This allowed irrigation to be scoped out of the project with significantly reduced operational water usage and associated cost.



*Downer offset more than 500 trees in local rehabilitation areas*

## 3. Heritage interpretation and urban design

To ensure the heritage and cultural value of the area was maintained and enhanced, the project incorporated a large number of heritage interpretation elements into the urban design. This included interpretive signage, public artwork (using recycled rail and heritage sandstone), landscaping and seating using recycled heritage items and the retention and improvement of various significant built heritage items along the alignment. Aboriginal heritage was also incorporated into the design with the commissioning of a large mural depicting a local aboriginal woman and child, with text in Aboriginal (Awabakal) language.

Sustainable urban design principles were incorporated into the entire project. Through Downer and its design JV's work in sustainable design, the project recently achieved an Infrastructure Sustainability Council of Australia rating of '**Excellent**'.



*Heritage investigations regarding the old Burwood Railway*



#### 4. Complex environmental management, working near ecologically sensitive marine environment, navigational waterways

The NLR project was adjacent to Newcastle Harbour and traversed directly over a sensitive ecological habitat known as Cottage Creek.

This creek is an important ecological habitat flowing directly into the Kooragang Nature Reserve, a RAMSAR Wetland of National Significance found under the Australian Government 'Protected Matters Search'.

Flagged by Downer during the works planning phase, the ecological value of this area was further highlighted by the NSW Department of Industry (DoI) and the NSW Environmental Protection Agency (EPA). Downer's management system on the project took particular focus on the risk around Cottage Creek.



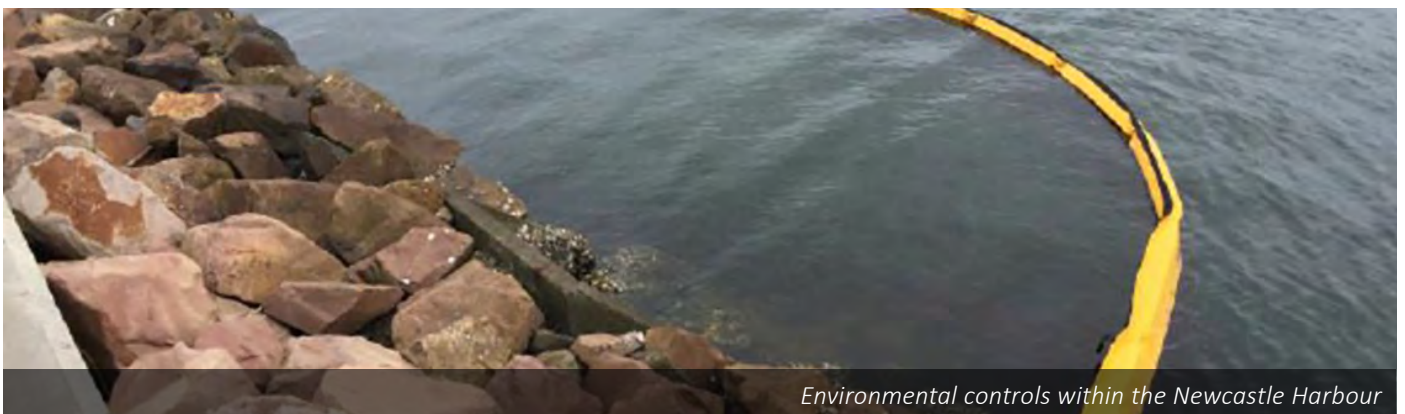
*NLR alignment over Cottage Creek*

Downer's management system on the project took particular focus on the risk around Cottage Creek. For deep sewer and dewatering works requiring the dewatering and treatment of over 3G/litres of water from a high water table (circa 2m), the Project's Soil and Water Management Plan specifically states "The approval for water supply works, and/or water use is provided, noting that as part of this approval it is a condition that extracted groundwater will not be discharged into Cottage Creek." There are also numerous other examples relating to the management of Cottage Creek.

Environmental Control Maps were also developed indicating risk management measures, as well as sediment controls (silt fencing, sand bagging, exclusion zones, ground stabilisation, geofabric). Although not technically required under project approvals, a large network of silt booms were placed around stormwater outlets, which were associated with our disturbance footprint. This was used as an additional/secondary precautionary measure to ensure we did not impact surrounding waters near the project.

Cottage Creek was inspected at least weekly by project Environmental Advisors and the independent Environmental Management Representative, as well as the client (TfNSW) and the EPA on several occasions.

The creek was managed in accordance with the Blue Book standard. In addition, water quality baseline monitoring took place by ERM Environmental Consultants (DLA at the time) to understand existing conditions and be on the front foot with potential contamination concerns. Downer met and exceeded environmental management requirements to ensure our impacts are not only minimised but also left a positive impact as a result of our works. The project was recently awarded an Excellent ISCA design rating with one of the contributing factors being ecological management in sensitive areas.



*Environmental controls within the Newcastle Harbour*

## NLR key learnings

Downer's senior management team reveals some key learnings from the NLR projects that will hopefully assist in the smooth and successful delivery of future light rail projects.

### 1. Safety

- Focus on recognition was successful with our 'what good looks like' safety campaign, a 'just' safety culture and monthly site wide safety recognition BBQ's with up to 10 awards per month with particular focus on individual attitudes towards safety
- Thorough investigation of all high potential incidents to understand the route cause with a focus on solutions rather than blame
- Comprehensive onboarding process for plant and people (peaked at 480)
- Strict controls and approvals for temporary works design (especially for site changes)
- Deep excavations methods in poor ground conditions with a high water table
- Footpaths and external site controls require high levels of planning and management
- Traffic and pedestrian controls are key public interfaces which require a competency process to ensure the control staff have the right attitude to interface directly with members of the public
- Utility damage is hard to mitigate in full, despite extensive excavation permits
- General and comprehensive external finding way signage is fundamental to maintaining efficient foot traffic and minimise members of the public taking shortcuts
- Early and proactive engagement of unions can provide significant benefits and support to the project team.

### 2. Planning & team

*"Nice neat staging looks good at planning stage but never pans out that way"*

- Early alignment of project values, primary objectives and culture ('Dare to Fail') greatly benefits the project team, subcontractors and external stakeholders
- Right people in right roles (decision focused) greatly assisted within a high volume of change environment.
- Early alignment of project values, primary objectives and overall culture ('Dare to Fail') greatly benefits the project team, subcontractors and external stakeholders
- Right people in right roles and being decision focused greatly assisted within a high volume of change environment
- Set up all project controls/processes and mindsets for continual change (design, staging, methodologies, program, commercials, interfaces)
- Larger than normal delivery team (80+ personnel) is required for light rails due to the volumes of change experienced
- Nimble change control processes to allow the efficient management of high volumes of change
- Flexible and clear design tolerances to facilitate decisions being made on site without unnecessarily burdening the CPS team
- Stakeholders embedded in delivery team (in particular road authorities) greatly benefits clear understanding of key drivers for all parties, aligns objectives and assists in managing the necessary approvals
- CPS designers based on site allows quick responses to issues identified on site
- Control of temporary works design and installation process to ensure no short cuts onsite
- Early identification of acceleration options to provide enough time for those options to be fully developed and implemented effectively.

- Early identification of third-party approval requirements:
  - Heritage
  - Utilities, Council, RMS, Water Authority
  - Contamination (testing regime and storage)
  - Environmental (out of hours working)
  - Configuration Change Board (CCB).

### 3. Timing

- **Always have a plan B as plan A often isn't proving to be successful**
- Early site investigation for critical infrastructure to ensure the design fully considers existing in ground assets
- Late scope/performance criteria changes can and do have a major impact on the planned works and should be minimised where possible
- Target significant utility congestion areas as a primary driver for the project staging
- Significant contaminated materials and ground water requires extensive management and requires appropriate resource levels to manage effectively
- Early engagement of operator and LRV supplier to ensure the design is fully coordinated
- Challenge road closure strategy (lanes vs blocks vs mega block) as it is easy for the team to convince themselves the tender stage staging is the best solution
- Open up the ground and dig all required trenches within closures on day one as this facilitates being aware of any previously unknown issues and maximises the time available to develop a mitigation plan
- Challenge cable containment design asap including systems engineers as it may be over engineered or does not achieve the cabling requirements for the project
- Size and location of laydown areas can be challenging in an urban environment and therefore investigate all possible options early in the project.

#### Subcontractor commercial incentives:

- Increase in size of critical S/C delivery teams where it is becoming obvious the complexity, number of changes happening or about to happen are an issue for the subcontract team provided
- Commercial milestones to critical path subcontractor activities to align subcontractors with the overall key objectives of the project (both milestone and production rate incentives)
- Weekend working allowances
- Acceleration (resources, work hours) is very challenging in an urban environment where the available work areas are very constrained and out the required approvals are inflexible. Ensure resource levels and competency of staff and consultants is adequate to manage the changes required.

### 4. Communication & cost

- Management of betterment from third parties, where stakeholders may see the project as an opportunity to better its resources at the cost of others
- Risk based approach to starting construction should the works be required to start but the design has not achieved full approval status. Requires inclusion of key stakeholders to ensure risks are fully understood
- Don't communicate key dates to public too early as this can become a major issue if the program/staging is required to change. NLR communicated no dates within three months of the events which allowed the team to have a level of confidence the dates being communicated can be realistically achieved
- Have a large communications team as this will benefit the project greatly in terms of the public/businesses and is fundamental to quickly dealing with changes as they arise.



**Underestimation of production rates:**

- Cable containment (pit interfaces), it is difficult to achieve consistent production rates in a constrained environment where other elements are also being constructed
- Drainage (connections) – as above
- Track form production rates are significantly impacted by other works. Changes in staging/dates and access constraints, in particular the temperature of the track set up and concrete pours, as additional resources/work fronts are likely to be required if high volumes of change are being experienced.

**5. Existing infrastructure & access**

- Underestimated footpath interfaces as is often seen as the finishing works whereas it can become the most complex part of the project with high levels of planning, staging and public/business interfaces. Recommend a dedicated footpath team for the project team and subcontractors
- Many issues with levels into existing infrastructure (roads vs footpaths vs track) which often result in non compliances that can take an extended time to resolve with stakeholders
- Maintenance of access needs to be a primary focus and needs to be able to adapt to change, in particular:
  - Businesses (deliveries and foot access)
  - Residents (parking)
  - Public (pedestrian crossings)
  - Bussing and other transport modes.



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