

Wireless Monitoring of the Toowoomba Second Range Crossing

*'Climbing the range
your ears pop like champagne...'
You can smell the peace up here.
The proportion, the narrowness...'
'It moves, but oh so slowly
you would have to sleep years,
waking suddenly once in a decade
to surprise it in the act of change.'*

The Provincial City by Bruce Dawe



The Toowoomba Region is an area located in Queensland (Australia). The region was established in 2008 and brought together 8 districts, the largest of which is called Toowoomba City. It is the sixth largest in Queensland and is known as the "Garden City" as it has over 150 public parks and gardens. The dramatic landscape and the city itself are on the edge of an escarpment 700-800m above sea level. The city inspired the poet Bruce Dawe to write about his homeland in The Provincial City poem.

The area is steeped in a rich Aboriginal history with the indigenous tribes of the Jagera, Giabal and Jarowair inhabiting the area and the foothills of the escarpment for over 40,000 years before the first European settlers arrived. The roots of the city itself go back officially to relatively recently in comparison, it was only between 1860-1887 that it was recognised as a town. However, it was first established by Thomas Alford in 1852 when he decided to squat on some land north of Dryton, called 'The Swamp'. He called his property Toowoomba, which either means 'The Swamp' or refers to a variety of melon and reed that grows on the banks of the swamp. The name is actually thought to be a mixture of several Aboriginal words; Tchwampa – the swamp, Choowoom – native melon

and Woomba Woomba – 'reeds in the swamp'.

The town started to expand rapidly after a train station was built in 1867 and it remains the oldest surviving masonry station building in Queensland. This listed heritage railway station serves the Western railway line between south-east and south-west regions of Queensland and is approximately 810km long. The line was pivotal in the development of southern Queensland by European settlers. The adjacent highway has slowly developed over the years and now replaces the train line as the dominant mode for transporting passengers, although there is still a twice weekly service. The train line does still carry cattle, grain, freight and most recently 1-2 tonnes a month of coal from a newly opened mine. Part of the track is no longer in service after a truck, carrying ammonium nitrate, exploded and severely damaged one of the railway bridges.

The Toowoomba Second Range Crossing is the largest Australian Government funding commitment to a single road project in Queensland's history. The cost is over \$1.6 billion, jointly funded by the Australian federal and Queensland state governments, across 41km of terrain and will take 3 years. The crossing is a bypass route which takes heavy road traffic around the steep terrain of The Great Dividing Range instead of through it. This benefits the area by taking 80% of heavy freight

away from the central Toowoomba area, bypassing up to 18 sets of traffic lights and reliably reducing travel times by 40 minutes.

The new route is planned to cover 41km of bypass, a cutting at the top of the range, 24 bridges, 6 interchanges, 9 creeks and an 800m viaduct going over two rail lines. The route also carries a toll road, pavements, cuttings, structures and underground services.

In August 2015, Nexus Infrastructure (comprising of Plenary Group, Cintra and Acciona Infrastructure Australia) successfully won the contract to design, construct, operate and maintain the Toowoomba Second Range Crossing. Position Partners,



Above: Goods train at the Toowoomba railway station (1890)

Australia's leading provider of geospatial solutions, was brought on board to provide monitoring technology on this grand project.

Due to the abundance of nearby rock the Toowoomba Second Range Crossing is being built using a process called 'cut and fill'. The process involves cutting into the earth using excavators, scrapers and blasting (depending on the material) and then moving it to fill a space, build up an embankment or create a completely new area. Controlled blasting is only to be used as a last resort on the higher strength rock and can be unpredictable at times due to the constantly changing conditions and the geological make-up of the region. Safety is of the utmost importance and if blasting is used, then notice is given to motorists and local residents. A big concern is that the blast shock and other ground works can affect the rail tracks situated nearby and also could potentially cause a land slide. After a full survey of the area and review of all of the different construction works around this vast site, Position Partners quickly recognised that a highly accurate system was required to monitor the Brisbane-Toowoomba Railway and its surrounding embankments and various precarious large boulders during early earthwork, piling and blasting activity.

Position Partners had recently become the Oceania partners to a leading wireless remote condition monitoring company called Senceive. Senceive, although based in London UK and with 12 years of successful deployments on UK infrastructure, are expanding rapidly globally, on the back of recognition that wireless asset monitoring is quicker,



Above: Senceive wireless tilt nodes monitoring the rail track and a retaining wall. A solar powered 3G Gateway.

easier, cheaper and safer in the rail and construction industry. Their FlatMesh™ wireless solution was selected as it is specifically designed for challenging and remote locations, is completely wire and mains power free and has up to 15 years battery life. With little/no planned maintenance, they can also be quickly and easily deployed to other areas as work progresses.

The initial monitoring area was located directly under the bridge path where two rail lines ran. 42 wireless tilt nodes were positioned on the sleepers of the two tracks, measuring cant and twist. These were positioned at 3m intervals on one track and at 9m on the other. The reporting rates of the nodes could be easily adjusted remotely and were initially set at a 30 minute rate.

The data was then relayed to back to solar powered 3G Gateways. These Gateways were connected to the mobile network and the data could be easily viewed anywhere in the world using the Senceive WebMonitor™ software, and with the option to be seen through other software packages if required. A further 21 tilt nodes monitored the embankment next to the tracks, a retaining wall and multiple boulders on the side of the valley in order to identify any suspicious movement towards the tracks.



After several months, the first phase of work was finished and monitoring was now required several hundred metres to the south to monitor a blasting cut. 58 of the tilt nodes were easily relocated and reconfigured in only a few hours to monitor a larger portion of tracks with different specifications. These were placed at 5m spacings and the bracketry was changed to suit the new application.

In addition to providing highly stable, easy to view reliable readings (a resolution of 0.001° and repeatability of ±0.003°) which helped keep the public and site workers safe, Senceive was able to provide the Toowoomba Second Range Crossing project with a bespoke, quick and easily adaptable system. The easy to install, innovative FlatMesh™ system saved on cost and time as well as eliminating the need for any maintenance. Most importantly it provided the flexibility, reliability and accuracy of data focusing on the safety and reassurance that the project expected.

The whole project is due to be completed during 2018 and now that construction is in full flow, every week yields a breakthrough achievement. Just last month the first of 22 sections of the viaduct were successfully put in place, which will eventually make up the 800m long bridge over the historic Queensland rail line. This momentous occasion was marked with a visit from the Queensland Minister for Main Roads and Road Safety, Mark Bailey, as well as other federal dignitaries such as John McVeigh of Groom. Lastly, we would like to wish a very happy 150th birthday to the Toowoomba train station, which has always been at the heart of the Queensland rail line, which itself is truly the backbone to southern Queensland and the route to its successful growth.

For more information:
www.senceive.com