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*Bringing ideas
to life*

Hornsby Junction Remodelling

Using digital engineering
for clash detection

Sydney

Clash detection - managing the twists and turns

Opened in 1886, Hornsby Junction is a network of interconnected tracks serving intercity, metropolitan, and regional passenger services, as well as freight services, located within a skinny brownfield site in the Sydney suburb of Hornsby.

The Hornsby Junction Remodelling project aims to deliver faster turnaround times for trains, increase capacity, and improve service reliability for the T1 North Shore Line by incorporating new signalling and rail services.

The challenge for the design and construction teams was how to navigate the brownfield site, twisting and turning the new infrastructure to fit with the existing services, wiring and signalling, all with nothing clashing.

The Novo Rail Alliance -- Transport for NSW in partnership with Aurecon, Laing O'Rourke, and RCR Infrastructure -- were selected to model the interconnection between the site's existing structures and services, as well as the new signals, wiring and services.

The Alliance used a digital engineering collaboration software to federate different design and construction models into a single combined model.

This digital engineering approach serves as a tectonic shift away from the longstanding norms of managing complex rail services projects.

Delivering a new junction for increased train capacity



Final track possession works

The Hornsby Junction remodelling final track possession occurred between 29 December 2017 and 14 January 2018. During this 17-day window there were 7 turnouts constructed with connecting track, overhead wires and signalling equipment installed and commissioned.

This process would have taken more than three years to complete had the work been done on standard trackwork weekends only.

With clash detection undertaken during the design phase, this gave greater certainty to the construction works for the small window of time available on site. The works were installed and commissioned on time so that the 2018 Sydney Trains timetable could commence.



The Hornsby Junction project was described as the biggest rail project ever undertaken in Sydney. Not in the context of value, but the amount of rail, overhead wiring and signalling in a brownfield operating environment.

**James Griffin, Acting Program Director,
Transport for NSW**



SIGNALLING EQUIPMENT ITEMS INSTALLED



COMMISSIONED ON TIME

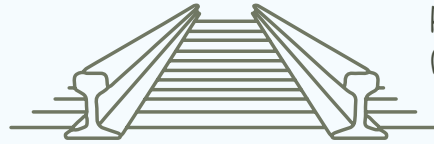
Digital engineering for challenging conditions

Due to the nature of the brownfield site at Hornsby Junction, the remodelling project was by no means straightforward. The small site was sandwiched between critical road infrastructure, existing station platforms and commercial precincts.

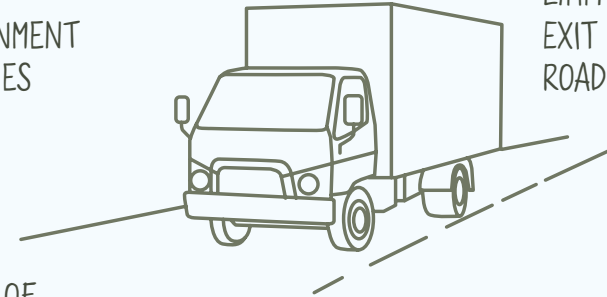
Within the project site, there were 11 different services competing for space, and the interoperability of the overhead wiring, signals and services meant that clash detection was of paramount importance.

All of this created significant limitations for the Alliance design team to work to. It was indeed obvious early in the project that a different and collaborative approach was required for the team to see success.

THE CHALLENGE OF A BROWNFIELD SITE



RAIL ALIGNMENT CHALLENGES



LIMITED ENTRY AND EXIT ON NEARBY ROAD INFRASTRUCTURE

Km

MANY KILOMETRES OF WIRING AND SERVICES

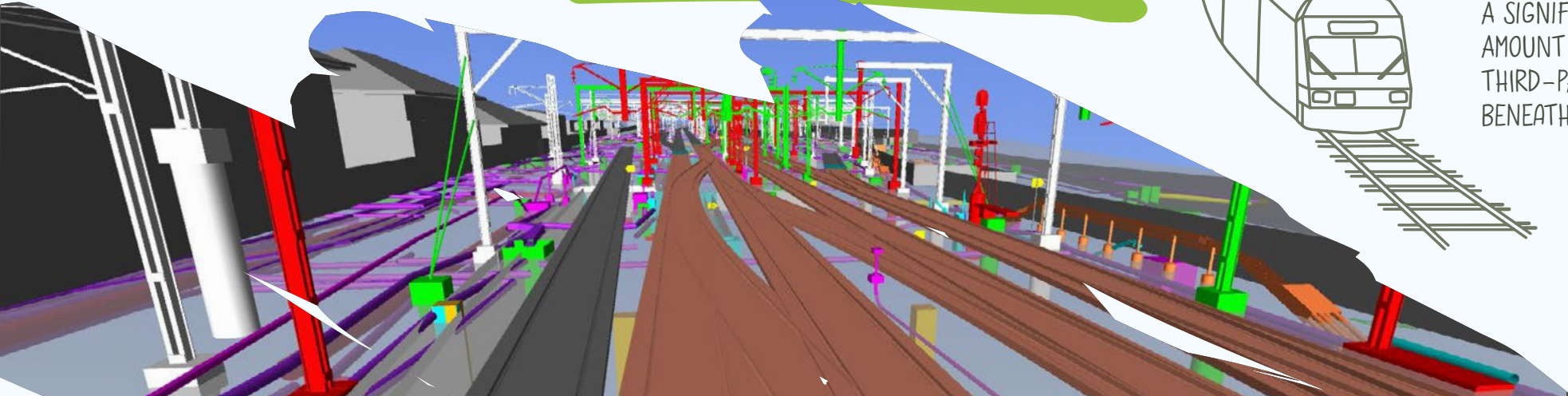
CHALLENGES ASSOCIATED WITH WORKING ADJACENT TO LIVE TRACKS



A SIGNIFICANT AMOUNT OF RAIL AND THIRD-PARTY SERVICES BENEATH THE SURFACE

What is clash detection?

Clash detection and coordination helps to find and remove the potential incompatible interactions between differing elements of a design long before the actual **construction** begins



Digital tools delivering better collaboration

By using collaborative clash detection software, the Alliance design team federated all design elements and construction models into one source of truth, to enable detection of potential clashes between services, wiring and signalling.

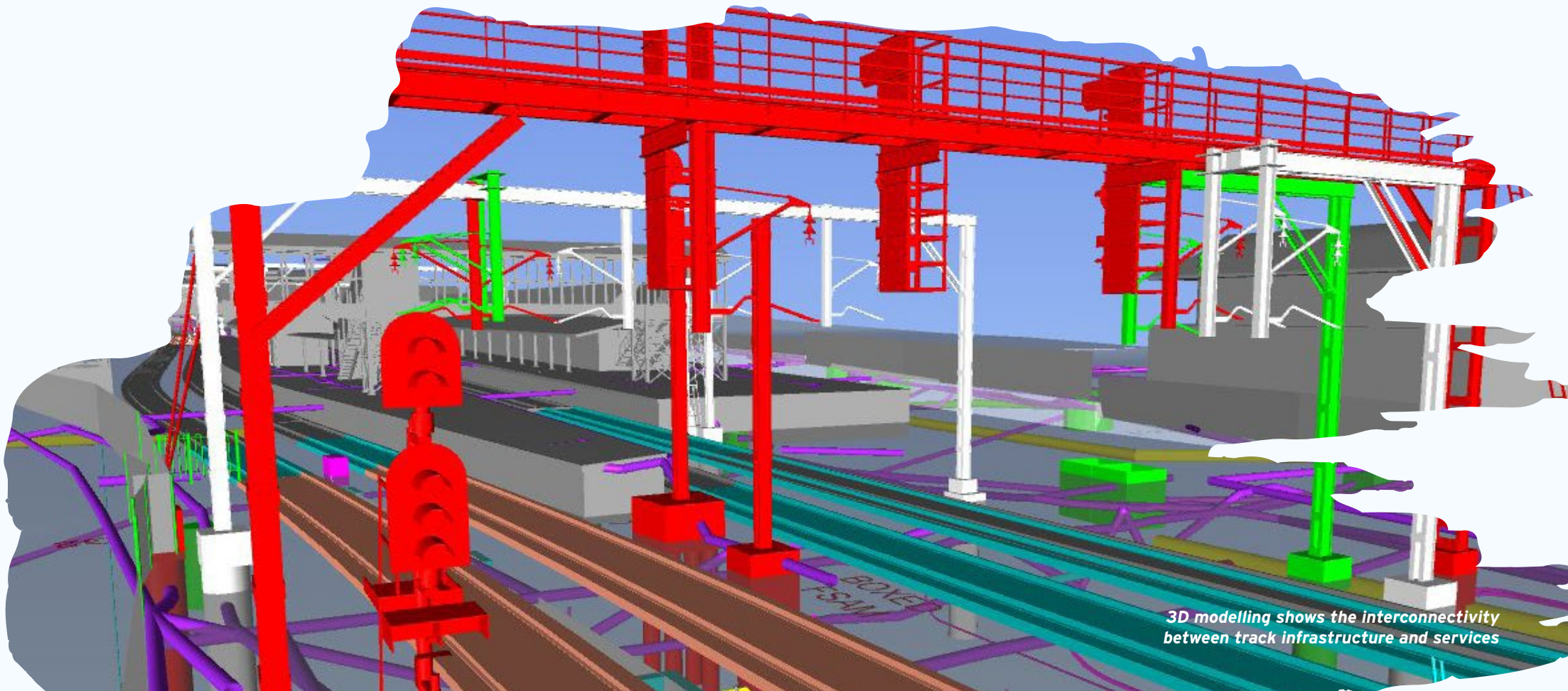
To do this, the interconnection between existing structures and services, with the new signals, wiring and services, was modelled to allow the threading of design through the existing service network.

This achieved zero clashes between the rail project elements, which demonstrated significant value and certainty to the construction phase.

It was essential to the Novo Rail Alliance that clash detection and coordination was undertaken to achieve greater certainty around the location of services, wiring and signalling before actual construction began.

The Novo Rail Alliance approached clash detection in two ways:

1. Manual design and engineering coordination review, based on the collective experience of the reviewers
2. Automatic software clash detection, based on rules set, within the clash detection software



3D modelling shows the interconnectivity between track infrastructure and services

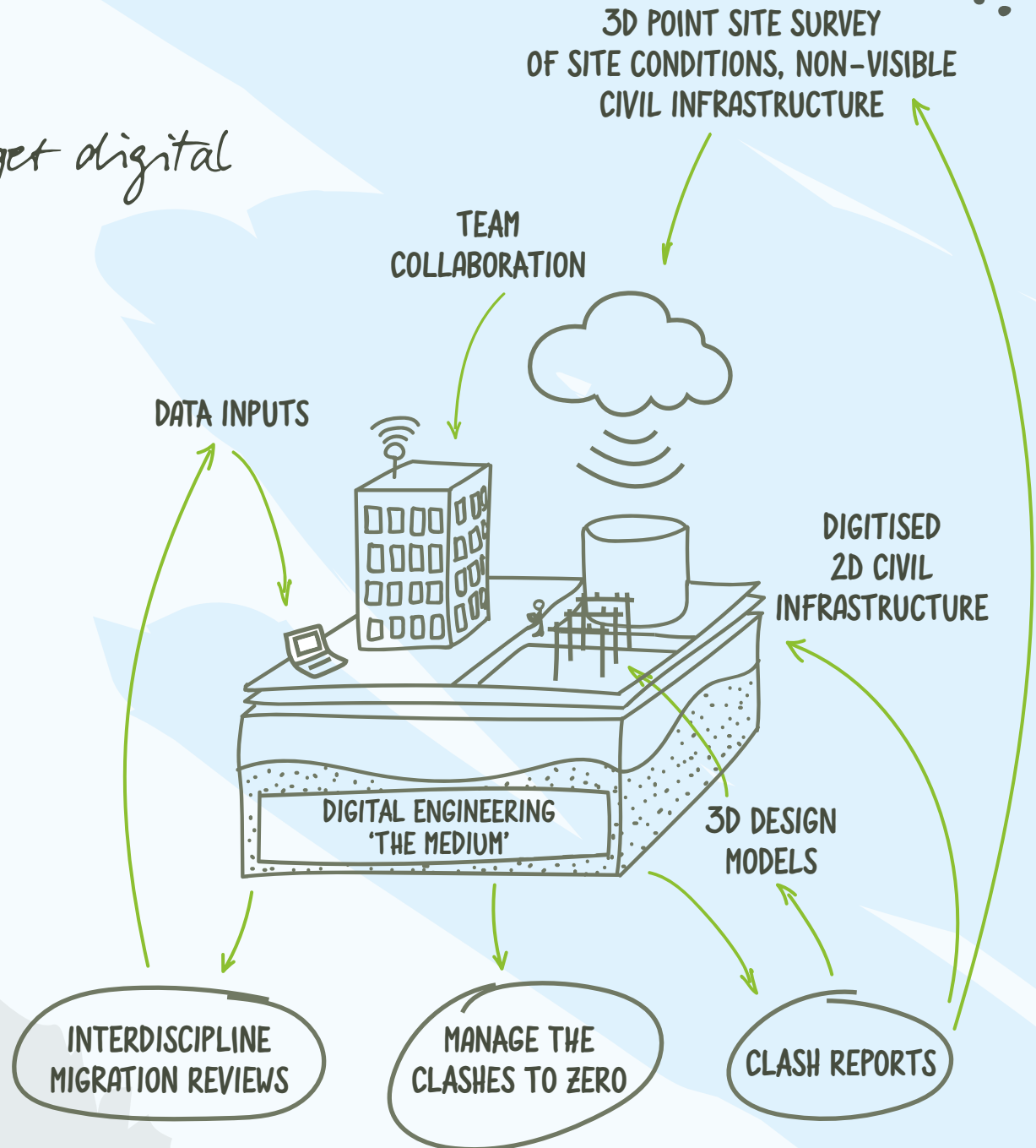
When the going gets tough, get digital

"The digital engineering software was the medium to coordinate and carry out interdiscipline mitigation reviews, create and present clash reports, and manage the progressive reduction of all clashes to zero before construction installation," said Anne Williams, Aurecon Design Scholar.

"It was used to maximise efficiencies throughout the project life cycle. The use of this digital engineering tool created a coordinated and consistent approach that couldn't be realised in a 2D environment."

"It maximised data sharing and promoted collaborative working," said Williams.

The federated models and reports from the digital engineering software were vital for design coordination workshops. Any clashes that were detected could then be amended during the design stage, and well before construction commenced.



Collaboration + Coordination = Clash Detection

To promote regular collaboration between the Alliance design delivery teams and stakeholders, it was essential to share project information frequently.

The 3D project models aided design development, constructability reviews, collaboration and coordination, as well as clash detection.

Modelling for stakeholder engagement

In one example, the 3D model was used by the Novo Rail Alliance to animate the crane lift of the new signalling building into place. This animation was presented to the project owner, Transport for NSW, to give them confidence regarding the methodology of the crane lift, which was in the vicinity of 11 kV aerial conductors.

Detect and correct

The Novo Rail Alliance delivery teams were better able to anticipate and reduce potential clashes, and interference problems, before construction. This created value for the project as it gave greater certainty and clarity on construction works, so they could proceed without delay or design re-work.

HOW IT WORKED



1

Clash detection tests were performed in 3D, against specified geometry, to find conflicts



2

Clash detection data was compared to the 3D designs



3

The model then captured a snapshot of each individual clash



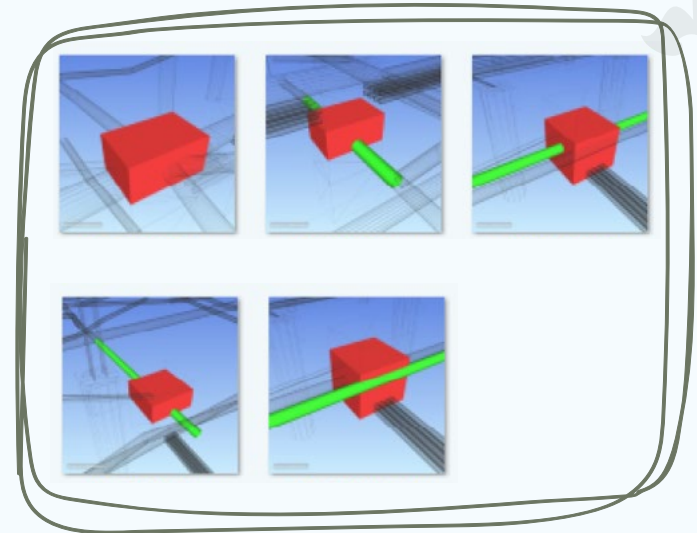
4

Designers collaborated to determine which service or piece of infrastructure needed repositioning



5

A new clash test was performed every two weeks



Creating a benchmark for future projects and leaving an operational legacy



With an unprecedented level of complexity and intense external scrutiny, it has been a real privilege to witness the collective team rise to the challenge over these last 17 days.

The project has been a shining example of collaboration and will be a benchmark for future projects for rail construction in a brownfield rail environment.

The project team has demonstrated professionalism and perseverance to the end and should take enormous pride in the new, improved Hornsby Junction and the legacy of its operational benefits.

**Daniel Roche, Senior Project Manager,
Transport for NSW.**

The implementation and integration of digital tools was used to great effect on this complex project. As digital tools continue to evolve, they can help drive a brighter future for infrastructure design and construction.

About Aurecon

Aurecon brings ideas to life to design a better future. Imagining what is possible, we turn problems into solutions.

Aurecon offices are located in:

Australia, China, Hong Kong, Indonesia, Macau, New Zealand, Philippines, Qatar, Singapore, Thailand, United Arab Emirates, Vietnam.

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The Aurecon logo features the word "aurecon" in a bold, lowercase, sans-serif font. A small green square is positioned above the letter "a".

www.aurecongroup.com

The Novo Rail Alliance logo consists of a stylized blue "N" shape that incorporates a white "n" inside it.
novo rail
alliance