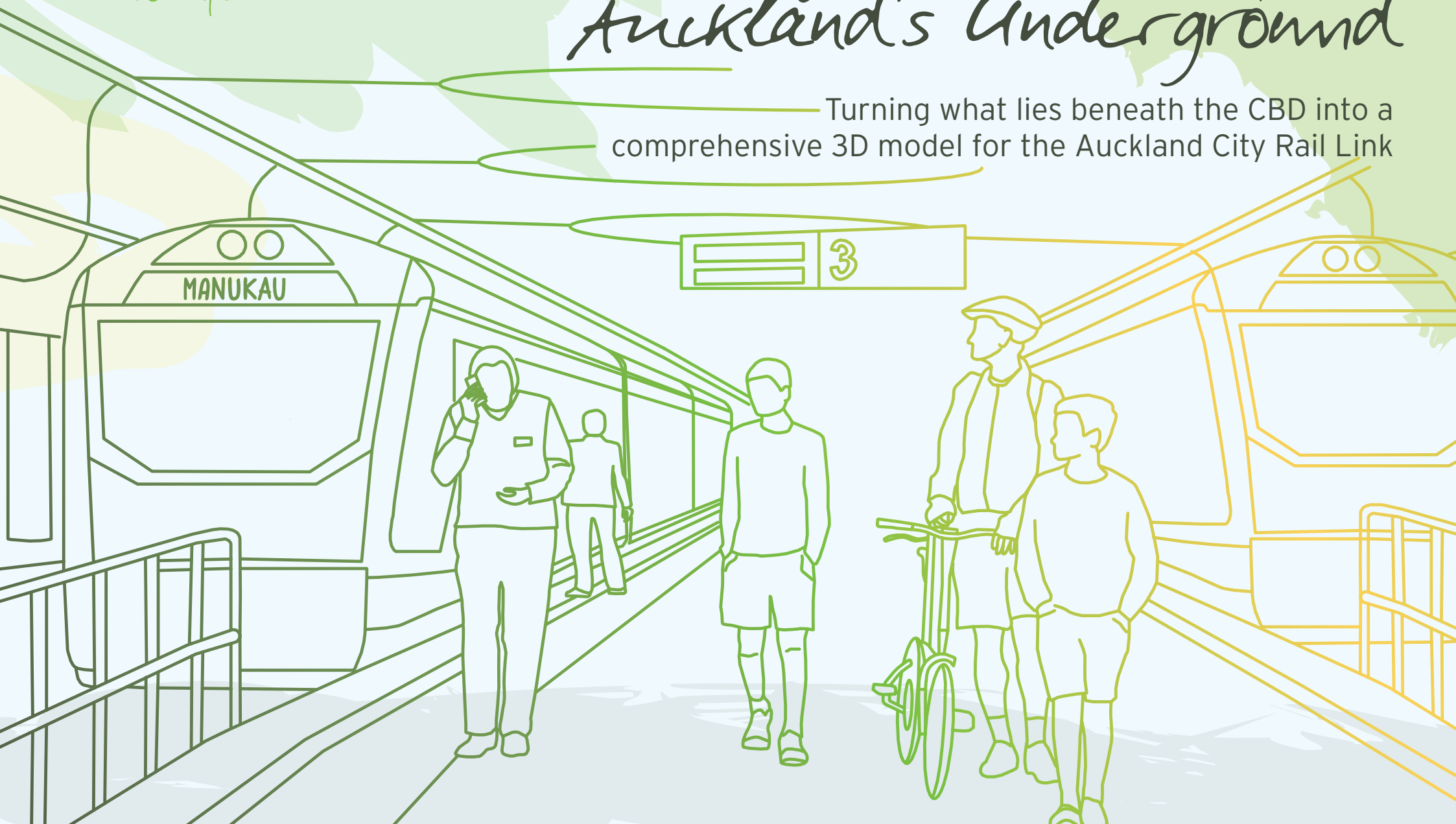


aurecon

*Bringing ideas
to life*

The Digital Discovery of Auckland's Underground

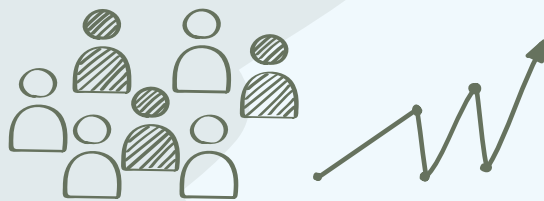
Turning what lies beneath the CBD into a
comprehensive 3D model for the Auckland City Rail Link



Understanding Auckland's ancient geology

The different geological layers of the Central Auckland Business District date from as little as 100 years ago, around the time of European settlement, to as far back as 22 million years ago. The complicated mix of ground materials presented a challenge for the Aurecon geotechnical team working on the biggest transport infrastructure project in New Zealand, the City Rail Link (CRL).

With one of the new stations up to 32m underground and 3.45km twin tunnels, the complex ground conditions called for a new approach. It called for a digital engineering solution that could take all the information gathered underground and produce a 3D interactive image so ground risks could be clearly communicated to the client and all the teams involved.

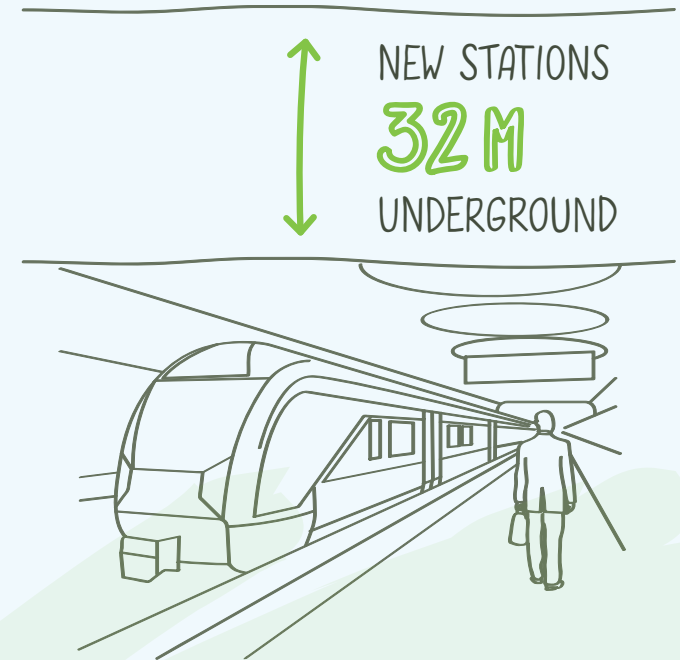


2.9%

POPULATION GROWTH



3.5 KM OF TRACK



Uncovering a new way to visualise the City Rail Link

The challenge facing the Geotechnical team was to mitigate the ground risks along the route the CRL would be taking. Much of the tunnelling for the project will be carried out in the weak rock of the Waitemata group, made up of mainly alternating layers of sandstone and mudstone.

At the Northern end near the Auckland Domain, the geology becomes more complex with reclaimed land sitting on top of soft marine sediments while at the south end the lava flows of Mount Eden are intertwined with soft sediments.

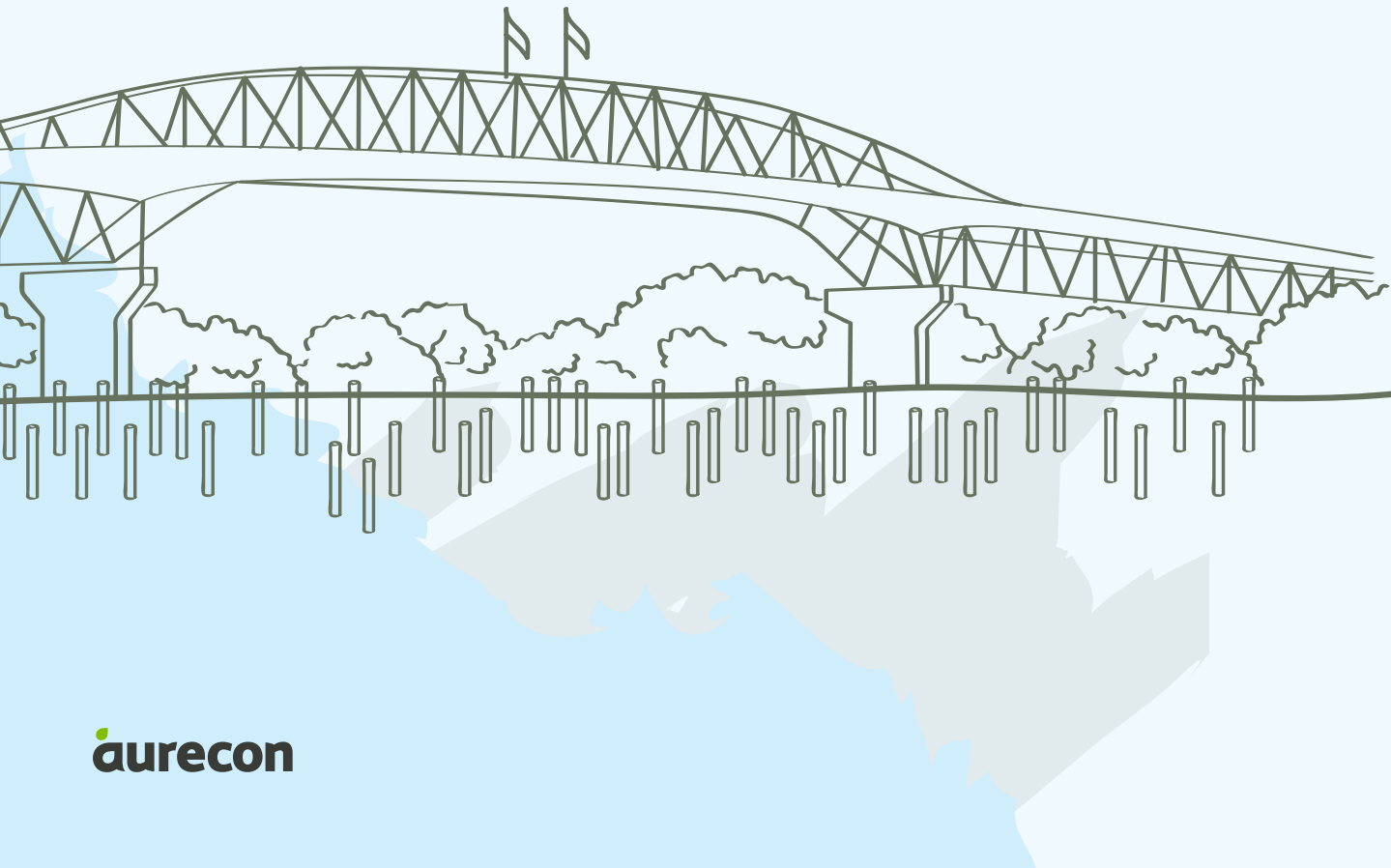
By taking Leapfrog, a mining software package, and repurposing it to suit the CRL, Aurecon was able to build a full 3D model of the geological conditions to inform and mitigate ground risks for the construction team and client.

Weaving between two volcanoes

The redesign of Mt Eden Station was the catalyst for the creation of the first full 3D model of the geological conditions beneath the project. The City Rail Link twin tunnels will surface from bedrock into an area dominated by ash and lava from the Domain and Mount Eden volcanoes. The challenge is the interaction between the intertwining hard lava materials with pockets of soft sediments.

The ability to tell the complex engineering and geological story of Mount Eden had never been done before, using multiple environments with multi-discipline data to create an accurate picture of the new Mount Eden Station. The new station requires a section of storm water drain to be shifted, and with a comprehensive geological model of the difficult ground conditions, the tunnelling team were able to prepare the micro tunnel boring machine to handle not only the soft ground but also hard basalt.

The modelling assisted with the placement of ground investigations and the Aurecon team could prepare the client for the difficult conditions and clearly communicate the risks. While the ground conditions encountered may differ from the model, having a way to quickly understand the complex conditions provided a basis for resolving any issues faced during the tunnelling process.



Painting a picture of Auckland's geology

Aurecon's 3D geological model is proving invaluable to Auckland Transport and to contractors. Engineers and constructors can see how ground conditions will interact with structures and make informed decisions on structural design, services relocations and construction methods.

Consider the task of designing hundreds of structural pilings for the two Auckland CRL underground stations with little information on what ground conditions lie beneath the CBD. Over 3000m of core samples were removed from 127-cored boreholes that had been drilled. If laid end to end, the samples would cross the 1020m Auckland Harbour Bridge three times. To overlay the ground conditions with the design in 2D, a designer might draw, redraw, print, change, draw again.

In Aurecon's 3D geological model designers can insert the pilings and view their location from any angle. From pilings to services, track design and access points, tweaking the design due to ground conditions is simply a matter of picking them up and putting them in a different location.

Precise engineering data is being mixed with geological data to design into a virtual ground. This richer output of information is a vital tool to communication with project stakeholders. But bigger than that it's getting the designs right, from the start.

This is linear infrastructure so there's no escaping challenging ground conditions when you're building an underground railway and infrastructure. We didn't want the construction team to encounter unexpected ground conditions that would compromise the project or delay it. We had to get it right.

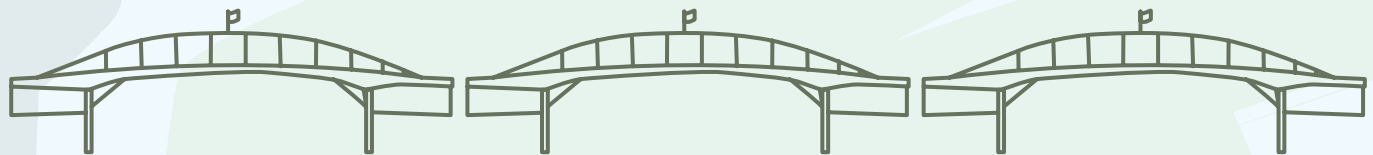
Philip Kirk, Aurecon Geotechnical Team Leader

3000M OF CORE SAMPLES
127 CORED BOREHOLES



IF LAID END TO END, THE SAMPLES
WOULD CROSS THE AUCKLAND
HARBOUR BRIDGE THREE TIMES

3X



Mapping the digital underground

In order for Auckland to continually grow its public transport network, understanding what lies beneath is critical. The 3D model has given easy access to information on the ground conditions and better visualisation of what the City Rail Link will look like in detail not found in traditional 2D designs.

The 3D model provided better coordination between the different disciplines and allowed potential conflicts to be identified within the design and not during construction. Being able to perform visual checks before construction was one of the biggest benefits.

The use of 3D geology, particularly within an Alliance contract model, has helped break down traditional barriers between sharing of geological interpretations between client and contractor, and has resulted in a successful tender process where ground risks are identified and expressly mitigated.



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.

For more information please visit

www.aurecongroup.com

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

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