



### Project summary

Organization:  
Arcadis

Solution:  
Roads and highways

Location:  
Sydney, New South Wales, Australia

Project playbook:  
Bentley LumenRT™, iTwin®,  
MicroStation®, OpenBridge®,  
OpenRoads™, PLAXIS®,  
ProjectWise®, SYNCHRO™

### Project overview

The Warringah freeway needed an upgrade as part of Sydney's broader Western Harbour Tunnel program to improve mobility.

Being one of the busiest urban corridors in Australia, upgrading the freeway presented several technical, logistics, and sustainability challenges.

Arcadis adopted a digital delivery model built with Bentley's solutions, enhancing coordination and communication, reducing work hours and design reviews, and preventing significant carbon dioxide emissions.

### ROI

Using SYNCHRO 4D, Arcadis staged simulations and early risk mitigation, gaining six to eight weeks on the schedule.

Eliminating 20,000 truck movements with optimized earthworks, the firm avoided an estimated 450 tons of carbon dioxide emissions.

324,000 work hours were saved on the design by applying the digital-based model.

# Arcadis implements a federated model to upgrade the busy Warringah freeway

The digital-first approach saved 324,000 work hours and accelerated the schedule by six to eight weeks

### Upgrading a freeway corridor for an improved traffic flow and safer infrastructure

The Warringah freeway upgrade is part of Sydney's broader Western Harbour Tunnel program and is designed to improve mobility along one of Australia's busiest urban corridors. Carrying more than 240,000 vehicles each day, it requires significant reconfiguration to support smoother traffic flow, enhance safety, and prepare the network for future public transport and tunnel connections. The work includes re-shaping complex interchanges, widening key sections of the roadway, strengthening links to the Sydney Harbour Bridge and Tunnel, and incorporating upgraded bus and active-transport facilities.

Arcadis, a global engineering and design consulting company with a focus on sustainability and resilient infrastructure, served as a core delivery partner throughout the project. The Warringah Freeway Upgrade is expected to open in 2026. The firm's role "encompasses digital model management, design coordination, clash detection, and data federation across disciplines, including road geometry, structures, utilities, drainage, intelligent transportation systems, signage and lighting, and construction staging," explained Mark Shamoun, principal road designer at Arcadis. This digital upgrade will help make the corridor safer and more efficient for Sydney's long-term transport needs.

### An integrated model streamlining design and organization

Given the scale and complexity of the upgrade, Arcadis adopted an integrated digital delivery built with Bentley's connected ecosystem throughout the detailed design period. "We adopted a federated model approach supported by Bentley's ProjectWise and iTwin platform, allowing over a dozen design and construction teams to collaborate efficiently in real time," Shamoun explained. ProjectWise served as the project's central data environment, ensuring controlled, consistent information across disciplines, while the iTwin platform unified all models into a live digital twin that "allowed Transport for NSW (TfNSW) and stakeholders to access, review, and validate spatially coordinated designs in the browser," added Shamoun.

Within this digital ecosystem, several of Bentley's solutions helped the teams deliver clear and smarter designs during their work on the project. OpenRoads supported road and corridor design to optimize earthworks, OpenBridge delivered structural modeling, and MicroStation enabled detailed engineering across multiple disciplines. PLAXIS contributed geotechnical insights, while the iTwin platform integrated designs from other Bentley software into a real-time unified model, helping TfNSW

and stakeholders make informed decisions. SYNCHRO 4D provided a dynamic view of the project and traffic staging, and Bentley LumenRT delivered photorealistic visualizations for stakeholders' engagement and clearer communication with the community. "By integrating all design disciplines into a single, live digital twin, the project team was able to resolve design clashes, optimize construction staging, and respond quickly to site conditions," said Shamoun.

### Digital-driven sustainability and efficiency in transportation infrastructure

The project's digital approach delivered real, measurable improvements from efficiency and coordination to communication and sustainability. By using Bentley's integrated solutions, the team was able to detect issues early, cut down on rework, and speed up the review process before problems became costly. "Bentley's integrated software solutions enabled significant reductions in design time, increased ROI through early risk mitigation, improved coordination across disciplines, and enhanced outcomes for the client and the community," highlighted Shamoun.

One of the most significant gains was the reduction of design work. The project saved 324,000 work hours, which represented 20% of total design coordination time, just by moving away from traditional manual reviews and adopting model-based collaboration. These savings came from efficiencies enabled by the digital federated

model, automated clash detection and browser-based coordination, which also cut design review cycles by 60%.

With clearer models, construction-related RFIs were reduced by 65%, minimizing cost overruns and keeping the construction timeline under control. SYNCHRO 4D further contributed to smoother delivery, with staging simulations identifying potential bottlenecks early enough to avoid delays, accelerating the program by six to eight weeks.

The environmental impact of this digital delivery was also important for Arcadis. By using OpenRoads to refine earthworks and staging, the firm eliminated approximately 20,000 truck movements, avoiding more than 300,000 kilometers of haulage through urban neighborhoods. This prevented an estimated 450 tons of carbon dioxide emissions. These efficiencies also helped reduce noise, air pollution, and disruption to residents living alongside the corridor. The iTwin platform enabled real-time spatial validation and "reduced unnecessary construction in sensitive zones and supported compliance with biodiversity offsets and heritage preservation," said Shamoun.

These outcomes demonstrate how the digital delivery model can extend beyond efficiency. Arcadis, with this freeway upgrade project, established a new benchmark for digital-driven sustainability in major transport infrastructure. They demonstrated that smarter design is fundamentally greener, safer, and better aligned with the needs of 21<sup>st</sup> century urban communities. When complete, this upgrade will significantly improve the surrounding community.

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Bentley's connected digital tools have been critical in transforming the way we deliver complex infrastructure in urban environments. Through platforms like ProjectWise, iTwin, and SYNCHRO, we were able to accelerate collaboration, reduce rework, and improve sustainability outcomes on the Warringah freeway upgrade.

— Mark Shamoun, Principal Road Designer, Arcadis



The Warringah freeway upgrade project improved traffic flow in a high-density urban area.



Arcadis developed photorealistic visualizations for public engagement and internal communication.

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