Australian Government
High Speed Rail Authority

NOVEMBER 2025

Important information about the contents of this business case.

Some information in this document is no longer applicable because it has been refined and updated since this document was produced in 2024.

This section summarises those changes, made primarily to further de-risk the project.

Business Case development

The High Speed Rail Authority started the Newcastle to Sydney High Speed Rail Business Case in May 2024. The Final Business Case was submitted to the Australian Government on 16 December 2024.

The Business Case represents a point in time and was developed to meet the assessment requirements of Infrastructure Australia, the Australian Government's independent advisor on nationally significant infrastructure.

This assessment informed the Australian Government's subsequent decision to proceed to the Development Phase of the project.

Since submission of the Business Case, the Authority has identified a number of refinements as part of the Pre-Development Phase. These refinements included:

- Changes to the proposed railway alignment to mitigate environmental and property impacts
- Additional design work
- The refinement of the delivery strategy to minimise interface risk
- Changes to the potential delivery methodology to align with refined delivery strategy and reduce land acquisition risks.

These changes reduce the overall delivery risks of the project but do not materially change the findings of the Business Case.

Development Phase

During the Development Phase, communities and stakeholders will have a number of opportunities to provide feedback on the project.

A key part of the work will also include Early Contractor Involvement where design work will be substantially progressed, allowing greater certainty on the project cost and program.

In addition, planning approval will be obtained for the key aspects of the project, allowing the corridor to be preserved and critical land acquired.

On completion of this work, the Business Case costs and benefits assessment will be updated to inform the investment decision to move into the start of major construction.

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Summary of refinements

This fact sheet provides a summary of the key refinements since submission of the Business Case. A number of smaller refinements have also been proposed and may not be documented in this list.

Please contact the Authority at **info@hsra.gov.au** if you would like more information on any specific detail in the Business Case not detailed below.

Stations	Refinements
Newcastle Station	Relocated Newcastle High Speed Rail Station within an underground cutting. This to be further reviewed once further geotechnical investigation work is completed.
Lake Macquarie Station	Relocated the station and the alignment closer to the M1 Motorway.
Sydney Central	Reduced excavation work and improved the design of the terminal crossover cavern at Central Station to reduce potential impacts.
Alignment adjustments	**Refinements**
Length of corridor	Refinements to the indicative business case alignment will continue as part of the development phase and will subject to further community, stakeholder, and industry consultation.
Hornsby Break	A potential Hornsby Break has been removed from the project scope as part of refinement activities.
Drive strategy	**Refinements**
All sites	Refinements have been made to the drive strategy, these will be further refined during the development phase.
Other clarifications	**Refinements**
Property acquisition	The property acquisition approach is subject to further consultation with the NSW Government.
Delivery strategy	Refined the proposed delivery strategy to use 'Area Packages' of work to minimise interface risks, and adopted an Incentivised Target Cost Alliance approach rather than Hybrid Incentivised Target Cost approach. Following the submission of the Business Case, further industry consultation demonstrated very high support to participate in the project. As such, HSRA has increased the number of tenderers to up to three for each package. This will not only increase competition for each package but also reduce the substantial risk of a party withdrawing during the tender process.
Standards	Relevant compliance standards will be confirmed with industry.
Program	Updated the program based on refinements.

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Business Case Redactions

Within the published Business Case there are a limited number of redactions for the following reasons:

- Refinements as detailed in the summary above, noting some information contained within the Business Case has been superseded.
- Commercial and confidential information related to estimated price breakdowns and potential contract values. Noting that this work will be subject to a competitive tender process.
- Commercial and confidential information associated with potentially affected property and associated valuations, recognising these may change through detailed design.
- Maintaining privacy of potentially impacted stakeholders, recognising impacts are subject to change as designs are developed further.

Australian Government
High Speed Rail Authority

Generations of opportunities

Newcastle to Sydney High Speed Rail Business Case

Executive Summary

The first stage of National High Speed Rail

Quick, convenient, reliable journeys

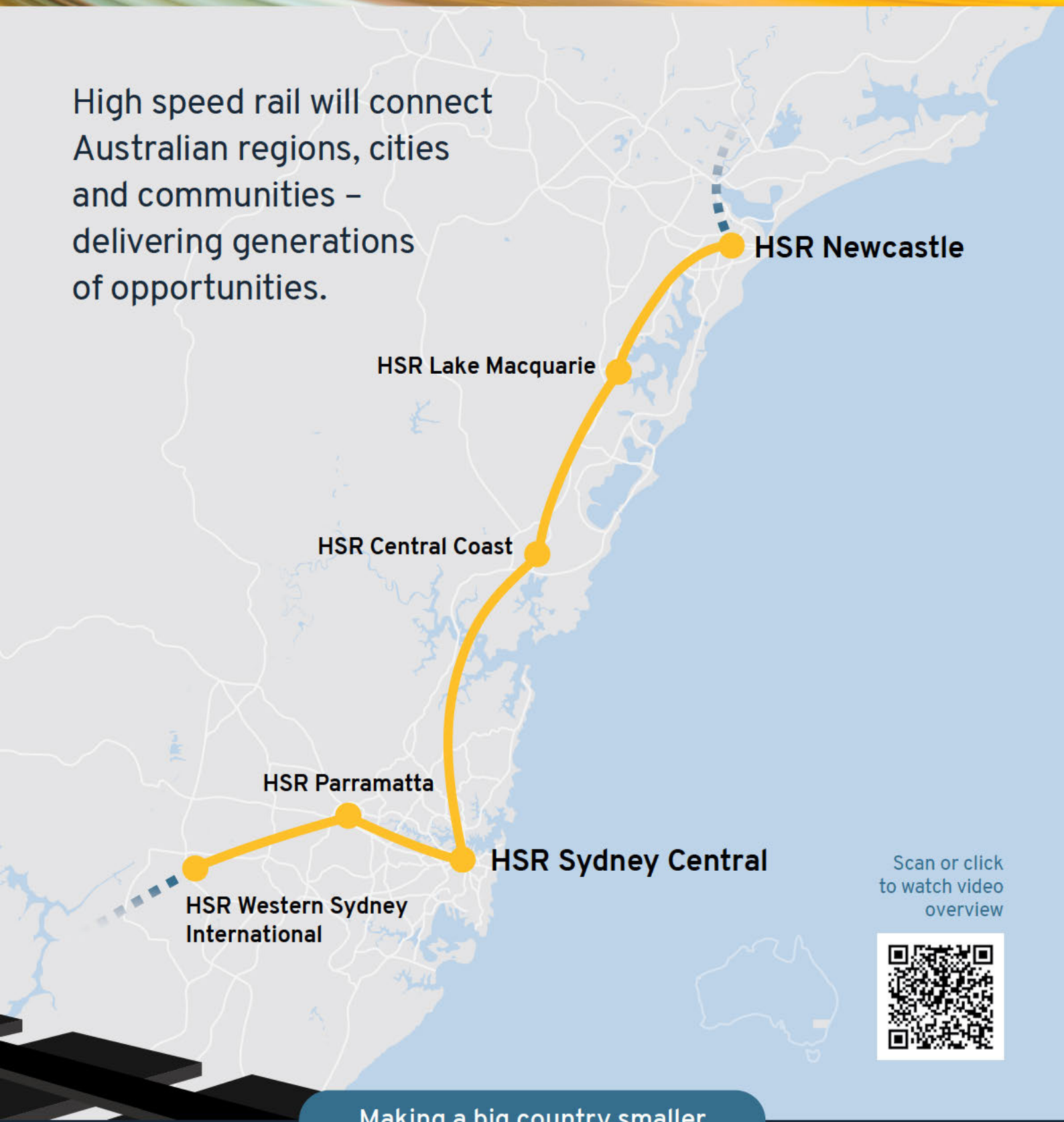
0:30

Central Coast–Sydney
Central Coast–Newcastle
in under **30 minutes**

1:00

Newcastle–Sydney
in under **1 hour**

High speed rail will connect Australian regions, cities and communities – delivering generations of opportunities.



Scan or click to watch video overview

Making a big country smaller

AN OPPORTUNITY FOR
160,000
new homes

CREATING MORE THAN
99,000
new jobs

DELIVERING A
$250 billion
economic boost over 50 years

Contents

This artwork, by Mununjali and Kabi Kabi woman Navada Currie, celebrates the proposed high speed rail that will take passengers between Newcastle and Sydney. Australia is a vast country with great distances between each of our cities and communities. The railway will traverse the countryside quickly and efficiently, connecting many communities along the way.

The wattle and banksia represent the growth and benefit of the railway being created for many communities, opening up these communities to be easily accessible for more people. They are also a visual nod to the beautiful national parks that surround the area. The blue strokes represent the coastline and the many beautiful waterways. The brown pattern represents the Country that the trains will be travelling across.

The High Speed Rail Authority acknowledges the traditional owners of Country throughout Australia and their continuing connection to land, sea and community. We pay our respects to them and their cultures, and to the Elders past and present.

A compelling vision for a new east coast high speed rail network

The High Speed Rail Authority is tasked with planning, developing, and delivering a national high speed rail network: an investment that will benefit all Australians. This Newcastle to Sydney High Speed Rail Business Case examines the case for a first stage of this network.

Delivering a step change in connectivity between Australia's preeminent global city and its largest regional economy, this first stage will set the scene for the development of a world-class, national high speed rail network. This is an investment to alleviate congestion and prepare us for the significant population growth – vastly outpacing many of our OECD peers – that the coming decades will bring.

Progressively linking the regions, cities, and communities of the eastern seaboard, high speed rail will bring people and places closer together, creating generations of opportunities. Through phased delivery of individual sections, our vision is that by 2060 a high speed rail network will connect Brisbane, Sydney, Canberra and Melbourne. Connecting capital cities to the regions will deliver significant local benefits.

High speed rail is much more than a transport project – it is a strategic economic intervention to catalyse economic growth and productivity by supporting more jobs in more locations across Australia's east coast.

By decisively overcoming barriers of distance, high speed rail will unlock the potential of Australia's diverse and dynamic economies, spreading opportunities more equitably across the east coast. By making our regions more attractive places to do business, make a home, or visit, high speed rail offers an unrivalled means to extend the benefits of national growth to regional Australia. It will provide greater choice over where people live, work, study, and play. It will also offer a genuine alternative to other modes, improving liveability and providing a sound pathway to decarbonise long-distance travel and achieve net zero by 2050.

This vision aligns directly with the government's vision for sustainable urban growth. It is a key intervention to support the development of cities and places that are liveable, equitable, productive, sustainable, and resilient.

Jill Rossouw
Chair
High Speed Rail Authority

A confident first step in the journey towards National High Speed Rail

As the first step in the delivery of a national network, this Newcastle to Sydney High Speed Rail Project represents a once-in-a-century opportunity to reshape Australia and redefine how we live, work, and travel.

The Project will activate the latent economic power of a vital multicity region and support a new pipeline for housing and development. It will link people to jobs, support manufacturers and suppliers, boost our tourism and leisure market, and connect communities to generations of opportunity.

By reinforcing the connections between cities and regions, and bringing thriving sectors closer together, the Project will catalyse growth and unleash the corridor's full economic potential. At the same time, by driving land use change it will ease uneven population pressures and enhance quality of life in cities and regions.

This will be a truly world-class offering. Dedicated tracks will enable passengers to travel at speeds of up to 320 km/h, enjoying unparalleled reliability and a calm, pleasant onboard experience. It is an environmentally sustainable form of travel, and will be an important measure to reach net zero by 2050.

This defining investment in a stronger, more connected future has an equally forward-looking plan for delivery. Drawing on decades of global high speed rail experience, the innovations it embeds will reduce costs, control risks, and accelerate progress. It will set a new standard for Australian infrastructure which benefit future network stages, as well as catalysing industry change and increasing productivity.

Together, we have the chance to deliver a legacy that meets the challenges of today while laying track towards the opportunities of tomorrow.

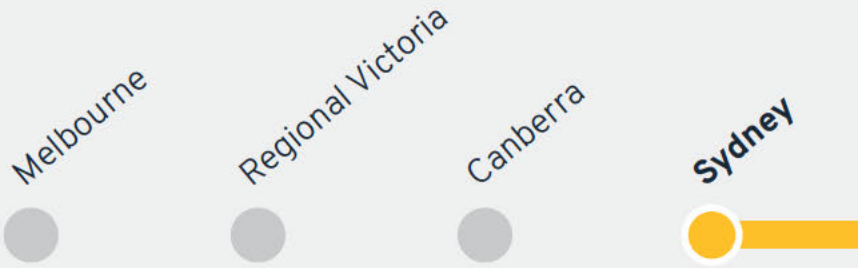
Tim Parker
Chief Executive Officer
High Speed Rail Authority

Generations of benefits to regions, cities and Australia's east coast

A national high speed rail network will boost the Australian economy by $1,680 billion (real undiscounted, 2024-25$) by 2086. This economic uplift will be driven by enhanced connectivity along the east coast, fostering regional development, expanding tourism opportunities and unlocking the potential of vibrant regional hubs.

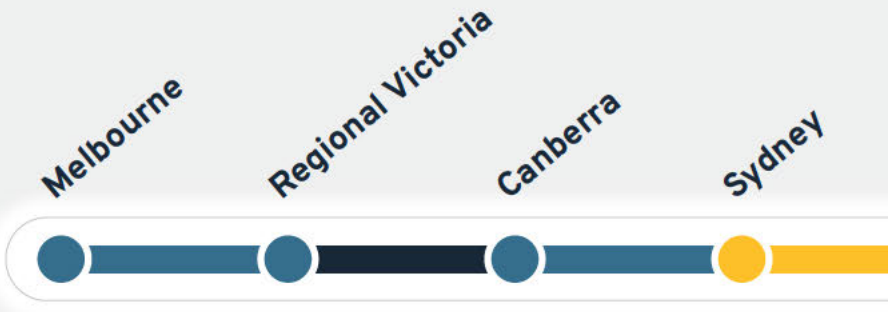
A long-term commitment amounting to less than 1 per cent of the Commonwealth budget would support efficient incremental delivery of Australia's high speed rail network, also giving industry the confidence to invest.

Newcastle to Sydney is the first step in a national network, delivering immediate benefits to this region.

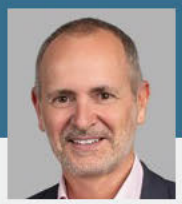


Future stages will connect east coast capitals and regional centres, delivering benefits to each area as individual stages come online.

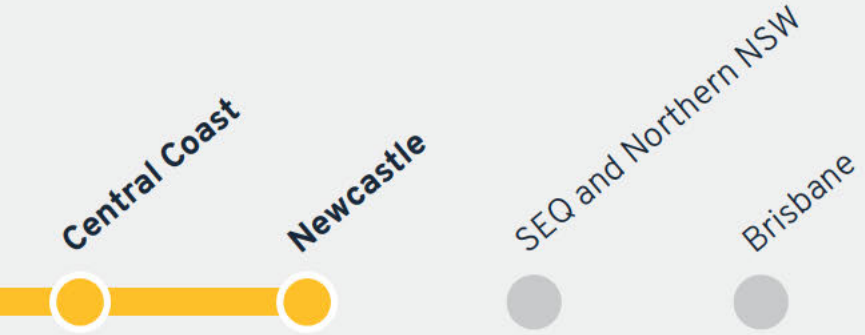
A new high speed rail network will reshape Australia's east coast, delivering benefits to the nation on top of the benefits from each individual section.

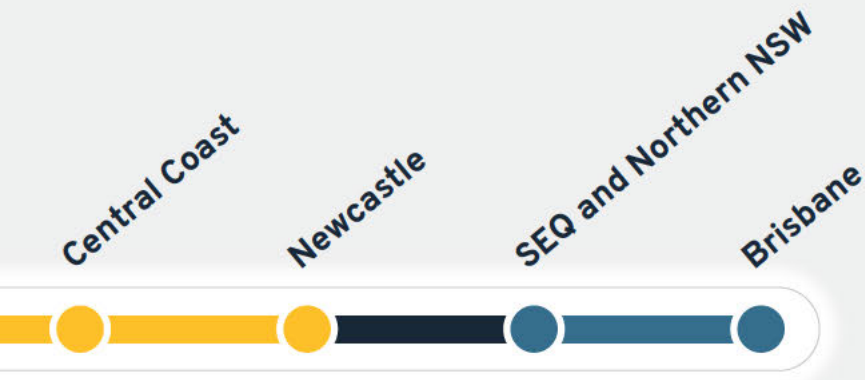


The procurement and delivery approach proposed by the Authority has the potential to be significantly more efficient than traditional approaches, to support innovation and to provide increased certainty of project outcome. If this project proceeds as envisaged, as well as delivering much needed infrastructure it could be a positive case study for improved delivery of all major infrastructure in Australia.



JON DAVIES
CEO, Australian Constructors Association





The network provides an opportunity to connect regions to cities, but also just as importantly cities to regions – as regions become more attractive destinations for visitation, satellite business operations and places to live.

The network also enhances connectivity to airports across the nation, both increasing the attractiveness of regions to overseas visitors as well as improving the mobility of people in the regions.

The investment required is significant but it is sustainable on an annual basis if governments commit to this as a multigenerational undertaking that would see a consistent annual investment over a 10 to 30 year time horizon. This long-term horizon will ensure a more sustained rollout, something that is the hallmark of many successful HSR networks around the world, and avoid the stop-start approach that inevitably pushes up infrastructure costs. Progressive building of capability enhances the return on investment.

Newcastle to Sydney High Speed Rail Project

This Business Case demonstrates that the Newcastle to Sydney High Speed Rail Project (the Project) is feasible, economically viable and a necessary and important priority for the country.

It examines the case for a first stage of the east coast high speed rail network (the network) between Newcastle and Greater Sydney.

This first stage will enable a step change in connectivity between Australia's preeminent global city and its largest regional economy.

This is the transformative action that is needed to fully address critical constraints that currently prevent the project corridor functioning to its full potential and open up immense new opportunities.

The rationale for this investment is illustrated in this Business Case.

The Project will

UNLOCK THE OPPORTUNITY FOR UP TO

160,000 new homes

in Newcastle and the Lower Hunter Valley, the Central Coast and Sydney by 2061, and support a future pipeline of housing across the corridor to relieve housing pressures over time.

SUPPORT AND ATTRACT MORE THAN

99,000 new jobs

in these areas by 2061, by encouraging companies to expand to places that are easier for workers to get to because of faster transport.

BOOST THE AUSTRALIAN ECONOMY BY MORE THAN

$250 billion

(real undiscounted, 2024-25$) by 2086, largely driven by new investment and tourism opportunities.

DELIVER A STEP CHANGE IN CONNECTIVITY AND CAPACITY between the Hunter, Newcastle, the Central Coast and Sydney, relieving pressure on road and public transport corridors, delivering

$12.7 billion PRESENT VALUE (PV) in transport benefits.

Save more than 86,000 tonnes

of carbon dioxide equivalent emissions and generate $90 million PV through shifts from carbon-intensive transport options, laying the foundation for a network that is a cleaner alternative to emissions-intensive air travel.

ESTABLISH A NETWORK OF GREAT PLACES AND PRECINCTS,

designed with Country from the outset, providing new opportunities for people to connect, work and visit.

ACCELERATE PROGRESS TOWARDS

net zero commitments

catalysing economic development and legacy around industries such as those providing low carbon concrete and steel to support the Project's construction.

Generate $16.4 billion

PRESENT VALUE (PV) of productivity benefits.

"It's a project we can't afford not to do, because Australia will lag behind."

Community forum participant, Lake Macquarie

Selecting Newcastle to Sydney as the network's first stage directly addresses a series of strategic imperatives, including transport potential, population growth and housing opportunity, economic development and integration, liveability and quality of life, and environmental impact:

- **A transport corridor in high demand** – Sydney and Newcastle anchor Australia's busiest regional corridor, but current transport options between them are limited, slow and congested. High speed rail, with train speeds up to 320 km/h, will reduce travel times and ease road and rail congestion in the corridor, connecting more people to more places on a highly reliable, fully dedicated line.
- **A high-potential and future focused economy** – The project corridor is home to some of Australia's most dynamic industries – clean energy, advanced manufacturing and defence – anchoring the country's largest regional economy. High speed rail will attract investment, catalyse job creation and expand labour markets to support a transition to future-focused industries and fuel a globally competitive, resilient economy.
- **A rapidly growing population** – Significant population growth is anticipated, with an expected 9.2 million people in the project corridor by 2061. High speed rail will be a critical enabler that opens up more land for housing and eases Sydney's housing pressures. By enabling residents to better access job opportunities and amenities, high speed rail will foster balanced growth beyond Sydney, easing housing demand and supporting sustainable population distribution.
- **An appealing place to live and work** – High speed rail will facilitate affordable housing opportunities across the Central Coast, Lake Macquarie, and Newcastle, enabling these regions to become more vibrant, well connected communities. It will enhance liveability, capitalise on existing appeal, and support the growing city-to-region migration trend through improving access to public services and social opportunities.
- **A leader in renewable energy** – Building on existing corridor initiatives like the Hunter-Central Coast Renewable Energy Zone, high speed rail will advance Australia's net zero targets by shifting demand from road to rail, reducing emissions and supporting sustainable land use. The corridor will serve as a model of climate resilience, and a catalyst for low-carbon infrastructure at scale, positioning Australia as a global leader in emission-free transport and sustainable urban planning and place making.

Including Western Sydney International Airport (Nancy-Bird Walton) Airport (WSI) in the Project provides a first step towards the future connection to Canberra and Melbourne. It also drives patronage through harnessing strong demand for airport travel and significantly enhances the viability of the airport by improving connections with Sydney and the Central Coast.

Nobbys Lighthouse, Newcastle

The case for National High Speed Rail

This Business Case builds on the 2013 High Speed Rail Study, and the more recent NSW Government 2019 Sydney to Newcastle Fast Rail Strategic Business Case, taking account of important changes in the context since those studies were prepared, including:

- Higher population growth forecasts for cities and regional Australia, particularly along the east coast, and a widely acknowledged shortage of housing availability and falling affordability.
- A renewed emphasis on boosting economic development in regional areas.
- The urgent need to meet legislated net zero emissions targets, and a growing focus on sustainability and the need for greater resilience in transport infrastructure.
- Increased rates of interstate and regional travel, particularly by air and car.
- A pronounced shift toward remote working and regional living, enabled by digital technology and spurred on by the COVID-19 pandemic and housing pressures.
- Rapid advancements in technology.

> High speed rail will be a catalyst for growth in the Hunter and Central Coast, opening up significant opportunities for residential and commercial development and allowing people to access more affordable housing outside of Sydney.
>
> By vastly improving connectivity with Sydney, it will make our regions more accessible and competitive.

AMY DE LORE
Hunter and Central Coast
Regional Director
Property Council of Australia

The preferred Project

Building on the network vision, six project objectives were defined to guide the planning and design of the Project.

A comprehensive options assessment, governed by the project objectives and network objectives, has confirmed the preferred stations and route alignment.

The preferred Project performed strongly against the project objectives and network objectives and outperformed the other options under the rapid economic appraisal analysis.

Analysis also highlighted the potential benefit of a staged approach where the line first connects HSR Newcastle Station to HSR Sydney Central Station (Stages 1A and 1B), before a second stage completes the connection to HSR Western Sydney International Station (Stage 1C).

The benefits of dedicated track

Our assessment confirmed that operating entirely separately from existing rail networks, on dedicated new tracks, is the only way to ensure speed, reliability, and operational efficiency that meet the project objectives, allowing the service to perform at its full potential.

A transformative, safe high speed rail product, providing better connectivity and a genuine alternative for customers

Deliver a safe, reliable high-speed rail service that transforms rail capacity and travel time between Sydney and Newcastle, integrates with exisitng transport networks and reduces private vehicle use.

Environmentally sustainable, resilient and contribute to net zero

Design, construct and operate a resilient and sustainable network that minimises and mitigates impacts to the environment, biodiversity and national parks, and contributes to meeting Australia's net zero targets.

More housing choice and great places

Create opportunities for place making, urban renewal, planned growth, greater housing choice and more affordable housing. Create liveable, sustainable places. Support the clustering of commercial, social, cultural and recreational activities to create vibrant places. Explore innovative funding and development partnerships.

Regional and urban productivity, increased tourism and job creation

Support and grow regional and urban productivity, new jobs and industries, by providing fast and efficient access to employment centres and tourist attractions.

Improved community quality of life and equity

Improve accessibility to health, education and support services, particularly for lower socio-economic communities and local heritage. Celebrate and reduce impacts to First Nations peoples' cultural and heritage significant sites.

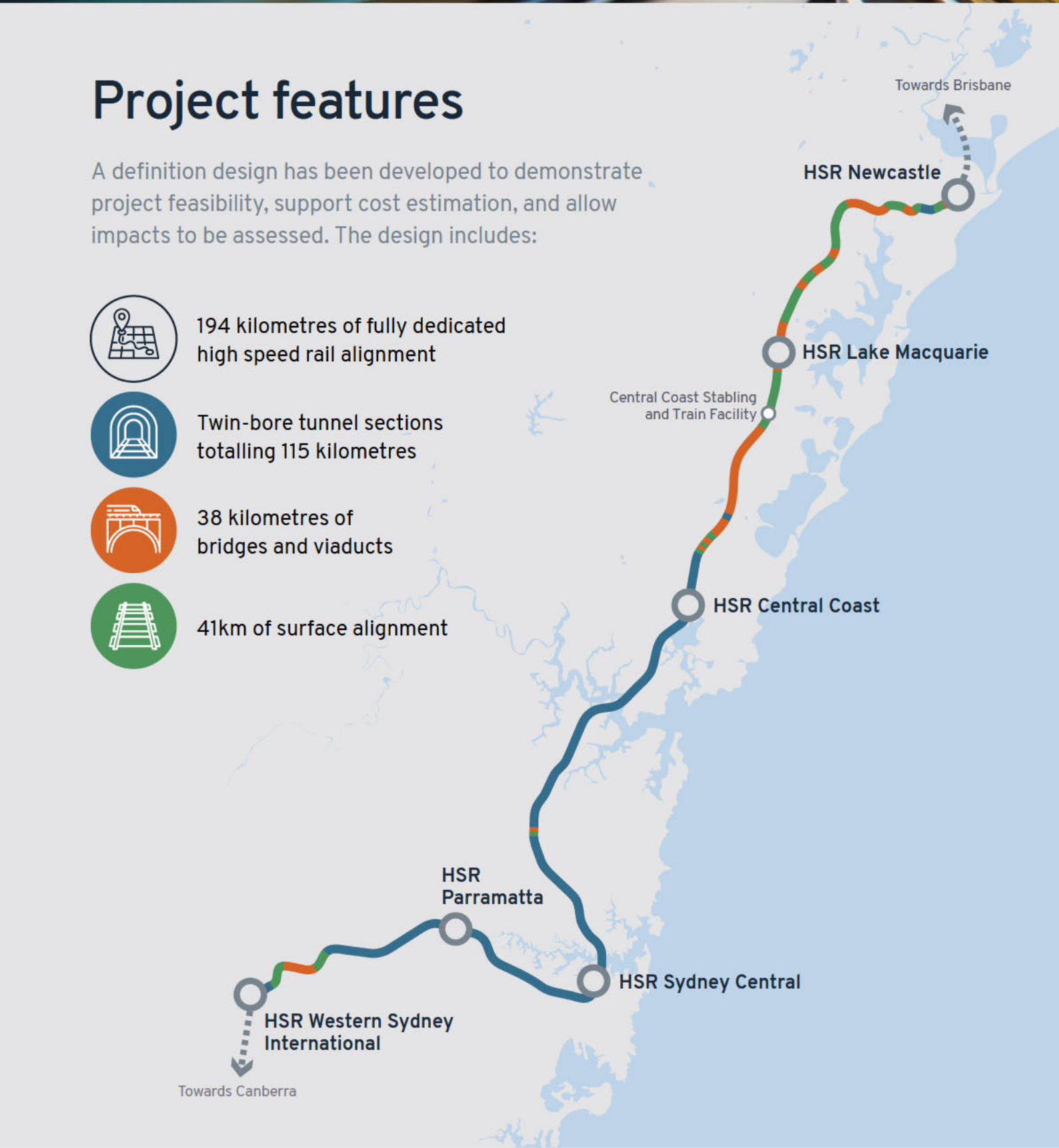
Scalable, innovative, commercially sustainable and value-for-money solutions

Construct and deliver a value-for-money solution with financially sustainable operations to support the long-term success of the high-speed rail network. Ensure efficient, productive and innovative construction that minimises property impacts and supports local manufacturing.

Project features

A definition design has been developed to demonstrate project feasibility, support cost estimation, and allow impacts to be assessed. The design includes:

- 194 kilometres of fully dedicated high speed rail alignment
- Twin-bore tunnel sections totalling 115 kilometres
- 38 kilometres of bridges and viaducts
- 41km of surface alignment



200 metre train and platform lengths.

Maximum travel speeds of up to **320 kilometres per hour** outside tunnels and **200 kilometres per hour** inside tunnel sections.

The fare strategy developed for the Business Case compares favourably with current travel options. This includes rail fares (which are heavily subsidised), coach prices, and car travel when accounting for toll costs.

When broader journey time savings and the benefits of more productive travel onboard are added to these direct cash costs, high speed rail emerges as a significantly attractive mode of travel, offering an unbeatable combination of speed, comfort, and cost.

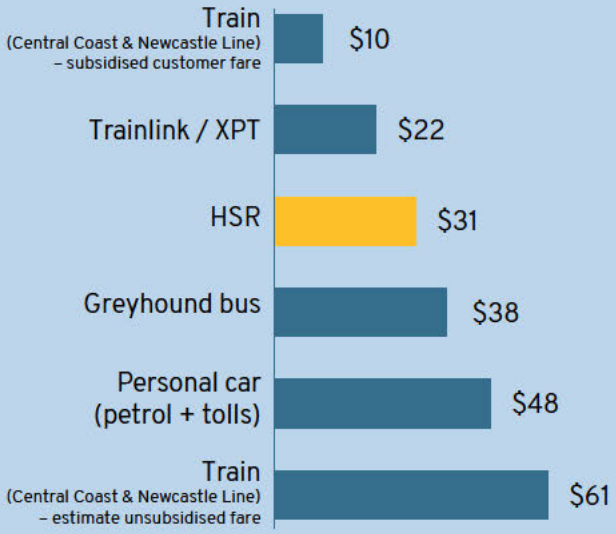
Proposed fares have also been benchmarked against high speed rail services overseas, and are comparable to fares on similar services in Taiwan, China and France, and significantly lower than fares for HS1 in the United Kingdom and the Nagano-Kanazawa services in Japan. The fare strategy will continue to be refined during the Development and Delivery Phases.

Once fully developed, the network will operate a two-tier service model, balancing the diverse needs of customers:

Intercity services: High speed, long-distance services offering express connectivity between major cities, including Brisbane, the Gold Coast, Newcastle, Sydney, Canberra, and Melbourne.

Regional services: Services with more stops to serve regional centres and intermediate locations, servicing city-region journeys such as Wagga Wagga to Canberra, regional cities to capital city services such as Shepparton to Melbourne, and region-to-region services such as the Hunter to the Northern Rivers.

Comparing fares and prices between Newcastle and Sydney (FY25)



> High speed rail was always right for Australia and Newcastle, and the case has only grown stronger. Offering residents more choice for housing, employment, business, tourism and lifestyle. Strengthening connections between Australia's largest city and regional economy, securing productivity dividends for generations.
>
> **ALICE THOMPSON**
> **CEO, Committee for the Hunter**

Stabling, rolling stock maintenance, infrastructure maintenance, and operational control.

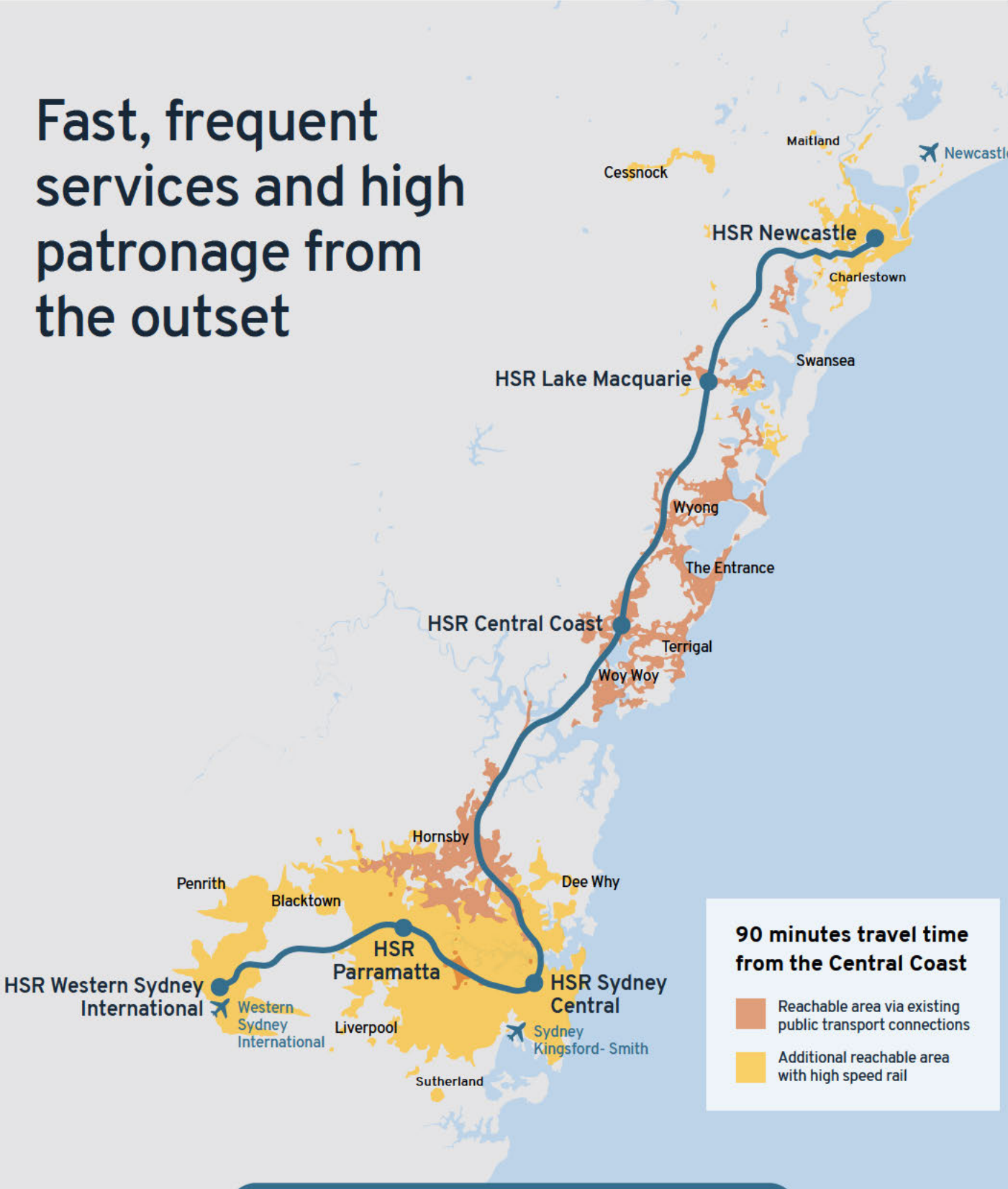
Wi-fi, onboard device charging, bistro, luggage space, and quiet zones.

People in the Hunter Valley and Central Coast would get quick, direct access to 200,000 future jobs at Bradfield and the surrounding Aerotropolis precinct:

- **Central Coast to HSR Western Sydney International:** Less than 1 hour trip time.
- The Project unlocks the full potential of WSI for the Western Sydney economy, creating demand for up to an extra 2.8 million airport customers annually – boosting tourism and international competitiveness.
- Compared to terminating at Sydney Central, the Project to WSI doubles HSR demand: WSI connection increases weekday demand from 30,000 trips without WSI to 72,000 trips with WSI by 2061.

Parramatta Square

Fast, frequent services and high patronage from the outset



Journey time savings

The project will achieve a travel time of around **1 hour** between HSR Newcastle and HSR Sydney Central Stations, and **1 hour and 30 minutes** between HSR Newcastle and HSR Western Sydney International Stations.

By comparison, the existing service takes around **2 hours and 40 minutes** between Newcastle Interchange Station and Central Station.

1:00

Newcastle–Sydney in under **1 hour**

1:30

Newcastle–Western Sydney International in around **1 hour 30 minutes**

Business Class, artist impression

Problems and opportunities

Solving connectivity challenges on the corridor

- Public transport characterised by slow journey times, low reliability and poor customer experience
- Heavy reliance on private vehicles
- Ageing and vulnerable infrastructure.

Enables regional productivity, tourism and jobs

- Poor integration of the Sydney, Central Coast and Newcastle economies
- Economic growth and opportunities concentrated in Greater Sydney
- Precinct upgrades could facilitate improved place outcome
- Local industries and communities in the Hunter are impacted by industry transition
- Opportunity to support net zero industries
- Opportunity to increase visitor economy numbers.

Facilitates a long-term housing pipeline

- Population growth is leading to pressures on housing and infrastructure
- Insufficient well located and affordable
- Limited choice for dwelling types, sizes and price points on the corridor outside of detached housing.

Significant patronage from the outset

Patronage reflects this impressive performance, with over 16 million passengers expected to call at the six stations between HSR Western Sydney International and HSR Newcastle soon after opening, and almost 23 million by 2061.

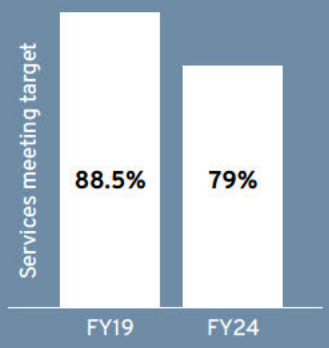
+3.7m
reachable residents

+2.4m
reachable jobs

Trips that start or end at the 6 stations of the Project		
Year	Typical weekday	Yearly
2041	53,000	16,800,000
2061	72,000	22,700,000

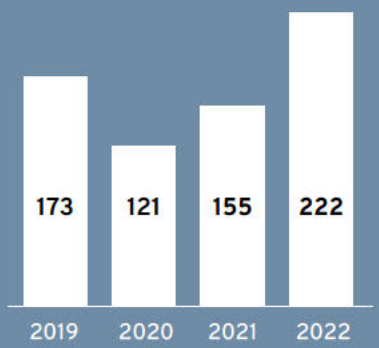
Existing travel options

Declining Central Coast and Newcastle Line punctuality and performance



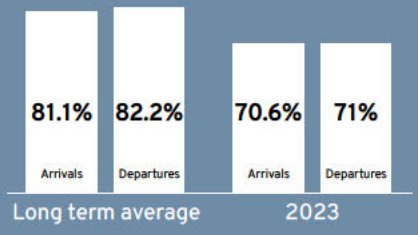
Punctuality performance target is 92% of peak services arriving within 6 minutes

Vehicle collisions and crashes increase as traffic volumes rise, compounding the reality impacts of growth traffic congestion



Annual crashes on the M1 Pacific Motorway between Hornsby and Newcastle

Below average on time performance from Australian airlines



A flight is "on time" within 15 minutes of the carriers' schedule

Operational cost recovery from Opal fares makes up only

The remainder is heavily subsidised by Government and taxpayers

A new travel option

Artist impression

A compelling service

With a minimum frequency of 3 trains per hour (a train every 20 minutes) and up to 6 trains per hour at busier times (or a train every 10 minutes) the service will support regional development and enable people to travel when they want.


Artist impression

Vibrant precincts

As well as providing seamless integration with public and active transport, the new high speed rail stations will establish a network of great places and precincts, providing new opportunities for people to connect, work and visit. Stations designed with Country from the outset will become inviting public spaces – places which people truly enjoy being in and which celebrate culture and community – encouraging activation in their surroundings.

"I look at this, that this is for my 6 month old granddaughter. That needs to be part of how this is communicated. That's what it is about. The legacy."

Community forum participant, Gosford

A journey on National High Speed Rail

World-class trips for customers

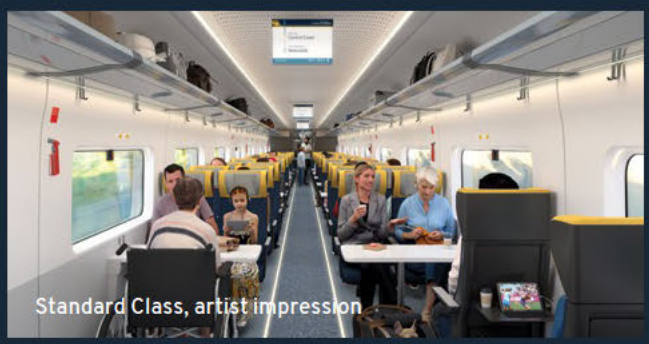
A superior on-board experience would be provided across two travel classes, providing flexibility to select an experience that suits different preferences and budgets.

Customers in standard class would enjoy a comfortable and efficient travel experience with modern reclining seats, ample leg room and designated quiet zones for relaxation and focused work. Business class tickets would offer enhanced comfort with spacious ergonomic seating and additional amenities.

Onboard amenities, such as power to charge personal devices, real-time passenger information displays, internet connectivity and streaming entertainment would keep passengers connected, informed and entertained.

The onboard bistro would keep passengers refreshed with a selection of food and beverages. Meanwhile, the trains' aerodynamic design and advanced technology would ensure a smooth, quiet and efficient ride.

Interior layouts will balance seated capacity and customer amenities, accommodating between 400 and 520 seated passengers—comparable to contemporary high speed trains in Europe and Asia—with the eventual design configuration optimised to match passenger demand forecasts, customer preferences and route lengths.


Standard Class, artist impression

Our vision is that by 2060, Australia's east coast will be connected by a world-class high speed rail network, extending over 1,800 kilometres between Brisbane, Sydney, Canberra and Melbourne. Dedicated tracks will enable speeds of up to 320 km/h, with unparalleled reliability, and a quiet, pleasant onboard experience.

Dedicated infrastructure:

A dedicated high speed rail network is essential for delivering the performance and reliability that make high speed rail so effective. Unlike conventional rail, which relies on aging, multi-use tracks shared by freight and passenger services, high speed rail operates on exclusive tracks designed specifically for uninterrupted travel. This dedicated infrastructure removes speed constraints, reduces conflicts, and minimises disruptions, ensuring speed, reliability, and operational efficiency.

This dedicated infrastructure will ensure seamless operations, free from conflicts with freight and conventional passenger services, enabling the network to reach its full potential. By separating high speed rail from existing rail corridors, it maximises reliability, capacity, and commercial viability—further enhancing the benefits of a purpose-built high speed rail system. Evidence shows that upgrades to existing networks, while valuable, cannot deliver the transformational journey time reductions required to unlock the full potential for growth in key regions.

Only a purpose-built system can achieve the speed, reliability, and connectivity needed to activate these opportunities and drive significant economic and social benefits.

Journey times (twice as fast as travelling by road) will encourage people out of cars and planes. In the first phase alone, travel time from Newcastle to Sydney will be around an hour, while trips between the Central Coast and Sydney or Newcastle will fall to just half an hour. As the network progressively expands, a trip from Canberra to Sydney will be cut to around an hour and a half, while journeys from Sydney to Brisbane, or to Melbourne, will be cut to around four hours.

The high speed rail network will deliver a two-tiered system tailored to meet customer needs, ensuring fast, reliable, and flexible connectivity across the east coast. With express services linking major cities and regional services enhancing access to smaller hubs, the network is designed to evolve with changing passenger demands while setting new benchmarks for speed, capacity, and reliability.

Underpinning a new economic multi-city region

The Project will deliver important economic benefits that span transport, industry and the environment, while laying the foundation for a full east coast network.

The Project's unique ability to enable a step change in access to housing is fundamental to its economic impact. It will support the creation of a new 'Multi-city Region' in the project corridor, allowing the currently independent centres to function as a combined regional economic entity.

This Project represents the initial stage of an extended pipeline of work that would see the national high speed rail network delivered progressively over a number of decades. A secure pipeline would enable the implementation of local manufacturing and support the establishment and development of new regional high speed rail related industries, providing new jobs and opportunities along with wider economic benefits.

The Project's economic impact can be conceptualised as a three-step process:

1. A step change in connectivity.
2. This unlocks economic, investment and place-based opportunities in high speed rail station catchments.
3. Unique to high speed rail, transformational change in access to well located, diverse and affordable housing in the Sydney Greater Metropolitan Area by creating a 'Multi-city Region', enabling more people from across the corridor and the wider Greater Metropolitan Area to access more affordable housing in the corridor.

The economic appraisal demonstrates the extent of these benefits.

"The project could reframe how people consider where they live and work, and to bring people closer to jobs and services."

Community forum participant, Hunter Valley.

A full-spectrum boost to productivity

The Project will directly support productivity by:

Enabling people to work as they travel with excellent wi-fi facilities.

Reducing door to door journey times.

Reducing road congestion and delivering other road user benefits.

Enabling businesses to choose regional locations with lower overheads and a readily available workforce.

Bringing firms and workers closer together to support knowledge-sharing and agglomeration.

Enabling people to live in affordable housing but retain competitive travel times to employment, education and medical facilities.

Increasing local manufacture in line with the Made in Australia policy.

Increasing tourism and leisure travel through improved services and travel times.

Without high speed rail, future productivity will be stifled by inefficient travel times and increasing congestion, limiting employment access and constraining workforce mobility.

An artist impression of a high speed rail precinct

Advanced manufacturing facilities that maximise delivery efficiency

The Project will be the first in Australia to fully embed advanced manufacturing techniques – a vital innovation that will drive significant efficiency. Advanced manufacturing integrates cutting-edge technologies such as automation, robotics and additive manufacturing to enable the production of highly specialised rail components with greater precision and durability.

Advanced manufacturing facilities will produce repeatable, pre-manufactured parts offsite, supplying a complete, ready-made 'kit' of engineered components for each element of the high speed rail infrastructure (for example, modular segments of tunnel lining).

Several separate facilities will be implemented to develop components for each of the different elements and maximise efficiencies, including facilities with manufacturing lines, assembly lines and consolidation lines. Each will be designed to allow for ready adaptation to meet the future demands of delivering the high speed rail network.

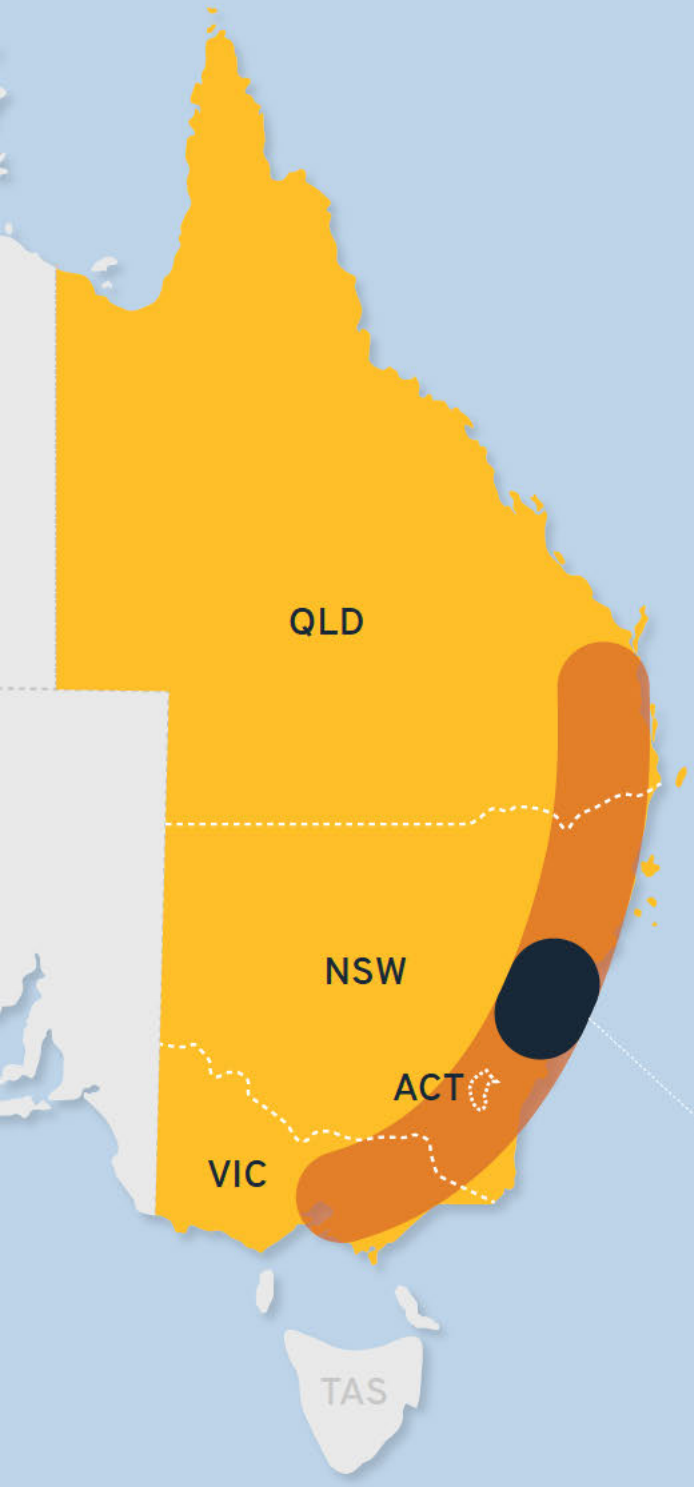
These innovations will reduce construction timelines, cut transportation costs and boost delivery certainty. They will also support the Project's sustainability objectives through increasing energy-efficiency and minimising waste.

Beyond the obvious benefits for the Project's bottom line, advanced manufacturing presents a unique opportunity to support local industry and drive skills development and employment. It will generate new job opportunities, direct and indirect, ranging from skilled tradespeople to engineers and technicians, supporting local industries and improving construction productivity in major cities and across the region. Meanwhile, training programs set up to prepare for advanced manufacturing will equip people with future-ready skills to ensure long-term career pathways in a high-growth sector.

By harnessing these innovations, the Project will not only set a new benchmark for rail infrastructure, but will help position Australia as a global leader in construction and manufacturing.

Explainer: Australia's population challenge.

Australia's growth is outpacing many developed countries around the world. The East Coast's population will increase 33 per cent by 2051, or an extra 7 million people.



East Coast Australia

21.5m
Current population

28.5m
2051 population

↑33%

+7m
people

By 2051

11% ↑
United States and New Zealand

10% ↑
United Kingdom

16% ↓
19 million fewer people in Japan

East Coast Corridor

60%
of Australian population

2%
of the land mass

104
people per square kilometre

NEWCASTLE-CENTRAL COAST-SYDNEY
624
people per square kilometre

High Speed Rail Countries

United Kingdom
279/sq km

Japan
339/sq km

France
124/sq km

Spain
95/sq km

Find out more

ES24

Economic appraisal results

Table 1 Core economic appraisal results ($m, real, excluding escalation, 4% discount rate, 2024-25$, 50-year appraisal period)

	Project	Stages 1A and 1B
Total economic benefits	50,800 - 59,700	38,100 - 47,000
BCR	0.8 – 1.0	0.9 – 1.2

Bar Beach, Newcastle

A new approach to delivery

The Project's robust, market-tested delivery strategy, informed by expert analysis and industry engagement, will ensure the Project is delivered more efficiently and productively than previous mega projects. Informed equally by past successes and recent challenges, this new approach will reduce risk and improve certainty on cost estimates.

Packaging and staging that responds to market capacity

The approach to packaging includes a combination of discipline-based and geographical packages designed to align with market capability, reduce interfaces and provide opportunities for private financing. This approach is specifically designed to mitigate the kinds of market capacity challenges that have emerged in the delivery of previous mega projects and reflects wider global high speed rail experience.

The packaging strategy has been configured around a staged delivery approach, illustrated below – where services would commence between HSR Newcastle to HSR Central Coast two to three years before services are extended to HSR Sydney Central, and subsequently to HSR Western Sydney International.

Taking the time to plan and prepare

Learning from high-profile mega project challenges, an upfront two-year development phase will allow appropriate time to plan and execute a project of this complexity and scale, reduce risks prior to delivery and to lay the groundwork for substantial productivity improvements.

During this period, proponents from each package will participate in an Early Contractor Involvement process to develop a Scheme design, appropriate specification, and detailed program and budget for delivering the works.

Procuring effectively and incentivising performance

The procurement model will be tailored to the specific characteristics and risk profile of each individual package. The High Speed Rail Authority will adopt a lean and agile structure, supported by a project integration partner to manage interface risks across multiple packages. A consistent approach to contracting will be adopted across all packages where possible using a Hybrid Incentivised Target Cost approach.

Applying global best practice to boost productivity in delivery

Instead of adopting complex, bespoke designs, the Project will adopt a proven and trusted approach, building on success of high speed rail operations around the world. This approach:

- Minimises works in brownfield locations.
- Makes extensive use of digital tools to design and manufacture components, with a single Building Information Model across the whole Project.
- Harnesses Early Contractor Involvement for all major contracts and outcomes to create genuine opportunities for innovation.
- Mandates modularisation, standardisation, and repeatability, along with targeting speed and simplicity of construction to reduce construction time and increase quality of outcome.
- Mandates use of Modern Methods of Construction to maximise off-site manufacture.
- Invests in state of the art Advanced Manufacturing Facilities which support Modern Methods of Construction and can be used for other projects in future.

These measures will improve safety, significantly reduce risks and increase productivity not just for high speed rail but for other projects once this new way of working is established for the construction industry. Feedback from industry has been very positive, and support for the approach is overwhelming.

"I'm excited about high speed rail ... You could move to live in a house in Newcastle and commute to Sydney to work. Sometimes it takes me 45 minutes from Glebe to the city on a bus. It would be good for regional centres to get away from Sydney CBD. It could be good for house prices because people have more options of places to live."

Female, 18-39, Sydney focus group

Partnering with industry to deliver

Project cost estimates

The Project's operational and renewal costs are covered by revenue under most scenarios assessed. The operating cost recovery ratio is forecast to increase over time as increased patronage drives revenue growth.

The cost of the two-year Development Phase is estimated at around **$650 million** for Stages 1A and 1B, excluding property acquisition costs.

The total Delivery Phase cost, based on recent market data and benchmarked against high speed rail projects in Spain, the United Kingdom, and the United States of America, is estimated to be **$61.2 billion** (nominal, P90) for Stages 1A and 1B and **$32.4 billion** (nominal, P90) for Stage 1C, before financing.

Delivery Phase costs include direct and indirect costs, project delivery costs, rolling stock, property, risk and contingencies and escalation.

Investing differently

To help make this investment manageable for government and taxpayers, two different potential funding and financing strategies have been explored:

- **Privately Financed Packages approach:** under this model, a PPP model would be used for some infrastructure packages, in which private finance is used to maximise value for money, with PPP delivery for key alignment-wide packages and rolling stock (in line with the delivery strategy) plus private finance potential for stations and over station or adjacent station developments.
- **Annual Investment Cap approach:** under this model, government investment would be capped at around $5 billion per annum (for Stages 1A and 1B) during the Delivery Phase, with the remaining capital funded through a combination of private construction finance for the major tunnel and civil infrastructure packages and the use of PPP packages as above. This would give government and taxpayers investment certainty on an annual basis, and would define a new investing model for mega projects in Australia.

Further value sharing opportunities

The transformational nature of the Project provides opportunities to share the value created through additional interventions by Commonwealth, State, and Local governments. Examples could include additional development contribution schemes, broad-based betterment levies and increased involvement in station and precinct development and leasing.

To date, two such measures have been quantified, and while they are not included in the financial appraisal, it is estimated that these alone could potentially contribute between [redacted] on average per year in Stages 1A and 1B, and between [redacted] on average per year for the Project.

Defining the long-term planning horizon for the national high speed rail network

Representing less than 1% of the annual Commonwealth budget, making a long-term commitment to the annual investment cap envisaged here would give sustainable budgetary clarity that would allow delivery of the full high speed rail network in logical stages, with an investment pipeline that spans across electoral cycles. Avoiding costly stop-start delivery, it would provide the line of sight that inspires confidence among stakeholders and industry to invest for the long term, while ensuring the major local manufacturing opportunities and economies of scale inherent in the proposition can be realised.

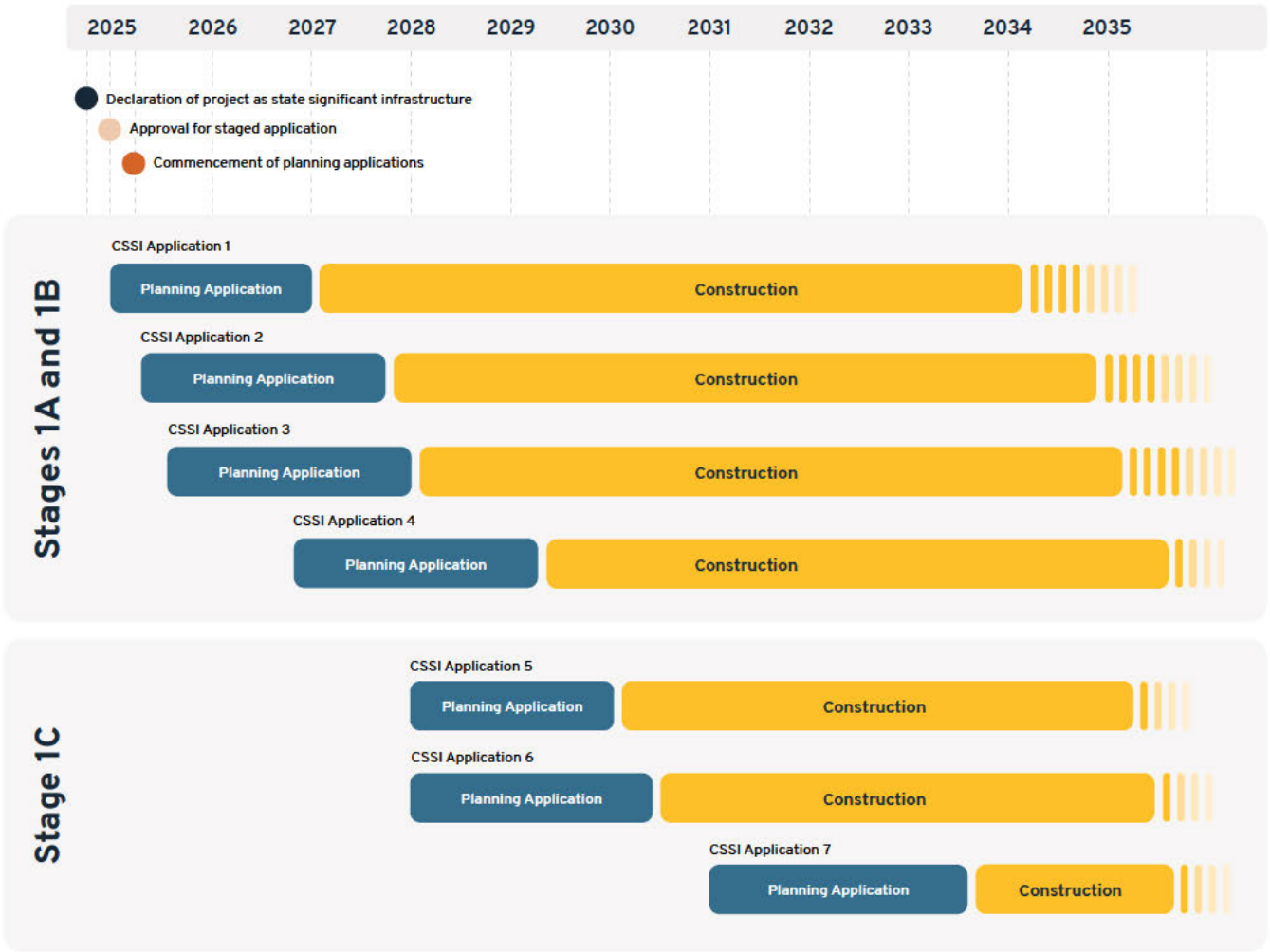
Securing approvals for the Project

The scale and complexity of the Project means that securing planning and environmental approvals will be a significant task, requiring various planning legislation, approvals and development pathways, navigating potential impacts on sensitive environmental features and Aboriginal and non-Aboriginal heritage features, and delivering on net zero commitments.

A Planning Approvals Strategy has been developed for the Project in consultation with relevant Australian and NSW Government agencies and in line with relevant legislation. It includes:

- Declaration of the Project as State Significant Infrastructure and Critical State Significant Infrastructure.
- A staged infrastructure application under the *Environmental Planning and Assessment Act 1979 (EP&A Act)* for HSR Newcastle to HSR Western Sydney International via Sydney.
- Subsequent staged State Significant Infrastructure (SSI) and *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* applications for sections of the Project.

The timeline for approvals and construction is illustrated below:



Geotechnical drilling on Hawkesbury River, October 2024.

Community engagement, Lake Macquarie, September 2024.

A strategy for meaningful engagement that de-risks delivery

Early stakeholder engagement with all levels of government, industry and peak groups, community and First Nations representatives, has raised awareness and momentum and shaped Project development.

Feedback from early engagement has identified strong support for the Project among stakeholders and community members and reflects the benefits high speed rail could deliver in unlocking significant opportunities for local and regional communities – particularly across housing and jobs. Of the 1,357 participants initially surveyed, 86% indicated they would travel on a future Newcastle to Sydney line and 85% indicated they would use high speed rail to travel across other cities and regions if the option was available.

Several findings from early engagement have directly shaped the Project:

- Reflecting community desires for the Project to reflect community needs, the alignment was shifted to areas experiencing significant housing and employment growth, including areas with planned growth at Broadmeadow and Morisset.
- Government agency representatives encouraged the Authority to consider strategic land use to enable economic regional development opportunities, prompting the Authority to coordinate with NSW government agencies to integrate strategic land uses and transport planning.
- Key stakeholders and peak bodies communicated their support for high speed rail connecting to Western Sydney International Airport, Newcastle Airport and other key travel hubs across Sydney and Western Sydney, encouraging the Authority to investigate a station at Western Sydney International Airport as part of the first stage of the network.

Strong engagement with First Nations stakeholders has helped to:

- Identify First Nations culture and significant heritage sites.
- Capture First Nations narratives for sites across the project corridor.
- Incorporate infrastructure into planning and designing for Country.

Next steps are to continue to engage with stakeholders and First Nation stakeholders and develop an engagement framework to support planning approvals and property acquisition.

"High speed rail is an enabler of economic development. Overseas, the stations create mini-cities, and this is a great opportunity for the Central Coast."

Community forum participant, Central Coast

The National High Speed Rail Hub, our community information centre, was officially launched in central Newcastle on 13 December 2024.


Australian Government
High Speed Rail Authority
high speed
More job and lifestyle choices
Greater housing options

How the Project design has responded to challenges and opportunities

Tunnelling

Sections of the alignment pass through environmentally significant areas, including Ku-ring-gai Chase National Park, Brisbane Water National Park, the Western Sydney Nature Reserve and the Hawkesbury River. The tunnelled sections of the Project avoid significant environmental risks and preserve these environments.

Intermediate Stations

Several intermediate station options were explored between HSR Central Coast and HSR Newcastle as mechanisms for adding more capacity for housing and picking up a larger population catchment along the corridor. Morisset was identified as the preferred intermediate station location due to significant land availability and its close proximity to the M1 Pacific Motorway interchange which facilitates connectivity to the greatest population across the Hunter.

Staging

Staging significantly reduces annual spend by extending capital expenditure across a longer period and reducing the Project's inflationary potential. Without staging, peak infrastructure spend for the Project would exceed previous peak transport spend in eastern Australia by 50 per cent. Staged delivery is proposed to minimise the impact on the market and create opportunities for early opening and testing.

Value engineering

A systematic approach was undertaken to enhance the Project's value by refining cost through design improvements while maintaining the overall outcomes and functionality. Several value engineering opportunities have been included in the cost plan, such as merging two stabling facilities into a single facility at Central Coast, optimising the designs of HSR Central Coast Station and HSR Lake Macquarie Station, and using Advanced Manufacturing Facilities to drive significant efficiencies through modular, repeatable elements.

Environmental risks have been uncovered, avoided where possible, and mitigation strategies identified

Preliminary environmental assessment has informed the Project's design. Major risk areas such as surface-level impacts to national parks and other sensitive areas have been avoided entirely, and strategies are in place to avoid and mitigate residual risks as detailed design is developed.

> The Committee offers its full support, and any assistance required to the High Speed Rail Authority and the Australian Government in the consideration of this business case that is critical for the first stage of this transformational project that will connect the two largest cities in New South Wales to Sydney.

ANNA CRUCKSHANK
Acting Chair
Regional Development Australia Central Coast, NSW

Artist impression

Next steps: undertaking a Development Phase

The Authority has applied the lessons learnt from recent mega project delivery in Australia and worldwide, and is ready to take the next steps towards delivery of the Project.

Initially this involves a two-year Development Phase to further develop the designs, cost and schedule while collaborating with stakeholders, industry and the community. This phase will assist government in providing a more refined cost and schedule for the Project, developed in collaboration with industry, to reduce uncertainty and risk before commencing the Project's Delivery Phase.

The Development Phase will include:

- Putting in place the legal and regulatory arrangements necessary to support land acquisition and other aspects of project delivery.
- Securing planning approvals, corridor preservation and property acquisitions.
- Establishing a lean client model suitable for procurement of the Project.
- Undertaking Early Contractor Involvement processes with industry and collaborative design to develop the Project further.

High Speed Rail Authority

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COVER IMAGES: Artist impressions

Australian Government

High Speed Rail Authority

Contents

Chapter 1

Introduction and vision

Australian Government
High Speed Rail Authority

The compelling vision for high speed rail

- High speed rail is a nationally significant opportunity. It connects cities, regions and communities and brings people and places closer together – delivering generations of opportunities. High speed rail provides faster and more reliable connections than current options, and it creates more jobs in more locations, giving people more choices in where they live, work, study and play.
- A first stage between Newcastle and Greater Sydney will enable the necessary step change in connectivity between the two largest cities in NSW.
- This Business Case builds on the 2013 High Speed Rail Study – Phase 2, and work undertaken since, and determines important aspects of the new rail line including the proposed alignment, station locations, the type of train to be used, and the estimated cost and timeframe for delivery.
- Project objectives have guided planning and design for the Project. The project objectives are consistent with the objectives of the Network.

1.1. Introduction

The Australian Government's High Speed Rail Authority (the Authority) is planning for a future high speed rail network (the Network) which will strengthen connections between Brisbane, Sydney, Canberra and Melbourne, and activate the economic potential of regional communities across the east coast of Australia.

The Network will move thousands of people an hour between major cities and regional centres on new world-class trains, at speeds up to 320 kilometres an hour. Services will be reliable, comfortable and frequent.

The Minister for Infrastructure, Transport, Regional Development and Local Government highlights the instrumental role this Network will play in "improving the lives of Australians by supporting shifts in population settlement, better connecting skilled workers with major job centres, and putting us on a pathway to achieve our ambitious carbon reduction targets".

1.1.1. A staged approach to ensure success

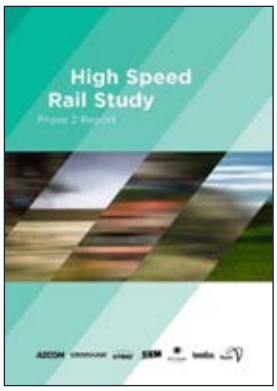
The Network is a generational undertaking which will necessarily be delivered in stages. This Business Case concerns the Network's first stage – the Newcastle to Sydney High Speed Rail Project (the Project), which will provide a fast, reliable and regular link between the two largest cities in NSW which form a nationally significant corridor.

The Project will dramatically reduce journey times. Trips from Newcastle to Sydney will fall to around an hour, while trips from the Central Coast to Sydney or Newcastle will fall to 30 minutes – more than halving current journey times. As the Network evolves, services will connect Canberra to Sydney in around 90 minutes, while intercity connections, such as from Sydney to Brisbane or Melbourne, will fall to about 4 hours.

This Business Case outlines the case for investing in the Project and determines critical aspects of the new rail line, including proposed station locations, the rail alignment that will connect them, the type of trains which will serve them, and estimated costs and timeframes for delivery. The Business Case is accompanied by a Product Definition Report which provides an overview of the Network as a whole.

1.2. Background and history

1.2.1. High Speed Rail Study



The Australian Government's 2011 to 2013 High Speed Rail Study was the last major investigation into connecting Australia's capital cities by high speed rail. It demonstrated that high speed rail is economically viable, technically feasible and has the potential to transform how Australians live, work and travel.

The 2011 Phase 1 study identified a short list of potential corridors and stations, assessed the likely range of costs, estimated future patronage levels, and considered the potential social and regional development benefits of a high speed rail network.

The 2013 Phase 2 study built on the work completed during Phase 1 and refined the Phase 1 scope and estimates.

1.2.2. Fast Rail Strategic Business Case

During 2019, Transport for NSW (TfNSW) and the Department of Infrastructure, Transport, Cities and Regional Development, jointly developed the Sydney to Newcastle Fast Rail Strategic Business Case, with support from the NSW Department of Premier and Cabinet and the NSW Fast Rail Panel. The Strategic Business Case confirmed the case for intervention and identified the best performing options as:

- Fast rail – A hybrid alignment making use of sections of existing rail track to access population and employment centres. The Strategic Business Case identified potential for this option to deliver significant travel time savings and encourage denser urban development around key hubs.
- High speed rail – A new, fully independent high speed rail alignment between Greater Sydney and Newcastle with new stations along the route. This option would deliver major travel time savings and system reliability improvements, with potential to support significant land use change, following rezoning, given careful selection of station locations.

1.2.3. Changes in the wider context

Since these earlier studies were completed, there have been important developments in the following areas:

- Higher population growth forecasts for cities and regional Australia, particularly along the east coast, and a widely acknowledged crisis of housing availability and affordability.
- A renewed emphasis on boosting economic development in regional areas.
- The urgent need to meet legislated net zero emissions targets and a growing focus on sustainability and the need for greater resilience in transport infrastructure.
- Increased rates of interstate and regional travel, particularly by air and car.
- A pronounced shift toward remote working and regional living, enabled by digital technology and spurred on by the COVID-19 pandemic and housing pressures.
- Rapid advancements in technology across all aspects of people's lives.

1.2.4. Taking high speed rail forward

The Authority is taking an important step towards delivery of high speed rail in Australia. The Australian Government committed $500 million to the early stages of developing high speed rail, including $78.8 million to deliver this Business Case.

Together with the accompanying Product Definition Report, this Business Case builds on the 2013 and 2019 studies and the work since that time. It has been informed by the insights of world-leading experts, and shaped by extensive consultation with stakeholders and industry. The documents set out a clear and compelling high speed rail vision, fit for Australia's current context and the future it deserves, and the initial stage for delivery.

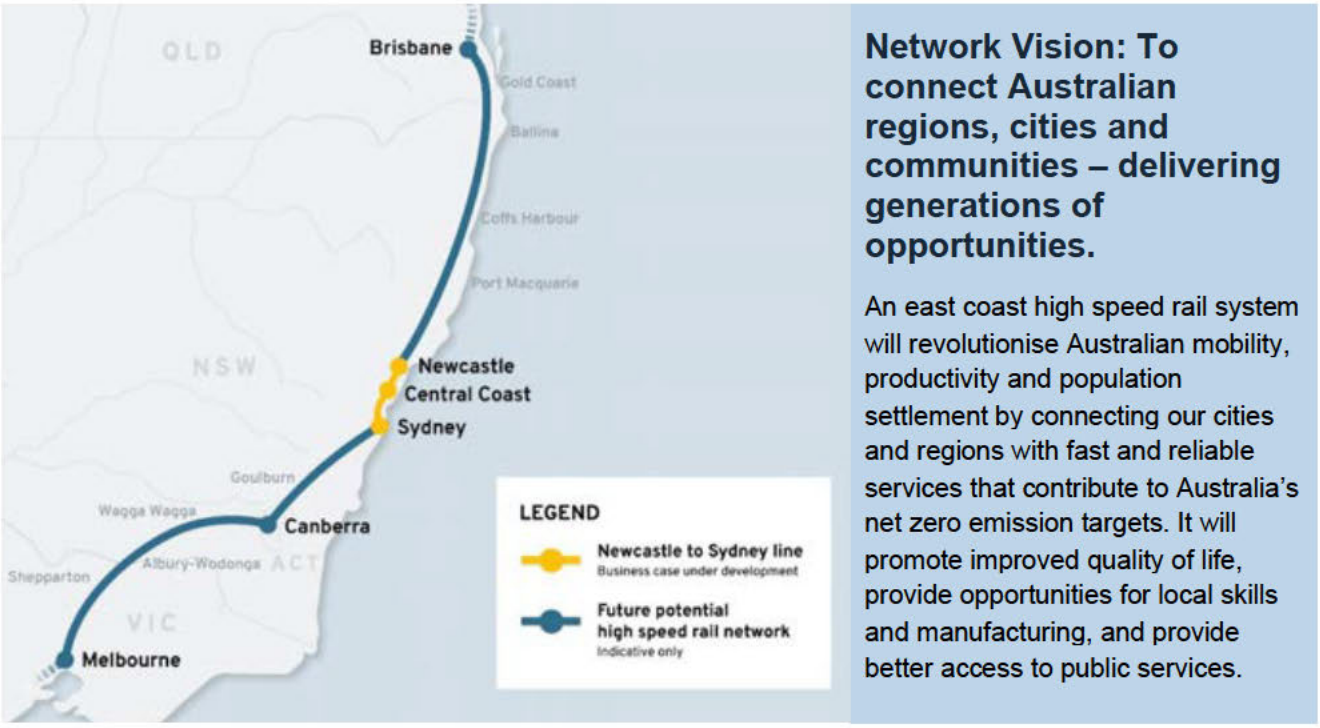
1.3. The vision for the Network

The Network is an investment in a stronger Australia. Its transformational benefits include:

- Boosting productivity, tourism and jobs in regional and urban areas.
- Delivering a step change in housing accessibility and choice.
- Improving quality of life and social equity.
- Supporting Australia's transition to a net zero economy and catalysing new green industries.
- Providing the most economically productive corridor with better connectivity to meet future needs.
- Supporting the opportunity for more efficient freight paths.

The vision for the Network is summarised below.

Figure 1-1 Network map and vision



Network Vision: To connect Australian regions, cities and communities – delivering generations of opportunities.

An east coast high speed rail system will revolutionise Australian mobility, productivity and population settlement by connecting our cities and regions with fast and reliable services that contribute to Australia's net zero emission targets. It will promote improved quality of life, provide opportunities for local skills and manufacturing, and provide better access to public services.

The Network Vision is supported by the six high speed rail network objectives outlined in the following figure.

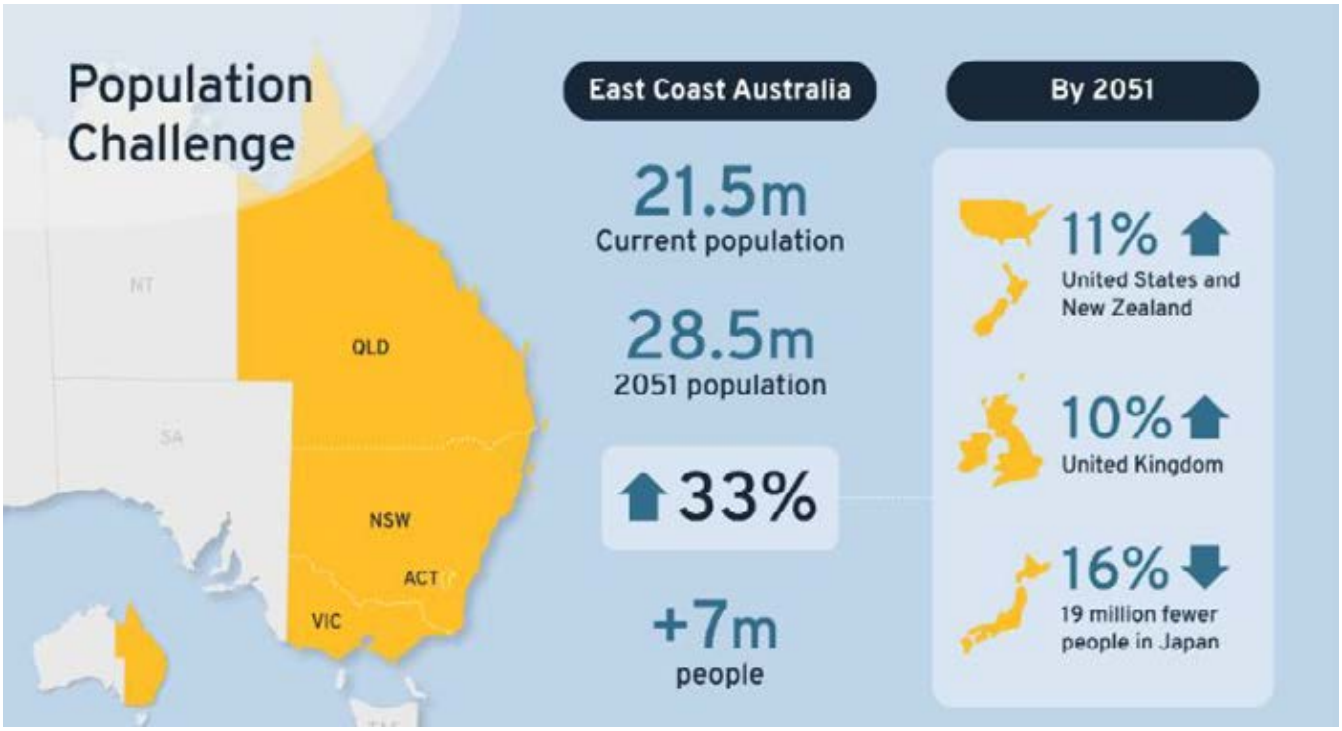
Figure 1-2 Network objectives

Together with the Project's objectives which are described below, the Network's vision and objectives will guide decision making around critical high speed rail choices, such as the selection of the rail corridor, station locations, route alignment, rolling stock, rail systems, service specification, fare strategy and staging.

1.3.1. Responding to a rapidly growing population

The east coast of Australia is home to over 21.5 million people – nearly 80 per cent of the nation's total. By 2051, the population will grow by a third to 28.5 million people, ramping up the pressure on the largest cities and regional centres. The pace of this growth will vastly outpace many developed countries around the world.

Figure 1-3 Australia's population challenge



The east coast is also the powerhouse of Australia's output, comprising some of the country's most diverse and dynamic economies, and contributing $1,850 billion or 72 per cent to GDP.[1] Its thriving knowledge industries, manufacturing, tourism and production are supported by critical infrastructure such as ports, airports, tertiary education and vocational training, and healthcare facilities.

At the same time, global megatrends – including urbanisation, technological advancements and climate change – are reshaping travel demand and infrastructure needs.

By reducing travel times and enhancing connectivity, high speed rail will create new economic opportunities, supporting clustering and enhancing productivity, expanding labour markets and improving access to essential services like education and healthcare. It will cement the status of Melbourne, Sydney and Brisbane as global economic powerhouses, while revitalising regional cities and supporting visitor economies.

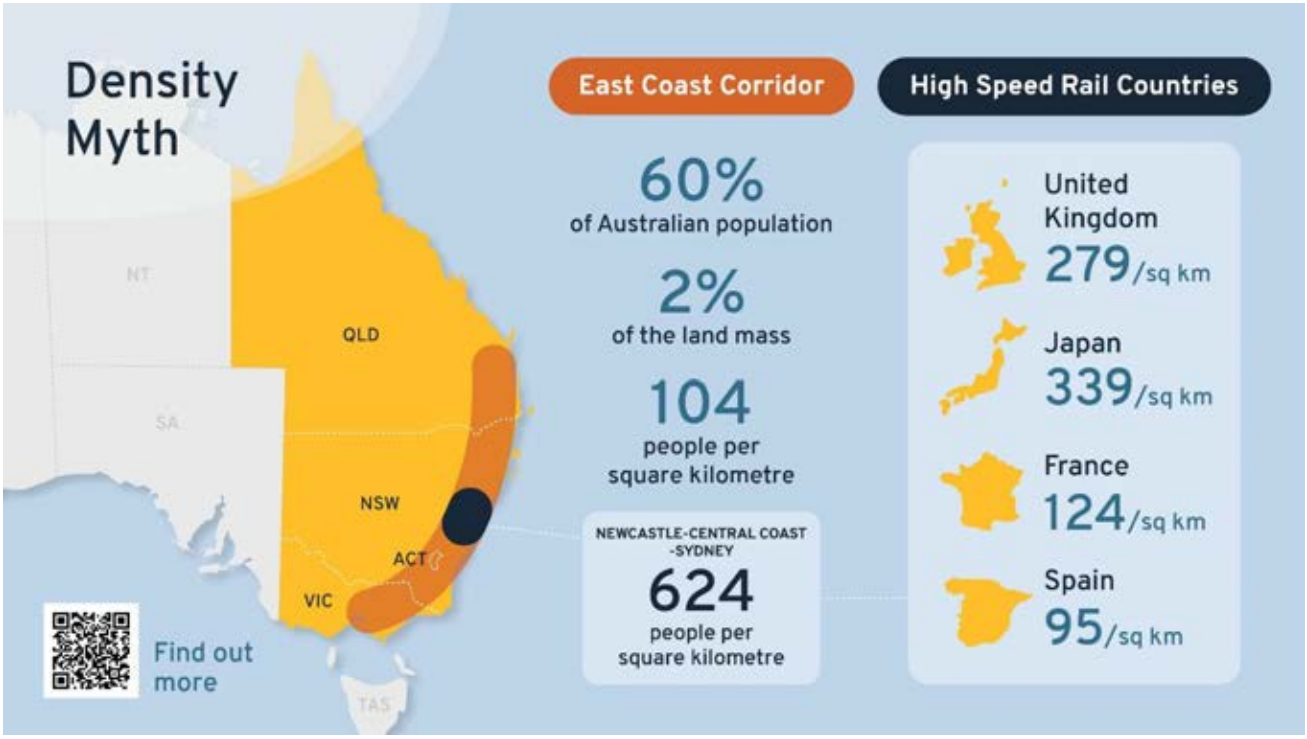
International examples (such as Lille's thriving Euralille business hub) show how high speed rail, when paired with complementary investments, can support population growth, stimulate business activity and rejuvenate town centres.

1.3.2. The 'density myth'

The east coast has more than sufficient density to support the Network. The east coast corridor is not only the most densely populated part of Australia, containing 60 per cent of the nation's population on just 2 per cent of its land mass, but it compares very favourably to the density of international locations where high speed rail networks have already been implemented.

The Newcastle to Sydney corridor has a population density of 624 people per kilometre. This is more than twice the density of the Spanish high speed rail corridor between Barcelona and Zaragoza which has a population density of 244 people per square kilometre, suggesting the corridor is primed to benefit from high speed services.

Figure 1-4 Density myth



1.4. The Project and the Network

The Network will be a long term pipeline of staged infrastructure investment, one of the most significant in the nation's history. It will deliver a modern, sustainable transport system that benefits future generations.

Expanding their networks by 70 to 120 kilometres each year, Spain and France have proven the value of phasing the delivery of high speed rail networks. Australia's network will be rolled out through a similar phased approach, designed to:

- Deliver early benefits – such as reduced travel times, housing growth, and job creation – often before each phase is fully operational and well ahead of the Network's completion.
- Optimise value and drive innovation by leveraging design efficiencies, modern construction methods, advanced manufacturing and long term industry partnerships.
- Build a long term investment pipeline, fostering new skills and technologies that can seamlessly transfer to subsequent stages, and providing unprecedented opportunities for industries and workers.
- Create opportunities for scalable, repeatable packages that attract all tiers of industry, promote competition and ensure world-class delivery for each phase.

This Project – the first stage of the Network – will connect Newcastle to Greater Sydney, enabling the whole region to tap into Sydney's wealth of opportunities, services and experiences, while creating the potential for new offerings beyond.

1.4.1. Why Newcastle to Sydney first?

The Newcastle to Greater Sydney corridor (the project corridor) presents a unique opportunity for the first stage of the Network, as it links the country's preeminent global city and its largest regional economy.

- **Sydney and Newcastle anchor Australia's busiest regional corridor, but current transport options between them are limited, slow and congested.** There are nearly 15 million annual rail trips, some taking up to 3 hours, while there are 31.5 million annual trips through the busiest part of the M1 Pacific Motorway, including between Newcastle, Lake Macquarie, the Central Coast and Sydney. High speed rail, with train speeds up to 320 kilometres an hour, will reduce travel times and ease road and rail congestion in the corridor.
- **Significant population growth is coming – but it will be unevenly distributed.** With an expected 9.2 million people in the project corridor by 2061, high speed rail will be a critical enabler to open up more land for housing and ease Sydney's housing pressures. Facilitating housing opportunities across the Central Coast, Lake Macquarie and Newcastle, high speed rail will enable these regions to become more vibrant, well connected communities. It will enhance liveability, capitalise on existing appeal, and support the growing city-to-region migration trend, fostering balanced growth beyond Sydney, easing housing demand.

  Industry in the region is being held back. The project corridor is home to some of Australia's most dynamic industries – clean energy, advanced manufacturing and defence – anchoring the country's largest regional economy. High speed rail will attract investment, catalyse job creation and support key centres like Gosford and Newcastle. Fast, efficient connectivity to more skilled workers will enable Newcastle's universities and research centres to strengthen their role in national innovation, while the Hunter region's shift to renewable energy and future focused industries gains momentum. Ultimately this will support talent retention and attract new industries in a transitioning economy to fuel a competitive, resilient economy.

- **This corridor is already a leader in renewable energy, with initiatives like the Hunter-Central Coast Renewable Energy Zone.** High speed rail will advance Australia's net zero targets by shifting demand from road to rail, reducing emissions and supporting sustainable land use. The Project in this corridor will serve as a model of climate resilience, a catalyst for low carbon infrastructure at scale, positioning Australia as a global leader in emissions free transport and sustainable urban planning and place making.
- **There is a huge opportunity to strengthen tourism.** Renowned for its natural beauty and cultural heritage, Newcastle and the Central Coast are prime tourism destinations with strong arts sectors. Drawing on international experience, high speed rail will become an iconic travel choice that will boost connectivity to major destinations, including World Heritage parks and areas of First Nations significance.

Why is Newcastle to Sydney the first stage, over Sydney to Canberra?

The prioritisation of Newcastle to Sydney for the first stage of the Network – over Canberra to Sydney – is driven principally by the potential for economic integration of the Newcastle, Central Coast and Sydney economies and the opportunity to enable a long term pipeline for housing. While the Canberra to Sydney line is an important and viable future phase of the Network, the Project will deliver maximum impact from the outset.

Limited economic development and integration

Canberra has a unique role as a successful capital city and centre of government. However, Canberra's economy is largely independent of Sydney's, with minimal reliance on its workforce or markets. A high speed link to Canberra would drive significant regional economic benefits. However, a connection to the Central Coast and Newcastle (where intra-regional travel and economic integration with Sydney are well established and industry ecosystems are complementary) would yield greater benefits sooner.

Minimal impact on housing uplift

Canberra's housing market operates largely independently of Sydney's, meaning that a high speed rail connection to Canberra would have limited impact on overall housing supply and affordability. The housing capacity which could be enabled in the Canberra to Sydney corridor is estimated as 32,500 additional dwellings. Meanwhile, the Project will support substantial housing growth in the Central Coast, Lake Macquarie and Newcastle areas. The additional dwelling capacity estimated to be enabled by the Project is six-fold at approximately 195,000.

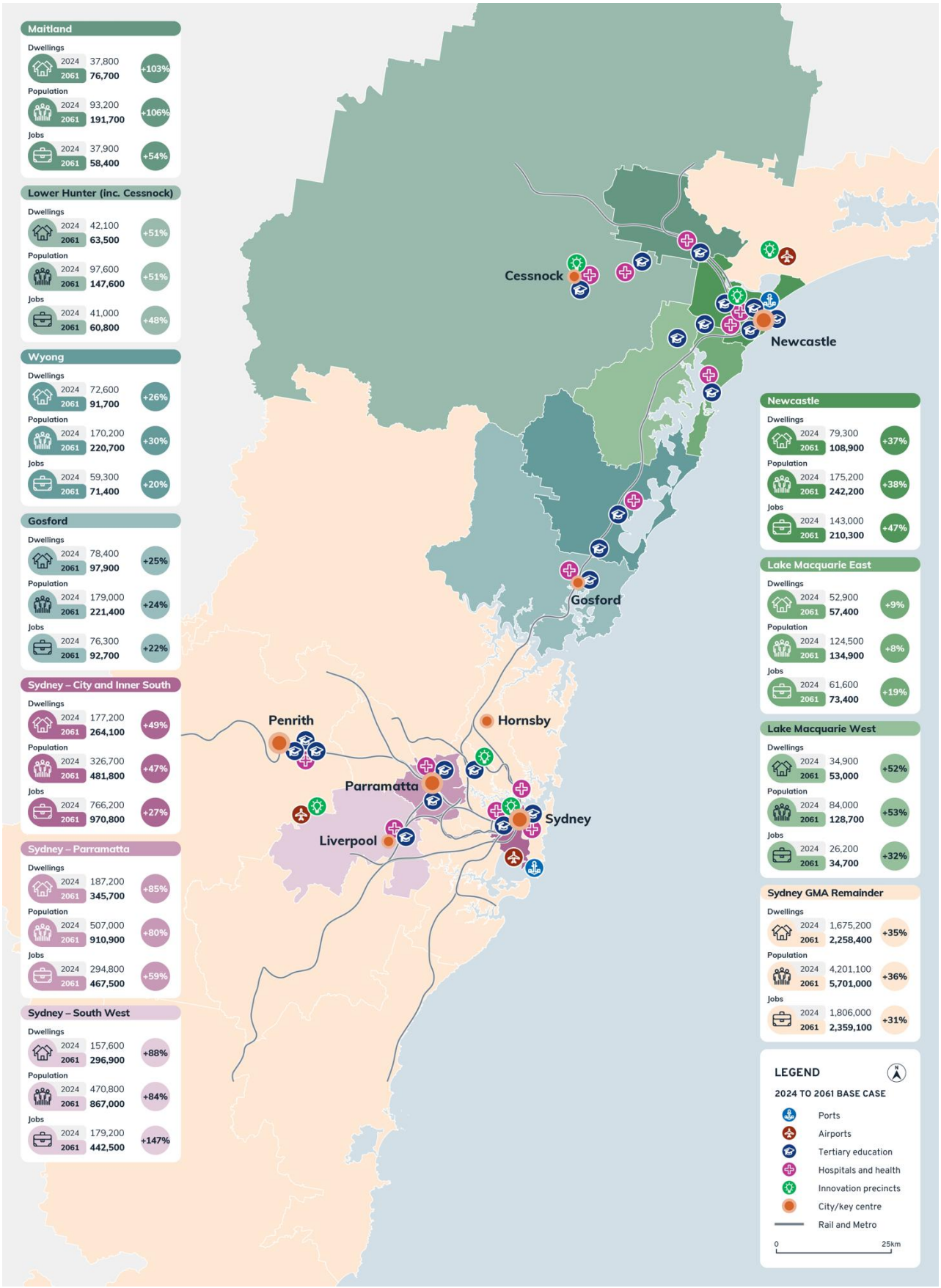
1.4.2. Defining the corridor

The project corridor between Newcastle, Sydney and Western Sydney International is defined as:

- The northern part of the corridor that includes the Lower Hunter, Newcastle, Lake Macquarie West, Lake Macquarie East, Maitland, Wyong and Gosford.
- The southern part of the corridor includes Greater Sydney between the Sydney CBD, the Parramatta CBD and Western Sydney International/Bradfield.[2]

The corridor is shown in the figure on the following page, which also illustrates the forecast growth in the corridor without the Project. While there are some areas of strong growth in Maitland, Lake Macquarie West and around Newcastle, most growth will be concentrated in the Sydney metropolitan area. Without the step change delivered by the Project, Sydney's infrastructure and resources will continue to be strained and an opportunity to spread the growth outside of Sydney into regional NSW will be lost.

Figure 1-5 Base Case growth in the project corridor



Source: KPMG (2024), Land Use Modelling and Socio-Economic Impact Assessment Report.

1.5. Project objectives

Six project objectives, aligned with the network objectives described above, have guided the planning and design of the Project. Collectively, they address the challenges, opportunities and critical considerations for the project corridor, which are considered in more detail in the next chapter.

Figure 1-6 Project objectives

Together with the network objectives (see Figure 1-2), these project objectives form the foundation for the assessments in this Business Case.

1.6. Outline of the Business Case

This Business Case outlines a preferred option for high speed rail between Newcastle and Greater Sydney as the first stage of an east coast high speed rail Network.

It summarises the investigations and analyses undertaken and the options investigated to determine a preferred solution that best meets the opportunities and challenges outlined. This includes analysis of the problems the Project would seek to address and the opportunities it would provide.

The Business Case includes the Project's costs and justification, technical designs and optioneering, and cost-benefit and financial analyses based on detailed scope and design. It complies with Infrastructure Australia's *Assessment Framework*[3] and has been developed to meet the requirements of Infrastructure NSW and the NSW Treasury's *TPP-018 NSW Government Business Case Guidelines.*[4]

This Business Case consists of the chapters outlined in the following table, which also maps the chapters against Infrastructure Australia's three assessment themes.

Table 1-1 Business Case chapter and Infrastructure Australia's three assessment themes

Chapter	Purpose	Infrastructure Australia theme
1. Introduction and vision	Introduces the Project and the Network, the vision and objectives, previous studies undertaken and this overview of the document structure.	Strategic fit
2. Need for investment	Outlines the Project's context, challenges and opportunities the Project seeks to address, the investment logic map and the 'counterfactual'.	Strategic fit
3. Options analysis	Assesses alternative options to the Project, resulting in defining the preferred Project and a staging option.	Strategic fit
4. Customer, network and operations	Defines the future Network's operations context, the high speed rail customer product and customer value proposition, the Project's concept of operations, stabling and maintenance, and the business requirements specification.	Strategic fit Societal impact
5. Project definition and design	Provides an overview of elements of the Definition Design for the Project, including alignment and station localities, tunnels, bridges, train specification, station design, rail systems, constructability and spoil strategy.	Strategic fit Societal impact
6. Corridor land use, precincts and transport integration	Outlines nation shaping, land use, regional development, place making and urban design opportunities. Outlines the transport integration opportunities and how each station will be designed to respond to the unique needs and features of its location. Also presents the Economic Development Strategy.	Societal impact
7. Economic potential	Presents the Project's expected benefits, including land use, regional development, transport, productivity, social, community, climate and resilience benefits. It also provides the results of the economic appraisal of the Project.	Societal impact
8. Delivery strategy	Outlines the industry engagement undertaken and the recommended delivery strategy for the Project and for staging the Project.	Deliverability
9. Funding and financing	Presents the results of a financial appraisal of the Project that estimates its lifecycle costs and revenues, and assesses alternative funding, financing and value sharing options along with opportunities to further improve affordability.	Deliverability
10. Environment, sustainability and planning	Outlines the Project's social, economic and environmental impacts, sustainability initiatives and planning approvals strategy.	Deliverability Societal impact
11. Government, community and stakeholder engagement	Identifies the Project's stakeholders, the processes for engaging and collaborating with them and how feedback has shaped the Project.	Strategic fit
12. Project implementation	Provides an overview of the plans and strategies needed to deliver the Project, including program, governance and the risk management framework, and the overview of the 2-year development phase	Deliverability

[redacted]

[1] Australian Bureau of Statistics (21 November 2024), Australian National Accounts: State Accounts.
[2] The broader study area is the Greater Metropolitan Area (GMA) that includes the Sydney Greater Capital City Statistical Area, the Southern Highlands and Shoalhaven Statistical Area 4 (SA4), Illawarra SA4, Newcastle and Lake Macquarie SA4, and Lower Hunter, Port Stephens, and Maitland Statistical Areas 3 (SA3s), as defined by the Australian Bureau of Statistics.
[3] Infrastructure Australia (2021), Assessment Framework, Stages 1–3.
[4] NSW Treasury (2018), TPP-018 NSW Government Business Case Guidelines.

Chapter 2

Need for investment

Australian Government
High Speed Rail Authority

The need for investment is compelling

- The existing transport network in the project corridor faces significant challenges from slow and unreliable travel times, poor customer experience and dependence on private vehicles.
- Poor connectivity is holding back economic growth and the ability to address geographic disparities across the project corridor, including supporting transitioning areas such as the Hunter region.
- Housing supply has not kept up with demand or the need for different dwelling types and sizes, particularly impacting low income and vulnerable communities. Improved connectivity and accessibility are needed to drive increased housing supply and choice.
- High speed rail is an opportunity to accelerate net zero outcomes.
- The investment rationale has been robustly mapped, connecting the identified problems and opportunities with the benefits and intended outcomes of investment.
- Alternative investments in road or existing rail also have significant costs and environmental impacts and are unlikely to meet the project objectives.

2.1. Connectivity challenges

The transport network in the project corridor faces significant challenges from slow and unreliable travel times, poor travel experience and dependence on private vehicles that limits the potential for economic growth.

Newcastle to Sydney is a nationally significant corridor. With nearly 15 million trips on the rail line, it is the nation's busiest intercity rail route, and there are also 31.5 million trips through this part of the M1 Pacific Motorway annually. Rail is a growing market, with over 20 million trips expected by 2061. However, passengers use infrastructure that is either ageing or capacity-constrained and often unable to provide a good level of service. The existing rail line between Newcastle and Sydney is also the second busiest freight corridor in Australia, carrying 11 million tonnes of vital coal, steel, grain and containerised freight each year.

2.1.1. An ageing rail line under pressure

Despite its importance to the national economy, the Newcastle to Sydney Line – originally planned for steam trains – has barely changed since completion in 1899. At an average speed of 60 kilometres per hour, a journey between stations in Newcastle and Sydney takes about 2 hours and 40 minutes, half an hour slower than the equivalent drive. Topographical constraints and ageing infrastructure limit the ability to materially improve speeds on the existing line. As shown in the table below comparing similar city pairs – where one is a major economic hub and the other, a smaller but significant centre that are approximately 150 to 250 kilometres apart – the Newcastle to Sydney rail line is slow by world standards.

Capacity constraints and ageing infrastructure also place significant pressure on reliability. Since 2019, on time performance on the project corridor has been falling steadily, with fewer than 79 per cent of trains meeting punctuality targets in 2024. In fact, it is the most unreliable intercity corridor in the greater Sydney area.[1]

Table 2-1 National and international travel speeds and distances

Corridor	State or country	Distance (km)	Approximate time (h:mm)	Approximate speed (km/h)
Berlin – Leipzig	Germany	150	1:15	120
London – Birmingham	United Kingdom	163	0:45	220
Sydney – Newcastle	**NSW**	**165**	**2:30-3:00**	**60**
Ankara – Eskisehir	Turkey	200	1:30	130
Paris – Lille	France	215	1:10	185
Berlin – Hannover	Germany	250	1:50	135

London Birmingham travel time following the opening of HS2.

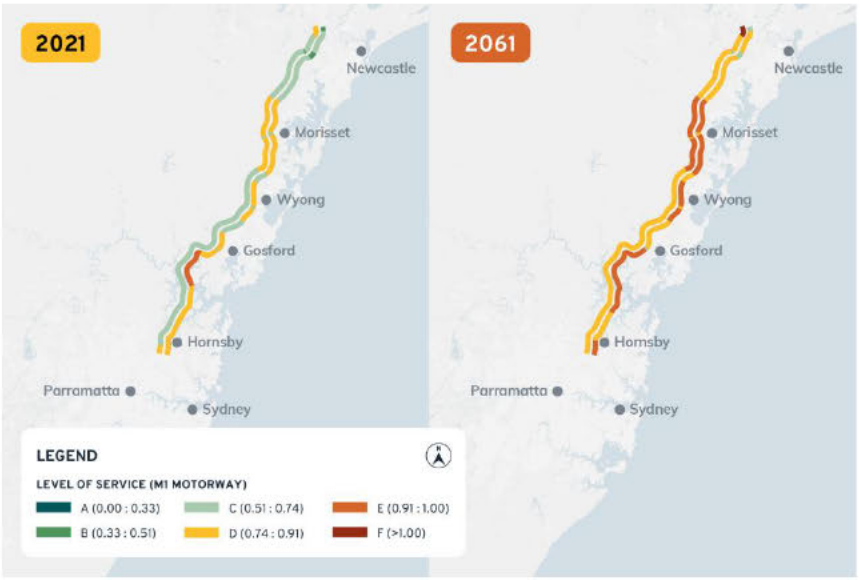
Beyond journey times, rail passengers consistently rate service frequency as one of the least satisfying elements.[2] While there are two services from Newcastle to Wyong, Gosford and Sydney each hour during the peak, the different stopping patterns often result in wait times of significantly more than 30 minutes for express services. Outside the peak period, rail services become more infrequent, falling to once an hour or less.

The corridor is operating at its maximum possible frequency. Increases are prevented during peak periods by the need to accommodate multiple stopping patterns and a lack of train paths in the Sydney suburban network. The need to share train paths with freight is a constraint outside peak times. The result is the line cannot provide frequent all-day services to give people greater flexibility in choosing where they live and work.

2.1.2. Road alternatives are also under pressure

Although the capacity of the motorway is likely sufficient to meet aggregate demand over the next 40 years, the picture at busy times is already very different. Congestion is a regular feature of southbound travel north of the Hawkesbury River in the morning, as well as on connecting road networks. While journeys by road tend to be quicker than the train, travel time is highly influenced by traffic congestion and incidents; e.g. during holiday periods congestion significantly increases travel times. Road congestion in the project corridor is forecast to increase, adding an average of 15 minutes by 2061. Travelling by high speed rail would be more than twice as fast as making the equivalent journey by road or existing rail.

Figure 2-1 Level of service M1 Pacific Motorway busiest time of the day



Note: Level of Service A represents excellent driving condition and Level of Service F represents very poor performance.

2.1.3. The human costs of car dependence

The high reliance on private vehicles brings challenges of congestion, unreliability and, importantly, safety. As traffic volumes rise, vehicle collisions and crashes increase, with the most serious crashes occurring on highways or arterial roads. From 2016 to 2023, there were 374 serious injuries on the M1 Pacific Motorway and 31 people died.[3]

2.2. Lost opportunities for regional and urban productivity, tourism and jobs

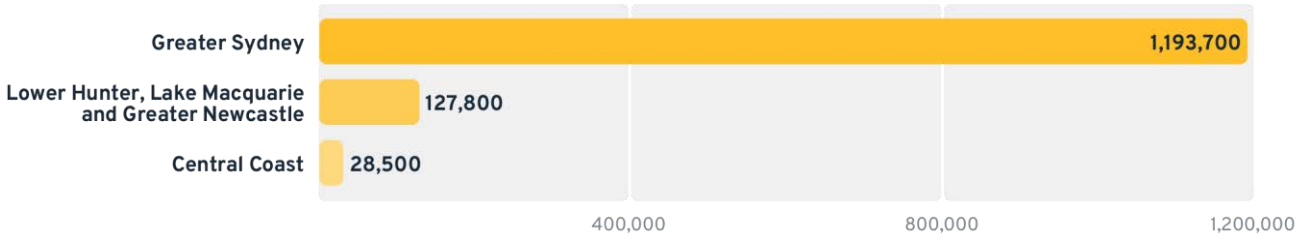
Poor connectivity is holding back economic growth and the ability to address geographic disparities across the project corridor, including supporting declining and transitioning areas such as the Hunter region.

The economic potential of the project corridor is significant. The regions of Greater Newcastle, the Central Coast and Greater Sydney are home to 24 per cent of Australia's population and 24 per cent of its employment market. The project corridor includes 3 international airports, 2 deepwater ports, a renewable energy zone, 14 hospital and health precincts (including 3 major hospitals with research and education presence), 21 tertiary education facilities including 7 major university campuses, and 5 stadiums and sporting precincts.

A global city, Sydney is an economic powerhouse, a major population centre, and the gateway to Asia and other major international economies. Its continued success is vital to the NSW and national economies. However, international research demonstrates that mono-centric regions experiencing growth can eventually suffer from a series of costs – including increasing business occupancy costs, increasing costs of living and housing, increasing costs of labour that impact on labour supply, spatial polarisation, social segregation and traffic congestion – which eventually come to constrain long term economic growth.[4]

Sustainable long term prosperity depends on the cities and regions of the wider corridor working together as an integrated economic engine. But while they lie close geographically, the economies of Greater Newcastle, the Central Coast and Greater Sydney function essentially independently, with Sydney outpacing its peers. Unless action is taken, further economic growth is likely to intensify this trend, as shown in the following figure. Though the Lower Hunter and Greater Newcastle City are likely to see some growth in employment, without action 85 per cent of the new jobs in the project corridor between 2021 and 2061 will be created in Greater Sydney.

Figure 2-2 Projected employment growth between 2021 and 2061 by city area



Addressing the connectivity challenges on the project corridor will provide the opportunity to:

- Bring key employment centres and education precincts across the project corridor closer together.
- Broaden the labour pool available to Greater Newcastle, the Central Coast and Greater Sydney businesses.
- Improve access to the higher value employment opportunities enjoyed by residents of Greater Sydney.

- Give current and future residents more choice in where they live, allowing them to live in one area and work in another, using accessible and efficient public transport options.
- Create new opportunities to support economic development in future-focused industries to help the transition from traditional industries, including maximising the visitor economy.

At present, these benefits are stymied by a lack of cohesion across the region.

2.2.1. Improving access to jobs to reduce socio-economic disparity and increase productivity

Knowledge-intensive industries generate high value jobs, and have the capacity to grow the local economy and employment faster than other sectors. However, while 28 per cent of NSW workers overall are employed in these sectors, this rate varies widely by geography. In the northern part of the project corridor (across the Central Coast, Lower Hunter and Greater Newcastle regions), it stands at 22 per cent, while in the southern part of the project corridor that includes Sydney, 34 per cent of residents employed work in these sectors.[5]

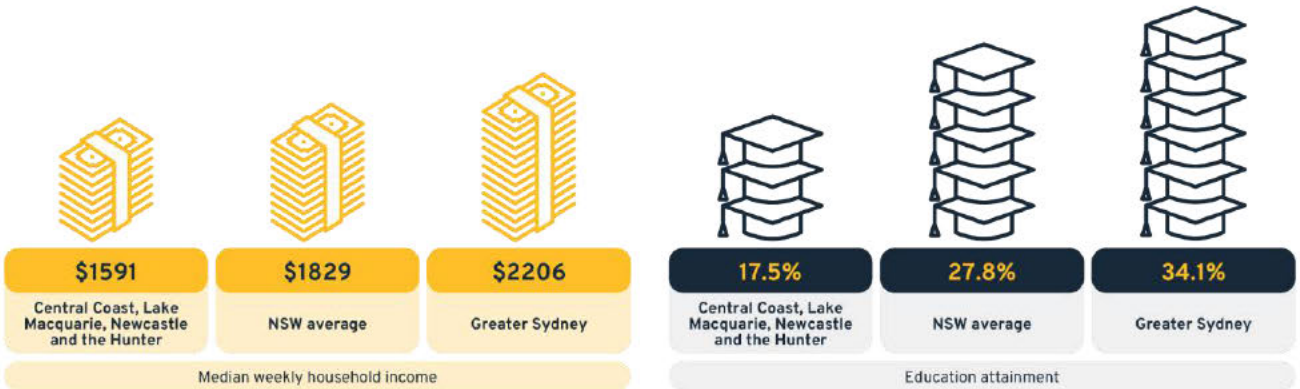
This disparity is reflected in socio-economic outcomes, such as educational attainment and average weekly household income, which both sit below the NSW average in the Central Coast, Lake Macquarie, Newcastle and the Hunter. Conversely, outcomes in the southern portion of the project corridor encompassing Greater Sydney outperform the NSW average.[6]

The Randstad Region, Netherlands: how rail investment can foster regional productivity

The Randstad region in the Netherlands is an example of a successful mega-region. Comprising the four previously independent cities of Amsterdam, Rotterdam, Utrecht and the Hague, and with a population of 7.5 million people and a GDP of €288 billion, the Randstad has coalesced to become one of the largest metropolitan regions in Europe. The Randstad's economic energy has been underpinned by significant investment to improve rail connectivity, and development policies that have prioritised the urban cores of the constituent cities. It now stands as an advanced urban economy, specialising in logistics, horticulture and financial services, and boasting one of the largest start-up ecosystems in Europe.

Source: Committee-for-Sydney (2018),The Sandstone Mega-Region

Figure 2-3 Weekly median household income (by SA3 for aged 15+)



This pattern of disparity directly reflects the connectivity challenges which prevent the region functioning as a cohesive economic system. Research shows that the knowledge-intensive jobs which raise performance are also the most sensitive to changes in transport travel times, benefitting more than other sectors from agglomeration impacts flowing from better connections.[7] This means the project corridor's slow travel times place economic productivity and equitable outcomes in jeopardy.

2.2.2. Access to jobs is unequally shared

The uneven distribution of employment opportunities and limited connectivity also means many people must choose between moving out of the regions towards Greater Sydney or compromising on income and opportunities to maintain their lifestyle and community connections.

The Central Coast, for example, has a particularly low employment containment level, with a job-to-worker ratio of under 0.8, compared to a ratio of just under 1 for both Greater Newcastle and Greater Sydney.[8] This reflects a lack of local employment opportunities. The consequence is people travelling longer distances to find work, which impacts personal and family wellbeing, and undermines the region's liveability and attractiveness.

2.2.3. The benefits of tourism and the visitor economy are unequally shared

Australia's east coast draws many international visitors. But while Sydney is the top destination (attracting 47 per cent of the country's international visitors in 2023), the Hunter and Central Coast attract just 2 per cent and 0.6 per cent respectively.[9]

NSW also dominates the country's domestic travel market with 33 per cent of overnight trips, the largest share of any state. Again, Sydney has the highest percentage of domestic visitors, with notably fewer visits to regional and outer metropolitan areas.[10]

This unevenness means the Hunter, Newcastle and Central Coast regions are failing to capitalise on their strong tourism potential. A faster connection to Greater Sydney and more direct connections between Western Sydney International can support increased visitor numbers and leverage the attractions of the project corridor including the Central Coast and the Hunter Valley wine region and surrounds.

Newcastle city centre has recently welcomed three 5-star hotels in response to growing visitor numbers and the Australian Government has committed $55 million for a new terminal at Newcastle Airport. By increasing access for international and domestic tourists to the region, there are opportunities to catalyse investment in the region's visitor economy, support the continued growth in tourism jobs and connect the Hunter's major tourism assets with the rest of the world.

2.2.4. Support is needed for areas in transition and decline

Within this story of economic disparities, parts of the project corridor are also undergoing profound change. Mining has historically been a major industry in the Hunter region, employing more people in the sector than anywhere else in NSW. The region's coal mines currently account for 17 per cent of the region's economic output and, together with coal-fired power stations, employ over 15,300 people and contribute over $23 billion to the national economy.[11]

Today, due to the urgent global need to reduce emissions, the Hunter region must rapidly transition to new industries. Mines and coal-fired power stations are expected to close over the next 20 years,[12] as the International Energy Agency forecasts that by 2050, global demand for coal will decrease by 30 per cent.

As a result, there is a pressing need to support local industries and communities along the project corridor, particularly those impacted by industry transition. Without access to new employment opportunities, rates of unemployment in the region will rise and wages will fall.

Case study: Regeneration of Lille

In the 1970s, the French city of Lille faced similar challenges of a declining coal mining and textile industries. The TGV Nord line became a key initiative to breathe new life into the struggling economy and grow the region's services sector, bringing Lille within an hour of Paris. The Lille Europe high speed rail station opened in 1994, along with a retail, residential and business complex. Connections to the UK were improved with the Channel Tunnel Rail Link in 2003, which connected Lille to Kent and Central London.

Lille transformed into a regional business hub, with several large companies relocating or opening offices in Lille including IBM, Capgemini, Booking.com and Egencia. An increase in the size of the logistics sector diversified employment in the region. State assistance that had previously been needed to make Lille attractive to private investment was no longer required.

The TGV Nord line has also been a catalyst for Lille's emergence as tourism and cultural centre, attracting many hotels with conference facilities into the area surrounding the station and being designated European City of Culture in 2014.

Source: NSW Government (2019), International fast rail projects – Challenges and opportunities.

2.3. Facilitating a long term housing pipeline

Housing supply has not kept up with demand or the need for different dwelling types and sizes, placing pressure on rents and housing prices. Improved connectivity and accessibility are needed to drive increased housing supply and choice.

High housing prices are being driven by strong population growth and a trend towards smaller household sizes, coupled with a lack of supply.

This reduces quality of life by requiring people to spend a higher proportion of income on housing, live in housing which does not meet their needs, and live further away from employment, family, friends and amenities, often with long commutes. These challenges disproportionately impact low income households and the most vulnerable people.

2.3.1. Population growth means more housing is needed

The project corridor is forecast to experience strong population growth, with 2.3 million more people expected to call Greater Sydney home by 2061. In the same period, an additional 431,000 new residents will be accommodated across the Central Coast, Lower Hunter and Greater Newcastle. The intense concentration of population growth in Sydney places increased pressure on infrastructure and services, housing affordability and liveability.

A sustained increase in the supply of well-located dwellings will be required over the long term to normalise housing prices, reduce rental stress and boost home ownership rates for younger households, ultimately increasing people's quality of life.

High speed rail will allow a more efficient distribution of future growth that capitalises on the land assets and resources available in the Central Coast and Newcastle to support an increase in population.

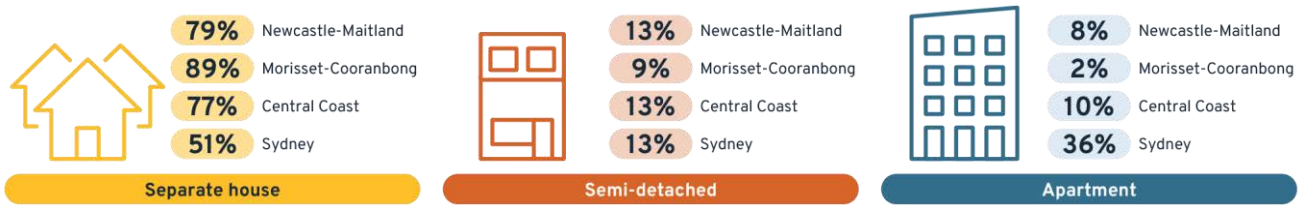
2.3.2. Community need for diverse new housing is left unmet

The strong demand for housing is compounded by an underlying trend to smaller households. This change has been occurring progressively for some time and is reflected in the changing demographics of the east coast where census data shows there are more smaller households and an ageing population, a trend which is projected to intensify. In 2021, over 55 per cent of households within NSW comprised either one or two people, while 45 per cent were larger. The absolute number of one- and two-person households increased by 21 per cent between 2011 and 2021, while the number of families with children, typically larger households, grew by 16 per cent.

The population's ageing profile will become more pronounced over the next 20 years as the number of people in NSW aged over 55 grows by approximately 38 per cent and the number of people over 85 year grows by over 135 per cent.[13] This trend will be more evident in the northern part of the project corridor where the population is older. These changes will increase the need for smaller dwellings, which is already being seen through trends showing a pattern of increased demand for townhouses and apartments.

Increasing the supply of diverse housing types to offer greater housing choice is one of the critical factors in increasing housing affordability. The range of housing types varies across the project corridor and is limited in some places (see figure below). For example, in 2021, only 21 per cent of dwellings in the Central Coast and Lower Hunter were medium or high density, compared to 48 per cent in Greater Sydney.[14] Only 34 per cent of dwellings have fewer than three bedrooms. As a result, many people must either live in unsuitable housing or relocate elsewhere in the state or beyond, disproportionately impacting low-income households and vulnerable people.

Figure 2-4 Housing diversity in the project corridor (2021)



A step-change in connectivity would improve the viability of high density, medium density, and 'missing middle' housing types across the project corridor, enabling a more diverse range of residential stock.

2.4. Contributing to net zero

High speed rail is an opportunity to accelerate net zero outcomes and progress towards net zero.

To meet Australia's Paris Agreement commitments,[15] deep and rapid abatement of greenhouse gas emissions is needed across all sectors of the economy. To achieve this, the Australian Government has developed a Net Zero Plan[16] for abatement across six key economic sectors, including transport which is being prioritised.

2.4.1. Transport emissions

Transport currently accounts for 21 per cent of Australia's total greenhouse gas emissions and was responsible for 90 megatons carbon dioxide equivalent (CO_2-e) of emissions in 2022. Without intervention, as other sectors decarbonise, transport will become the nation's largest source of emissions by 2030,[17] surpassing energy and agriculture.

Though road transport emissions currently account for 85 per cent of total transport emissions, with cars alone contributing 50 per cent road transport emissions, the twin trends of a growing market for electric vehicles and the steady decarbonisation of the Australian energy grid will substantially decarbonise car travel over coming decades.

The share of new electric vehicles has risen from 3.8 per cent of new light vehicle sales in Australia in 2022 to 8.4 per cent in 2023, and with the prices expected to fall, the Australian Energy Market Operator forecasts that the light vehicle fleet will transition to mostly electric between 2035 and 2050.[18] During the same period, the Australian Government forecasts that the national energy grid will continue to decarbonise[19] (the NSW grid emissions factor is forecast to fall from today's value of 0.63 ($kgCO_2/kWh$) to as low as 0.03 by 2050).

However, decarbonisation will be much harder to achieve in aviation. Not only is demand increasing substantially (demand for jet fuel is expected to increase by 75 per cent from 2023 to 2050 on domestic routes due to the increased volume of air travel[20]), but aviation is systematically more difficult to transition as it features expensive, long-lived assets with fewer opportunities for electrification. The development of alternative fuels is also in its infancy, with several cost and scalability barriers yet to be overcome.

While air travel is not a major means of travelling within the project corridor, there were 18.3 million passenger flights on direct routes between Melbourne, Canberra, Sydney, Newcastle and Brisbane during 2023[21], and 32 per cent of Australia's domestic aviation greenhouse gases are emitted on direct routes linking those 5 cities. This means finding alternatives to air travel is of vital importance. The Project has a critical role to play by enabling the delivery of the broader Network, offering a compelling alternative to air travel.

2.4.2. Construction emissions

The Australian Government's Net Zero Plan also addresses embodied carbon emissions associated with construction. Steel and concrete currently account for approximately 6 per cent of gross national emissions and 30 per cent of the industry and waste sector emissions. The scale of the Project means it has a unique ability to act as the catalyst for the rapid development, scaling and deployment of green steel and green concrete technologies, to deliver a widespread net zero benefit across all economic sectors.

In the face of the decarbonisation challenge across multiple economic sectors, Australia needs a diverse mix of decarbonisation solutions. The Network will play a key role in meeting the Net Zero Plan, not only through zero emissions travel but also through stimulating a world-leading green steel and concrete industry.

2.4.3. Climate change resilience

The Project also offers a similar catalyst in adapting Australia's infrastructure to be more economically and socially resilient. Climate change impacts are already impacting Australia economically[22] and socially.[23] Adapt NSW estimates that by 2061, between 700,000 and 2.7 million more days of work will be lost every year due to the increase in intense heatwaves alone.

Australian rail commuters are already familiar with the climate's ability to interrupt travel, most often through track closures due to inundation from severe weather. Along the existing Newcastle to Sydney rail line, storms and flooding are the most common weather events causing disruptions to the network, with an average of 1.6 to 2.5 delay events per week between 2018 and 2023.

Socially and economically disadvantaged communities are disproportionally affected by climate change as they are more exposed to hazards, more susceptible to loss and damage associated with these hazards, and less able to cope with and recover from damage.[24]

The Project offers the potential to support social and economic uplift along the project corridor and surrounding areas. It will concurrently mitigate emissions at a national scale while delivering connectivity and mobility that is designed to be resilient in a climate-changed future. This will, in part, act to mitigate the escalating climate change impacts already interrupting existing road and rail networks.

2.5. Planned strategic outcomes

A comprehensive investment logic map, set out below, links the problems and opportunities of the project corridor with the potential benefits and intended outcomes of a high speed rail connection. Many of the problems and opportunities are linked to the slow and unreliable existing transport network between Newcastle, the Central Coast and Sydney, which limits the potential for economic growth on the project corridor.

Figure 2-5 Investment logic map

2.6. Considering the counterfactual

Alternative investments in road or conventional rail capacity have significant costs ($65 to $145 billion) and environmental impacts (45 to 90 billion kilograms of carbon) and are unlikely to meet project objectives.

Counterfactual analysis examined the implications of providing equivalent capacity to high speed rail through road or conventional rail, comparing cost, embedded carbon and environmental impacts of alternative transport infrastructure expansions.

This analysis showed investment in major roads or conventional rail would entail significant capital cost and carbon impact, and other possible community impacts.

Expanding road infrastructure to deliver equivalent capacity to the Project would require $20 to $35 billion in investment and cause substantial environmental impacts, including surface disruptions to multiple national parks. Road widening would do little to address congestion, dispersed connectivity and high emissions. Even with the adoption of electric vehicles, road expansions would result in 15 to 25 billion kilograms of embedded carbon emissions for short corridors, further exacerbating environmental challenges.

Similarly, upgrading conventional rail to match high speed rail capacity through amplifying existing tracks would cost $45 to $110 billion, making it even more capital-intensive than road projects. These upgrades would have significant environmental and community impacts, limited by the existing alignment through environmentally sensitive areas and urban areas. The shared use of rail infrastructure by freight and passenger services further limits capacity for growth and complicates upgrades due to the challenges of line closures for maintenance.

Importantly, investments in road and rail networks would not meet project objectives related to economic productivity or the need for more housing as they would not address the slow journey times and lack of connectivity which lie at the heart of the need for investment.

The financial and carbon impacts of these investments are summarised in the following table.

Table 2-2 Counterfactual analysis

Corridor type	Strategic infrastructure cost (2024$ billion)		Strategic embodied carbon impact (billion kg)		Operating $C0_2e$ emissions per annum, high speed rail equivalised (bn kg)	
	Road	Conventional rail	Road	Conventional rail	Road	Conventional rail
Short (180 kms)	20-35	45-110	15-25	30-65	3	<1

Source: EY, HSR Counterfactual Report, 2024.

[redacted]

[1] Transport for NSW (2024), Sydney trains and NSW Trainlink intercity performance reports.
[2] Transport for NSW (2024), Customer Satisfaction Survey.
[3] NSW Government (2024), webpage: Transport Open Data: NSW Crash Data, accessed November 2024.
[4] Clark, G and Moonen, T (2017), International Case Studies of Connected Cities.
[5] Australian Bureau of Statistics (2021), Census of Population and Housing.
[6] Australian Bureau of Statistics (2021), Census: Socio-Economic Indexes for Areas (SEIFA), Australia.
[7] Transport for NSW (2019), Fast Rail Sydney to Wollongong-Nowra Pre-feasibility Study.
[8] A job to work ratio measures the number of jobs in the region compared to the number of workers who live in the region.
[9] Tourism Australia, International Market Performance – Corporate.
[10] Tourism Australia, Domestic Market Performance Statistics - Corporate.
[11] Department of Regional NSW (2024), Future Jobs and Investment Authorities – Issues paper.
[12] EY (2022), Diversification and growth: Transforming mining land in the Hunter Valley.
[13] NSW Department of Planning and Environment (2022), NSW Population Projections, accessed 6/11/24,
[14] Australian Bureau of Statistics (2021), Census data.
[15] DCCEEW (May 2024) webpage: International climate action, accessed 6/11/24.
[16] Department of Climate Change, Energy, the Environment and Water (2024), webpage: Net zero, accessed 13 June 2024.
[17] Australian Government (2024), Sector Pathways Review 2024, accessed 1/11/24.
[18] AEMO (2024), 2024 Forecasting Assumptions Update.
[19] DCCEEW (2023), webpage: Australia's emissions projections 2023, accessed 6/11/24.
[20] CSIRO (2023), webpage: Fuelling Australia's future sustainable aviation industry, accessed 6/11/24
[21] Bureau of Infrastructure and Transport Research Economics (2024), Domestic aviation activity.
[22] Adapt NSW (2024), webpage: Climate change impacts on our economy, accessed 6/11/24
[23] Department of Foreign Affairs and Trade (November 2023), Rethinking Social Protection and Climate.
[24] S. Nazrul Islam and John Winkel (October 2017), Climate Change and Social Inequality, United Nations Department of Economic and Social Affairs.

Chapter 3

Options analysis

Australian Government
High Speed Rail Authority

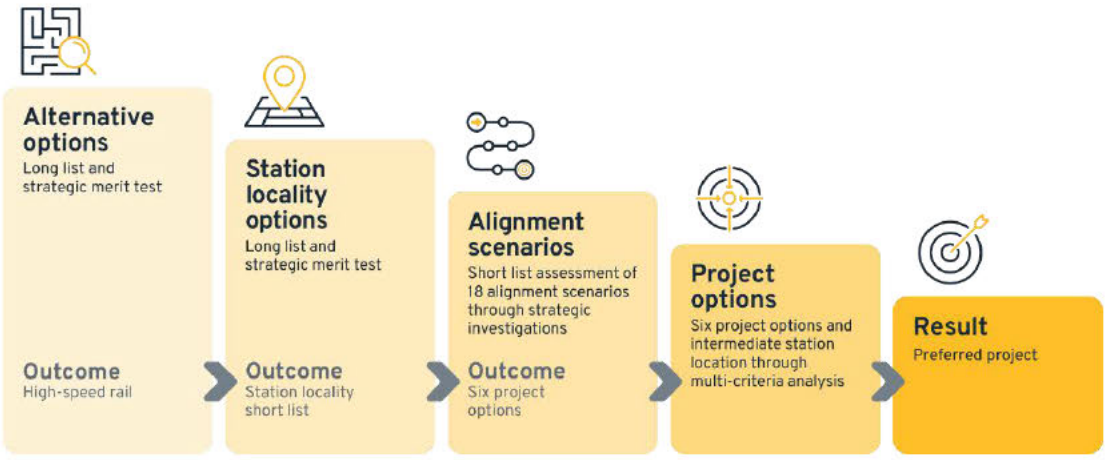
A robust options assessment process has established the case for the Project

- A wide range of potential solutions to the needs and challenges outlined in Chapter 2 were assessed using a robust assessment framework. Consideration was given to non-infrastructure interventions, as well as road, water, air and rail-based interventions.
- The Base Case (no project case) adopts NSW common planning assumptions, along with transport network assumptions.
- The assessment of potential solutions confirmed a dedicated high speed rail line best meets the outcomes sought. This reconfirms the findings of all previous studies and assurance reviews.
- A total of 26 possible station locations were investigated, including the locations identified in the 2013 study. These were integrated into a set of 18 alignment scenarios that were subjected to more detailed analysis. Six project options were identified from this assessment.
- Six project options were based on potential station locations at Broadmeadow, Wyong/Morisset, Gosford/West Gosford, Hornsby, Central Station, Parramatta and Western Sydney International.
- From multi-criteria analysis, Option 3 (linking Broadmeadow, Gosford, Central Station, Parramatta and Western Sydney International) emerged as the preferred concept with the potential for an intermediate station between Broadmeadow and Gosford. Additionally, Option 1 (where the line stops at Central) was identified as a potential staging option as part of Option 3 (to Western Sydney International).
- Morisset was identified as the preferred locality for an intermediate station.

3.1. Options assessment framework

A structured approach was developed to move through the process of options assessment, progressing from an initial assessment of potential strategic alternatives, through iteration of high level, high speed rail options, to a short list of options, before eventually defining the preferred Project and a staging option. An overview of the options assessment process is presented in the following figure.

Figure 3-1 Options assessment framework



The assessment was used to differentiate between options and determine which were most likely to meet the project and network objectives. The strategic nature of the assessment meant focusing on key differentiating factors and the relative merits of options, rather than absolute values.

An assessment framework was developed to guide this assessment, based on the project and network objectives. The assessment framework is consistent with Infrastructure Australia guidelines.

Assessments were undertaken by subject matter experts from across project team workstreams, including regional development, land use planning, transport integration, rail planning, environment and sustainability, and design, using quantitative and qualitative measures.

3.2. Base Case definition

A Base Case (no project case) was defined to enable comparison of options to a 'no project' scenario. The Base Case uses the latest NSW Government endorsed land use and transport forecasts and is based on the current state of the project corridor as well as committed projects (including those yet to be built or commence operations) that will interface with the Project.

3.2.1. Base Case land use assumptions

The land use Base Case is defined by the NSW Government's Travel Zone Projections 2022 which provides spatial forecasts for population, dwellings, workforce and employment. This dataset uses the best available input data including from the 2016 Census[1] and the 2022 NSW Population Projections.[2] It takes account of changes in forecasts resulting from the COVID-19 pandemic, but does not include results from the 2021 Census.

3.2.2. Base Case transport network assumptions

The Base Case transport network consists of committed and funded projects in the NSW Government's Transport Endorsed Network Assumptions (TENAS2023),[3] as outlined in the table below.

Table 3-1 Committed and funded transport network projects

Rail and light rail	Road	
• More Trains More Services (MTMS) Stage 3A. • Parramatta Light Rail Stage 1. • Sydney Metro City & Southwest. • Sydney Metro West. • Sydney Metro – Western Sydney Airport – St Marys to the Aerotropolis.	• M1 Pacific Motorway extension to Raymond Terrace. • M12 Motorway – connecting the Westlink M7 Motorway and The Northern Road via Western Sydney International. • M6 Motorway Stage 1 – connecting the M5 East Motorway at Arncliffe to President Avenue at Kogarah.	• Newcastle Inner City Bypass – from Rankin Park to Jesmond. • Singleton Bypass. • Sydney Gateway – connecting WestConnex to Sydney Airport. • Western Harbour Tunnel. • Westlink M7 Motorway widening.

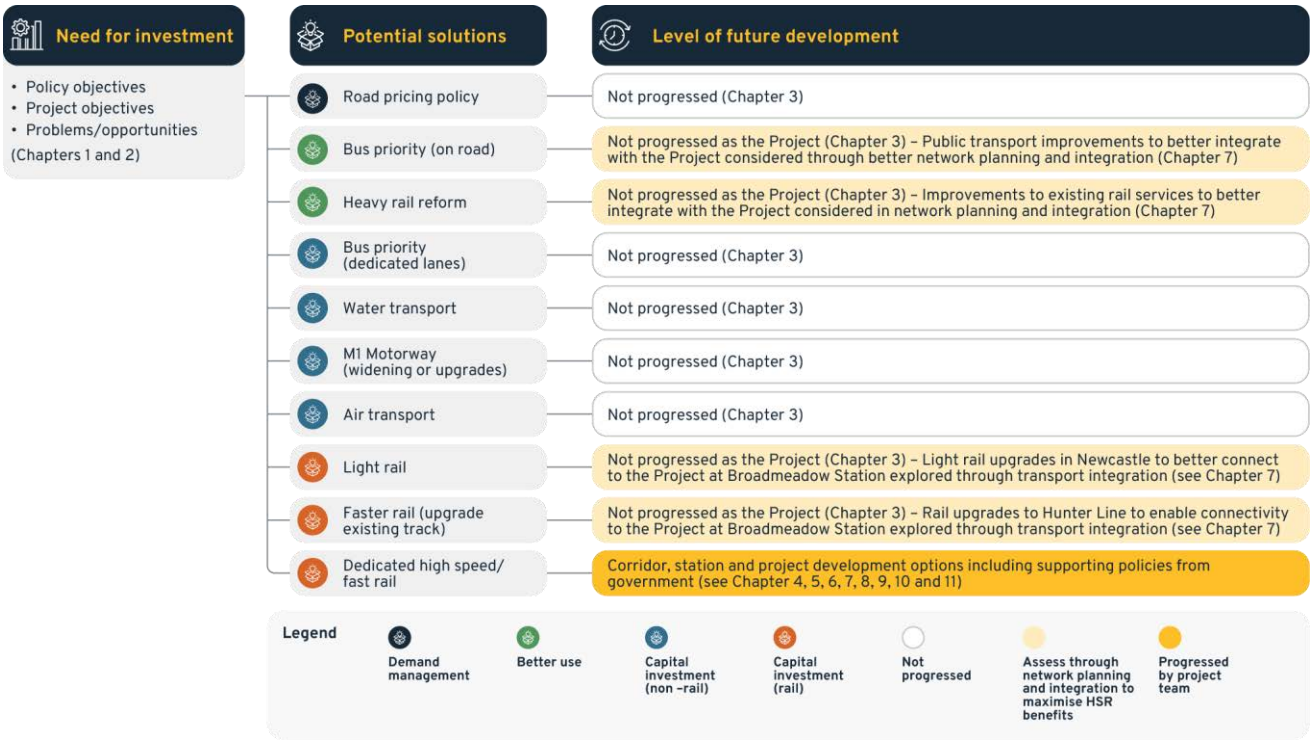
In addition, some small-scale changes were assumed where these are likely to be needed to sustain viable operations and serve expected greenfield developments under the Travel Zone Projections 2022 scenario.

3.3. Considering the strategic alternatives

The first step in the options assessment was to review the alternative strategic approaches that could possibly be implemented to address the need for investment, which include lower cost options, to determine how well they could each meet the project and network objectives.

The options assessed are summarised below, along with the findings of the assessment and whether they were taken forward for further consideration. The figure below provides an overview.

Figure 3-2 Alternative options assessed



Across the 10 strategic alternative options that were assessed, the assessment found that only the options involving the implementation of new heavy rail infrastructure could meet all 6 project objectives or network objectives.

Analysis has shown that alternative investment in major roads (including dedicated bus lanes) would have significant costs and environmental impacts, and would not meet project objectives related to economic productivity or the need for more housing. Provision of new air services also would not meet the project objectives for the project corridor. These alternative investments would not address the lack of connectivity which is at the core of the need for investment, as outlined in Chapter 2.

To assess the likely performance of the different types of heavy rail solution, the assessment drew on previous studies of possible rail projects in the project corridor. These have consistently demonstrated that dedicated lines would minimise disruption during construction and offer the fastest and most reliable service, maximising economic benefits, while in contrast alternatives – such as upgrades of existing tracks to make these faster or partially integrated options with shared tracks – result in slower speeds, lower levels of reliability, increased likelihood of congestion and significantly lower levels of benefit.

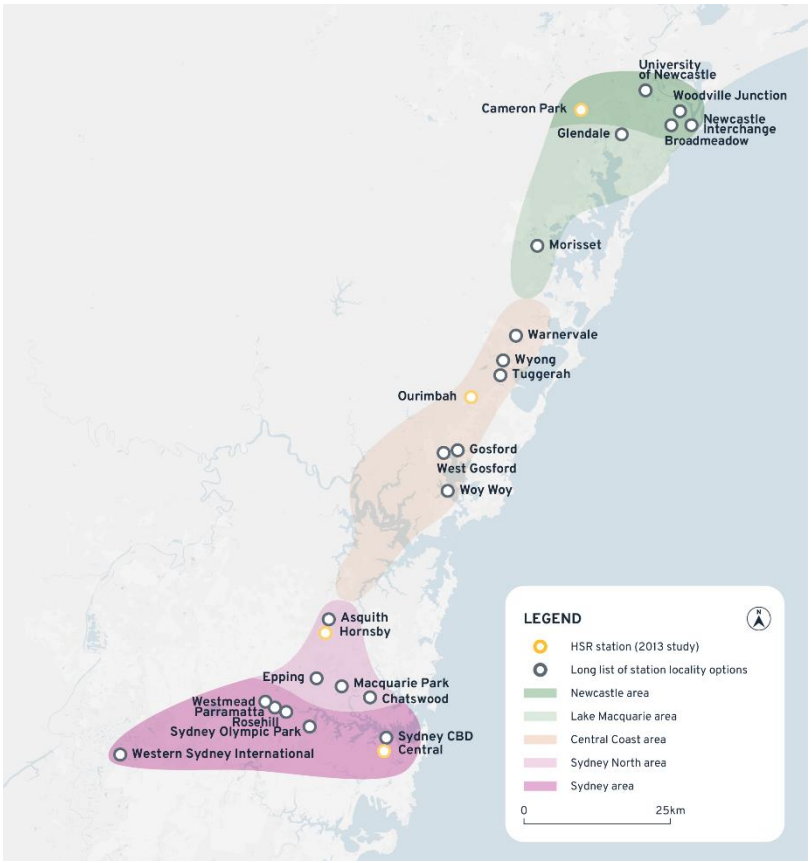
The dedicated high speed rail option was therefore assessed as being most closely aligned with the project and network objectives, and selected for further development and assessment.

International experience demonstrates that high speed rail is a proven and transformative mode of transportation, effectively complementing road and air travel in countries such as Spain, Italy, France, Germany and Japan. Decades of operations in these nations highlight its effectiveness as the ideal choice for medium to long distances, offering a compelling combination of faster and more productive journeys than road transport and greater convenience and connectivity than air travel, particularly for city-to-city links. It is particularly well-suited for journeys between 100 and 400 kilometres, where it provides a faster, more convenient alternative to car travel. For distances between 400 and 1,000 kilometres, high speed rail offers a seamless, efficient option alongside air travel, while air travel remains the dominant choice for trips exceeding 1,000 kilometres.

Some of the options that were unsuccessfully assessed as potential alternatives could nonetheless perform important roles as complementary initiatives alongside high speed rail. These (as well as other potential complementary initiatives) are further explored in subsequent chapters.

3.4. Assessing station location options

Figure 3-3 Station location options assessed



Having confirmed high speed rail as the preferred solution, a long list of 26 station locality options in the project corridor was investigated to confirm a short list of station options.

Long list options were identified from previous studies, including those identified in the 2013 study.

Stations were assessed against one another in five distinct geographical areas, with the objective of confirming one or more preferred station locations for each of the Newcastle, Lake Macquarie, Central Coast, Sydney North and Greater Sydney areas.

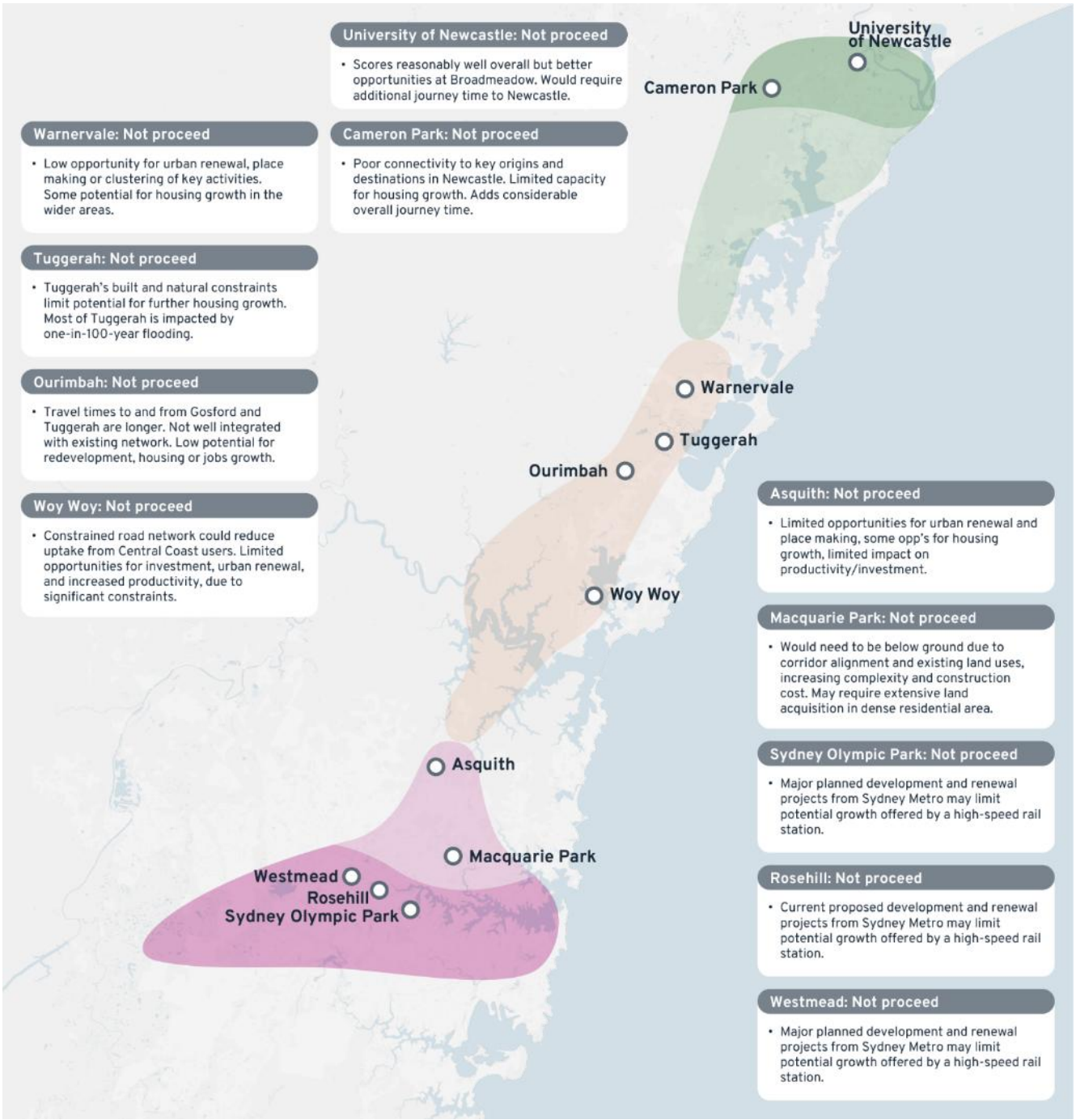
The assessment short-listed two types of potential station localities:

- **Anchor stations** – All potential station localities were assessed on a consistent basis against the project objectives, with the best performing stations short-listed as potential anchor station localities.
- **Potential intermediate stations** – Remaining localities between Newcastle and Sydney (that is, those not selected as anchor stations) were either removed from consideration, or progressed to a second stage

involving further assessment against the project objectives to determine localities which could support a potential intermediate station along the high speed rail alignment.

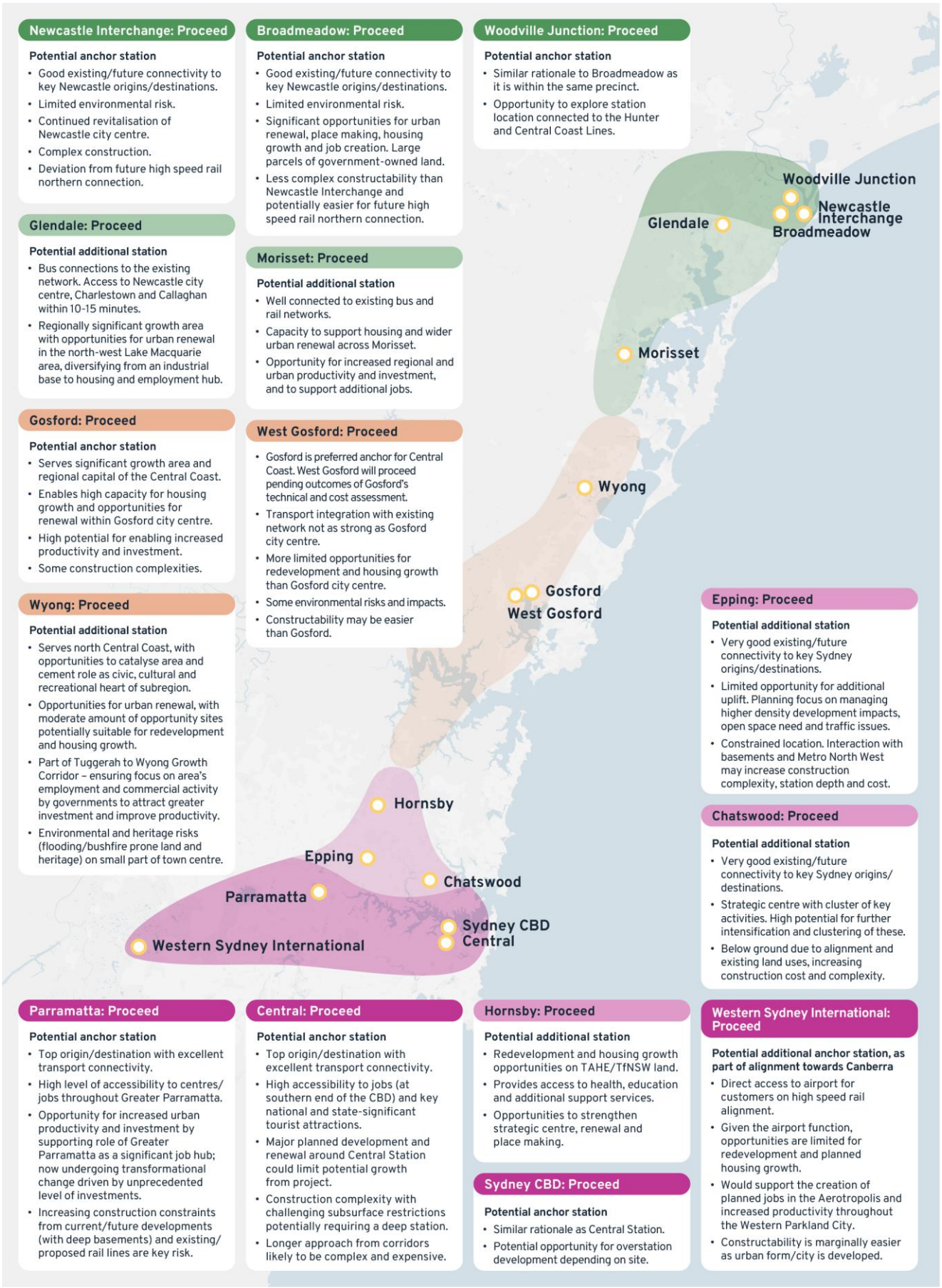
The following diagram presents the localities that did not proceed, with justification for each. For example, while Cameron Park was identified in the 2013 study as a potential station location, the strategic assessment showed it has limited capacity for housing growth and would add considerably to the overall journey time between Newcastle and Sydney.

Figure 3-4 Station locality options not proceeding



The following diagram presents the localities that did proceed, with justification for each locality.

Figure 3-5 Station locality options proceeding



A quality rail link will significantly improve Western Sydney International's accessibility

The Australian Government is in the final stage of constructing Western Sydney International (Nancy-Bird Walton) Airport, which is expected to become a significant future airport of a similar scale to Australia's largest airports. By 2033, Western Sydney International is projected to serve 10 million passengers annually.

Connecting Western Sydney International to the high speed rail network is expected to attract more passengers to Western Sydney International, support the development and success of the new Bradfield city centre and contribute to the State's future transport network. This will benefit Australian, State and local governments, airlines, other airports and local communities in Western Sydney.

The construction of high speed rail to Western Sydney International could expand the catchments readily accessible to the airport. Residents of Newcastle, for example, would be able to access Western Sydney International in 83 minutes, compared to current road travel times of over 130 minutes. The journey from Central Station and Western Sydney International by rail would reduce significantly from 88 minutes to 26 minutes with no interchange.

Research indicates that a high speed rail stop at Western Sydney International could add 2.3 to 2.8 million incremental passenger trips to the airport by 2039, with this number expected to grow significantly in the following decades. The high speed rail connectivity will be a critical enabler for Western Sydney International's ambitious public transport mode share targets, aiming for a 26 per cent train mode share by 2063, which is in line with the highest global standards.

A fast, frequent and reliable rail connection to Western Sydney International would mitigate the risk of losing aviation traffic to interstate or international markets due to poor connectivity with key destinations like the Sydney CBD. It would enhance the airport's strategic appeal for airlines and provide opportunities to balance aviation capacity within Greater Sydney, aligning with global best practices.

Connecting Western Sydney International to the high speed rail network could significantly increase patronage growth and lay the foundation for future extensions to Canberra and Melbourne. This integration also enhances operational flexibility by enabling efficient train turnaround and stabling at the airport.

There are numerous examples of high speed rail connections to European airports including Frankfurt International Airport (opened 1999), Paris Charles De Gaulle Airport (opened 1994) and Copenhagen Kastrup Airport (opened 2001), which extended each airports' catchment area, increased rail passengers to the airport and enabled more lucrative services to replace short haul flights.

Source: LEK research and analysis.

3.5. Assessing alignment scenarios

The short-listed anchor and intermediate station location options were arranged in various logical combinations to form 18 alignment scenarios, which were then subject to strategic investigation.

Figure 3-6 Alignment scenarios

3.5.1. Strategic investigation of alignment scenarios

The assessment of the 18 alignment scenarios focused on five priority investigation areas: catchment and accessibility analysis; preliminary demand and land use considerations; strategic technical analysis; preliminary rail operations analysis; and strategic costings.

The conclusions from the analysis are outlined below by geographical area: Sydney area, Newcastle area, Central Coast area, Sydney north area and Lake Macquarie/Central Coast area.

Preferred alignment – Sydney area (anchor station/s)

Central Station and/or Parramatta are the preferred anchor station(s) for Sydney:

- Central Station preferred due to its CBD location, access to jobs, network connectivity and growth potential.
- Parramatta preferred for a second station due to its strategic location, employment growth and connectivity.
- With two anchor stations, an alignment to Central Station then connecting to Parramatta is preferred.
- Western Sydney International is emerging as the preferred location for an additional anchor station, as an opportunity to support the success of Bradfield and a step towards Canberra and Melbourne.

Preferred alignment – Newcastle area (anchor station)

Preferred option is for a station at Broadmeadow with an alignment allowing for future extension to the north.

Preferred alignment – Central Coast area (anchor station)

Gosford is a preferred location for a Central Coast anchor station as it best supports the project objectives for economic development, improved growth and liveability. However, an alternative location at West Gosford was found to have reasonable merit for further testing.

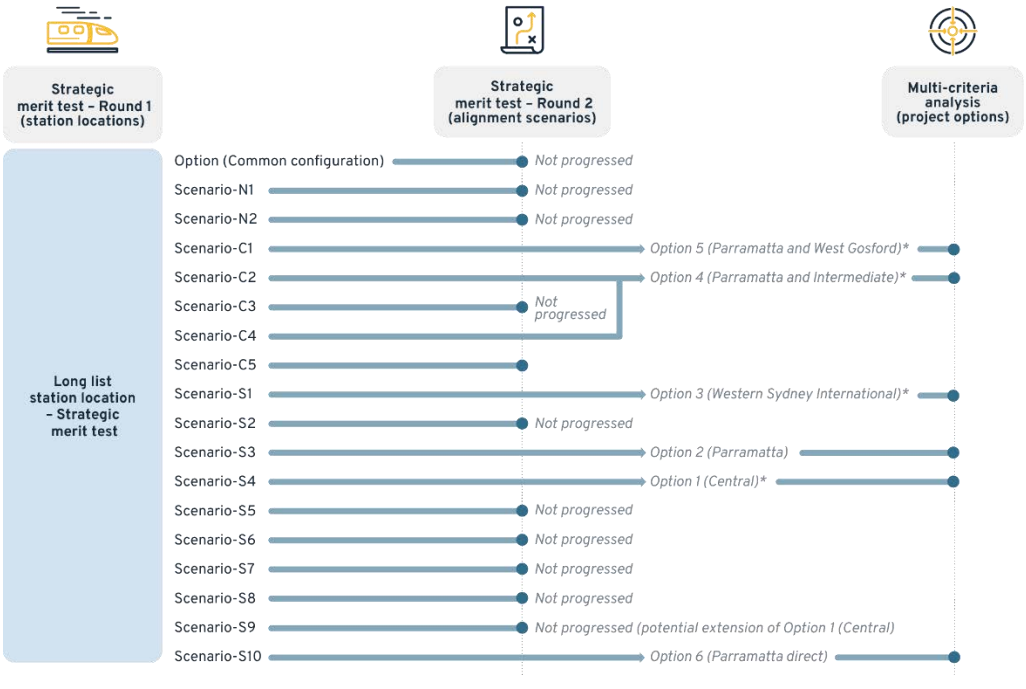
Preferred alignment – Sydney north area (potential additional station)

Accessibility analysis supports maintaining Hornsby if Parramatta is the only Greater Sydney anchor station.

Preferred alignment – Lake Macquarie/Central Coast area (potential additional station)

Accessibility and technical feasibility of potential additional stations on the Central Coast supports further analysis to explore value for money. The following figure shows the alignment scenarios that were eliminated at the short-listing stage and the six project options that progressed to the multi-criteria analysis stage.

Figure 3-7 Short-listed options



*The option excludes Hornsby compared to the alignment scenario. Hornsby considered as part of Option 6 (Parramatta direct).

3.6. Assessing project options

The 6 short-listed project options resulting from this process are illustrated in the figure below. All options featured a station at Broadmeadow, with options testing different combinations of the preferred stations above.

Figure 3-8 Six project options proceeding to multi-criteria analysis

Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Central	Parramatta	Western Sydney International	Parramatta + Intermediate	Parramatta + West Gosford	Parramatta direct

A multi-criteria analysis was undertaken to determine the preferred project option. The analysis incorporated 3 complementary aspects (illustrated below), each of which were considered for all 6 options.

Figure 3-9 Three-part multi-criteria analysis framework

3.6.1. Multi-criteria analysis part 1: Alignment with project and network objectives

Overall, Option 3 (Western Sydney International) and Option 4 (Parramatta + Intermediate) performed best against the project and network objectives. Key summary conclusions across differentiating criteria for the project objectives are summarised in the following table.

Table 3-2 Summary of assessment

Objective	Differentiating criteria	Summary
A transformative, safe high speed rail product, providing better connectivity, and a genuine alternative for customers	Customer experience, travel time, and transport integration	• Options capturing the Central Coast to CBD commuter market performed best against this objective. Option 1 (Central) and Option 2 (Parramatta) would attract between 47,400 and 49,700 customers daily. • Option 3 (Western Sydney International) would generate additional customers because of the strong demand to/from the airport. • Option 4 (Parramatta + Intermediate), with an intermediate station, generates additional demand from the potential for additional housing. • A station at West Gosford (Option 5) reduces travel benefits to and from Gosford but improves access to M1 Pacific Motorway and provides more capacity for parking, which could improve mode shift. Overall, it attracts 15,000 fewer customers daily than Option 2. • Option 6 (Parramatta direct) would almost halve patronage (to 25,800 customers daily).
Environmentally sustainable, resilient, contribution to net zero	Environmental and corridor impacts	• All options perform relatively poorly because of significant carbon footprints in construction (pre mitigation) and impacts on national parks and state forests. Design optioneering will focus on mitigating these impacts.
More housing choice and great places; improved community quality of life and equity	More housing choices, great places and improved community equity	• Options with both Central Station and Parramatta would have higher capacity for new dwellings along the corridor and more opportunities for urban renewal than options with one or the other. • The addition of an intermediate station would add more capacity for new housing, and pick up a bigger population catchment, including areas with a high proportion of First Nations people and areas of social disadvantage around Wyong. • The addition of Western Sydney International would provide further opportunities for clustering and additional development through partnering with landowners outside of areas controlled by Western Sydney International. • Option 5 (Parramatta + West Gosford) has limited opportunities for urban renewal and less dwelling potential than the options via Gosford.
Regional and urban productivity, increased tourism and job creation	Access to employment, and industry investment and jobs	• Options 2, 3, 4 and 5, which include Parramatta and Central Station, would have the highest accessibility to jobs and centres/attractors. • Option 3 (Western Sydney International) would generate significant new jobs capacity and create the highest increase in job accessibility, including greater access to people from lower socio-economic areas in western and south-west Sydney. This option would enable direct access to jobs around Bradfield (the Aerotropolis) for communities on the Central Coast. • Option 4 (Parramatta + Intermediate) would be the best performing against this objective as the intermediate station combination results in the highest capacity for new jobs and the highest change in accessibility. • Option 5 (Parramatta + West Gosford) would significantly reduce accessibility to jobs and centres compared to other options via Gosford.
Scalable, innovative, commercially sustainable and value for money solutions	Cost and constructability	All options would have constructability challenges and delivery risks. Differentiating factors include: • Option 3 (Western Sydney International) would have additional complexity and risk in tunnelling under the airport. • All options other than Option 3 (Western Sydney International) would require interim terminating infrastructure and/or stub tunnels to safeguard for future extension.

Objective	Differentiating criteria	Summary
		• An above ground station at West Gosford would be easier to construct, reducing delivery risk associated with tunnelled construction in Gosford and geotechnical risk with crossing Brisbane Water. • Option 6 (Parramatta direct) would remove the complex construction at Central Station.
	Commercial development and revenue	• All options other than Option 6 (Parramatta direct) would recover operating costs with the potential for some lifecycle recovery. Option 6 would require ongoing subsidy.

3.6.2. Multi-criteria analysis part 2: Implications for the Network

Part two of the multi-criteria analysis was to carry out a review of the implications of the options for the eventual delivery of the Network. The options were assessed against the network objectives to confirm their performance, particularly from the perspective of customer experience and convenience, and delivery and future proofing implications for the Network.

All 6 short-listed project options would support the delivery of the desired future Network frequency and allow for the future Network's product vision and desired customer experience.

Option 3 (Western Sydney International) would enable a straightforward expansion to the full Network, with the ability to establish a stabling and depot site for the whole Network from the first phase.

Option 6 (Parramatta direct) would pose a significant threat to the value proposition for the overall Network because of the additional travel time and transfers needed to reach the Sydney CBD, which is a key market for the Network overall.

3.6.3. Multi-criteria analysis part 3: Rapid economic appraisal

Part 3 of the multi-criteria analysis was to carry out a rapid economic appraisal of the options, focused on transport benefits only.

The appraisal highlighted the benefits of stopping at Central Station, with the 5 options stopping at Central Station generating significantly more benefits than Option 6 (which does not stop at Central Station).

Of the options including Central Station:

- Option 3 (Western Sydney International) offers the best value for money overall. In terms of absolute benefits, it is significantly more impactful than the next best performing option, generating benefits 55 per cent greater than the second ranked option, but its high absolute costs place it only one percentage point ahead of Option 1 (Central) in terms of its ratio of benefits to costs.
- Option 2, in which the line is extended from Central Station to Parramatta, does not generate additional transport benefits to outweigh the cost.
- Option 4 (Parramatta + Intermediate) performs marginally worse than Option 2 (Parramatta).
- Option 5 (Parramatta + West Gosford) has a net negative impact compared to Option 2 (Parramatta) due to loss of demand.

The rapid appraisal results are summarised in the following table.

Table 3-3 Transport benefits as a percentage of total costs

	Option 1 Central	Option 2: Parramatta	Option 3 Western Sydney International	Option 4 Parramatta + Intermediate	Option 5 Parramatta + West Gosford	Option 6 Parramatta direct
Transport benefits as a percentage of total costs	21%	18%	22%	17%	16%	13%
Rank	**2**	**3**	**1**	**4**	**5**	**6**

Note: Core results with intra-Sydney trips unblocked – real $m FY25 discounted at 4 per cent over 50-year appraisal period.

3.6.4. Overall multi-criteria analysis outcomes

The multi-criteria analysis highlighted the merits of Option 3 (Western Sydney International) in performing strongly against the project and network objectives, and it also outranked the other options under the rapid appraisal analysis. The assessment also identified the potential benefit of further investigating an intermediate station between Gosford and Broadmeadow (see below).

Furthermore, the analysis highlighted the benefit of potentially delivering Option 1 (Central) as a staged approach towards Option 3 (Western Sydney International).

3.7. Intermediate station assessment

Further detailed assessment was undertaken to determine the preferred location for a potential intermediate station between Gosford and Broadmeadow. This included:

- Developing a long list of locations, considering large landholdings near the project alignment between Gosford and Broadmeadow.
- Short-listing locations considering potential environmental concerns, significant topographical and engineering challenges to the alignment, and constraints on housing development potential.
- Assessing short-listed station locations against agreed criteria with reference to the project objectives: ability to expand the high speed rail catchment, housing uplift, technical and constructability considerations, high speed rail journey time impact and property impact.

Morisset was identified as the preferred intermediate station location for the purposes of this Business Case, given the following:

- There is significant land potentially available for urban development (225 hectares east of the M1 Pacific Motorway and 430 hectares to the west).
- The location is close to the M1 Pacific Motorway interchange, enabling a large driving catchment.
- There are strong opportunities for development partnerships with landowners and local government.

The economic analysis comparing the options with or without an intermediate station at Morisset is outlined in Chapter 7.

3.8. The Project

An overview of the resulting Project is provided in the following figure, with stations located as follows:

- **HSR Newcastle Station** will be located in Broadmeadow.
- **HSR Lake Macquarie Station** will be located in Morisset.
- **HSR Central Coast Station** will be located in Gosford.
- **HSR Sydney Central Station** will be located in Surry Hills.
- **HSR Parramatta Station** will be located in Central Parramatta.
- **HSR Western Sydney International Station** will be located at Western Sydney International.

Figure 3-10 Project route

[1] Australian Bureau of Statistics (2016), Census data.
[2] NSW Department of Planning (2022), webpage: Population projections, accessed June 2024.
[3] Transport for NSW (2023/24), Transport Endorsed Network Assumptions (TENAS2023).

Chapter 4

Customer, network and operations

Australian Government
High Speed Rail Authority

A rapid, reliable and customer-focused system

- The Project's diverse customer market will include people travelling for work, study, personal business and leisure throughout the day. High speed rail between Newcastle and Sydney will offer a transformative value proposition that will provide a genuine alternative to existing travel choices.
- The high speed rail service will be frequent, reliable and rapid – halving travel times between key locations and providing a connection that is much more reliable than current options. There will be regular all-stops services throughout the day and additional services at busy times to cater for demand. The service plan is designed to allow for transition to a multi-tier Network.
- Customer needs are clearly defined and underpin station and train designs to provide a customer experience that makes for easy, intuitive and enjoyable customer journeys. Trains will feature onboard amenities including internet connectivity, food and beverage options, and clear customer information.
- The Project will be a dedicated and independent line with infrastructure that equals the standards seen on leading international networks to facilitate safe, rapid and reliable operation throughout the day. The operations and maintenance infrastructure concept enables expansion to the Network.
- Specific business requirements have been developed to establish what the Project needs to deliver. The business requirements respond to the needs of future customers and draw from highly successful international high speed rail systems as precedents.

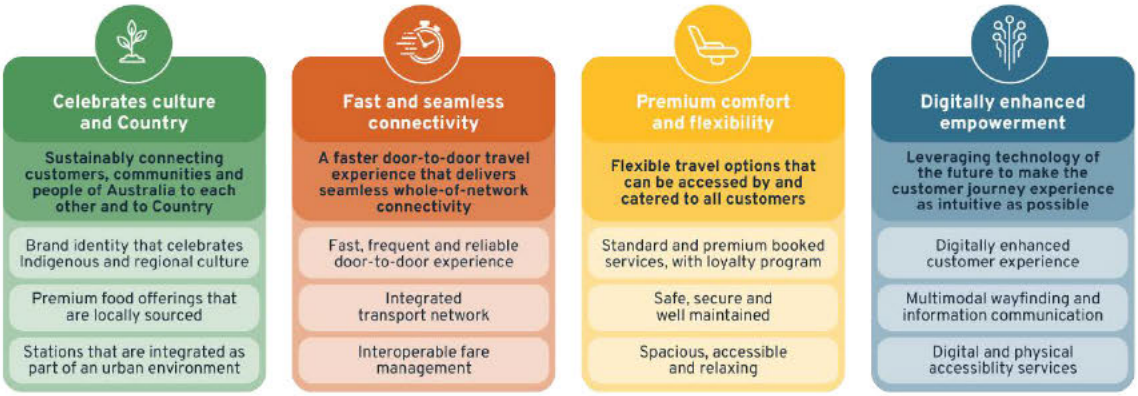
4.1. Customers

4.1.1. Reflecting customers' needs

High speed rail will serve a diverse customer market. Throughout the day, it will attract people travelling to work, attending meetings, accessing places of study, and for personal and leisure purposes.

The value proposition for high speed rail reflects the different needs and values of these customers, as identified through customer research, to enable local context to be applied to a tried and tested product (as shown in the following figure). While different customer segments will have different priorities, they will all share the desire for fast and reliable services, comfort and affordability, and seamless connections with other modes.

Figure 4-1 Customer-led high speed rail value proposition



Source: EY Sweeney (2024), High Speed Rail Customer Strategy.

The Project presents a superior value proposition. Offering a genuine alternative to other modes of travel in a new product that caters for all, it will cut journey times between Newcastle and Sydney to about an hour, more than 60 per cent quicker than travelling by existing rail services, car or coach.

The Project will bring many areas of Newcastle and Lake Macquarie within a 90 minute journey of Sydney and many areas of the Central Coast within a 60 minute journey. This will make it attractive to commuters who value fast and frequent services, and more time back in their day.

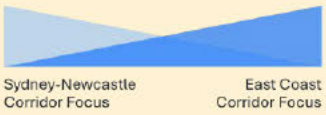
An increasing leisure and personal travel market will use high speed rail across the day, including for onward air travel, and will value quality amenities with luggage space and quiet zones, and well-located stations.

Developing the Network's Customer Strategy

The Customer Strategy leverages new insights from research and consultation with over 2,000 people living in and around the future Network across NSW, Queensland, ACT and Victoria. The Strategy identifies future customers and defines their needs, values, priorities and preferences, and responds to these with a clear product value proposition and customer requirements. The research found that customer needs and preferences were similar for the Project and the Network.

Whole-of-Network view

Responds to the immediate Project need within the context of the Network vision.



Systems thinking approach

Captures customer sentiment from the perspectives of individuals and local communities along the project corridor, as well as the broader perspective of communities across Australia.

Insights to inform proposition

Substantiates the value proposition and customer requirements with data and global benchmarking, ensuring a Customer Strategy that leverages best practice.

4.1.2. Travel markets and demand

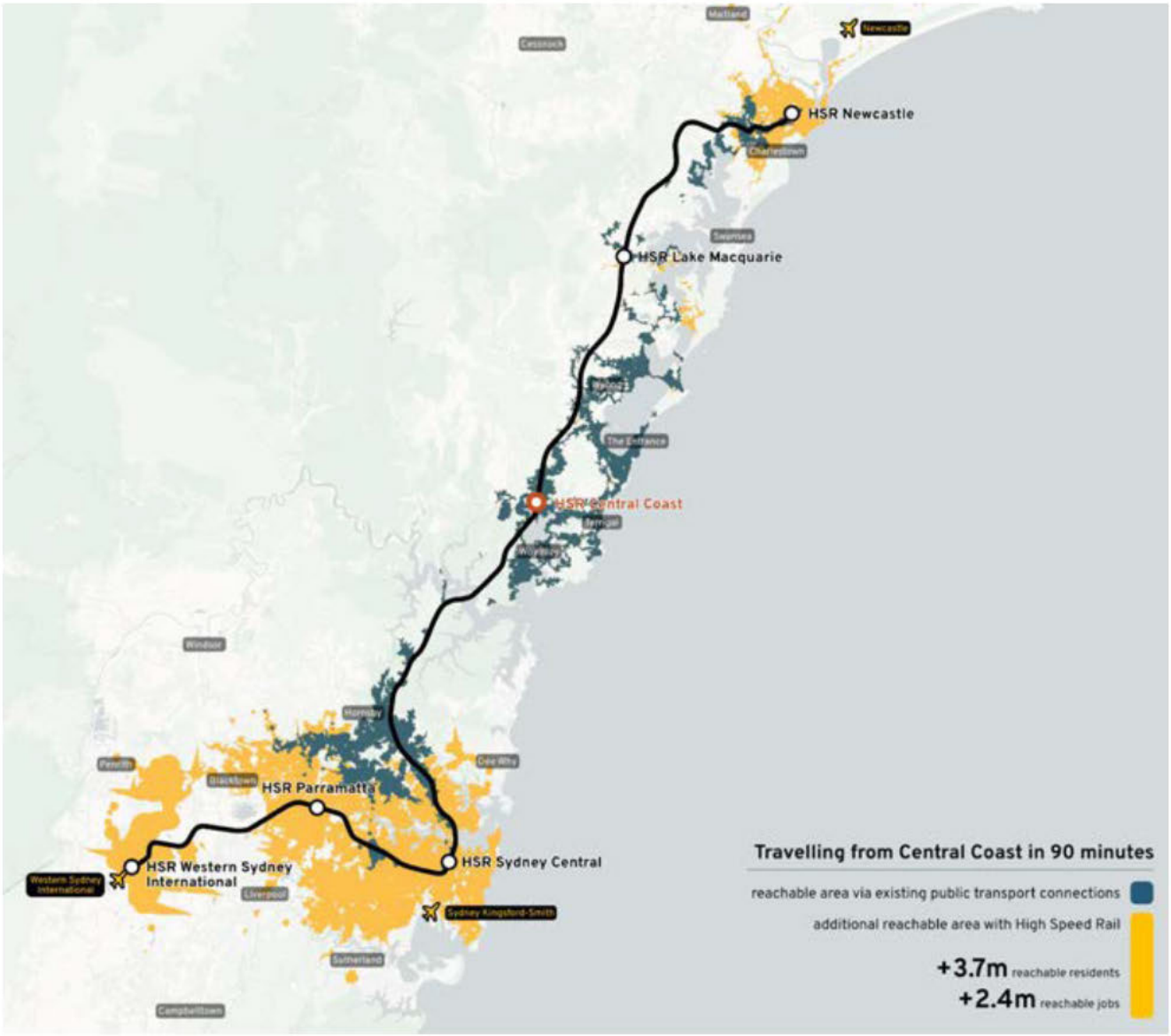
Serving a diverse range of customer journeys

The Project's high speed rail service will trigger a step change improvement in travel time and accessibility which reaches beyond stations to increase connectivity between large areas of Newcastle, the Hunter, Lake Macquarie, the Central Coast and Greater Sydney.

The Project will achieve a travel time of around an hour between HSR Newcastle Station and HSR Sydney Central Station, and 1 hour and 30 minutes between HSR Newcastle Station and HSR Western Sydney International Station. In comparison, the existing service takes around 2 hours and 40 minutes between Newcastle Interchange Station and Central Station.

The following figure shows how the Project will open up new horizons, highlighting the additional areas accessible from the Central Coast in 90 minutes with the Project, compared to current public transport options.

Figure 4-2 Travelling from the Central Coast in 90 minutes



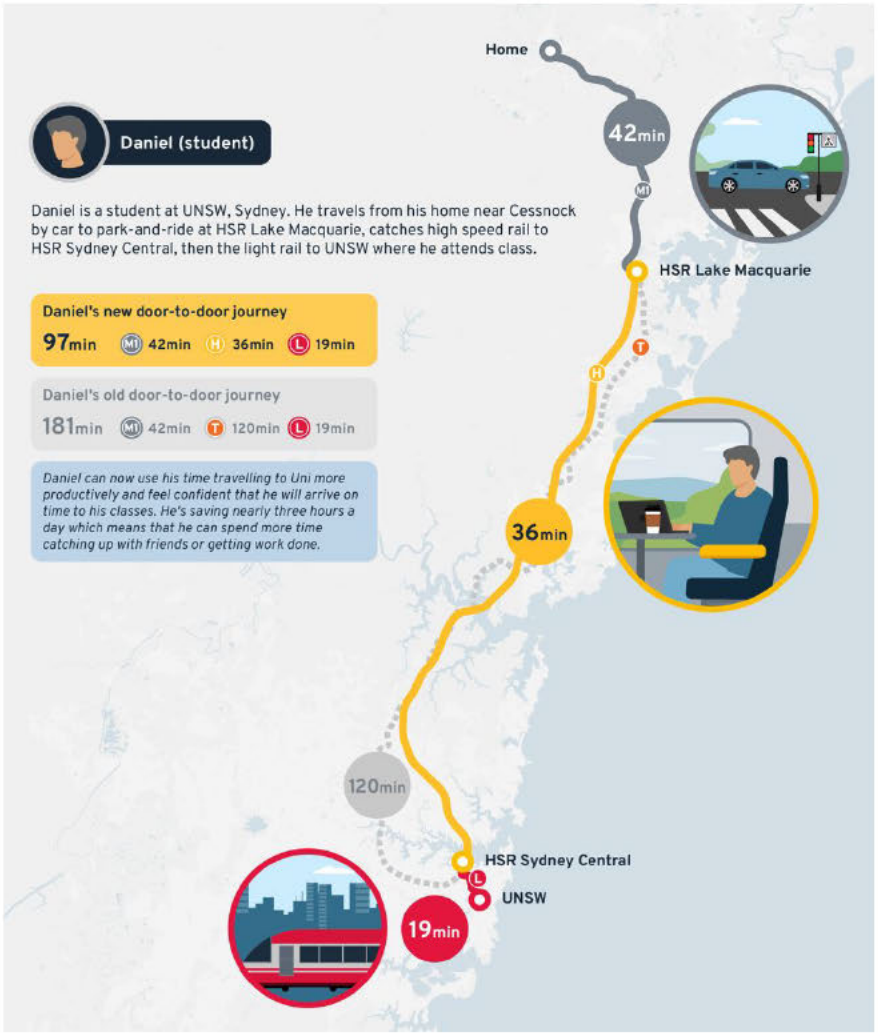
This accessibility will translate directly to new and improved opportunities. The table below shows how the Project will amplify the number of jobs and people reachable within 90 minutes from stations along the route.

Table 4-1 Additional opportunities reachable within 90 minutes in 2061, with the Project

Location	Jobs	Residents
HSR Newcastle	+1.2 million	+0.8 million
HSR Central Coast	+2.4 million	+3.7 million
HSR Sydney Central	+0.1 million	+0.2 million
HSR Western Sydney International	+1.1 million	+2.2 million

At the level of an individual passenger, this means that journeys which are currently arduous would become manageable, productive and comfortable. The figure on the next page illustrates the opportunities for future students like Daniel, who previously had to leave regional NSW to study in Sydney.

Figure 4-3 Day in the life of a student using high speed rail



Attracting significant demand

Global experience clearly demonstrates that the enhanced connectivity and reliability provided by the Project is likely to lead to an increase in rail travel outside the traditional peaks in the mornings and evenings, and attract many people who currently travel by car or who currently choose not to travel at all.

Preliminary demand forecasting using the NSW Public Transport Project Model and the High Speed Rail Demand Model (see Approach to demand forecasting on page 44) provides an estimate of passenger demand on the Project soon after opening and also after it has been operating for 20 to 25 years (the latter both as a standalone asset and as part of an expanded Network).

The following table summarises the findings.

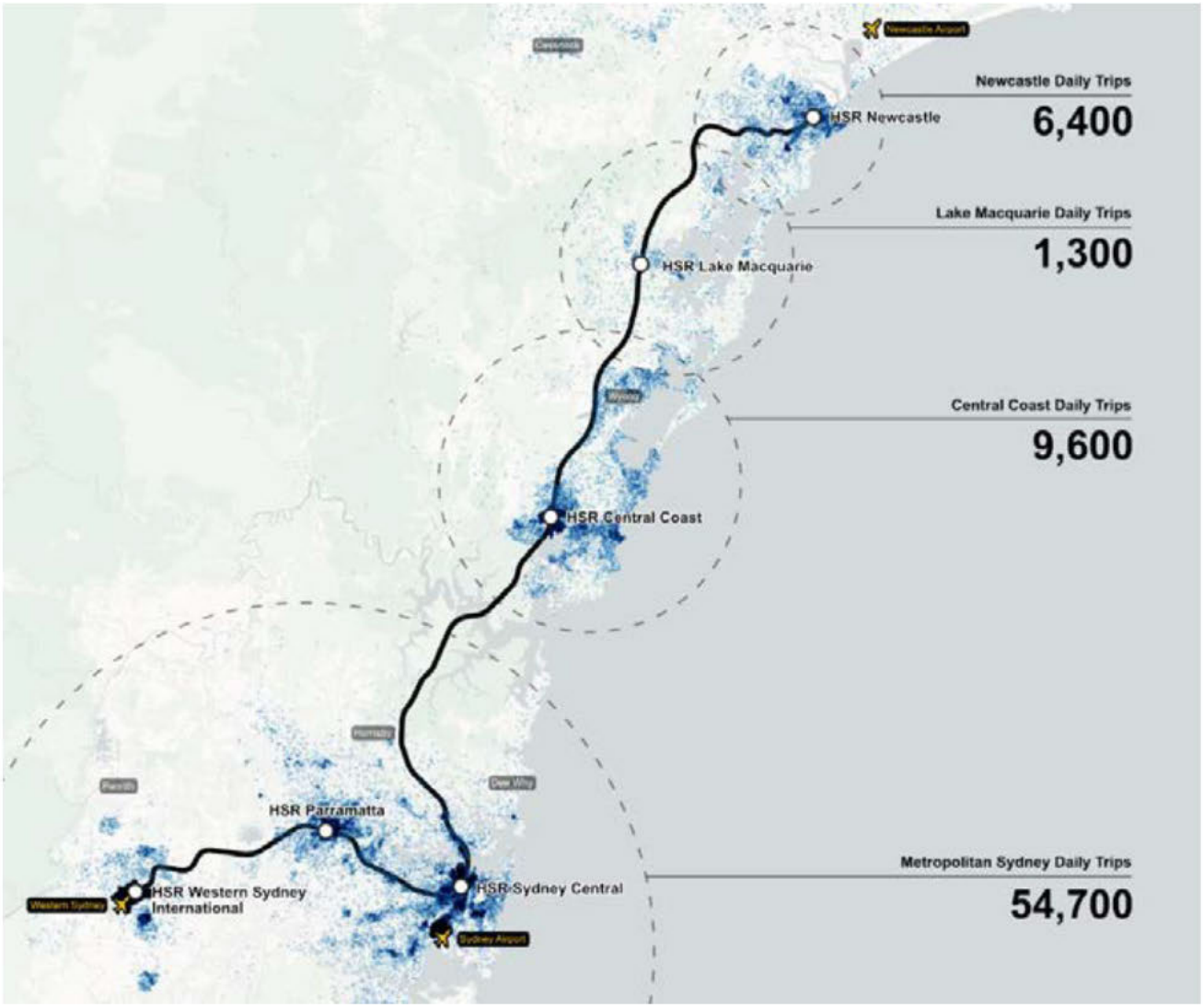
Table 4-2 Forecast project demand

	Boardings at the 6 stations of the Project		Passenger loads approaching the Sydney Metropolitan Area	
Year and Network	**Typical weekday**	**Yearly**	**Typical weekday**	**Busiest hour**
2041 (Project only)	53,000	16.8 million	13,500	1,600
2061 (Project only)	72,000	22.7 million	18,000	2,100
2061 (Network)	146,000	50.3 million	65,000	5,200

As a standalone asset, the Project is forecast to carry 53,000 trips on a typical weekday upon opening, rising to 72,000 trips by 2061. In 2061 as a section of the full Network, boardings at the 6 stations of the Project (which will serve as its core) would reach 146,000 trips per weekday, as they become gateways to the east coast of Australia, with opportunities for easy and rapid travel to Melbourne, Brisbane, Canberra and regional locations.

The following figure shows how different sections of the route will contribute to customer demand for stations between the Sydney CBD and Western Sydney International in 2061.

Figure 4-4 Origins and destinations of high speed rail trips in 2061 (Newcastle to Sydney only)



Approach to demand forecasting

Demand forecasts for the Project have been informed by several Transport for NSW demand models covering Sydney's Greater Metropolitan Area:

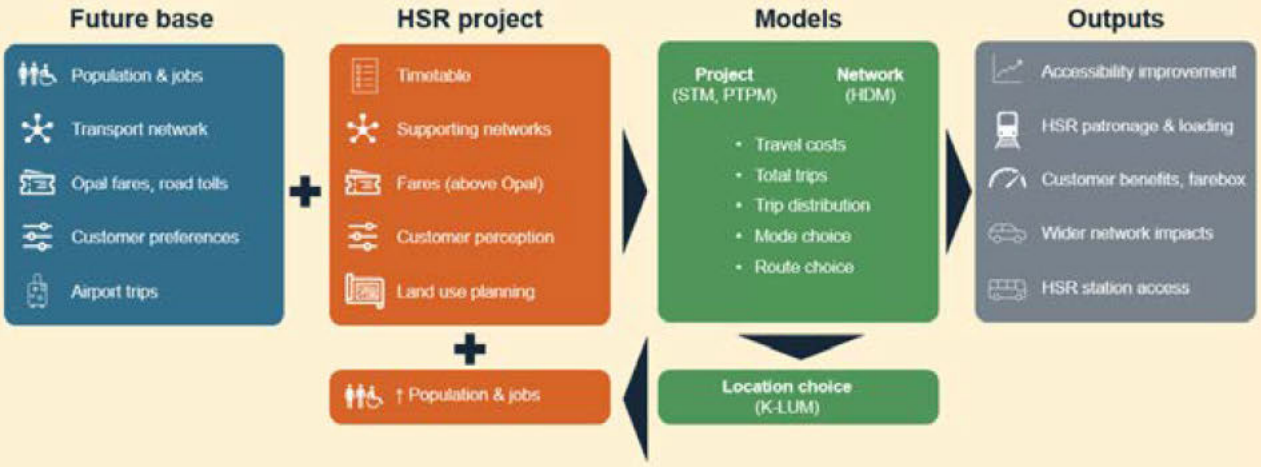
- Sydney Strategic Travel Model (STM) which forecasts travel patterns in the Greater Metropolitan Area under various land use and transport scenarios, testing alternative settlement, employment and transport assumptions to identify future outcomes.
- Public Transport Project Model (PTPM) which complements the STM by addressing public transport needs through incremental, multi-modal mode choice and assignment analysis.

Additionally, a bespoke High Speed Rail Demand Model (HDM) was developed for the east coast to inform wider network planning and analysis.

The future Base Case assumes NSW Government population and employment projections, current day travel behaviour preferences, and committed and funded transport infrastructure as at September 2023. Project Case scenarios are then modelled to forecast the travel behaviour response to the Project, based on timetables, fares, customer perception of high speed rail and supporting transport networks.

Demand modelling has also been informed by a location choice Land Use Model (K-LUM) developed specifically for the Project and covering the entire east coast study area. The Project adopts an 'open city' land use approach across the east coast (outlined in Chapter 6). K-LUM Project Case forecasts are based on land development opportunities and changes in travel costs derived from the STM and HDM, compared against the future Base Case. These settlement patterns are then fed back into the STM and HDM to refine and finalise demand forecast for the Project.

An overview of the demand modelling process is provided in diagram below and further information on the forecasting approach is provided in the Project Demand Modelling Report.



Three key travel markets for the Project

The Project is initially expected to serve the three primary travel markets outlined in the following table.

Table 4-3 Project travel markets

Travel market	How high speed rail forms and supports this market	Demand forecast and opportunity
Region to capital Newcastle – Sydney, Parramatta and Western Sydney International (non-airport related) Lake Macquarie – Sydney, Parramatta and Western Sydney International (non-airport related) Central Coast – Sydney, Parramatta and Western Sydney International (non-airport related)	Travel times between Sydney and Newcastle are halved. Rail becomes the fastest and most reliable way to travel between Newcastle – Sydney and Central Coast – Sydney.	**35,000 daily trips in 2061** Significant demand with higher usage in the morning and evening periods. Notable leisure and business demand throughout the day – with an opportunity to further grow this market.
Western Sydney International access Western Sydney International – Parramatta, Sydney Central, Central Coast, Lake Macquarie and Newcastle	Newcastle and Central Coast receive new direct connection to international airport. Opportunity for travellers and workers to reach airport rapidly. Central and Parramatta connected to airport more rapidly by high speed rail.	**19,000 daily trips in 2061** Mix of leisure and business trips. Opportunity to grow market of customers connecting to and from flights at Western Sydney International, and to the Bradfield ity entre via Sydney Metro services.

Travel market	How high speed rail forms and supports this market	Demand forecast and opportunity
Intra-regional Central Coast – Lake Macquarie Lake Macquarie – Newcastle Newcastle – Central Coast	Rapid travel times between stations in Newcastle, Central Coast and Lake Macquarie.	**1,000 daily trips in 2061** Opportunity for increased population. Opportunity to grow travel market and diversify travel patterns within the Central Coast, Lake Macquarie, Newcastle and the Hunter.

The critical role of HSR Sydney Central Station

HSR Sydney Central Station, located in the Sydney CBD, is expected to handle over 55,000 passenger movements per weekday in 2061 with the Project. The new station will become a critical hub for trips between Sydney, the wider region and Western Sydney International.

As the Network expands, HSR Sydney Central Station will serve as a major gateway for journeys between Sydney and Melbourne, Brisbane and Canberra, as well regional locations across the east coast. The station will cater for over 145,000 passengers (boardings and alighting) per weekday once the Network is completed.

Balancing intra-Sydney and regional trips

The Project includes three stations within Greater Sydney – HSR Sydney Central, HSR Parramatta and HSR Western Sydney International. The connection between these stations is expected to attract intra-Sydney passenger trips (for example between HSR Parramatta and HSR Sydney Central). Supporting these trips will benefit customers and provide a valuable revenue stream but will require management to ensure efficient service operations.

As the Network expands, intra-Sydney travel demand will be managed through pricing and access restrictions in order to prioritise long distance regional and intercity passengers. This approach is practiced commonly in high speed rail systems around the world such as Germany, China and South Korea.

Co-locating high speed rail with Central Station, Australia's largest transport hub, will significantly expand the Project's reach through integration with heavy rail, metro, bus, light rail and coach networks. This will provide customers with comprehensive connectivity across Greater Sydney, facilitating quicker end-to-end journeys.

Case study: The merits of a dedicated network – Spain

Spain's high speed rail network, A a Velocidad Española (AVE), was developed as a dedicated system, separate from the existing network. The first line opened in 1992, linking Madrid, Córdoba and Seville – and at 3,973 kilometres, AVE is the longest dedicated network in Europe and the second longest in the world.

Unlike Spain's conventional rail, which runs on wide gauge, the country's high speed network adopts the European standard gauge, which enables interoperability with European networks and allows direct high speed, cross-border services to France. (In Australia too, a dedicated network with standard gauge and defined standards will avoid interoperability issues across states which constrain existing rail networks.)

The advantages of operating AVE as a separate network (avoiding interference from slower trains, while minimising congestion and safety risks) are clear to see in performance. Its punctuality ratio sat at 98.5 per cent in 2018, while it enjoyed an 84 per cent customer satisfaction rating. By comparison, in France, where the high speed rail network is not fully separated from conventional rail, the equivalent statistics in 2024 were 88.3 per cent punctuality and just 62 per cent customer satisfaction.

4.2. Services and passenger experience

4.2.1. A superior and intuitive service

The Project will offer a compelling and comprehensible service that makes it a mode of choice along the corridor.

Figure 4-5 Summary of key service elements

Time of day	Trains per hour
Busy time periods	6
All day service	3
Stations	**Stopping**
HSR Newcastle	✓
HSR Lake Macquarie	✓
HSR Central Coast	✓
HSR Sydney Central	✓
HSR Parramatta	✓
HSR Western Sydney International	✓
Journey	**Travel times**
HSR Newcastle to HSR Sydney Central	0:57
HSR Newcastle to HSR Central Coast	0:33
HSR Newcastle to HSR Western Sydney International	1:29
HSR Sydney Central to HSR Western Sydney International	0:27

Predictable stopping patterns and frequencies

All high speed rail services on the Project's route will call at all stations, making the product simple for customers.

Services will operate with a minimum frequency of 3 trains per hour (a train every 20 minutes) and at busier times up to 6 trains per hour, or a train every 10 minutes, to cater for demand and support economic development.

High reliability and efficient operations

With the first departure at approximately 05:00, and the last arrival at around 23:00, high speed rail services will run for around 18 hours a day, 7 days a week. This will provide for most passenger journeys, while allowing sufficient time for maintenance that ensures reliability.

The reliability of dedicated high speed rail services is a factor that will set them apart from services on the existing congested rail network, where over 20 per cent of trains arrived more than 5 minutes outside their scheduled time (FY2024). Benchmarked against high speed railways in similar operating contexts, the Project will target 99 per cent of trains arriving within 5 minutes of the scheduled time.

Case study: Why high speed rail won't operate 24/7

Allowing time to carry out maintenance overnight will ensure services operate consistently throughout the week and year-round, including during holidays, while upholding high standards of safety and reliability.

This approach is well established internationally. Japan's Shinkansen system closes between midnight and 6am each day for essential maintenance work. France follows a similar schedule on its Paris-Bordeaux high speed rail line, where sections close for maintenance from to 5 . Spain's AVE system schedules overnight maintenance closures on major lines including Madrid to Barcelona and Madrid to Seville.

Why 320 kilometres an hour?

The selection of a 320 kilometre an hour maximum speed for the Network provides the right balance between achieving fast travel times, comfortable experience, maintenance requirements, energy consumption and environmental impacts. Analysis by the International Union of Railways[1] and international benchmarking suggests that a maximum speed between 300 and 320 kilometres an hour offers the optimal balance between speed, efficiency, passenger experience and sustainability. This range best trades increasing energy consumption and emissions, infrastructure and maintenance costs, and noise and vibration, for attractive travel times. High speed rail networks operating at 320 kilometres an hour maximum speeds, such as those in Japan, France and Morocco, demonstrate this balance.

Broader context: Network service specification

The Project has been future proofed to enable the efficient, progressive expansion and evolution of the Network, with consideration of future capacity, flexibility and interoperability. The Project design allows for transition to meet future demand and service needs while retaining flexibility to allow operators to develop their own service offering.

Service patterns: As the Network is expanded, a second service tier will be introduced, to balance regional connectivity with the need for fast inter-capital journeys. At this stage, the service between Newcastle and Sydney is expected to form part of a regional service tier, with an overlay of additional intercity express services provided to rapidly connect Sydney, Newcastle, Brisbane, Melbourne and Canberra.

Service tier	Role and function
Intercity	• Long-distance express connectivity between Brisbane, Gold Coast, Newcastle, Sydney, Canberra and Melbourne.
Regional	• Regional connectivity between Brisbane and Melbourne via intermediate locations. • Potential 'short regional' services connecting capitals to other destinations within approximately one hour (Newcastle to Sydney will become a short regional service within the Network).

Service capacity: The Network will ultimately have a maximum capacity of 12 trains per hour in each direction, carrying up to 6,200 passengers. This service target has been defined based on long-term passenger demand forecasts, infrastructure, and international benchmarks.

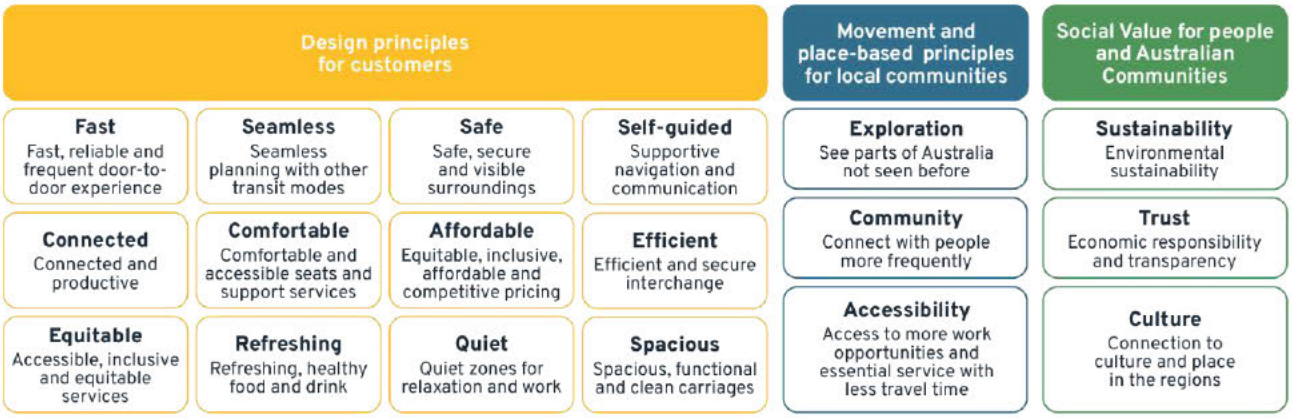
Service targets: The Network will provide a high level of reliability. For services from Sydney to Melbourne or Brisbane, the Project will be designed so that 98.5 per cent will arrive within 15 minutes of schedule while cancellation rates will be less than 1.3 per cent. This is in line with international HSR benchmarks for independent networks. Importantly, this will not only exceed reliability on conventional rail services but improve significantly on air travel. In the year ending December 2023, on time performance by the main Australian airlines averaged 70.6 per cent for arrivals and 71 per cent for departures, while 3.7 per cent of services were cancelled.[2]

Journey times: Operating speeds on the Project and the Network will be 320km/h above ground and 200km/h in tunnel. This will enable an appropriate balance to achieve travel time targets while optimising costs. The Network is targeting travel times of around 1.5 hours between Canberra and Sydney and around 4 hours between both Melbourne and Sydney and Brisbane and Sydney.

4.2.2. Customer-centred design

The perspectives and preferences of future high speed rail customers have been collected through research and public engagement and have informed product definition, design and optioneering decisions through the customer-centred design principles set out in the Customer Strategy and summarised in the figure below.

Figure 4-6 Customer-centred design principles



Source: Customer Experience Toolkit, High Speed Rail Customer Strategy (2024)

These principles drive design, not only for the service and onboard experience, but for the stations and places high speed rail will create, maximising the value it brings to the people, communities and culture along the route. The high speed rail product will continue to be refined over the subsequent stages of the Project to align with the expected needs and preferences of customers.

4.2.3. A comfortable onboard experience

A superior onboard experience will be provided across two travel classes, providing flexibility to select an experience that suits different preferences and budgets.

Customers in standard class will enjoy a comfortable and efficient travel experience with modern reclining seats, ample leg room, essential amenities, and designated quiet zones for relaxation and focused work. Business class tickets will offer enhanced comfort with spacious ergonomic seating and additional amenities.

Onboard amenities, such as power to charge personal devices, real-time passenger information displays, internet connectivity and streaming entertainment, will keep passengers connected, informed and entertained. The onboard bistro will keep passengers refreshed with a selection of food and beverages.

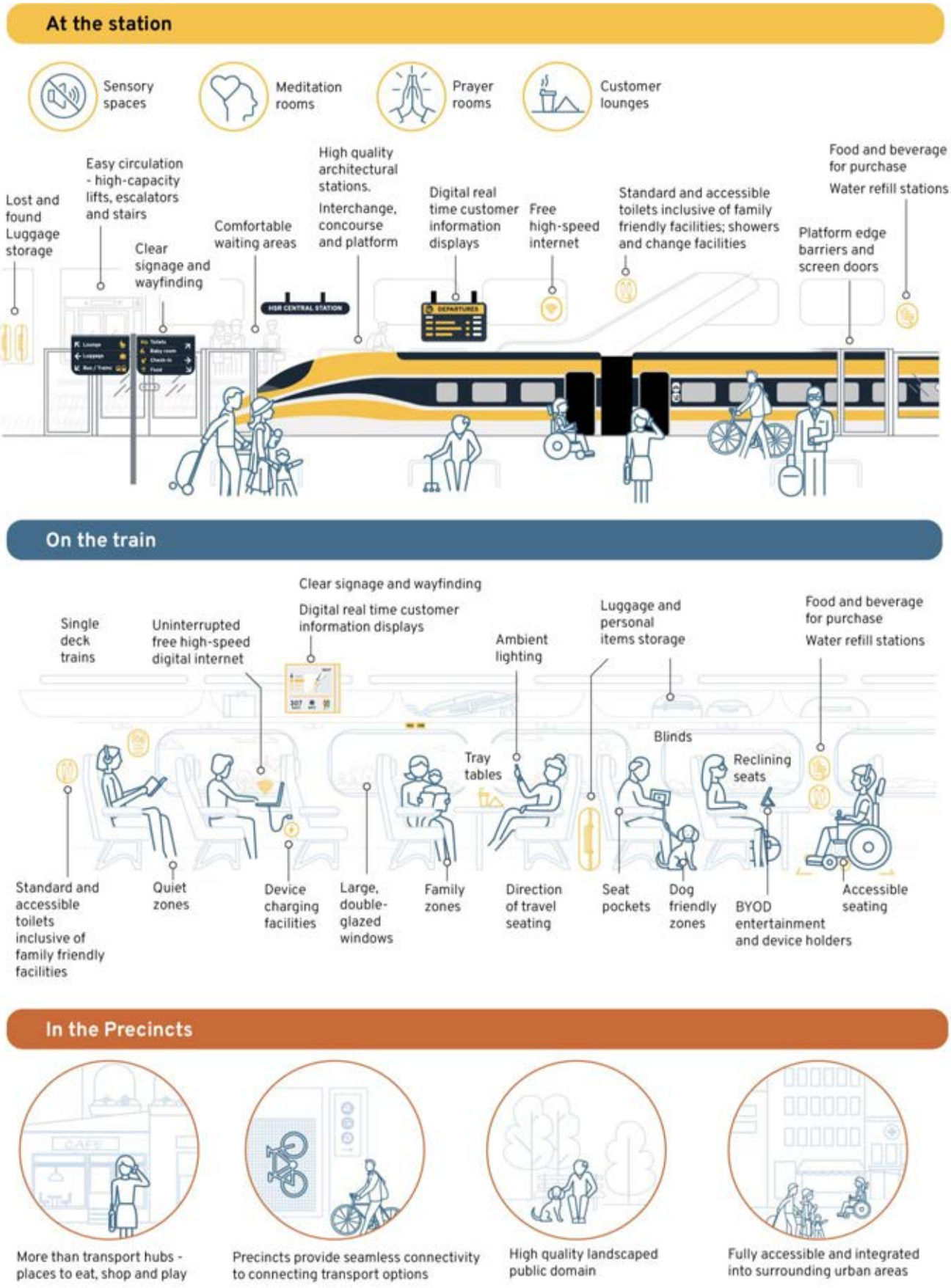
Interior layouts will balance seated capacity and customer amenities, accommodating between 400 and 520 seated passengers – comparable to contemporary high speed trains in Europe and Asia – with the eventual design configuration optimised to match passenger demand forecasts, customer preferences and route lengths.

Case study: Iryo (Spain)

Travelling across Spain at over 300km/h, the top quality onboard experience provided by Iryo gives a glimpse of what is possible in Australia.

Iryo's modern, sustainable, design combines services such as wi-fi, digital entertainment, multiple travel classes, ample luggage storage, pet, family and restaurant areas and comfortable seating.

Figure 4-7 Features that will provide a great customer experience



4.2.4. Easy and comfortable station experience

Reflecting the lessons of global high speed rail networks, stations will be more than just transport hubs, with a role as destinations where people meet and gather.

Stations are being designed to maximise space and comfort, providing spaces where travellers can relax and recharge before their service or the next leg of their journey.

Travellers will benefit from universally accessible stations offering a full suite of customer amenities including waiting areas and lounges with ample comfortable seating, retail and food and beverage outlets.

Stations are also being designed as intuitive and safe places, with layout, signage and wayfinding elements to guide customers easily between platforms, concourse areas and station precincts.

Moving between different levels will be supported by escalators and fast, high capacity lifts that support large numbers of people travelling with luggage, prams or wheelchairs.

4.2.5. Seamless, integrated ticketing

High speed rail between Newcastle and Sydney will be a bookable seated service that requires pre-purchased tickets through an easy to use integrated booking and ticketing system. Similar to ticketing systems used around the world, this system is intended to be interoperable with other public and private transport providers. The high speed rail ticketing solution will be further defined in the future development phases.

Case study: Berlin Hauptbahnhof, Germany

Berlin Hauptbahnhof (Central Station) is not only an important transport hub but, thanks to its mixed use, is a vibrant building complex that has become the urban core at the centre of Berlin. Its multi-level train platforms are flanked by shops, restaurants, office space, pedestrian bridges and public realm.

With a focus on comfort and functionality, the station's spacious design and light filled, clutter free environment facilitates navigation. These attributes speak to the future of high speed rail in Australia.

Artist's impression of a high speed rail train

4.3. Operations and maintenance

Safe, efficient, reliable and sustainable operations and maintenance conducted by a future operator-maintainer has informed the development of a robust Definition Design for the Project.

This section summarises the operations and maintenance concept for the Project in full. Details related to staging are summarised in Chapter 5.

4.3.1. Dedicated high speed rail infrastructure and service

Independent and dedicated operations

High speed trains will operate on dedicated infrastructure, independently from existing rail systems, similar to systems in Japan and Spain. (As opposed to a model in which high speed trains share upgraded sections of existing lines, independence offers substantial customer and operational benefits, superior reliability, performance and safety, and a genuine boost in rail capacity.)

Table 4-4 Benefits and opportunities with a dedicated high speed rail network

Journey times	• One hour between Sydney and Newcastle. • Four hours between Sydney and Melbourne, or Sydney and Brisbane.
Reliability	• High degree of punctuality and reliability. • 99.0% reliability for Sydney to Newcastle services (within 5 minutes). • 98.5% reliability for Sydney to Melbourne and Sydney to Brisbane services (within 15 minutes).
Capacity	• Up to 12 trains per hour for the ultimate service with the National HSR Network – only achievable with consistent rolling stock and speeds.
Operations	• Simplified operations – avoids conflict between high speed trains and slower conventional passenger and freight services. Easier to recover from disruptions.
Existing network impacts	• No disruptions to the existing network during construction. Capacity relief. Frees up existing network, creating more paths for freight and local passenger services.
Market attractiveness	• Wider rolling stock supplier market and stronger operator interest.
Governance and regulation	• Avoids additional standards, certifications and institutional arrangements required for trains and drivers to operate on both networks.
Maintenance	• Simplified maintenance regime. • Larger maintenance window available.
Safety	• Reduced risk of operational conflicts due to controlled access within a segregated corridor.

The challenge of shared operations between Newcastle and Sydney

Since the project corridor will form a core component of the Network, it is critical that it can reliably deliver high capacity. A shared operations concept is incapable of delivering this level of performance:

- The existing Central Coast and Newcastle Line already faces significant challenges including low speeds, poor reliability and limited capacity.
- The line is shared by intercity and regional passenger services, and freight services, with limited scope for faster services to overtake slower services.

- The line is presently the busiest intercity rail line in Australia, with little capacity to add more trains.
- Even with major upgrades there are fundamental limitations with the existing corridor, including increased urban density, national parks and challenging topography that limit the possibility for additional tracks, passing loops or other upgrades required to allow for high speed rail operations at high frequencies.

A shared operational arrangement would require bespoke high speed rail rolling stock and a series of infrastructure upgrades, systems interventions and new accreditations to allow for interoperability.

International benchmarking strongly suggests that shared operations using existing rail network segments would deliver lower reliability than a dedicated network solution.

4.3.2. Operations and maintenance infrastructure

Operations and maintenance infrastructure has been designed to support a reliable, efficient and safe system. The configuration will meet the demand of the Project's initial service plan and support an expanded Network service of 12 trains per hour, aligning with the long term vision of establishing a comprehensive Network.

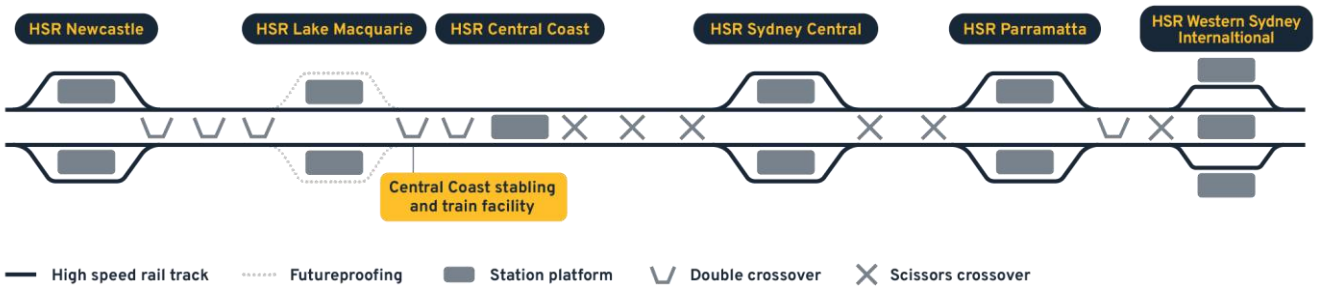
Track configuration

The Project will consist of a dual-track railway, with four tracks and four platforms at the termini at HSR Newcastle Station and HSR Western Sydney International Station, as well as at the Sydney stations at HSR Sydney Central Station and HSR Parramatta Station. These stations, other than HSR Parramatta, will also allow for overnight train stabling.

HSR Central Coast Station will have two tracks and two platforms, while HSR Lake Macquarie Station will also have two initially, but safeguard space for a further two tracks and platforms to allow express intercity trains to overtake all-stops regional trains when the second service tier is overlaid as the Network expands.

This configuration, including facilities to support operations during disruption, is shown in the following figure.

Figure 4--Core operations and maintenance infrastructure



Services between HSR Western Sydney International and HSR Newcastle will travel at up to the following speeds:

- At-grade or viaduct: 320 km/h.
- Inside tunnelled sections: 200km/h.
- Station (outside tunnel): 120km/h.
- Station (within tunnel): 80km/h.
- Turnout and crossover speed between 50km/h and 80km/h.

Train control, signalling, and communication systems

The European Train Control System will be implemented to facilitate safe and reliable high speed operation using proven technology. Alongside this, supporting technologies equivalent to the European Rail Traffic Management System will ensure safe separation of high speed trains and enable Automatic Train Operation.

These systems enable throughputs and headways as illustrated in the table below, under two distinct operating conditions:

- **Normal mode:** To deliver the timetable under normal operational conditions.
- **Degraded mode:** Major failure or outage mode where a track is blocked due to a failure or maintenance and operational headway is set at 30 minutes (dictated by crossover locations on subsections of the network).

Table 4-5 Summary of throughput and operational headway requirements

Stage	Peak frequency (tph)	Operational headway	
	Normal mode	Normal mode	Degraded mode
Project requirements	6	Approximately 180 seconds*	30 minutes
Future-proofing requirements for the Network	12	Approximately 180 seconds*	30 minutes

*Note – Tunnel ventilation constraints not considered in this normal operational headway.

The Central Coast Stabling and Train Facility is currently planned to accommodate both the Operations Control Centre and the backup Operations Control Centre.

While the backup Operations Control Centre is assumed to be within the same precinct, it will remain technically fully independent from Operations Control Centre systems, with its exact location to be determined during the development phase.

4.3.3. Stabling and maintenance

Passenger train stabling and maintenance

The operation of high speed rail between HSR Newcastle and HSR Western Sydney International will require 20 trains (17 in-service, 1 standby and 2 maintenance spares). The fleet maintenance facility will be located at the Central Coast Stabling and Train Facility.

The Central Coast Stabling and Train Facility will operate 24/7, accommodating stabling for 18 trains and a maintenance facility for two trains. Most trains will be stabled overnight at this facility, with additional stabling at selected stations to minimise dead running and maximise maintenance time. The facility's footprint is designed to allow for additional stabling capacity to support future network expansion.

Infrastructure maintenance

Regular infrastructure maintenance for all aspects of the Network will occur overnight during an indicative five-hour window between 23:30 and 04:30, allowing 30 minutes before and after for train stabling movements.

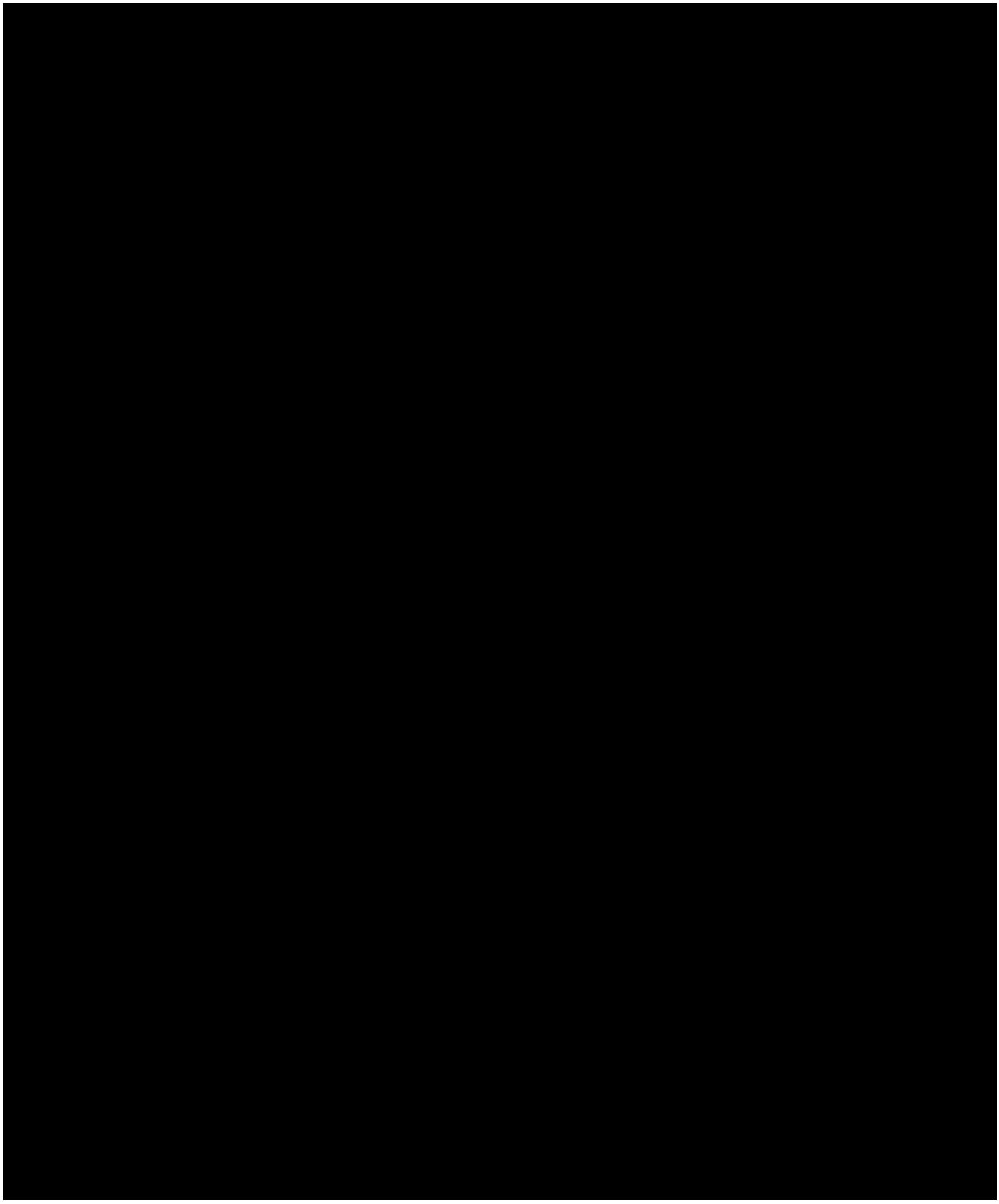
Since access to tunnelled sections will be limited by their significant length, the maintenance strategy is designed to proactively maintain the system to prevent failures by:

- Prioritising preventive and predictive maintenance.
- Monitoring asset condition digitally to support predictive maintenance.
- Devising systems to support maintenance planning, maintenance vehicle movements, track protection, power removal and rail connection.
- Locating railway assets where they can be readily accessed for maintenance wherever possible.

The Central Coast Stabling and Train Facility will act as the main infrastructure maintenance facility.

The locations of maintenance and stabling facilities are shown in the following figure.

Figure 4-8 Maintenance, stabling and operational control locations



4.3.4. Managing disruption

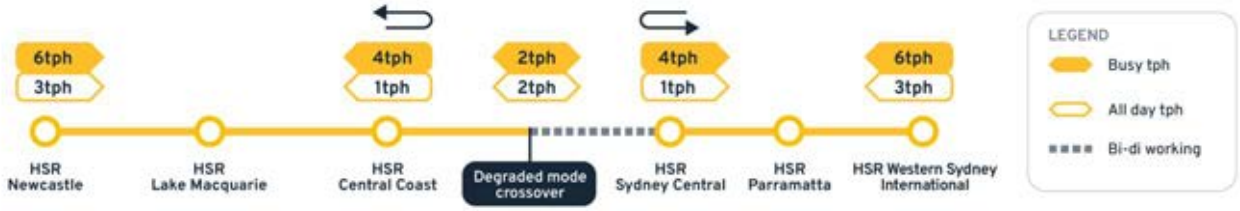
The degraded operations strategy ensures service continuity during disruptions, such as track blockages or train faults, aiming to maintain a minimum service level of two trains per hour. The strategy hinges on designated hub stations with turnback facilities that are strategically located where alternative transport options are readily available.

These locations are HSR Newcastle, HSR Central Coast, HSR Sydney Central, HSR Parramatta, and HSR Western Sydney International. In the event both tracks in a section are blocked, hub stations will allow all trains to turn back before the disrupted section, effectively isolating the incident area from the rest of the sector, as illustrated in the following figure.

Figure 4-9 Example of track blockage and turnback response for service continuity

When only one line is affected, some trains would turn back at the closest hub stations, allowing two trains per hour to operate in both directions through the affected area, as shown in the following figure.

Figure 4-10 Example of track inoperability with single line working response for service continuity



4.3.5. Operating within tunnel sections

The Project includes 115 kilometres of tunnel. Drawing on insights from the many high speed rail networks around the world which operate in long tunnels, including through the Channel Tunnel between France and the UK, specific consideration has been given to maximising customer experience and minimising operational impacts of a tunnel environment in the development of the Project.

Maximising customer experience in tunnels

Customers will spend around 30 minutes travelling through tunnels between Sydney and Gosford. This is comparable to the time spent travelling through tunnels on modern metro projects and high speed rail globally. A superb onboard experience, including high quality digital connectivity, lighting treatments, window blinds, onboard entertainment and real-time information displays, will support passenger comfort and productivity while travelling below ground.

Operational considerations in tunnel environment

Tunnels will be designed to support speeds of 200 kilometres per hour to deliver journey times and to support throughput and headway requirements. The length of tunnel ventilation sections and the number of trains permitted within a section at any one time will limit the headway achievable within tunnel sections.

The tunnels on the Network will be designed to support up to two trains per ventilation section, with a recommended maximum of 10 kilometre ventilation sections. This allows future proofing for an ultimate frequency of 12 trains per hour per direction in the tunnel section, which will be required for the expanded Network and associated increased demand along the corridor. Signalling will enforce this limit on trains in each ventilation section.

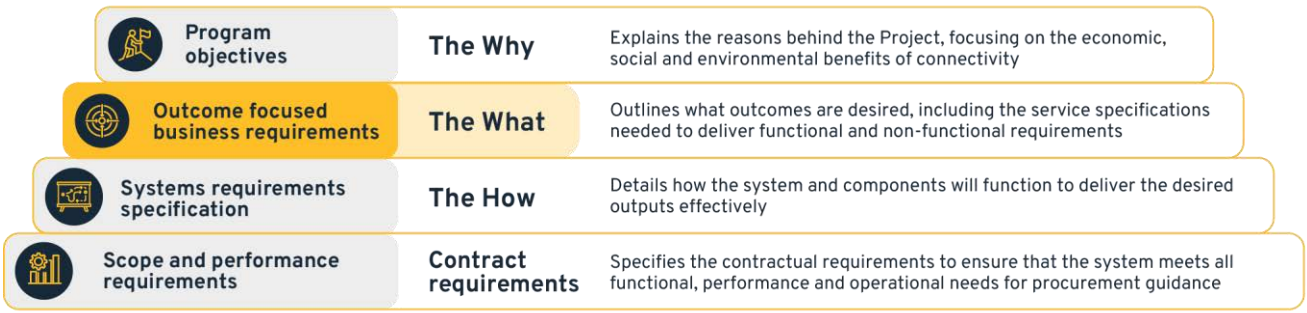
4.4. Business requirements

The high speed rail Business Requirement Specification has been developed with an outcomes-focused approach, aligned to project objectives and informed by analysis, benchmarking and extensive stakeholder, industry and adviser feedback. It outlines the outcomes needed to deliver a world-class, sustainable and customer-centric transport solution, guiding the design, development and procurement of a proven high speed rail system for Australia.

The Business Requirement Specification focuses on Network-level outcomes to ensure a high quality, efficient and sustainable rail service. It includes around 70 requirements across 9 categories including design, operations, customer experience and commercial viability, all tied to network objectives and designed to meet performance targets and deliver measurable benefits.

As the Project moves beyond the Business Case phase, specific requirements will be refined to deliver the best possible product for future customers. The Business Requirement Specification serves as a foundational guide, supporting the definition and development phases, including the creation of System Requirements Specifications, and Scope and Performance Requirements. This ensures alignment with key project objectives and goals throughout the project lifecycle.

Figure 4-11 Business and system requirements



[redacted]

[1] International Union of Railways (UIC) (2017), Research on Optimal Speed for High Speed Lines – Volumes 1 and 2.
[2] Bureau of Infrastructure and Transport Research Economics (2023), Airline On Time Performance, 2023 Calendar Year Report.

Chapter 5

Project definition and design

Australian Government
High Speed Rail Authority

A robust design to inform feasibility, cost estimates and impact assessment

The Definition Design for the Project includes:

- 194 kilometres of alignment, with high speed rail stations located at Broadmeadow, Morisset, Gosford, Central, Parramatta and Western Sydney International.
- 79 kilometres of surface and viaduct alignment.
- 115 kilometres of tunnelling including 112 kilometres of twin bore tunnels [redacted]
- 320 kilometres per hour maximum speed outside of tunnel sections and 200 kilometres per hour maximum speed inside tunnel sections.
- High speed rail fleet of up to 20 trains, each 200 metres in length, with 400 to 520 seats per train.
- Stabling at Central Coast Stabling and Trains Facility with up to 18 stabling sidings and capacity for 2 trains stabled in the maintenance building.
- Traction power requirements are 25 kilovolt AC. To support the net zero project objective, renewably sourced power will be used where possible.
- The constructability strategy has been developed to safely and efficiently carry out the significant project works. The Project is estimated to generate 21 million cubic metres of spoil. Most of the spoil will be retained and reused where possible with a commitment to the beneficial reuse of spoil.
- Ongoing staged delivery and value engineering enhancements of the Project may result in adjustments to the Definition Design, the constructability and spoil strategies.

5.1. Definition Design

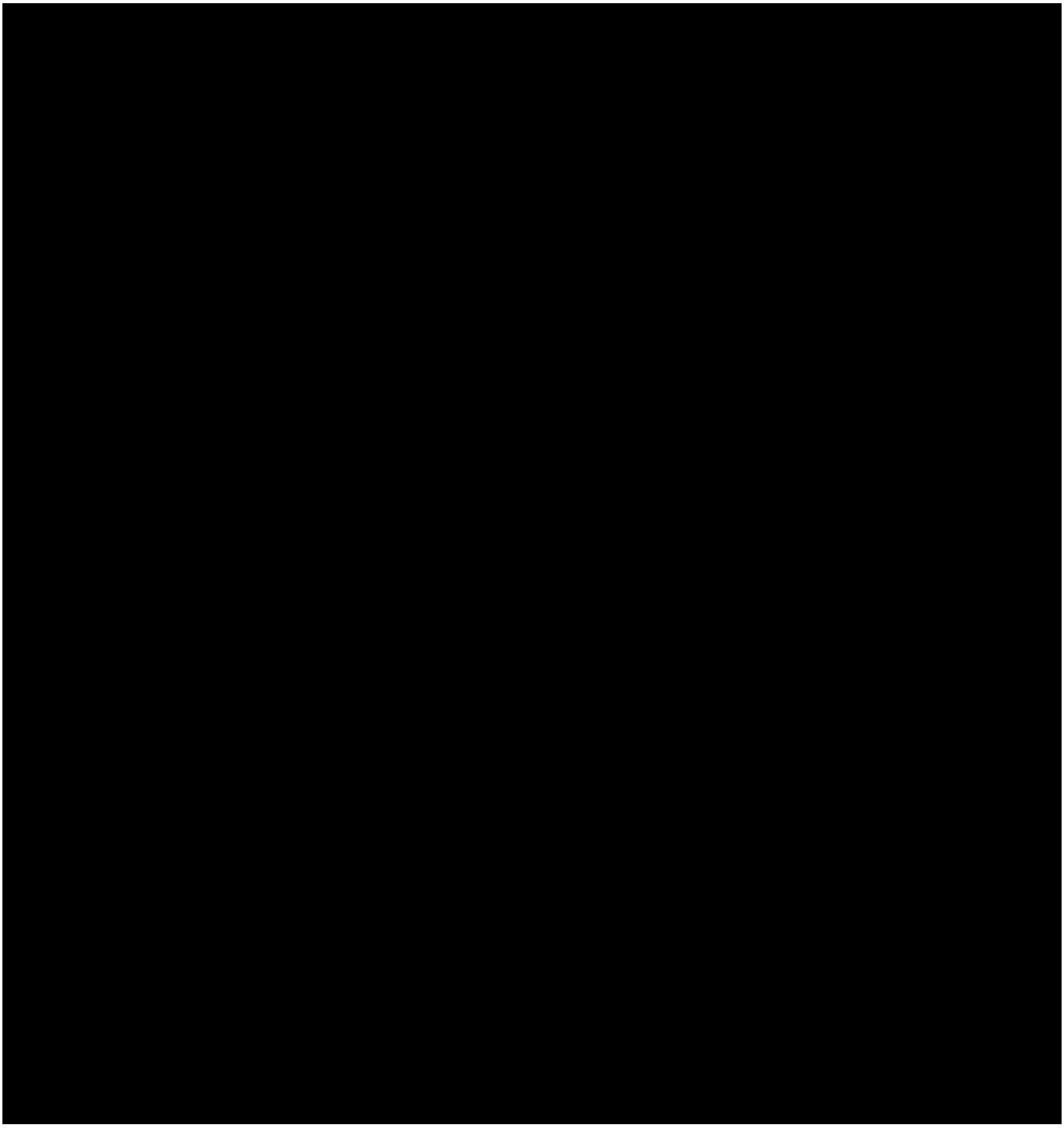
A Definition Design [redacted] has been developed for this Business Case to assess and confirm the technical feasibility of the Project, to allow costs and benefits to be quantified and to allow impacts to be considered. If the Project is approved to proceed, further investigations, design work and industry engagement will continue to optimise and refine the Project.

Figure 5-1 Design evolution

The features of this current Definition Design are outlined in the following table and two figures.

Table 5-1 Features of the Definition Design

Feature	Description
Stations	Six HSR stations: • HSR Newcastle, located in Broadmeadow. • HSR Lake Macquarie, located in Morisset. • HSR Central Coast, located in Gosford. • HSR Sydney Central, located in Surry Hills. • HSR Parramatta, located in Parramatta. • HSR Western Sydney International, located at Western Sydney International Airport.
Alignment	194 km, including 115 kilometres of tunnelling and 79km of surface track and viaducts (illustrated in Figure 5-3). Additional 3.6km of surface track to Central Coast Stabling and Train Facility.
Tunnels	Twin-bore tunnel sections totalling 112 kilometres and single bore tunnels of 3 kilometres in total.
Bridges and civils	38 kilometres of bridges and viaducts
Speed	Maximum travel speeds of up to 320 kilometres per hour outside of tunnels and 200 kilometres per hour inside tunnel sections based on the current design, noting that procured rolling stock may be capable of higher speeds.
Rolling stock	200 metre train lengths (eight single-deck 25-metre carriages per train), with 200 metre platforms.
Facilities	Stabling facility, rolling stock maintenance facility, infrastructure maintenance depot and Operation Control Centre located at the Central Coast Stabling and Train Facility approx. 9km north of Wyong.
Signalling and communications	European Train Control System (ETCS) Level 2, via GSM-R (Global System for Mobile Communications – Railway) or FRMCS (Future Railway Mobile Communications System).
Power supply	Traction power supply (25 kilovolt AC) and infeed substations at HSR Newcastle Station, Central Coast Stabling and Train Facility, Brooklyn, Artarmon, and Badgerys Creek. The Definition Design currently indicates the requirement to space auto-transformer substations every 10 kilometres along the alignment, generally co-located with other facilities.
Emergency refuge	Emergency Response Train sidings at Ourimbah (Northern Train Siding), Hornsby East (Hornsby East Tunnel Break) and Mount Vernon (Southern Train Siding). The Definition Design currently indicates the requirement for refuge locations along the alignment every 15 to 20 kilometres.



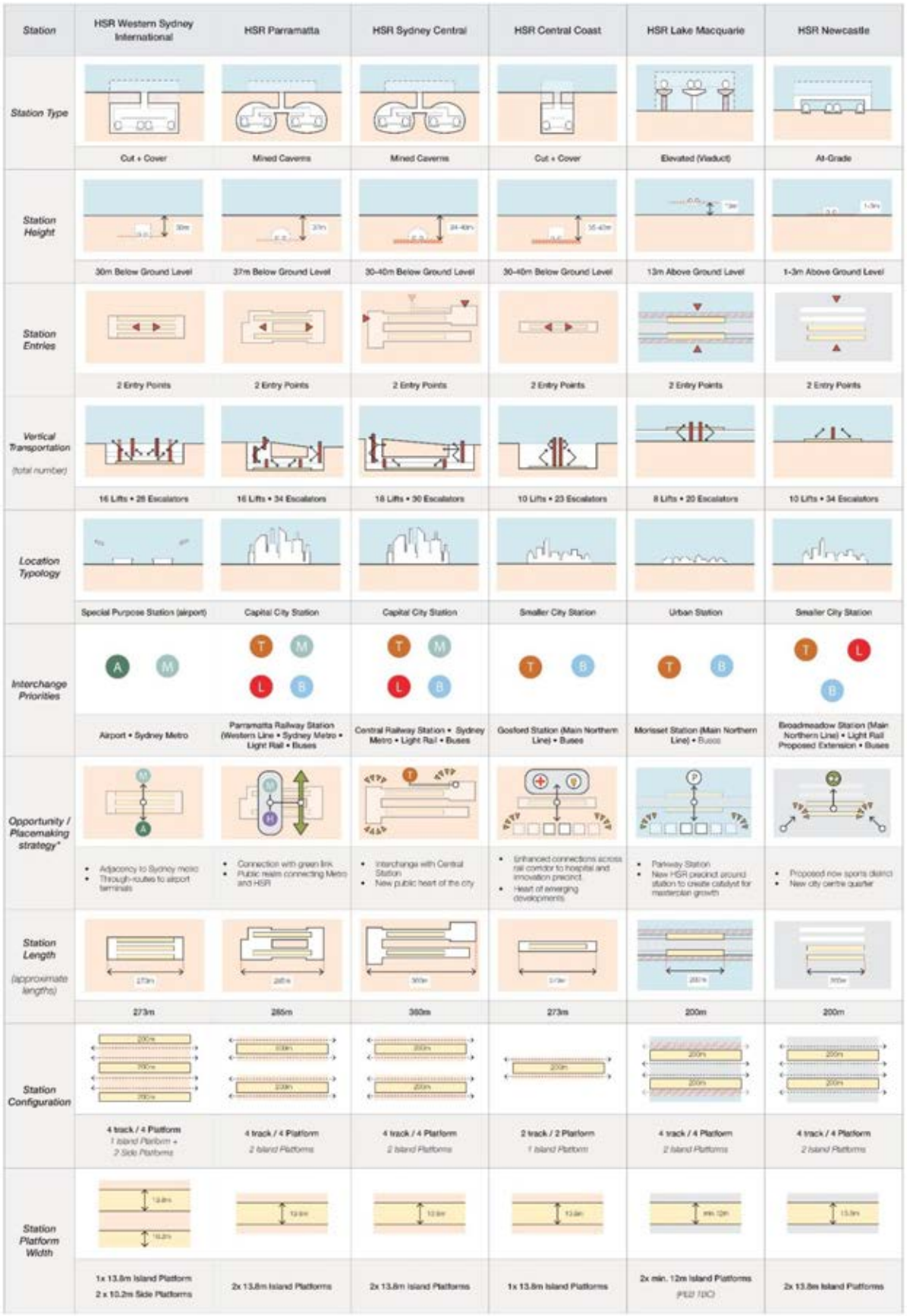
5.1.1. Station design and optimisation

An overview of the characteristics of each station is presented in the figure below.

The Definition Design considered a range of station characteristics, from technical platform specifications to wider place making opportunities. Requirements for platform sizes, off-platform waiting space, vertical transport and station entrances were informed by core project passenger demand forecasts.

Station designs were optimised as part of the Definition Design stage, guided by forecast demand considerations and operational requirements for both the Project and the Network. Two stations, HSR Lake Macquarie and HSR Central Coast, were selected for optimisation and will require only two platforms and two tracks. Safeguarding and passive provision at HSR Lake Macquarie will enable the station to expand to four platforms and four tracks in the Network.

Figure 5-4 Key station characteristics



Station vision, drivers, and characteristics

The following subsections step through the design of each station in turn, detailing the vision and drivers for each station design and setting out their core design characteristics, supported by sections and aerial imagery.

HSR Newcastle Station (located in Broadmeadow)

A regionally significant growth area, Newcastle is the second largest city in NSW and serves the broader Hunter region. A station at Broadmeadow will promote land use uplift and economic development in both Newcastle and the broader Hunter region. HSR Newcastle Station will be integrated with the local precinct and the wider transport network, with connections to heavy rail, bus and a future extension of the light rail.

Figure 5-5 HSR Newcastle Station aerial view and connections

Figure 5-6 HSR Newcastle Station section and connections

Table 5-2 HSR Newcastle Station characteristics

Element	Characteristic
[redacted]	[redacted]
[redacted]	[redacted]
Station length	200m
Station configuration	2 island platforms, 4 tracks
Platform length	200m
Station platform width	13.8m island platforms
[redacted]	[redacted]
[redacted]	[redacted]

HSR Lake Macquarie Station (located in Morisset)

Morisset is a commercial centre in the Lake Macquarie local government area situated approximately halfway between Gosford and Newcastle. The station at Morisset will be an intermediate station with convenient access to the M1 Pacific Motorway and arterial roads. This station will support greenfield housing delivery and improved private vehicle access to the high speed rail network from a wider driving catchment across the Lower Hunter, Lake Macquarie and the Central Coast. The station will integrate with public and active transport networks in the surrounding area.

Figure 5-7 HSR Lake Macquarie Station aerial view and connections

Figure 5-8 HSR Lake Macquarie Station sections

Table 5-3 HSR Lake Macquarie Station characteristics

Element	Characteristic
Station type	Elevated
Station height	13m high
Station length	200m
Station configuration	2 side platforms, 2 tracks (safeguarded for 2 island platforms, 4 tracks in ultimate state)
Platform length	200m
Station platform width	12m (minimum) island platforms
Station entries	2 entries
Vertical transport	20 escalators and 8 lifts

HSR Central Coast Station (located in Gosford)

Gosford is the 'capital of the Central Coast' and an important administrative, tourism, health and education centre and regionally significant growth area. The station will support project objectives by accelerating the economic development of the city centre and promoting housing delivery in the city centre and broader Central Coast region. HSR Central Coast Station will be seamlessly integrated with both the precinct and the wider transport network connecting to heavy rail and bus services.

Figure 5-9 HSR Central Coast Station aerial view and connections

Figure 5-10 HSR Central Coast Station section and connections

Table 5-4 HSR Central Coast Station characteristics

Element	Characteristic
Station type	Underground – cut and cover.
Station depth	40m
Station length	275 metres (includes station equipment, ventilation ducts etc)
Station configuration	1 island platform, 2 tracks
Platform length	200m
Station platform width	13.8m island platform
[redacted]	[redacted]
Vertical transport	23 escalators and 10 lifts (inclusive of access to heavy rail platforms)

HSR Sydney Central Station (located in Surry Hills)

Central Station is Australia's largest railway station, serving Australia's most important economic and financial centre – the Sydney CBD – and the Greater Sydney region. High speed rail at Central will support and uplift housing delivery and economic development in the entire project corridor by connecting to Sydney's global economy. High speed rail will use the station's integration with the precinct, CBD and wider transport network providing connections to Sydney Train and Sydney Metro services, light rail and bus services.

Figure 5-11 HSR Sydney Central Station aerial view and connections

Figure 5-12 HSR Sydney Central Station section and connections

Table 5-5 HSR Sydney Central Station characteristics

Element	Characteristic
Station type	Underground – mined cavern, plus access shafts
Station depth	37-47m
Station length	300 metres (includes station equipment, ventilation ducts etc)
Station configuration	2 island platforms, 4 tracks
Platform length	200m
Station platform width	13.8m island platforms
[redacted]	[redacted]
Vertical transport	30 escalators and 18 lifts

HSR Parramatta Station (located in Parramatta)

Parramatta is the heart of Western Sydney and the geographic centre of central Sydney. A high speed rail station at Parramatta will leverage strong accessibility provided by existing and planned public transport networks to provide more convenient end-to-end journeys for customers across Western Sydney. HSR Parramatta Station will integrate with the local precinct and the wider transport network, with nearby connections to heavy rail, light rail, bus and ferry services.

Figure 5-13 HSR Parramatta Station aerial view and connections

Figure 5-14 HSR Parramatta Station section and connections

Table 5-6 HSR Parramatta Station characteristics

Element	Characteristic
Station type	Underground – mined cavern, with access shafts
Station depth	37m
Station length	275m (includes station equipment, ventilation ducts etc)
Station configuration	2 island platforms, 4 tracks
Platform length	200m
Station platform width	13.8m island platforms
[redacted]	[redacted]
Vertical transport	34 escalators and 16 lifts

HSR Western Sydney International Station (located at Western Sydney International)

Western Sydney International will open as Sydney's second airport in 2026, providing more convenient access to domestic and international destinations for residents across Western Sydney. Western Sydney International will be accessed through metro to St Marys, bus connections to surrounding centres and private vehicle access including commercial parking. A high speed rail station at the airport terminal will facilitate transfer to domestic and international flights, support the development of Bradfield city centre and the wider Aerotropolis, and improve access across Greater Sydney, the Central Coast and Hunter regions.

Figure 5-15 HSR Western Sydney International Station section and connections

Figure 5-16 HSR Western Sydney International Station aerial view and connections

Table 5-7 HSR Western Sydney International Station characteristics

Element	Characteristic
Station type	Underground – cut and cover
Station depth	30m
Station length	275 metres (includes station equipment, ventilation ducts etc)
Station configuration	1 island platform 2 side platforms, 4 tracks
Platform length	200m
Station platform width	1x 13.8m island platform, 2x 10.2m side platforms
Station entries	2 entries, one at east end and one at west end of the box
Vertical transport	28 escalators and 16 lifts

See Section 6.5 for information about each station's precinct, catchments, land use and transport integration.

5.1.2. Proposed alignment

The alignment efficiently connects stations through a mix of tunnelled, at-grade and viaduct configurations. The alignment minimises changes between above-ground and below-ground construction, avoiding road vehicle access to those sites. The alignment includes 115 kilometres of tunnel, with the longest segment involving 65 kilometres of twin tunnel between the Southern Train Siding west of Parramatta and the Hornsby Train Siding.

The Central Coast Stabling and Train Facility will provide stabling capacity for 18 trains, a rolling stock maintenance facility, an infrastructure maintenance depot and an operations control centre. The facility is approximately 9 kilometres north of Wyong [redacted] Emergency Response Train sidings will be located at Ourimbah (Northern Train Siding), Hornsby East (Hornsby East Tunnel Break) and Mount Vernon (Southern Train Siding).

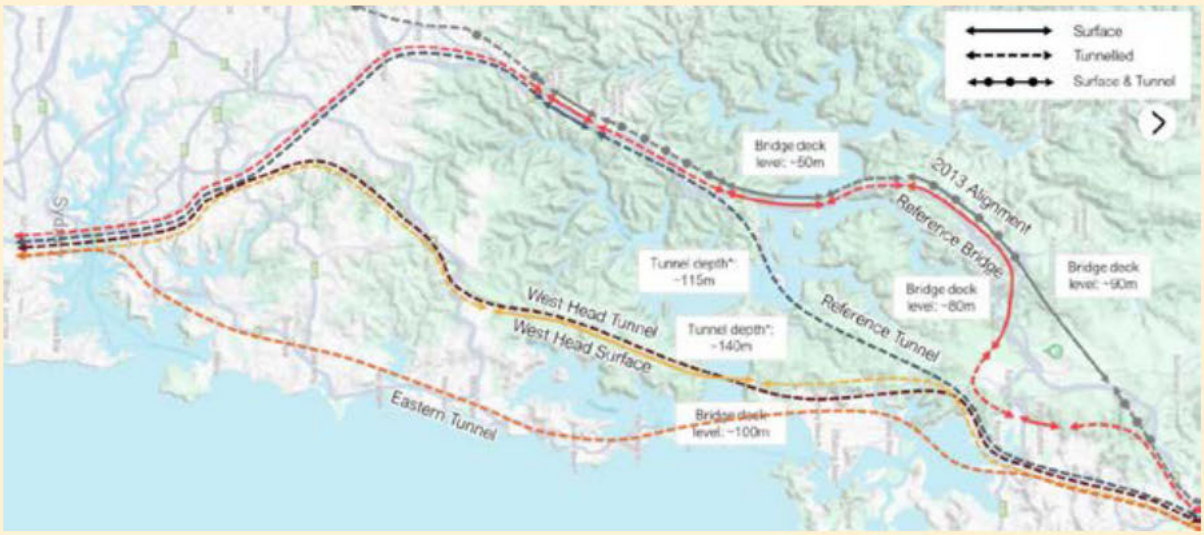
The Monash University Institute of Rail Technology has undertaken an independent technical study of the proposed alignment, rolling stock specifications, maintenance and concept of operations documents. The study focused on the technical requirements for safety and passenger comfort, operational performance and international benchmarking. The study determined that the Definition Design aligns with global best practices and that further refinements during the Delivery Phase will enhance the performance and operations of the proposed Network.

Spotlight on Hawkesbury River crossing alignment

Several options were considered to address the section of the alignment from Gosford to Sydney which includes the most challenging part of the alignment, crossing the Hawkesbury River.

Five alignment options were considered as part of the Scoping Design phase (see the figure below). The investigation leveraged work from the 2013 High Speed Rail Study which considered a bridge crossing from Brooklyn to Cheero Point and the NSW Government 2019 Fast Rail study which considered a tunnelled crossing to allow for a station at Gosford.

Figure 5-17 Hawkesbury River crossing alignment options



The five alignment options were assessed against the criteria derived from the project objectives. Based on an assessment against the project objectives, the Reference Tunnel was recommended as the preferred alignment option. While it is a longer alignment, the assessment concluded that the Reference Tunnel carries fewer delivery risks and that mitigations to manage areas of identified risks are more feasible. The Reference Tunnel scheme was then subsequently refined as part of the Definition Design. A summary of the alignment options considerations is presented in the following table.

Table 5-8 Hawkesbury River crossing alignments options considerations

Criteria	Reference tunnel	Reference bridge	West Head tunnel	West Head bridge	Eastern
Alignment configuration (length, at time of assessment)	167km	172km	158km	158km	157km
Alignment configuration (tunnels/bridge)	93km	82km 2.0km river bridge	88km	74km tunnel 2.3 km sea bridge	87km

Criteria	Reference tunnel	Reference bridge	West Head tunnel	West Head bridge	Eastern
Constructability /site access	Constructability and site access okay. Challenges with crossover location south of Gosford.	Program and cost impact of switching between tunnel, at grade and viaduct sections. Deep launch site at Cowan (90m).	Deep vent shaft at national park /West Head (250m). Deep tunnel under Hawkesbury (140m).	Bridge constructability issues: abutments, foundations, remote location. Challenging bridge (100m above seas level, 2.3km).	Some challenges for underwater crossing. Some access issues for vent shafts. Deep tunnel under Hawkesbury (140m).
Environment (surface impacts)	Some impact to national park (15ha), some to native bushland (20ha) and ecological (2ha).	High impact to national park (45ha), native bushland (105ha) and ecological.	Some impact to native bushland (10ha), minimal to national park (2ha) and ecological.	High impact to national park (70ha), native bushland (80ha) and ecological.	No surface impact to national park and ecological, minimal impact (2ha) to native bushland.
Customer, community and property	Moderate impact at sites.	Moderate impact at sites. Additional 1min journey time.	Moderate impact at sites. Saving 2.5min journey time.	Moderate impact at sites. Major visual impact at Hawkesbury. Saving 2.5min journey time.	Disruption in developed residential areas. Saving 2.5min journey time.
Capital expenditure change from Reference Tunnel	–	-$1.6B	-$3.6B	-$1.5B	-$4B

Note: Alignment lengths are between Broadmeadow and Parramatta during the Scoping Design Phase, August 2024.

Further assessment of the precise locations and footprints of surface interventions and opportunities for optimisation are outlined in the Definition Design.

The vertical grade limits used in the development of the alignment have been guided by the European technical specifications for interoperability. Sustained grades are limited to:

- A preferred maximum gradient of 2.5 per cent.
- An exceptional vertical gradient of 3.5 per cent.
- An average slope of less than 2.5 per cent over ten kilometres.
- An average slope of less than 3.5 per cent over six kilometres.

For the Project, the maximum gradient is currently proposed at approximately 3 per cent over 4 kilometres. This compares with:

- The Japanese Shinkansen between Takasaki and Karuizawa at 3 per cent over 22 kilometres.
- High Speed 2 in the United Kingdom with a 2.5 per cent grade over two kilometres and 3 per cent grade over 700 metres.

5.1.3. Tunnels

The proposed alignment will require substantial tunnelling works between Newcastle and Greater Sydney to overcome topographical challenges (including the Hawkesbury River and Cowan Bank), minimise impacts on national parks and environmentally sensitive areas, avoid significant disruption in densely populated urban areas, and meet the desire to provide more direct routes, reduce travel times and improve efficiency.

International experience of long high speed rail tunnels

Several international precedents demonstrate the feasibility of using long tunnels to operate high speed rail.

- **Japan and Korea** are home to 14 of the longest railway tunnels in the world. For instance, the Seikan Tunnel in Japan is 53.8 kilometres long and the Yulhyeon Tunnel in South Korea is 50.3 kilometres long. The Seikan Tunnel – the first rail tunnel with a length of over 50 kilometres – was put into operation in 1988. It is a double-track tunnel with forced ventilation and provision for emergency stops.
- **Switzerland, Italy and Austria** have high speed rail tunnels that connect cities and countries located on opposite sides of the Alps, such as the Gotthard Base Tunnel in Switzerland, which is 57.1 kilometres long.
- **The United Kingdom and Europe** are connected through the Channel Tunnel Rail Link (HS1) which features significant tunnelling, including a section that tunnels under the River Thames. The Channel Tunnel is approximately 50 kilometres long, beneath the English Channel and Strait of Dover sea.

Tunnel configuration options

A range of tunnel configuration options were assessed, including:

- Twin tunnel configuration comprising two parallel tubes, each housing one track.
- Single bored tunnel housing two tracks side-by-side (within one large diameter tunnel).
- Single bored tunnel housing two tracks side-by-side (within one large diameter tunnel with a wall providing separation).
- Single bored tunnel housing with two tracks arranged vertically.
- A separate service/emergency egress tunnel was included for both the single bore and twin bore options.

The assessment concluded that a twin tunnel configuration will offer superior outcomes, particularly in terms of fire and life safety. The configuration will also enable greater flexibility for station typologies and alignments, reduce geotechnical and construction program risks, provide safe and easier access for maintenance, reduce impacts on the surrounding built environmental (including construction generated vibration) and minimise tunnel spoil handling.

Tunnel sizing analysis

Tunnel sizing analysis was undertaken to determine the optimal tunnel diameter based on the maximum travel speed required to meet the proposed travel time reduction targets for the Project. The analysis also considered several alignment constraints within Sydney including the Cross City Tunnel and Sydney Water Pressure Tunnel.

The Project's proposed tunnel will have a minimum internal diameter of 7.6 metres. With allowances for a structural lining of 300 to 350 millimetres and a reasonable tunnel boring machine grouting annulus, the excavated diameter of the running tunnel will be around 8.5 to 8.6 metres, allowing for a maximum train speed of up to 200 kilometres per hour. This specification is based on a twin-tube running tunnel configuration with each tunnel carrying a single track.

Allocation of space within the tunnel size has been benchmarked with the UK's HS2 and is driven by the need to accommodate the following functional requirements:

- Rail track form
- Rolling stock structure gauges and kinematic envelopes clearance profile
- Emergency egress (such as raised walkways)
- Emergency, maintenance and operations access
- Traction power supply and communications equipment
- Rail and tunnel services
- Tunnel support.

Tunnel ventilation modelling

Tunnel ventilation modelling was conducted to assess tunnel air temperatures and changes from heat generated by the trains. The analysis demonstrated that tunnel air temperatures can be maintained at a reasonable level through effective ventilation design. The modelling also assessed the ability for tunnel ventilation systems to achieve the critical velocity for smoke control.

A train fire has been assessed in ventilation sections. The assessment took into consideration a scenario where smoke has to be pushed down the track gradient against the buoyancy force of the hot smoke. These outputs were used to define tunnel ventilation fan capacities in the Definition Design.

Tunnel break

The Hornsby East Tunnel Break serves several important purposes. It improves natural ventilation within the tunnels and helps to control air temperatures and acts as an emergency access point, eliminating the need for an underground refuge station. Additionally, it provides an intermediate location to stable an Emergency Response Train, which would otherwise only have stabling locations at the Ourimbah and Mount Vernon portals, leading to extended emergency response times. The tunnel break also offers a maintenance access point, reducing travel times for maintenance personnel by breaking up the continuous tunnel between the Ourimbah and Mount Vernon portals. Lastly, it serves as a construction access point for fitting out the tunnels.

Geotechnical conditions for tunnelling

A geotechnical desktop study was undertaken to provide a high level assessment of likely geological and geotechnical conditions that could affect tunnelling across the project corridor to inform the development of the Definition Design and reduce future delivery costs and time risks. The study identified high priority locations for further geotechnical investigations including areas with potential faults or other adverse hydrological conditions.

Geotechnical fieldworks were undertaken at the high priority locations to better align design and construction with anticipated ground conditions. This included investigating areas where tunnels were expected to cross waterways, such as Sydney Harbour, Hawkesbury River and Brisbane Water, to confirm the level of rock below the waterway to inform tunnel depth and associated alignment and grade requirements.

The geotechnical investigations informed the Definition Design alignment, tunnelling and stations. These investigations confirmed tunnelling alignments under the Hawkesbury River and led to a modified HSR Newcastle Station design. A Geotechnical Interpretative Report documents the findings of the geotechnical investigations.

The Definition Design alignment does not impact the surface of national parks. The alignment is designed to avoid these areas, for example Sugarloaf State Conservation Area, by optimising the alignment and design speed. Above ground facilities and surface construction, such as for tunnel ventilation shafts and refuges, have been positioned on sites outside of national park boundaries.

Tunnel fire and life safety

The Project's fire and life safety response strategy has been developed leveraging international case studies and best practice examples from comparable projects with long tunnels and/or complex geography. Future engagement with key stakeholders including the Office of the National Rail Safety Regulator, Fire and Rescue NSW and Rural Fire Brigade NSW will inform the ultimate tunnel fire and life strategy.

The Project's fire and life safety strategy includes:

- Technical Specification of Interoperability Category B rolling stock equipped with onboard water mist suppression system. The Technical Specification of Interoperability categorises rolling stock as Category A or B based on its ability to continue to operate with a fire onboard. Category B trains are built with fire resistant materials and have safety features and control systems that enable them to continue operating for 20 kilometres at 80 kilometres per hour to an evacuation point.
- Dedicated high speed rail alignment without freight train operations.
- Cross-passages in the tunnels with a one-metre wide elevated walkway.
- Emergency refuge stations every 15 to 20 kilometres, equipped with the following: 3-hour fire-rated waiting space, connecting doors from trainway every 30 metres, smoke exhaust over the track, pressurised waiting area for passengers, hydrant connections (fed by water supply from surface), surface access for the fire brigade (roads to rescue station at surface, parking, shafts including stairs and elevators for brigade use).
- Dedicated emergency response teams and emergency response trains with capacity to carry passengers and fire personnel, equipped with water tank, firefighting equipment, air tanks and breathing equipment, and medical equipment. Emergency Response Trains are to be stabled at the northern portal (Northern Train Siding), approximately midway (Hornsby East Tunnel Break) and at the southern portal (Southern Train Siding).
- Dry standpipe with hose connections at cross-passages only (in the running tunnels), with the pipe running from one bore to the other (the water for firefighting in the tunnel is brought in aboard the emergency response trains (ERT)).
- Longitudinal ventilation in tunnels with maximum vent zone length of 10 kilometres (achieved by provision of rescue stations or ventilation shafts noting that ventilation shafts only provide ventilation, no access or egress).

The 10-kilometre interval between ventilation shafts allows two trains (in each direction) to be within the ventilation zone between adjacent vent shafts. Cross-passages will be provided to enable escape from incident to the non-incident or adjacent tunnel.

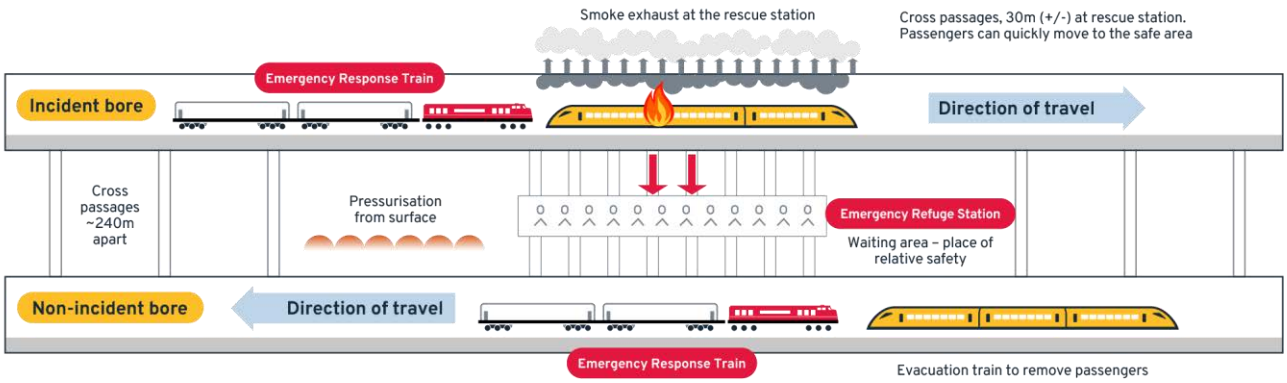
Given tunnels are primarily being proposed to pass under areas of national park and the Hawkesbury River, exits would likely need to be in remote areas, noting the current Definition Design does not directly impact the surface of national parks. To address this risk, the use of emergency refuge stations in tunnels at intervals of 15 to 20 kilometres is under consideration. Emergency refuge stations will be equipped with smoke exhaust and

pressurised fire-rated areas and smoke extract fans and ducts to allow passengers to gather in a safe area and await rescue.

The approach to managing emergencies in tunnels is summarised in the figure below and concerns the following scenarios:

- **If there is a fire in a tunnel** (onboard a train, trackway or other equipment):
  - Continue to the nearest station. All train traffic into the tunnels will be halted and other trains in the tunnels will exit while emergency responders intervene.
  - Otherwise, continue to a refuge station. All train traffic into the tunnels will be halted and other trains in the tunnels will exit (forward or reverse) while fire brigades intervene at the refuge station (via surface access and/or using the emergency response trains). Passengers will evacuate to the refuge station and will be taken out of the tunnel using an empty train.
- **If the train is stranded in the tunnel:**
  - All train traffic into the tunnels will be halted and other trains in the tunnels exit. Emergency responders will intervene using the emergency response trains. Passengers will evacuate via the nearest cross passages to the non-incident tunnel.

Figure 5-18 Emergency response trains and refuge stations



Emergency response train can enter via incident or non-incident bore, used to bring in firefighting crews and equipment – staging locations, crossovers, etc, to be determined at a design development phase. Note emergency response trains in Europe are designed with sealed cabs and independent air supply so it could theoretically operate in a smokey environment. Whether intervention occurs via incident bore will need to be determined per ongoing discussion with Fire and Rescue NSW and design development.

5.1.4. Bridges and civil structures

The Project's alignment includes 38 kilometres of bridges and viaducts. A 'kit of parts' strategy has been adopted to deliver these components to support the project objective for delivery and manufacturing.

The concrete box girder will be used for long viaducts and underbridges. This structure is common for international high speed rail projects given its reliability, compatibility with architectural guidelines, constructability in remote locations and suitability for off-site prefabrication.

Substructures (abutments, retaining walls and piers) will be made of reinforced concrete, with some in-situ work but also using pre-cast concrete for much of these elements. Pre-casting piers in segments is common in Australia and offers advantages in quality, safety and speed of construction.

Foundations are assumed to be large diameter (1.5 to 2.5 metres) cast-in-situ concrete piles with a cast-in-situ concrete pile cap. Piles will be embedded into rock, which is commonly 15 to 20 metres below ground surface along the Project's alignment.

A standard box structure has been assumed for culverts.

5.1.5. Civil engineering and utilities

Civil works will ensure the stability, efficiency and safety of the railway. Where the alignment is proposed to be constructed at grade, a combination of embankments, cuttings and retaining walls will be utilised.

Embankment design will account for soil compaction, drainage and the potential for settlement. The embankment slopes and materials will be specified to minimise the risk of erosion and instability. Embankment slopes are not to be steeper than a ratio of 2:1 (horizontal distance by vertical height) unless approved and designed by a geotechnical engineer.

The design of cuttings will be dependent on the local geological conditions of the cutting and soil or rock material. These conditions impact the permissible batter slopes. Cut batters will require benching to provide drainage and erosion control and allow access for maintenance. Retaining walls will be utilised in locations where there are spatial constraints or to reduce the amount of land that must be acquired to support the high speed rail alignment. Retaining walls will be specified based on factors including required height, soil conditions, aesthetic preferences and budgetary considerations. Precast units and modular solutions are proposed to improve productivity, reduce complexity and cost.

Roads will be required to support the Project. The pavement type will be dependent on road purpose, vehicle usage, traffic load and design life. Temporary and permanent roads will be required for the following uses:

- Public roads and highways
- Access and service roads
- Maintenance and inspection road
- Construction roads
- Emergency roads
- Utility roads.

Other right of way works will include drainage, erosion control, access gates, fencing, landscaping and vegetation management.

An initial desktop review was undertaken to identify those areas along the alignment where the proposed infrastructure clashes with an existing utility. The utilities reviewed along the alignment have been classified as low risk and high risk. Low risk utilities have not been assessed at this stage. High risk utilities are those that have the potential to have a major impact on the project costs and/or program. High risk utilities have been assessed in the developing the Definition Design and have been considered in developing the alignment with the aim to avoid any impacts.

New utility connections will be required to support both construction works and permanent infrastructure. These connections will include electricity, communications, water, stormwater and sewer, and the electrical infeed systems. New connections will require coordination with existing utilities networks which may need to be enhanced to support the additional requirements.

5.1.6. Train specification

A train specification has been prepared to define the passenger trains' parameters for the Business Case and modelling scenarios.

The specification has been developed to support the performance requirements of the Network through use of available trains from existing suppliers. An assessment of available trains has been undertaken to confirm that

this is achievable. The Definition Design currently adopts the following train standard characteristics which will be reviewed and optimised during the Development Phase:

- Trainset formation: 8 x single deck 25-metre carriages. Power cars and trailer configuration determined by suppliers.
- Trainset length: 200 metres.
- Height: 4.1 to 4.3 metres.
- Width: 2.9 metres (EU standard).
- Gauge: 1435 millimetres.
- Kinematic gauge: GC upper and GI2 lower.
- Temperature range: -25^{o}C to +45^{o}C.
- Seated capacity: 400 to 520 passengers.
- Classes: Provision for two classes of travel, business and standard.
- Platform gap: vertical <12mm, horizontal <40mm, so as to comply with Disability Discrimination Act and Building Code of Australia requirements.
- Doors: automatic and accessible, able to meet dwell time <300 seconds for terminal/major stations and <120 seconds for intermediates stations.
- Train mass: less than 470 tonnes for 200-metre unit.
- Axle load: less than 18 tonnes.
- Maximum speed: up to 320 kilometres an hour (based on the current design, noting that procured rolling stock may be capable of higher speeds.
- Traction power: 25 kilovolt AC.
- Power rating: 9 MW, based on current design.
- Signalling: ETCS level 2.
- Communications: GSM-R or FRMCS system capable of operations at ETCS level 2.
- Fire protection: comply with the requirements of Category B as defined in the Safety in Railway Tunnels Technical Specification of Interoperability, and other relevant standards.

The customer amenities of the train include the following features:

- **Lighting** – General LED lighting is indirect and ambient, avoiding reflections on windows and screens. At-seat personal lighting is direct for activities like reading. Emergency lighting is battery-powered and activates automatically.
- **Windows** – Large, non-opening double glass windows provide excellent visibility, with individual blinds fitted.
- **Digital Connectivity and Infotainment** – A data network supports onboard information and entertainment services, with high-quality continuous internet connectivity accessible via wireless connection, even through tunnels.
- **Travel Information** – Real-time information is provided through inscriptions and pictograms, compliant with Disability Standards for Accessible Public Transport 2002 (Cth). Exterior displays detail car number and destinations.
- **Luggage Storage** – Overhead luggage storage and designated luggage areas in each car, such as at the entrance or vestibule.
- **Passenger Seats** – Each seat includes armrests, headrest, personal lighting, seat recline, folding table, personal stowage, power supply, and high-power USB-C sockets. Seats can pivot to face the direction of travel where possible.
- **Two Travel Classes** – Business and standard class offers with separate configurations and inclusions. Business class seating (2+1) is more spacious than standard class (2+2).

- **Zones** – Designated zones for quiet travel and groups, with suitable group seating arrangements.
- **Public Address** – A system for broadcasting pre-recorded and live messages.
- **Toilets** – At least one toilet per car, meeting Disability Standards for Accessible Public Transport 2002 (Cth), with family-friendly facilities like baby change stations.
- **Cafeteria Onboard Food and Beverage** – Provision for food and beverage via a cafeteria car, bistro service, or other, with water bottle refill stations throughout the train.
- **Bicycle Storage** – Limited storage for bicycles, considered only where other customer features and capacity requirements are met.

The trains are equipped with detection systems to monitor the condition of the entire train environment, ensuring proactive maintenance and operational decisions to avoid service failures. This includes monitoring assets like track, rail, and overhead catenary systems to enable prompt intervention and eliminate safety or service compromises through condition-based monitoring.

Emergency response trains

Three emergency response trains will be procured and will be stabled along the alignment. The emergency trains need to be capable of operations when the overhead line is out of service with diesel or battery traction, both by powering with a pantograph from the overhead line and with traction batteries from the train itself (tri-mode).

The maximum speed of the emergency response trains will be at least 160 kilometres per hour in electric traction with overhead line and at least 120 kilometres per hour in diesel or battery traction (without electrified overhead line).

The total length of the emergency response trains is proposed to not exceed 150 metres. The trains will have the following functional areas:

- Water tank to enable firefighting.
- A space for firefighting equipment.
- A space for evacuating passengers.
- A driving cabin at each end to enable operation in both directions
- A space for transporting fire fighters and amenities for them.

There will also be a range of works trains and on track plant to facilitate maintenance works along the route.

5.1.7. Rail systems

Horizontal and vertical track geometries have been designed to support train operation at high speed. The rail system characteristics have been defined for the Project rail system based on the European standard Technical Specification of Interoperability 1299/2014.

Table 5-9 Rail systems specifications

Element	Specification
Track radius	Minimum radius of 7,300 meters for design speeds above 300 kilometres per hour.
Track gradient	Maximum gradient of 3.0 per cent south of Sydney harbour and 1.25 per cent on surface sections.

Element	Specification	
Track form	• [redacted] • Ballasted on viaduct, at-grade sections and in the two short tunnels at Kangy Angy and the Tickhole tunnel.	
Crossovers and turnouts	• Spacing to support the operational requirements in both normal and degraded modes. • Standardisation of infrastructure to support efficiencies in construction and maintenance with crossing speeds of 50 and 80 kilometres per hour. • Higher speed turnouts of 100 kilometres per hour when entering and exiting the Central Coast Stabling and Train Facility.	
Signalling and controls	ETCS Level 2 signalling and train control system. ETCS Level 2 involves continuous supervision of train movement with constant radio communication between the train and trackside. Movement authorities are generated trackside and are transmitted to the train via radio. ETCS level 2 provides Automatic Train Protection and enables the use of Automatic Train Operation to improve the efficiency of train operations.	
Overhead wiring	• At-grade and viaduct: Open-route and stitched. • Tunnels: Simple catenary system supported from tunnel roof. • Maintenance facilities: Retractable 'rigid overhead conductor bar'.	
Power system	25 kilovolt AC traction power system with a static frequency converter double-end feed and substations at approximately 40- to 60-kilometre intervals with intermediate autotransformers.	
Communication sub-systems	• Train radio • Operations and maintenance (O&M) radio • Emergency services radio • Mobile network operator radio • Radio rebroadcast • ICT networks • Precise clock systems • Public address system	• Audio visual systems • Emergency warning system • Electronic ticketing systems • Telephone • Passenger information systems • Accessibility, mobility and inclusivity systems • Control centre systems • Train control
Security control systems	• CCTV • Electronic access control systems • Intruder detection systems	• Intercoms • Duress systems • Perimeter intrusion detection system

5.1.8. Power supply

The power for the Project, including traction power, stabling facilities and stations, will require multiple bulk power supplies and feeder substations at intervals of 50 to 60 kilometres. Bulk power supplies and feeder substations currently proposed within the Definition Design will be located at Central Coast Stabling and Train Facility, Brooklyn, Artarmon, Badgerys Creek and south-west of HSR Newcastle Station. Stations are proposed to have dedicated in-feeds.

Auto-transformer substations will be placed at approximately 10 kilometre intervals along the alignment and co-located with other facilities where possible. The substations will provide traction power for the line, transitioning the power supply to an operating voltage that is reticulated to nearby stations and to the stabling facilities.

Smaller auto-transformer substations will be required at intervals of approximately 15 kilometres. These will transform the power supply to the voltage required by the trains, thereby allowing traction to feed at higher voltages of 50 kilovolts with fewer supply connections. Some auto-transformer substations will also function as sectioning substations to allow non-affected sections to continue to operate in the event of a partial failure.

The station and auxiliary power systems consist of the infrastructure to deliver electrical power to the stations, ventilation and control systems. These are proposed to consist of electrical connections between the electricity grid substations and switch room substations located at stations and along the route.

Permanent power supplies will be required at other facilities along the alignment. These may be supplied from local network substations and collated with the following facilities noting discussions with power supply providers and power studies will inform local network power feed locations:

- Ventilation relief shafts
- Refuges
- Operation Control Centre
- Water treatment plants
- Tunnel portal laydown/maintenance yards
- ATS and MPATS substation auxiliary supply

Temporary power supplies will be required to support major electrical plant and equipment during construction. Where possible, these will be combined with permanent power supply requirements to allow constructed temporary power supply to become the permanent supply for the final installation. Doing so will require early construction of some larger bulk substations.

To support the net zero project objective, renewably sourced power will be used where possible. Onsite solar can be used at high speed rail facilities such as maintenance depots and stabling yards, supplemented by batteries to provide storage when the system is not generating electricity. Where demand exceeds production, commercial arrangements for renewable energy supply will be explored. The energy demand for traction power cannot be met through implementing renewable energy producing schemes along the alignment and high speed rail will therefore need to procure renewably produced energy through commercial arrangements.

5.2. Constructability strategy

A constructability strategy was developed to plan for the delivery of the Project. The strategy was iteratively refined during the development of the Definition Design and highlights considerations that are likely to impact the construction program and cost across the Project's lifecycle, from construction site establishment to completion of construction.

Three overarching objectives guided the development of the constructability strategy:

- The preferred option should be buildable and informed by constructability considerations.
- Alignment options should be informed by general constructability considerations.
- The constructability, delivery strategy, program and contract works packaging elements are compatible.

5.2.1. Constructability considerations

The constructability strategy considered the following aspects:

- Project mobilisation, early works and enabling works.
- Advanced manufacturing supporting a 'kit of parts' construction strategy.
- Construction of surface viaducts, water crossings and other civil infrastructure elements.
- Construction aspects associated with the rail maintenance, and stabling yard and facility.
- Rail systems and linewide works.
- Commissioning, start-up and hand-over of works.
- Demobilisation.

- Excavation, ground support and lining of:
  - Tunnel boring machine driven tunnels
  - Mined tunnels (tunnels, cross connections and adits)
  - Tunnel cross passages
  - Shafts
  - Crossovers and station caverns
  - Ventilation shafts and emergency stations
  - Portals

5.2.2. Construction feasibility

The assessment considered the feasibility of construction, concluding that all sections of the Project can be built using current general construction methods and materials. While the construction methodology was developed based on current best practice and technology, it was determined that alternative methods of construction may be applicable as technology, best practice and the industry evolve.

5.2.3. Sites for construction

The constructability strategy identified suitable construction sites. The sites are suitable to support project delivery and do not preclude the delivery of future stages. This has informed the requirements for permanent and temporary land acquisitions.

5.2.4. Tunnel constructability

Australia's long tunnel expertise

Australia has demonstrated significant expertise in building long tunnels through several recent large-scale infrastructure projects. These projects highlight Australia's capability to undertake complex tunnelling operations, utilising advanced machinery and techniques to achieve significant milestones in infrastructure development, and include:

- **Sydney Metro West:** Involves extensive tunnelling activities. The tunnel boring machines excavated around 24 kilometres of twin tunnel underground railway.
- **Sydney Metro City & Southwest:** Involves 15.5 kilometre twin tunnels from Chatswood, under Sydney Harbour through the Sydney CBD to Sydenham.
- **WestConnex (Sydney):** Included multiple tunnelling projects such as the M4 East Motorway, the new M5 Motorway and Rozelle Interchange with 22 kilometres of driven tunnels and a total of 29 kilometres of mainline, ventilation and access tunnels.

Running tunnels will be constructed in pairs using tunnel boring machines with a precast segmental lining. The tunnel boring machine and lining arrangement will be selected to suit the specific requirements, while balancing the productivity and value for money benefits that standardisation and modularisation can bring to this repetitive and linear activity.

The underground structures (other than tunnel boring machine driven tunnels) will be excavated by roadheader and/or conventional excavation means and methods. This includes the following structures:

- Tunnels (short rail tunnels at Kangy Angy and Tickhole Creek)
- Caverns and crossovers

- Small tunnels and connections, and cross passages
- Other – such as small caverns and back shunts for temporary storage of spoil, plant and equipment, utilities and facilities

The general method of work will include the excavation and temporary ground support required to create the initial profile of the structure. Temporary support will include rock anchors and sprayed concrete as determined by the construction contractor. Waterproofing and permanent linings will follow the installation of temporary support, with cast in-situ lining assumed as the permanent lining finish.

5.2.5. Station constructability

The project includes various station types: at grade, elevated, and underground. At grade stations use traditional construction methods, while elevated stations use viaduct structures. Underground stations are built using a mix of conventional excavation and underground caverns, either by cut and cover or mined cavern methods.

Cut and cover stations involve a large excavated station box, typically constructed bottom-up, with ground support based on geotechnical conditions. Alternatively, a top-down method may be used, installing diaphragm walls at the box perimeter, followed by progressive excavation and wall construction.

Mined cavern stations feature split caverns with two platforms separated by a rock column. Construction requires a station box at each end for machinery access and spoil removal, using cut and cover techniques. Mining equipment is lifted through the station box to excavate the caverns, with temporary support like shotcrete or rock anchors. Once mining is complete, equipment is removed, and bottom-up construction finishes the station.

Integrated stations and places

Australia has extensive experience in integrated station and precinct design and construction. Throughout the country, stations have been developed and are being delivered to integrate rail within the areas around them with connections to Country, creating vibrant public places for everyone to enjoy.

The following are examples that aim to enhance connectivity and accessibility, connection to land, creating a sense of place, high amenity living and mixed-use places – Sydney Metro stations (Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Central and Waterloo), Melbourne Metro Stations (Town Hall, Anzac, State Library, Parkville and Arden), Caulfield to Dandenong Level Crossing Removal Programme, and Cross River Rail Stations (Roma Street, Albert Street and Woolloongabba).

The construction methodologies for the stations are detailed in Table .

Table 5-10 Proposed station construction methodologies

Station	Construction methodology
HSR Newcastle	At grade station and precinct development.
HSR Lake Macquarie	Raised viaduct station.
HSR Central Coast	Combination of cut and cover station construction and mined cavern crossover construction.
HSR Sydney Central	Station constructed using mined cavern method. Shafts will be excavated at the north-east and south-west corners of the station, and cavern mining and station construction logistics will need to pass through these points.

Station	Construction methodology
HSR Parramatta	Combination of cut and cover station construction and mined cavern.
HSR Western Sydney International	Cut and cover.

5.3. Spoil strategy

The Project will generate an estimated 21 million cubic metres (bank) and 26 million cubic metres (bulk) of spoil. The majority will be generated by tunnel boring machines and from mined tunnel excavations at these worksites: tunnel boring machine running tunnels and cross passages, mined tunnels, station crossovers, station boxes, mined cavern stations, ventilation shafts, emergency stations, portals, maintenance and stabling yard (assumed balanced cut-and-fill, unless future flood level design requires build up), rail (assumed balanced cut-and-fill at this stage), bridges and viaducts, and other surface and underground structures.

The Project will target 100 per cent reuse of suitable spoil, with a commitment to beneficial reuse of spoil. While geotechnical investigations are ongoing, preliminary results suggests that most spoil will have favourable reuse qualities, as is generally observed with Hawkesbury Sandstone (for both engineering and general fill).

The Project will take into consideration the spoil and waste hierarchy, with an objective to reduce the volume of excess spoil generated as far as practical. Where possible and fit for purpose, spoil will be beneficially reused as part of the Project before alternative spoil disposal options are pursued. Depending on the quality and classification of the spoil, there may be potential for reuse of materials within the wider construction industry.

Table 5-11 Spoil reuse examples

Reuse options	Examples
Within the Project	• Filling embankments and mounds within short haulage distance of source or as construction materials (such as concrete). • Restoration of any pre-existing contaminated sites within the Project boundaries.
Environmental works	• Reuse in coastal protection works such as beach nourishment and land raise. • Reuse in flood mitigation works.
Other development projects	• Reuse for fill embankments and mounds on projects within an economic distance from site. • Reuse for land reclamation or remediation works.
Land restoration	• Reuse to fill disused facilities, such as mines and quarries, to enable either future development or ecological rehabilitation.
Landfill management	• Reuse to cap completed landfill cells. • Reuse in daily covering of landfill waste.

5.4. Staged delivery implications

The Project can be delivered in stages, as indicated in Chapter 3. This section discusses the high level approach and implications of staging the Project as follows: HSR Newcastle Station to HSR Central Coast Station; HSR Central Coast Station to HSR Sydney Central Station; and HSR Sydney Central Station to HSR Western Sydney International Station.

5.4.1. HSR Newcastle Station to HSR Central Coast Station

This stage enables a railway to operate between HSR Newcastle and HSR Central Coast, while the next stage (HSR Central Coast to HSR Sydney Central) is being constructed.

To facilitate services between HSR Newcastle and HSR Central Coast, trains will be turned back at both stations. Trains approaching HSR Central Coast will stop at the platform, and when departing to head to HSR Newcastle, will utilise the crossover at the Northern Train Siding. At the HSR Newcastle end, trains will reverse into the station via the Broadmeadow crossovers. These movements are only necessary during the initial phase of operations and eliminate the need for additional crossover infrastructure to achieve Network operations.

To support HSR Newcastle to HSR Central Coast operations, infrastructure will need to be constructed beyond Central Coast to Woy Woy in this stage. This will minimise interruptions on services between HSR Newcastle and HSR Central Coast during construction of the next stage (HSR Central Coast to HSR Sydney Central).

The Central Coast Stabling and Train Facility will service trains for or this stage and the ultimate Project. Similarly, the Northern Train Sidings will service emergency response trains for this stage and the ultimate Project.

5.4.2. HSR Central Coast Station to HSR Sydney Central Station

To support operations between HSR Newcastle and HSR Sydney Central, infrastructure will then be required between Woy Woy and to the south of HSR Sydney Central Station. As with the previous stage, extending infrastructure beyond HSR Sydney Central Station to the south in this stage will enable the construction of the next stage (HSR Sydney Central to HSR Western Sydney international) while minimising passenger interruptions between HSR Newcastle and HSR Sydney Central.

To facilitate operational services between HSR Newcastle and HSR Sydney Central, trains will utilise crossovers to the north of HSR Sydney Central. Turnback movements of trains at the HSR Newcastle end remain the same as per the previous stage.

The Central Coast Stabling and Train Facility will service trains for this stage and the ultimate Project. Similarly, the Northern Train Sidings will service emergency response trains for this stage and the ultimate Project.

5.4.3. HSR Sydney Central Station to HSR Western Sydney International Station

The full Project will operate between HSR Newcastle Station and HSR Western Sydney International Station. To turn back at HSR Western Sydney International Station, trains will utilise the crossovers north of the station without requiring additional infrastructure. The Southern Train Sidings will service emergency trains for this stage and the Project. The Hornsby Train Sidings will service emergency trains for this stage and the Project.

5.4.4. Operations and maintenance

Each section of the Network will undergo testing, commissioning and operational readiness activities before customer services commence. Additional crossovers to facilitate turnbacks are not required to deliver the staged opening approach.

The key operations and maintenance implications are summarised as follows:

- Lower frequency of services in the initial sub-stage to Central Coast HSR, with a maximum of 4 trains per hour. This avoids the need for additional crossovers at HSR Central Coast. Passengers travelling between Sydney and Newcastle can interchange with the Sydney Trains network at HSR Central Coast.

- Lower number of trains required in initial stage as compared with the ultimate.
- Interim terminus locations at HSR Central Coast Station and HSR Sydney Central Station:
  - At HSR Central Coast, turnaround moves are achieved using two platforms and a set of turnouts located approximately 9 kilometres on the north side of the station.
  - At HSR Sydney Central, the station has been designed to be able to turnback services in the end configuration and is able to function as a terminus in interim stages.

5.4.5. Constructability and spoil strategies reflecting a staged approach

Delivering the Project in stages will have implications for the proposed whole-of-project constructability and spoil strategy approaches. The key impacts to constructability are summarised as follows:

- Further investigations are required for the use of the permanent ventilation shaft south of HSR Sydney Central Station to retrieve the HSR Western Sydney International to HSR Sydney Central tunnel boring machine, as this ventilation shaft will be operational for the earlier stage (HSR Newcastle to HSR Sydney Central). A larger ventilation shaft or an alternative tunnel boring machine shaft may be required, or a change in methodology may be necessary.
- Retrieval of the tunnel boring machine at HSR Central Coast will impact the station construction methodology and potentially the program.
- Longer tunnel boring machine drives from Woy Woy to Hornsby East Tunnel Break will result in a 29-kilometre tunnel drive.
- A 7.2-kilometre roadheader tunnel from Ourimbah to Gosford is currently proposed, but may be replaced by tunnel boring machine drive(s).
- Impacts to access and egress because of staged opening/operational system may affect production rates.

A tunnel construction strategy has been developed to support the staged delivery of the Project, identifying launch and retrieval locations, size of construction area required, distances and tunnel drive directions, and is shown in the following figure.

Table 5-12 Tunnel construction strategy

Feature Name	Structure description	Worksite Space Required (m^2)	Chainage (km)	Tunnel direction
Western Sydney Airport Portal West	TBM launch and operation	100,000	57.7	
Western Sydney Airport	Permanent station	20,000	53.5	
Western Sydney Airport Portal East	Roadheader Launch and Operation	40,000	51.5	
Southern Train Siding (Mount Vernon portal)	TBM launch and operation	100,000	41.5	
Wetherill Park	Ventilation	5,000	32.5	
Parramatta	Permanent station & TBM launch and retrieval	20,000	22.9	
Homebush	TBM launch and operation	60,000*	14.4	

5.5. Future proofing for operations

Further investigations, design work and industry engagement will continue to optimise and refine the Project. The Project is futureproofed to facilitate the progression to the Network with specific infrastructure design elements including but not limited to:

- Tunnel ventilations sections at 10 kilometres to support 12 trains per hour.
- Station configurations (built or future proofed for 4 tracks and 4 platforms at all stations, except HSR Central Coast) to support ultimate service plan with a maximum of 12 trains per hour and 2 tiers of services with different stopping patterns.
- Additional capacity (space proofing) at Central Coast Stabling and Train Facility to accommodate fleet requirements of the Network.
- Space proofing for future train crew and operational facilities at key locations.
- Signalling and traction power systems to operate at higher train frequency.

Chapter 6

Corridor land use, precincts and transport integration

Australian Government
High Speed Rail Authority

Overcoming the tyranny of distance to shape growth and enable opportunities

- By dramatically enhancing access and addressing barriers to connectivity, the Project will set the stage for nation shaping change in the project corridor.
- Better connections that enable increased housing capacity and support a growing population will, in turn, integrate disparate economies into a highly competitive region. The benefits will be felt locally and nationally, through strengthened communities and economies.
- A step change in housing supply (including a long term pipeline of approximately 160,000 new homes by 2061) will enable more people to live in the corridor, particularly around Lake Macquarie and Newcastle, facilitated by better access to new stations.
- Seamlessly integrating with the project corridor's existing transport connections, new stations will provide a focal point for improved active transport and bus services that benefit beyond the immediate station, with strategically located park-and-ride facilities to support long distance access.
- High speed rail stations will also support the development of great places, accelerate and elevate urban revitalisation along the project corridor, and underpin growth and development while allowing for new revenue generation opportunities such as retail and parking.

6.1. Land use, precincts and transport integration context

This Project is a nation shaping initiative, enabling transformative change along one of Australia's most dynamic and rapidly growing corridors. By connecting places and fostering sustainable growth, the Project will create significant opportunities for housing, jobs and economic development.

Positioned at the heart of Australia's future high speed rail Network, the project corridor is already responsible for nearly a quarter of the nation's housing growth. As the central link in the Network that extends to Brisbane and Melbourne, the Project will enable access to 75 to 80 per cent of Australia's population within 3 to 4 hours once the full Network is operational, driving integration and accessibility across the east coast of Australia.

Despite significant population growth over the past two decades, Greater Sydney, the Central Coast and the Hunter have largely functioned as separate economies, leaving substantial potential untapped. Looking ahead to 2061 and beyond, population growth will intensify challenges under a business-as-usual approach, including escalating demand for costly infrastructure, sprawling lower density housing and misalignment between housing, jobs and transport priorities.

High speed rail offers a critical solution, connecting housing, jobs and infrastructure to foster sustainable growth and balanced development. By linking these regions, the Project will shape a cohesive 'Multi-city Region', driving regional integration, addressing spatial inequity and unlocking its potential as a globally competitive, interconnected network of thriving communities.

Realising these benefits will depend on a coordinated and collaborative approach which integrates economic development, place making, and land use and transport network planning.

The ability of high speed rail, supported by complementary strategies, to help reshape how people live, work and connect has been demonstrated repeatedly around the world (see call out box, right).

Drawing on these successes and developed alongside complementary initiatives and planning, the Project will connect regions, expand housing opportunities, enable thriving economic centres and support vibrant, transit-oriented precincts at the new stations. Integrated transport connections will link communities to the new stations, facilitating a resilient, liveable, and sustainable region – primed to face the emerging challenges of the coming decades with confidence.

Fostering the wider benefits of high speed rail

Over many decades, Spain's Madrid-Barcelona corridor highlights how enhanced connectivity drives regional economies and tourism, while Japan's Shinkansen fosters balanced growth by stimulating housing and jobs beyond major cities. At a local scale, France's Lyon Part-Dieu and Rotterdam Central Station illustrate the economic and social value of well-designed station precincts, and London's King's Cross-St Pancras showcases how multimodal hubs amplify benefits across cities and regions.

6.2. The corridor-wide view

6.2.1. A project corridor vision that guides development

Global research into major linear infrastructure projects highlights the critical importance of a well-defined project corridor vision to enable delivery of long-term benefits. Projects such as HSL Zuid in Europe and HS1 in the UK have shown the power of a clear vision to align stakeholders, support informed decision-making and guide the delivery of outcomes – regional economic growth, land use change and environmental sustainability – while incorporating flexibility for future opportunities that extend far beyond project completion.

The vision for the project corridor, illustrated in the figure below, developed collaboratively with stakeholders and facilitated by the Authority as part of the Business Case, aims to connect Sydney, Australia's preeminent global city, with Newcastle, the largest regional economy in NSW, in about an hour. It seeks to create a single, integrated economic powerhouse along the project corridor while supporting a long-term housing pipeline and delivering broader economic and social benefits.

Several Australian examples, including Sydney's Metro North West and Bankstown Line, Perth's Mandurah Line, and Brisbane's Moreton Bay Rail Link, also highlight the importance of aligning transport and land use visions. These projects demonstrate how new rail infrastructure reshapes and enables urban development, improves connectivity and enhances residents' quality of life by fostering vibrant precincts and better integrating transport and housing opportunities.

The project corridor vision reflects the unique economic and social significance of the corridor, the potential of its major centres, the diversity of its communities (including thriving First Nations communities), the beauty of its natural landscapes and the high quality of life offered. This vision recognises that high speed rail presents an opportunity to reimagine the project corridor as an integrated 'Multi-city Region' that addresses population growth, housing demand, economic productivity and environmental sustainability for future generations.

Previous strategic planning has largely focused on specific regions, overlooking the opportunity to harness the corridor's collective potential. This Project is an opportunity to build on existing strengths and investments, maximise the use of current resources and infrastructure, and defer or avoid the need for costly alternative projects, guided by a contemporary vision for planned growth and economic integration.

Figure 6-1 Project corridor vision

Informed by stakeholder engagement and underpinned by plans for individual precincts, the project corridor vision provides a strategic starting point. It will evolve through further consultation with agencies and stakeholders as the project advances, ensuring it adapts to emerging priorities and opportunities.

6.2.2. Actively fostering economic development

The project corridor is home to some of Australia's most dynamic industries, with clean energy, advanced manufacturing and defence anchoring the country's largest regional economy at the northern end of the corridor, and the economic powerhouse of Greater Sydney at the southern end, which alone contributes 22 per cent of the national economy.[1]

The Project will connect Western Sydney International, Parramatta CBD, Sydney CBD, the Central Coast, Lake Macquarie and Newcastle, vastly improving accessibility and driving agglomeration economies and wider economic benefits by building on existing strengths and investments. It will also enhance the role of Newcastle's CBD and port, supporting advanced manufacturing and related industries, while maximising the value of existing infrastructure, including the new freight line and employment lands.

The Project will generate significant social and economic benefits by improving access to businesses, labour, job opportunities, key centres, healthcare and higher education, with transformational outcomes like:

- Allowing the average business to access over 7,250 more workers and benefit from agglomeration, increased productivity and knowledge sharing with other businesses (or around 160 additional jobs for each business) through improved connectivity.
- Improved job opportunities, with the average worker in the corridor gaining access to 1,500 additional jobs promoting equitable access to employment and skills retention in the region.

This will generate economic benefits of $16.4 billion PV. There is nevertheless scope to significantly amplify these benefits.

The role of the Project's Economic Development Strategy

Global case studies provide ample evidence that the transformative potential of high speed rail is maximised when complemented by initiatives that promote integrated and sustainable development.

Recognising this, the Economic Development Strategy, shaped through extensive stakeholder engagement, outlines a coordinated approach to unlock the Project's full economic growth potential.

While the Authority is not the primary deliverer of these initiatives, it will play a critical enabling role, working closely with state agencies, local authorities and other stakeholders to identify and catalyse targeted initiatives and investments.

Case study: Economic growth and transformation through high speed rail

In 2012, the United Kingdom Government announced its intention to develop High Speed 2 (HS2) from London to the West Midlands, and in February 2017, the *High Speed Rail (London – West Midlands) Act* received Royal Assent. This commitment spurred significant economic growth and development in the West Midlands and Birmingham, enhancing regional connectivity, attracting investment, and driving urban regeneration.

In 2021 and 2022, the West Midlands was named the country's fastest-growing tech sector – home to more than 2,000 tech startups and more than 6,000 tech businesses overall. The West Midlands also has the largest share of foreign direct investment (FDI) of all UK regions outside London: recording 181 FDI projects in 2022/23, an increase of 171 per cent since 2021/22.

Businesses are also choosing to set up additional offices in the West Midlands, while remaining headquartered elsewhere, either London or internationally. HSBC's domestic operations relocated to Birmingham after the HS2 announcement. Recognising the city's ongoing revitalisation, HSBC's chief executive stated *"Birmingham city council has worked hard and significantly invested to make the city an attractive home for UK businesses and their employees".*

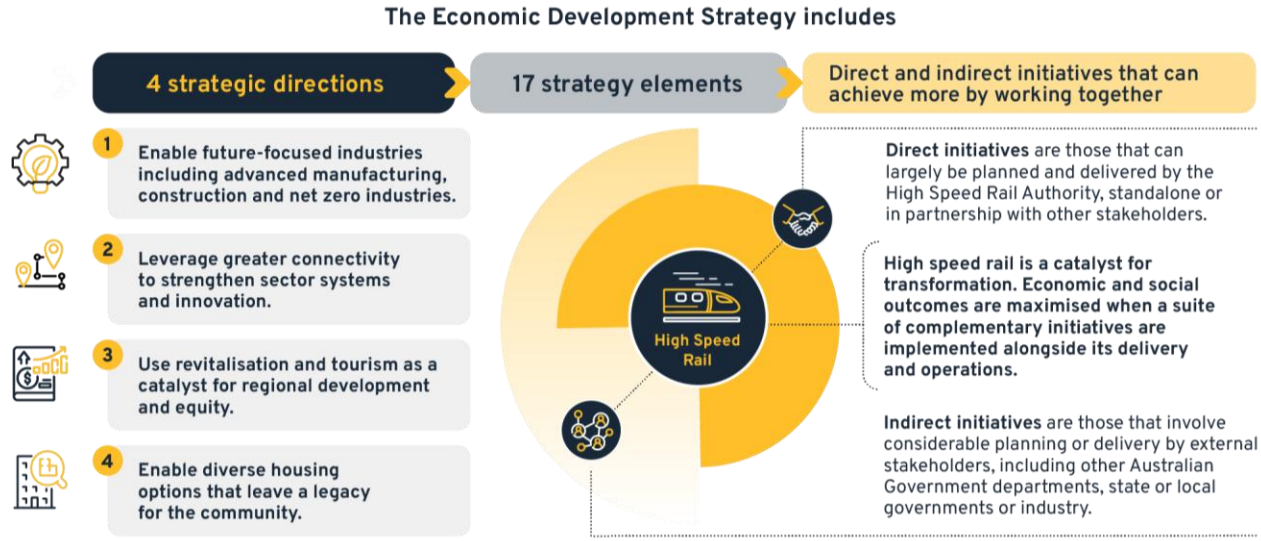
Several other initiatives have contributed to the area's success, including business and innovation programs, the Deeper Devolution deal which provided local powers and funds to level up the region, and hosting the 2022 Commonwealth Games which saw record visitor numbers.

The strategy outlines four strategic directions, supported by a range of direct and indirect initiatives. These initiatives include:

- Place-specific opportunities such as precinct activation in Gosford and Broadmeadow, innovation clustering in Newcastle and Lake Macquarie, and enhanced tourism infrastructure to improve access to the Hunter Valley and Port Stephens.
- Community-specific opportunities such as support for First Nations communities, transitioning workforces, key workers, social equity through affordable housing, and education and skills development for sustainable employment.

The Project's Economic Development Strategy is summarised in the figure below.

Figure 6-2 Economic Development Strategy summary



Modelling and economic analysis indicates that implementing the Economic Development Strategy alongside high speed rail will:

- Enable additional dwellings, population, jobs and students above what would be achieved by the Project alone and business-as-usual land use change.
- Amplify the Project's economic impact, fostering sustained regional and urban growth through increased connectivity and productivity.
- Further strengthen key sectors such as healthcare, education, defence and the visitor economy.
- Drive additional growth in advanced manufacturing, net zero industries and biodiversity-related sectors.
- Guide the delivery of vibrant station precincts that become major destinations in their own right.

When implemented in collaboration with partners, these initiatives will further enhance the Project's ability to shape the corridor into an integrated, prosperous, liveable and globally competitive region, showcasing its unique assets and lifestyle to a global audience. By positioning the corridor as more than the sum of its parts, the strategy enhances its global standing, diversifies employment opportunities, and drives growth in creative and knowledge-intensive industries.

6.3. Land use change

6.3.1. Housing and jobs

Well planned urban environments focused on transport hubs such as high speed rail are proven to create vibrant, attractive precincts that offer greater access to services, more efficient infrastructure provision and diverse housing through more economic use of land.

High speed rail will catalyse and accelerate land use change across the project corridor, enabling greater urban density, increased housing diversity, and more dwellings and jobs near stations. Strong integration with connecting public and private transport networks will enable these land use benefits to extend over wider areas. These outcomes are demonstrated in a range of case studies (see call out box, below).

Detailed land use analysis that combines these global insights with a proven land use methodology aligned with Australian Transport Assessment and Planning guidelines shows high speed rail will:

- Create thousands of new jobs near high speed rail stations by improving access to employment opportunities, unlocking regional economic potential and attracting investment in key industries.
- Significantly enhance urban renewal initiatives in Broadmeadow, Morisset and Gosford by providing connections that make these areas more attractive. These areas will benefit from improved connectivity to major job centres and regional markets, catalysing higher density development and vibrant precincts.
- Extend benefits to stations in the NSW Government's Transit Orientated Development Program, including Adamstown, Cardiff, Cockle Creek, Wyong, Tuggerah and Woy Woy, which will be linked to high speed rail stations by the existing heavy rail network.
- Drive growth across Western Sydney, including key precincts around Western Sydney International and Aerotropolis, and renewal around Parramatta and the Westmead to Sydney Olympic Park corridor.

Regional reach: Leveraging faster, seamless travel between centres to drive change beyond the station

High speed rail sets itself apart from other rail technologies by breaking barriers of distance and delivering faster, seamless connectivity between cities and regional centres. This enhanced connectivity creates dynamic station precincts that integrate housing, services and infrastructure, transforming them into focal points for investment, growth and economic activity. Unlike metro systems, which focus on localised urban development, high speed rail drives large scale regional transformation, unlocking potential in high amenity areas, and fostering economic and housing growth across broad catchments. This underpins the approach to attributing land use change to high speed rail.

Globally, Japan's Shinkansen spurred suburban housing growth and reduced urban congestion, while France's TGV and Spain's AVE integrated cities like Lyon and Zaragoza into larger economic systems, reducing isolation and attracting investment. Stations like Lille-Europe and Ebbsfleet exemplify urban renewal and mixed-use development, helping regions fully realise their economic potential.

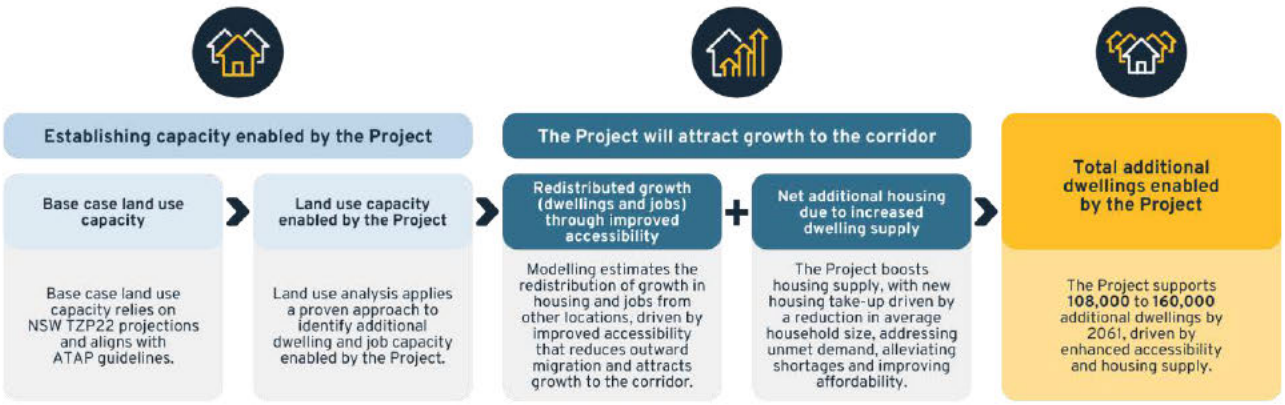
By unlocking capacity in station precincts, enabling urban renewal, and creating jobs and housing across broader areas, high speed rail supports sustainable growth. It redefines connectivity and settlement patterns, integrating separate economies and labour markets into cohesive regions. With transit-oriented planning and strong local transport links, as seen in France and Germany, high speed rail delivers lasting regional and economic benefits far beyond the rail corridor itself.

6.3.2. Land use scenario development

Land use scenarios have been prepared to understand the land use change that could occur with the Project. These identify the potential future land use and ultimate development capacity for dwellings, jobs and population in response to the increased accessibility and amenity afforded by the Project. These scenarios, developed in consultation with the NSW Department of Planning, Housing and Infrastructure, addressed key issues such as station options, housing and land use planning for the Project, with stakeholder discussions confirming support for Broadmeadow and Gosford station options, alignment with state-led rezonings and a focus on urban infill over greenfield development.

The resulting land use capacity numbers are a critical input into the land use redistribution model that has been used to estimate dwelling and job capacity uptake in the project corridor by 2061. The model also takes into account travel costs, land use capacities and development rates. This methodology is outlined in the following figure.

Figure 6-3 Land use methodology



Land use capacity

The Base Case for the Project is TZP22 forecast numbers for 2061, with the assumed rezonings and infrastructure provided to achieve the proposed growth (see call out box below for more information on TZP22).

Building on the Base Case, detailed land use scenario analysis using a proven typology-specific approach has identified an additional capacity of 194,500 dwellings and 94,000 jobs that could be enabled in the project corridor by the Project. This includes potential future growth that could be attributed to the Project within high speed rail station precinct catchments (a 2-kilometre walking catchment) and broader catchments (a 30-minute public transport catchment) – the direct area of influence.

Table 6-1 Land use capacity across the corridor

	Total corridor	Northern corridor (around the HSR Central Coast, Lake Macquarie and Newcastle stations)	Greater Sydney corridor (around the HSR Sydney Central, Parramatta and Western Sydney International stations)
Existing corridor capacity (TZP22)			
Dwellings	1,210,800	–	–
Jobs	2,337,000	–	–
Additional corridor capacity (over TZP22)			
Dwellings	+ 194,500	+ 190,000	+ 4,500
Jobs	+ 94,000	+ 94,000	No additional

This transformative potential aligns with international case studies, such as Lille-Europe, where high speed rail connectivity supported new housing within the station precinct, and the Shinkansen network in Japan which showed high speed rail has influenced growth beyond traditional administrative boundaries.

This land use analysis highlights the Project's ability to enable capacity across the project corridor:

- The northern section of the corridor, particularly around HSR Newcastle Station and HSR Lake Macquarie Station, offers the highest potential for additional capacity, in view of its significant development opportunities and strategic regional location. This potential reflects the limited constraints on land use and the availability of larger, underutilised areas compared to other parts of the corridor, incorporating growth outlined in draft plans such as the Broadmeadow Place Strategy and the Morisset Place Strategy.
- More modest capacity is identified around HSR Central Coast since much of the growth potential around Gosford has already been realised or is underway, there are greater development constraints, and the scale of development opportunities is more limited compared to the larger, more expansive regions further north.

- The Greater Sydney section of the corridor has limited capacity for additional dwellings and jobs resulting from the Project, and take-up of existing capacity is expected to accelerate due to enhanced connectivity and increased demand. This also reflects that many areas in Western Sydney have undergone extensive strategic planning and redevelopment, with much of the available growth potential already accounted for in existing precinct plans, such as the Western Sydney Aerotropolis Precinct Plan.

Which Travel Zone Projections (TZP) were used for modelling purposes?

Travel Zone Projections (TZP) are small area land use estimates supporting NSW strategic planning and the Strategic Travel Model (STM). Modelling for the Project has used TZP22 as it is the most recent available forecast.

TZP22 was released in October 2022 and is based on 2016 Census data and inputs available as of early 2022. It incorporates known land use developments and strategic plans together with post-COVID-19 travel assumptions but does not assume new transport infrastructure.

Updated 2024 population projections, using 2021 Census data, were released by the NSW Government in late November 2024. These show the population in the Newcastle to Sydney corridor is expected to be 12 per cent higher by 2041 compared to previous estimates, adding 170,500 more people.

Updated travel zone projections (TZP24) based on these recently released population projections are expected to be released in early 2025. These travel zone projections were unavailable for demand modelling to inform the Business Case and will be used to inform future demand modelling activities.

Land use redistribution (take up) – projected change in land use to 2061

Land use redistribution modelling was undertaken to determine how much of the land use capacity would be taken up by 2061 within the project corridor as a result of the Project. Key inputs into the model included travel costs (derived from demand modelling) and the land use capacities described above, which are drivers in determining the location choice of dwellings and jobs, as well as development rate assumptions, which influence the speed at which capacity is taken up.

Improved accessibility will enable significant increases in land and housing supply across the project corridor. As a direct effect of improved accessibility, a redistribution of projected population growth across the east coast corridor is expected to occur with stronger growth attracted to the project corridor.[2]

Additionally, the improved connectivity may reduce migration out of the project corridor, as more people find opportunities enabled by the Project for work, housing and services. The change in households in the project corridor due to accessibility and capacity in 2061 is presented in the following table.

Table 6-2 Redistribution of projected growth in project corridor through improved accessibility and housing capacity 2061 (rounded to nearest 100)

Area	Households	Population	Employment
Newcastle	13,200	31,600	22,900
Lake Macquarie west	7,000	16,700	4,100
Lake Macquarie east	1,500	3,500	1,500
Maitland	9,000	21,500	3,200
Lower Hunter (including Cessnock)	100	300	-200
Wyong	-100	-400	1,100
Gosford	7,100	17,000	4,100
Sydney – city and inner south	700	1,900	700
Sydney – Parramatta	-	-200	800
Sydney south west	8,400	19,900	56,500
GMA remainder	8,700	19,700	4,600
Total	**55,500**	**131,400**	**99,200**

Source KPMG (2024), Land Use Modelling and Socio Economic Assessment Report. Totals may not sum due to rounding. .

Modelling the transformative impact of high speed rail through an 'open city' land use approach

The 'open city' approach models high speed rail impacts by assuming population, household and employment growth can be drawn from outside the immediate area, reflecting transformative potential of high speed rail. Unlike closed models that redistribute fixed growth, this better reflects the impact of high speed rail by capturing induced development across broader regions, including the east coast of Australia.

The approach integrates improved accessibility and land use capacity unlocked by the Project to simulate dynamic shifts in population and employment patterns. It positions high speed rail as region shaping infrastructure, driving urban development and economic activity by making key locations more attractive.

Outcomes include the forecast of significant residential and employment growth near high speed rail stations, particularly in Newcastle and Lake Macquarie, and improved access for disadvantaged communities. By reflecting high speed rail's potential to generate net positive growth, the open city approach aligns infrastructure planning with broader regional development goals, ensuring sustainable and equitable benefits across urban and regional areas.

A secondary outcome of the significant increase in housing capacity associated with the Project is that it enables a material boost in housing supply in Greater Sydney and the surrounding market. The resulting increase in housing supply near high speed rail stations will have a wider market impact, enabling more people to live in their own home or access more rental options, allowing average household size to reduce to their preferred level (see Section 7.4).[3/4]

This reduction in household size is expected to have the effect of generating demand for approximately 52,000 to 104,000 net additional dwellings in the project corridor, as presented below. The lower and upper bound housing scenario account for uncertainty around the level of latent demand.

Table 6-3 Distribution of net additional dwellings across the project corridor (rounded to nearest 100)

Area	Low scenario	High scenario
Newcastle	13,000	26,000
Lake Macquarie west	14,600	29,200
Lake Macquarie east	3,700	7,400
Maitland	3,200	6,300
Lower Hunter (including Cessnock)	–	–
Wyong	12,000	23,900
Gosford	4,100	8,300
Sydney – city and inner south	–	–
Sydney – Parramatta	–	–
Sydney south west	800	1,500
GMA remainder	800	1,500
Total	**52,000**	**104,100**

Source: EY modelling. Totals may not sum due to rounding.

Summarising these land use effects

In summary, the Project will enable additional capacity for 194,500 new dwellings within the project corridor, whose take-up is then driven by two further Project effects:

- Housing growth that would otherwise have been expected to be distributed more widely across Sydney Greater Metropolitan Area being drawn into the project corridor.
- A net increase in housing demand resulting from the release of latent demand for smaller household sizes, reflecting consumer preferences which are currently constrained by housing shortages and unaffordability.

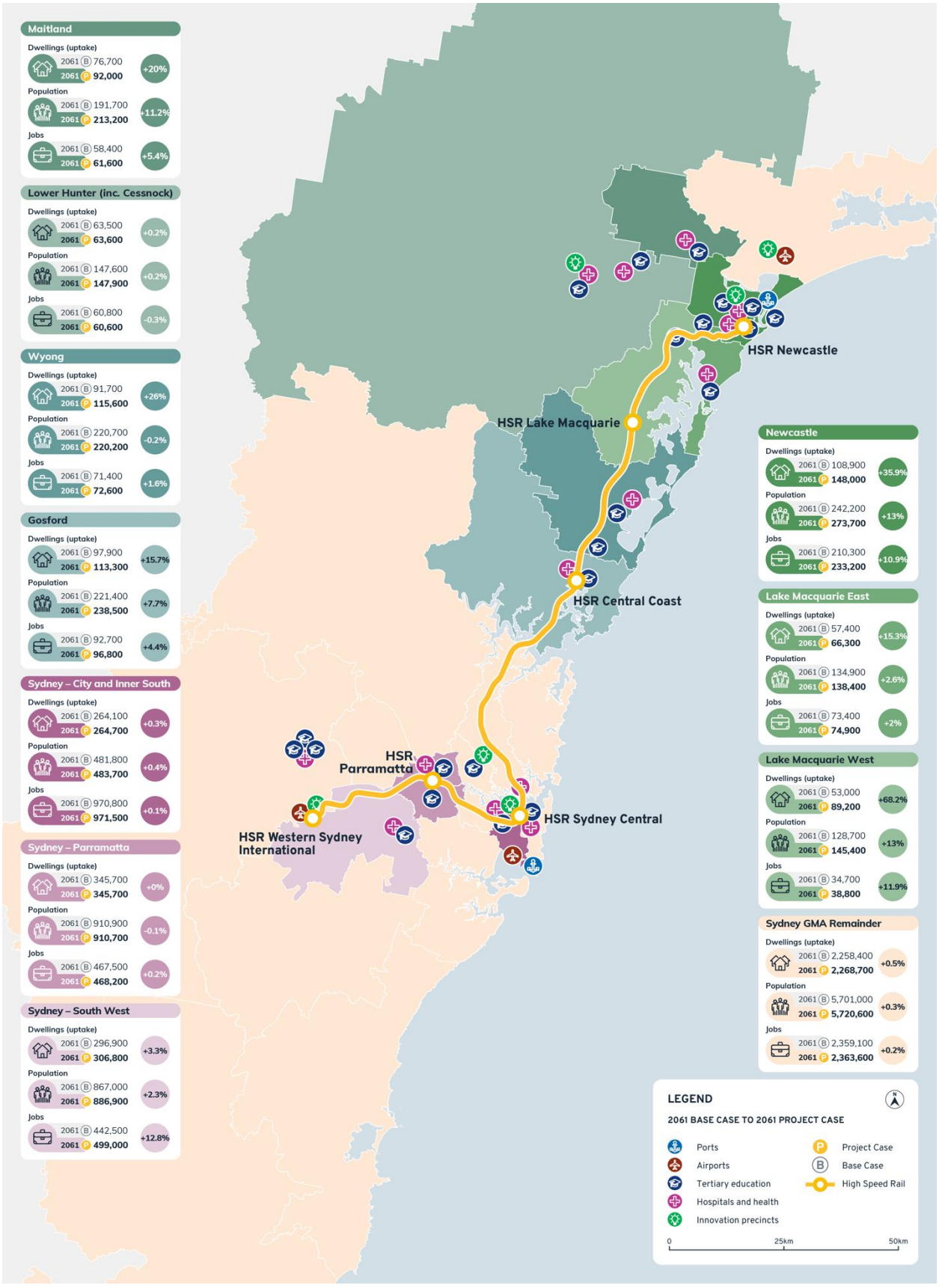
Collectively, these impacts are forecast to result in approximately 108,000 to 160,000 additional dwellings across the corridor by 2061 enabled by the Project, with the majority concentrated north of the Hawkesbury. This is summarised in the table below and detailed in Figure 6-4.

Table 6-4 Dwellings in the project corridor by 2061 (rounded to nearest 100)

Area	Additional capacity for dwellings across project corridor enabled by the Project	Redistribution of projected growth into the project corridor	Distribution of net additional dwelling demand		Total additional dwellings enabled by the Project in the corridor	
			Low scenario	High scenario	Low scenario	High scenario
Northern part of the corridor	**190,000**	37,800	50,600	101,100	88,400	138,700
Southern part of the corridor	**4,500**	17,800	1,600	3,000	19,300	20,900
Total	**194,500**	**55,600**	**52,200**	**104,100**	**107,700**	**159,600**

Totals may not sum due to rounding.

Figure 6-4 Comparison of 2061 Base Case and Project Case land use



Case study: Leveraging the regional influence of high speed rail to shape population dynamics

Introduced in 1964, the Shinkansen, the world's first high speed rail system, transformed connectivity in Japan, linking major cities like Tokyo, Osaka and Nagoya with regional centres. Over time, it became the backbone of Japan's transport network, driving urban growth and addressing regional imbalances.

A 2024 study of 20 years of data highlights the Shinkansen's profound influence on regional settlement and land use. Major hub stations like Osaka and Nagoya experienced significant population density increases within a 15-kilometre radius, driven by clustering effects. This fostered vibrant urban centres, spurring economic activity and creating opportunities for retail, housing and mixed-use developments.

The study also reveals how the system's integration with local transport extends its influence beyond administrative boundaries. Previously underutilised regions within station catchments have seen improved land use efficiency, with commercial and residential developments replacing lower value uses. Over 10 to 20 years, high speed rail sustainably reshaped land use patterns and population distribution. These findings show high speed rail's potential to drive sustainable growth, and highlight the need for strategic station placement, supportive policies and integrated planning to replicate Japan's success.

6.3.3. Coordinating infrastructure and land use

As this chapter has shown, major rail projects often significantly influence land use. Achieving the transformative outcomes of high speed rail requires a deliberate and coordinated approach that aligns efforts across national, state and local levels. Land use change optimally aligned with the project objectives will not occur spontaneously; it demands focused leadership and collaboration.

High speed rail offers a unique opportunity to deliver sustainable growth, diverse housing and job creation. However, infrastructure provision – such as water, sewer, roads and rail – remains a barrier to planned growth. Without these investments, land releases are delayed, slowing housing and employment delivery.

A dedicated coordination framework, as for other major projects, is essential, with a focused team to:

- Align land release timing with infrastructure delivery.
- Leverage existing budgets for planned infrastructure.
- Extend high speed rail's reach by integrating it with transport networks, improving accessibility and driving behavioural change.

This approach will streamline approvals, provide certainty for the development industry and help fast track housing delivery to complement the Project's delivery and operations. By aligning resources and investments, high speed rail will transform underutilised rezoned land into thriving communities with quality housing, jobs and sustainable development – all underpinned by its transformative connectivity.

6.4. Transport integration

6.4.1. Integrating high speed rail with local and regional transport networks

Effective connectivity between high speed rail and the surrounding transport networks is essential to maximise accessibility and extend the reach and benefits of the Project. Station precincts play a key role in this integration, being designed for seamless and accessible transfers between modes. This will position each station as a regional gateway, driving land use uplift, economic development and commercial outcomes.

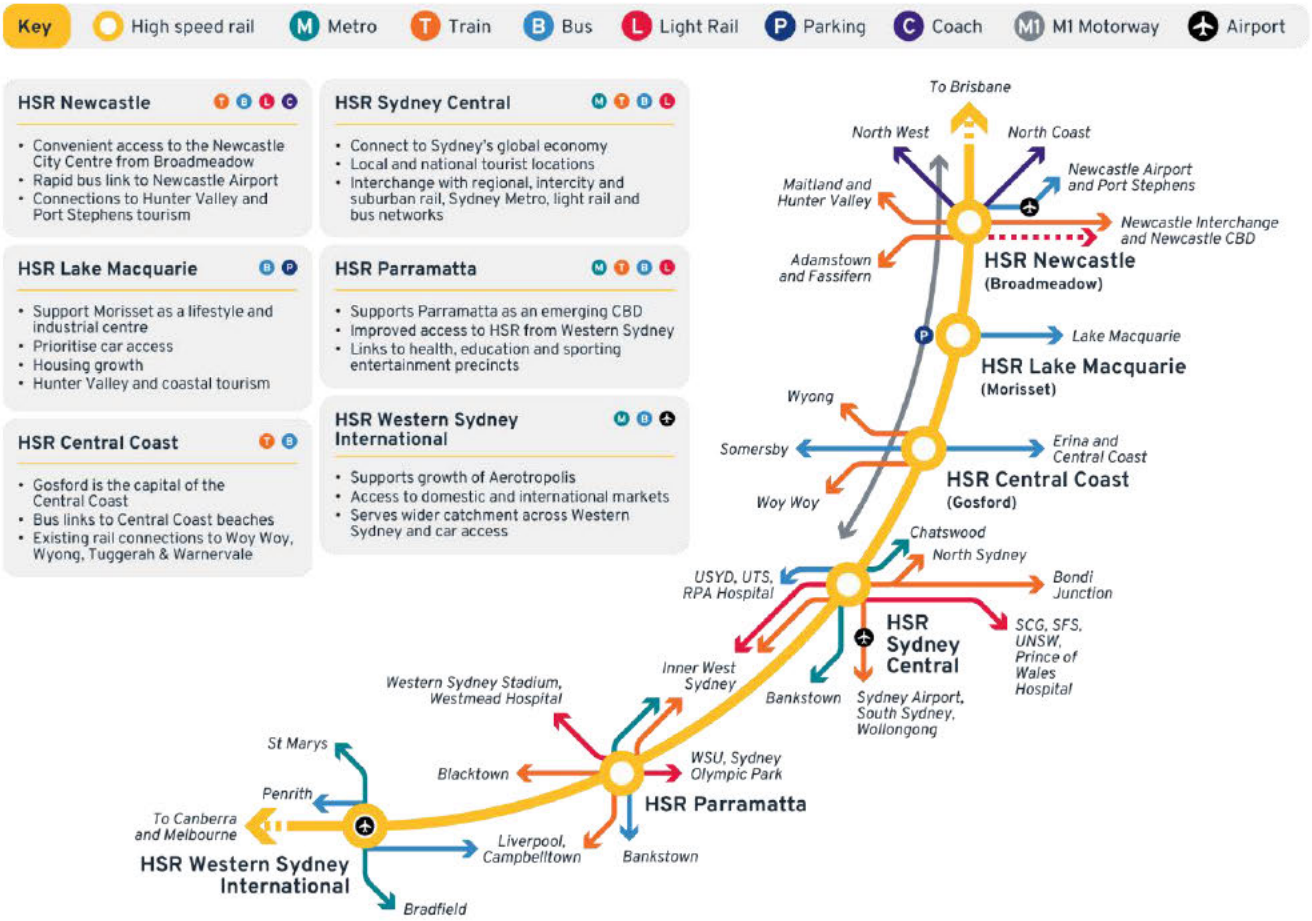
Many high value destinations, such as employment hubs and tourist attractions, are located beyond the immediate station precincts, necessitating strong connections to other transport networks. Fully integrating high speed rail with feeder services and surrounding networks will enhance local and sub-regional access, enabling customers to travel easily between regions and realise the broader benefits of the Project. This presents an opportunity to work closely with relevant agencies and operators to optimise regional public transport services, aligning them with high speed rail arrival and departure times to ensure seamless connectivity and improve the overall door-to-door customer experience.

Demand modelling demonstrates that public transport and walking is crucial for accessing high speed rail, with over half of high speed rail trips relying on these modes. Specific insights at each station include:

- HSR Newcastle: 86 per cent of passengers will access the station by bus and rail, with many travelling over 5 kilometres from locations across the Hunter region.
- HSR Lake Macquarie: Half of all passengers will arrive by bus, while a third will travel to the station by car, with passengers typically travelling 10 to 20 kilometres.
- HSR Central Coast: 78 per cent of passengers will access the station by bus or rail, with almost half travelling over 5 kilometres, highlighting the station's role as a key regional transport hub.
- HSR Sydney Central: Rail dominates access, with a third of passengers travelling 5 to 10 kilometres. Walk access accounts for over a quarter of trips due to the dense Sydney CBD, emphasising the importance of safe, attractive walking connections.
- HSR Parramatta: Pedestrian access is again significant, with half of all passengers travelling less than 1 kilometre, and bus and rail access each accounting for 20 per cent of trips, reflecting Parramatta's role as a key transport hub for Western Sydney.
- HSR Western Sydney International: 78 per cent of passengers will travel less than 1 kilometre to access the station, primarily from the airport for travel or work, with bus and rail being used for the remainder of trips to reach jobs and services in Bradfield and the Western Parkland City.

The transport integration opportunities across the project corridor are shown in the following figure.

Figure 6-5 Corridor-wide integration opportunities on the project corridor



Case study: Transforming connectivity and renewal through world-class local, national and international integration

London St Pancras International, the eighth busiest station in Britain, showcases the transformative power of integrating high speed rail with broader transport networks. After Eurostar moved its terminus to St Pancras in 2007, journey times to Europe were reduced by up to 25 minutes, boosting accessibility across Britain. Eurostar patronage grew significantly in regions north of London, with increases of 154 per cent in Derbyshire and 118 per cent in South Yorkshire.

St Pancras connects seamlessly with King's Cross railway station and King's Cross St Pancras tube station, creating a world-class transport hub that enhances movement across local, national and international networks. This integration has also driven urban regeneration, transforming brownfield land into a vibrant precinct with commercial, residential and cultural developments. Between 2009 and 2019, employment in the King's Cross area tripled and economic output grew by over 300 per cent.

The success of St Pancras highlights the potential of transport hubs as anchors for regeneration, improving regional connectivity, attracting investment and fostering long term growth. It serves as a benchmark for future infrastructure projects, demonstrating how well integrated, high speed rail stations can deliver sustainable, transformative outcomes.

6.4.2. Complementing existing rail and metro networks

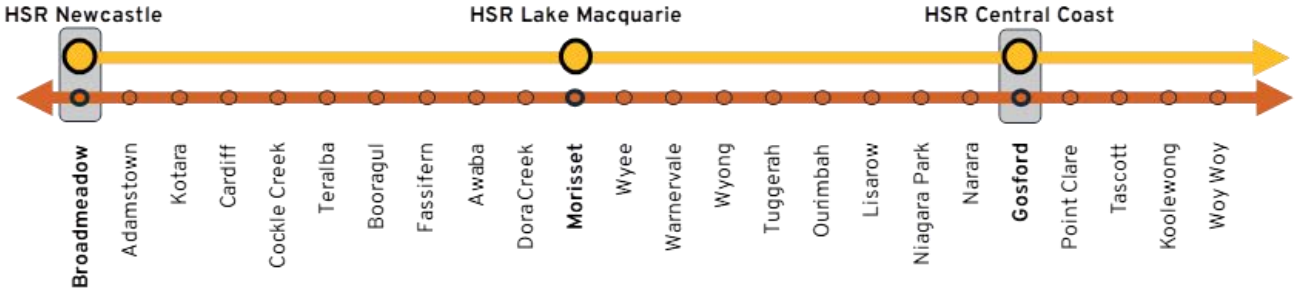
The Project will complement the existing rail and metro networks by providing convenient transfer options at all stations, except HSR Lake Macquarie. This connectivity will expand station catchments through reliable, frequent connections across Greater Sydney, the Central Coast and the Hunter regions.

In Greater Sydney, the Project will connect conveniently with Sydney Trains and Sydney Metro at HSR Sydney Central, HSR Parramatta and HSR Western Sydney International. These connections, particularly with Sydney Metro, will provide rapid access to employment hubs such as Macquarie Park and North Sydney, health and education precincts like Westmead, and cultural and entertainment areas such as Sydney Olympic Park.

Between HSR Sydney Central and HSR Parramatta, high speed rail will complement the Sydney Metro West network. While some intra-Sydney trips are expected, the main focus is on fast, convenient connections for longer distance travel, such as between HSR Parramatta and HSR Newcastle, and eventually the Network. Demand will be managed through pricing to complement metro services.

In the Central Coast and Hunter regions, the Hunter Line and Central Coast and Newcastle Line will seamlessly integrate with high speed rail at HSR Newcastle and HSR Central Coast, similar to how Japan's Tōhoku Shinkansen works with the older Tōhoku Main Line (see call out box below). The station designs for both locations will facilitate convenient transfers between the two networks, making interchange attractive for customers and expanding the reach of each network, as illustrated in the figure below.

Figure 6-6 Interchanges with existing networks



Case study: Integrating high speed rail and conventional rail networks

Japan's connected high speed and conventional rail services by building dedicated Shinkansen lines due to limited capacity on its conventional network. Many high speed lines run parallel to and intersect with existing conventional railways, facilitating access to high speed services and enhancing local networks.

An example is the Tōhoku Shinkansen, which spans 675 kilometres from Tokyo to Shin-Aomori, with a 497-kilometre segment running parallel to the conventional Tōhoku Main Line. While the Tōhoku Main Line is divided into 7 service segments with 166 stations, there is no continuous service from Tokyo to Morioka. In contrast, the Shinkansen has 18 stations, 13 of which interchange with the Main Line.

The Utsunomiya Line section of the Tōhoku Main Line, which covers 158 kilometres, mirrors the Project's expected length of about 180 kilometres. It has 33 stations for local and rapid services, with six offering interchange with the Shinkansen. Journey times are also comparable to the project corridor: the Shinkansen covers the distance in one hour 6 minutes at up to 320 kilometres an hour, while the conventional railway takes 2 hours 40 minutes at a maximum of 120 kilometres an hour.

6.4.3. Station precincts and interchange

Future high speed rail customers will value fast, seamless transfers, with station and interchange designs focused on providing an easy and efficient experience.

Each station has been designed to respond to the unique features and needs of its location, including:

- The size and function of the place, city and region the station serves.
- The station's access and network service needs (such as the stopping patterns).
- The surrounding land uses (such as urban or greenfield) and desired land use outcomes.
- The purpose of the station, including unique needs such as being at an airport or supporting special events.

Interchange planning and design has prioritised customer needs, such as space for luggage, pre-boarding services and amenities (such as pre-booked travel, pre-boarding lounges, food and retail), and provision for kiss-and-ride, rideshare and regional coach connection spaces.

Future changes to the transport network have also been considered, including bus services, metro lines, light rail extensions and cycle improvements. High speed rail stations will function as critical interchanges, supporting corridor development, future network connections and expansions to Brisbane and Melbourne, while complementing potential extensions to Sydney's metro network.

An interchange access hierarchy has been used to guide the design of high speed rail stations and the provision of facilities for each access mode within the station interchange. The hierarchy aims to encourage customers to use more efficient and sustainable modes wherever possible.

6.4.4. Parking

Car parking will play a pivotal role in enhancing accessibility, supporting mode shifts and optimising revenue across the Network. For the Project, the approach to car parking is tailored to the unique functions of each station, aligned with sustainability, integration, place making and revenue outcomes:

- HSR Lake Macquarie Station – Up to 1,000 commercial parking spaces are planned to serve customers from local and regional catchments, including the Hunter Valley. Strategically located near the M1 Pacific Motorway, the station will be similar to European high speed rail stations such as Avignon TGV in France and Reggio Mediopadana in northern Italy, where parking supports both access and revenue generation.
- HSR Western Sydney International Station – Parking will be integrated with the airport to create a seamless air-rail hub, maximising passenger convenience. This approach mirrors examples like Frankfurt Airport, where co-located parking supports multi-modal connectivity.
- HSR Newcastle, HSR Central Coast, HSR Sydney Central and HSR Parramatta Stations – Planning for these stations prioritises active and public transport to minimise congestion and enhance place making outcomes. Commercial parking will be limited, with options such as off-site valet parking and premium priced visitor parking considered to balance access and revenue while minimising precinct impacts. This aligns with international examples like Lille Station in France, where parking complements public transport.

All stations will incorporate kiss-and-ride zones, taxi ranks, car share rental services and flexible mobility options, reflecting a global shift away from traditional self-parking and ground parking, including at airports and major transport hubs.

Parking infrastructure will be designed to support electric vehicles and emerging technologies such as connected and autonomous vehicles. This flexible approach addresses customer needs upon opening while preparing for future mobility trends. Further opportunities to optimise commercial parking and revenue will be evaluated to ensure a balance between short-term functionality and long-term adaptability and value creation.

6.5. Making great new places, designed with Country

As well as providing seamless integration with public and active transport, the new high speed rail stations will establish a network of great places and precincts, providing new opportunities for people to connect, work and visit. Stations designed with Country from the outset will become inviting public spaces – places which people truly enjoy being in and which celebrate culture and community – encouraging activation in their surroundings.

Design principles to underpin great places

Design principles will be used to guide detailed planning and design at each station. These principles, illustrated below, build from the experience of successful linear infrastructure projects which have prioritised place outcomes, such as Sydney Metro, and balance community growth with enhanced neighbourhood amenities and a strong sense of identity.

Figure 6-7 Place making design principles

Designing with Country

Designing with Country is core to the Project's design philosophy. It represents a sustainable and ongoing commitment to integrate First Nations culture into all aspects of the Project, including both the places it creates and the places it effects. Stations and places could celebrate First Nations culture and heritage by referencing significant touchstones such as:

- **Flora:** For example, plants used for tools, medicine or food.
- **Fauna:** Animals that might have been hunted or may be an important part of the surrounding ecosystem.
- **Materials:** Soils, stones, or rocks that may be found in this area, which may have been used as a resource.
- **Colours:** Including those found in Country itself or associated with the local mob.

Taking opportunities to embed Country into the Project's design will ensure the value of both contemporary First Nations culture and heritage are represented in the project corridor and supporting infrastructure.[5]

The station profiles in the following sections set out a preliminary vision for each station and precinct. Each will be enhanced through further engagement with First Nations people to ensure that the specific cultural significance is reflected in the ultimate designs.

Designing with Country to weave the Project securely into its context

The uniquely Australian opportunity to design with Country is another means of amplifying its core benefits. Embracing First Nations perspectives encourages different thinking, adopting new viewpoints, words and phrases which reflect physical experiences of Country.

The Project's lifecycle interweaves First Nations knowledge systems and conventional project management processes, as follows:

- **Project formation**: An immersive process of sensing, establishing Country as the foundation of the Project.
- **Project design and conceptualisation**: The process of imagining, in which listening to and planning with Country is central.
- **Project delivery**: The process of shaping and designing with Country.
- **Project maintenance**: Part of the ongoing continuum of caring for Country.

Figure 6-8 Project lifecycles with a First Nations perspective

Informed by early engagement with First Nations knowledge holders, stakeholders and community elders, the Project integrates Designing for Country principles and customer-centred design. The initial design stage explores the critical elements within the corridor that make up Country – elements that will be further explored in the Detailed Design.

Designing with Country is not a task that will ever be completed. It is an ongoing commitment to renewal and change that requires the usual way of doing things to be challenged at every step of the way, in the knowledge that doing so will secure the best outcomes for all.

6.5.1. HSR Newcastle Station

Newcastle is the second largest city in NSW. It is a vibrant coastal city and regionally significant growth area serving the broader Hunter region. Traditionally a coal export powerhouse, Newcastle has diversified its economy to become a leader in advanced manufacturing, health services and the digital economy, positioning the city as a hub for economic and sustainable development in New South Wales.

Figure 6-9 HSR Newcastle Station 3D drawing

Precinct vision

By 2061, Broadmeadow will lead the way in transit-oriented development in Australia. It will be Greater Newcastle's most connected hub and a centre for productivity, culture and leisure that attracts locals and visitors all year round. Broadmeadow will be known as the gateway to the Hunter, providing easy access to surrounding tourist destinations while inviting higher visitation to the Newcastle city centre and other local attractions.

As a magnet for knowledge and innovation in future-focused industries, Broadmeadow will attract high value jobs and talent. These assets will be complemented by globally competitive sport and entertainment offerings and a diverse mix of local businesses to ensure the area remains a lively destination from morning to night.

Economic development opportunities

Redeveloping the Tudor Street corridor will better connect Newcastle's city centre and Broadmeadow, creating a vibrant commercial hub to support regional growth and attract higher-value jobs. The Broadmeadow precinct can also serve as a gateway to destinations like the Hunter Valley, Barrington Tops and Port Stephens, boosting high speed rail patronage, enhancing tourism and unlocking broader economic opportunities for Newcastle and its surrounds.

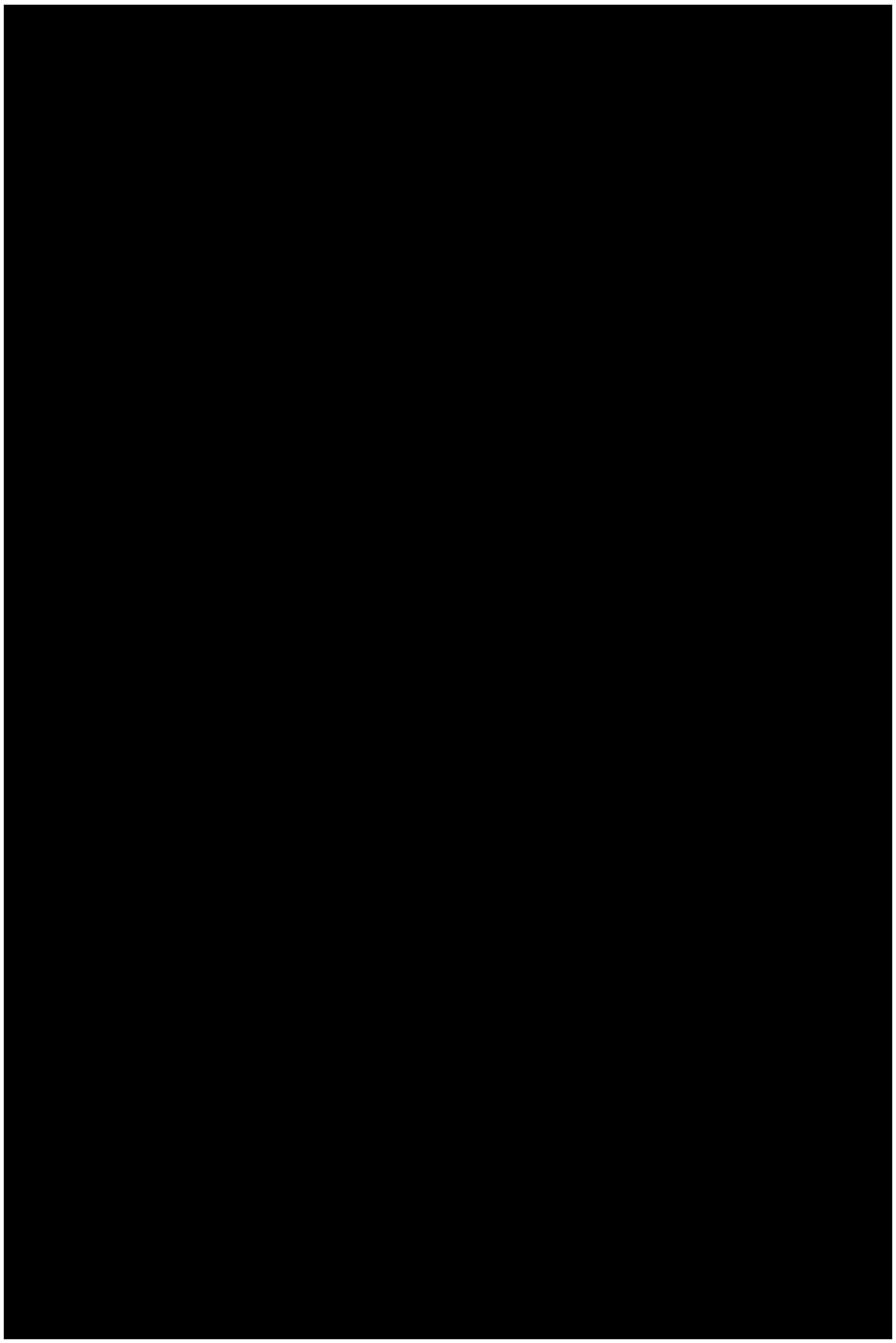
Newcastle is well-positioned to capitalise on high speed rail's transformative potential. With a workforce ready for reskilling, renewable energy investments in the Hunter-Central Coast REZ and the Port of Newcastle's global reach, it can become a hub for advanced manufacturing and net zero innovation. High speed rail will enhance connections to Newcastle Airport, Sydney Airport, and Western Sydney International, creating a cohesive transport network that boosts tourism, research and industry, such as links between Astra Aerolab and Sydney's National Space Industry Hub. These opportunities, including further analysis of demand modelling of a connection to Newcastle Airport, will be undertaken in the transition to delivery.

Land use change (direct area of influence)

High speed rail will accelerate the delivery of the City of Newcastle's 'Broadmeadow Place Strategy' to provide high density, mixed use, commercial and residential uplift around the HSR Newcastle Station located at Broadmeadow.

The Project will unlock a Project Case capacity of 51,000 dwellings and 44,000 jobs within the HSR Newcastle Station precinct, as shown below (approximately 2 kilometre or 20 minute walking catchment).

Figure 6-10 Interventions in HSR Newcastle precinct catchment (upper)/broader catchment (lower)



Transport interchange

HSR Newcastle Station will integrate with Broadmeadow's existing rail station, offering direct transfers to Sydney Trains services and centres like Maitland and Singleton. [redacted]

New on-street bus interchanges on both sides of the station will support bus routes connecting high speed rail to the Newcastle city centre and the broader catchment. New coach bays will accommodate growth in NSW TrainLink coaches and connect communities in the Hunter and Mid North Coast with high speed rail. Space will also be provided for private operators to support tourism and access to Newcastle Cruise Terminal. [redacted]

Opportunities for an integrated, rapid, and convenient public transport link between HSR Broadmeadow and Newcastle Airport will be explored in the next phase. Options such as high frequency bus services or shuttles will be developed in consultation with stakeholders to strengthen Newcastle's role as a regional transport hub and boost tourism and economic growth.

Car parking for high speed rail customers will not be provided at HSR Newcastle Station; however, access will be available from taxi ranks and kiss-and-ride areas, including space on the western side of the station oriented towards Newcastle's urban catchment. The station will also include retail facilities for private car rental businesses with valet services.

The high speed rail station will be integrated with the planned surrounding urban precinct to support improvements in active transport infrastructure, with a strong focus on sustainable travel choices, improved accessibility, safety and wayfinding, and a network of connected open space. Protected bicycle parking will be integrated into the HSR Newcastle Station concourse to encourage cycle access.

Figure 6-11 Transport interchange at HSR Newcastle Station

6.5.2. HSR Lake Macquarie Station

Blending semi-rural living and modern amenities with abundant natural beauty and green space, Lake Macquarie is a top destination for living, working and travelling in the Hunter Region. Morisset is emerging as a key regional hub in the Lake Macquarie area, with an expanding retail and residential development attracting more residents and businesses each year.

Figure 6-12 HSR Lake Macquarie Station

Precinct vision

By 2061, Morisset will be transformed into an exemplar for sustainable living, demonstrating best practice in housing delivery and neighbourhood development. The precinct will leverage its natural beauty and proximity to Lake Macquarie, positioning itself as an attractive lifestyle and leisure destination for residents, workers and visitors.

Morisset will become a key strategic element of the high speed rail economic corridor. The area will embrace its entrepreneurial spirit and drive advancements in precision agriculture, sustainable food production, eco-friendly manufacturing and net zero construction activities.

Economic development opportunities

Delivering HSR Lake Macquarie Station will reinforce and revitalise Morisset as a strategic economic growth centre. Morisset will emerge as an important origin node for the Hunter and Central Coast regions, enhancing accessibility and providing faster connections to employment opportunities in the surrounding area.

HSR Lake Macquarie Station will present new opportunities for lifestyle and leisure around Morisset, strengthening the local cultural and visitor economies by attracting residents and visitors. High speed rail will provide rapid, convenient connections from the Lake Macquarie region to Newcastle Airport, Sydney and Western Sydney International, creating a cohesive transport network that boosts tourism.

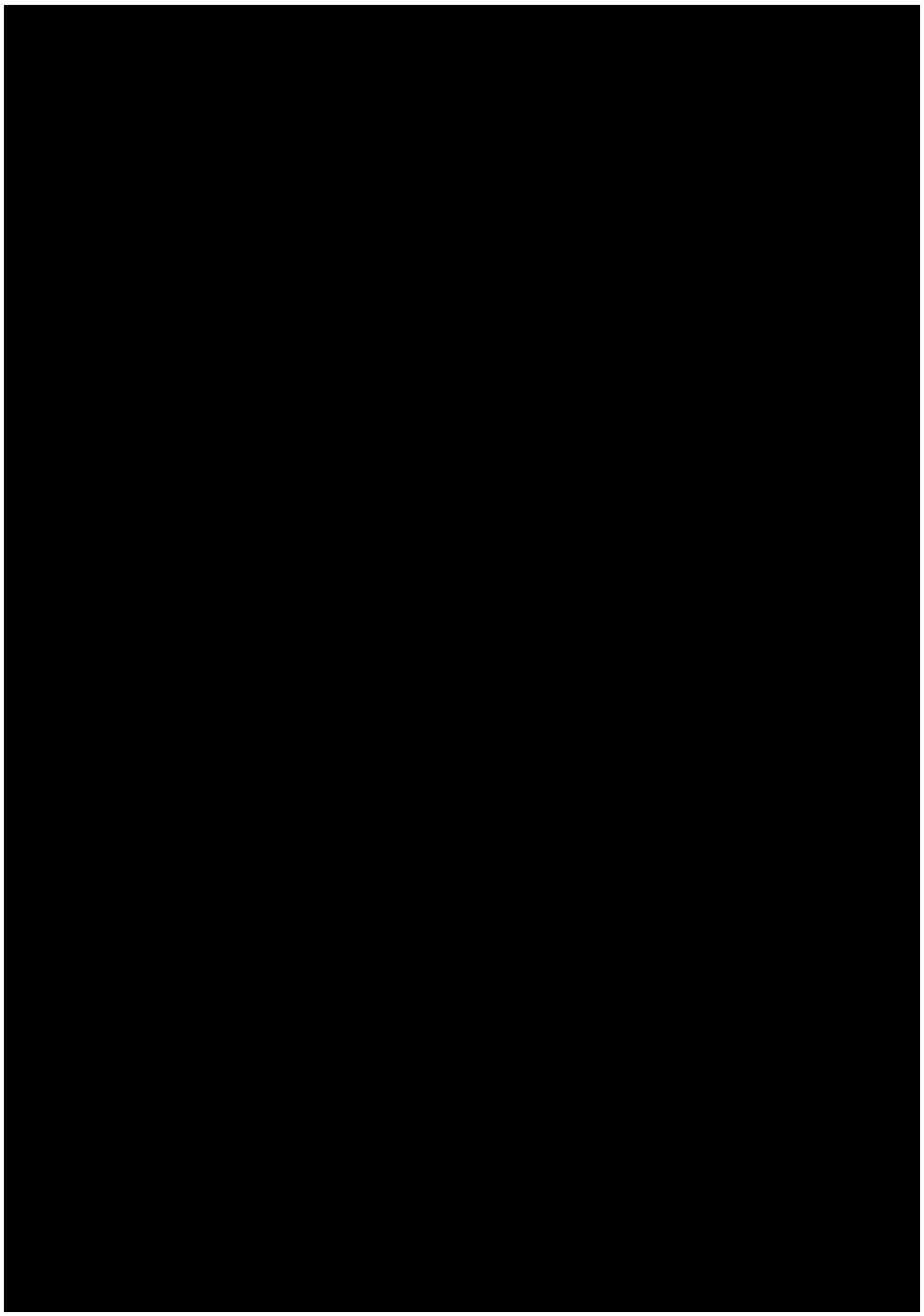
Strategically located in the Hunter Renewable Energy Zone and close to existing major transport infrastructure including existing heavy rail and the M1 Pacific Motorway, the station is well-positioned to attract new ventures in clean energy, green construction, intensive agriculture, urban food production and food technology.

Land use change (direct area of influence)

Significantly enhancing connectivity to Greater Sydney and the Hunter will enable medium density mixed use developments to be planned around the station, with additional new medium and low density housing in the area of influence. There is also potential for a new suburb to be established west of the M1 Pacific Motorway at Mandalong.

A Project Case capacity of 80,000 dwellings and 7,800 jobs will be unlocked across the HSR Lake Macquarie Station precinct catchment (approximately 2 kilometre or 20 minute walking catchment), as shown in the figure below. A Project Case capacity of 11,000 dwellings and 14,000 jobs will be unlocked across the broader catchment.

Figure 6-13 Interventions in HSR Lake Macquarie precinct catchment (upper)/broader catchment (lower)



Transport interchange

HSR Lake Macquarie Station will be located approximately one kilometre from the M1 Pacific Motorway interchange at Morisset. As an intermediate station between Broadmeadow and Gosford, HSR Lake Macquarie Station will prioritise access from the wider driving catchment across the Central Coast and the Hunter Valley by providing space for parking and pick-up and drop-off modes. Public and active transport alternatives will be provided to support growth in nearby Morisset town centre, Bonnells Bay, Balcolyn and Brightwaters.

A commercial car park will provide the potential for over 1,000 spaces to encourage this station as the preferred access point to the high speed rail network for park-and-ride. Kiss-and-ride will be incorporated into the ground floor of the car park with marked spaces to allow for longer dwell times for picking up passengers. Parking will be supported by new signalised intersections and localised road upgrades to accommodate higher access demand. A taxi rank will be provided separately to the car park for convenient access to the station.

On-street bus bays will be provided to support local bus connections to the existing Morisset Station and township, greenfield developments and surrounding areas. High quality walking and cycling infrastructure will support place making opportunities and connect to key routes toward the Cedar Mills event precinct, Avondale University, Morisset township and Wyee.

Figure 6-14 Transport interchange at HSR Lake Macquarie Station

6.5.3. HSR Central Coast Station

The Central Coast is a coastal region renowned for its popular beaches and nature reserves. Gosford, the region's central business area, has undergone significant transformation in recent years to emerge as the social and economic core of the Central Coast with a growing focus on healthcare and education.

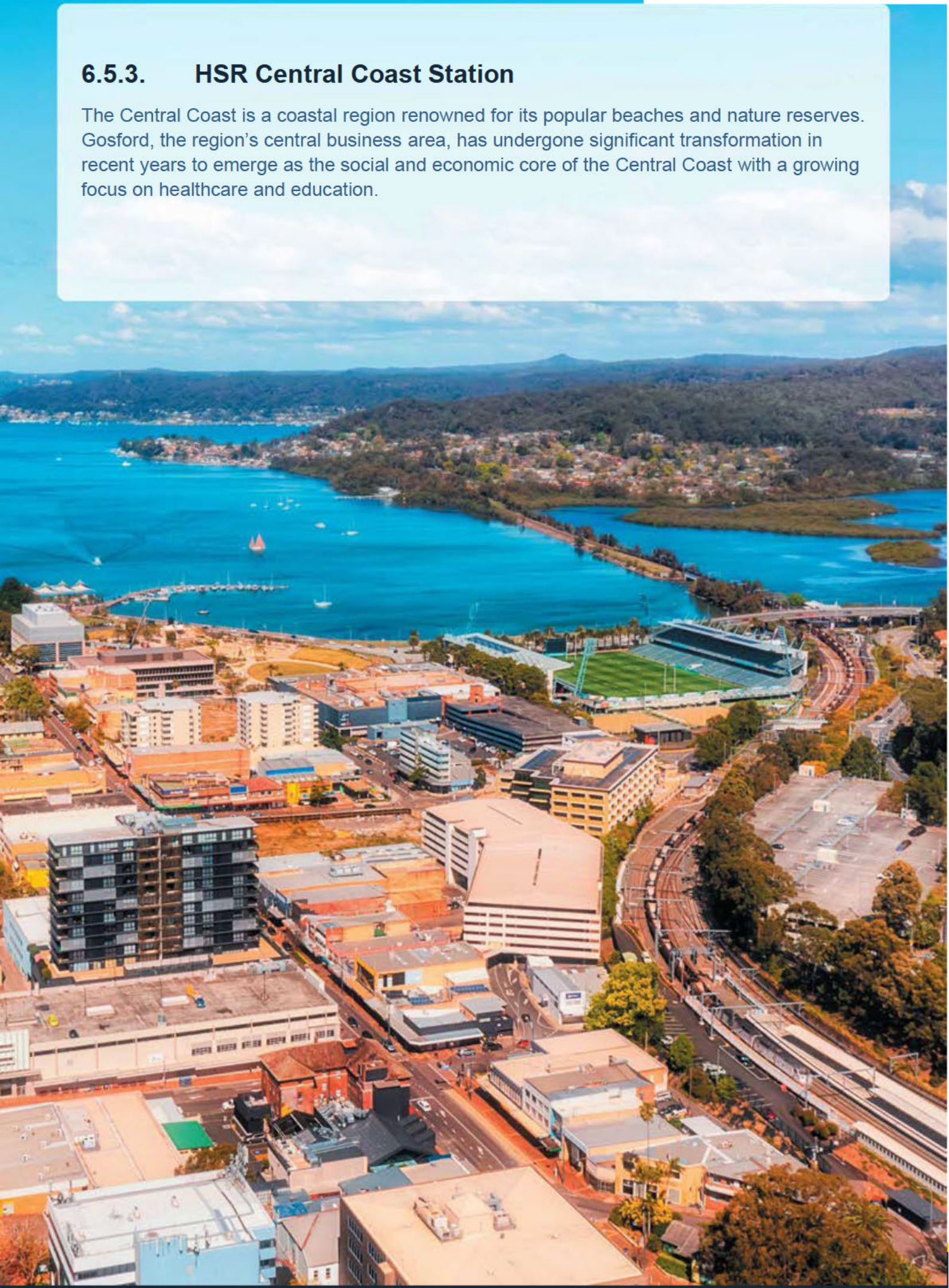


Figure 6-15 HSR Central Coast Station 3D drawing

Precinct vision

By 2061, the Central Coast will be a modern lifestyle region at the forefront of innovation in health, education and food manufacturing. It will be renowned as a destination for entrepreneurship and creativity that supports start-ups and small businesses, anchored by HSR Central Coast Station at Gosford.

With excellent transport connections to the north and south of the city, Gosford will be transformed into a vibrant civic centre for the Central Coast. New residents, businesses and visitors will be drawn to Gosford for its diverse mix of urban and natural landscapes, including an activated waterfront redevelopment. The city's growth will be sustainable and thoughtful, enhancing its natural beauty and local character. Gosford will become the gateway to the Central Coast, both as a tourism destination and as a node for the region’s surrounding areas.

Economic development opportunities

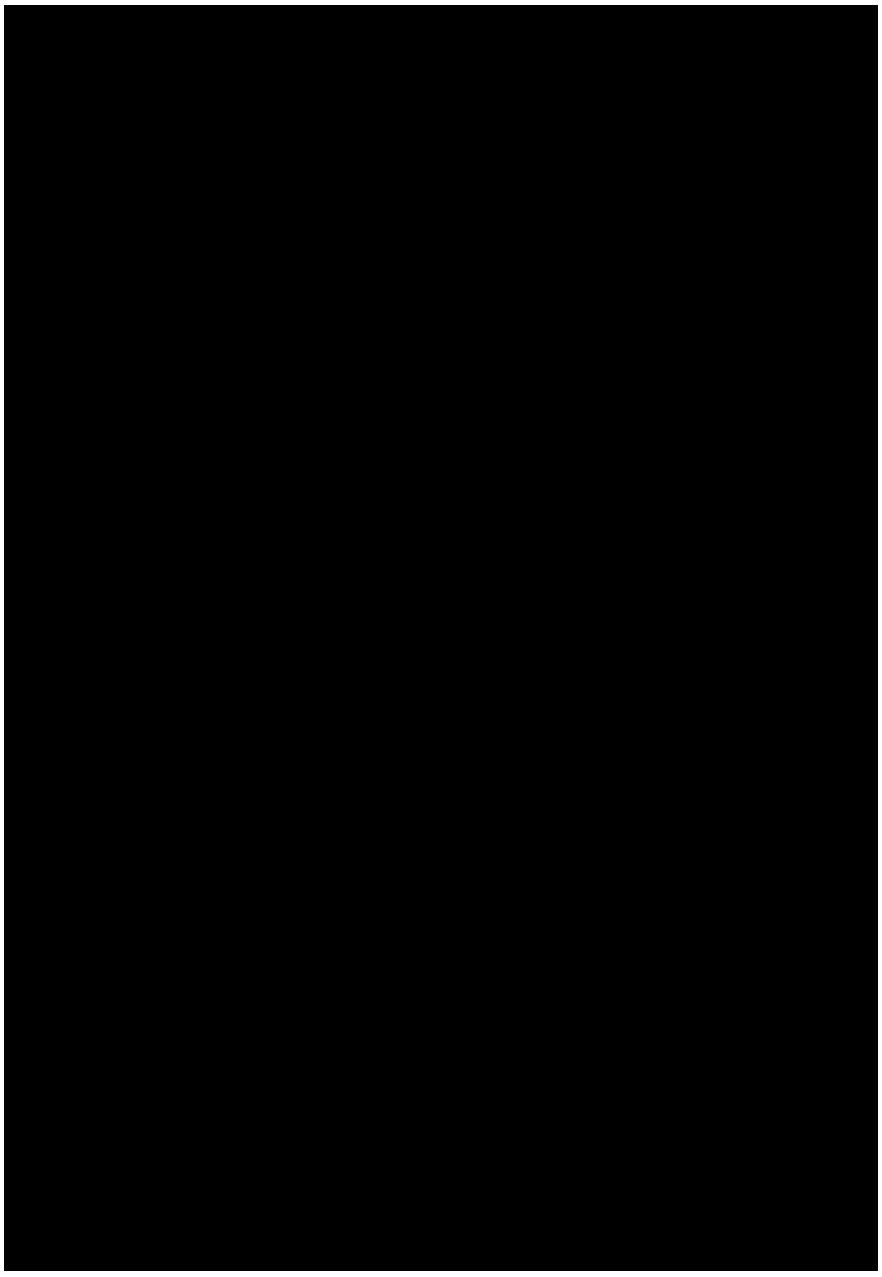
A high speed rail station in Gosford will significantly enhance accessibility to major economic centres along the east coast. Improved connectivity with Greater Sydney and Newcastle will attract workers and businesses, enabling Gosford to leverage its strengths in health and education and reclaim its role as the Central Coast’s civic heart. High speed rail will position Gosford as a convenient destination for visitors, bolstering regional tourism and providing rapid links to Newcastle Airport and Western Sydney International.

Land use change (direct area of influence)

HSR Central Coast Station will support and accelerate the ongoing revitalisation of Gosford city centre, encouraging population growth and housing delivery. The Project Case identifies a minor increase of 8,400 dwellings within the HSR Central Coast Station precinct catchment. No employment increases are anticipated. A Project Case capacity of 12,000 dwellings and 14,000 jobs will be unlocked within the broader catchment.

The proposed land use change assumes accelerated take-up of the existing planning capacity in the Base Case for 2061, with modest areas of residential uplift identified in strategic locations with the highest renewal potential. East Gosford is proposed to accommodate medium density mixed use development along the Central Coast Highway, with surrounding medium density residential developments and a transition to higher densities towards the Gosford waterfront. Medium density uplift of existing residential areas in North Gosford is proposed in a corridor along Henry Parry Drive and Dwyer Street, with additional pockets of medium to high density residential uplift proposed to the west of the existing Gosford Station along the perimeter of Waterview Park.

Figure 6-16 Interventions in the HSR Central Coast precinct catchment (upper)/broader catchment (lower)



Transport interchange

HSR Central Coast Station will be integrated with the existing heavy rail station at Gosford to support the ongoing redevelopment of Gosford by improving links between the two stations and the city centre. A shared station concourse will connect the existing station with new high speed rail platforms to provide an improved unpaid connection across the existing rail line.

Improved active transport connections to and from the station and surrounding precinct will support pedestrian friendly, people-centric streets that encourage sustainable travel, reduce reliance on private vehicles and help improve the liveability of the town centre.

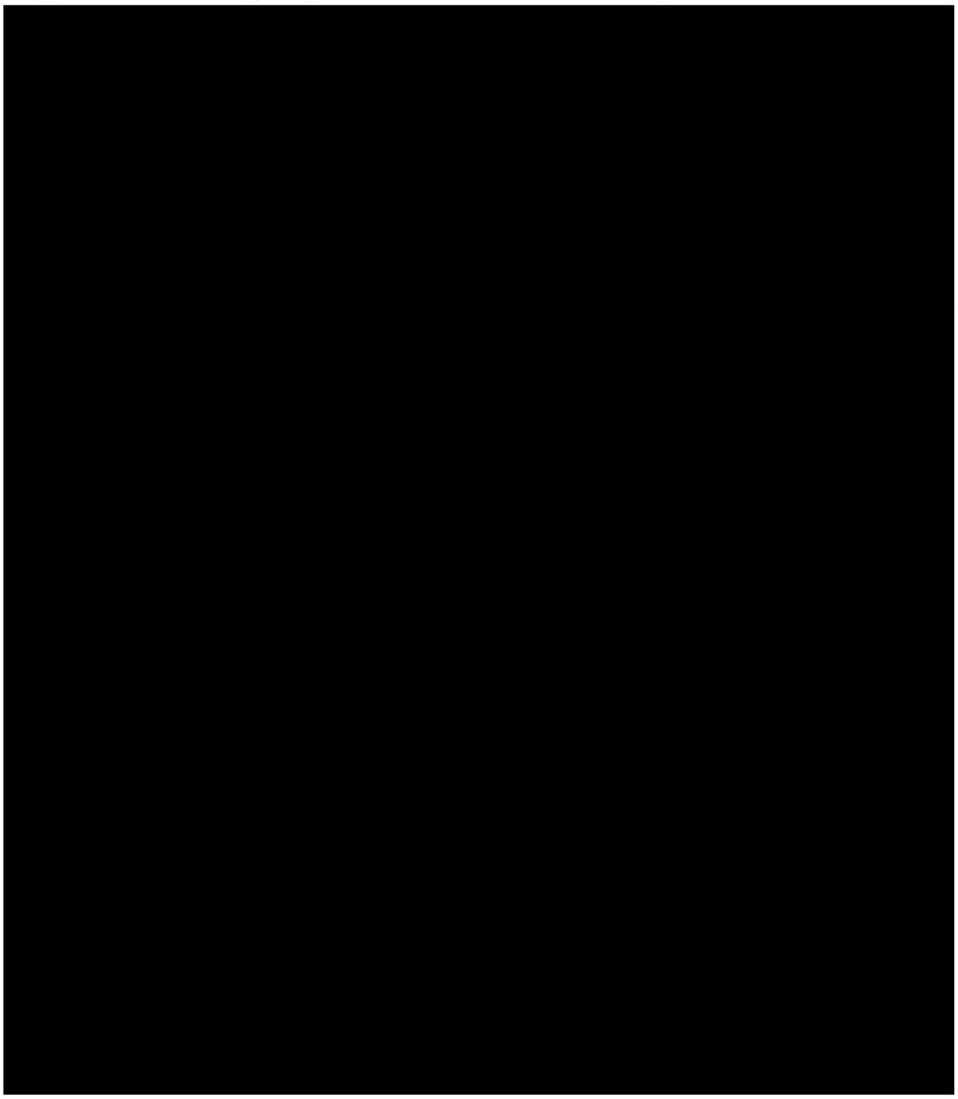
[redacted]

Figure 6-17 Transport interchange at HSR Central Coast Station

6.5.4. HSR Sydney Central Station

Sydney's Central Station precinct is a major transportation and commercial hub in the heart of Sydney. The area is centred around the iconic Central Station, which connects the city's various train lines, bus services and light rail networks. Beyond the station, the precinct includes numerous retail and dining outlets, commercial offices and mixed use urban spaces. The precinct is increasingly becoming a hub for innovation and technology, driven by its proximity to key educational institutions, businesses and tech startups.

Figure 6-18 HSR Sydney Central Station 3D drawing



Precinct vision

By 2061, Sydney's Central Station precinct (which includes Central Station and HSR Sydney Central Station) will be a globally recognised destination that blends different uses and experiences, with small businesses, cafes, studios and creative spaces that promote a lively 24/7 atmosphere. Superior accessibility will drive urban transformation across the city, connecting the creative energy of Surry Hills, the knowledge intensive activities of Ultimo and the entrepreneurial spirit of Haymarket. The area will be transformed into a thriving innovation community where students and start-ups share space with some of the world's leading digital tech companies.

Economic development opportunities

The Sydney Central Station area, home to innovation precincts like Tech Central, St Vincent's Hospital (including the Garvan Institute), the University of Sydney, and the University of Technology, will gain significantly from high speed rail. It will unlock greater access, support knowledge-sharing, and broaden the worker and customer base.

Direct connections from HSR Sydney Central to Western Sydney International, as well as Newcastle Airport and Sydney Airport, through seamless transfers will bolster Sydney's role in the visitor economy, leveraging the CBD's potential as a gateway for regional and international tourism. Demand modelling to HSR Sydney Central will account for travellers to Sydney Airport, with detailed analysis of the Newcastle Airport catchment to be undertaken in the next phases.

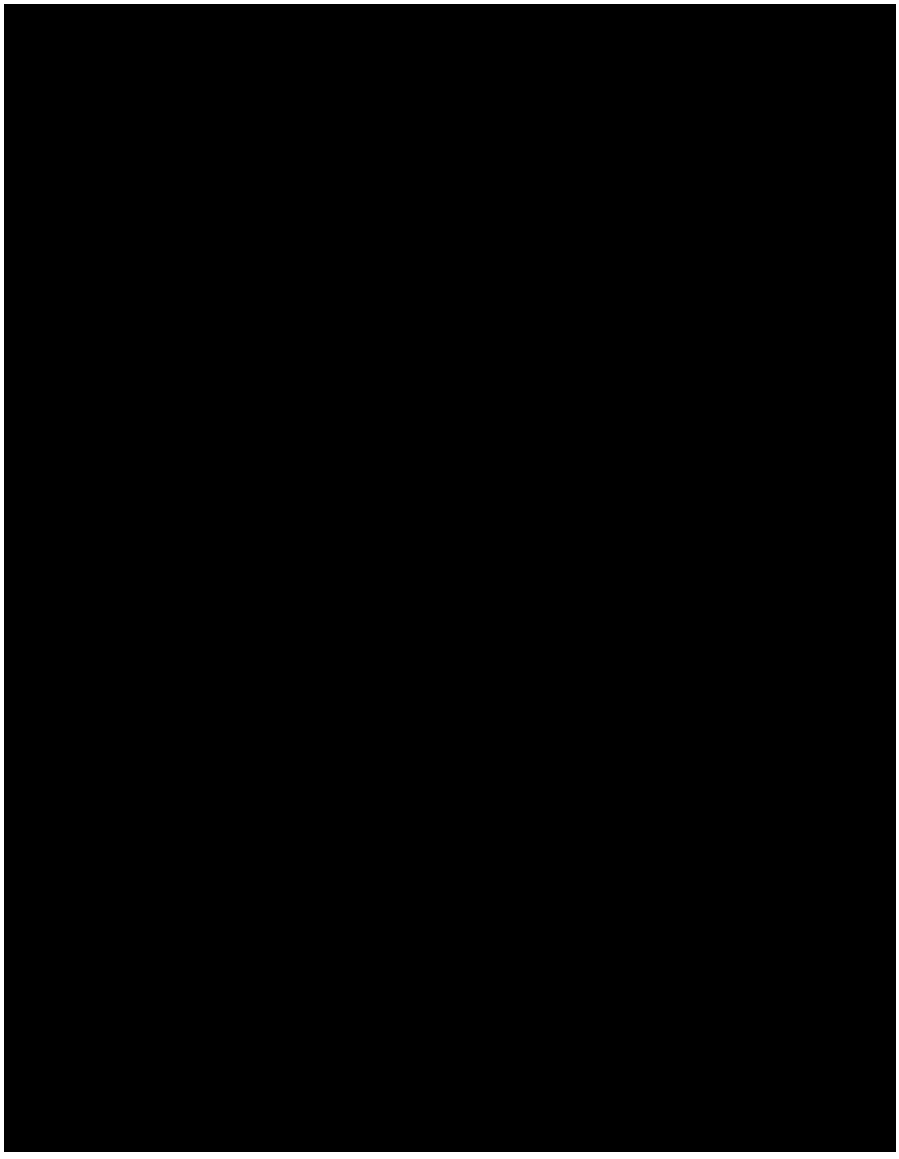
Land use change (direct area of influence)

With an existing base capacity of 660,000 dwellings and 1,541,000 jobs, development opportunities within the immediate precinct are limited by substantial portions of constrained land, largely impacted by heritage-listed sites, lot fragmentation, existing infrastructure, limited open spaces, airspace height limits and overshadowing planning controls. As such, HSR Sydney Central Station is anticipated to support and accelerate the realisation of the existing planned precincts and target densities, rather than unlock additional capacity.

By improving connectivity into the area and leveraging high accessibility with the existing public transport network, the station is expected to promote residential and employment take-up in line with existing strategic initiatives, including Bays West, Pyrmont Peninsula Place Strategy and Green Square.

Seamless connection with Sydney Airport and the wider public transport network will connect the area to Sydney's tourism destinations including Sydney Harbour, beaches and the Blue Mountains. Light rail services will also link to Sydney Football Stadium and Sydney Cricket Ground in Moore Park, supporting access to major sporting events and concerts. Rapid bus services will support improved accessibility to healthcare, education and jobs by providing access to the University of Sydney, University of Technology Sydney and the Royal Prince Alfred Hospital.

Figure 6-19 Interventions in HSR Sydney Central precinct catchment (upper) / broader catchment (lower)



Transport interchange

Sydney Central Station is Australia's largest railway station, with superior accessibility already provided by the existing Greater Sydney public transport network. HSR Sydney Central Station will leverage these connections by extending Central Walk to integrate the new high speed rail concourse with the existing station, providing direct connectivity to the suburban platforms, Sydney Metro and light rail. The existing intercity platforms and coach terminal will also be accessible from within Central Station, while a future western extension from Central Walk will provide a direct connection to Haymarket.

[redacted] These features will be on-street rather than in dedicated facilities to support the vision for the station as a bustling global village that supports continuous street life.

While no commercial parking will be provided at HSR Sydney Central Station, there is an opportunity for car rental services to operate via valet service or be integrated with the over-station development to support tourism and leisure travel.

Figure 6-20 Transport interchange at HSR Sydney Central Station

[redacted]

6.5.5. HSR Parramatta Station

Parramatta is a major business and commercial district and a centre for finance, healthcare, innovation and technology in the geographic heart of Greater Sydney. As one of Australia's oldest settlements, the city is renowned for its rich history and vibrant cultural scene, boasting art galleries, festivals and cultural events that attract millions of visitors annually. Balancing its cultural and historical assets with investment in growth and innovation, the city is emerging as a major economic hub in greater Sydney.

Precinct vision

By 2061, Parramatta will be a recognised destination for global business and talent, supported by a thriving innovation ecosystem and competitive knowledge-intensive industries in the surrounding areas of Westmead and Parramatta North.

The city will attract visitors with its well preserved heritage sites and unique character reflecting its cultural richness and diversity. Parramatta will be a place where creativity and culture are woven into daily life, with an art scene, shopping, food offerings, festivals and cultural celebrations that enhance its appeal as a 24-hour destination.

Economic development opportunities

HSR Parramatta Station and its surrounds are home to major innovation precincts and key institutions including Westmead Health Precinct, Western Sydney University, the Western Sydney Start-Up Hub, Parramatta Stadium and the future Powerhouse Parramatta. High speed rail will support agglomeration between precincts and institutions to enable stronger collaboration, and provide access to a deeper pool of workers, customers and suppliers.

Direct connections to Western Sydney International and seamless links to Newcastle and Sydney Airports will amplify economic and tourism opportunities, positioning Parramatta as a pivotal gateway for regional and international visitors and a driver of Western Sydney's economic growth.

Land use change (direct area of influence)

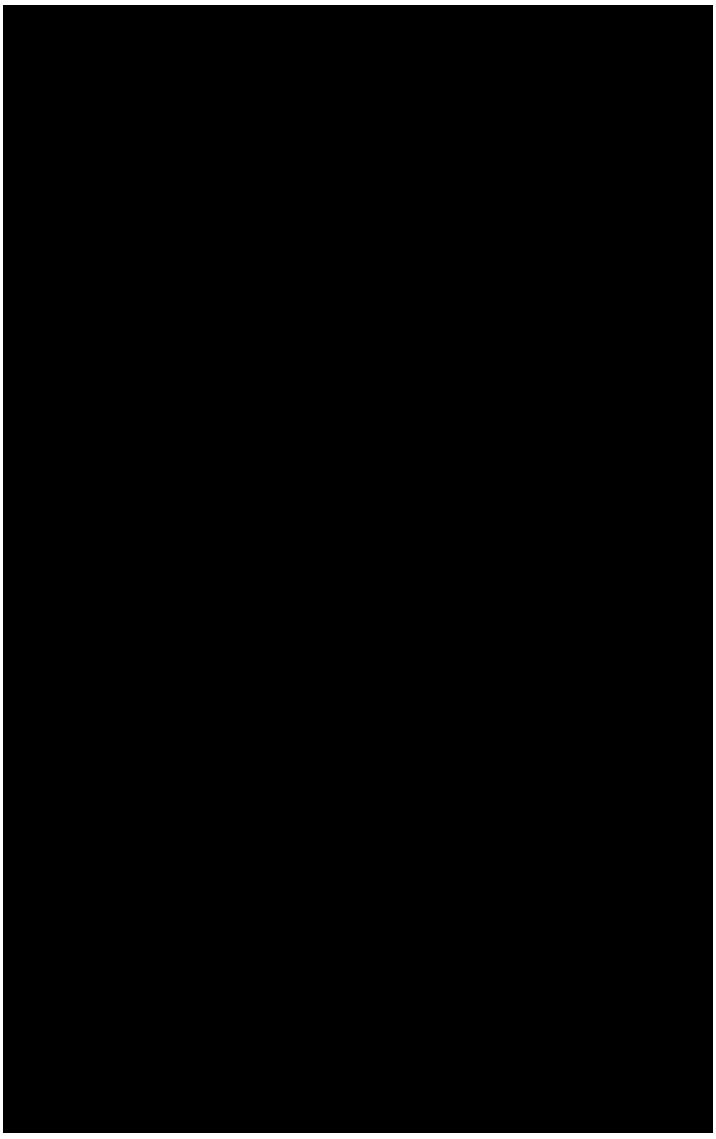
With an existing base capacity of 476,000 dwellings and 633,000 jobs, substantial portions of constrained land, largely impacted by heritage-listed sites, existing infrastructure and flooding associated with Parramatta River limits development opportunities within the immediate vicinity of HSR Parramatta Station. Given these constraints, HSR Parramatta Station is anticipated to support and accelerate the realisation of the existing planned precincts and target densities, rather than unlocking additional capacity.

A high speed rail station in Parramatta is expected to promote residential and employment take-up by improving accessibility to areas identified within the Westmead Health Precinct, Camellia Place Strategy, Parramatta East and West Growth Precinct, and Parramatta Road Urban Renewal Transformation Strategy.

Parramatta Light Rail will serve as a spine for education, health and events by connecting high speed rail to the Westmead Health and Innovation District, Western Sydney University campuses (Parramatta CBD, Westmead and Rydalmere), Parramatta Stadium and Sydney Olympic Park.

Rapid bus connections from the precinct to major centres including Liverpool, Macquarie Park, Sydney Olympic Park and Bankstown will support collaboration and knowledge sharing, particularly between health and education innovation districts. Buses will also provide a critical connection to across Western Sydney, deepening the pool of workers and providing new job opportunities to residents located outside the precinct.

Figure 6-22 Interventions in HSR Parramatta precinct catchment (upper) / broader catchment (lower)



Transport interchange

HSR Parramatta Station will leverage Parramatta's existing and planned future public transport network to enhance connectivity across the wider Western Sydney area. [redacted]

[redacted]

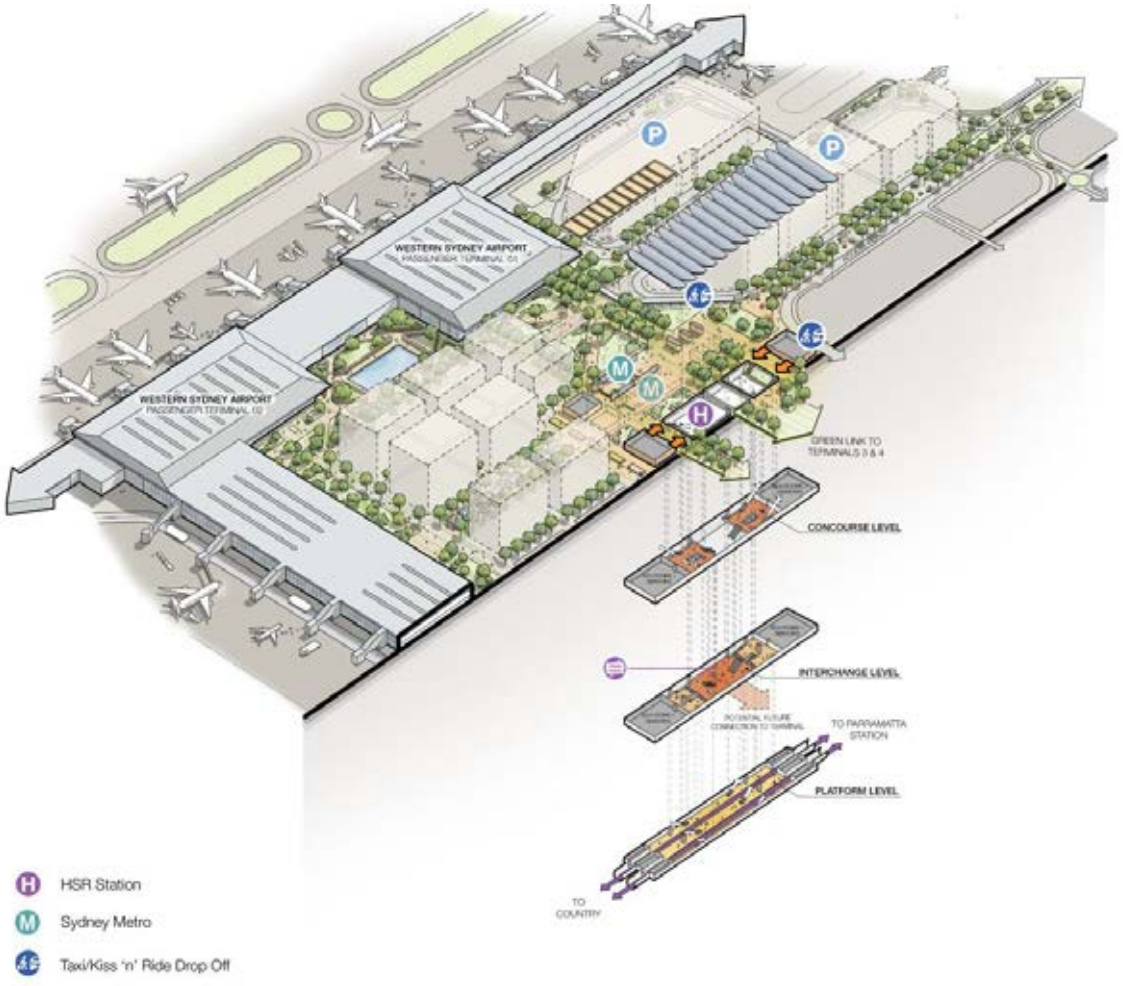
[redacted]. No commercial parking will be provided at Parramatta; however, there is an opportunity for car rental services to be integrated with over-station development.

[redacted]

6.5.6. HSR Western Sydney International Station

The Aerotropolis is a rapidly developing region in Greater Sydney currently undergoing significant transformation due to several major planned infrastructure and urban development projects, including the Western Sydney International (Nancy-Bird Walton) Airport and the emerging city of Bradfield. The airport currently under development in Badgerys Creek, approximately 45 kilometres west of Sydney's CBD, is set to open in 2026. Together with Bradfield, a hub for advanced manufacturing and future-focused industries, Western Sydney International will drive economic growth, create jobs and ease airport congestion, becoming one of Australia's largest global gateways.

Figure 6-24 HSR Western Sydney International Station 3D drawing



Precinct vision

By 2061, HSR Western Sydney International Station will build on the precinct and place outcomes delivered by the new airport and Sydney Metro investments, and be a further catalyst for the growth and transformation of a new, world-class city – one that prioritises future-focused industries and global connectivity while continuing to nurture and encourage local productivity and innovation.

It will bring together local talent and world-class research, leveraging stronger accessibility to the regions and overseas to enhance knowledge sharing and innovation. A commitment to fostering culture and creativity, and protecting and enhancing its surrounding parkland environment, will provide 24/7 vibrancy and activation. The precinct will be a place where international visitors choose to stay and explore, while providing opportunities to explore different regions along the corridor and beyond.

Economic development opportunities

Western Sydney International will be directly serviced by high speed rail, and indirectly connected to Sydney Airport and Newcastle Airport, creating an air travel network that can support 24-hour, daily air travel flows. An integrated air travel network will unlock significant tourism opportunities across the corridor and beyond, enabling visitors to explore regions outside of Greater Sydney and encouraging longer stays.

Defence and aerospace industries in Bradfield (the Aerotropolis) will benefit from the increased accessibility to complementary research institutions, such the National Space Industry Hub in Sydney's east and Astra Aerolab in Greater Newcastle.

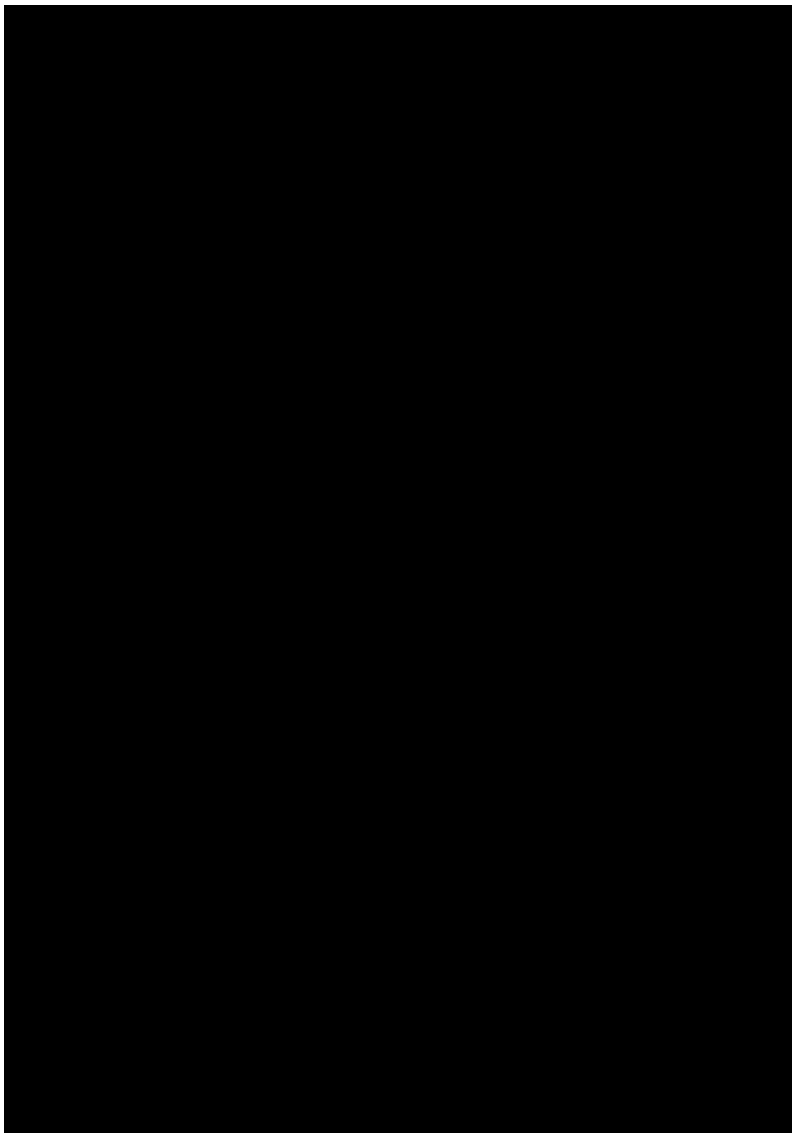
Land use change (direct area of influence)

Following recent extensive strategic planning, no additional land use capacity has been proposed within the precinct catchment. Instead, the addition of HSR Western Sydney International Station is anticipated to accelerate the realisation of existing plans, strategic visions and target densities proposed under the Western Sydney Aerotropolis Precinct Plan and Western Sydney International (Nancy-Bird Walton) Airport – Airport Plan.

By improving access to the airport and associated transport interchange, and enhancing regional connectivity to innovative employment precincts, the high speed rail station is expected to expedite employment and residential take-up across Bradfield, Northern Gateway Precinct, Badgerys Creek Precinct, Leppington, Mamre Road and north towards Science Park.

The addition of HSR Western Sydney International Station will provide an opportunity to accelerate take-up of an existing Base Case capacity of 75,000 dwellings and 163,000 jobs. [redacted] Future land uses were also explored along the Northern Road, including a variety of residential densities along with a small mixed-use core. This identified an additional 4,500 dwellings bringing the Project Case capacity to 79,000 dwellings.

Figure 6-25 Interventions within HSR Western Sydney International Station precinct catchment (upper) / broader catchment (lower)

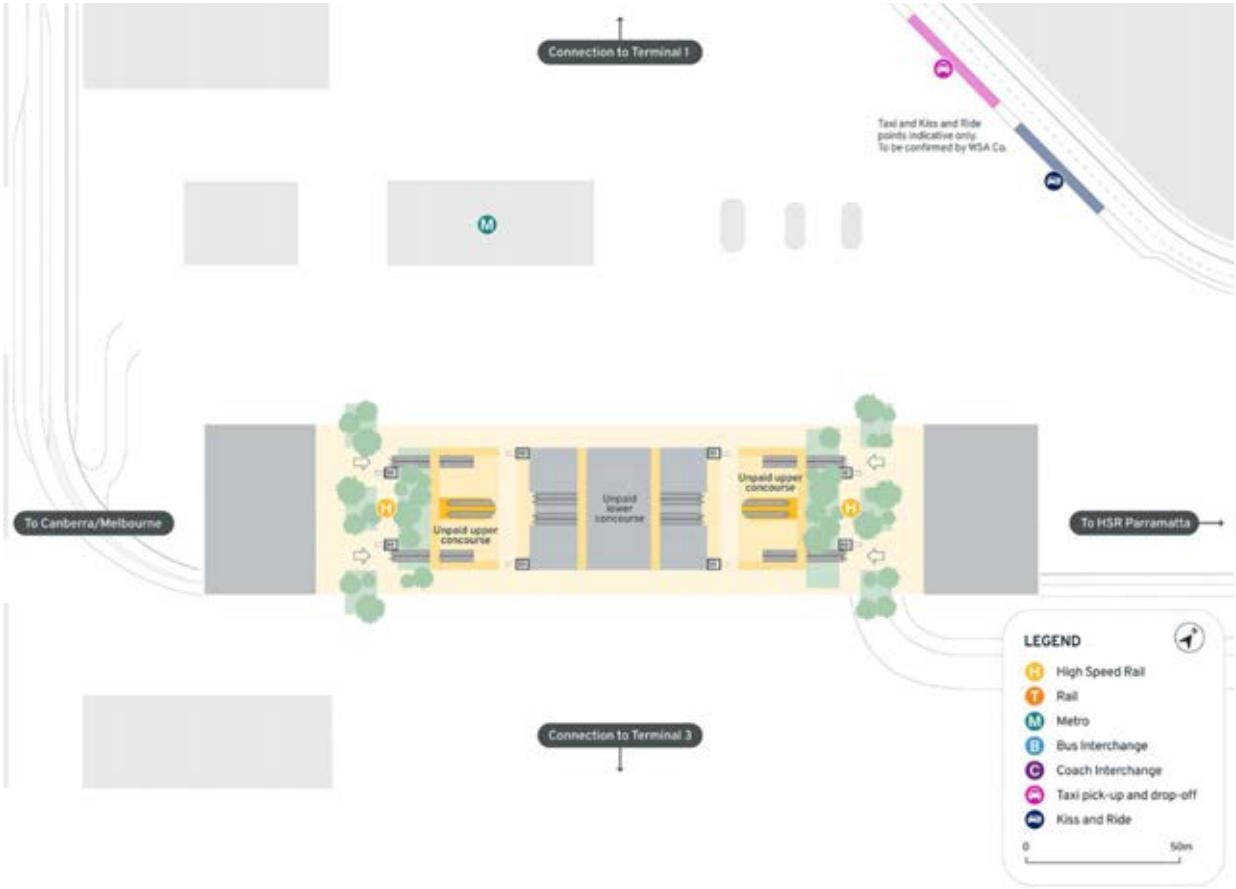


Transport interchange

HSR Western Sydney International Station will leverage its co-location with the airport to consolidate its position as a national and international gateway to Western Sydney. The high speed rail station will be located adjacent to the Sydney Metro – Western Sydney Airport station, close to the airport terminal. The direct interchange will include provision for buses, coaches, cycle connections and storage. Parking facilities will ensure the station serves a wide catchment, including the centres of Penrith, Liverpool and Campbelltown.

This Business Case assumes the requirements of the high speed rail station will be accommodated within the airport interchange. However, the sheer scale of the airport will present a challenge for transport integration. For instance, residents of south-west Sydney will likely rely on this interchange to connect with the high speed rail corridor, while others may use it to reach Western Sydney International itself. These complexities will require close cooperation between the Authority, Western Sydney Airport Corporation and Transport for NSW to progress station, interchange and precinct planning for HSR Western Sydney International Station and to achieve a seamless and connected interchange.

Figure 6-26 Transport interchange at HSR Western Sydney International Station



[redacted]

[1] SGS-Economics-and-Planning_SGS-Cities-and-Regions-Wellbeing-Index_2024_Website.pdf

[2] An open city approach was undertaken for the land use modelling, allowing redistribution to be considered from within the entire east coast corridor.

[3] The additional land and housing supply enabled by the Project that drives a household size reduction, because people can access new homes more affordably where the Project delivers capacity. A decrease in household size of 2.8% has been assumed in the land use modelling, see Chapter 7 for further detail.

[4] The benefit of more people being able to afford their own homes and improved rental affordability is included in the CBA; however, the Impact of net additional dwellings is not included in demand modelling.

[5] Government Architect NSW (2023), Better Placed: Connecting with Country.

Chapter 7

Economic potential

Australian Government
High Speed Rail Authority

High speed rail underpinning a new 'Multi-city Region'

- The Project will generate economic benefits of $50.8 billion to $59.7 billion present value (PV) (2024-25$), with a benefit-cost ratio (BCR) of 0.8 to 1.0 and net present value (NPV, 2024-25$) of - $10.5 billion to $2.6 billion PV (2024-25$) over 50 years of operations. These benefits are generated in the following main ways.
- The Project will deliver a step change in connectivity and capacity between the Hunter, Newcastle, the Central Coast and Sydney, relieving pressure on road and public transport corridors delivering $12.5 billion to $12.7 billion PV (2024-25$) in benefits.
- The Project will integrate the Sydney, Central Coast and Newcastle economies. It will enable sustainable and inclusive multi-generational growth that will generate $16.4 billion PV (2024-25$) of productivity benefits, including an increase of 99,000 jobs in the project corridor and bringing an extra 134,000 people within an hour of key economic centres by public transport in the corridor.
- The Project will unlock an ongoing pipeline of diverse and affordable housing across the project corridor, helping to address the housing crisis over time. By enabling governments to boost housing supply and choice, it supports the delivery of 52,000 to 104,000 new homes and generates $21.8 billion to $30.9 billion PV (2024-25$) in benefits through increased affordability and accessibility.
- High speed rail will accelerate Australia's progress towards net zero commitments with environmental, sustainability and net zero benefits. The scale of the Project means it has a unique ability to act as the catalyst for the rapid development, scaling and deployment of green steel and green concrete technologies, to deliver a widespread net zero benefit across all economic sectors. As the first step towards the Network, which will provide a sustainable, high capacity alternative for intercity travel, this Project will lay the foundation for a significant reduction in emissions from aviation.
- There is potential for the Project's significant housing and community benefits to be amplified through complementary initiatives identified in the Economic Development Strategy (outlined in Chapter 6).
- Further opportunities are being explored to enhance the benefits of the Project, including optimising capital costs and delivery schedule, refining demand modelling to better capture the full extent of transformational user benefits of high speed rail and demand uplift from new housing, and further researching the role of high speed rail in attracting higher value jobs and new industries.

7.1. A 'Multi-city region'

This Project will deliver important economic benefits that span transport, industry and the environment, and lay the foundation for the Network. The Project will enable an increase in access to housing in the project corridor, which is fundamental to its economic impact. The Project will support the creation of a new 'Multi-city Region' in the project corridor, which allows the currently independent centres to function as a combined economic entity.

The NSW Intergenerational Report forecasts there will be 3.3 million more people in NSW by 2061, taking the population to 11.5 million people. This will require 1.7 million new homes, representing a 50 per cent increase to the existing housing stock. NSW will need to build 42,000 homes every year to keep up with population growth and demand for smaller household sizes.

Housing is a significant, complex issue. Sydney's housing supply is constrained by a number of factors, and also lacks diversity – in particular there is a chronic shortage of medium-density housing.

Through its dramatic improvement in connectivity, the Project will unlock new precincts and economic growth around its stations, integrating the housing markets of Sydney, the Central Coast and Newcastle into one large market, giving people more choice in where they live, study and work. With effective, integrated planning, the Project will unlock additional housing capacity and diversity around key station catchments in Newcastle, Lake Macquarie and the Central Coast, and accelerate take up of housing in the broader Sydney station catchments.

A tangible benefit is that more people will be able to own their own home, access a more affordable owner-occupier and rental market, and enjoy flow-on benefits for overall social wellbeing. The economic impact of high speed rail can be conceptualised through a three-step process:

- First, a step change in connectivity between the Hunter, Newcastle, the Central Coast and Greater Sydney, including to Western Sydney International and the emerging city of Bradfield, reducing journey times and improving the performance of the transport network for commuters, business travellers and visitors.
- This will unlock economic opportunities in the catchments that surround high speed rail stations, including supporting the growth of new industries through improved connectivity for labour and capital.
- Finally, unique to high speed rail, will be a transformational change in access to well located, diverse and affordable housing in the corridor by creating a 'Multi-city Region' through a step change in connectivity to areas with significant land capacity. This will enable more people from across the project corridor and Greater Sydney to access more affordable housing in the project corridor.

7.1.1. An appraisal framework for high speed rail

Consistent with the scale of investment and the transformational nature of high speed rail, the benefits of the Project will extend well beyond conventional transport benefits as illustrated in the figure below.

Figure 7-1 Economic appraisal framework

The economic appraisal assesses the Project on an incremental basis against the Base Case. In accordance with Infrastructure Australia Guidelines, the Project only assumes the scope costed in this Business Case, which is the Newcastle to Sydney High Speed Rail Project. No future stages of the Network are assumed within the Project for the purpose of the economic appraisal.

The complementary initiatives identified in the EDS would amplify the benefits of high speed rail through improved connectivity and

accessibility, enabling housing and jobs, and facilitated through effective cross-government coordination and delivery. These complementary investments have not been included in the cost estimate or benefits of the Cost-Benefit Analysis, except for direct industry benefits from high speed rail commercial development, direct tourism benefits from high speed rail accessibility and direct benefits from more diverse and more affordable and social housing.

The outcomes of the economic appraisal, reported in the remainder of this section, follow the structure of this framework. Results are rounded to the nearest hundred million dollars PV unless otherwise specified. This reflects the scale of impact and the strategic level of analysis that should be applied when interpreting results.

7.2. Transformative high speed rail product and better connectivity

High speed rail will transform connectivity between Sydney, the Central Coast, Newcastle and the Hunter region, relieving pressure on road and public transport corridors and deferring or removing the need for other long-term investments, such as widening the M1 Pacific Motorway, equating to $12.5 to $12.7 billion PV (2024-25$) in benefits.

High speed rail will provide a world-class regional and long distance transport service that will be frequent, reliable and comfortable, delivering transformational improvements in journey times for an estimated 22.7 million trips per annum in 2061.

The Project will deliver significant benefits to high speed rail users, with improvements in journey times including a step change in connectivity with Western Sydney International, via the new metro line, the emerging city centre at Bradfield. By 2061, it is projected to attract 7.9 million annual trips to and from the airport and Bradfield. Overall, the Project will deliver high speed rail user benefits of between $7.5 billion and $7.7 billion PV (2024-25$).

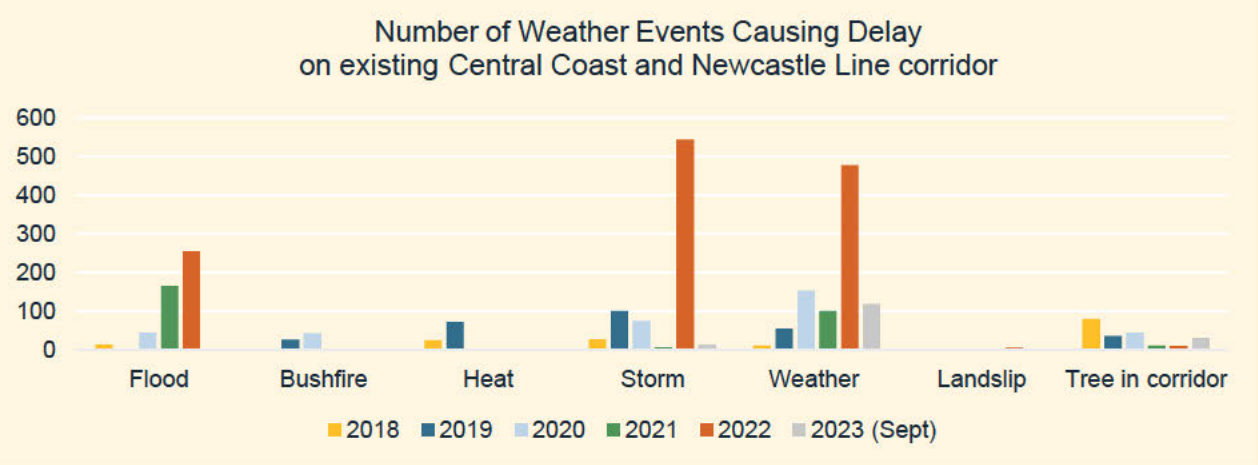
Other important high speed rail product benefits include high levels of reliability and improvements in journey experience through premium amenities, delivering $1.4 billion PV (2024-25$) of benefits, including:

- Operating on a dedicated line separate from freight services and suburban commuter trains will enable high speed rail to operate with greater than 99 per cent on time running – improving on the 73 per cent average on time running on the current Central Coast and Newcastle Line, delivering $100 million PV (2024-25$) in benefits.
- Improvements in journey experience through premium amenities, superior to existing train services. High speed rail will introduce a new travel experience with - i, food and drink services, and more comfortable seating, providing greater comfort and enabling productive use of time, particularly for commuters and business passengers. This will deliver $700 million PV (2024-25$) in benefits.

The importance of boosting resilience on the project corridor

The existing Central Coast and Newcastle Line was built and progressively opened between 1886 and 1888, serving passengers and freight for over a century. The route traverses challenging topography and heavily vegetated areas, including national parks on either side of the Hawkesbury River. Bushfires and fallen trees in the corridor are risks in these areas, particularly after high winds or storms. Other sections of the line are low lying and prone to flooding during storms, and exposed sections of track are also subject to the impact of high temperatures during extreme weather events.

The ageing and exposed nature of the existing train line means it is highly prone to disruption and closures, impacting the resilience of the line connecting Newcastle and Sydney. In 2023, there were an average of 3.3 delay events per week on the line, with the average being even higher in the years prior.



Source: Transport for New South Wales (2024)

The Project will deliver wider transport network benefits. By 2061, it will take nearly 10,000 cars a day off the road, improving road safety and reducing traffic congestion. It will also free up freight rail and passenger capacity on the existing Central Coast and Newcastle Line, improving transport network performance and

freight productivity. By 2061, approximately 60,000 seats are estimated to be freed up on Sydney Trains services. This will deliver transport network benefits totalling $2.6 billion PV (2024-25$) including:

- Reduced crowding on train services on the Central Coast and Newcastle Line as people shift to high speed rail. This will deliver more comfortable journeys and free up capacity for more passenger or freight services. Reduced crowding will deliver benefits of $1.0 billion PV (2024-25$).
- Road user benefits, including a reduction in road congestion, vehicle operating costs and crashes because of reduced vehicle kilometres travelled, will deliver benefits of $1.6 billion PV (2024-25$).

Other long-term transport projects could be deferred due to capacity delivered by high speed rail. For example, it might allow deferral of potential future projects such as widening of the M1 Pacific Motorway, a western extension of Sydney Metro West (Westmead to Western Sydney International) or Outer Sydney Orbital Stage 3 (new motorway and rail corridor connecting the Central Coast to Western Sydney). This would help to reduce fiscal pressures or support other local investments that may facilitate access to high speed rail stations. These benefits have not been quantified or incorporated in the economic appraisal.

Beyond benefits to users and government, high speed rail will unlock land for housing through investment in developments at the stations and precincts, enabling businesses and residents to relocate to station precincts. These benefits amount to $1.0 billion PV (2024-25$).

The connection to Western Sydney International also lays the foundation for a future phase of the Network between Greater Sydney and Canberra, enabling onward construction from south-west Sydney, and helping to unlock significant benefits for a corridor to Canberra as well as the wider Network. These have not been captured in the appraisal. Overall, the monetised transport benefits are set out below. A further breakdown of these benefits is provided in the Economic Appraisal Report.

Table 7-1 Project transport benefits ($m real, PV 2024-25$, 4% discount rate, 50-year appraisal period)

	Project	Stages 1A and 1B
Total high speed rail user benefits*	7,500 – 7,700	4,600
Total exceptional travel experience benefits	1,400	1,100
Total Newcastle to Sydney transport network benefits	2,600	1,500
Total premium stations and precincts benefits	1,000	1,000
Total benefits	**12,500 – 12,700**	**8,200**

Source: EY Economic Appraisal Report 2024. Totals may not sum due to rounding. *Range based on inclusion of residual value (capital cost estimate is ranged) and net additional housing range (see Section 7.5 for details). Consistent with Australian Transport Assessment and Planning (ATAP) Guidelines – T2 Cost Benefit Analysis, residual value is included as a benefit on the basis that the asset lives of several infrastructure categories within the cost estimates extend beyond the economic appraisal period.

7.3. Regional and urban productivity, tourism and jobs

High speed rail will help integrate the Newcastle, Hunter, Central Coast and Greater Sydney economies, creating a connected and dynamic economic corridor. By enabling this growth the Project will unlock $16.4 billion PV (2024-25$) in productivity benefits. This includes 99,000 new jobs within the corridor and 134,000 more people gaining access to key economic centres within an hour by public transport.

High speed rail will deliver unmatched centre-to-centre travel times, connecting urban and regional economies. It will enable additional jobs within the corridor and improve access to key economic centres (see Section 7.6), driving economic growth and expanding opportunities for jobs, education and business.

This will help unlock and expand the economic potential of centres along the corridor, including Western Sydney International and Bradfield city centre, with the Project bringing the new airport to within around 27 minutes of Central Station and 54 minutes of Gosford. This will support tourism growth, strengthen workforce and business connections, and drive economic growth in Bradfield.

Project Case land use projections indicate that the increase in commercial development is likely to be highest around the HSR Western Sydney International catchment area as improved accessibility attracts more businesses and jobs to the airport and Bradfield. By 2041, high speed rail could attract an additional 580,000 square metres of commercial gross floor area to the HSR Western Sydney International catchment.

Improved accessibility will underpin wider economic benefits, including more productive business connections, greater competition and access to markets and access to higher paying jobs and labour supply, amounting to $3.7 billion PV (2024-25$). Other key regional and urban productivity, tourism and job benefits from the Project are expected to include:

- Attracting a sustainable rolling stock manufacturing industry to Australia, aligning with the government's National Rail Manufacturing Plan and generating over 3,600 full-time equivalent jobs. This industry will build on existing rolling stock assembly in the Hunter and Central Coast, and be supported by a long-term pipeline as the Network is developed. This will deliver economic benefits of $200 million PV (2024-25$).
- Attracting additional advanced manufacturing, knowledge intensive services and population-serving industries. High speed rail is widely recognised for its ability to foster growth in knowledge intensive industries by enhancing connections between workers and businesses in highly productive centres, leading to improved workforce outcomes. As summarised below, improved accessibility will boost the number of domestic and international visitors within the corridor by 2 and 3 per cent respectively. High speed rail offers visitors more accommodation choices across the Hunter, Newcastle, Central Coast and Greater Sydney by dramatically reducing travel times. Collectively, these tourism and investment attraction benefits are expected to total $12.5 billion PV (2024-25$), with opportunities to enhance these benefits through investment and initiatives identified in the Economic Development Strategy (see Chapter 6).

Industry and investment benefits will underpin new opportunities for communities across the corridor, including new training and job opportunities for First Nations communities and regional areas.

Table 7-2 Estimated growth in tourism visitation within corridor (2061)

Type	Estimated uplift in tourists in Project Case	% growth from Base Case
Domestic visitors	4,318,000	2%
International visitors	875,000	3%

Source: EY Economic Appraisal Report 2024

Overall, the monetised productivity benefits are set out in the following table. A further breakdown of these benefits is provided in the Economic Appraisal Report.

Table 7-3 Project productivity, tourism and jobs benefits ($m real, PV 2024-25$, 4% discount rate, 50-year appraisal period)

	Project	Stages 1A and 1B
Total increased business productivity benefits	3,700	2,600
Total creating a new rail industry benefits	200	200
Total tourism and investment attraction benefits	12,500	6,000
Total benefits	**16,400**	**8,800**

Source: EY Economic Appraisal Report 2024. Totals may not sum due to rounding.

Unlocking benefits for Bradfield: Australia's newest city

High speed rail will supercharge Bradfield, Australia's newest city, into a more connected, innovative and sustainable hub at the heart of Sydney's Western Parkland City and on the doorstep of the new airport.

Direct connectivity with Sydney Metro – Western Sydney Airport at HSR Western Sydney International will allow a trip from HSR Sydney Central to Bradfield city centre in approximately 30 to 35 minutes. Integration with buses and other transport modes at Western Sydney International will further connect high speed rail with Bradfield and the wider Aerotropolis. This connectivity will bring significant benefits, including:

- Easy, all-day access to 200,000 jobs across the Aerotropolis in sectors such as aerospace, defence, advanced manufacturing and logistics, supporting workers from as far as the Hunter region and fostering economic agglomeration and industry growth.
- Boosting economic growth and innovation in advanced manufacturing and other future-focused industries, attracting investment and positioning Bradfield as a hub for innovation in Western Sydney.
- Rapid and reliable connections between the Sydney CBD, Parramatta CBD and the Aerotropolis, enhancing productivity, facilitating business travel, promoting public transport and reducing congestion on key arterial roads.
- Strengthening Bradfield's competitiveness within Greater Sydney and globally by linking major economic centres and leveraging its proximity to Western Sydney International.

As part of a future Network, Bradfield will also be positioned as a gateway linking Greater Sydney to Newcastle, Canberra and beyond, driving connectivity and economic benefits across Australia's east coast.

High speed rail, seamlessly integrated with Western Sydney International and enhanced local transport links, will fast track Bradfield's full economic, social and environmental potential, strengthening its position as a key driver of growth, innovation and sustainability in Australia.

Artist's impression of Bradfield.

7.4. Housing and improved community outcomes

The Project will unlock more diverse and affordable housing options in more places. It will boost housing supply and choice, enabling delivery of 52,000 to 104,000 new homes and $21.8 billion to $30.9 billion PV (2024-25$) in benefits associated with more affordable housing options.

The Project will unlock areas with improved access to jobs and services, which will enable a boost in housing supply and choice in NSW, in turn reducing the social impacts of high housing costs and rents.

By enabling the supply of new land for housing, the Project will help address imbalances in the housing market in Greater Sydney and across the project corridor, enabling more people to own their own home, rent more affordably, and to live and work in the corridor delivering $5.5 billion to $10.3 billion PV (2024-25$) in benefits, including:

- Improved social and wellbeing outcomes from improved access to housing, delivering $5.4 to $10.1 billion PV (2024-25$) in benefits.
- Enabling the supply of land for more diverse housing including townhouses and semi-detached housing, providing greater housing choice for residents in the corridor that are aligned to community preferences ($100 million to $200 million PV 2024-25$).

Other key housing and community benefits from the Project are expected to include:

- Changes in land use zoning around the corridor will accelerate the delivery of medium-density housing in growing and established areas, thereby lowering 'per unit' costs to government associated with housing provision and enabling more productive use of capital ($12.7 billion to $15.5 billion PV 2024-25$). This includes facilitating more efficient use of capital otherwise held in housing, enabling a broader distribution of investment into small businesses and other productive sectors ($800 million to $1.7 billion PV 2024-25$).
- Supporting the development of 'social and affordable' housing in the corridor to alleviate rental cost pressures and enhance residents' wellbeing (through improved feelings of safety and security) and avoiding health, justice and eviction costs to government ($2.2 billion to $3.7 billion PV 2024-25$).
- Improving social outcomes access as a result of high speed rail ($1.4 billion PV 2024-25$).

New housing supply is expected to be taken up over time through a combination of fewer households migrating out of the project corridor ('redistributed' housing), as well as net growth in the number of households as the dramatic improvement in housing supply enabled by high speed rail supports average household sizes to return to a level that is more in line with apparent market preferences.

Overall, the monetised housing benefits are set out in the table overleaf. [redacted]

The table highlights the estimated housing-related benefits for the Project and Stages 1A and 1B, expressed as a range based on net additional housing scenarios. The range is based on an upper and lower bound of market demand in response to new housing supply enabled by the Project (see call out box on the next page). The upper bound assumes demand from across the broader Sydney Greater Metropolitan Area housing market, while the lower bound assumes demand is restricted to the project corridor.

Differentiation between the options is driven by the level of net additional housing within the corridor and the redistribution of households resulting from improved accessibility. Both options exhibit comparable levels of net additional housing and similar redistribution patterns, although the Project achieves greater housing and

community benefits due to the additional capacity unlocked around the HSR Western Sydney International Station catchment.

Table 7-4 Project housing benefits ($m real, PV 2024-25$, 4% discount rate, 50-year appraisal period)

	Project	Stages 1A and 1B
More housing choice benefits	5,500 – 10,300	5,400 – 10,200
More productive land use benefits	12,700 – 15,500	12,600 – 15,200
Social and affordable housing benefits	2,200 – 3,700	1,800 – 3,300
Better access to services and cultural destinations benefits	1,400	1,400
Total benefits	**21,800 – 30,900**	**21,200 – 30,100**

Source: EY Economic Appraisal Report 2024. Totals may not sum due to rounding. *Range based on net additional housing range (see overleaf for details).

Economic analysis of high speed rail and housing – direct and indirect effects

The economic analysis of high speed rail highlights its transformational impact on housing, both directly and indirectly. By significantly enhancing accessibility, high speed rail enables new housing supply, attracting people to areas near station catchments. This enables an ongoing pipeline of diverse and affordable housing across the corridor, addressing long-term housing needs. This increased supply alleviates housing shortages in Greater Sydney and surrounding regions, improving affordability and providing more people with options for home ownership or rental housing.

High speed rail will deliver transformational changes in accessibility to major job centres from areas across the Hunter, Newcastle, Central Coast and Greater Sydney, with journey times reduced by up to 70 per cent. This improved accessibility unlocks up to 194,000 additional dwellings along the corridor, particularly in key growth areas such as Broadmeadow and Morisset.

As a direct effect of improved accessibility and housing capacity, 46,000 redistributed households are expected to relocate to high speed rail station catchments from elsewhere, including 33,000 in station catchments in Newcastle, Lake Macquarie and the Central Coast, and a further 12,000 in station catchments in Greater Sydney. These 'redistributed' (or 'displaced') households are expected to mainly come from Brisbane and Melbourne due to less outward migration out of the corridor, generating economic benefits associated with improved accessibility and more efficient housing.

A secondary outcome of the increase in housing land area enabled by the Project is a significant boost in new ('net additional') housing supply along the corridor. This will help redress the market failure of housing supply shortages in Sydney and surrounds, enabling more people to own their own home than if the Project were not delivered.

Household sizes

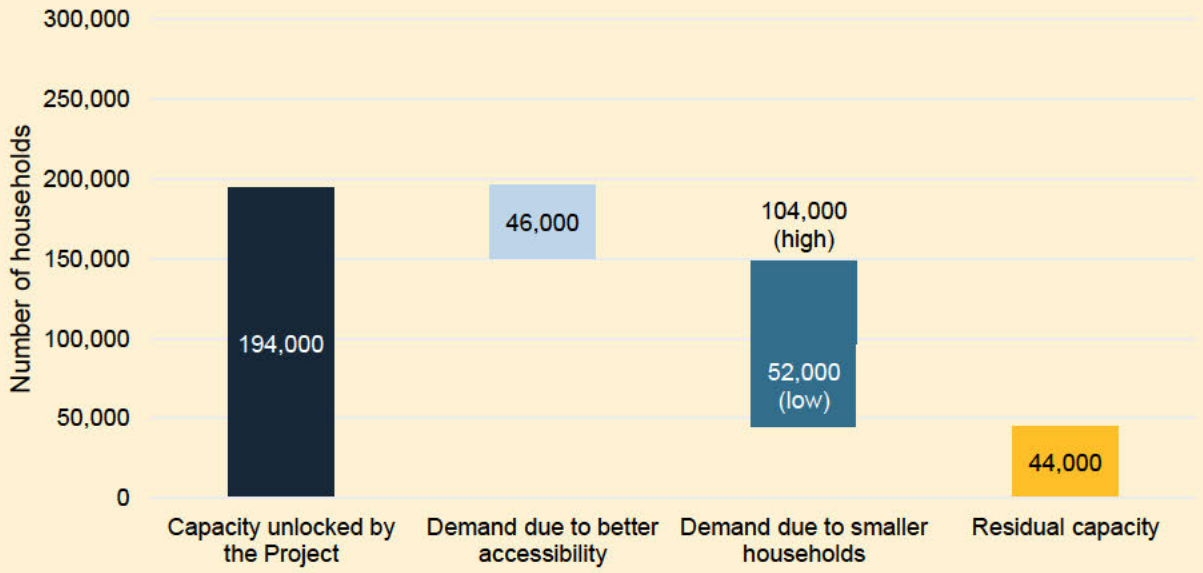
During the pandemic, longer-term housing market failures in NSW were made plain – average household size decreased by 2.8 per cent to 2.41 in December 2021 due to easing pressure on rental markets (through events such as a decrease in net overseas migration or construction constraints) – allowing more households to form in line with their preferences. Average household size increased again in December 2023 as constraints returned. In other words, the pandemic highlighted the inherent preference many have to form their own household, with the post-pandemic experience highlighting that when market constraints return (that is, higher demand and constrained supply) this preference is unable to be met.

A paper prepared for the RBA Bulletin[1], while noting that other factors such as demographic changes are contributing to smaller household sizes, states that from late 2020 to 2022, 'greater affordability combined with changed preferences and strong income growth, likely encouraged individuals to form smaller households with more space per person over 2021 and 2022.' The continuation of this trend – and the failure of the market to support this – is also highlighted by:

- The NSW Intergenerational Report, which found that housing undersupply has led to a rapid increase in house prices and the reversal of a decades-long trend towards fewer people per household. The report predicts that household sizes in NSW will fall from 2.5 to 2.3 people per household by 2061, which is an 8 per cent change from today. This demand will be driven by people living by themselves, families without children and an ageing population.
- The RBA, which has previously estimated that average household size declined from 2.55 individuals to 2.48 individuals nationally between late 2020 and August 2022, meaning an additional 120,000 homes needed to be built just to accommodate the existing population. The RBA has noted that with a shortage of new homes being built, household size preferences are not being met.[2]

By dramatically improving well connected housing supply, high speed rail will enable new (or 'net additional') households to form – that is, more people owning their own home and affording their own rental, measured by average household sizes declining towards the preferred level. This generates a range of welfare benefits associated with improved access to housing.

Given the scale of this impact and to account for a level of uncertainty in how households may respond to the scale of supply change – the growth in net additional housing is ranged, with the lower end of the range assuming demand for new households comes from only within the corridor, and the upper end of the range assuming a response from across the wider Greater Metropolitan Area. The column of 'demand due to smaller households' in the figure below shows this range for the Project in the context of new housing capacity and displacement in areas of influence around stations. The figures differ by Project option (such as for Stages 1A and 1B only) based on the extent of new housing capacity enabled.



Source: EY Economic Appraisal Report 2024, drawing on Cox, KPMG and EY analysis. Totals may not sum due to rounding. The 46,000 households within high speed rail station catchments is a subset of the 55,500 households redistributed into the project corridor.

7.5. Environmental, sustainability and net zero outcomes

High speed rail will help Australia meet its net zero commitments through sustainable construction and operations. This will help reduce the need for additional road capacity between Newcastle and Sydney and lay the foundation for a Network that is a cleaner alternative to emissions intensive air travel.

Powered entirely by renewable energy, the Project will reduce total transport emissions by attracting people to a faster, cleaner form of transport. Excluding growth from new residents and workers moving into the corridor, the Project will generate a 0.1 per cent reduction in road vehicle kilometres in the Sydney Greater Metropolitan Area, helping to reduce emissions by 86,000 tonnes carbon dioxide equivalent (CO_2eq) over 30 years.[3] While the rollout of electric vehicles, which the Australian Energy Market Operator forecasts will reach 100 per cent take-up in Australia by 2055, will help to reduce the gap in emissions over time, a reduction in car trips because of high speed rail will have other sustainability benefits, including improved road safety. Reduction in emissions and other externalities due to mode shift will generate $90 million PV (2024-25$) in benefits.

Table 7-5 Expected change in vehicle kilometres travelled (all day, 2061)

Type	Base Case	Project Case	% growth from Base Case
Vehicle kilometres travelled	172,078,000	171,941,000	-0.1%

Source: PTPM 2024. See Project Demand Report (VLC 2024) for further information.

Although the Project is being designed and will be delivered to minimise its environmental impact through zero or low emission technologies and materials, including becoming net zero in construction by 2035, residual carbon and other impacts during initial construction mean there is an environmental disbenefit. This is currently accounted for through inclusion of carbon offset costs. The direct environmental benefits of the Project account for a disbenefit of between $200 to $210 million PV (2024-25$). Further analysis will be undertaken to explore additional emission reduction mechanisms (see Chapter 10). The economic appraisal also quantifies the net environmental impact from new housing development in the corridor that delivers a disbenefit of between $10 and $40 million PV (2024-25$).

Overall, the monetised environmental benefits are set out below. In line with recent updates to Infrastructure Australia guidelines, this accounts for embodied carbon in materials and construction. A further breakdown of these benefits is provided in the Economic Appraisal Report.

Table 7-6 Project environmental benefits ($m real, PV 2024-25$, 4% discount rate, 50-year appraisal period)

	Project	Stages 1A and 1B
Environmental benefits of high speed rail from mode shift	90	50
Biodiversity and amenity impacts to landscape	(30)	(30)
Infrastructure with lower embedded carbon	(180) – (170)	(110)
Environmental impacts from housing construction*	(10) – (0)	(10) – (0)
Environmental impacts from housing energy*	(30) – (10)	(30) – (10)
Total benefits/(costs)	**(150) – (130)**	**(130) – (100)**

Source: EY Economic Appraisal Report 2024. Results rounded to the nearest ten million PV and totals may not sum due to rounding.
*Range based on net additional housing range (see Section 7.5 for details).

7.6. Project economic appraisal

7.6.1. The Project

The Project will generate economic benefits of $50.8 billion to $59.7 billion PV (2024-25$), with a BCR of 0.8 to 1.0 and NPV of -$10.5 billion to $2.6 billion (2024-25$) over 50 years of operations.

The Project's economic benefits will be generated across four categories. As outlined in the previous sections and summarised in the table overleaf, the core economic benefits include:

- Transformative high speed rail product and better connectivity to meet future needs, representing $12.5 to $12.7 billion PV (2024-25$) of benefits, driven by farebox revenue and overall journey time savings.
- Regional and urban productivity, tourism and job benefits of $16.4 billion PV (2024-25$), which will arise from more productive business connections and investment attraction to key regions, including Newcastle and Gosford.
- Greater housing choice and improved community outcomes, representing $21.8 billion to $30.9 billion PV (2024-25$) of benefits, largely driven by the change in land use, enabling more residential housing and improvements in housing affordability.
- Environmental sustainability and net zero outcomes. Net economic costs of $150 million to $130 million PV (2024-25$) associated with this category reflect the combination of lower network emissions due to people shifting from car to high speed rail powered by renewable energy as well as construction impacts from the Project and new housing.

For comparative purposes, the table also shows the economic appraisal results for Stages 1A and 1B only. Stages 1A and 1B alone would deliver economic benefits of $38.1 billion to $47.0 billion PV (2024-25$), with a BCR of 0.9 to 1.2 and NPV of -$5.4 billion to $6.5 billion (2024-25$) over 50 years of operations.

The marginally higher NPV and BCR for Stages 1A and 1B only compared to the full Newcastle to Sydney Project (including Stage 1C) reflects that most new housing enabled by the Project is expected to be north of the Hawkesbury, around Broadmeadow, Morisset and Gosford, where new land is available. In contrast, housing supply in Western Sydney is largely taken up in the Base Case due to Sydney Metro – Western Sydney Airport and other infrastructure investments in the area. This means additional housing benefits from Stage 1C are limited, contributing to the incremental costs of Stage 1C exceeding the incremental benefits.

Despite the marginally higher NPV and BCR for Stages 1A and 1B only, the full Project to Parramatta and Western Sydney International has important benefits, including:

- ~$4.3 billion PV (2024-25$) (52 per cent) more 'transformative high speed rail product and connectivity' benefits, with the Project expected to attract 50 per cent more demand than Stages 1A and 1B only, including 7.9 million trips per year to/from HSR Western Sydney International in 2061 as a result of a 37 minute reduction in journey time between Central Station and Western Sydney International compared to the Base Case.
- ~$7.6 billion PV (2024-25$) (86 per cent) more 'regional and urban productivity, tourism and jobs' benefits, with the Project expected to attract five times more tourism benefits and double the investment attraction benefits due to connectivity to Parramatta and Western Sydney International.
- Potential network and constructability benefits that are not included in the Project's CBA but that may be considered – Connectivity to HSR Parramatta and HSR Western Sydney International Stations as part of the Project would lay the foundation for a future phase of the Network between Greater Sydney and

Canberra, unlocking higher demand in future phases from these key trip generators. The inclusion of Western Sydney International as part of the Project would also enable construction of a future stage to Canberra to commence outside the Sydney or Parramatta CBDs, where access is more constrained.

The Project's economic costs are in real prices in line with the Infrastructure Australia Assessment Framework, ranged based on low and high P50 contingency amounts. The box on the following page provides further information on the difference between the cost estimates included in the economic appraisal and financial appraisal (outlined in Chapter 9).

In addition to the core Project estimates, the economic appraisal includes several additional costs that are necessary to support the claimed benefits, including:

- Additional bus fleet and network operating costs – Additional capital costs of $84 million (real 2024-25$, undiscounted) every 15 years as well as annual operating costs of $41 million (real 2024-25$, undiscounted) are included to account for improvements in the frequency of bus services outside core high speed rail station areas. This is included to support the inclusion of a wider catchment for housing uplift in the Hunter, Newcastle and Central Coast areas in the Project Case.
- Housing infrastructure costs – Costs associated with enabling infrastructure for redistributed and net additional dwellings are accounted for, and include per dwelling costs for electricity, water, telecommunications, gas, local roads and stormwater. Costs differ by greenfield, infill, greenfield Transit Oriented Development and regional, as well as by state or territory.
- Social and affordable housing costs – Costs for delivery of social and affordable housing are accounted for in the fact that higher value land use (associated with rezoning) is not applied to these dwellings.

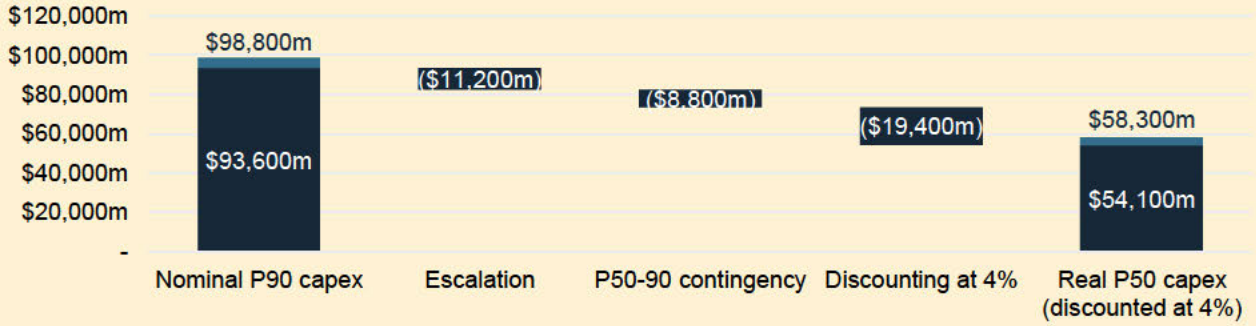
Table 7-7 Core economic appraisal results ($m real, PV 2024-25$, 4% discount rate, 50-yer appraisal period)

	Project	Stages 1A and 1B
Delivery Phase costs	54,100 – 58,300	38,200 – 41,200
Operating Phase costs	3,000	2,300
Total economic costs (P50)	**57,100 – 61,300**	**40,500 – 43,500**
Transformative high speed rail product and better connectivity to meet future needs	12,500 – 12,700	8,200
Regional and urban productivity, tourism and jobs	16,400	8,800
More housing choice and improved community outcomes	21,800 – 30,900	21,200 – 30,100
Environmental sustainability and net zero outcomes	(150) – (130)	(130) – (100)
Total economic benefits	**50,800 – 59,700**	**38,100 – 47,000**
NPV	**(10,500) – 2,600**	**(5,400) – 6,500**
BCR	**0.8 – 1.0**	**0.9 – 1.2**

Source: EY Economic Appraisal Report 2024. Totals may not sum due to rounding. *Range based on net additional housing range (see Section 7.5 for details) and capital cost range.

The difference between economic and financial costs

Consistent with guidelines and established practice, the Project economic appraisal uses real P50 costs. The lower and upper bound Delivery Phase costs reflect low and high P50 contingency estimates, with the 'high range' determined through a stress test approach outlined further in Chapter 9. Economic costs differ to costs used in the financial appraisal which uses nominal P90 costs (including escalation). Further, the core economic appraisal discounts costs using a real discount rate of 4 per cent as illustrated below (noting that alternative discount rates are presented in the following section).



Source: EY Economic Appraisal Report 2024. Totals may not sum due to rounding. *Range based on capital cost range.

The economic appraisal is based on a 4 per cent discount rate. The box below provides further detail on the context and justification for the 4 per cent discount rate. Summary appraisal results at alternative discount rates are provided in Section 7.6.2, with a more detailed breakdown of results at a 7 per cent discount rate provided in the Economic Appraisal Report.

Selection of an appropriate discount rate

Undertaking Cost Benefit Analysis (CBA) requires the comparison of monetised economic costs and benefits that are realised over different time frames. For the Project, this involves comparing large upfront capital expenditure with a stream of economic benefits over a long-term horizon. Discounting future cost and benefit profiles to their present values in a CBA enables a like-for-like comparison of current and future costs and benefits in determining the net present value of a project.

There is debate between different jurisdictions regarding the choice of an appropriate discount rate for use in the appraisal of public infrastructure projects. For comparability across national, state and territory guidance and reporting, Infrastructure Australia provides default discount rates and sensitivity tests to present appraisal results. These currently include a standard real discount rate of 7 per cent, with sensitivity tests at 4 per cent and 10 per cent.

However, in an economic appraisal of large-scale infrastructure investments consideration should be given to the particular challenge for such investments to generate net benefits using comparatively high discount rates (at 7 per cent for example). This is because these projects tend to create longer term benefit profiles with very high upfront costs. A higher discount rate will therefore favour shorter-term benefits focused on current generations rather than those that may underpin longer term transformation.

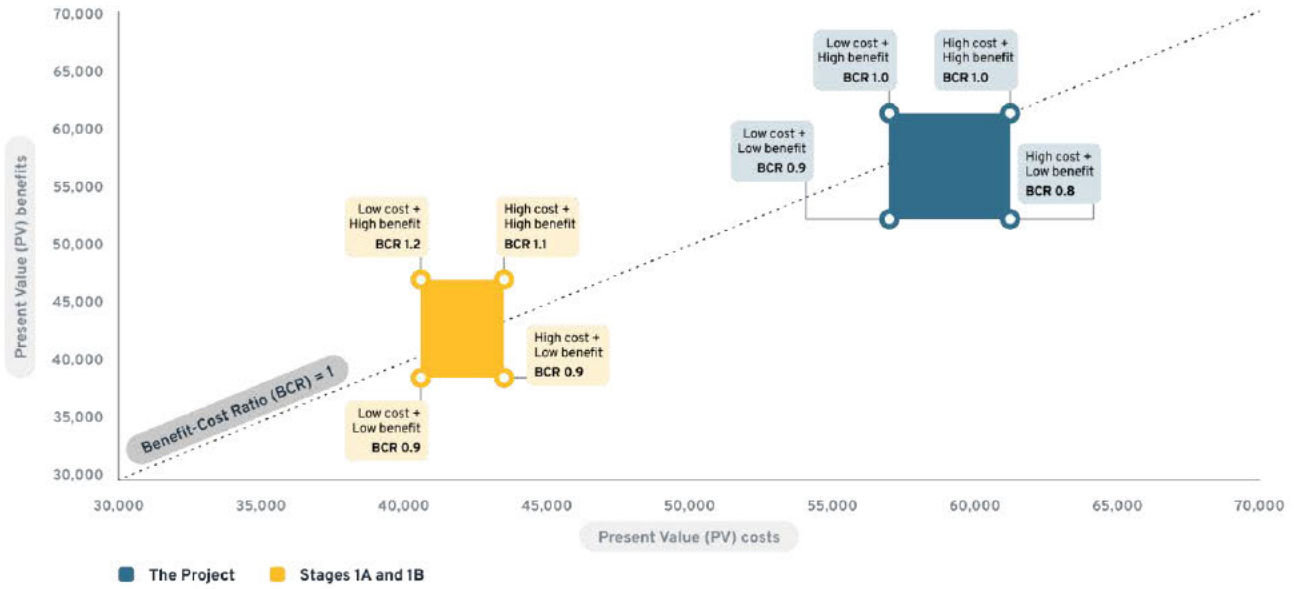
In recognition of the challenge for large scale infrastructure investments to sufficiently demonstrate its longer term, multi-generational benefits, major infrastructure project appraisals across the world have applied fit-for-purpose discount rates:

- **Inland Rail** – For the expansive multi-generational rail infrastructure initiative, the Australian Government and Australian Rail Track Corporation applied and reported results at both 4 per cent and 7 per cent real discount rates in the economic appraisal.
- **Suburban Rail Loop (Victoria)** – For a multi-decade project with increasing benefits across time, Victoria State Government and the Suburban Rail Loop Authority opted for a 4 per cent real discount rate in the economic appraisal.
- **UK rail projects (London Crossrail, High Speed Rail 1 and High Speed Rail 2) (UK)** – Several UK rail projects adopted a 3.5 per cent real discount rate for the first 30 years of appraisal which was then lowered to a 3 per cent real discount rate for the following 30 years of the appraisal period to reflect the impacts of the project on future generations.
- **Grand Paris Express (France)** – A real discount rate of 4 per cent was adopted to assess a large-scale urban transport and regeneration in Paris and greater Ile-de-France to demonstrate the rate of return appropriate in France for public projects.

The transformative nature of high speed rail means it is aimed at delivering long-term, multi-generational benefits. The use of a 4 per cent real discount rate is therefore applied for the economic appraisal of high speed rail to maintain consistency with appraisals for similar, precedent projects and to better reflect the long-term nature of the Project. The standard real discount rates of 7 per cent and 10 per cent in sensitivity tests are reported to comply with Infrastructure Australia Guidelines.

The economic appraisal results for the Project, and for Stages 1A and 1B, are illustrated below, ranged by both low and high capital costs and benefits. The Project has a BCR above one under the low cost and high benefit assumptions and breaks even with the high cost and high benefit assumptions. The comparative results demonstrate that delivering the Project unlocks higher economic benefits compared to delivering Stages 1A and 1B only, although Stages 1A and 1B only has more points with a BCR above one due to its lower costs.

Figure 7-3 Range of core economic appraisal results ($m real, PV 2024-25$, 4% discount rate, 50-year appraisal period)



Source: EY Economic Appraisal Report 2024. *Range based on net additional housing range (see Section 7.5 for details) and capital cost range.

Further opportunities are being explored to enhance the benefits of the Project, including:

- Optimising capital costs and the schedule for Project delivery.
- Refining transport demand modelling to better capture transformational user benefits, induced demand and market segment response, which demand modelling undertaken for the Network indicates is possible.
- Further exploring the role of high speed rail in attracting higher value jobs, new industries and investment.
- Further demand modelling to test the inclusion of new (net additional) households around stations.
- Exploring further opportunities to reduce residual embodied carbon and emissions.

The box below provides further information on the key limitations and opportunities of current demand modelling, which expands on points 2 and 4 above.

Demand analysis and transport benefits – limitations and future opportunities

The Project's transport benefits are underpinned by travel demand modelling using Transport for NSW (TfNSW) models – the Strategic Travel Model (STM) and Public Transport Project Model (PTPM). Both base models are maintained and assured by TfNSW, and PTPM pivots off observed demand on existing services, meaning base year demand is well validated. Limitations of current high speed rail modelling include:

- Given the influence of historical travel modes and preferences, the model's ability to fully capture the transformative potential of high speed rail is limited. Although perceived time and fare adjustments were incorporated to reflect the high speed rail product, the interaction with proposed fares constrained the mode shift from car to rail. Consequently, private car trips remain dominant in the Project Case, with 80 per cent of high speed rail demand drawn from conventional rail users.
- The demand model lacks several features relevant to modelling high speed rail demand, including accounting for wholly new (generated) trips, or induced demand for trips that are only taken due to the introduction of high speed rail. International experience suggests this is an important response to high speed rail. Research also suggests that those who relocate to areas with high speed rail access may have a higher propensity to travel by rail than assumed by the current modelling.
- Unlike redistributed households, the 52,000 (lower bound) to 104,000 (upper bound) net additional households projected in the corridor under the Project Case reflect demand driven by the formation of smaller households. These households have not been modelled in STM/PTPM. Although the net additional households do not assume an increase in total population, given demand is generated by the change in household size, the location of most of these new households close to high speed rail stations, where new capacity is delivered, means greater high speed rail demand could be expected. The Economic Development Strategy sensitivity analysis outlined in Section 7.7 provides an indication of the increased demand due to more people living or working close to high speed rail stations.

Results from demand modelling using the High Speed Rail Demand Model (HDM), which has been specifically developed to model high speed rail for the full Network, indicates materially higher transport benefits per customer on the project corridor compared to STM/PTPM. Half of this delta between HDM and STM/PTPM high speed rail user benefits is included in the Project economic appraisal, as further comparative analysis is warranted given HDM adopts a different structure and resolution to STM/PTPM. It also highlights the potential opportunities in the Development Phase.

Further information on limitations and opportunities is provided in the Demand Modelling Report.

7.6.2. Sensitivity analysis

Sensitivity analysis has been undertaken to test the impact of different variables on the NPV and BCR, including changes in costs, benefits and the discount rate. Specific analysis has also been undertaken to understand the impact that excluding HSR Lake Macquarie Station would have on the economic appraisal.

Table 7-8 Sensitivity economic appraisal results ($m real, PV 2024-25$, 4% discount rate, 50-year appraisal period)

Sensitivity	Project		Stages 1A and 1B	
	NPV	BCR	NPV	BCR
Project	**(10,500) – 2,600**	**0.8 – 1.0**	**(5,400) – 6,500**	**0.9 – 1.2**
Excluding HSR Lake Macquarie Station and associated land use change	(15,700) – (6,200)	0.7 – 0.9	N/A	N/A
+20% benefits	(100) – 14,700	1.0 – 1.3	2,700 – 16,000	1.1 – 1.4
-20% benefits	(20,600) – (9,300)	0.7 – 0.8	(13,200) – (3,100)	0.7 – 0.9
+20% costs	(22,700) – (8,900)	0.7 – 0.9	(14,200) – (1,600)	0.7 – 1.0
-20% costs	1,800 – 14,000	1.0 – 1.3	3,200 – 14,600	1.1 – 1.5
Best case (+20% benefits; -20% costs)	12,200 – 26,100	1.2 – 1.6	11,300 – 24,100	1.3 – 1.7
Worst case (-20% benefits; +20% costs)	(32,800) – (20,800)	0.6 – 0.7	(22,000) – (11,200)	0.6 – 0.8
7% discount rate	(24,900) – (17,500)	0.5 – 0.6	(16,500) – (10,000)	0.5 – 0.7
10% discount rate	(26,100) – (21,200)	0.3 – 0.4	(18,500) – (14,300)	0.4 – 0.5

Source: EY Economic Appraisal Report 2024. Totals may not sum due to rounding. *Range based on net additional housing range (see Section 7.5) and capital cost range.

Project with and without HSR Lake Macquarie Station

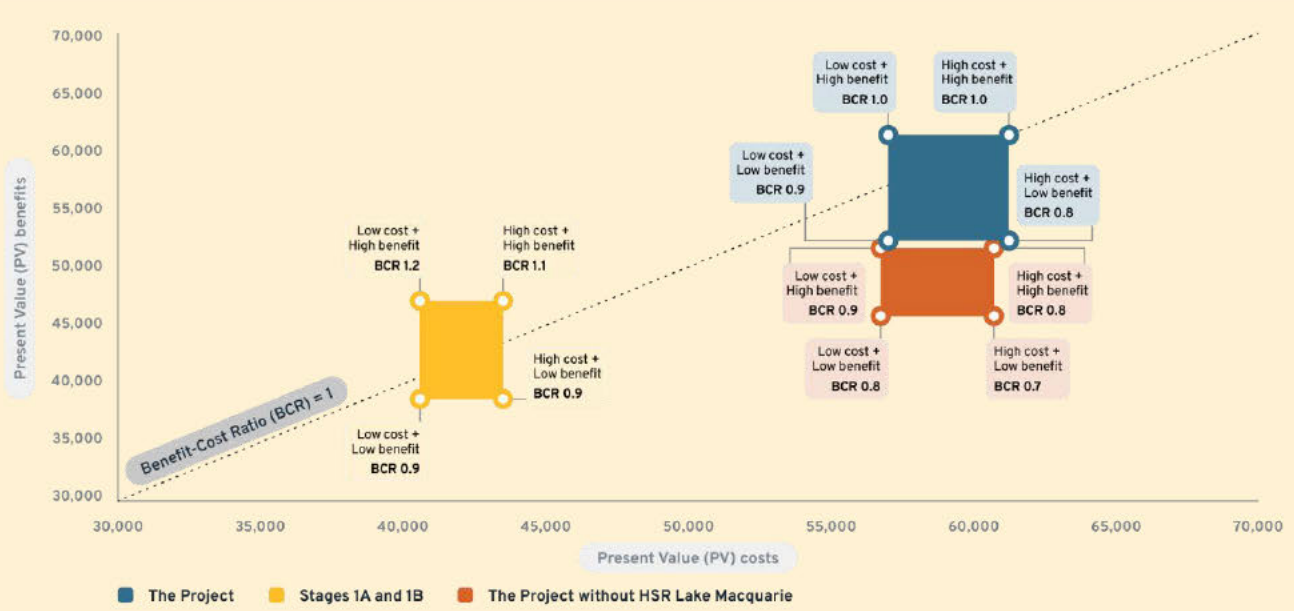
HSR Lake Macquarie is a proposed intermediate high speed rail station near Morisset serving the Lake Macquarie area and enhancing connectivity to the Hunter. It will offer parking for up to 1,000 vehicles and fast access to the M1 Pacific Motorway, connecting communities like Kurri Kurri and Cessnock.

Demand forecasts show the station is projected to attract an additional 264,000 users per year by 2061, increasing high speed rail demand by one per cent. This accounts for an increase in users from Morisset and a 12 per cent reduction in average daily users from HSR Newcastle from a 6-minute increase in journey times.

The station's greenfield location will significantly enable housing supply, contributing 91,000 additional homes – 47 per cent of the Project's total and an 88 per cent increase compared to the scenario without HSR Lake Macquarie Station.

Economic analysis shows delivering the Project without HSR Lake Macquarie Station results in an economic benefit of $45.2 billion to $50.5 billion PV (2024-25$) and a BCR of 0.7 to 0.9. This compares to $50.8 billion to $59.7 billion PV (2024-25$) and a BCR of 0.8 to 1.0 with HSR Lake Macquarie Station.

This shows that including HSR Lake Macquarie Station in the Project significantly boosts benefits, adding $5.6 billion to $9.2 billion PV (2024-25$). The results highlighting these substantial gains are detailed below for the full Project and Stages 1A and 1B. The option without HSR Lake Macquarie Station is not taken forward.



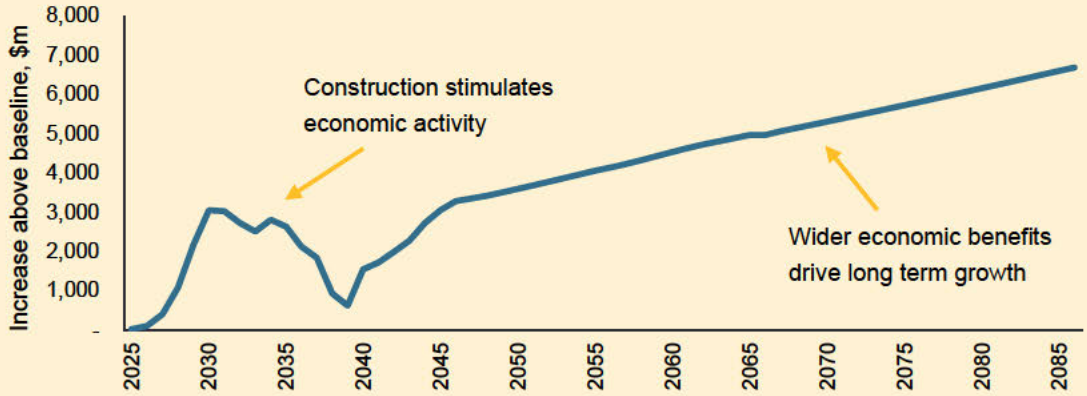
Economic impact analysis: Project

Economic impact analysis of the Project has been undertaken using computable general equilibrium (CGE) modelling. CGE modelling assesses the economy-wide impact of the Project through key economic indicators, including economic output, employment and productivity. In contrast to Cost Benefit Analysis (CBA), which estimates specific changes in community welfare from the Project, economic impact analysis using CGE explores the wider macroeconomic impacts.

Economic impact modelling of the Project highlights several key impacts:

- Capital investment boosts jobs and economic activity:
  - The initial construction phase of the Project will boost activity in Australia by stimulating demand for goods and services and supplying employment opportunities.
  - onstruction of the Project reaches its peak around 2031 with GDP increasing by $2.8 billion (real 2024-25$) and 15,600 jobs (on a full-time equivalent basis).

Figure 7-4 Projected change in GDP from Project (real, 2024-25$)



- High speed rail uplifts the transport industry:
  - Completion of high speed rail will deliver a transformational improvement in connectivity between Newcastle and Sydney, increasing the passenger trips and transport revenue.
  - This will directly support jobs through the maintenance and operations of the system.
  - This will result in an uplift of $0.7 billion (real, 2024-25$) in the transport industry in 2061.
- Better connectivity boosts productivity:
  - The faster connection between the cities will give a boost to labour productivity due to reduced travel times and the opportunity to work while travelling.
  - This will shift some drivers out of their cars, which will reduce travel times, accidents and vehicle costs. This will have benefits to road users, especially in logistics, further boosting productivity.
- Increased housing supply alleviates price pressures:
  - The reduced cost of housing (including rents) will give consumers a higher disposable and discretionary income. This will increase demand in other industries, especially the services sectors.
- Better transport options draw tourists to the area:
  - The Newcastle, Hunter and Central Coast regions will become easier to access, increasing domestic and international tourism.
  - The increased tourism spend will especially benefit the hospitality, accommodation and food sectors, which nationally are expected to see a combined uplift of $2.4 billion (real, 2024-25$) in 2061.

Overall, high speed rail will contribute to growth across the economy due its transformational impact on productivity, unlocking land for housing and attracting international tourists to the area. By 2086 (construction and 50 years of operations), the Project is expected to increase Australian GDP by a total of $65.6 billion (NPV, 4 per cent discount rate). On an undiscounted basis, the increase to national economic output would be $250 billion over the same period.

Source: EY Economic Impact Analysis 2024.

7.7. Economic opportunities from complementary investment

The Economic Development Strategy outlined in Chapter 6 identifies a range of complementary initiatives and investments to amplify the benefits of high speed rail. These initiatives aim to support broader project objectives, including net zero and sustainability, housing choice and affordability, industry growth and transition, and regional liveability and equity. The strategy also defines coordinated actions and investments across governments, industry and communities to fully realise the transformational potential of high speed rail.

As the Economic Development Strategy does not form part of the costed scope of the Project, its initiatives are not included in the cost benefit analysis of the Project. However, sensitivity analysis has been undertaken to assess the potential impact of these initiatives on high speed rail demand. The analysis considers scenarios with higher population and increased employment in advanced industries across the Hunter, Newcastle and the Central Coast, aligned with the Strategy's focus on net zero and sustainability, housing choice and affordability, industry growth and transition, and regional liveability and equity.

The results of the sensitivity analysis indicate a potential 26 per cent increase in high speed rail weekday demand, with a notable rise in demand travelling towards the Central Coast and Newcastle in the mornings,

and towards Sydney in the evenings. This response is consistent with the Strategy's intent to promote higher all day demand on high speed rail through enhanced business to business connections and leisure travel. This scenario assumes an additional 500,000 people and 250,000 jobs within the corridor, representing a strategic estimate that would require further analysis. Key results of the sensitivity analysis are shown below.

Table 7-9 Key demand metrics from Economic Development Strategy demand scenario

Metric	Core Project Case 2061	EDS sensitivity test 2061 (% change to Project Case)
High speed rail weekday daily demand	72,000	91,000 (+26%)
Contra-peak high speed rail demand (AM peak) (northbound)	3,000	6,000 (+104%)
Contra-peak high speed rail demand (PM peak) (southbound)	4,000	6,000 (+70%)
Two-way high speed rail Hawkesbury crossings	34,000	40,000 (+16%)

Source: PTPM 2024. See Project Demand Report (VLC 2024) for further information.

7.8. The Network's economic potential

The Project will deliver the first stage of the Network, establishing the foundation for transformative transport, land use, and economic outcomes across regions home to nearly 80 per cent of Australia's population. This Network will revolutionise travel between Australia's largest cities and regional centres, offering faster end-to-end journey times, reduced transport emissions and improving access to jobs along the east coast. Representing a transformative investment in Australia's future, the Network offers substantial economic, social, and environmental benefits, with the latest strategic analysis of potential costs and benefits confirming that high speed rail continues to be a viable investment for Australia.

The Project will lay the foundation for the future Network by delivering some of its most complex and busiest sections in Greater Sydney and its surrounds. It connects Sydney CBD and Western Sydney International, major generators for both business and leisure trips. This will strengthen demand for future phases of the Network, ensuring high speed rail is an attractive choice for centre-to-centre trips along the east coast. It will also support future housing and commercial development outcomes along the Network's corridor through convenient access to major centres and interchanges, including HSR Sydney Central and HSR Western Sydney International.

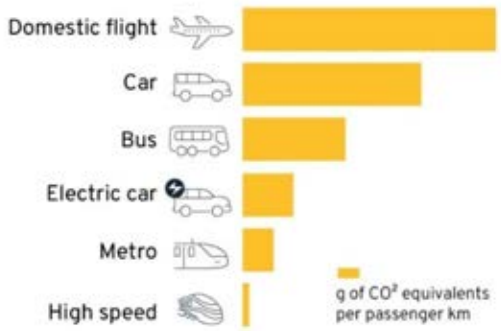
The Project integrates Newcastle into the future high speed rail network, enhancing its connectivity to major cities and regions across the east coast. This positions Newcastle as a key destination within the Network, unlocking new opportunities for economic growth, tourism and regional development.

Key benefits of the Network, relative to the Project, include:

- Transformative high speed rail product and enhanced connectivity to meet future needs – High speed rail supports productive long-distance travel, consolidates air services, frees up freight capacity, reduces road maintenance costs and contributes to safer roads through a shift in travel modes.
- Boosting productivity, tourism and jobs – High speed rail enables sustainable economic growth and local manufacturing opportunities for the development of the Network.
- More housing choice and improved community outcomes – High speed rail creates opportunities for more housing between capital cities and in regional areas, increases housing diversity in more locations, expands the supply of social and affordable housing, and enables the more productive use of land for housing.

- Environmental sustainability and net zero outcomes – High speed rail provides a much more reliable and sustainable alternative to air and road travel, reducing emissions and mitigating environmental impacts from air and road travel.

Figure 7-5 CO_2e by transport mode (emissions per passenger km travelled)[4]



[redacted]

[1] Nalini Agarwal, James Bishop and Iris Day (2023), A New Measure of Average Household Size, RBA Bulletin, A New Measure of Average Household Size | Bulletin – March 2023 | RBA

[2] Read, Michael (2024), article: It turns out Philip Lowe was right about finding a flatmate, Australian Financial Review, 16 October 2024.

[3] Based on fixed land use.

[4] UK Government, Department for Energy Security and Net Zero (2022) – processed by Our World in Data. Transport emissions per kilometre travelled (dataset). UK Government, Department for Energy Security and Net Zero, Greenhouse gas reporting: conversion factors 2022 (original data).

Chapter 8

Delivery strategy

Australian Government
High Speed Rail Authority

An efficient approach to delivery that reduces risk and activates benefits early

- The Delivery Strategy has been developed to deliver the Project in a more efficient and productive manner than previous mega-projects, reducing risk and improving certainty on cost estimates. The Delivery Strategy draws on lessons learnt and includes initiatives based on these findings:
  - Spending time to get the design right – A two-year Development Phase is proposed where contractors will be paid to develop their designs to a high level.
  - Increasing use of Modern Methods of Construction – A key focus during the Development Phase will be to maximise use of common, modular, repeatable sections that can be manufactured offsite.
  - Reducing the claims based culture through better risk sharing – A risk sharing approach is proposed (Hybrid Incentivised Target Cost) across all relevant packaged which will create a more collaborative environment.
- Strong industry feedback obtained through targeted meetings, industry roundtables and international validation and verification exercises has been used to shape and refine the Delivery Strategy, ensuring that the Project is attractive to, and deliverable by, the market.
- The packaging approach includes a combination of discipline-based and geographical packages. It has been validated by market feedback and structured to align to market capability, reduce interfaces and provide opportunities for private financing. The strategy has been developed in the context of the future Network, with the packaging and procurement approach to effectively enable future extensions a key consideration.
- A staged approach to the Project will be implemented due to challenges in delivering a mega-project of this size within market capacity limits. The staged opening of the Project includes:
  - Stage 1A: HSR Newcastle Station to HSR Central Coast Station.
  - Stage 1B: HSR Central Coast Station to HSR Sydney Central Station.
  - Stage 1C: HSR Sydney Central Station to HSR Western Sydney International Station.
- The scale of the Project offers an opportunity to support local industry, improve construction productivity and drive skills development and employment through local manufacturing of rolling stock, and centralised advanced manufacturing and modular development of common project elements. Advanced manufacturing as part of the Project's delivery offers a unique opportunity to revolutionise Australia's construction and manufacturing sectors.

8.1. Overview of the Delivery Strategy

A preferred approach to packaging, procuring and executing the Project has been defined to enable efficient delivery. The delivery approach has been underpinned by the desire to:

- Drive efficiency across the Project's lifecycle, including in procurement, design and delivery.
- Maximise deliverability and market attractiveness.
- Optimise risk sharing between government and industry, leveraging insights from recent mega-projects.
- Support the long-term vision for the Network, including delivery and operation of future extensions.

The strategy to deliver Australia's first high speed rail project has leveraged lessons from local and international mega-projects, and been informed by industry. The strategy will enable the Project to be delivered efficiently and productively, reducing risk and increasing certainty on cost estimates.

This strategy has been developed through an intensive process including detailed analysis of best practice, in-depth engagement with industry, assessment of supply chain capacity, and validation and verification through engagement with existing high speed rail operators, as illustrated in the following figure.

Figure 8-1 Packaging and procurement options steps

8.2. The preferred approach to packaging and staging

The Delivery Strategy reflects market soundings, an assessment of previous projects and a detailed analysis of supply chain capacity. The approach is the outcome of an iterative process and testing with industry.

The strategic priorities of the preferred packaging strategy include:

- Balancing anticipated package size with market capacity and appetite, while also managing the number and nature of interfaces between packages.
- Geographically based packaging of alignment-wide elements, providing flexibility to facilitate staged opening.

- Discipline-based packaging of key Project-wide interoperability elements to retain flexibility for the future Network and drive whole-of-life benefits by combining design, construction and maintenance of these packages.
- Separate station packages to ensure flexibility for staged opening of the Project.
- Centralised manufacturing of standardised and modularised components to drive efficiencies in project delivery (Advanced Manufacturing Facilities).
- Creating or retaining opportunities to achieve broader aims of the Project including:
  - Achieving efficiencies through common design, delivery modularisation and/or procurement approaches (such as framework agreements).
  - Minimising cost and resource duplication in delivery.
- Providing opportunities for private financing, including PPP options.

A staged approach is proposed in response to the market conditions and capacity (see figure below):

- Stage 1A: HSR Newcastle Station to HSR Central Coast Station.
- Stage 1B: HSR Central Coast Station to HSR Sydney Central Station.
- Stage 1C: HSR Sydney Central Station to HSR Western Sydney International Station.

Findings from international benchmarking and industry engagement

There is no standard packaging approach for high speed rail projects. Rather, contract packaging is determined by bespoke factors such as project size and complexity, stakeholder requirements, program, local market conditions and capacity.

While significant tunnelling and civils capability is available in Australia, the scale of the Project, and particularly the tunnelling task, is likely to stretch market capacity unless staged.

The high speed rail rolling stock and systems market is sufficiently competitive, with 6 to 7 providers competing globally. However, multiple high speed rail procurement processes are currently underway globally, which may constrain market capacity.

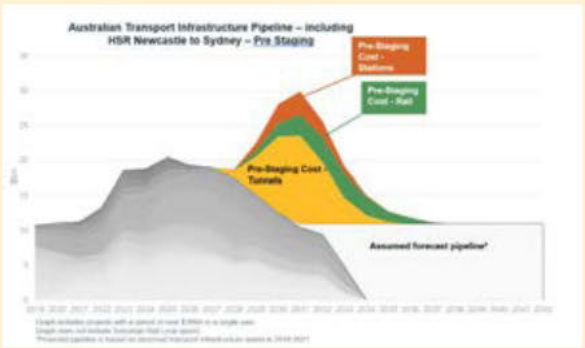
International market participants expressed a willingness to explore skills transfer and local manufacturing, with appetite for some local assembly or manufacture of rolling stock.

A long-term commitment to the Network (that is, certainty of the pipeline) is needed to warrant significant investment in local manufacturing, with support for an overall target of 50 per cent local content in rolling stock manufacturing.

There is sufficient national and international capacity and capability to support competitive fields for the range of high speed rail delivery and operations packages being considered.

Without staging, infrastructure spend at peak would exceed previous transport (eastern Australia) peak spend by 50 per cent.

Staging the Project makes it deliverable within current market capacity.



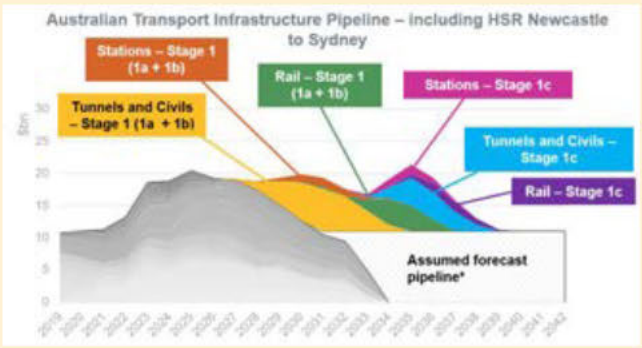


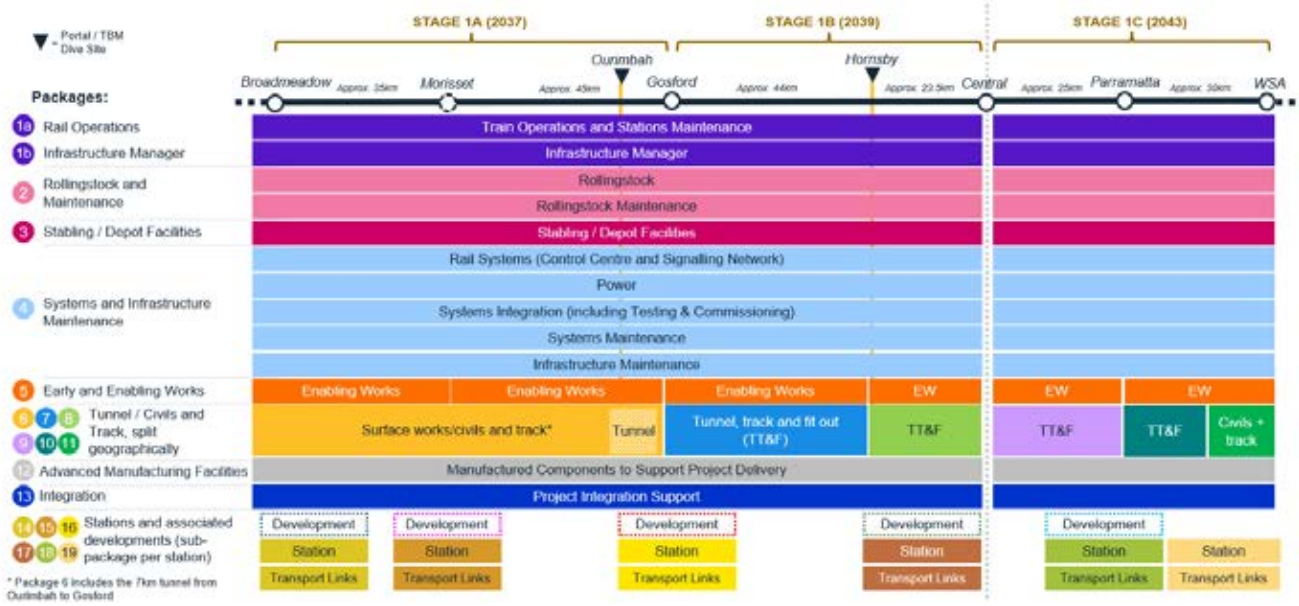
Figure 8-2 Staging strategy

The sequencing of stages has been developed considering opportunities for early realisation of benefits, practical implications associated with the location and ability to access stabling and maintenance facilities to support interim operations together with cost of sections and impacts on market capacity. The staging strategy also considers opportunities to derisk the Project by commencing operations in a lower risk environment.

Staging the Project extends the capital expenditure across a longer period, significantly reducing annual project spend and bringing it in line with a steady-state total Australian transport infrastructure spend of $20 billion per annum (see call out box below). It will also reduce the inflationary potential of a mega-project of this scale.

The packages of work across the stages are organised by discipline and geographical area, with some discipline packages covering the entire extent of the Project, while others are focused on specific geographical locations, as illustrated in the following figure.

Figure 8-3 Packaging strategy



8.3. Delivering differently to reduce mega-project risk

Delivery of mega-projects is almost always challenged by cost and program. Drawing on experiences from previous projects, several initiatives and innovations have been included in the approach to delivery of the Project in response to these challenges and to reduce risk.

8.3.1. Development Phase

A two-year Development Phase is an innovative response to the known challenges of mega-project delivery. The intent is to use this time to derisk the Project's delivery by:

- Securing planning approvals to avoid delays to awarding contracts.
- Undertaking strategic property acquisition to increase program certainty.
- Commencing early engagement with delivery partners through competitive Early Contractor Involvement processes to develop their designs to a high level of detail
- Leveraging advances from Modern Methods of Construction and designing for manufacture and assembly
- Defining interfaces between packages and developing interface risk management strategies.
- Using tried and tested approaches – building on the success of other high speed rail projects and where possible avoiding bespoke or complex designs.
- Using outcome-based rather than prescriptive specifications.
- Identifying further opportunities to reduce or derisk brownfield works.
- Optimising the proposed procurement models.

More haste, less speed (and higher costs)

Many recent projects have faced significant challenges stemming from a common, foundational problem: the tendency to sacrifice opportunities for planning in favour of demonstrating rapid progress towards delivery.

Where this has been the case, it has reduced the ability to thoroughly understand key issues and risks, develop an effective delivery plan, and ensure essential clarity over interface management and scope.

In turn, this lack of adequate up-front planning has often resulted in well-publicised program and cost overruns.

These initiatives will improve productivity during the Delivery Phase and significantly increase confidence in delivery costs and timeframes of the Project.

The Development Phase creates confidence for both the Authority and contractors that the Project can be completed within the timeframes and budget. It is proposed that a Development Phase is implemented for Stages 1A and 1B, and similarly for Stage 1C (encompassing lessons learnt from Stages 1A and 1B). The staged opening of the Project will allow for learning efficiencies to be incorporated – further derisking the Project. The proposed timings of the Project's staged delivery are outlined in the following diagram.

8.3.2. Design development – Early Contractor Involvement

During the initial two-year Development Phase, two proponents from each package will participate in a comprehensive , fostering a competitive environment to maximise innovation and encourage cost and time savings.

The ECI proponents will develop their design to a greater level of detail than would be typical during a bid period – which will assist in refining pricing.

This will also allow for identification of risks prior to any contracts being awarded, reducing the likelihood that they will materialise during the Delivery Phase and affect timely delivery.

Relevant findings from industry engagement

- Given the size of the Project, there is broad support for the adoption of an ECI process, contingent on appropriate cost reimbursement, clarity on the procurement process and timing, and involving no more than two parties or consortia.
- Industry broadly supports the hypothesis that the Project presents better opportunities to achieve cost efficiencies through leveraging ECI to develop designs, promote use of common components and derisk delivery.

This ECI will be run over a period of 12 to 18 months with a set of pre-agreed deliverables. This process will be highly interactive to allow each proponent to develop its proposal with input from the Authority. After a review period, including alignment of common aspects, each proponent will submit a binding offer, based on its proposal, for assessment.

The benefits of Early Contractor Involvement

Through the ECI process proponents will develop:

- A design to meet the outcome requirements specified by the Authority with intellectual property retained by the Authority.
- An appropriate specification, based on good industry practise and recognised international high speed rail standards for the works.
- A detailed program and budget for delivering the works.

This approach will enable the Authority to modify design, program and cost as necessary, while also ensuring that these elements are feasible, considering the fluctuating market capacity throughout the period.

Alongside the ECI process, the relevant Environmental Impact Statements will be prepared, taking account of the emerging schemes that are being developed. Once the ECI process has been completed, the successful contractor will move into a 'preferred' status and work with the Authority to finalise any outstanding issues associated with the relevant Environmental Impact Statement, with award only taking place once planning approval has been given.

Project integration

The packaging of the Project has considered the minimisation of interface risk; however, with the Delivery Phase involving the concurrent construction of 13 packages of work over 11 to 12 years for Stages 1A and 1B this will remain a significant risk.

Digital modelling will be used to identify and resolve potential issues during the Development and Delivery Phases and streamline the construction processes. The use of standardised components (detailed further below in Section 8.3.3.) will further reduce this risk.

A supplier will be engaged to provide project integration support that will assist in mitigating the risks associated with package interfaces. This will allow the rapid mobilisation of highly experienced delivery support personnel through the ECI process and on to delivery. However, the Authority will be ultimately responsible for managing the risk and key decision making roles will be held by Authority personnel.

Relevant findings from industry engagement

- An 'integrator' entity would drive benefits in managing design and construction interfaces, including to support implementation of common design and coordinate design refinements.
- As the client delivery organisation, the Authority should be small but agile, with the right balance of technical and operational expertise.
- A forum in which the Authority, designers and delivery partners meet to resolve interface and integration issues on whole of project basis would be beneficial – the Sydney Metro City and Southwest Joint Project Committee was highlighted as a successful model with strong support from industry.

See Chapter 12 for additional detail on proposed client model during Development Phase.

Over time, it is planned that the Authority's systems and processes would be developed and implemented, and that the Authority will recruit more staff to gradually move towards a full employee delivery management team. The procurement strategy for the Project Integration Support package is included in the Section 8.3.5.

8.3.3. Improving productivity during construction using modular, repeatable elements

A failure to take advantage of Modern Methods of Construction has been a key factor holding back productivity in the delivery of major projects, with the focus often being on traditional site-based construction, there has been a lack of modularity and a trend of bespoke elements instead of repeatable elements.

The use of Modern Methods of Construction will be mandated across all elements of the Project, with designers tasked from the offset to maximise in the design the creation of elements that can be manufactured off site with site work limited to assembly rather than full construction.

This will require a fundamental change in the design approach where designs are completed and then reviewed for offsite construction opportunities rather than being an integral part of the design philosophy. Contractors and designers will be required to ensure they have Modern Methods of Construction and manufacturing expertise within their teams to ensure this approach is implemented fully and is successful.

During the ECI phase, a key focus will be on developing common modular, repeatable design elements that can be manufactured offsite. This will facilitate productivity increases and cost reductions over time and, as these design elements can be reused on subsequent stages, it will reduce design costs over the life of the Network.

To support this approach, the Authority is proposing to develop Advanced Manufacturing Facilities that will allow production and manufacture of these elements to be of high quality, effective and efficient. The procurement strategy for the Advanced Manufacturing Facilities is included in Section 8.3.5.

How Advanced Manufacturing Facilities will streamline construction

The Advanced Manufacturing Facilities will produce a finished 'kit of parts' for each of the rail infrastructure systems to save time and cost and increase delivery certainty.

For example, a tunnel 'kit of parts' may include concrete segments, concrete track slab, walkways and overhead lines.

- **Manufacturing line** facilities will manufacture tunnel segments, sections of viaduct and other large civil elements.
- **Assembly line** facilities will assemble rolling stock.
- **Consolidation line** facilities will store parts from suppliers, consolidate components into kits and manage distribution to construction sites.

8.3.4. A standard procurement model for all applicable packages: Hybrid ITC

The Authority is seeking to realise efficiencies and opportunities for economies of scale through a common commercial approach across packages (as appropriate), including the use of standardised contracts and/or common terms.

A Hybrid Incentivised Target Cost (Hybrid ITC) model, which combines features of traditional and collaborative contracting models, will be implemented for all packages where it can be suitably applied, to establish a common commercial approach.

The Hybrid ITC approach optimises risk allocation between government and industry, taking into consideration the lessons learnt from recent challenges on mega-projects.

Relevant findings from industry engagement

Given the scale of construction packages, in addition to the long construction program, there is strong appetite for a Hybrid ITC model where risk can be optimised.

The Hybrid ITC model would allocate package scope between risk-sharing and fixed price portions, allowing for differing levels of risk transfer within a single package. Where packages have a clearly defined scope, the level of fixed price portion may be very high, with a limited risk-sharing portion. The Hybrid ITC will be further tested in the Development Phase with consideration given to the incremental benefits, costs and risks of including fixed price elements versus a fully open book approach.

The Hybrid ITC model is illustrated below.

Figure 8-5 Hybrid ITC model

Hybrid ITC is assessed as being suitable for all packages except for the following, which have whole-of-life considerations:

- **Rail Operations**: Operations concession and operations franchise were assessed as alternative procurement models.
- **Rolling Stock and Maintenance**: In addition to Hybrid ITC, PPP and Lease and Maintain were assessed as an alternative procurement models.
- **Systems, Power, Systems Integration and Infrastructure Maintenance**: In addition to Hybrid ITC, PPP was assessed as an alternative procurement model.
- **Advanced Manufacturing Facilities:** In addition to Hybrid ITC, Design and Build plus Supply Concession and PPP were assessed as alternative procurement models.

8.3.5. The preferred procurement approach

The preferred approach is summarised in the table below with further detail provided in the subsequent table. This approach follows an iterative process and testing through the industry engagement, industry roundtables, validation and verification visits, and updates in response to feedback.

Table 8-1 Preferred procurement approach by package

Package		Preferred model – Stages 1A and 1B	Extension approach – Stage 1C
1a 1b	Rail Operations Infrastructure Manager	Operations concession	Priced option Option to retender
2	Rolling Stock and Maintenance	PPP	Priced option Ability to procure separate rolling stock
3	Stabling / Depot Facilities	Hybrid ITC	N/A – minimal Stage 1C work anticipated
4	Systems and Infrastructure Maintenance	PPP	Priced option Option to retender
5	Early and Enabling Works	Hybrid ITC	Hybrid ITC

Package		Preferred model – Stages 1A and 1B	Extension approach – Stage 1C	
6 7 8	Tunnels, Track and Fit-out/Surface Works and Track	Hybrid ITC	9 10 11	Hybrid ITC
12	Advanced Manufacturing Facilities	Design and Build plus Supply Concession		Option to extend
13	Project Integration Support	Modified delivery partner with incentives to drive value for money	→	Priced (rates) option
14 15 16 17	Stations and Associated Developments	Hybrid ITC with separate sale of development rights	18 19	Hybrid ITC with separate sale of development rights

The Development Phase will be used to further challenge and refine the procurement approach.

1a 1b

Rail Operations
Infrastructure Manager

Operations concession

The Authority would retain control over fares, timetabling and service planning, and retain all demand risk associated with rail operations. The private sector operator would provide rail and station operations, subject to a performance regime based on key performance indicators (KPIs) this may include limited revenue-related KPIs

The Rail Operator will be engaged early during the ECI process (as opposed to the use of a shadow operator), as recommended through the industry engagement process. The operator would provide input to the project design, specification, stations and business requirements development. Rail operations will involve a single procurement of two operations concession contracts: Train Operator and Infrastructure Manager. The procured Rail Operator will sign both contracts initially; however, separation of these responsibilities enables the Authority to ultimately adopt the role of infrastructure manager once it has developed the capability. This is discussed further in Section 8.4.

2 3

Rolling stock, depot and maintenance

Rolling stock and maintenance – PPP
Stabling and depot – Hybrid ITC

Rolling stock procurement provides a major opportunity to grow Australia's long-term rail manufacturing capability – representing approximately 60 per cent increase in the value of the combined Queensland, NSW and Victorian pipelines over the next 30 years. Localising 50 per cent of this value has the potential to create over 26 million direct employment hours and a total of over 1,100 full time equivalent jobs with associated wider economic benefits.

The overarching rolling stock strategy includes contracting for trains with a long-term supply agreement beyond initial fleet requirements, including long-term maintenance to ensure whole-of-life outcomes, and a tender process that includes a focus on localisation (50 per cent local content to be mandated), maintenance strategies and associated facility requirements. The strategy includes awarding early to provide time to efficiently and effectively localise manufacture, with flexibility to fully import prototype trains, reducing risks and providing an opportunity to transfer technology and train local staff.

Rolling stock

- Package delivered as a PPP with an ECI process.
- ECI procurement will prequalify parties based on suitability of rolling stock product.
- ECI will then be undertaken with two entities to develop the train concept design, performance modelling, localisation strategy and targets, maintenance strategy and interfaces, and facilities design.
- Once the design and scope has been developed, ECI parties will submit an offer to design, build, finance, operate and maintain the rolling stock. The Authority will undertake the RFP evaluation through to contract and financial close.

Facilities (Stabling and Depot)

- Authority will procure a civil contractor to deliver the rolling stock advanced manufacturing and maintenance facilities using the Hybrid ITC approach (noting that a significant portion of this contract could be fixed). The facilities concept design developed through the Rolling Stock ECI process will be novated to the Authority (and potentially to the selected civil contractor).
- Facilities will be leased to the rolling stock supplier who will undertake the specialised fit out and provide equipment.

Workforce for local content

- The Authority will assist in establishing local capability and capacity, including through promoting and encouraging skills development and training through the tertiary education systems and enabling time in the delivery program for knowledge transfer by the successful supplier.

Systems and Infrastructure Maintenance

ECI and PPP

- Delivered as a PPP with an ECI process. During ECI, short-listed consortia are engaged to develop the design and are paid a Development Phase fee for activities undertaken in this phase.
- Following ECI, consortia will submit an offer to design, build, finance and maintain the package scope of work (systems, power, systems integration and infrastructure maintenance) under an availability PPP structure.
- The PPP commercial principles and risk allocation will be further developed and tested with the market in the Development Phase. Given the scale of the PPP package, there will be some elements of the ITC structure within the PPP contract.
- The Authority is exploring the option of the geographical packages (that is, tunnels and surface works) to install the systems equipment under the supervision of the systems provider to reduce the access interfaces for the geographical packages during construction and installation. This approach will be further explored during the Development Phase.

Tunnels, Track and Fit-out / Surface Works and Track

ECI and Hybrid ITC (using a framework approach)

Framework Agreement

- A Framework Agreement will cover all tunnel packages (and separately, all surface works and civils packages) and will include the commercial principles for the ECI and subsequent phases. The use of the Framework Agreement intends to streamline and standardise the procurement process by securing agreement upfront which will limit contractual changes to limited, package specific issues.

Competitive ECI

- A competitive ECI process will be used to develop reference designs for each of the packages to be awarded under the Framework Agreement.

- For the first tunnel package, the ECI process will cover the design of both the tunnel and the design for the linewide track and infrastructure across the full alignment. This design will then be used by later contractors who only construct / install the linewide track and infrastructure within their geographic package (tunnel or surface portion).
- For later packages, a shorter or condensed ECI process can be used to develop the tunnel / civils design, leveraging the previous design work to drive efficiencies in design and reduce duplication across packages.
- A preferred contractor for each package will be selected and enter into a Hybrid ITC contract with the Authority. This captures the main commercial terms agreed as part of the Framework Agreement and other detailed terms and conditions agreed at the competitive ECI step.

12 Advanced Manufacturing Facility

ECI and Design, Build plus Supply Concession

To develop all infrastructure kits and achieve the desired efficiencies, several Advanced Manufacturing Facilities will be required. Facilities with manufacturing lines will be required for the manufacture of tunnel segments, as well as for the production of viaduct and other large civil sections. Facilities with assembly lines will be required for the assembly of components into finalised products (such as switchgear and signalling), and facilities with consolidation lines will be required to store parts from suppliers, consolidate components into kits, and manage distribution to the construction sites. Each AMF developed for the Project will be designed to allow for adaptation to facilitate new functions to meet the future demands of the National High Speed Rail Program.

Design

Two design ECI options are currently being considered for design of common components (such as segments), which will be further tested against agreed criteria as the scope of the AMF is confirmed:

- Option 1: A single Authority-led ECI to establish standard design pre-procurement where the Authority procures a design team to develop the project design. Once the design is complete and certified, it is then taken to market for each contractor to use as the basis for their individual package designs.
- Option 2: Through the competitive ECI established for Package 1 (Tunnel, Track and Fit-out), the successful proponent sets the consistent design for the alignment. The Authority would establish performance and design principles and the successful contractor's design becomes the standard for future packages.

Procurement strategy

During the development of the design ECI, the Authority, supported by the Integrator will go through all approvals processes and publish a call for EOIs for interested contractors to design and build the AMFs and enter into a concession to supply the segments to contractors. Based on EOI assessment criteria, two to three parties will be short-listed to develop detailed proposals.

Once the design of the tunnel segments has been reviewed and adopted by the Authority and the Integrator, the Authority will provide the segment design to the short-listed parties to develop the detailed proposals.

Proponents will be required to develop their proposals based on:

- Design provided by the Authority.
- Guaranteed minimum volume from the Authority.
- Automation in line with the Authority's Modern Methods of Construction philosophy.
- Storage facilities to deliver segments based on the tunnel contractors' program.

The successful tenderer will be offered an initial 10 year concession (the term will be determined based on the length of the civils contracts) and 5-year extensions based on performance.

During the Development Phase the Authority will investigate alternative options for private finance.

13 **Project Integration Support**

Modified delivery partner with incentives to drive value for money

A delivery partner will be engaged to provide Project Integration Support to the Authority, in order to rapidly mobilise an experienced delivery support team through the ECI process and Delivery Phase and to support in the execution of the AMF strategy. This package will be procured under a modified delivery partner contract, including a smaller scope and a modified fee arrangement, and clearly defined KPIs to drive outcomes throughout the Project. The delivery partner will be selected based on prior experience acting as a delivery partner for major infrastructure projects and a proven track record in managing complex package interfaces.

14 15 16 17 **Stations and associated developments**

Hybrid ITCs. With sale of OSD air rights or DevelopmentCo

- Stations will be delivered through a Hybrid ITC approach with a sale of the development rights. Under this model, Government will procure the land for the station inclusive of over/adjacent developments. A private developer will pay for the rights to develop over/adjacent to the station (upfront payments and/or staggered through contributions to station costs). The overnment will deliver the station under a Hybrid ITC model with an interface agreement put in place between the two contracts. To develop reference designs for each of the station packages, a competitive ECI process will be used.
- Where appropriate a participation model will be considered as an alternative to an OSD air rights sale. Under this model, Government would purchase and rezone the land. Unlike the above Hybrid ITC model, the land would be vended into a 'DevelopmentCo' SPV. A private developer would be engaged to finance and build the development. This allows both government and the developer to participate in the upside from the development and any long-term urban renewal activated by the high speed rail station. Market feedback has indicated developers would view this positively as it reduces their upfront capital requirements. The station would be developed through a Hybrid ITC model with an interface agreement between the two entities.

8.3.6. Preferred approach to operations

The Operations Phase of the Project aims to ensure the efficient, safe and reliable functioning of the high speed rail system. This phase will involve three main parties, including:

- **The Operator**: For Stages 1A and 1B of the Project, the selected train operator will undertake two main roles:
  - **Train operation:** Includes responsibility over day-to-day operations of the trains, as well as Level 1 maintenance of the rolling stock and evel 1 maintenance of all stations (Level 1 maintenance typically involves general cleaning, light repairs and any other non-specialised simple interventions).
  - **Infrastructure management:** Includes monitoring infrastructure asset condition and ensuring regulatory compliance. The infrastructure manager is also responsible for coordinating system shutdowns with the Rolling Stock Maintainer and the Systems and Infrastructure Maintainer to facilitate maintenance or renewal of the rail infrastructure assets.

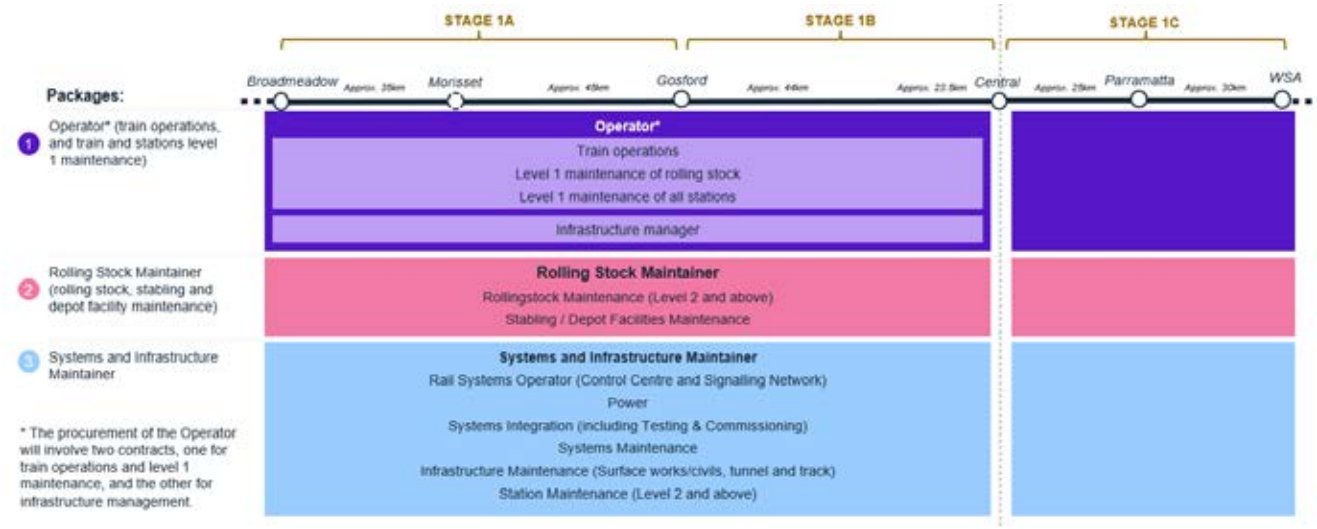
Validation and verification of the approach

Existing high speed rail networks and operators emphasised the importance of engaging an expert operator early. There are a number of European high speed rail operators that would be interested in bidding for the train operations and infrastructure manager package.

- **Rolling Stock Maintainer**: Includes responsibility over maintenance of the rolling stock for Level 2 and above works, as well as the maintenance of stabling and depot facilities.
- **Systems and Infrastructure Maintainer**: Includes provisions for the operations and maintenance of the control centre, signalling network and track power, as well as for maintenance of civil infrastructure elements such as viaducts, tunnels and track.

This Operations Phase packaging approach is illustrated in Figure 8-6 below.

Figure 8-6 Operations Phase packaging strategy



8.4. Laying foundations for the Network's operating model

The Delivery Strategy has been developed in the context of the future Network, with the packaging and procurement approach structured to effectively enable future extensions.

To ensure that the Delivery Strategy for the Project supports the transition to the Network vision, a set of commercial principles for long-term operations and a future network business model were developed which have guided the development of the Delivery Strategy.

8.4.1. Future network commercial principles

The six commercial principles developed for future network operations are as follows:

- The operating model must allow competitive fleet operations.
- Revenue risk is to be held by operators to incentivise patronage uptake.[1]
- Infrastructure financing, ownership and management is to be undertaken separately for fleet operations.
- Rail infrastructure is to be owned by one or more private or public infrastructure companies.
- Fleet operators will have to bid and pay an infrastructure access charge where revenues are sufficient.[2]
- Access charges will be used for asset maintenance, and for enhancements and partial repayment of capital where possible.

8.4.2. Future network business model

A partially vertically separated model was selected for its ability to achieve an optimal long-term outcome for the Network. This model best aligns to the objectives and enables separation between the train operations and infrastructure management and delivery across the Network. The future commercial principles and business model have been considered as part of the development of the Delivery Strategy, to ensure the approach to the Project does not preclude or impede the desired end state.

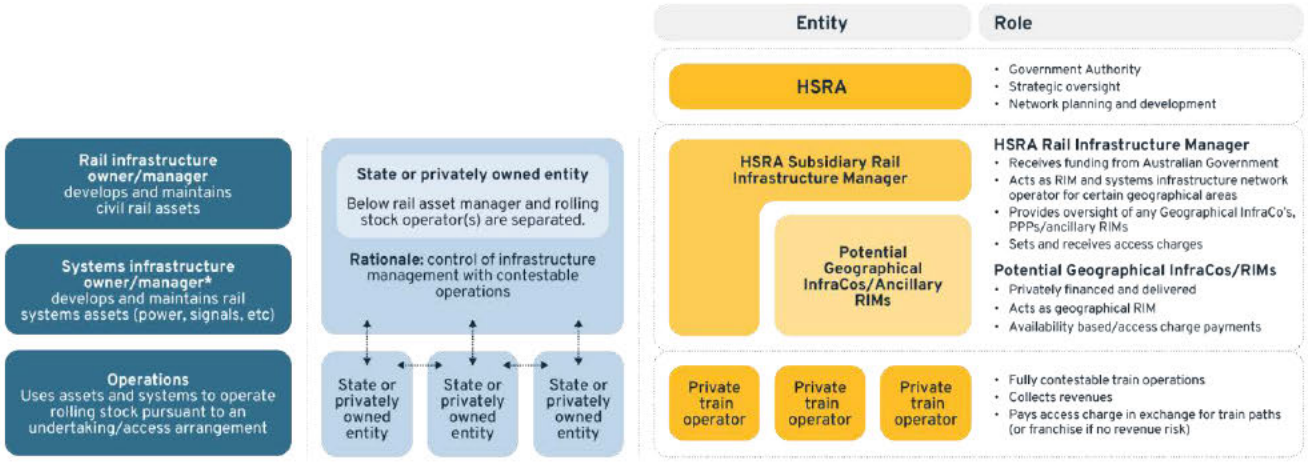
Validation and verification of the approach

The tour of European high speed rail operators indicated a strong recommendation that the Authority should set itself up for the ultimate operating arrangement.

Key findings from industry engagement

There is sufficient appetite for high speed rail operations in Australia, with at least four international operators expressing interest in the Project.

Figure 8-7 Partially vertically separated model



[redacted]

[1] Revenue risk unlikely to be taken by operators until stable operations established. May require underwriting.
[2] Fare setting mechanism and responsibility between private operators and government to be confirmed.

Chapter 9

Funding and finance

Australian Government
High Speed Rail Authority

Staging delivery costs and operating without need for subsidy

- The Project will not require ongoing subsidy during operations. The estimated revenues (including fares and commercial revenues) will cover operations, maintenance and lifecycle replacement costs.
- [redacted]
- Sensitivity analysis for the Project and Stages 1A and 1B indicate that even in the event that operating expenses are significantly higher than expected, or revenues are lower than expected, the Project would still recover its operating costs and lifecycle replacement costs.
- Government funding will be required for the construction of infrastructure and repayment of systems and rolling stock financing. The total delivery phase cost is estimated to be $61.2 billion (P90, nominal) for Stages 1A and 1B and $32.4 billion (P90, nominal) for Stage 1C.
- The scale and complexity of the funding and financing required to deliver the Project will require collaboration from government and the private sector. A range of approaches were considered based on industry feedback, market capacity analysis and alignment with the proposed Delivery Strategy. The selected scenarios use a combination of private finance through Public Private Partnerships to maximise value for money outcomes for the Project, and private financing for selected major construction packages to smooth the government funding requirement by capping the annual funding contribution to a $5 billion per annum cap for Stages 1A and 1B.
- The transformational nature of the Project means that value sharing mechanisms have the potential to support funding the Project. These mechanisms could potentially contribute between [redacted] on average per year in Stages 1A and 1B, and between [redacted] for the Project. Effective implementation and revenue collection would require consultation and agreement between the Australian, NSW and local governments. These mechanisms have not been included in the financial appraisal for the Business Case but present opportunities for further development.
- Future opportunities to improve affordability include optimising commercial revenue streams such as in-station retail, car parking and commercial development of integrated station precincts.

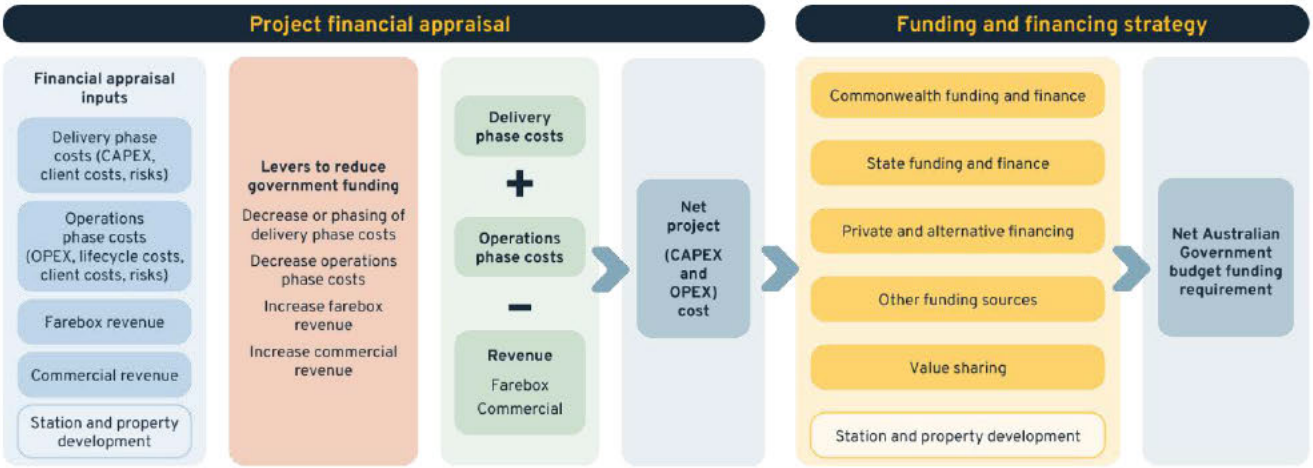
9.1. Overview and approach

The approach to funding and financing for the Project reflects the proposed Delivery Strategy described in Chapter 8, including a staged delivery and funding approach: Development Phase, Stages 1A and 1B, and Stage 1C. Each of these presents its own funding and financing implications that could be considered as sequential steps towards delivery of the Project.

The funding and financing strategy comprises two core components. A project financial appraisal considers the estimated costs of developing, delivering and operating the Project, alongside anticipated revenue streams, to derive a net Project capital expenditure (capex) and operating expenditure (opex) requirement. A funding and financing strategy then reviews and assesses optimal funding and financing options to identify the net Australian Government budget funding requirement.

A conceptual framework illustrating the funding and financing strategy is set out below.

Figure 9-1 Funding and financing framework



Consistent with Infrastructure Australia guidelines, the financial appraisal presents project cashflows, the net present value of costs, revenues and net project cost. This informs government of the whole-of-life financial ask to deliver the Project.

The funding and financing strategy then identifies the funding sources and financing mechanisms that may be applied.

The development of this funding and financing strategy has been guided at all times by the Authority's funding and financing objectives for the Project (see call out box, right).

Two further strategies (outlined in this chapter) have been developed to inform this strategy:

- Fare strategy – The preferred fare strategy, including level and structure of fares for Newcastle to Sydney. This will inform farebox revenue inputs into the Project's financial appraisal.
- Value sharing strategy – The preferred value sharing strategy, including how can the Project best capitalise on value uplift related to the Project. This will inform the funding and financing options assessment.

The Authority's funding and financing objectives for the Project

- Minimise total government funding.
- Smooth government budget funding over time.
- Use private finance where it can drive the most benefit across construction, operations and program, and align commercial drivers of private financiers with government objectives.
- Align risk profile of government and market during delivery and operations.
- Project financing structures maintain flexibility and value for money for future changes or stages.
- Alternative funding options are practical and will be accepted by stakeholders and the community.

Reflecting the Project staging assumptions outlined in Chapter 8, this chapter presents findings separately for the Development Phase, Stages 1A and 1B (HSR Newcastle Station to HSR Sydney Central Station) and for the Project (HSR Newcastle Station to HSR Western Sydney International Station).

The funding and financing strategy has also been informed by feedback from industry engagement and market capacity analysis.

9.2. Capital cost estimates and uses

The capital cost estimates were prepared for each stage on a P50 and P90 basis in real (excluding escalation) and nominal (out-turned inclusive of escalation) to meet the differing requirements of the economic appraisal presented in Chapter 7 and the financial appraisal presented in this chapter. Consistent with guidelines and established business case practice, the economic appraisal uses the P50 real estimates. The financial appraisal presented in this chapter uses the P90 nominal cost estimates to inform the funding and financing requirements consistent with relevant guidelines.

The figure below outlines how the capital cost estimates were built up to P50 and P90 estimates in real (excluding escalation) and nominal (out-turned inclusive of escalation).

Figure 9-2 Project capital cost estimates

9.3. Development Phase costs

As noted in Chapters 8 and 9, an upfront two-year Development Phase for Stages 1A and 1B is proposed to ensure sufficient time is taken to plan and execute a project of this size and scale. A similar Development Phase is proposed for Stage 1C. The estimated costs associated with the Development Phase – excluding property – are outlined below.

Table 9-1 Estimated Development Phase costs

Item	Estimated cost ($m)
Technical advisors and support	213
Early Works and Early Contractor Involvement and Design	402
Authority additional staff	53
Development Phase costs Stages 1A and 1B	**667**
Development Phase costs Stage 1C	**400**
Total Development Phase costs	**1,067**

The Development Phase costs assume that Early Contractor Involvement will be undertaken for 11 packages with 2 contractors involved per package and their participation costs being met by the Authority. The costs assume further geotechnical assessments of the alignment and limited advanced early works for utilities are required in this phase. Specialist technical advisors would be engaged to support technical work, environmental assessments, planning approvals, commercial, transactions and legal advice. The Authority will require additional internal resources to build internal capability, oversight, governance and corporate functions.

The Development Phase is expected to be directly funded by the Australian Government with no private financing or alternative sources assumed for this phase.

Further information on the key milestones and deliverables for the Development Phase and the proposed client delivery model is outlined at Chapter 12 – Project implementation and roadmap.

9.4. Delivery Phase costs

The total Delivery Phase costs for the Project are estimated to be $61.2 billion (P90, nominal) for Stages 1A and 1B and $32.4 billion (P90, nominal) for Stage 1C.

Detailed whole-of-life costs have been prepared using a combination of build-up benchmark data and unit rates based on the technical inputs from the Definition Design outlined in Chapter 5. The cost plan aligns with the Department of Infrastructure, Transport, Regional Development, Communications and the Arts Cost Guidance, and the Transport for NSW Cost Estimating Standard at the level of detail required for a business case.

The Delivery Phase cost covers the period between the completion of the Development Phase in 2027 and the commencement of operational services to the public, that is, FY35-39 for Stages 1A and 1B (HSR Newcastle to HSR Sydney Central) and FY41-FY43 for the full Project (HSR Newcastle to HSR Western Sydney International).

Table 9-2 Delivery Phase cost estimate (P90 nominal)

	Stages 1A and 1B	Stage 1C	Project
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]		[redacted]
[redacted]	[redacted]		[redacted]
[redacted]	[redacted]		[redacted]
[redacted]	[redacted]		[redacted]
[redacted]		[redacted]	[redacted]
[redacted]		[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

The key assumptions underpinning the Delivery Phase costs were based on recent market data for similar infrastructure projects in Australia, benchmarked against high speed rail projects in Spain, the United Kingdom and the United States of America.

- **The civil construction of tunnels and tracks** [redacted]. The assumed tunnel productivity rates were based on data from recent extensive tunnelling in NSW, including for projects such as Sydney Metro, and adjusted accordingly to reflect the proposed longer average tunnel lengths and construction strategy. For example, the productivity rates for double-shield tunnel boring

machines were assumed to range from 420 metres per month (lower bound) to 750 metres per month (upper bound) with a base line of 600 metres per month.

- **The systems development package** [redacted] This includes the procurement of signalling network, train controls, communications and central control systems, high voltage power systems and maintenance of infrastructure. The estimated cost is based on European Train Control System (ETCS) Level 2 train control systems and typical rail control communications and systems available for high speed rail services internationally. The cost estimate has applied recent ETCS Level 2 upgrade benchmark rates as the baseline cost. International benchmarked data and experiences were adjusted as required to the project specifications.
- **The station construction costs** [redacted] Cost estimates were based on project definition design sizes for excavation, structural requirements and fit outs. The assumed rates were based on benchmark contracted rates for similar relevant projects at each station location and construction type such as cut and cover, cavern, viaduct or at grade.
- **The rolling stock acquisition and maintenance** cost estimates [redacted]. The rolling stock estimates were based on assessment of market rates and engagement with international industry for train models that meet the Project's specifications and were adjusted accordingly for required quantity and exchange rates.

Further information on cost estimate assumptions is included in the Cost Plan.

9.4.1. Approach to contingency and escalation

The risk contingency amounts have been developed using a probabilistic risk process that follows best practice, specifically the requirements of the Department of Infrastructure, Transport, Regional Development, Communications and the Arts 'Guidance Note 3A — Probabilistic Contingency Estimation' and the NSW Risk Engineering Society (Engineers Australia) 'Contingency Guideline 2nd Edition 2019'.

To inform the probabilistic risk model, the Authority and its external experts developed a comprehensive range of risk model inputs, including estimates of uncertainty associated with cost estimation assumptions, estimates of typical client retained schedule risks (informed by a separate schedule risk analysis), and a residual risk quantification exercise incorporating the various project risks not directly costed within the project cost estimate.

Key sources of uncertainty considered within the probabilistic risk model include:

- **Design:** Key scope and design assumptions relating to station locations, type, size and layout; stabling and maintenance facilities location, sizing and requirements; tunnel designs and lengths; viaduct designs and lengths; and operational and fire life safety requirements including crossovers and rescue caverns.
- **Construction and Delivery Strategy:** Constructability assumptions including those related to access, construction techniques, temporary storage, manufacturing, logistics matters, haulage, craneage and spoil sites. There has been extensive market consultation, resulting in a contract packaging strategy that optimises design and construction interfaces.
- **Property:** Extent of property required and associated cost uncertainty for all permanent and temporary land and property requirements necessary to design, build and operate the proposed railway.
- **Schedule:** Consideration of key schedule and critical path assumptions including key productivity rates and activity durations (such as tunnel boring machine production rates) as well as consideration of schedule risks such as those relating to delayed approvals, latent conditions, constructability challenges, interface risks, and testing and commissioning delays.

- **Rolling stock:** Rolling stock costs have been informed through direct supplier consultation. A range of costs were obtained for a range of product standards and specifications. The Cost Plan adopted a relatively high standard of rolling stock into the project cost estimate.
- **Contingent risks:** Consideration of specific project risks, either not considered directly within the cost estimate or within assessments of the cost and schedule risk assumptions as outline above. Examples of contingent risks considered within the model include: unexpected planning approval conditions, discovery of latent conditions (geotechnical, heritage, contamination or hydrological), areas of potential scope growth or design changes, unforeseen operational requirements, unplanned upgrades to network power supplies, unforeseen constructability challenges, and additional fire and life safety requirements.

The risk model was independently validated to ensure accuracy and robustness, and standard major infrastructure project parameters were applied including a simulation using 10,000 iterations.

Outputs from probabilistic risk analysis are typically expressed as a distribution of results, from which cost confidence levels of interest are determined. For example, a P90 figure means that there is a 90 per cent chance of the nominated cost not being exceeded for the currently defined design and scope. By extension, it means there is a 10 per cent chance of the nominated cost being exceeded. The P50 figure means that there is a 50 per cent chance of the nominated cost not being exceeded for the currently defined design and scope.

The difference in contingency amounts between P50 and P90 were benchmarked against typical 'expected' ranges for P50 and P90 figures for projects at a similar project stage. The P50 contingency of 12 per cent and P90 contingency of 26 per cent (for the Project) are within guidance for projects at business case stage. The guidance suggests a P50 range of 10 to 15 per cent and P90 of 25 to 40 per cent at this stage. The assumed P90 contingency amount is within this range and has been informed by expert advice that noted the following:

- There are significant elements of the Project considered to be relatively low to moderate risk due to recent experience, lessons learnt and knowledge gained from the delivery of comparable projects within the Sydney basin, including the various Sydney Metro and Transport for NSW motorway projects (completed or currently underway).
- These project benchmarks, in particular, the associated competitively tendered prices, actual construction productivities and nominal project costs form a genuine basis for a relatively high confidence in the assumptions informing the Project cost estimate and schedule. There is a high confidence in the design, schedule and cost assumptions in particular in the areas of tunnelling and roadheader operations in Sydney sandstone, tunnelling under major waterways, constructing viaducts and building large scale train stations in relatively low level built-up areas.
- The areas where there is a lower level of design confidence have attracted significant contingency allowances in the order of 40 per cent or higher. This includes elements such as enabling works in challenging terrain, construction of stations in complex city environments (cavern and cut and cover), and construction of linewide systems over significant distances where access is constrained.
- There are further value-engineering opportunities over and above those identified in Section 9.4.2 that have not been included in the cost estimate or contingency analysis. These will be investigated during the Development Phase with direct engagement with the market to optimise the solution.

The escalation costs have been applied to the proposed construction expenditure profile from 2025 and adjusted to the relevant packages as required. For example, rail construction cost escalation rates were based on Transport for NSW guidance for FY25 to FY28 (reducing from 4 per cent per year to 2.7 per cent per year) and from FY29 it was assumed to remain at 2.7 per cent. Specific escalation rates for property costs were developed by specialist advisors, as were other specific scope items such as biodiversity costs.

The cost plan excludes allowances for future pandemics such as cost increases experienced during the COVID-19 pandemic or future geopolitical risks, as aligned with the cost estimating guidelines.

9.4.2. Stress testing cost estimates

A project of this scale and complexity carries inherent cost overrun risks. The Authority has drawn lessons from other mega-projects that have faced extraordinary cost increases to develop a 'high range' scenario that stress tests the estimated costs. The stress test identified key drivers of risks based on industry engagement, published research on mega-projects and generally accepted causes of cost overrun and delays. The stress test increased the P50 and P90 contingency to 21 per cent and 34 per cent respectively (see figure below).

The approach involved running several probabilistic simulations using discrete scenarios in isolation and in combination to derive the estimated 'high range' costs that combines all identified risk scenarios:

- Under-estimation of risk allowances for conditions such as contamination, geotechnical or heritage.
- Under-estimation of scope and design, in particular stations, at-grade civil works and viaducts, line-wide systems, and stabling and maintenance facilities.
- Under-estimation of market rates and prices including pricing of transferred risk for key contract packages.
- Inability to achieve assumed cost efficiencies from the proposed Advanced Manufacturing Facilities.
- Under-estimation of scope and technical interface and interdependency risks.
- Under-estimation of potential project delays arising from client retained risks that impact contractors following award (during the Delivery Phase).

Figure 9-2 'High range' project capital cost estimates

The 'high range' costs were developed for reference only to provide additional sensitivity analysis of potential costs. While the economic appraisal use the 'high range' costs for sensitivity analysis, the financial appraisal and funding and finance scenarios in this chapter uses the total nominal P90 estimate of $61.2 billion (P90 nominal) for Stages 1A and 1B, and $32.4 billion (P90 nominal) for Stage 1C.

9.4.3. Value enhancement

The Authority identified opportunities to reduce construction and operating costs throughout the Definition Design process. A systematic approach was undertaken to refine costs through design improvements, while maintaining the overall project outcomes and functionality. The following scope items were identified for value enhancement and integrated into the Definition Design:

- Two stabling facilities that would have required extension of alignment, tracks and property acquisition were consolidated into a single facility along the alignment.
- Station platforms were optimised at HSR Central Coast and HSR Lake Macquarie.
- The number of train sets was reduced and costs benchmarked to existing and proven technology.
- Station design sizes were reduced, a structural design approach was undertaken and underground infrastructure was shifted to above ground where possible.
- Advanced Manufacturing Facilities were maximised to produce all the required tunnel and viaduct precast segments.
- Ballast would be used for most at grade sections.
- Noise wall and parapet design were optimised.

Several additional value enhancement opportunities have been included in assumptions underpinning the cost plan, but have not been integrated into the Definition Design:

- A standardised length and span approach for determining viaduct structure size.
- Reduced construction access and permanent access roads for surface alignment.
- Further minor optimisation of station sizes, canopy coverage and structural approach to be achieved in the Development Phase.

Further value enhancement opportunities included rescue station optimisation, viaduct height optimisation, station design to further optimise front of house and back of house opportunities, and property acquisition footprint for temporary sites. These opportunities will be further investigated during the Development Phase.

9.4.4. Peripheral and precinct works

The cost plan includes provision for direct costs relating to peripheral and precinct works that will be needed to connect the stations to surrounding precinct infrastructure, create vibrant local communities and enhance customer experiences. These include roadworks, station maps, street furniture, wayfinding guides and internet services. The costs for road infrastructure required for access during construction where the existing infrastructure is either not fit for purpose or in place are captured as part of the early works.

The allocation for peripheral and precinct works for each station area is outlined below.

Table 9-3 Peripheral and precinct works – construction costs

Location	Construction costs ($ real)
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

9.4.5. Property costs

[redacted] These acquisitions will be undertaken in accordance with relevant Australian and NSW Government land acquisition legislation and to best meet project and timing objectives for delivery. Property acquisition for Stages 1A and 1B is estimated to commence during the Development Phase. The property costs for Stages 1A and 1B, and for Stage 1C, together with a breakdown by land use, are provided below.

Table 9-4 Property acquisition costs ($ million, real)

[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Table 9-5 Property acquisition costs by land use

Land use	Percentage
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

9.5. Operating Phase costs

Operating Phase costs cover all costs associated with operating the services, as well as maintenance, replacement and renewal of the Project's assets.

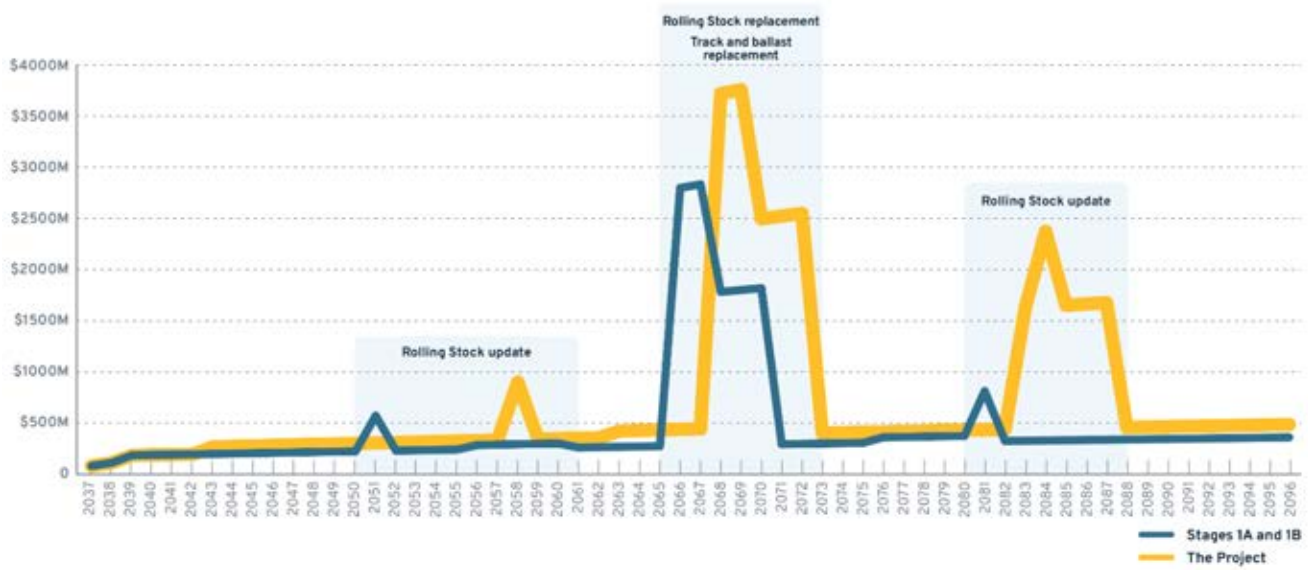
Operating and maintenance costs for Stages 1A and 1B are estimated at $203 million (nominal) in FY44, and for the Project they are estimated at $273 million in FY44.

The Operating Phase costs cover four main categories:

- **Operations:** Electricity, customer services at station and in trains, control centre, train drivers, corporate services, security and cybersecurity and cleaning.
- **Maintenance:** Regular and periodic rolling stock maintenance, station maintenance, track routine maintenance, stabling and depot facilities, power distribution and overheads.
- **Replacement:** Rolling stock updates and replacement, track replacement, ballast replacement and rail systems upgrades.
- **Contingency:** Allowances for contingency expenses.

The cost profile presented below includes an average escalation rate of 2.5 per cent per year based on standard industry benchmark data.

Figure 9-3 Operating Phase costs profile for Stages 1A and 1B and the Project (P90, $millions, nominal)



9.6. Revenues

The Project is expected to generate farebox and commercial related revenues.

9.6.1. Farebox revenue

The fare strategy for the Project has been developed to achieve the following objectives:

- Facilitate accessibility to all potential passenger segments by providing appropriate price points for all potential customers.

- Achieve an appropriate balance between maximising demand and optimising fare revenues to ensure commercial and financial sustainability.
- Provide a fare structure that is simple for customers to understand and select the most appropriate fare for their journey.
- Do not preclude it from being deployed across the Network.

The fares for the Project were informed by benchmarking of high speed rail services overseas. The Project's fares are comparable to similar service fares in Taiwan, China and France, and significantly lower than fares for HS1 in the United Kingdom and the Nagano-Kanazawa services in Japan.

Figure 9-4 Comparable fares

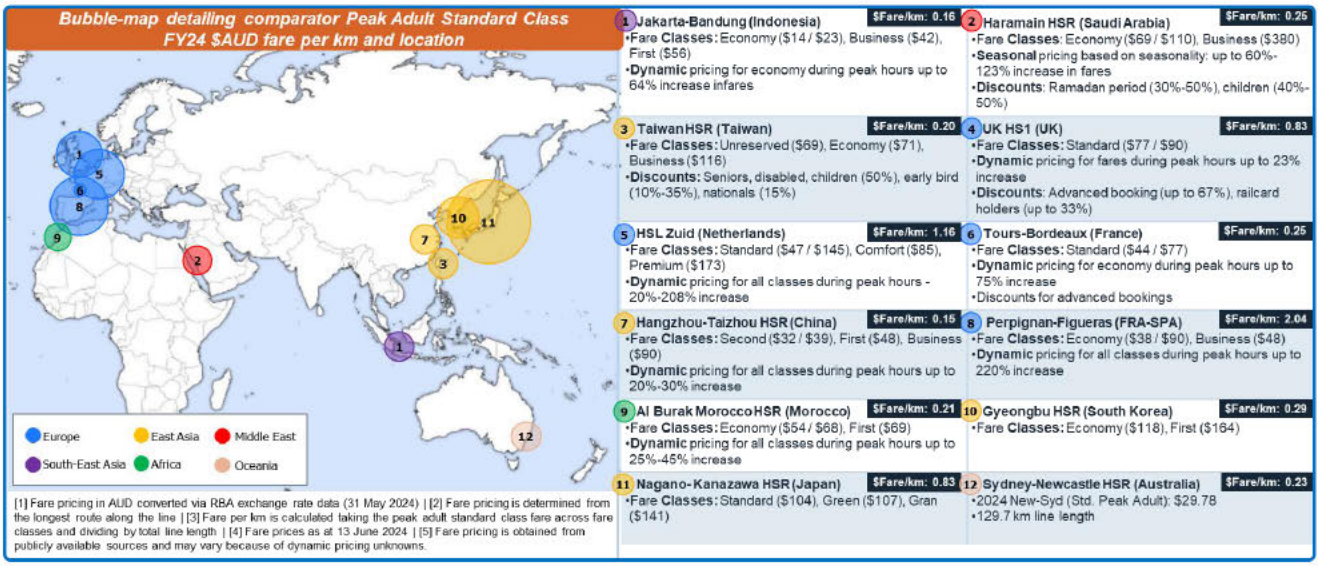
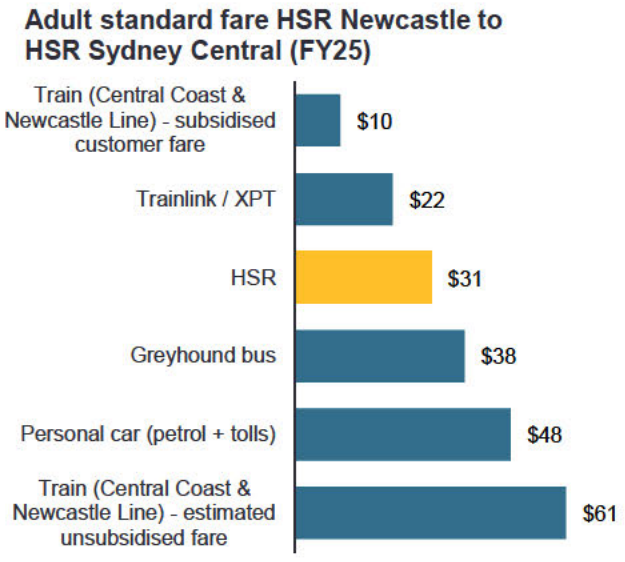


Figure 9-5 Fares between Newcastle and Sydney



In developing the appropriate fare structure, consideration has been given to the proposed premium onboard product as well as existing transport mode costs within the project corridor. As shown in the figure on the left, these include the heavily subsidised existing rail fares (estimated at approximately 84 cents in the dollar subsidy for intercity services and 83 cents in the dollar for metropolitan services[1]), coach costs (approximately $38 from Newcastle to Sydney) and car travel taking account of tolls ($48, with costs in addition to this expected for parking). Another consideration is the value of time, recognising the journey time saving will be around 90 minutes for station-to-station journeys and that time on the train with onboard i- i and working space will be far more productive than other modes of travel. Customer research involving over 2,000 participants across the east coast confirmed that journey time, frequency and reliability are critical to customer behaviour and willingness to pay.

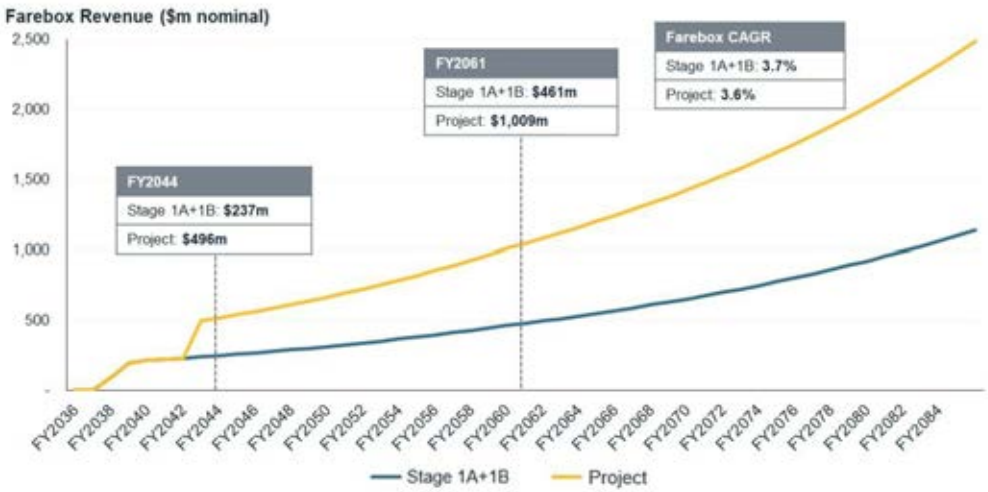
The fare strategy adopts a flag fall plus distance structure with bespoke fares for travel within Sydney and a 'gate charge' added to the fare for journeys starting or ending at Western Sydney International. Discounts are assumed for frequent users through time-based tickets, passenger segments such as seniors, children, students and disabled passengers, and for travel outside the morning and evening peak periods and to/from destinations outside Sydney in the counter-peak direction.

The fare strategy results in the following range of adult fares for key origin-destination pairs, depending on the class and time of travel and whether a time-based ticket is used. Passenger segments eligible for discounts would pay lower fares than those shown.

The fare strategy informed the assumptions in this Business Case and will continue to be refined during the Development and Delivery Phases.

The farebox revenue forecast for Stages 1A and 1B only and the Project, based on the fare strategy and demand forecasts, is set out in the following figure. The figure also presents the compound annual growth rate (CAGR) combining volume and price growth, which applies following an initial 'ramp up' period and implementation of staged opening.

Figure 9-6 Farebox revenue



9.6.2. Commercial revenue

A combined top-down and bottom-up approach to estimating commercial revenue has been undertaken. The commercial revenue streams in the following table were considered potentially suitable for the Project, based on comparator projects and the definition of the Project's high speed rail product.

Table 9-7 Commercial revenue streams

In-train revenue streams	Station revenue streams
• Advertising inside train. • Entertainment and streamed content. • Onboard sales (such as food and beverage).	• Advertising in stations. • Car parking. • In-station retail. • Commercialisation of rail corridor (such as telecommunications and other fibre networks). • Other (such as lockers and vending machines).

A bottom-up approach was taken to estimating revenue from carparking at HSR Lake Macquarie Station, resulting in a nominal value of [redacted] (first year of Project operations after ramp up) for Stages 1A and 1B only, as well as for the Project.

There are also future opportunities to develop in-station retail revenue streams that would improve revenue estimates in the future.

A top-down approach was taken to estimating revenue for the remaining revenue streams identified (that is, station and in-train advertising, other in-train revenue streams and commercialisation of rail corridor). An estimate of 5.4 per cent of farebox revenue was developed based on international benchmarking of non-farebox revenues of similar projects, excluding car parking and in-station retail revenues. [redacted]

9.7. Financial appraisal

9.7.1. Financial appraisal approach

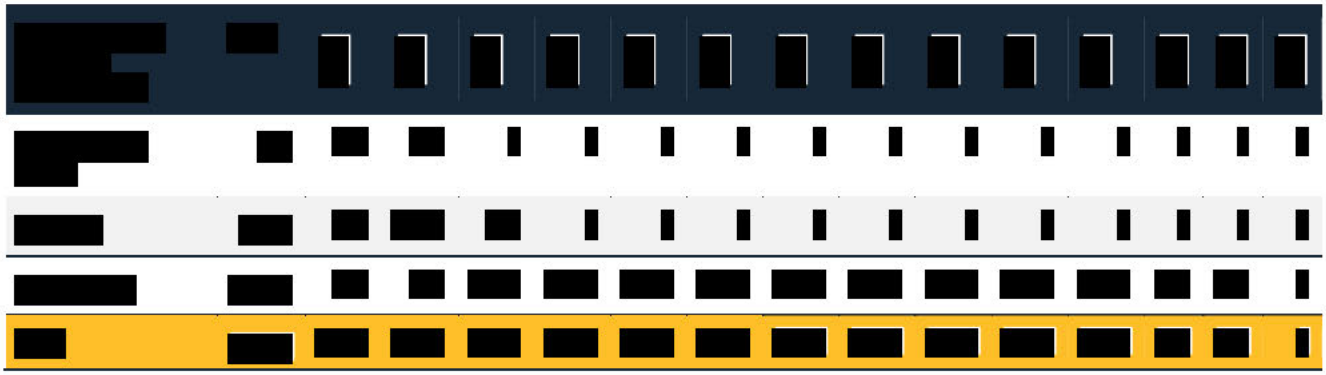
The financial appraisal presents Delivery Phase, Operations Phase and whole-of-life-project cashflows, including capital and operating costs, revenues and net project cost assuming traditional funding. The subsequent sections present the financial appraisal for Stages 1A and 1B and for the Project.

9.7.2. Stages 1A and 1B financial appraisal

Stages 1A and 1B Delivery Phase

The following table provides a summary of the annual cashflows during the Delivery Phase for Stages 1A and 1B, including the Development Phase, property and capital costs of Stages 1A and 1B.

Table 9-8 Stages 1A and 1B Delivery Phase summary (nominal $m)



Stages 1A and 1B Operations Phase

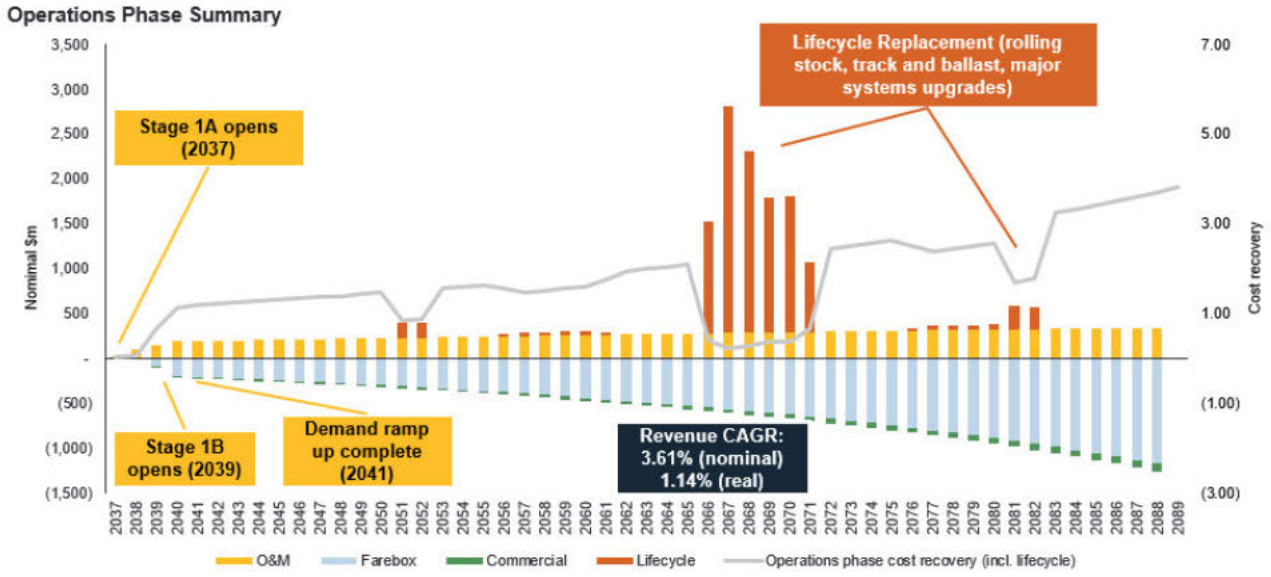
The following table provides a summary of annual Operations Phase cashflows in FY42 and the figure below it provides a summary of cashflows over the 50-year Operations Phase.[3]

The Project achieves operational cost recovery from Stages 1A and 1B operations, with a total Operations Phase cost recovery of 2.25 excluding lifecycle replacement and 1.25 including lifecycle replacement over the appraisal period.

Table 9-9 Stages 1A and 1B Operations Phase summary (nominal $m)

Operations Phase summary (nominal $m)	FY42 (post demand stabilisation for Stages 1A and 1B)
Operations and maintenance cost	195
Farebox revenue	(220)
Commercial revenue	(18)
Net cost/(surplus) to government (excluding lifecycle)	(43)
Operations Phase cost recovery (excluding lifecycle)	1.22

Figure 9-7: Stages 1A and 1B Operations Phase summary (nominal $m, 50 years)



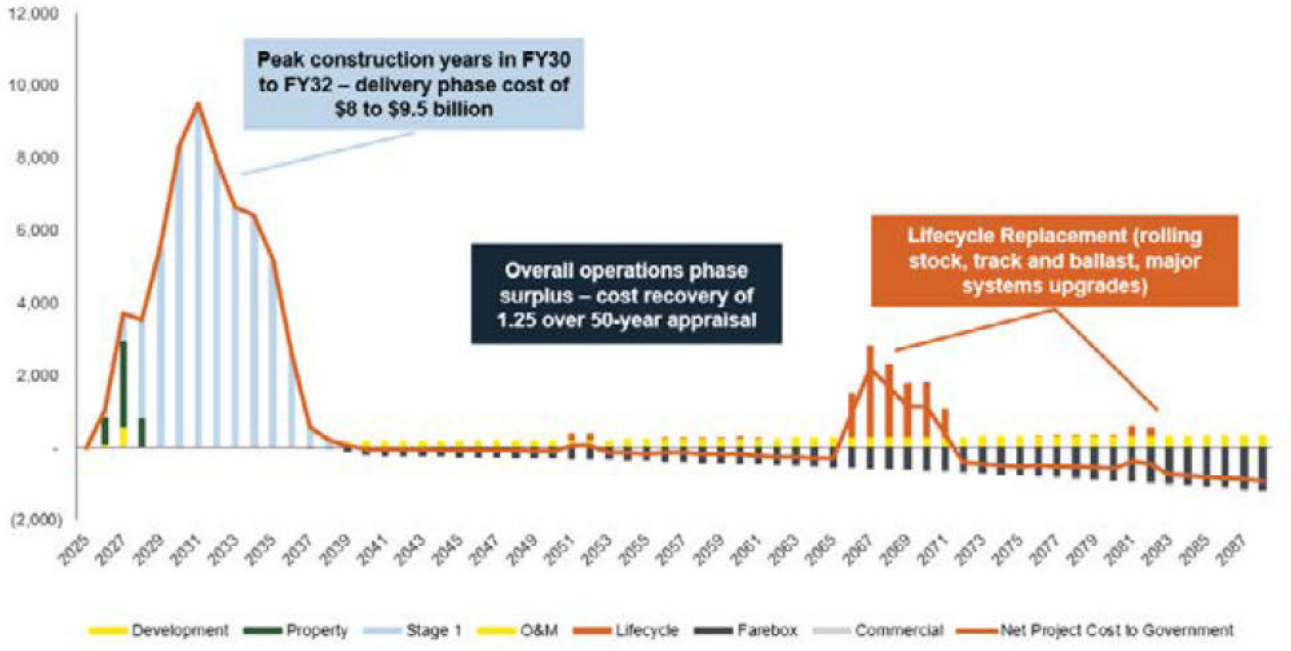
Stages 1A and 1B whole-of-life appraisal

The following table below provides a summary of the whole-of-life costs for Stages 1A and 1B in real, nominal and net present value (NPV) terms and the figure below it shows whole-of-life net project cost to government.

Table 9-10 Stages 1A and1B whole-of-life financial appraisal

$ millions, 50 years operations phase	Real (FY25)	Nominal	NPV (@ 4.255%)
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
Total Stages 1A and 1B Development and Delivery Phase cost	**55,287**	**61,237**	**45,124**
Stages 1A and 1B Operating Phase costs			
Operations	3,659	7,704	1,603
Maintenance	2,745	5,784	1,201
Lifecycle	4,860	10,916	1,758
Total Operating Phase cost	11,264	24,404	4,563
Revenue			
Farebox revenue	(9,628)	(28,307)	(4,717)
Commercial revenue	(721)	(2,085)	(358)
Total revenue and cost savings	(10,349)	(30,392)	(5,075)
Stages 1A and 1B whole-of-life net project cost	**56,202**	**55,249**	**44,611**

Figure 9-8 Stages 1A and 1B net project cost to government (nominal $m)



9.7.3. Project financial appraisal

Project Delivery Phase

The following table provides a summary of the annual cashflows during the Delivery Phase for the Project (including Stages 1A and 1B, and Stage 1C), including Development Phase, property and capital costs.

Table 9-11 Project Delivery Phase summary (nominal $m)

Project Operations Phase

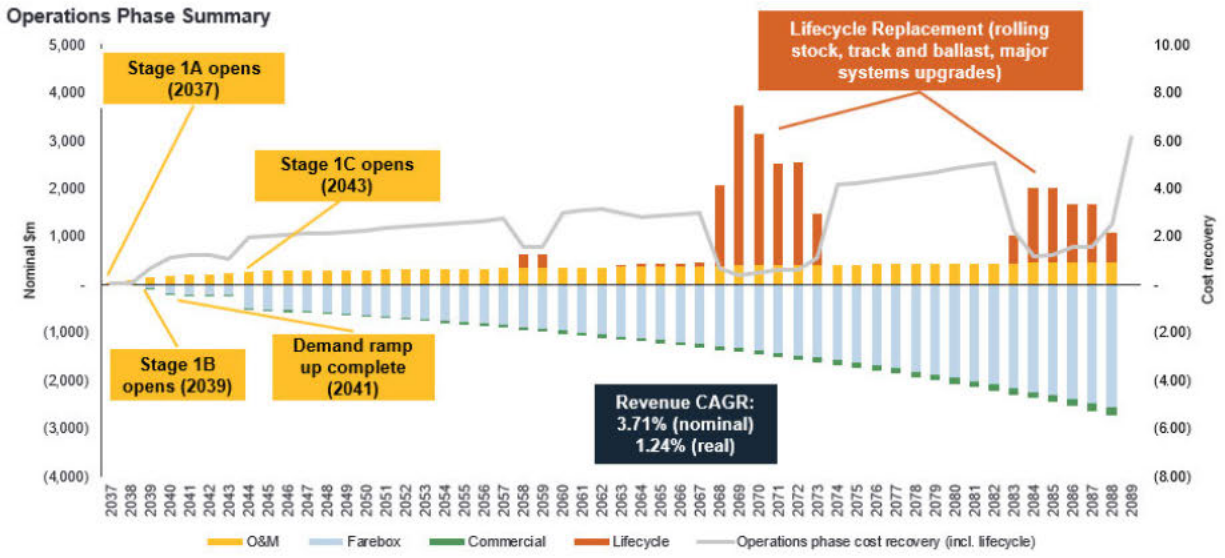
The following table provides a summary of Operations Phase cashflows in FY44 and the figure below it provides a summary of Operations Phase cashflows over the 50-year Operations Phase.

The Project achieves operational cost recovery from Stages 1A and 1B operations which further improves with the commencement of Stage 1C operations, with total Operations Phase cost recovery of 3.61 excluding lifecycle replacement and 1.67 including lifecycle replacement over the appraisal period.

Table 9-12 Project Operations Phase summary (nominal $m)

Operations Phase summary (nominal $m)	FY44 (first year full operations)
Operations and maintenance cost	271
Farebox revenue	(496)
Commercial revenue	(33)
Net cost/(surplus) to government (excluding lifecycle)	(258)
Operations Phase cost recovery (excluding lifecycle)	1.95

Figure 9- Project Operations Phase summary (nominal $m, 50 years)



The commencement of Stage 1C operations drives a significant increase in operating revenue for the Project. This is due to the increased demand and associated increase in farebox revenues to HSR Western Sydney International.

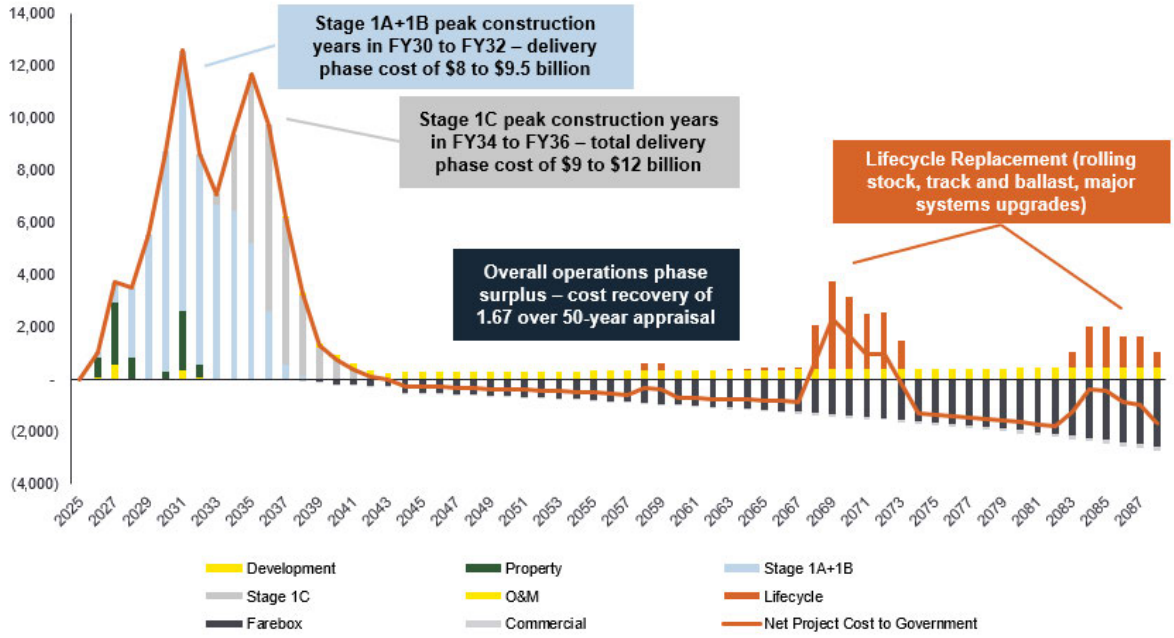
Project whole-of-life appraisal

The table below provides a summary of the whole-of-life costs for the Project in real, nominal and net present value (NPV) terms and the figure below it shows whole-of-life net project cost to government.

Table 9-13 Project whole-of-life financial appraisal

$ millions, 50 years operations phase	Real (FY25)	Nominal	NPV (@ 4.255%)
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
Total Development and Delivery Phase cost	**82,401**	**93,624**	**65,175**
Project Operating Phase costs			
Operations	5,718	12,134	2,458
Maintenance	2,685	5,697	1,154
Lifecycle	8,673	20,715	2,623
Total Operating Phase cost	17,076	38,546	6,236
Project revenue			
Farebox revenue	(20,161)	(60,521)	(9,678)
Commercial revenue	(1,293)	(3,835)	(628)
Total revenue and cost savings	(21,454)	(64,355)	(10,306)
Project whole-of-life net project cost	**78,023**	**67,815**	**61,105**

Figure 9-9 Project net project cost to government (nominal $m)



9.7.4. Sensitivity analysis

Sensitivity analyses have been undertaken on key inputs to the financial appraisal, including:

- Construction Phase costs (-20 per cent and +20 per cent).
- Operating Phase costs (-20 per cent and +20 per cent).
- Revenue (-20 per cent and +20 per cent)

Further, the impact of upside (Operating Phase costs decrease and revenues increase) and downside (Operating Phase costs increase and revenues decrease) scenarios with adjustments in line with the sensitivities above have been tested.

The impact of varying these inputs on key outputs (Australian Government Delivery Phase contribution and Operations Phase cost recovery) are shown for Stages 1A and 1B, and for the Project in the figures below.

Figure 9-10 Stages 1A and 1B Delivery Phase Australian Government contribution

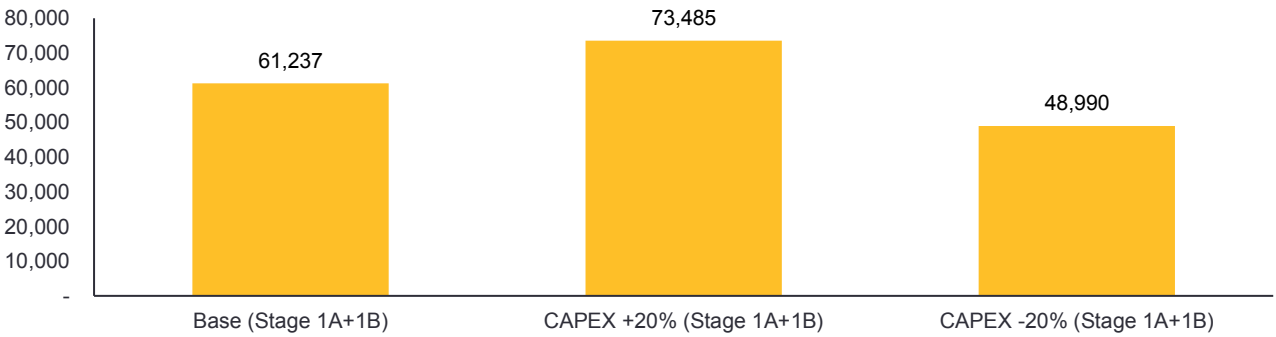


Figure 9-11 Project Delivery Phase Australian Government contribution

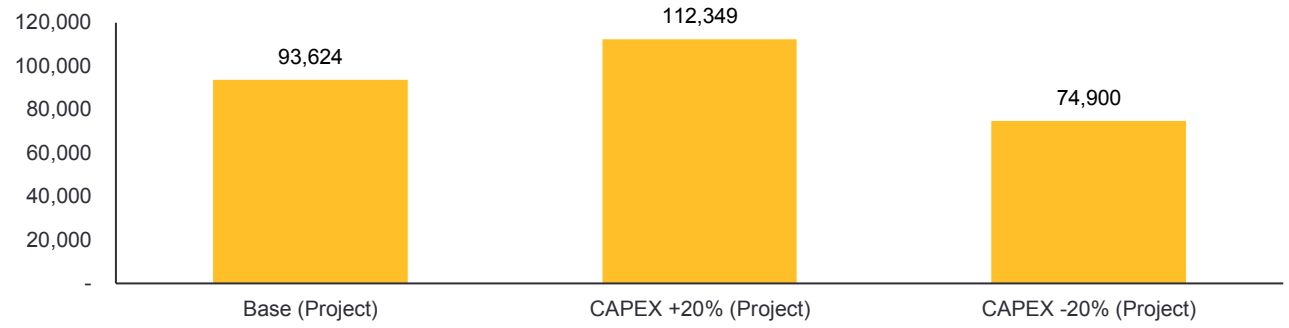


Figure 9-12 Stages 1A and 1B Operations Phase cost recovery, total over 50 years (including lifecycle)

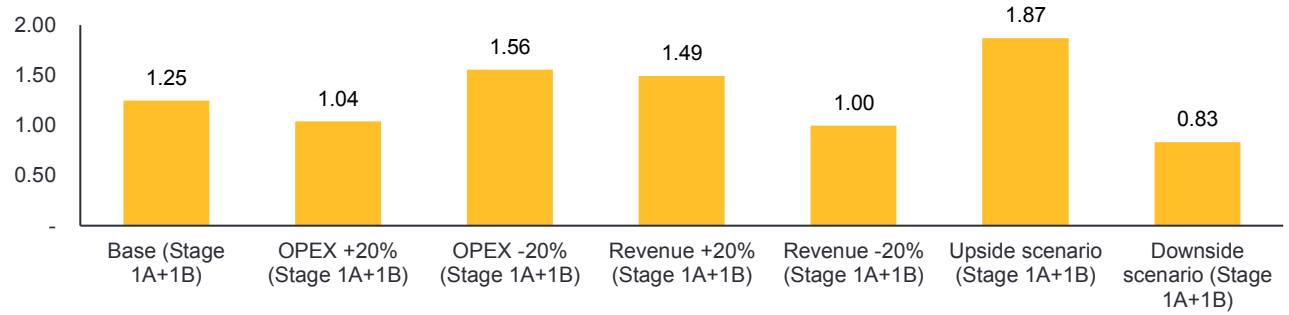
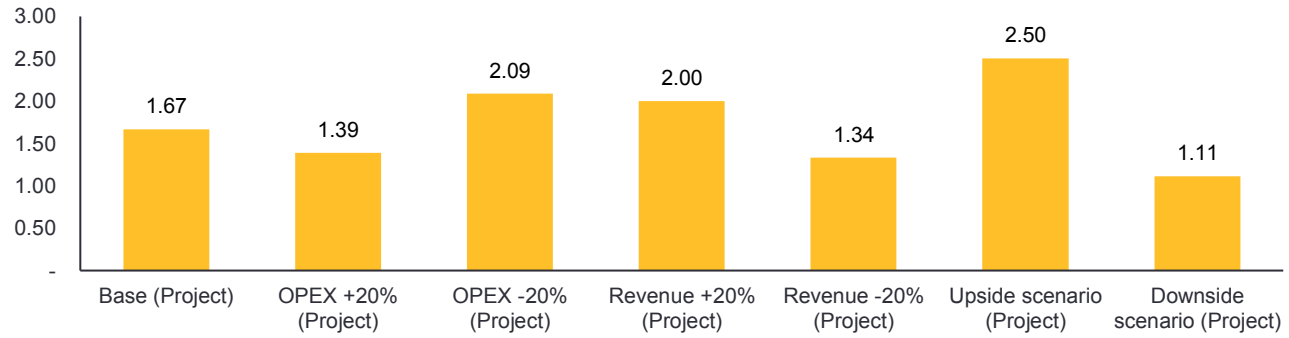


Figure 9-13 Project Operations Phase cost recovery, total over 50 years (including lifecycle)



The sensitivity analysis shows that even if operational expenditures are significantly higher than expected, or revenues are lower than expected, operating costs and lifecycle payments will be recovered for Stages 1A and 1B (aside from the downside scenario where additional subsidy would be required), and for the Project.

9.8. Funding and financing strategy

Funding and financing strategy objectives

The Authority's funding and financing objectives have been central to the development of the funding and financing strategy. The table below outlines how each of these objectives has been addressed through the funding and financing analysis.

Table 9-14 Funding and financing objectives

Objective	How this has been addressed
• Minimise total government funding. • Smooth government budget funding over time.	• Staged delivery of the Project over a longer timeframe to reduce inflationary impacts of a mega-project and smooth the government budget funding ask. • Smoothing government annual contributions into a sustainable program through use of alternative financing options including Public-Private Partnerships (PPP) and construction finance. • Additional funding sources that would further minimise budget funding have been considered and are outlined further in this chapter.
Use private finance where it can drive the most benefit, across construction, operations and program, and align commercial drivers of private financiers with government objectives.	• There is appetite for private finance in long-term infrastructure projects. In line with the Delivery Strategy, PPPs have been considered for packages where there are value for money drivers, including opportunities for whole-of-life risk transfer and incentives, innovation and program benefits. • The proposed approaches align the commercial drivers for private financiers, including predictable cashflows and appropriate returns, with government objectives of minimising funding requirements and appropriate allocation of risks.
Optimise risk profile to government and market during delivery and operations.	• In addition to opportunities for optimal risk transfer, funding and financing mechanisms that provide certainty on timing and the value of contributions to both the government and the market have been considered.
Project financing structures maintain flexibility and value for money for future changes or stages.	• For geographical civil packages, short-term construction finance has been recommended as a mechanism to retain maximum flexibility for future stages. This structure may be replicated or adapted for future project expansions. • For packages delivered under a PPP, these structures may be augmented or re-tendered for future stages depending on value for money drivers. • As an initial stage of a Network, project financing options that impact ownership and control have not been considered further to retain future flexibility for the Authority to deliver the Network.
Alternative funding options are practical and will be accepted by stakeholders and the community.	• Stakeholder acceptance and practicality have been key to the assessment and short-listing of alternative financing and value sharing options, which are further outlined in Section 9.9.1.

Funding and financing scenarios overview

Core scenarios have been quantified for Stages 1A and 1B, and for the Project (Stages 1A and 1B, and 1C) based on introducing two potential private financing approaches: PPP and Construction Finance (see figure below). The Development Phase costs are assumed to be fully funded by the government.

The **PPP scenarios** (Scenario 1 and 3) seek to use private finance to maximise value for money outcomes of the Project, with PPP delivery for key alignment-wide packages in line with the Delivery Strategy. These scenarios assume PPP delivery for the rolling stock and systems packages with the remaining project scope grant funded.

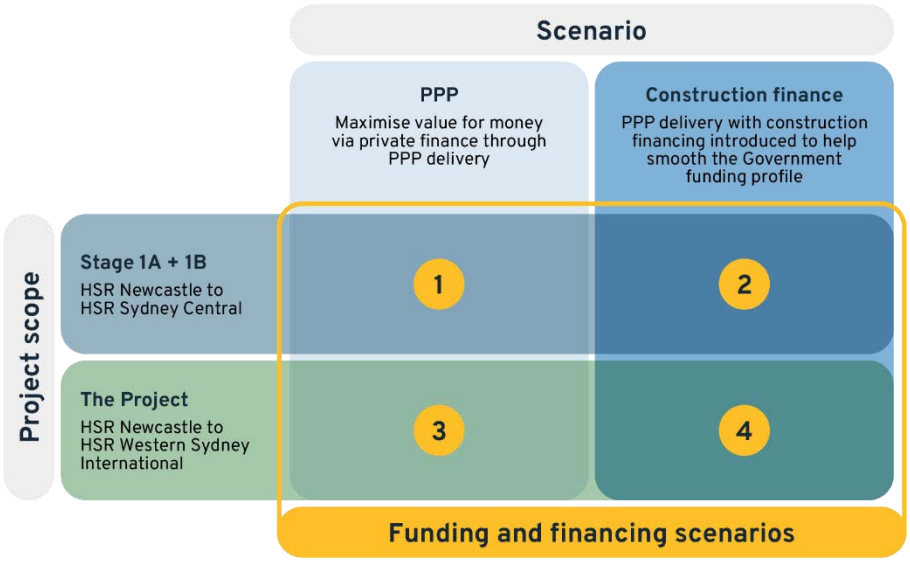
Construction finance

Construction finance provides the opportunity to defer cashflow and transfer some performance risk to the private sector, through the use of private capital during the construction period.

This is a form of short-term finance which is on-balance sheet for the contractor, which results in an increased incentive for the contractor to deliver given the carrying cost of the finance and the scrutiny of its financiers. The contractor is paid by the government at defined milestones, typically driven by the achievement of delivery and performance outcomes.

While this is not typically used in Australia, there are a number of international precedents for construction finance, including in Canada (Ontario Line), USA (multiple road projects) and the Middle East (Dubai Metro).

Figure 9-14 Funding and financing scenarios



The **Construction Finance scenarios** (Scenario 2 and 4) build on the PPP private finance for the rolling stock and systems packages and seek to further smooth government budget cashflows during the Delivery Phase through the use of private finance for major civils packages. Under this scenario, portions of major civils packages are financed via construction finance to ensure grant funding does not exceed a $5 billion per annum cap for Stages 1A and 1B, or a $10 billion per annum cap for the Project (that is, when Stage 1C is also included). This cap has been applied for illustrative purposes to show the potential for smoothing annual government contributions through the use of construction financing.

Based on these packages, the following funding and financing scenarios are analysed in the sections below.

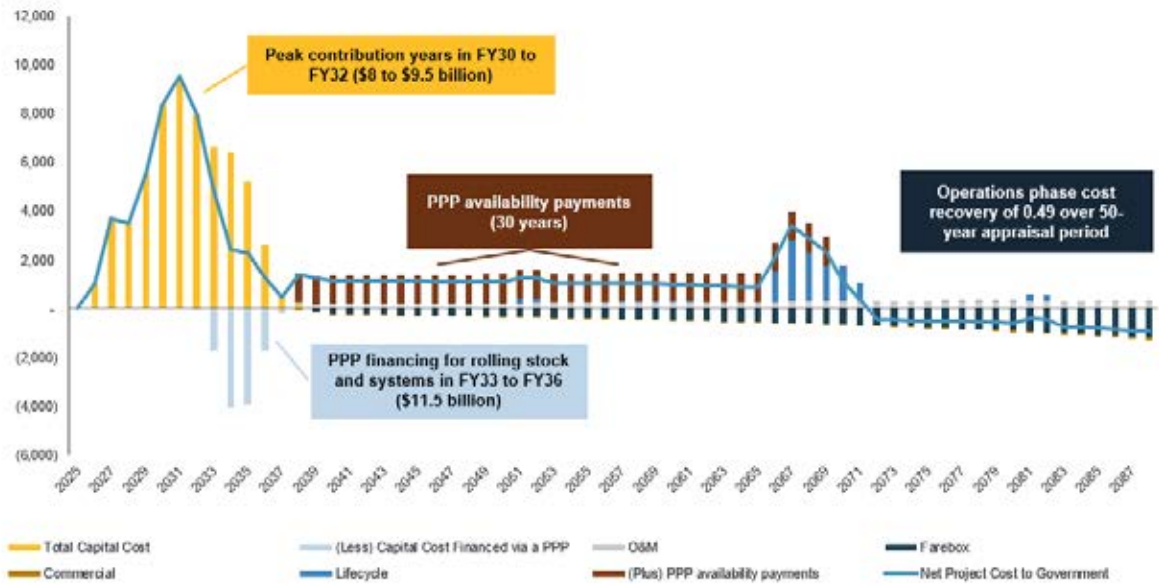
Additional scenarios were tested and are outlined in the Funding and Financing Strategy Report; however, these were discounted based on their outcomes relative to the scenarios below.

9.8.1. Stages 1A and 1B : HSR Newcastle to HSR Sydney Central

An overview of Scenario 1 (PPP) and Scenario 2 (PPP and Construction Finance) is shown in the figures below.

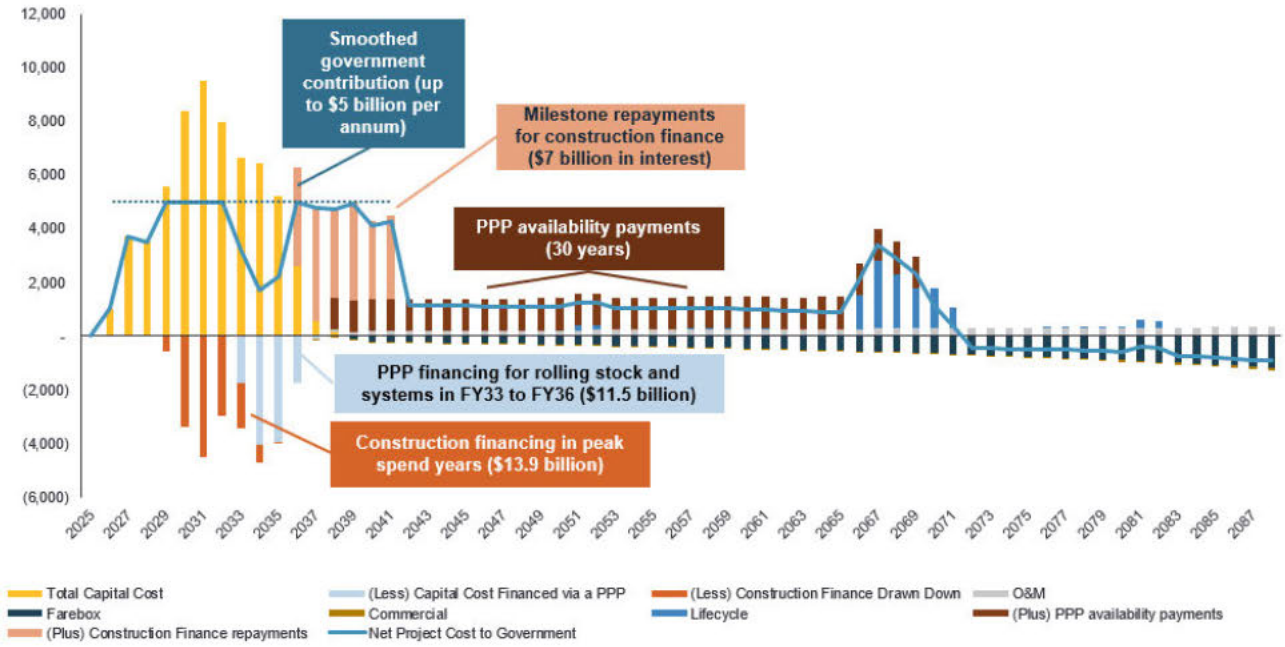
Scenario 1 Overview

Figure 9-15 Scenario 1 net project cost to government – private finance (nominal $m)



Scenario 2 Overview

Figure 9-16 Scenario 2 net project cost to government – private finance (nominal $m)



Scenario 1 assumes PPP delivery for the systems [redacted] and rolling stock [redacted] packages. Noting the size of the systems package, a $1.5 billion government capital contribution is assumed for this package to meet private financing market capacity.

In addition to these assumptions, Scenario 2 assumes a cap on Australian Government grant funding of $5 billion per annum for Stages 1A and 1B , including for the repayment of capital. To meet this cap, two packages are construction financed:

- Surface works and civils (HSR Newcastle to HSR Central Coast) is fully construction financed [redacted]
- Tunnel, track and fit out (HSR Central Coast to HSR Sydney Central) is partially construction financed [redacted] to reduce grant funding in peak construction years.

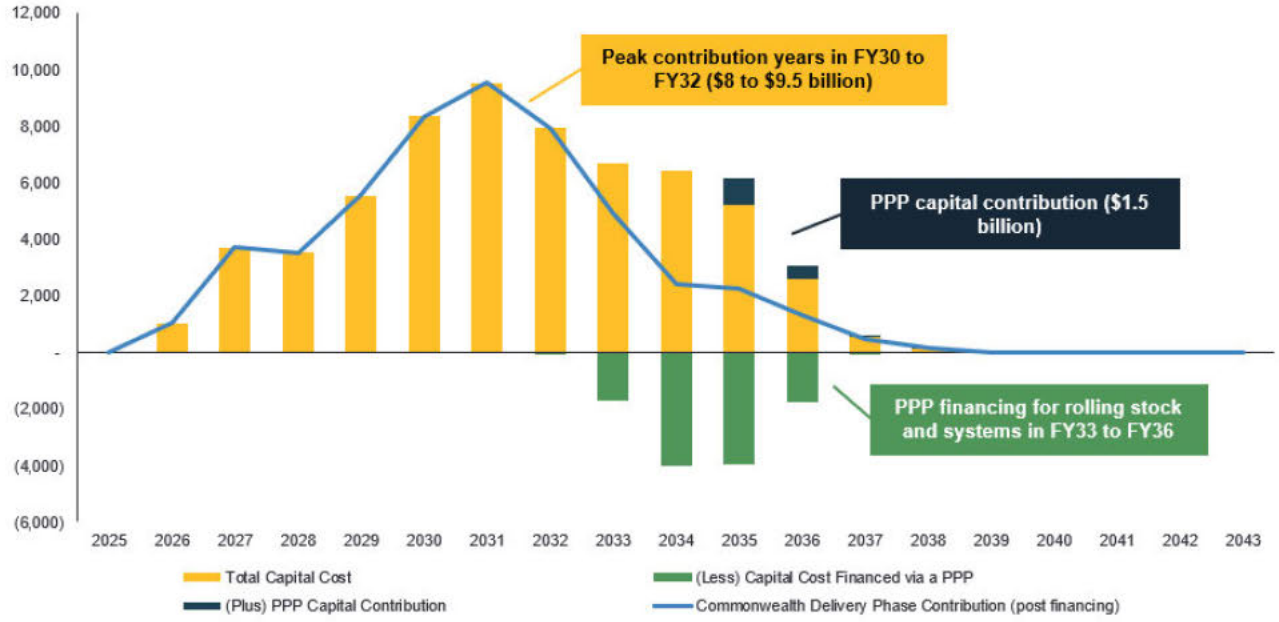
A summary of the Delivery Phase cashflows for each scenario is shown in the table below. While the financing options applied to Scenario 1 allow for deferral of cashflows, these cashflows do not coincide with peak spend years (FY30 to FY32), with Australian Government contributions in these years ranging between $8 billion and $9.5 billion. Meanwhile, Scenario 2 significantly smooths the profile of Australian Government delivery contributions, with the $5 billion cap being reached in FY30, FY31 and FY32.

Table 9-15 Delivery Phase cashflow summary (nominal $m)

Delivery Phase summary (nominal $m)	Scenario 1	Scenario 2
Total capital cost	61,237	61,237
(Less) Capital cost financed via a PPP	(11,554)	(11,554)
(Less) Construction finance drawn down	–	(13,846)
(Plus) PPP capital contribution	1,500	1,500
Australian Government Delivery Phase contribution (post financing)	**51,183**	**37,338**

Scenario 1 Delivery Phase

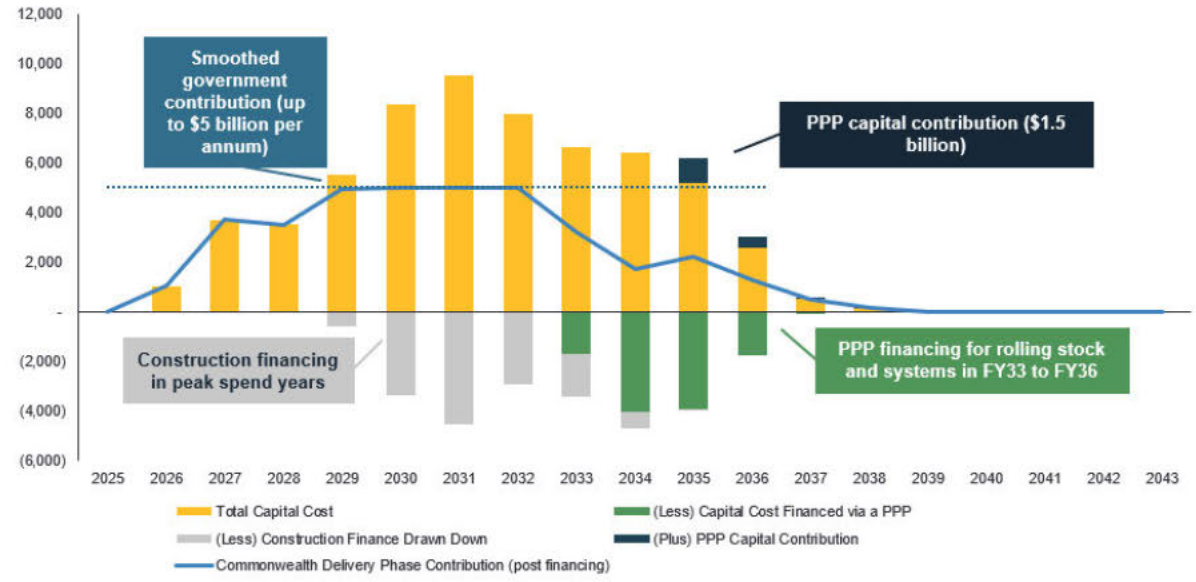
Figure 9-17 Scenario 1 Delivery Phase cashflow summary (nominal $m)



Scenario 1 (nominal $m)	Total	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39
Delivery Phase contribution (post financing)	**51,183**	1,038	3,712	3,519	5,548	8,361	9,525	7,939	4,944	2,407	2,247	1,288	488	153	15

Scenario 2 Delivery Phase

Figure 9-18 Scenario 2 Delivery Phase cashflow summary (nominal $m)



Scenario 2 (nominal $m)	Total	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39
Delivery Phase contribution (post financing)	**37,338**	1,038	3,712	3,519	4,969	5,000	5,000	5,000	3,230	1,726	2,201	1,288	488	153	15

A summary of the Operations Phase cashflows are shown in the table and figures below. Under Scenario 1, the capital costs (including financing costs and capitalised interest) financed via PPP are repaid through availability payments over a 30-year term. This repayment of capital impacts Operations Phase cost recovery, which is reduced to 0.49. For Scenario 2, the capital costs that are construction financed are assumed to be repaid in milestone instalments post completion, and have been sized to maintain the $5 billion per annum cap. This further impacts Operations Phase cost recovery, which is reduced to 0.36.

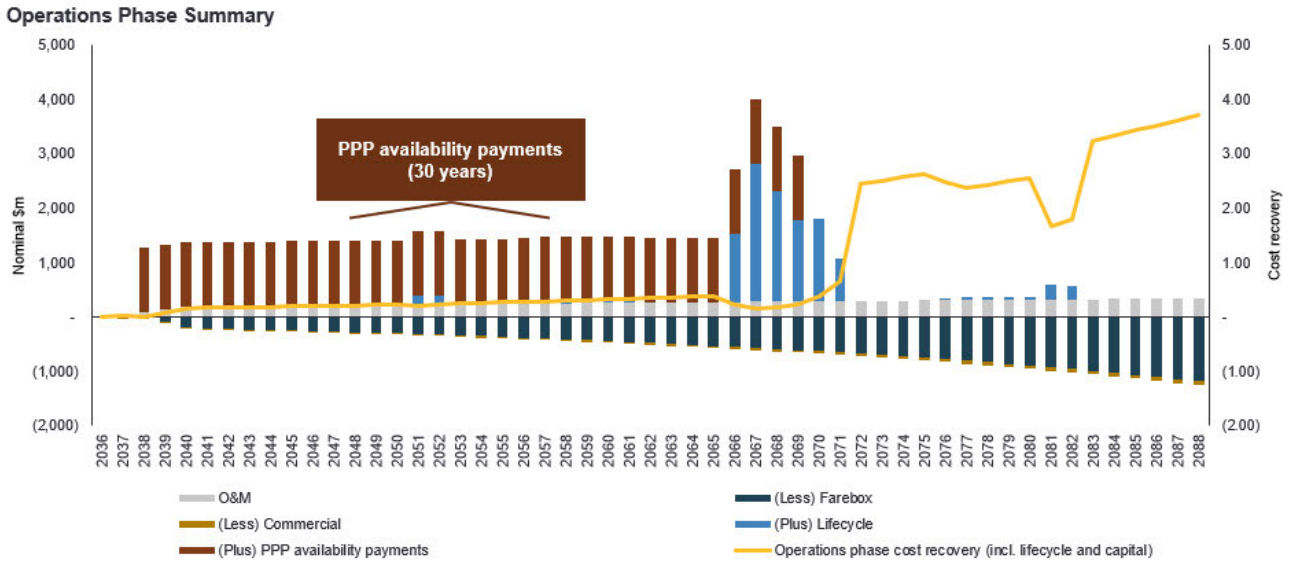
Table 9-16 Operations Phase cashflow summary (nominal $m)

Operations Phase summary (nominal $m)	Scenario 1 total (50 years)	Scenario 1 cost recovery	Scenario 2 total (50 years)	Scenario 2 cost recovery
Operations and maintenance cost	13,488		13,488	
Farebox revenue	(28,307)		(28,307)	
Commercial revenue	(2,085)		(2,085)	
Net cost / (surplus) to government (excluding lifecycle)	(16,904)	2.25	(16,904)	2.25
Lifecycle	10,916		10,916	
Net cost / (surplus) to government (including lifecycle)	(5,989)	1.25	(5,989)	1.25
(Plus) PPP availability payments (capital component only)	37,949		37,949	
(Plus) Construction finance repayments (principal)			13,846	
(Plus) Construction finance repayments (interest)			7,127	
Net cost / (surplus) to government (including lifecycle and capital)	31,961	0.49	52,933	0.36

The following figures summarise cashflows during the Operations Phase for Scenario 1 and Scenario 2:

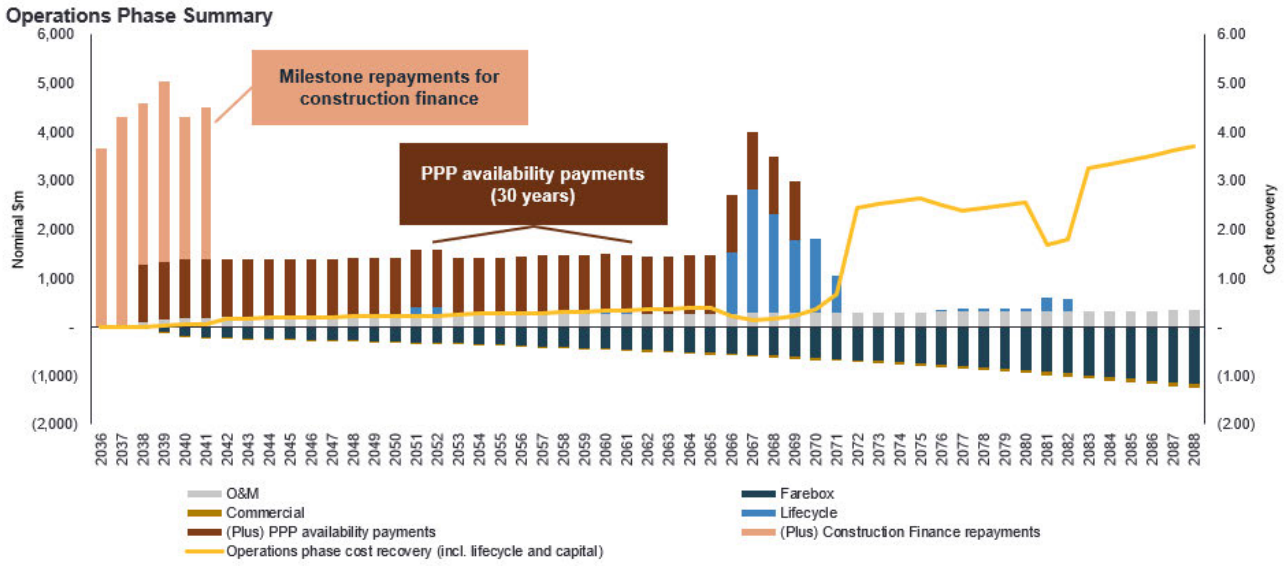
Scenario 1 Operations Phase

Figure 9-19 Scenario 1 Operations Phase cashflow summary (nominal $m)



Scenario 2 Operations Phase

Figure 9-20 Scenario 2 Operations Phase cashflow summary (nominal $m)

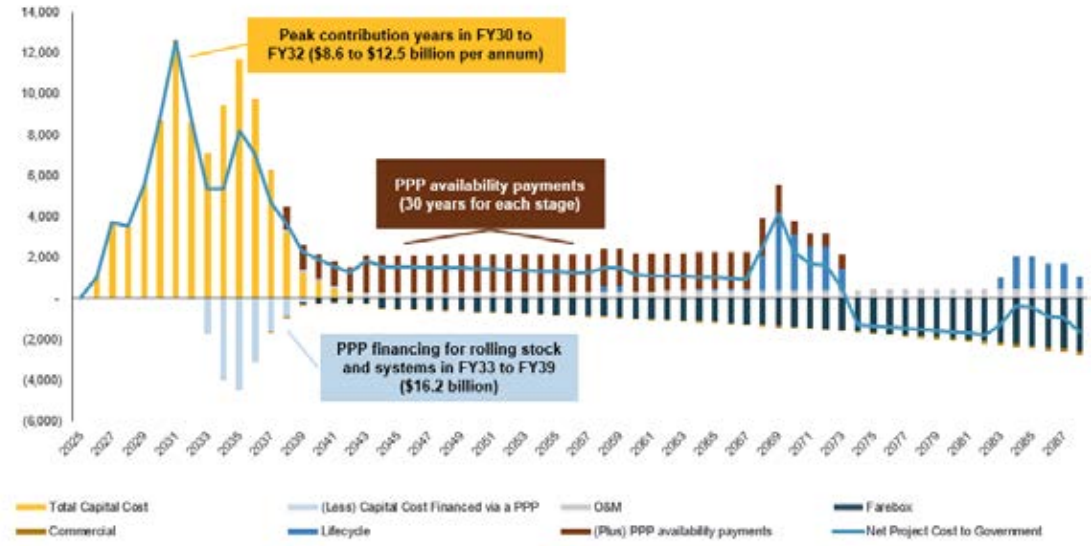


9.8.2. The Project: HSR Newcastle to HSR Western Sydney Airport

An overview of Scenario 3 (PPP) and Scenario 4 (PPP and Construction Finance) is shown in the figures below.

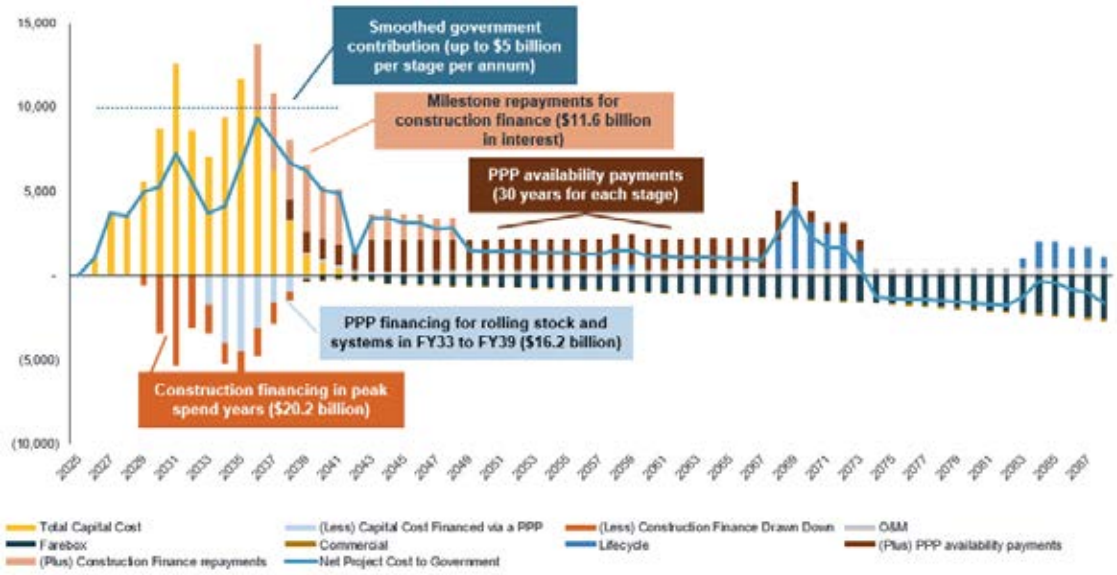
Scenario 3 Overview

Figure 9-21 Scenario 3 net project cost to government – private finance (nominal $m)



Scenario 4 Overview

Figure 9-22 Scenario 4 net project cost to government – private finance (nominal $m)



In addition to the assumptions for Scenario 1, Scenario 3 assumes PPP delivery for the systems [redacted] and rolling stock [redacted] packages for Stage 1C. No capital contribution has been assumed for these packages.

Scenario 4 adopts the same assumptions as Scenario 2 and also assumes a cap on Australian Government grant funding of $5 billion per annum for Stage 1C, including for the repayment of capital. In years where Stages 1A and1B and Stage 1C overlap (FY33 to FY42), a total cap of $10 billion per annum is assumed. Property acquisition costs are excluded from the cap. To meet this cap, an additional package, tunnel, track and fit out (HSR Sydney Central to HSR Parramatta) is fully construction financed [redacted] and a greater proportion for the tunnel, track and fit out (HSR Central Coast to HSR Sydney Central) is partially construction financed [redacted]

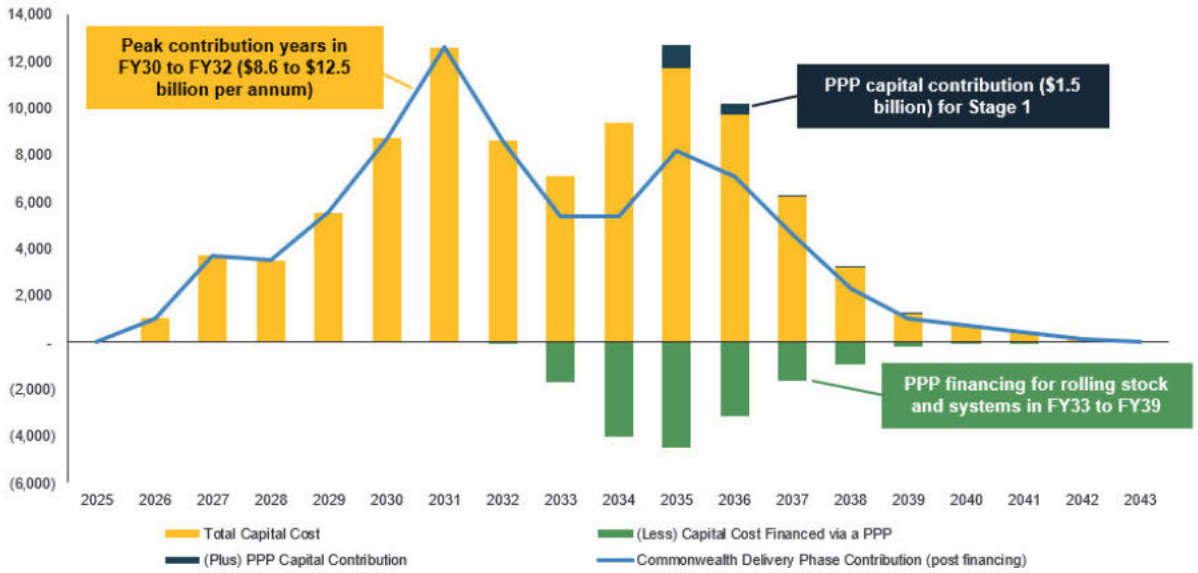
A summary of the Delivery Phase cashflows for Scenarios 3 and 4 are presented in the table and figures below. For Scenario 3, as the Delivery Phase for Stage 1C overlaps with peak spend years for Stages 1A and 1B, the Australian Government contributions in these years are increased, in particular in FY31 ($12.6 billion). Meanwhile Scenario 4 smooths the profile of the Australian Government contributions, and the total cap is not reached in any year, with peak years of FY31 ($7.3 billion) and FY35 ($6.7 billion).

Table 9-17 Delivery Phase summary (nominal $m)

Delivery Phase summary (nominal $m)	Scenario 3 total	Scenario 4 total
Total capital cost	93,624	93,624
(Less) Capital cost financed via a PPP	(16,167)	(16,167)
(Less) Construction finance drawn down		(20,226)
(Plus) PPP capital contribution	1,500	1,500
Australian Government Delivery Phase contribution (post financing)	**78,957**	**58,731**

Scenario 3 Delivery Phase

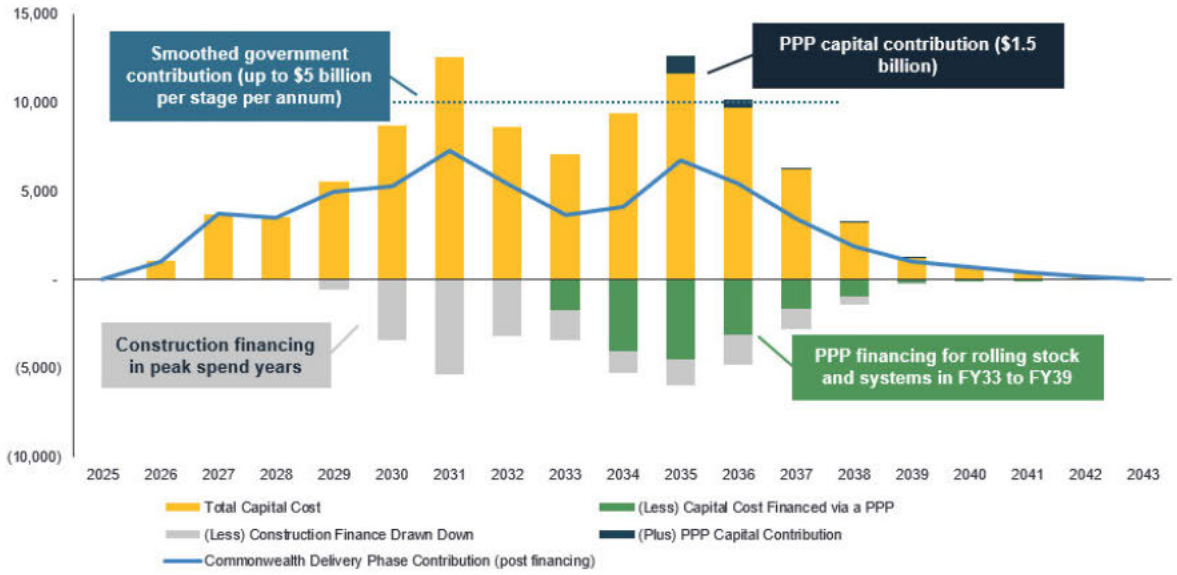
Figure 9-23 Scenario 3 Delivery Phase cashflow summary (nominal $m)



Scenario 3 (nominal $m)	Total	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43
Delivery Phase contribution (post financing)	**78,957**	1,038	3,712	3,519	5,548	8,713	12,587	8,609	5,370	5,358	8,181	7,049	4,638	2,298	1,043	734	419	136	6

Scenario 4 Delivery Phase

Figure 9-24 Scenario 4 Delivery Phase cashflow summary (nominal $m)



Scenario 4 (nominal $m)	Total	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40	FY41	FY42	FY43
Delivery Phase contribution (post financing)	**58,731**	1,038	3,712	3,519	4,969	5,259	7,250	5,468	3,656	4,139	6,741	5,400	3,410	1,848	1,028	734	419	136	6

A summary of the Operations Phase cashflows for Scenario 3 and Scenario 4 are shown in the table and figures below. Similar to Stages 1A and 1B, the capital costs financed via PPP are repaid through availability payments over a 30-year term for Stage 1C. This repayment of capital significantly impacts Operations Phase cost recovery, which is reduced to 0.67; however, is still an improvement on the Scenario 1 cost recovery of 0.49 due to the significant step up in operating revenues when Stage 1C is included.

Similar to Stages 1A and 1B, the capital costs that are construction financed (Scenario 4) are assumed to repaid in milestone instalments following completion and have been sized to maintain the grant funding cap in each year. This further impacts Operations Phase cost recovery, which is reduced to 0.50, but is still higher than the Scenario 2 cost recovery of 0.36 due to the step up in operating revenue relating to Stage 1C.

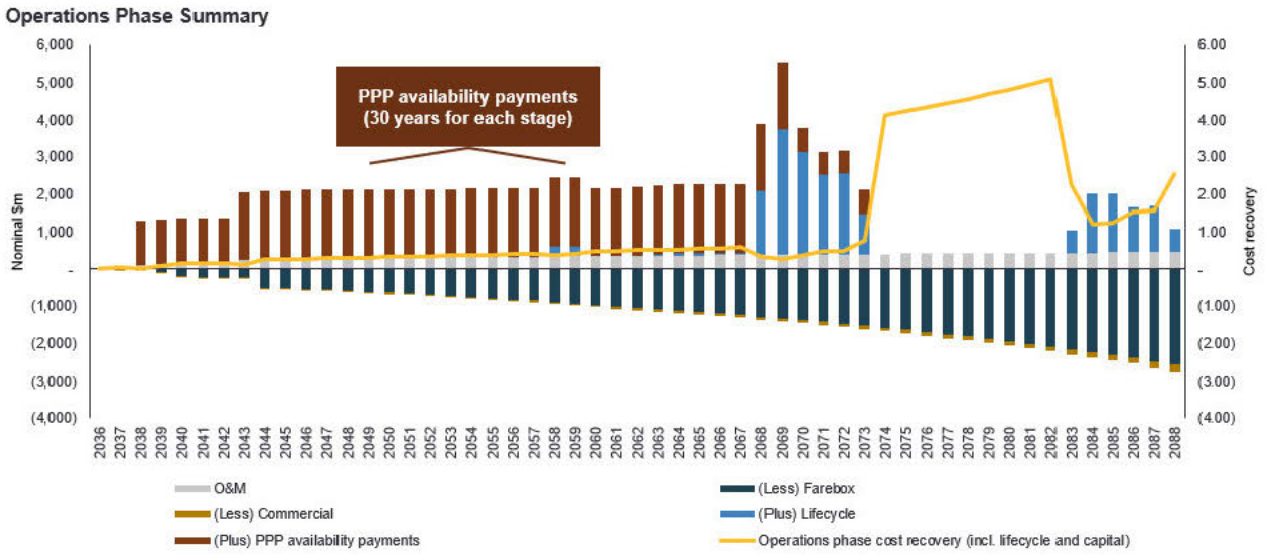
Table 9-18 Operations Phase summary (nominal, $m)

Operations Phase summary (nominal, $m)	Scenario 3 total (50 years)	Scenario 3 cost recovery	Scenario 4 total (50 years)	Scenario 4 cost recovery
Operations and maintenance cost	17,830		17,830	
Farebox revenue	(60,521)		(60,521)	
Commercial revenue	(3,835)		(3,835)	
Net cost / (surplus) to government (excluding lifecycle)	(46,525)	3.61	(46,525)	3.61
Lifecycle	20,715		20,715	

Operations Phase summary (nominal, $m)	Scenario 3 total (50 years)	Scenario 3 cost recovery	Scenario 4 total (50 years)	Scenario 4 cost recovery
Net cost / (surplus) to government (including lifecycle)	(25,810)	1.67	(25,810)	1.67
(Plus) PPP availability payments (capital component only)	57,739		57,739	
(Plus) Construction finance repayments (principal)			20,226	
(Plus) Construction finance repayments (interest)			11,600	
Net cost / (surplus) to government (including lifecycle and capital)	31,929	0.67	63,756	0.50

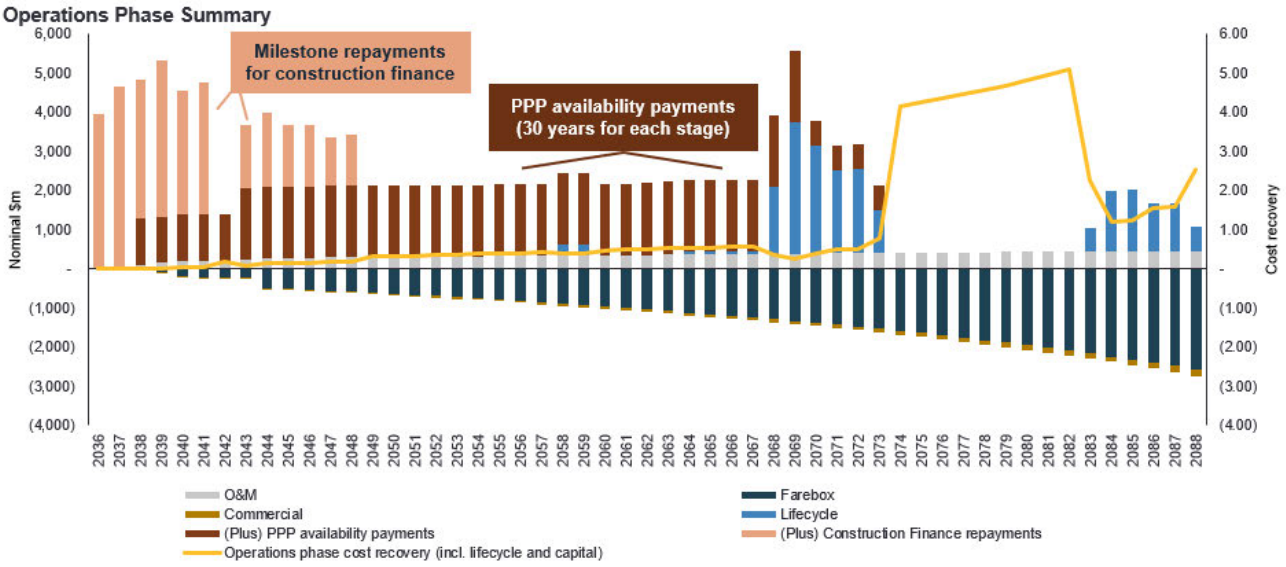
Scenario 3 Operations Phase

Figure 9-25 Scenario 3 Operations Phase cashflow summary (nominal $m)



Scenario 4 Operations Phase

Figure 9-26 Scenario 4 Operations Phase cashflow summary (nominal $m)



9.8.3. Summary

The funding and financing scenarios use a combination of private finance through PPPs to maximise value for money outcomes for the Project; and through construction financing for selected major construction packages to smooth the government funding requirement by reducing the annual funding contribution to a $5 billion per annum cap for Stages 1A and 1B, or a $10 billion per annum cap for the Project (that is, when Stage 1C is also included).

Comparison of Scenarios 1 to 4 to the base financial appraisal (with no private finance) shows that there is a trade-off when introducing private finance, whereby the operational cost recovery is diluted by additional costs relating to the repayment and servicing of the debt and equity that was used to finance capital in the Delivery Phase.

While debt interest during construction is typically capitalised, during operations a portion of the project revenues need to be redirected to repay private finance (including interest) and provide its required return. This is represented as PPP availability payments in all four Scenarios. Additionally, Scenarios 2 and 4 also include construction finance debt repayments.

9.9. Opportunities to reduce government funding contribution

9.9.1. Value sharing

Value sharing options for the Project have been considered as a possible alternative funding source. A two-step qualitative evaluation of an initial long list of 27 options resulted in the following 3 short-listed active value-sharing mechanisms.

Two of these three mechanisms were quantitatively modelled to estimate their materiality. Value sharing revenue sources have not been included in the financial appraisal, noting that the applicability of the

mechanisms is subject to further consultation and agreement between the Australian, NSW and local governments. [redacted]

Table 9-19 Value sharing options for the Project

Mechanism	Description	Revenue (avg $m p.a., FY24 $m)	
		Stages 1A and 1B	Project
Developer contribution scheme	Development contributions to NSW Government used to provide improved or increased public infrastructure and facilities. The regional infrastructure contribution (RIC) funds a defined list of infrastructure based on a defined number of new dwellings. For quantification purposes, the RIC calculation is based on: • SA4 geographical basis. • Standard charges per NSW legislation. **Precedent:** NSW Housing and Productivity Contributions scheme; Western Sydney Aerotropolis SIC; Crossrail London; Parramatta Light Rail.	[redacted]	[redacted]
Betterment levy (business / residential) or special council rates / charges	Levying of special council rates and service charges within defined local government areas along the alignment or more broadly. A low and broad-based flat annual charge, applicable to dwellings within the SA4 region. Two options are presented: • A low and broad-based flat annual charge [redacted] applicable to all dwellings within the SA4 region. • A higher charge [redacted] applicable to dwellings [redacted] **Precedent:** Melbourne City Loop; Crossrail London; Gold Coast Light Rail.	[redacted]	[redacted]
Government owns and leases land around high speed rail	Government consolidates / acquires strategic land parcels around the project corridor, to enable development and infrastructure opportunities and capture value uplift from rezoning. **Precedent:** ACT – Lease variation charge.	Not quantified	

9.9.2. Additional revenue opportunities

The Project may present opportunities for additional revenues to be generated over and above those presented in the estimates above. These include the following:

- **Maximising demand through flexible discounts** – In order to maximise utilisation of the high speed rail asset, variable fare discounts in addition to those outlined in this chapter could be applied via advance purchase tickets for those willing to commit to travel during times with lower demand. Evidence from overseas, and the principle of better matching fares with passengers' willingness to pay to encourage mode shift from customers who would not otherwise use high speed rail, means it is reasonable to expect that such demand management would result in an uplift in revenue as well as an increase in demand, without any 'surge pricing' above published standard fares. Further development of demand management models would be required to quantify this flexible discount approach.

- **Cost recovery adjustment** – The farebox revenue forecast set out in the Business Case assumes fares will rise annually in line with the Consumer Price Index (CPI). In the event that operating costs are estimated to increase above CPI, there may be opportunity to escalate fares at a higher rate to ensure costs are recovered through the farebox.
- **Fare bundling** – The fare strategy considers the potential for high speed rail fares to be bundled with travel on local public transport used to access high speed rail, and/or local amenities and attractions. This may improve high speed rail's attractiveness to customers and therefore demand and revenue. Implementation would be subject to agreement between the Authority and Transport for NSW around fare revenue allocation, and commercial arrangements with relevant local businesses.
- **Additional commercial revenue from car parking and in-station retail** – Car parking revenue at one station location has been included in the financial appraisal. Given the geographical locations of the stations, offering car parking facilities for passengers and visitors at other station locations should be explored. In addition, in-station retail has not been included in the financial appraisal. Leasing spaces within stations for commercial activities, including shops, cafes and restaurants has the potential to generate additional revenue, particularly given the Project is likely to attract significant foot traffic, making retail spaces highly lucrative and therefore should be considered in the future.
- **Property revenue** – There is a significant opportunity to undertake developments above or adjacent to the stations using land that is required for construction but not for the permanent station. This can create additional housing, as well as commercial and retail spaces which will further enhance passenger experience as well as drive long term demand. In addition to opportunities at stations, sites used for construction such as tunnel boring machine launch and retrieval sites, tunnel break locations and ventilation facilities may present an opportunity for development. Consideration has been given to alternative commercial models which may better align with developers cashflows whilst also driving additional returns and this could be explored further in the Development Phase.

9.9.3. Additional funding sources

The Project may present opportunities to leverage other funding sources, which may improve affordability from an Australian Government budget perspective. This includes the potential to leverage funding from:

- **State government** – Funding from NSW Government is subject to negotiation and agreement between the Australian and NSW Governments. To the extent that NSW Government provides a direct funding contribution to the Project, this assists reducing the Australian Government's budget funding requirement.
- **Alternative Australian Government sources** – The Australian Government has a number of targeted existing funds that may be able to provide funding to elements of the Project.
  - **Clean Energy Finance Corporation (CEFC)** – The CEFC is Australian Government specialist investment vehicle with a mandate to invest in clean energy technologies. Some elements of the Project, such as those that relate to sustainable infrastructure and electrification, may be eligible for CEFC funding.
  - **Future Made in Australia** – As part of the 2024-25 Budget, the Australian Government announced funding for Future Made in Australia, which seeks to support investment in developing domestic capability in priority industries. Key manufacturing elements of the Project, including local manufacturing of rolling stock and development of advanced manufacturing capability may be eligible for this funding.
  - **National Reconstruction Fund (NRF)** – The NRF invests to facilitate increased flows of finance into priority areas to help diversify and transform Australia's industry and economy. Transport, including rail vehicles, is a priority area for the NRF to foster innovative manufacturing and technologies to support the development of the transport sector.

9.9.4. Application to future stages of Network development

The proposed funding and financing strategy and scenarios developed for this Project could establish a model that could be adopted, with appropriate modification and flexibility, to future stages of the Network. This would ensure the funding of a Network is considered in a long-term staged program of works that provide predictability for industry to develop the skills and productivity enhancing methods that would reduce the cost of deploying the Network overtime. It would also allow governments to accommodate the scale of funding required within affordable and appropriate budget allocations. This is expected to generate long-term benefits to the government, industry and private financiers which would enable the transformative benefits of this Project to become reality.

[redacted]

[1] IPART (2020), Centre for International Economics Report
[2] The fares presented for travel to and from Western Sydney International are inclusive of the assumed gate charge.
[3] 50 years from commencement of Stage 1b operations
[4] Figure is incremental to base case.
[5] Figure is incremental to base case.

Chapter 10

Environment, sustainability and planning approvals

Australian Government
High Speed Rail Authority

Charting a confident course through planning and environmental approvals

- The project corridor between Sydney and Newcastle has a number of significant environmental challenges, including national parks, threatened biodiversity, waterways, wetlands, and Aboriginal and non-Aboriginal heritage features. The route between Sydney and the Central Coast is particularly challenging with a number of national parks, the Hawkesbury River and Brisbane Water.
- Avoiding impacts to national parks and other sensitive environmental features was a key priority of the Business Case design development and was consistent with feedback from stakeholders.
- A Planning Approvals Strategy has been developed for the Project in consultation with relevant Australian and NSW Government agencies and in line with the relevant legislation. It includes:
  - Declaration of the Project as state significant infrastructure and critical state significant infrastructure.
  - A staged infrastructure application under the *Environmental Planning and Assessment Act 1979* (EP&A Act) for HSR Newcastle to HSR Western Sydney International via Sydney corridor concept.
  - Subsequent staged State Significant Infrastructure (SSI) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) applications for sections of the Project.
- The Project will be sustainable by:
  - Achieving net zero during operation.
  - Delivering a world-class high speed rail project that is planned and delivered to be environmentally resilient and socially conscious.
  - Sharing knowledge and demonstrating innovation in sustainability.
  - Delivering a workforce and supply chain transformation for the region, including legacy industry participation and sustainable procurement initiatives to support the net zero ambition.
  - Designing, constructing and operating a climate resilient high speed rail corridor that is ready to operate beyond the twenty-first century.
  - Contributing to achieving the Australian and NSW Governments' 2035 and 2050 net zero targets.

10.1. Managing complex project delivery

10.1.1. High speed rail projects are inevitably large and complex

Since the Network will span several jurisdictions along Australia's eastern seaboard, its development will be governed by several (sometimes conflicting) pieces of legislation, regulation and policies, while its sheer scale means it has significant potential to influence the environmental and cultural assets of the nation.

Critical complexities include:

- Planning legislation, approvals and development pathways that differ due to the nature and scale of development, significance of potential environmental impacts, and between individual states and the Australian Government environment and planning legislation.
- Sensitive environmental features throughout the Project's alignment, including national parks, threatened flora and fauna, and communities, waterways and wetlands.
- Aboriginal and non-Aboriginal heritage features across the lands and waterways within and adjacent to the Project's alignment.
- Overarching government policy that supports an ultimate transition to net zero emissions, like the Australian Government's Net Zero Plan or NSW Government's Net Zero Plan Stage 1: 2020-2030.

10.1.2. A structured approach to manage project risks

The successful delivery of this Project and the Network depends on managing these approvals and risks appropriately. The overall Delivery Strategy is therefore supported by a robust process that:

- Streamlines delivery and avoids major issues, where possible.
- Manages project delivery risks effectively.
- Avoids, minimises and mitigates negative impacts on the environment and the community.

10.2. Approach to planning approvals

A Planning Approvals Strategy has been developed in consultation with relevant Australian and NSW Government agencies and in line with relevant legislation.

Planning approvals for the Project will be subject to Commonwealth and NSW legislation.

The legislation that regulates land use planning and development for the Project is outlined in the following table.

Table 10-1 Infrastructure development legislation

Legislation	How it applies to the Project
Environmental Planning and Assessment Act 1979 (NSW)	On 26 July 2024, the *Environmental Planning and Assessment Regulation 2021* (EP&A Reg) was amended to list the Authority as a public authority in NSW for the purposes of the EP&A Act, allowing it to act as a determining authority (that is, can approve its own developments). This also allows the Authority access to the 'exempt development' provision of the *State Environmental Planning Policy (Transport and Infrastructure) 2021*, for activities such as geotechnical investigations. Clause 79 of the *State Environmental Planning Policy (Infrastructure) 2007* provides that development on any land for the purpose of a railway or rail infrastructure facilities may be carried out by or on behalf of a public authority without development consent. High speed rail meets this requirement, and will be carried out by the Authority, a public authority. Accordingly, high speed rail is permissible without obtaining development consent under Part 4 of the EP&A Act. The assessment and approval process for state significant infrastructure projects in NSW is established under Part 5, Division 5.2 of the EP&A Act. The Project will most likely be declared state significant infrastructure and critical state significant infrastructure under Sections 5.12 and 5.13 respectively. A concept proposal for State Significant Infrastructure may be assessed as a Staged Infrastructure application (Section 5.20 of the NSW EP&A Act). A Staged Infrastructure (Concept)

Legislation	How it applies to the Project
	approval describes the entire project in a broad sense, establishes its need and benefits, and provides an overview of likely impacts. The approval of a Concept does not allow for any construction to take place, but it does present some potential advantages for a major infrastructure development. These are primarily related to the ability to gain separate project approvals for components of the project, and therefore avoiding the need for a single detailed EIS/planning approval for the entire Project. A staged Infrastructure application under Section 5.20 of the EP&A Act is the most suitable pathway for the Project.
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	The Authority would seek approval under the EPBC Act where the Project has the potential to significantly impact 'matters of national environmental significance', or where the action is taken by an Australian Government agency, that is the Authority, and is likely to significantly impact the environment.
Airports Act 1996 (Cth)	Western Sydney International is being built and will be operated under the *Airports Act 1996*. This Act requires airports to prepare a master plan for approval by the Minister. The Project includes a station at Western Sydney International and passes through Western Sydney International land, therefore an amendment to the Airport Plan will be required.

A Planning Approvals Strategy has been developed for the Project in consultation with relevant Australian and NSW Government agencies. Engagement with government agencies will be ongoing to further discuss and evolve the approach to planning approvals.

The key objectives and drivers for the Planning Approvals Strategy are to:

- Meet Commonwealth and State government legislative requirements.
- Align with the outcomes of government agency engagement.
- Align with the Project's Delivery Strategy and construction packages.
- Ensure approvals are in place prior to major contract award to provide certainty of environmental requirements in delivery, with the first construction package scheduled for award in the third quarter of 2027.
- Consider key environmental investigations and appropriate lead time.

Based on the current project construction program (see Chapter 12) the approach to planning approvals is illustrated on the following page and outlined below:

- A staged Infrastructure application under Section 5.20 of the EP&A Act is the most suitable pathway for the Project. CSSI Application 1 will be a staged infrastructure application and include a concept assessment for HSR Newcastle to HSR Western Sydney International and a detailed project assessment for the construction (only) of a tunnel section between Hornsby and Ourimbah.

- All detailed CSSI applications will require referral to the Australian Government for approval under the EPBC Act. A split referral assessment process is proposed for each detailed assessment to the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW).
- Determinations by a public authority, that is the Authority, under Part 5 Division 5.1 where development approval is not required, supported by Review of Environmental Factors for activities such as enabling works.

The planning approval approach is endorsed by the NSW Government Department of Planning, Housing and Infrastructure (DPHI) and DCCEEW.

Section 45 of the EPBC Act provides for bilateral agreements between the Australian and State governments. A bilateral agreement accredits components of a State based assessment and/or approval process for the purposes of assessment and/or approval under the EPBC Act. The Australian/NSW Government bilateral agreement (Amending Agreement No. 1, 24 March 2020) accredits the NSW State Significant Infrastructure assessment processes, such that relevant projects do not require separate assessment under Part 8 of the EPBC Act. The changes made to the bilateral agreement in 2020 specifically allow for projects being undertaken by Australian Government agencies to be addressed under this agreement, overriding a previous exclusion. The bilateral agreement provides for efficiencies throughout the Project's environmental assessments, whereby the State undertakes the assessment on behalf of the Australian Government.

10.3. Preliminary environmental assessment

The project corridor includes sensitive environmental features, such as national parks, threatened flora and fauna, waterways and wetlands, as well as Aboriginal and non-Aboriginal heritage features. Avoiding these sensitive environmental features was a key objective during the Business Case and design development process.

A preliminary environmental assessment has been carried out for all key environment and heritage matters, based on the best available desktop data.

This assessment identified potential impacts on sensitive environmental features and proposed next steps to avoid, minimise and mitigate these impacts.

While the assessment of potential environmental impacts is preliminary and based on desktop information, a range of potential mitigation measures and areas for further assessment have been identified to minimise impacts and incorporated into the Definition Design where appropriate. The cost plan includes provision for elements which would result in significant costs – for example noise walls, treatment of contaminated soil, overpasses and underpasses for fauna, and biodiversity offsetting.

The scope of the preliminary environmental assessment included potential impacts associated with:

- National park estate and state forests
- Biodiversity
- Noise and vibration
- Surface water groundwater and flooding
- Contamination
- Social factors
- Visual amenity
- Hazards and risk
- Environmental heritage
- Traffic and transport
- Land use.

10.3.1. Key risks identified in the preliminary environmental assessment

The preliminary assessment revealed particularly important risks and issues in relation to national parks, biodiversity, and noise and vibration. A summary of the findings on these issues is provided below.

National parks

National parks are important areas set aside to protect significant ecological, heritage, scenic and recreational values. Continued protection of these areas is critical to the community. Consideration of potential impacts to national parks was a key focus of the options assessment and design for the Project. Impacts to national parks were avoided wherever feasible. The Definition Design (Chapter 5) avoids all surface impacts by tunnelling under national parks and locating surface facilities, such as ventilation shafts, outside of national parks.

Locating a Project alignment that avoids impacts to national parks was particularly challenging between Sydney and the Central Coast because of the extent of national parks north and south of the Hawkesbury River. As national parks are defined to include below ground areas, the Project alignment traverses national park land even when in tunnel through the Brisbane Water and Ku-Ring-Gai Chase National Parks.

High speed rail is not a permissible activity in a national park and requires the land to be transferred out of national park (Part 11 of the *National Parks and Wildlife Act 1974* (NSW)) to proceed. The process of

transferring land from national park to the Authority would need to be supported by the NSW Minister for the Environment and involve the alignment section being revoked from the gazetted park by an Act of Parliament. Revocation will be required for all sections of the alignment within national park land, including those in tunnel.

A compensation package may be required if there is an impact to the conservation, cultural heritage or other values of the land being revoked. This would be negotiated with the NSW National Parks and Wildlife Service. The Authority has engaged with NSW National Parks and Wildlife Service through preparation of the Business Case to keep it informed of design development and to understand the requirements for any revocation of national park estate. The likelihood of requiring compensation for national park impacts is unknown and would be further discussed with NSW National Parks and Wildlife Service in the Development Phase.

Land to be revoked for the Project must be clearly identified and surveyed. Once supported via an Act of Parliament and any compensation provided, the land is to be transferred from the national park to the Authority. This requires certainty about the location of the alignment and any surface facilities prior to the revocation and land transfer. This is an important ongoing consideration for the design process and delivery timeframes.

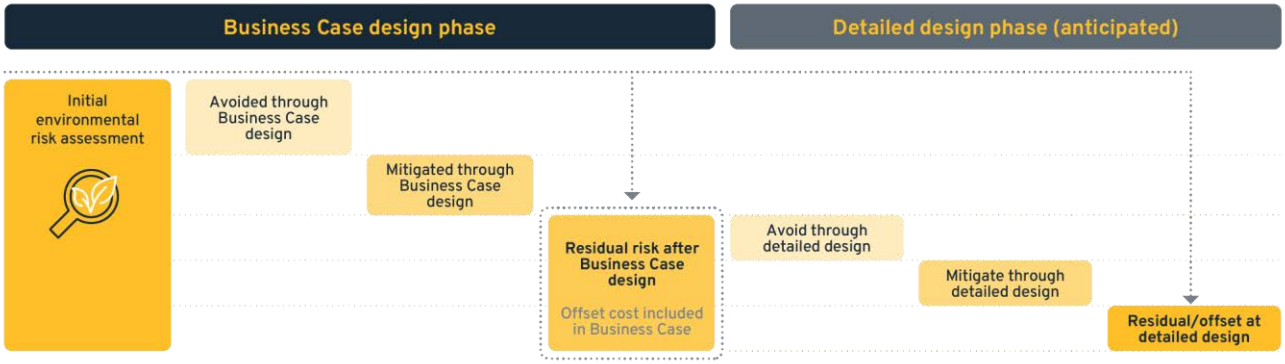
[redacted]

10.3.2. Avoiding, minimising, and mitigating risks identified in the preliminary environmental assessment

Identifying and avoiding potential environmental risks, while also identifying positive outcomes, was a key priority of the Business Case optioneering and design development process. The Project has already been developed in a way that avoids several potential environmental risks, while mitigation for others has been incorporated into the plans in line with best practice. As the design progresses to a more detailed level, further avoidance of the residual environmental risks will be implemented, thus minimising future mitigation and offsetting. This iterative approach to risks minimisation is illustrated below.

Further avoidance of sensitive environmental features will be considered at later stages of design.

Figure 10-2 Iterative approach to environmental risk through Business Case and detailed design



Risks avoided at Business Case design stage

Key risks avoided at this stage of design development include:

- Possible surface impacts on Sugarloaf Conservation Area avoided by relocating the alignment to the east.
- The alignment passes through Ku-ring-gai Chase National Park in tunnel. Surface impacts have been avoided through the adoption of tunnelling through this section of the alignment which has avoided severance of a large area of continuous high quality habitat.
- Surface impacts to Brisbane Water National Park have been avoided through the adoption of tunnelling through this section of the alignment. This avoids up to 20 hectares of surface impacts as well as avoiding Somersby Mint Bush habitat, considered an 'Asset of Intergenerational Significance'.
- The alignment was shifted to avoid tunnelling underneath the Western Sydney Nature Reserve that forms part of Western Sydney Parklands. This avoids the need for revocation of this land under the *National Parks and Wildlife Act 1974* (NSW).
- Bridge options were considered and dismissed for the Hawkesbury River crossing. The bridge alternatives would have required a series of large bridges. The tunnel option avoided significant surface impacts associated with construction to Brisbane Water and Ku-ring-gai Chase National Parks and impacts to the river system and the communities that use it.
- The Definition Design avoids all surface impacts to national park estate through careful siting of surface infrastructure, including vent shafts, evacuation sites and tunnel boring machine launch and retrieval sites.

[redacted]

- Construction of HSR Parramatta Station as a mined cavern to avoid surface disruption to numerous State and local heritage items, including Roxy Theatre, Parramatta Park and Old Government house. Impact to the World Heritage Australian Convict Sites (Old Government House and Domain) has also been avoided.
- [redacted] Construction of HSR Sydney Central Station as a mined cavern also avoids surface disruption to numerous local heritage items.

How residual risks will be avoided and mitigated through detailed project design and delivery

There are environmental risks that can be identified at the Business Case design stage but cannot be avoided or mitigated until more detailed design work is underway. These will be addressed in the following ways:

- Further design of track, tunnel portals and rolling stock to reduce noise and vibration.
- Restricting hours of construction and identification of property treatments after all feasible noise mitigation has been applied.
- Further avoidance of impacts to biodiversity including minimising construction footprints in biodiversity corridors and riparian zones. A preliminary biodiversity offset strategy has also been developed that outlines the approach to offsetting, which will continue to be refined as the design develops.
- Extending viaducts to reduce construction footprints and allow native vegetation regeneration below.
- Identification of other specific biodiversity mitigation measures to minimise impacts on habitat, including fauna underpasses and overpasses, nest boxes and hollow replacement.
- Site specific mitigation for Aboriginal and non-Aboriginal heritage sites where impacts are unavoidable.
- Retention of vegetation for visual screen and visual treatments.
- Design watercourse crossings to minimise disturbance and harm to riparian corridors.
- Incorporation of measure to improve resilience to climate risks, particularly along the surface alignment.

Where impacts cannot be avoided or residual impacts remain after mitigation, offsetting may be required, particularly for biodiversity. In NSW, the *Biodiversity Conservation Act 2016* provides the framework for biodiversity offsetting. A preliminary Biodiversity Offset Strategy sets out an approach to offsetting. A project of this scale is uniquely placed to explore strategic approaches to offsetting that can support the delivery of regional conservation outcomes. As detailed in the Economic Development Strategy, the Authority can also generate additional benefits from its offsetting program by working with First Nations communities, providing jobs on Country and benefiting from the thousands of years of knowledge in sustainable land management.

10.3.3. Next steps for environmental impact mitigation

The Preliminary Environmental Assessment and associated technical studies ha been completed to understand the potential risks and impacts of future construction and operation of the Project. The assessments have been based on the best available information and most reasonable assumptions given the level of design available at this stage.

Future design activities will avoid and mitigate impacts wherever practicable. The detailed environmental assessments completed as part of planning approval applications under Commonwealth and NSW legislation will identify further potential impacts to the environment, along with any mitigation and offsetting required. Ongoing engagement with government agencies and the community will continue to build on the engagement already undertaken during the Business Case.

10.4. Sustainability

The Project will be sustainable by:

- Delivering a world-class high speed rail project that will achieve net zero during operation and will align with the pathway to net zero during construction by adopting all reasonable initiatives and without the reliance on purchased offsets.
- Contributing to achieving the Australian and NSW Governments' 2035 and 2050 net zero targets.
- Delivering a workforce and supply chain transformation for the region, including legacy industry participation and sustainable procurement initiatives to support the net zero ambition.

High speed rail provides significant sustainability benefits. The direct benefits include reducing greenhouse gas emissions by shifting from more carbon intensive travel modes, reducing air pollution, reducing road related injury and death, and improving resilience to climate change shocks and stresses.

While the Project is likely to generate substantial carbon emissions during construction, its significant scale means it offers a major opportunity to catalyse a new wave of low carbon construction through its commitment and initiatives to reduce carbon in construction and operation, greatly reducing the carbon impact of both future stages of the Network and wider industries in Australia. The Network will also be designed for improved resilience to climate change, now and in the future. A Sustainability Management Plan, which includes objectives, targets, actions and initiatives, the approach to assurance, and a Carbon Management Plan and Climate Risk Assessment has been prepared.

10.4.1. Net zero emissions

The Project will result in 86,414 tonnes carbon dioxide equivalent (CO_2eq) saving through mode shift from mainly roads. As the Project will be first stage of the broader Network, it will also support more significant reductions in CO_2eq of 5.7 million tonnes from mode shift expected from air travel.[1]

The construction and operation of high speed rail will generate greenhouse gas emissions. Estimates of emissions were a consideration in the options assessment, and have been calculated for the Definition Design and across the project lifecycle. A Net Zero Roadmap, contained in the Carbon Management Plan and summarised in Figure 10-4, outlines the broad emissions reduction measures being targeted over time to achieve net zero carbon. The Authority has made the following commitments regarding its carbon footprint:

- Net zero in operations.
- During construction, it will align with its pathway to net zero by adopting all reasonable initiatives and without the reliance on purchased offsets.
- Catalyse broader economic development and legacy around industries such as low carbon concrete and steel industries needed to support construction of high speed rail.
- Contribute to NSW decarbonisation through provision of a zero carbon transport option.
- Increase percentage of reused and recycled materials in construction and reduce end-of-life waste, including through engagement and collaboration with suppliers and through innovation.

During construction, high speed rail will continually reduce absolute carbon emissions through the progressive uptake of low carbon technologies and materials, with net zero carbon achieved by the end of construction. As outlined in the Sustainability Plan and in Figure 10-4, these techniques include use of low and zero carbon concrete, zero carbon steel, and sustainable fuel for construction and transportation of materials, as well as design optimisation. These initiatives will substantially reduce carbon emissions during construction, as outlined below. The Sustainability Plan identifies plans for further reductions to minimise the requirement for offsets.

Case study: HS2 United Kingdom

Earth friendly concrete

Earth friendly concrete is a combination of GGBS, fly ash and a high alkaline chemical, which has been used as a temporary foundation slab for HS2. A geopolymer binder system reduces embodied carbon by around 70 per cent, saving 250 kilograms of CO_2 per cubic metre poured.

Electric crane and biofuels

The project's Canterbury Road Vent Shaft site used the United Kingdom's first 160-tonne electric crane. The crane uses biofuels (hydrogenated vegetable oil), an electric compressor and mains power on a 100 per cent renewable energy tariff for construction.

Table 10-2 Sustainable infrastructure use by the Project

Initiative	Description
Low and zero carbon concrete	High supplementary cementitious materials (SCM) concrete (fly ash, ground granulated blast furnace slag (GGBS), calcined clay), geopolymers
Zero carbon steel	100% renewable and recycled steel (electric arc furnace)
Construction and transportation fuels	Emission-free sites, electric construction equipment, hydrogen powered construction equipment, renewable diesel
Operational electricity	100% renewables through a combination of on-site and off-site renewables
Design optimisation and manufacturing	Advanced manufacturing facility to control and minimise embodied carbon of materials and transportation
Integrating carbon into governance	Carbon literacy training, KPIs to incentivise contractors and management system requirements (PAS 2080)

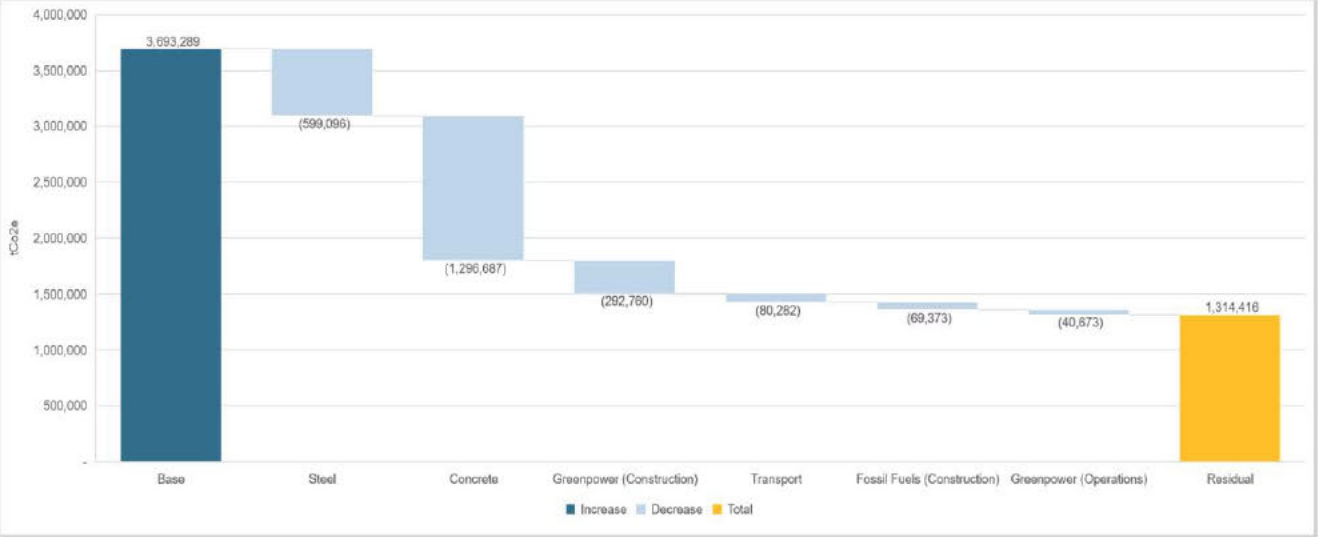
Source: WSP 2024

The total carbon footprint for the Project is illustrated in the following figure and shows a 64 per cent reduction of emissions against the Base Case at the Business Case design phase after sustainable infrastructure initiatives adopted by the Project. The initiatives are incorporated into the design and the Project's cost estimate. The residual value of carbon is captured as a disbenefit in the economic appraisal in compliance with Infrastructure Australia guidelines. As discussed above, further work in the detailed Design Phase will seek to align the Project with its pathway to net zero and reduce residual carbon further.

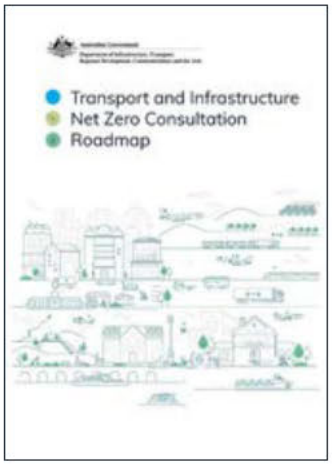
Case study: Sydney Metro

Sydney Metro's Claremont Meadows shaft site has deployed a 250-tonne electric crawler crane. Operating 8 to 10 hours a day, it is estimated that it will save 18,750 litres of diesel fuel annually. It has the additional benefit of reducing construction noise.

Figure 10-3 Project's carbon baseline and footprint with carbon reduction measures contained in the Net Zero Roadmap



High speed rail operations will be powered by renewable energy from the grid and will avoid producing direct greenhouse gas emissions during operations. The Project will also avoid generating indirect emissions by using renewable energy.



The principles of ecological sustainable development will be embedded throughout the design, construction and operation of the Project. There will be a focus on resource and materials efficiency, minimising environmental impacts, and ensuring balanced outcomes that promote long-term environmental resilience, community benefits and economic viability. The Project will comply with applicable environmental laws, regulations and statutory obligations. Achieving net zero carbon emissions by construction completion and during operations will position high speed rail as a leader in sustainable transport, reducing the Project's overall carbon footprint and contributing to Australia's net zero targets.

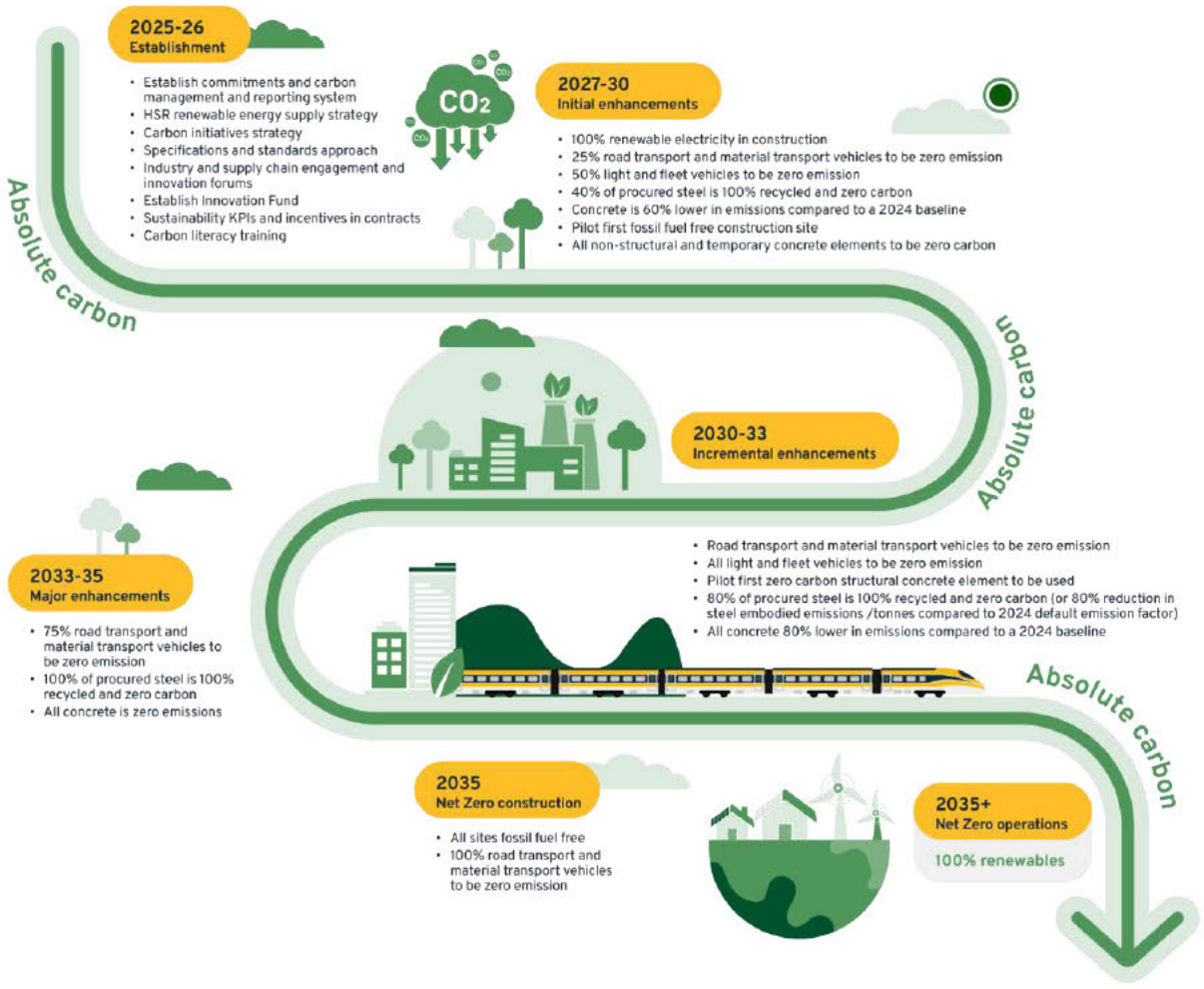
As described in Chapter 2 – Need for Investment, a critically important benefit of the Project is that – uniquely among infrastructure projects in Australia – it is of sufficient scale to act as the catalyst for the rapid development, scaling and deployment of green steel and green concrete technologies. While this will deliver a widespread net zero benefit across all economic sectors, it also means that the delivery of the Project sets subsequent stages of the Network up for net zero carbon delivery from the outset.

Table 10-3 Carbon reduction initiatives, risks and mitigations

Commitment/ initiative	Risk to implementation	Mitigation
Operational electricity sourced from 100 per cent renewables	Risk that the grid is not 100 per cent renewables by commencement of operations. In NSW the grid is projected to be 0.03 tonnes CO_2eq per MWh in 2035; that is, nearing zero emissions. Stage 1A is expected to commence operations in 2037.	Onsite renewable energy generation, where feasible, and one or more of the following: • Purchasing green power. • Purchasing large-scale generation (LGC) certificates. • Entering a long-term power purchase agreement with a renewable energy developer if shortfall is significant and longer term.

Commitment/ initiative	Risk to implementation	Mitigation
Net zero achieved by the end of construction of the Project	• Standards and specifications not developed in time for construction. • Industry capacity to supply low carbon materials. • Availability of alternative fuels and equipment. • Proven technology that can be deployed at scale.	Roadmap to net zero developed and updated annually including: • Industry engagement and innovation collaboration. • Innovation fund established. • Contracts established with targets and incentives. • Strategy to address specifications and standards. • Pilot fossil fuel free construction site.

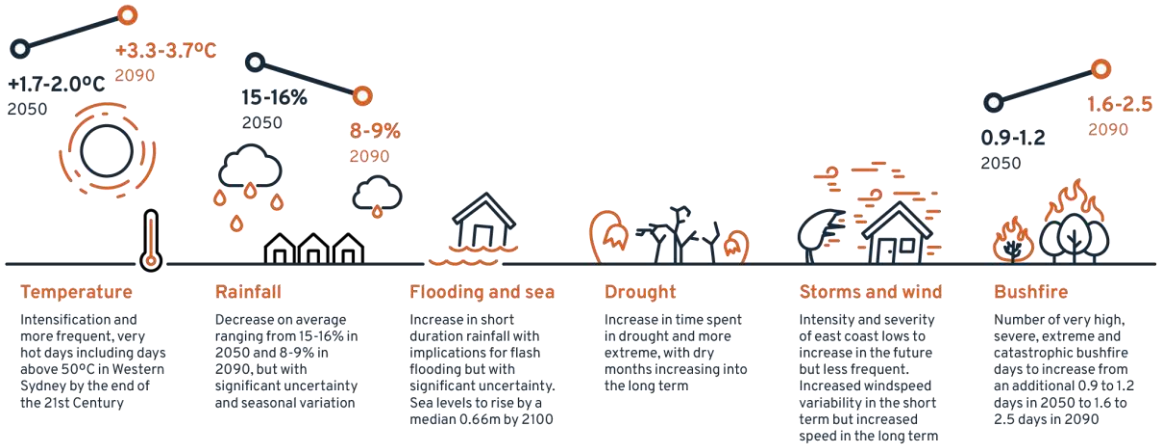
Figure 10-4 Net Zero Roadmap



10.4.2. Climate resilience

Climate change presents complex and uncertain impacts on the built environment, exacerbating known hazards and leading to new risks. A Climate Change Risk Assessment has been completed that considers the changing climate, relevant Project risks, risk severity and mitigations throughout the project lifecycle.

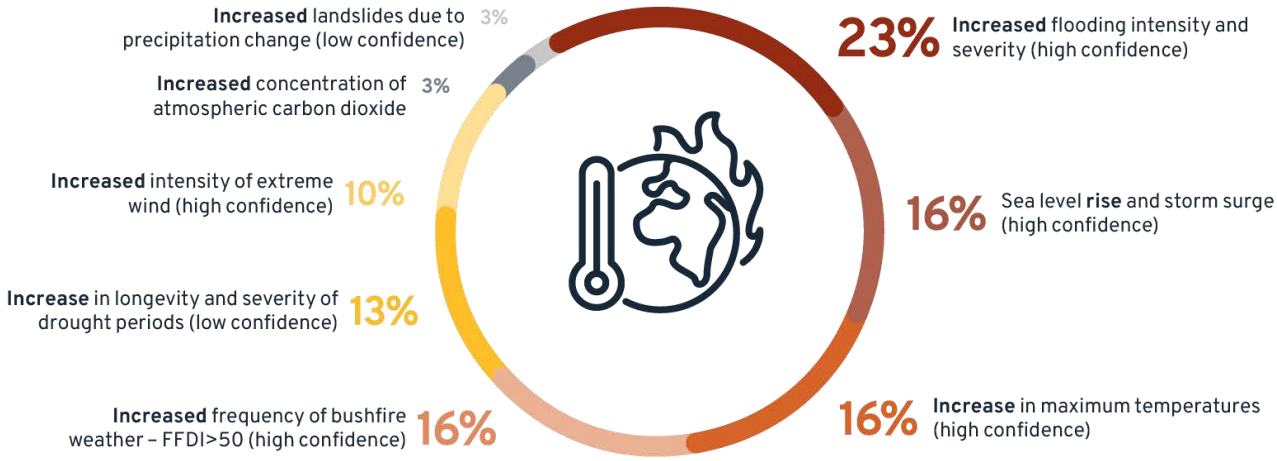
Figure 10-5 Changing climate across the project corridor



Source: NARCLiM (2024).

The Climate Change Risk Assessment undertaken for the Project identified a total of 31 key project risks across eight hazard types as illustrated in the following figure. The greatest number of the risks were associated with precipitation and flooding (23 per cent), followed by increased temperature, sea level rise and storm surge, and bushfire (all 16 per cent). Other risks were associated with drought, extreme wind, increased atmospheric concentration of CO_2 and landslides.

Figure 10-6 Key climate risks



The risks identified will increase over time as the likelihood and expected severity of climate events increase. Six of the risks were identified as either high or extreme, mostly in the medium to long term. The highest risks related to inundation from sea level rise and flooding. At-grade sections of the network are at most risk.

At this Business Case design stage and option definition, reducing the risk from increased flooding has been the focus of design. The design has responded by either avoiding flood prone areas or using bridge or viaduct structures instead of at grade construction. Later stages of design will further consider flooding and other climate change risks. Sections of the alignment that are in tunnel will be significantly less at risk.

Options for adaptation and risk mitigation have been identified for each risk across the Project's lifecycle stage including further design and planning, design development and construction, and operations stages. These are contained in the Project's Climate Risk Assessment and will be further explored during later stages of design to ensure the resilience of the Network to further climate risks.

Case study: Valley Arm Biobank

Location: Hunter Valley, NSW

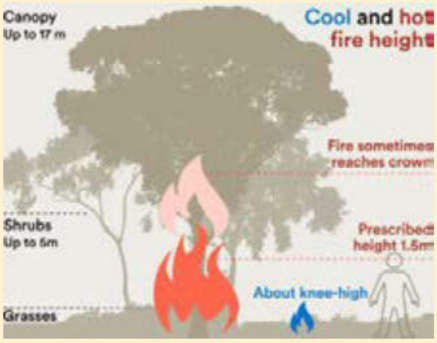
Owner/Operator: Wonnarua Nation Aboriginal Corporation

Area size: 74 hectares

Year of establishment: 2009-2010

Aboriginal people have coexisted with the environment for tens of thousands of years. Traditional knowledge systems have developed over time and continue to be used to pass on skills, values and knowledge about protecting and managing Country to support biodiversity and manage resources. Aboriginal people use this traditional ecological knowledge combined with cultural protocols to inform how they interact with Country, including land management practices. The use of cultural burning is one component of Aboriginal land management. Cultural burning has multiple objectives centred around respecting and increasing the health of Country. These may include but are not limited to:

- Spiritual objectives, health and wellbeing (healthy Country – healthy people).
- Cultural and landscape resilience.
- Traditional practices and use.
- Intergenerational knowledge transfer.
- Ecological outcomes.
- Cultural species management.



A key feature of cultural burning is that it uses 'cool', slow-moving, low flames. The fire is controlled on a local scale and creates a mosaic of burnt and unburnt areas. Over time, this creates vegetation patches of different ages, helping to maintain biodiversity across the broader landscape. This technique leaves refugia areas for animals to move out of the path of fire and provides food and habitat immediately after a fire. Cultural burning also reduces fuel load and minimises bushfire risk and/or reduces the intensity of bushfires therefore being a suitable tool for adapting to climate risks such as increased bushfire frequency and intensity.

Source: Government Architect NSW (2023), Case Study: Firesticks Alliance Indigenous Corporation.

10.5. First Nations culture and heritage

The Authority is committed to identifying and minimising impacts to First Nations cultural and heritage values throughout the planning and construction of the Project.

First Nations culture and heritage values consist of matters of significance to First Nations people, including both those which are physical and tangible (such as specific sites or objects) and those which may be non-physical and intangible (such as peoples, memories, storylines, ceremonies, language and practices). Culture and heritage values highlight the importance of celebrating and preserving cultural practices that can be

handed down to new generations, and may relate to the connection and sense of belonging that First Nations people share with the landscape and with each other.

To support the planning for the Project, an Aboriginal due diligence assessment and a cultural values evaluation was undertaken across the study area. These assessments helped identify the number of sites and the significance they have for First Nations people. This work was underpinned by extensive engagement with First Nations stakeholders, including land councils and knowledge holders. Ongoing engagement with First Nations stakeholders will continue as the Project progresses.

10.5.1. Aboriginal due diligence assessment

Figure 10-7 known sites of Aboriginal significance

The Aboriginal due diligence assessment developed three recommendations:

- Update Aboriginal due diligence assessment. The due diligence assessment will need to be updated once the final alignment has been determined and confirmed. Relevant approvals will be required from First Nations stakeholders.
- Avoid high sensitivity areas. The site prediction model predicts areas of high sensitivity around permanent and ephemeral water sources and rocky outcrops. To minimise impact to First Nations culture and heritage, these areas should be avoided and an alternative alignment should be identified.
- Undertake further investigation (Aboriginal heritage). The results of this due diligence assessment indicate that Aboriginal objects, sites and places are located within the study area and that these may be impacted by the proposed activity.

A comprehensive engagement strategy will be developed to guide engagements with First Nations stakeholders and knowledge holders for the next phase of the Project.

10.5.2. Cultural values evaluation

The cultural values evaluation focused on the intangible cultural and heritage sites only known by First Nations knowledge holders and First Nations cultural authorities, who protect the knowledge as sacred cultural information. The Authority carried out early engagement with First Nations stakeholders and knowledge holders compiling qualitative information about sites and the associated narratives that defines the significance of those sites across the study area. Some of the cultural values sites identified for further exploration are outlined in the following table.

Table 10-4 Cultural values themes

Cultural values category	Cultural values themes
Spiritual	• Women's and men's sites. • Burial grounds. • Songlines, sacred sites and ceremony sites.
Social	• Community. • Connectedness to surrounds. • Economic opportunities and community development.
Historic	• Caring for Country. • Access to Country. • Communication of knowledge.
Scientific	• Management of land and waterways. • Significance of native plants and animals. • Sustainability. • Traditional practices.
Aesthetic	• View lines and landscapes. • Cultural significance of aesthetic values. • Holistic approach.

There are opportunities to embed First Nations cultural values into the broader design process, including:

- Caring for Country – Co-create a plan with First Nations knowledge holders to enhance environmental land management outcomes; and support activities to educate and elevate First Nations connection to Country with the Authority.
- Recognition – Positively recognise the Traditional Custodians of Country, the rich culture that exists within the surrounding landscape, showcasing language, traditional place names, knowledges and the history of places.
- Interpretation – Work with Traditional Custodians and knowledge holders to develop strategies on how to apply cultural values along the corridor, including signage, photos, soundbites, artwork and sculptures to highlight the significance of the local knowledge and songlines.

This will be ongoing process throughout the project lifecycle and will require further consultations to unlock the cultural stories. An overarching communications and engagement strategy will be developed to support ongoing engagement with First Nations key stakeholders, including land councils and knowledge holders, as outlined in Chapter 11.

[redacted]

[1] Modelled on 2061 year.

Chapter 11

Government, community and stakeholder engagement

Australian Government
High Speed Rail Authority

Engaging with integrity to shape a Project for everyone

- Early stakeholder engagement has included all levels of government, industry and peak groups, community and First Nations representatives.
- Engagement to date has raised awareness and momentum for the Project and high speed rail, and identified issues, risks and opportunities that have shaped the Project.
- Various tools, such as forums and media, have been used to collaborate and engage with stakeholders.
- Strong engagement with First Nations stakeholders has helped to:
  - Identify First Nations culture and heritage significant sites.
  - Capture First Nations narratives for sites across the high speed rail corridor.
  - Incorporate infrastructure into planning and designing for Country
- Next steps for the Project include maintaining communications and engagement with stakeholders, developing engagement framework to support planning approvals and property acquisition approach, and ongoing engagement with First Nation stakeholders.

11.1. Relationships matter

Stakeholder and community engagement has played a critical role in shaping and informing the Business Case.

Engagement for the Project began in late 2023 as an immediate priority following the establishment of the High Speed Rail Authority. The effort to-date has been guided by a range of stakeholder and community research and early consultation activities on engagement preferences to ensure an evidence based approach.

Since its inception, the Authority has undertaken comprehensive engagement with Australian, State, and local governments, as well as key stakeholders, strategic partners, First Nations peoples, communities and industry.

Early engagement has focused on establishing meaningful relationships, facilitating open and transparent discussions, and creating opportunities for capturing a wide range of insights, feedback and recommendations to help shape the Project.

Feedback captured during early engagement gave insight into how stakeholders and communities would like to be involved and engaged in subsequent phases of the Project. These findings will serve as the foundation for future strategies and plans developed by the Authority.

11.1.1. Engagement principles and objectives

At the core of the Authority's engagement strategy is the commitment to act with integrity and collaborate with its partners to ensure stakeholder and community needs are considered and upheld across all phases of the Project. The following figure outlines the Authority's stakeholder engagement principles and objectives.

Figure 11-1 Stakeholder engagement principles and objectives

11.2. Engagement journey to date

11.2.1. Early engagement approach

The Authority carried out early engagement to gather initial insights and identify immediate issues, risks and opportunities relating to the Project. The program was the first opportunity to bring stakeholders together to align key objectives and regional plans, identify challenges and constraints, and explore enablers of local and economic development opportunities. The table and diagram below outline the engagement journey to date.

Table 11-1 Stakeholder overview and how we engaged

Stakeholder	Engagement focus	How we engaged	Who we engaged
Australian Government	Aligning with national objectives, priorities and plans	Australian Government agencies engaged through regular formal reference groups, working groups, participation at forums and one-on-one briefings. The Authority established an Inter-departmental Committee to facilitate ongoing engage with department representatives and capture insights to inform future planning.	• The Department of Infrastructure, Transport, Regional Development, Communications and the Arts • The Department of Finance • Department of Climate Change, Energy, the Environment and Water • Western Sydney Airport Co imited • The Treasury • Infrastructure Australia • Office of the National Rail Safety Regulator • ARTC

Stakeholder	Engagement focus	How we engaged	Who we engaged
NSW Government	Aligning with state objectives, priorities and plans with focus on environment, land use planning, economic and regional development strategies, transport and high speed rail integration, and rail safety.	NSW Government agencies engaged through NSW Intergovernmental Reference Group, regular weekly working groups, forums, one-on-one stakeholder briefings and deliberative workshops. The Group met monthly and enabled information sharing between the Authority and NSW Government agencies with executive representation from Transport for NSW, Infrastructure NSW, Department of Planning, Housing and Infrastructure, and the NSW Department of Regional Development and Delivery Department of Climate Change, Energy, the Environment and Water.	• Transport for NSW • Department of Planning, Housing and Infrastructure • Department of Climate Change, Energy, the Environment and Water • Infrastructure NSW • Fire and Rescue NSW • Landcom • Department of Primary Industries and Regional Development • Fisheries and Forestry • Investment NSW (Premier's Department) • Homes NSW • Hunter Central Coast Development Corporation
States and territories	Aligning with states and territory objectives, priorities and plans with focus on cross jurisdictional coordination and planning, environment protection, land use planning, economic and regional development, and transport and high speed rail integration.	State and territory governments engaged through working groups, and one-on-one stakeholder briefings.	• ACT Government • ACT – Transport Canberra and City Services • ACT– Chief Ministers, Treasury and Economic Development Directorate • ACT – Major Projects Canberra • ACT – Environment, Planning and Sustainable Development Directorate • ACT – City Renewal Authority • ACT – Suburban Land Agency • Queensland Investment Corporation • Queensland – Department of Transport and Main Roads • Victoria – Department of Transport and Planning
Local governments	Aligning with local environmental plans, place making initiatives and local developments.	Local government engagement along the study area helped identify and align priorities, initiatives and development with high speed rail planning. The project team proactively engaged local government representatives by providing Project briefings and updates, technical information sharing, identifying land uses and local development, and encouraging representatives to participate at key events, such as deliberative forums and industry briefings.	• Central Coast Council • Cessnock City Council • Inner West Council • Ku-ring-gai Council • Lake Macquarie City Council • Newcastle City Council • City of Sydney • Hornsby Shire Council • City of Parramatta • Maitland City Council • City of Blacktown • Dungog Shire Council

Stakeholder	Engagement focus	How we engaged	Who we engaged
First Nations	Capturing insights about First Nations significant lands, cultural values and heritage to help minimise impacts and avoid sites, and inform the design and future infrastructure. Engagement supported: • Culture and heritage assessment. • Participation strategy. • Designing with Country.	The Authority is working closely with First Nation stakeholders to help strengthen relationships, connect with people, and capture local knowledge and insights. Engagement undertaken between July 2024 and November 2024 through a series of one-to-one briefings to capture First Nations significant sites, song lines, and cultural narratives, as well as tangible and nontangible values.	• Land Councils including Awabakal, Biraban, Darkinjung, Deerubbin, Gandangara, Metropolitan, Worimi, Bahtabah, Biripai, Bunyah, Forster, Karuah, Mindaribba, Purfleet/Taree • Groups and Corporations including Barang Regional Alliance, Dharug Led Design Panel, La Perouse Aboriginal Community Alliance (LPACA), Western Sydney Aboriginal Regional Alliance (WSARA), Wonnurua Nation Aboriginal Corporation. • Local government groups include Guraki Aboriginal Advisory Committee and Local Government Aboriginal Network (LGAN). • Businesses and service providers including National Indigenous Business Chambers Alliance (NIBCA), NSW Indigenous Chamber of Commerce, Supply Nation, YARPA Indigenous Business and Employment Hub • Government and industry bodies including Aboriginal Affairs, National Indigenous Australian Agency, NSW Aboriginal Land Council, NSW Department of Industry and Regional Development – Regional Aboriginal Partnerships and Outcomes (Hunter Central Coast) team, NSW Treasury Procurement team, TfNSW Aboriginal Engagement team.
Community	Understanding local views about high speed rail, and sharing project benefits.	Communities were engaged through focus groups, community pop up information stalls, shopping centre activations and community surveys. The Authority is establishing a Community Information Centre in Newcastle to facilitate ongoing community and stakeholder engagements, provide information about the Project and to speak with the project team.	• Communities across the broad study area between Newcastle, Central Coast and Greater Sydney.
Key stakeholders and peak bodies	Understanding views about high speed rail, sharing project benefits and capturing constraints and opportunities insights	The Authority has been actively engaging with key stakeholder groups and peak bodies at forums, workshops, briefings and industry conferences.	• Industry stakeholders • Tourism and arts stakeholders • Education and health institutions stakeholders • Local business groups and chambers of commerce stakeholders • Planning and housing peak bodies • Local government peak bodies

Engagement snapshot

A comprehensive communications and engagement program was implemented with supporting activities to raise awareness and encourage stakeholder and community participation.

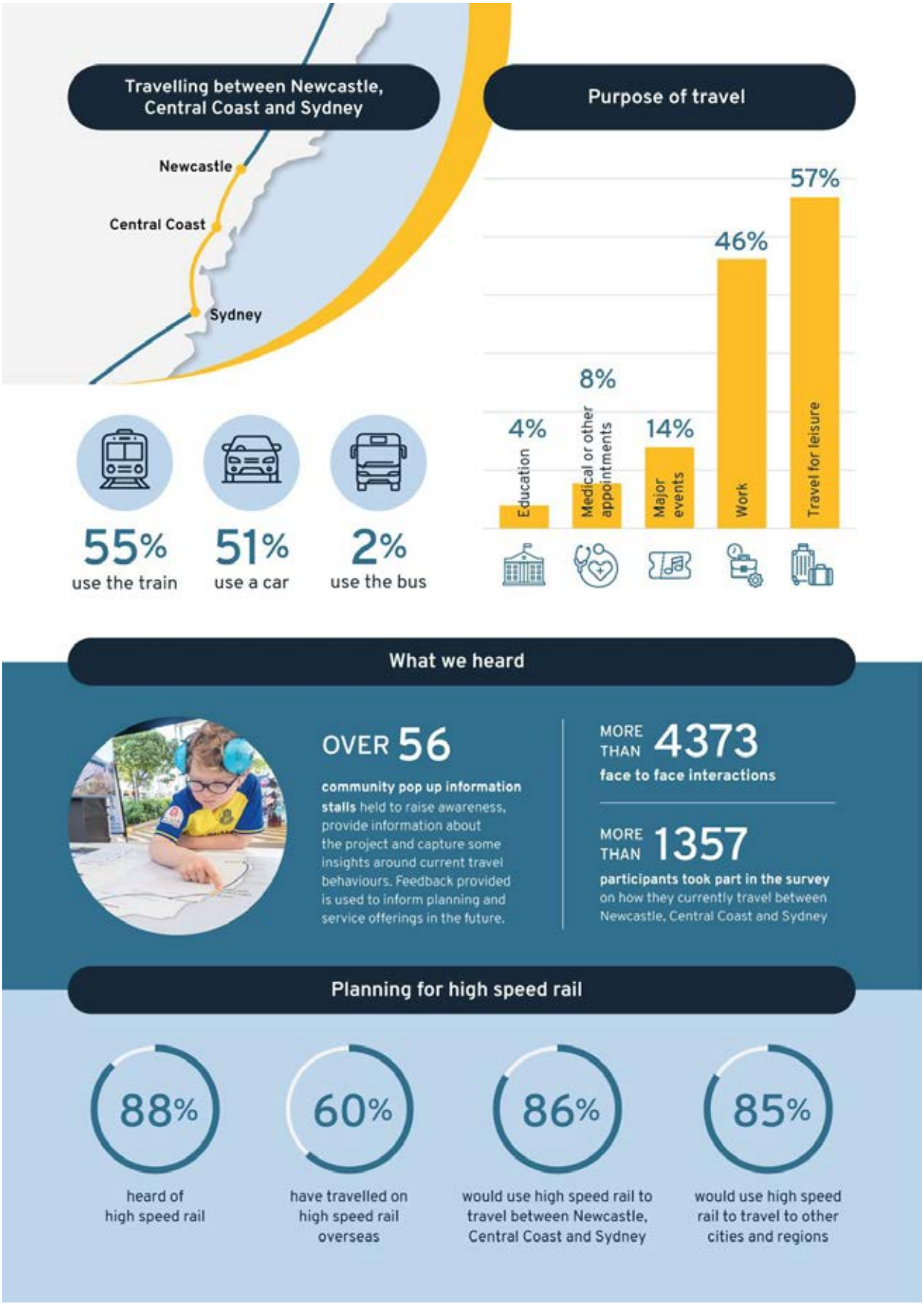
To date, the Authority participated in more than 400 stakeholder briefings and community events and spoken to more than 5,600 individuals about the Project. The Authority also organised a community survey to understand community views on high speed rail planning as well as how communities currently travel and for what purpose. More than 56 community pop up events held between Newcastle, Central Coast and Greater Sydney with more than 4,300 participants.

A total of 1,357 participants completed the survey with 88 per cent of individuals heard of high speed rail, 60 per cent indicated they travelled on high speed rail overseas, 86 per cent indicated they would travel on a future Newcastle to Sydney high speed rail network and 85 per cent indicated they would likely use high speed rail to travel across other cities and regions if the option was available.

Communications and engagement activities along with key findings from the survey are presented below.

Figure 11-2 Our engagement journey

Figure 11-3 Community survey results



11.2.2. Early engagement insights

Feedback from stakeholders and communities reflected the benefits high speed rail would bring to regional communities including upskilling within the region, attracting workers and new industries, and supporting local manufacturing and tourism. Some concerns were raised about the deliverability of the Project, noting cost and viability as key issues.

Stakeholder and community insights

- Stakeholders are excited about the opportunities high speed rail could bring to regional communities between Newcastle and Sydney. They see how improving ease and speed of travel could unlock a range of regional economic opportunities – particularly across housing and jobs. Many stakeholders acknowledged the presence of high speed rail in other major international cities and their views were underpinned by personal experiences travelling on high speed rail overseas.
- Some stakeholders expressed scepticism about whether high speed rail will be delivered, given it has been investigated several times in the past. Concerns were raised about whether the Business Case would stand up and whether the flow-on economic benefits would be factored in to bolster its viability.
- Enthusiasm for the Project was stronger among stakeholders based outside of Sydney, who acknowledged how the Project could help accelerate their vision for their region. While not disputing the vision, some Sydney-based stakeholders were concerned about the competition for funding and expressed a preference for improving intra-Sydney public transport instead of high speed rail.
- Recognising that regional areas are already undergoing significant change, many stakeholders noted that the Project should be 'future proofed' and designed based on what community needs are likely to be in the future, rather than aiming to provide immediate value. They also reinforced the need to provide supporting infrastructure and local services to ensure the full benefits of the Project are realised.
- Participants were positive about the Project and highlighted the possible benefits high speed rail could deliver to local communities, including easing congestion on road and rail and improving access to quality jobs.
- Most participants were excited by the prospect of high speed rail providing access to more affordable housing options outside of Sydney while still within reach of jobs.
- Some concerns were raised about the potential cost of delivering high speed rail and the impact of construction on communities. Participants expressed concerns about government funds being stretched or redirected from other projects to deliver the high speed rail Project.
- Most participants were interested in understanding the final route and station locations and wanted to ensure the infrastructure would be accessible and convenient.
- Some participants expressed cynicism about the Project being delivered and questioned how much progress would be made following the submission of the Business Case.

The findings from early engagement are presented below by engagement sub-group.

Table 11-2 Findings from early engagement

Community groups
Community groups expressed support for high speed rail and the significant economic benefits it would bring to the regions, including the opportunity for new housing, new and additional investment and development opportunities, job creation, small business support and easy commutes. They also expressed support for the Newcastle/Hunter region transitioning from coal to professional industries. Concerns were raised around the financial feasibility of planning and delivery, the lack of action to date on high speed rail planning, environmental impacts and impacts to First Nations significant lands.
First Nations
Feedback highlighted the importance of engaging early and transparently to build trust and robust working relationships with First Nations. Collaboration between First Nations stakeholders and the Authority will be crucial for the success of the Project. Participants expressed the need for the Authority to develop a clear plan to grow the capability of the First Nations workforce to enable technical skill evolution and protect cultural heritage and values, including sites as non-negotiables. They also emphasised the need to celebrate and integrate cultural narratives and incorporating Designing with Country principles into planning and design.
Local governments
Local governments highlighted opportunities for future connection and place making around station locations and aligning strategic land use and regional plans with high speed rail planning to enable new jobs, housing and industries. They expressed interest in understanding the criteria used to identify station locations, the associated infrastructure required to enable high speed rail and learning more about high speed rail service offerings and operations relating to travel times, frequency of services, the number of stops and fares.
NSW Government agencies
Agencies expressed support for the high speed rail program and committed to ongoing engagement with the Project. Participants were particularly interested in the potential land use change and economic development opportunities, and highlighted their interest in understanding how the corridor alignment and station locations might enable economic regional development opportunities. Agencies encouraged the Authority to consider strategic land uses across the study area and opportunities to integrate high speed rail with existing transport. They also expressed a desire for the Authority to align with NSW Government objectives and initiatives to support local outcomes, and minimise impacts to national parks.
Key stakeholders and peak bodies
Key stakeholders and peak bodies expressed support for high speed rail planning and keen to remain involved in the Project. There was a desire for visibility around the Delivery Strategy to understand how industry can participate in the planning, construction and operation phases. Participants were also interested in understanding high speed rail timeframes to inform stakeholder planning around future resourcing, market capacity and manufacturing. Participants expressed support for high speed rail connecting to Western Sydney International, Newcastle Airport and key hubs across Sydney and Western Sydney. Some participants raised questions around the political cycle and potential impacts it might have on the commitment to current and future phases of the Project.

11.2.3. How feedback has shaped the Project

Following extensive consultation, the Authority reviewed and considered all feedback submitted throughout the early engagement program. Feedback captured has directly shaped the following Project components:

- The emerging proposal for the use of viaduct and tunnels between Broadmeadow, Central Coast and Sydney has been designed to avoid and minimise impacts on communities, national parks and First Nations significant sites.
- The high speed rail alignment will shift to connect areas currently experiencing significant housing and employment growth including areas with planned growth at Broadmeadow and Morisset.
- Providing high speed rail connections to Sydney's fastest growing region including a station at Western Sydney International Airport.
- A staged delivery concept has been developed to enable early benefits of the Project.
- High speed rail to support tourism sector across Sydney, Central Coast, Newcastle, Hunter and northern NSW regions by partnering with NSW government agencies, local governments and tourism operators to align regional priorities and opportunities.
- The Authority is coordinating with NSW government agencies including Department of Planning, Housing and Infrastructure, and Transport for NSW to integrate strategic land uses and transport planning.
- The Authority has made a commitment to continually engage with First Nations people including key stakeholders, Land Councils and knowledge holders to help minimise impacts and avoid First Nations cultural and heritage significant sites.

11.3. Commitment to future engagement

The Authority is committed to maintaining stakeholder and community engagement activities following the submission of the Business Case.

An overarching stakeholder, communications and engagement framework will be developed to support the next phase of the Project outlined in the below diagram.

This framework includes a detailed engagement strategy and supporting plans for early 2025 after a final scope of works is determined.

The Authority will uphold and maintain sustainable and ethical practices at all phases of the project lifecycle, prioritising stakeholder and community engagement to build and maintain trust and goodwill as the Project evolves.

Figure 11-4 Engagement program to support project lifecycle

[redacted]

Chapter 12

Project implementation and roadmap

Australian Government
High Speed Rail Authority

A clear plan for action and efficient delivery

- The Authority has applied the lessons learnt from recent mega-project delivery in Australia and worldwide, and is ready to take the next steps towards delivery of the Project.
- Employing a new approach to delivery, the Authority will implement nine 'value-driver' practices, informed by best practice to ensure things are done differently, mitigating the risk of cost and schedule overruns from application of traditional design and construction practices.
- Clear milestones and deliverables, and the underpinning action plan, have been established for the Development Phase with a view to reducing risk to the delivery of the Project.
- The Development Phase will include:
  - Putting in place the legal and regulatory arrangements necessary to support land acquisition and other aspects of project delivery.
  - Securing planning approvals, corridor preservation and property acquisitions
  - Undertaking Early Contractor Involvement and collaborative design with industry to develop the Project, and de-risk the Project from cost overruns, delays and supply chain risks.
- The Authority has established a comprehensive risk management framework spanning enterprise, program and project risk management.
- The Authority will transition to an organisational structure based on a lean client model for delivery. The Authority will need to grow from around 40 people currently to between 80 and 120 people by the end of the Development Phase. The Authority will be lean, informed and agile with clear accountabilities.
- Delivering the Project will be a significant undertaking, requiring a dedicated workforce spanning multiple regions over several years. Approximately 7,500 direct construction-related jobs, across 25 occupations, are estimated to be required on an average annual basis over the 2026-38 period.
- The Authority's existing Corporate Commonwealth Entity structure will likely need to be reviewed through the phases of the Project to ensure that it appropriately supports delivery and operations.

12.1. Overview of major project phases

The Project will be delivered over several implementation phases, as outlined in the table below.

Table 12-1 Proposed activities for the Project's implementation phases

Phase	Activities
Pre-Development Phase [redacted]	• Complete Business Case assurance and optimisation. • Partner with the Australian Government to facilitate the resolution and in-principle agreement with the NSW Government on the terms of Section 51 (xxxiv) of the Commonwealth Constitution. • Prepare for the Development Phase including advisor briefs, EOI for ECI and strategic land acquisition. • Establish and implement the Authority's organisational changes (corporate support systems and processes (such as ICT, HR and finance), governance risk management and workplace planning).

Phase	Activities
Development Phase [redacted]	• Refine the design and implementation costs via competitive ECI processes for Stage 1 of the Project. • Obtain key environmental, planning and NSW Government consent for construction of the high speed railway network services, including property acquisition and corridor protection. • Organisational transition strategy, including engaging key advisors, preparing for Enterprise Agreement renegotiation and implementing required corporate support systems and processes. • Confirm the Authority's governance structures in Development Phase and subsequent phases in consultation with Department of Infrastructure and Department of Finance. • Submit final costings to government based on the ECI processes and detailed design for approval to move into Delivery Phase.
Procurement Stage [redacted]	• Establish Project/Procurement Committee. • Activate critical strategies including Benefits Realisation, Social Procurement and Workforce Development Strategy and First Nations Participation Plan. • Procurement and award of major packages including work packages, property acquisition, corporate support systems and processes. • Commencement of early and enabling works.
Delivery Phase [redacted]	• Construction and development of tunnelling, rolling stock, stations, depots, and the Advanced Manufacturing Facility across 16+ packages. • Consult and implement required legislative changes (such as National Governance Framework for National Authority). • Align with stakeholders (such as intergovernmental and major partners) on farebox, secondary revenue and integrated transport design. • Embed organisational changes including culture initiatives. • Secure national governance framework between key stakeholders for uniform standards, cooperation and collaboration on matters relating to planning, environment, land use and integrated transport planning on national level.
Commissioning, Testing and Operations [redacted]	• Engineering, testing, commissioning and maintenance and operations. • Asset management and land use management.
Implementation of Stage 1C	• Development Phase – investment decision [redacted] • Development Phase – planning approval and ECI ([redacted]). • Land acquisition ([redacted]). • Project delivery ([redacted]

12.2. Planning, environment and property strategy

Established by section 7 of the *High Speed Rail Authority Act 2022*, the Authority is a body corporate whose functions do not include powers to compulsorily acquire land or to self-determine planning approvals.

To overcome these limitations, the Authority is seeking engagement and partnership with the Department of Infrastructure, Transport, Regional Development, Communications and the Arts and the NSW Government for assistance with corridor preservation, securing land tenure and appropriate planning approval pathways reflecting the size and complexity of the Project.

12.3. Property acquisition

Property acquisition will be undertaken during the procurement phase to secure the corridor and facilitate project delivery in alignment with the program schedule. The acquisition program includes:

- Above-ground property for permanent infrastructure, station construction zones, service facilities and stabling and maintenance facilities.
- Below-ground or substratum property for tunnels and crossover caverns.
- Additional land for tunnel boring machine launch and dive sites, as well as construction areas for pre-cast unit manufacturing and spoil stockpiling or disposal.

The property acquisition footprint has been optimised through value engineering to minimise property requirements while maintaining project objectives and ensuring value for money. Cost estimates for property acquisition are provided Chapter 9.

Ongoing refinements, including determinations of full and partial acquisitions, will be guided by detailed due diligence and design adjustments during the Development Phase. Interim solutions, such as early land access licences and preliminary acquisition agreements, will be considered while finalising detailed strategies.

12.3.1. Property acquisition approach

Property acquisition will involve a combination of private negotiation, compulsory acquisition and third-party agency agreements. Due to the scale and complexity of compulsory acquisitions, the program is proposed to be managed through an agency agreement with the NSW Government, designating the Authority as an agent of a nominated state agency.

This proposed approach is designed to:

- Facilitate adherence to project timelines by commencing property acquisitions promptly.
- Provide the Authority with greater control over property acquisition timelines by managing the process directly.
- Enable the Authority to manage communications with the community and stakeholders.
- Allow the Authority to directly acquire land in its name through private agreements with landowners.

In line with the *Land Acquisition (Just Terms Compensation) Act 1991* (the Just Terms Act), private agreements with landowners will be prioritised. Properties will be compulsory acquired if negotiations cannot reach agreement. A 24-month timeframe has been assumed for the acquisition process, incorporating due diligence, negotiation and compulsory acquisition, in line with statutory notice periods. All acquired properties will be transferred to the Authority as freehold land.

This approach is based on a review of legislative frameworks, including the *Lands Acquisition Act 1989* (Cth), which has limited application for large-scale linear infrastructure projects. Over the longer term, the Authority will explore potential amendments to the Lands Acquisition Act to enhance its capacity to support the acquisition of complex property tenure for future stages of the high-speed rail network.

12.3.2. Proposed arrangement with the NSW Government

The Authority will engage with the NSW Government to confirm support, establish an appropriate acquiring authority, and streamline acquisition processes. A review of acquiring authorities has identified Transport for NSW as the most experienced, having conducted 80 per cent of NSW State property acquisitions between 2021 and 2023, with expertise in large, linear and complex infrastructure projects.

Subject to agreement, the Authority will act as an agent for Transport for NSW during the negotiation phase, while Transport for NSW retains responsibility for issuing statutory letters and managing internal approvals. It is proposed that property acquisition powers will fall under the *Transport Administration Act 1988* (TAA), and compensation will be determined in accordance with the Just Terms Act. Amendments to the TAA will be required to formally recognise the Authority as an acquiring authority.

The arrangement draws on precedents from agency agreements for other Australian Government-funded railway projects in NSW and includes potential enhancements such as embedding a senior Transport for NSW delegate within the Authority to streamline acquisition processes and establishing a dedicated property acquisition team within the Authority to manage acquisitions under the Just Terms Act, ensuring control and direct oversight of timelines and costs. This arrangement reflects NSW Government acquisition reforms, including mandatory negotiation periods, procedural enhancements, and ongoing reviews to improve practices and clarify compensation definitions.

The proposed agreement with the NSW Government will establish:

- Procedures for managing compensation related to Crown lands, national parks, and other State-owned properties.
- Defined roles and responsibilities to ensure collaboration between the Authority and TfNSW.
- The Authority's accountability for managing all aspects of the acquisition process, including NSW Centre for Property Acquisition oversight, engagement with the Valuer General, and management of negotiations and compulsory acquisitions.
- Steps for transferring acquired land from TfNSW to the Authority, aligned with the Just Terms Act and public purpose requirements.
- Provisions for addressing funding, approvals, indemnities and scope management.

This agreement aims to establish a transparent and collaborative framework to ensure an efficient property acquisition program is in place, which will help support successful project delivery.

Recognising this activity represents a key risk, it is important to note that within the Authority's executive team there are personnel with significant experience in undertaking large scale property acquisition for major transport projects for the NSW Government which will be critical for this Project.

12.4. Corridor protection

The Network is a long-term investment that requires securing a protected corridor to prevent costly acquisitions, avoid reliance on expensive tunnelling and mitigate urban development impacts. Delays in corridor protection have historically led to higher costs and increased project delays, as seen in Australia's capital cities, where rapid development and speculation have significantly increased land values.

A Corridor Protection Strategy has been developed to outline how a corridor for the Network could be safeguarded to enable cost-effective and timely delivery while minimising disruptions and providing greater certainty to communities. The Strategy adopts a three-step, risk-based framework focused on identifying high-

risk development zones, evaluating tailored protection measures, and implementing actions such as land use controls and zonings, strategic acquisitions, and interface management. Priority locations in high-risk urban areas have been identified for protection, particularly where immediate property acquisition is not progressed.

Key mechanisms include zoning land under state and territory planning frameworks for infrastructure to deter speculative development, acquiring critical properties early, and managing corridor interfaces for seamless integration with existing and planned infrastructure. Interim measures, such as development concurrence rights and strategic acquisitions, offer immediate safeguards while final measures are established.

The Strategy identifies commencing collaboration with state and territory governments to align planning frameworks and implement effective measures as a key next step. Future activities include detailed design refinements, environmental assessments, and ongoing risk monitoring. Ongoing community and stakeholder engagement will be a critical activity to maintain support and ensure corridor protection delivers its intended long-term benefits.

12.5. Benefits realisation

The Authority will continue to partner with key stakeholders to activate the identified benefits through each phase of the Project's lifecycle. The Authority's CEO would act as the Benefits Sponsor and would champion and drive overall benefits realisation process.

12.6. Business Case review

This Business Case has included ongoing review by the Authority Board, whose Business Case Committee has met regularly to provide feedback on key issues and Business Case contents. The Business Case was issued following Board approval.

The Business Case is also subject to a three-stage assurance process entailing Specialist Advisor Peer reviews across 15 disciplines, independent Expert Panel review and an Infrastructure Australia Gate 3 review. Following submission, the Authority will continue to engage with Infrastructure Australia through its assurance process and throughout the Project's lifecycle.

12.7. Development Phase governance arrangements and structures

For the Authority to successfully develop and maintain the confidence and trust of all levels of government and the community, across the Development and Delivery Phases of the Project, it is critical that the corporate governance arrangements within the Authority be fit for purpose and be adapted to suit the size of the undertaking.

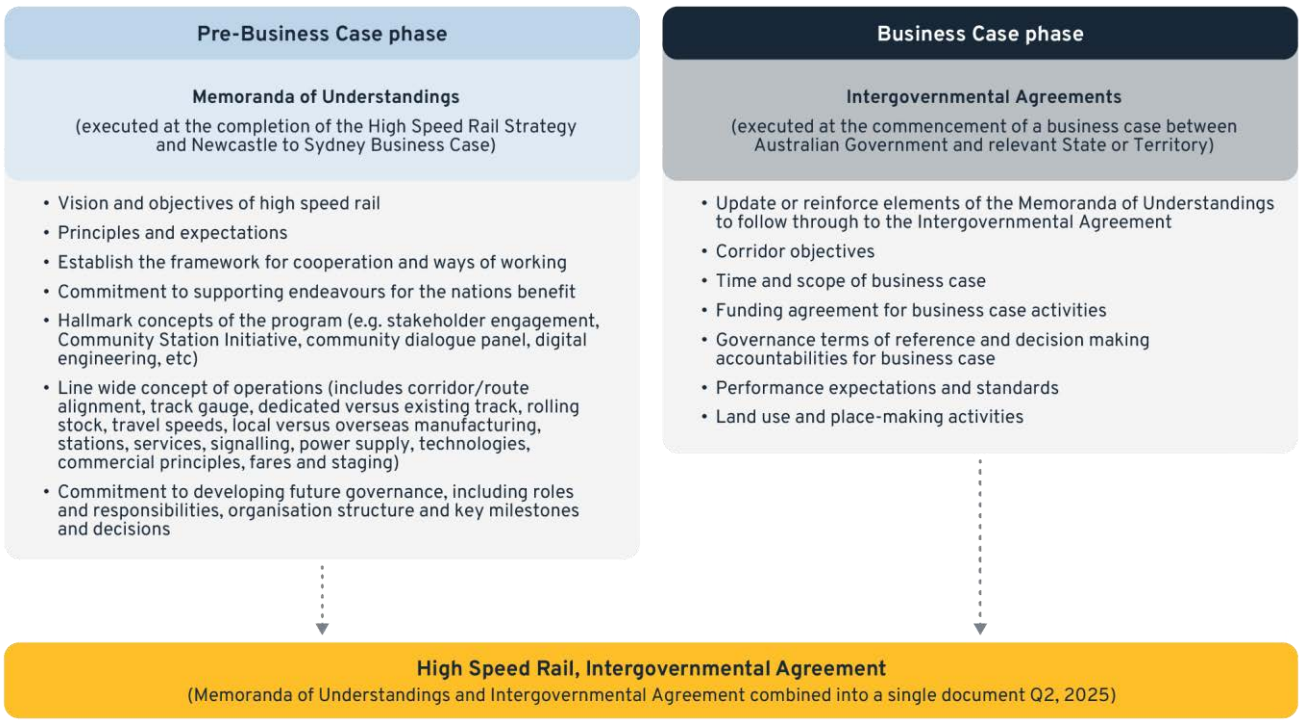
The Authority's current governance arrangements are prescribed by the enabling Act and by the *Public Governance, Performance and Accountability Act 2013* (Cth). The Authority is built on a strong governance

framework and has been purposed with the single focus on development of the Business Case and planning the Project's development. Its terms of reference under the *High Speed Rail Authority Act 2022* are clear.

The proposed governance structure /arrangement for the Development Phase (shown in the figure below) is designed to:

- Enable the Board and management team to identify and secure the right skills, experience and capability to execute on its Delivery Strategy.
- Monitor the Authority's performance, accountability and delivery across all stages of planning and the Development Phase.
- Provide a strong framework for the delivery of the broader project benefits.
- Ensure that a culture of integrity, ethical conduct and compliance are upheld at all times.
- Support and strengthen close cooperation, coordination and trust between intergovernmental agencies.

Figure 12-1 Proposed governance structure



The governance arrangements proposed include a culture of collaboration and dialogue built into the governance terms of reference and structure and are embedded into the operational activities of the Authority. The governance structures and arrangements will continue to be reviewed and evolve in lock step with the needs of the organisation and will help to drive:

- Strong accountability, transparency and ownership.
- Alignment and clarity of objectives and project outcomes.
- Reduced complexity, ambiguity and uncertainty.

12.7.1. Governance

The Authority is a single purpose entity established under its own Act for the purpose of providing advice to the Minister on matters relating to policy, planning and the development of the Network, and where state and territory constitutional consent under section 51 (xxxiv) is obtained, to develop the high speed rail network.

The Authority's current 5-person Board consists of highly experienced and capable individuals with deep local and international, infrastructure, investment, financial and project experience.

The individual members of the Board were appointed for a 3-year term (commencing in 2023) by the Minister for Infrastructure, Transport, Regional Development and Local Government, through a merit based selection process and in accordance with the *High Speed Rail Authority Act 2022*.

As an Accountable Authority under the *Public Governance, Performance and Accountability Act 2013* (PGPA), the Board members are directly accountable to, and report to, the Minister for Infrastructure, Transport, Regional Development and Local Government. Each member of the Board is required to comply with PGPA requirements in discharging their duties and functions. A direct reporting line to the Minister enables early escalation of critical issues.

In addition to its statutory functions, the role and responsibilities of the Board during the Development Phase include:

- Ensuring that there are the right skills and experience on the Board and within the Authority to oversee the successful delivery of the Project.
- Reviewing the appropriate corporate entity structure for the Authority during the Development Phase.
- Oversight of risk management systems and procedures.
- Overseeing the transition of the Authority from the Business Case to all phases of the Project.
- Continuing to monitor the performance and accountability of the Authority.
- Providing strategic direction over the development of the Network.
- Escalation point for strategic and project risks which threaten the achievement of Corporate Plan objectives.

Board subcommittees

In addition to the existing Audit and Risk Committee and the People and Culture Committee, further consideration will be given by the Board to creating a dedicated Project Committee and a Health, Safety and Environment Committee during the Development Phase.

The Project Committee assists to drive the monitoring, performance and oversight functions of the Board and provides dedicated forums for deep dives into specific strategic, technical and resourcing issues.

Project governance

Governance arrangements define the Network and Project stakeholder roles, responsibilities and decision-making processes. They also provide a framework for monitoring, controlling and communicating progress, risks and issues. Project governance will be applied to assess the readiness of the Project at each phase. This will allow for 'go/no-go' decisions to be made at critical junctures during the Project, ensuring regular alignment with strategic goals and adherence to key performance indicators.

The Authority will utilise:

- The existing Management Executive Committee comprised of the leadership team to drive management oversight and decisions/approvals.

- A newly established Project Steering Committee at the overall project level where the CEO, Project Sponsor, Program Director and functional General Managers can make trade-off decisions against schedule, cost and customer outcomes which are then reported to the Board.
- A roperty and lanning teering ommittee to help to monitor and manage complex stakeholder issues relating to planning approvals, property acquisitions and multi-agency/party interfaces. Intergovernmental agreements (see below) will help to secure a more streamline and consistent approach to planning, property and land use issues across states and territories.

The proposed activities for the Authority to implement the governance arrangements include:

- Developing terms of reference for each group detailing its purpose, membership and authority.
- Clarifying the role and responsibilities of the Authority and external stakeholders.

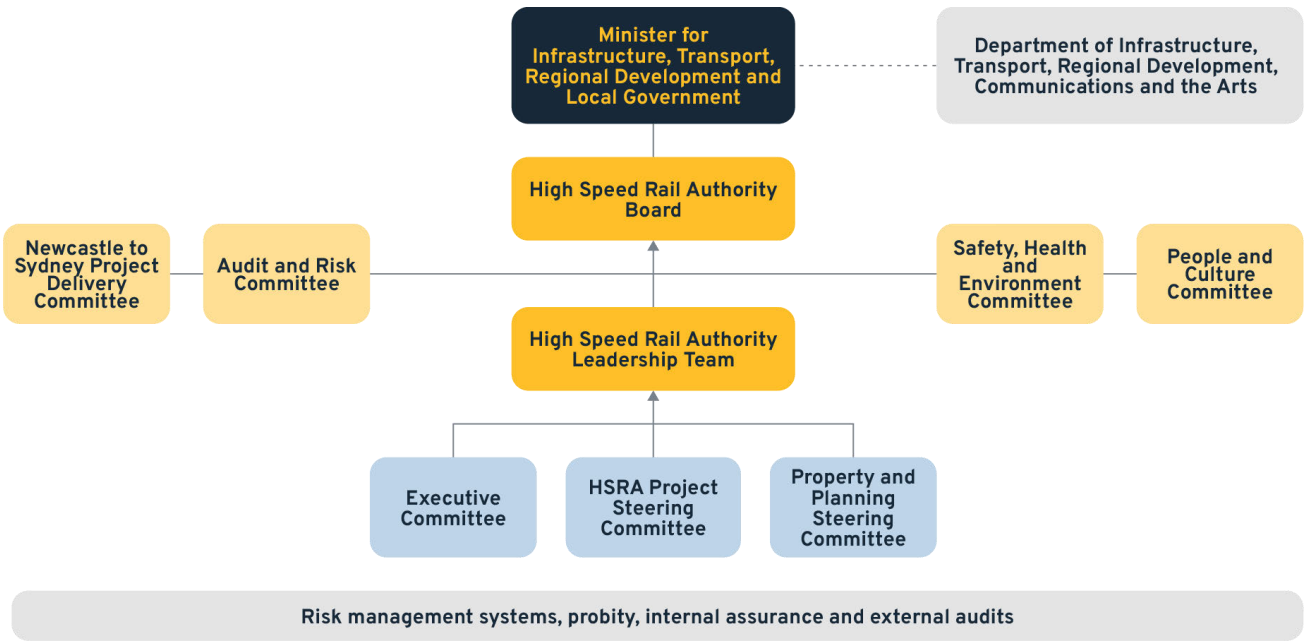
Intergovernmental agreements between states and territories

A key lesson from the Inland Rail case study is the need for early alignment between the Australian, state and ACT governments. National governance will be required to enable seamless integrated planning, development and future growth for the Network. Specifically, the Authority will seek to facilitate a successful partnership between relevant Australian and state government agencies, by working on joint initiatives to:

- Streamline Australian, state and local government coordination and approvals through, for example, special purpose legislation, a nationally consistent framework for intergovernmental agreements.
- De-risk future expansions into other states.

The proposed governance structure could be enhanced by establishing an intergovernmental agency consultation group and intergovernmental agency agreements, between various state and ACT department heads to facilitate a whole-of-Network operational concept and approach (as shown in Figure 12-1).

Figure 12-2 Development Phase potential governance arrangements



12.8. Client delivery model

For the Development Phase, the Authority will transition to the organisational structure set out below. The top level structure defines a leadership team which will drive a coherent program of works supported by strong governance and financial and risk management practices, to achieve the Project's benefits.

Figure 12-3 Top line functional matrix structure

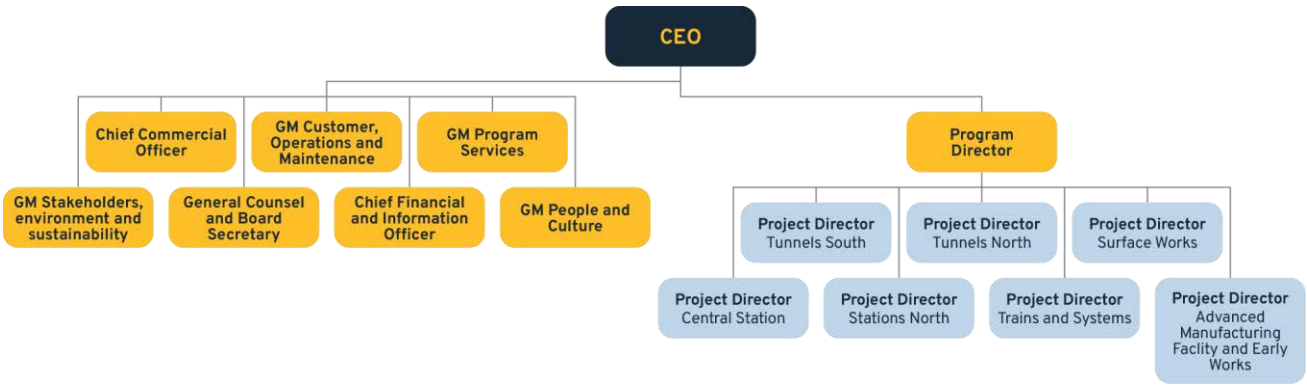


Figure 12-4 High Speed Rail Authority values

With up to eight direct reports to the CEO, the organisation will adopt a matrix model to support efficient and best use of resources, timely decision making and consistent outcomes across the Project and Network. There will be clear outcome accountabilities for each of the major project stages and delivery packages (such as tunnels, stations, rolling stock and systems). Functional leaders will have clear accountability for consistent whole of program outcomes for their function and for enabling delivery.

As the Authority steers the Project into future procurement and delivery phases, it will review and evolve its structure to ensure it remains fit for purpose, while remaining consistent with the fundamental design principles.

The Authority will continue to focus on establishing a strong culture aligned with its values, ensuring effective project delivery across each phase.

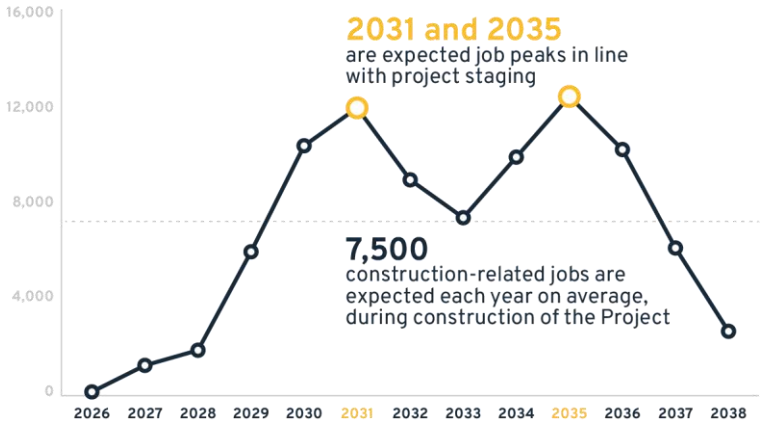
12.9. Resourcing and organisation design

The Authority has prepared a resourcing model for the Development Phase, which is included in the Cost Plan. The Project will continue to be managed by an integrated team of staff and external advisers. To progress the next phase of the Project, the Authority's full time equivalent (FTE) staff numbers will grow from the current 28 to around 80 to 120 by the end of the Development Phase. The FTE for external advisers will also be augmented during the Development Phase from around 70 to around 200.

The organisational structure will be further refined after completion of the Business Case, during the transition to the Development Phase. Further work will be undertaken to further define the organisational requirements, identify optimal framework for project integration and develop a workforce strategy and capability framework during the short, medium and long term of the Development Phase. In undertaking this work, the Authority will also further outline its principles around the Lean Client Model. This will be coordinated through an organisational transformation project in support of the whole Authority team. This approach is informed by reviews of best practice and interviews with a sample of infrastructure companies across different sectors (rail, water and airports) both locally and overseas.

12.10. Workforce development outcomes

Figure 12-5 Construction related jobs



Delivering the Project will be a significant undertaking, requiring a dedicated workforce spanning multiple regions over several years. Approximately 7,500 direct construction-related jobs, across 25 occupations, are estimated to be required on an average annual basis for the Project over the 2026-38 period. There are two peaks in job requirements throughout the period: the first in 2031 at 12,000 jobs, driven by the peak demand for Stages 1A and 1B, and the second in 2035 at 12,500 jobs, driven by peak demand for Stage 1C as demonstrated in the figure left. Significant workforce gaps are projected from 2029 to 2036 across NSW, where the total workforce required across the Heavy and Civil Engineering Construction industry (including high speed rail and other projects) is expected to exceed the projected supply of workers.

Although there have been decades of mega-project delivery in the domestic transport sector, requiring comparable jobs and skills, the scale and regional nature of the Project presents an opportunity to address disparities in regional inequity through increased participation and support industries in transition (including the mining and energy sectors). The Project provides an opportunity to catalyse jobs growth in knowledge intensive industries requiring degree qualifications, particularly in high speed rail design, tunnelling, advanced manufacturing and rail assembly to support project delivery and emerging industries.

Known shortages in construction jobs and skills, at the regional, state and national levels present an opportunity to co-design workforce development initiatives with industry, form new domestic and international education and training partnerships, and identify ways to accelerate and enhance training and qualifications.

Underpinning the workforce development approach is the commitment to producing outcomes that extend beyond the Project. The Social Procurement and Workforce Development Strategy has identified four outcome areas to achieve the social, economic and cultural objectives of the Project as outlined in the figure below.

Figure 12-6 Workforce development outcomes

12.11. Corporate entity structure

As a Corporate Commonwealth Entity (CCE), the Authority operates independently of the Australian Government. The Authority can enter into commercial/contract arrangements, manage risks and secure access to funding and finance.

12.11.1. Governance review in transition to development, delivery and operation

As the Authority transitions through the Project's stages, it is important that its governance arrangements and corporate structure align with the overall strategy and aims, and with the Department of Finance's Governance Assessment Framework. The Authority has commenced a governance review and benchmarking of the CCE structure against other government corporations, and intra/inter-group structuring requirements, to support transitional arrangements and the Authority's short- and long-term aims.

12.11.2. Access to finance and revenue generation

Although the current Statement of Expectations does not seek such an outcome, the CCE structure enables the Authority to raise finance and generate revenue from external sources (subject to obtaining section 51(xxxiv) consent to develop the Network and compliance with the *Public Governance Performance and Accountability Act 2013*), invest in property and start Early Contractor Involvement and other multi-stage procurement processes. These will become important capabilities as the Project develops.

12.11.3. Review of remuneration

To support Project's delivery, the Authority requires some enhanced ability to engage staff and pay competitive remuneration outside of the existing pay bands of the *Public Service Act 1999* but in alignment with market rates, to attract, retain and reward top talent. The skills and capabilities required for a project of this scale, magnitude and complexity – such as project directors, engineers, cybersecurity/ICT specialists and

construction lawyers – are highly sought after in infrastructure and commercial environments, and will need to be rewarded competitively to secure appropriate key skillsets in-house.

An exemption from the *Public Service Act 1999* or early review of the suitability of pay bands under the High Speed Rail Authority Enterprise Agreement 2024-27, would benefit the Authority's outcomes and government more broadly in the delivery of this Project. Targeted recruitment and higher remuneration bands would improve the Authority's ability to engage this specialist talent.

12.11.4. Corporate and legislative structure

In the future the Authority's corporate and legislative structure may require further consideration by government as the Authority moves into the Delivery Phase. This will support the Authority's future operating model and related structural considerations, particularly with respect to the establishment of Special Purpose Vehicles, or Government Business Enterprise/Authority subsidiaries, to account for future commercial considerations, time between expenditure and revenue generation, and government policy on asset delivery and operation.

[redacted]

12.12. Risk management

Given the complexity of the Project and multi-party interfaces, it will be important to rethink traditional risk allocation. In particular, the risk management strategy will include the management of shared risks, with clear accountability and responsibility identified, consistent with the Department of Finance's Resource Management Guide 211 – Element 6 Shared Risks.

The Authority has established a comprehensive risk management framework spanning enterprise, Network and Project risks, and has developed a comprehensive Risk Register and mitigation plan. With respect to mitigation measures to minimise and manage the Project's risks the following are the key activities adopted:

- Comprehensive risk identification and assessment of all project elements, interfaces and phases.
- Development of project staging, delivery strategy and contract packaging that is aligned to domestic and international capability and forecast industry capacity.
- Incorporation of design consistency, standardisation and modularisation to drive efficiencies and improved risk allocation between project delivery contracting parties and government.
- Extensive use of project cost and schedule benchmarking.
- Extensive expert panel peer review of key project elements including material cost and schedule assumptions.
- Adoption of P90 confidence level estimating for cost and schedule, including escalation allowances.
- Utilisation of a project-wide assumption register to ensure alignment and consistency, with ongoing testing and validation of assumptions through sensitivity analysis and risk/opportunity assessments.
- Significant optioneering and value engineering.
- Sensitivity analyses for the economic appraisal and financial appraisal.

The activities in the Development Phase (see Section 12.14) are targeted to further reduce risk to the Project and provide increased confidence in the Project's implementation.

[redacted]

12.13. Rail safety and accreditation

In accordance with the requirements of *Rail Safety National Law 2012*, a designated Rail Infrastructure Manager is required to oversee both the development and operation of high speed rail services.

12.13.1. Early Contractor Involvement

A Rail Infrastructure Manager will be required during the Early Contractor Involvement phase for the three major civils packages and for any systems-wide design integration between these three packages.

To enable these activities to take place, and to ensure that that adequate processes are developed to be included in the Early Contractor Involvement contracts, the Authority will take the role as the Construction Phase Rail Infrastructure Manager for the Early Contractor Involvement phase, after which the three short-listed options can be reconsidered.

12.13.2. Securing Rail Infrastructure Manager accreditation

To secure Rail Infrastructure Manager accreditation, the Authority will develop a Safety Management System that meets the requirements of the Rail Safety National Law and its Regulations, as well as a number of National Rail Safety Regulator Guidelines (including 'Major Projects' and the 'Asset Management' guidelines).

This process will commence in early 2025, such that the Safety Management System is in place by mid 2025 to be in line with the commencement of the Early Contractor Involvement. The Safety Management System will be submitted to the Office of the National Rail Safety Regulator for formal accreditation.

The accreditation process takes up to six months, so the Authority will work closely with the regulator to de-risk the formal accreditation stage. A team will be established to support the Authority in meeting these timescales.

[redacted]

12.13.3. Construction phase

The Rail Infrastructure Manager is determined in accordance with National Rail Safety Regulator guidelines. The possible models under consideration for the Delivery Phase are:

- The Authority acts as the Construction Phase Rail Infrastructure Manager throughout delivery, handing over to a third-party Rail Infrastructure Manager for operations.
- A third-party Operations Phase Rail Infrastructure Manager is procured early and covers Rail Infrastructure Manager duties during construction.
- A third-party delivery partner is engaged, which acts as Construction Phase Rail Infrastructure Manager for all of delivery and subsequently hands over to the Operations Phase Rail Infrastructure Manager.

12.14. Development Phase milestones

The table below provides an overview of the milestones and tasks for the Development Phase with a view to reducing timing, approval and price escalation risk to the Project and providing further confidence in the implementation of the Project. Detailed actions needed in the next 24 months to ensure the success of the Development Phase are provided in the relevant attachment.

Table 12-2 Development Phase milestones and tasks

Timing	Key milestones / tasks
Pre-Development Phase	
	• Secure funding approval for Development Phase. • Develop and prepare Advisor briefs and EOIs for Early Contractor Involvement process. • Develop and finalise the Authority's organisational changes for development phase (governance structure, risk management and workplace planning). • Secure in principle agreement with NSW Government on the terms of the section 51 (xxxiv) consent under the Commonwealth Constitution. • Obtain planning approval under the EPA Act (NSW) and EPBC Act (Cth) through DPHI and the Australian Government DCCEEW as a declared a CSSI. • Undertake initial geotechnical works. • Develop probity, contract, tendering and procurement strategy for ECI works packages. • Finalise the Communications and engagement strategy– EIS, geotech and early works.
Development Phase commences	
	• Release EOIs for ECI packages. • Resolution on need or otherwise of potential ARTC relocation of Broadmeadow facility. • Procurement of key advisors to support the Development Phase. • Finalise the alignment and property acquisition boundary. • Commence the land acquisition process. • Finalise key performance specifications. • Prepare and issue SSI Applications 1 and 2 including Scoping Reports. • Preparation of the Environmental Impact Statement. • Work with key stakeholders to secure national park revocation along the rail corridor. • Finalise the coordination framework for high speed rail, and alignment between land release timing and infrastructure delivery. • Commence further development of funding and financing strategies, including undertaking market soundings in respect of private financing options
	• ECI industry partners (2 x 3 packages) brought on board to commence collaborative design. • Prepare and issue the SSI Application 3 including Scoping Report. • Commence field investigations to support environmental assessment and approvals.
	• Further ECI industry partners (2 x 4 packages) brought on board to commence collaborative design. • Submit Stage 1A and Stage 1B (concept) EIS on public exhibition.
	• Commence advanced Early Works. • Obtain EIS approval for Stage 1A and Stage 1B (concept). • Project Development Report completed, updating Project scope, specifications, cost and program to reflect collaborative work undertaken with industry (ECI contractors).
	• Two ECI procurements completed to allow first major contracts be ready for execution, being the first tunnel package and the Advanced Manufacturing Facility.
Delivery Phase commences	
	• Submit Stage 1A and Stage 1B tunnelling and surface works EIS on public exhibition. • Continue procurement activities for remaining contracts.

[redacted]

High Speed Rail Authority

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