Great Western Highway (Katoomba to Lithgow) upgrade - East and West sections

PURPOSE OF EVALUATION
Committed and funded proposal

EVALUATION OUTCOME
Funded proposal (not eligible for the Infrastructure Priority List)

ASSESSMENT FRAMEWORK STAGE

1 DEFINING PROBLEMS AND OPPORTUNITIES
2 IDENTIFYING AND ANALYSING OPTIONS
3 **DEVELOPING A BUSINESS CASE**
PROJECT DELIVERY
4 POST COMPLETION REVIEW

LOCATION
Central West, NSW

GEOGRAPHY
Smaller cities and regional centres

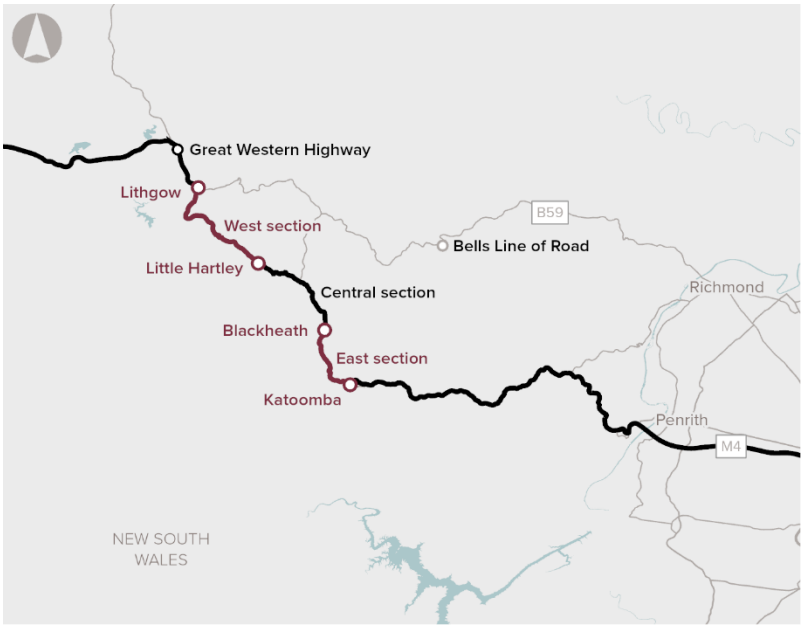
SECTOR
Transport

OUTCOME CATEGORY
National connectivity

PROPONENT
NSW Government

INDICATIVE DELIVERY TIMEFRAME
Construction start: Q4 2022
Completion by: 2027

EVALUATION DATE
8 September 2022



CAPITAL COST
Pending[1]

FUNDING COMMITTED

Australian Government: $2,030m, April 2022

NSW Government: $2,500m, March 2022

Review summary

Infrastructure Australia has evaluated the business case for **Great Western Highway (Katoomba to Lithgow) Upgrade - East and West Sections** in accordance with our Statement of Expectations, which requires us to evaluate project proposals that are nationally significant or where Australian Government funding of $250 million or more is sought. As the project is fully funded between the Australian and New South Wales governments, it is not eligible for inclusion on

[1] This Evaluation Summary currently excludes the capital cost (nominal, undiscounted) to maintain confidentiality during the current active procurement process. The capital cost will be added once procurement is complete.

the *Infrastructure Priority List*[2].

The Great Western Highway extends for 201 kilometres across the Great Dividing Range through the World Heritage listed Blue Mountains, connecting Bathurst and the surrounding Central West and Orana region to Sydney. The highway is a key enabler of regional development as it is the major route for road freight between Sydney and the Central West and forms part of the National Land Transport Network.

The Great Western Highway has been progressively upgraded since 1998, and the 34 km section between Katoomba and Lithgow is the last section to be addressed. This section follows a steep and difficult alignment that is narrow, with predominantly a single lane in each direction, and is highly vulnerable to delays and closures. Heavy vehicle access is currently restricted to heavy vehicles no longer than 19m, and Performance Based Standards (PBS)[3] Level 1 vehicles no longer than 20m.

The Great Western Highway (Katoomba to Lithgow) Upgrade responds to a nationally significant problem that is listed as an Early-Stage Proposal on the *Infrastructure Priority List* as *Great Western Highway improvements: Katoomba to Lithgow*. The program of work is comprised of the following sections.

1. East section (from Katoomba to Blackheath)
2. West section (Little Hartley to Lithgow)
3. Central section (Blackheath to Little Hartley)

This evaluation relates to the East and West sections only. The East and West sections involve lane duplication, intersection upgrades and grade improvements, and are being jointly funded by the Australian Government ($2,030 million) and the NSW Government ($2,500 million)[4]. Delivery of the Central section is unfunded and will be the subject of a separate business case.

The proponent's economic analysis states the net present value (NPV) of the East and West sections to be -$579.5 million with a benefit-cost ratio (BCR) of 0.57[5], representing a net economic cost to society. The BCR incorporating additional benefits, including land use benefits and Wider Economic Benefits (WEBs) is 0.68[6]. Investment is supported by the proponent on the basis that the project will contribute to six identified objectives:

1. Economic development and productivity of the Blue Mountains, Central West and Orana regions
2. Resilience and future-proofing, to ensure continuity and safety of transport and essential services.
3. Network performance, to improve the reliability and capacity of the transport network between Greater Sydney, and the Central West and Orana, improve connectivity for residents and reduce peak period congestion.
4. Safety, improving the overall safety of road users by minimising conflicts between heavy and light vehicles, pedestrians and cyclists.
5. Movement, place and amenity, to better balance the needs of different road users, improve the liveability of town centres to the west of Katoomba.
6. Value for money and deliverability, seeking a solution that is affordable and maximises benefits at an optimal cost.

The business case demonstrates that the project will enable improved travel reliability and improved local amenity. However, the largest economic benefit (28% of total benefits[5]) is derived from avoided routine maintenance of the existing roads and the basis of this contains some assumptions and methodological issues which could overstate the quantum of benefits in the Cost Benefit Analysis (CBA).

Delivering the project within the approved funding envelope, addressing community stakeholder feedback and meeting environmental approval conditions are key delivery risks. The NSW Government has demonstrated capability to procure and deliver the program of works, although we note that there may be some additional cost pressures for the procurement of contractors in competitive labour and materials markets. Environmental approvals required under State and Federal legislation are expected to be finalised in 2022. Finalising environmental approvals will determine the final cost of acquiring land or biodiversity credits to offset residual impacts. This may add to the estimated project costs and reduce the BCR.

The NSW Government has announced an 11-kilometre toll-free tunnel between Blackheath and Little Hartley (the Central section of the program). Although subject to further analysis, this section will be critical to the delivery of benefits for the whole upgrade program and thus the realisation of benefits from the East and West sections. Funding commitments for the Central section are still to be confirmed, with the business case currently being developed.

[2] The Infrastructure Priority List only identifies those proposals which are seeking investment.

[3] The basic principle of PBS is to match the right vehicle to the right freight task. For further information about the PBS scheme and PBS vehicle levels refer to https://www.nhvr.gov.au/road-access/performance-based-standards

[4] The Australian Government funding is capped at 80% of the capital cost as per the arrangement with the NSW Government.

[5,5] Using P50 costs, excluding land use and wider economic benefits, discounted using a 7 % real discount rate

[6] As assessed by the proponent, using P50 costs, discounted using a 7% real discount rate

Project description

The project includes:

- upgrading and a new alignment to provide a four-lane divided carriageway from Katoomba to Blackheath (East) and from Coxs River Road to Lithgow (West).
- intersection upgrades between Katoomba and Blackheath
- landscape treatments and strategic planting to enhance views towards local landmarks to improve place-making
- improved active transport paths for pedestrians and cyclists
- Medlow Bath station upgrades to comply with disability access standards
- pedestrian bridge over the highway connecting to the Medlow Bath Railway Station
- twin bridges over Jenolan Caves Road to form a grade separated intersection.

Transport for NSW (TfNSW) maintains a website with background and current status of the Great Western Highway Upgrade Program, which can be accessed at roads-waterways.transport.nsw.gov.au/projects/great-Western-highway/index.html.

Review themes

Strategic Fit	The case for action, contribution to the achievement of stated goals, and fit with the community.
Case for change	The current road alignments lead to congestion and safety risks from heavy vehicles mixing with local and tourist traffic, as well as amenity impacts for residents, and additional travel costs for freight. The use of high productivity vehicles is limited due to steep grades at Mt Victoria and poor horizontal alignment. Reliability of trip times is variable as the narrow and constrained corridor does not allow for easy alternative routes if an incident occurs. These problems have been determined as nationally significant, with the Early-Stage Proposal being added to the *Infrastructure Priority List* in February 2020.
Alignment	The project directly contributes to relevant national, state and local government goals, objectives, policies and strategic plans. The Great Western Highway is essential to serving the needs of the region, particularly for economic development, productivity and recovery. The Great Western Highway is specifically mentioned in the *Future Transport Regional NSW Services and Infrastructure Plan* (2018), *NSW Freight and Ports Plan 2018-2023* (2018), *NSW Heavy Vehicle Access Policy Framework* (2018), and the *Greater Sydney Services and Infrastructure Plan* (2018).
Network and system integration	A significant proportion of the whole-of-program travel time savings and freight vehicle operating cost savings are dependent upon delivery of the Central section, which is still in development. While the East and West sections have been designed for future compatibility with the Central section, they are also designed to function independently. That is, the future design of the Central section will include the tunnel portals and connections to the East and West sections. In this sense, the East and West sections are a no-regrets approach and can be implemented irrespective of the design and implementation of the Central section. The upgraded East and West sections will be consistent with upgrades to the Great Western Highway beyond Katoomba and Lithgow, with most upgrades occurring along the existing road alignment.
Solution justification	Based on the information in the business case, we are not confident that the scope of the East and West sections is most appropriate and if lower cost options would be more suitable - the detailed economic appraisal for the East and West sections considers only the preferred option against a base case. The earlier options analysis through which route options and project options were refined did not adequately consider environmental impacts. The preferred option had the second highest net present cost and second lowest BCR of all options considered.
Stakeholder endorsement	Engagement with community stakeholders has been undertaken for the East and West sections and is ongoing. Community stakeholders have been consulted regarding the preferred East and West options. Some community groups have indicated a preference for

	extension of the tunnel of the Central section over a longer section of the East section (Blackheath to Katoomba), citing road safety and environmental concerns. First Nations stakeholders have been consulted and have expressed concerns regarding impacts to cultural heritage sites that cannot be offset or mitigated. Community environment groups have provided feedback about the loss of native habitat and the risk to vulnerable fauna such as platypuses. Active engagement to address community concerns will be critical in progressing the project and realising desired outcomes.
Societal Impact	**The social, economic and environmental value of the proposal, as demonstrated by evidence-based analysis.**
Quality of life	Quality of life for local residents may be enhanced through amenity improvements and intersection upgrades. If realised, benefits from land use change, wider economic benefits and network impacts will be accrued by existing landholders and businesses in the region.
Productivity	Economic activity along the length of the highway is of strategic importance to NSW, in particular the Local Government Areas of the Blue Mountains, Lithgow, Oberon, Bathurst, Mid-Western, Dubbo Region and Orange. The completed Great Western Highway Upgrade Program (all three sections) will provide travel time savings, reduced vehicle operating costs, particularly for road freight, and improved safety and resilience to road users. However, until the Central section is delivered, these benefits will be relatively modest for the East and West sections. In addition, if the Central section is not constructed, potentially 37% of the benefits for the East and West sections may not be realised. Completion of the East and West sections is estimated to reduce travel times between Katoomba and Lithgow by 5 minutes, or 12%, compared to existing conditions for an average weekday journey. Private vehicle volume is anticipated to increase by approximately 3% with no assumed change in the freight task using the Great Western Highway until the central section is completed. These benefits are independent of the Central section, completion of which would increase the time saving to 12 minutes on average once the full program is developed.
Environment	The assessment for the West section shows potentially significant impacts on fauna and flora. A biodiversity assessment is currently being prepared and therefore biodiversity offsets requirements under the *Biodiversity Conservation Act* (NSW) have not yet been confirmed.
Sustainability	Although the project's sustainability strategy is well developed, the proposed sustainability initiatives, such as the use of recyclable materials and low carbon concrete, have not been costed so there is uncertainty that they will be delivered. The demand for travel on the highway is forecast to grow by 3% per annum. The Great Western Highway Upgrade Program (including the Central section) is projected to improve transport network performance and efficiency by increasing road capacity from 750 to 4,000 vehicles per hour. At the forecasted growth rate, the upgrade is expected to provide sufficient capacity for 33 years of growth, providing confidence that further major upgrades are unlikely for many years.
Resilience	The project aims to reduce the risk of accidents and improve reliability and resilience as the lane duplications allow vehicles to pass when there is an accident. The Great Western Highway can become congested in tourist season as caravans, passenger and freight vehicles mix at peak times. The lane duplication will allow better separation of heavy and light vehicles and will also provide infrastructure for active transport. Improvements to the Great Western Highway could also improve the resilience of the broader road network connections through the Blue Mountains. In circumstances where the Bells Line of Road has an incident, the upgraded highway, as the only alternative route, will have greater capacity to accommodate greater numbers of vehicles.

Deliverability	The capability to deliver the project successfully, with risks being identified and sufficiently mitigated.
Ease of implementation	The Aboriginal Cultural Heritage Assessment Report indicates that all sensitive sites within the boundaries of the proposed West section corridor would be directly impacted without the implementation of appropriate mitigation measures. An Aboriginal Heritage Impact Permit will be required before any known Aboriginal heritage sites are impacted. No financial contingency has been made for relocating or offsetting impacts to Aboriginal cultural heritage such as land acquisition or adjustments to the design.
Capability & capacity	There are significant risks that the timeframe and budget for the East and West sections cannot be met given wider market pressures on labour, fuel and materials supply and cost. These risks are likely to be exacerbated for the 11km tunnel for the Central section, which would be Australia's longest tunnel (noting delivery of this section is unfunded and subject to finalisation of a business case). Infrastructure Australia has estimated that Australia's annual infrastructure expenditure will double to $54 billion from 2021 to 2023. Investment rates are expected to exceed capacity limits identified as 'deliverable' over the next five years[7]. These risks are common to all infrastructure projects, but recent escalations in costs are higher than those anticipated in the project's costing reports.
Project governance	**Governance** Based on the information in the business case, we consider the governance and procurement models are suitable, with an appropriate approvals' hierarchy, stakeholder engagement strategy, risk management framework and program control group and committees. **Procurement** The procurement strategy has been formed based on collaborative workshops (involving the project team, advisors and government stakeholders), assurance feedback and industry consultation. It has been developed to address key project risks and constraints, project and delivery objectives and lessons from other projects. The program of works has been divided into six packages based on: • construction complexity, efficiency to facilitate design and construction innovation • risks, including interface risks • Transport for NSW resourcing capacity and cost • project milestones • market capacity • program objectives and • funding envelope. A 'Construct Only' contracting model is preferred for the simpler and smaller packages of works, reflecting the proponent's confidence in their ability to design and scope the works, manage the tender and manage interfaces. More complex packages of works with higher risk or complexity are to be tendered as design and construct contracts, to better manage those risks. **Funding** Funding through road tolls, including user-pays or alternatives to direct government funding, have not been considered. A toll road was deemed to be inconsistent with community expectations and the NSW Government objectives of economic development, although there is limited information in the business case to support this conclusion.
Risk	There are significant risks that the project could be delayed or exceed budget given that the Delivery Strategy identifies 16 major infrastructure projects on the east coast of Australia that will be under construction at the same time as the project. Key risks include: • Obtaining appropriate consents from landowners

[7] *Infrastructure Market Capacity*, Infrastructure Australia, 2021

	• Environmental issues, including whether the construction footprint is adequate, obtaining environmental approvals, and whether the allowance for biodiversity offset costs is sufficient.
Lessons learnt	Lessons from similar projects have been used to inform analysis during each stage of project development. These lessons have been incorporated into the procurement strategy approach and were included through the various workshops discussing the packaging of works and preferred contracting method. A post completion review has been considered, with a measurement strategy in place.

Economic appraisal results (preferred option)[8]

The project is expected to generate a cost to society, with a NPV of -$579.5 million. With wider economic benefits and land use benefits included, the NPV is -$431.5 million. The CBA shows little sensitivity to the level of demand, with many of the benefits being fixed, including avoided maintenance costs and residual value (collectively 33.4% of core benefits). There is potential for additional benefits related to travel time savings outside the corridor and unforeseen population growth that would increase demand, however these have not been able to be quantified. There is also a risk that costs could be higher than anticipated, further decreasing value for money.

In the absence of the Central section, it appears the benefits of the East and West sections would reduce. The economic appraisal includes an apportionment of 42% of the benefits of all three sections to the East and West sections, based on passenger hours by section. For the East and West sections, the second-round transport benefits (attributed to land use change), transport network resilience, road reliability and wider economic benefits are assumed to deliver 36.7% of total program benefits. Without the Central section, which is currently unfunded, the quantum of these benefits would be lower.

Demographic and land use projections were informed by Transport for NSW's 2019 Travel Zone Projections (for population, dwellings, workforce and employment) as an input into the Strategic Travel Model (STM) and transport demand projections. We consider this an appropriate basis for the demand modelling work that was subsequently undertaken in support of the Great Western Highway program business case.

The base case assumes significant capital investment will be required to refurbish the existing road at the end of its design life. Cost estimates for the base case have not been peer reviewed, as recommended by Infrastructure Australia. The annual cost difference between the base case and the project case widens over time in real terms, and the new roads appear to have no major periodic maintenance (compared to the base case) over the 30-year operating period, with the significantly lower operations and maintenance (O&M) expenditure in the project case estimated to cover renewals.

The estimated base case operating costs are high compared to benchmarked operating costs. Avoided maintenance costs of the preferred option were initially reported in the Strategic Business Case for the program to have a present value of $33 million. In the Final Business Case for the program, this figure increased to $215 million, and in the project economic analysis report for the East and West sections, it was $212 million (the base case roads in the Central section are assumed to be maintained as a service lane, and rest stops).

The business case also assumes higher contingencies in the base case O&M (of 20% - P50 and 30% - P90) compared to the project case O&M (East & West sections: 10% - P50, 15% - P90). The higher base case contingencies are included to account for:

- greater risk that additional items will require maintenance or replacement due to their age and anticipated condition;
- limited information on the existing assets and subsequent uncertainty around the allowances in the estimate.

Overall, we consider the base case estimates of O&M costs to be disproportionate relative to the O&M cost estimates in the project case. This will have the effect of overestimating the benefits and the BCR of the project.

[8] Economic appraisal results reported in this section are based on P50 costs, excluding land use and wider economic benefits, and discounted using a 7 % real discount rate.

Economic Appraisal Results

	Discount rate:	4%	7% (central)	10%
Core evaluation results[1]	**BCR:**	0.80	0.57	Not stated[2]
	NPV ($m):	-$307.4	-$579.5	Not stated
Results with land use benefits, if applicable	**BCR:**	0.87	0.61	0.43
	NPV ($m):	-$201.9	-$520.2	-$665
Results with land use benefits and WEBs, if applicable	**BCR:**	0.96	0.68	0.48
	NPV ($m):	-$60.4	-$431.5	-$605
Key benefits measured[1]	The list of benefits identified is comprehensive and all material benefits have been monetised and included in the economic appraisal. • The largest benefit is avoided routine maintenance costs compared to the 'do minimum' base case (28.0%). Although, as previously noted, we have some concern on the validity of these costs. • Avoided delays due to improved network resilience is valued at $205.7 million, or 27.2% of project benefits. • Freight travel time, vehicle operating cost and induced freight benefits were valued at $46.2 million, 6.1% of project benefits.			
Key observations and issues[1]	Based on the evidence provided in the business case, the costs of the East and West sections will exceed the benefits. Avoided maintenance costs could be overstated as the difference between routine maintenance in the project case and the base case is approximately $10 million per annum with an additional $40–80 million every five years in real terms. This difference does not materially diminish even by 2057-8 when the project has been in operation for ~30 years. There is a risk that further biodiversity offsetting costs may be identified through the Environmental Impact Assessment process, or that capital costs may be higher than anticipated due to escalating engineering, fuel and materials costs.			

(1) Using P50 costs, excluding land use and wider economic benefits.

(2) The economic appraisal has not included sensitivity testing on a discount rate of 10% for core economic benefits as suggested by the Infrastructure Australia Assessment Framework.

Project development

The strategic analysis of options was carried out at the program level (involving all three sections), culminating with the Program Business Case.

Options analysis

Initially, eight infrastructure and non-infrastructure options for the Great Western Highway upgrade program, including the East, West and Central sections, were identified based on an initial viability screening of 19 alternative options. These eight options were refined down to two road corridor options through a strategic merit test.

Having defined the road corridor, the options identification for the whole upgrade program considered four main options for more detailed analysis, namely a 'do minimum' option, surface upgrades, a short tunnel, and a long tunnel. An indicative capital cost for all four of these options was developed, however the refinement of these four options through a strategic merit test does not appear to have given sufficient weight to project costs. Overall, the costs of both infrastructure and non-infrastructure options have not been analysed at a sufficient level of detail to provide confidence that the preferred option is the best option.

The cost-benefit analysis (CBA) of the four shortlisted options of the whole program identified that the 'Do Minimum' option had the highest NPV and BCR. A multi-criteria analysis (MCA) was undertaken after the CBA and this significantly changed the prioritisation of options from that indicated by the CBA. The weightings and scores within the MCA implied extremely high valuations on some identified benefits, far higher than calculated for those items by the CBA. This suggests an optimism bias in the design of the MCA results that favours the project option.

The economic appraisal report for the East and West sections assessed one option, the preferred option, against a 'do minimum' base case. Multiple scenario tests were performed; however, justification was not provided for analysing only the preferred option and the base case in the CBA.

Impacts of COVID-19

The project's economic analysis aligned with TfNSW's 2019 guidance note "Technical note on assessing the impacts of COVID-19 on Business Cases" with three sensitivities being run through TfNSW's Strategic Transport Model: Reduced population growth, impacts of working from home, and a volume uplift which reflects increased commuter demand from those who have relocated outside of Sydney. The first two of these sensitivities are required by TfNSW's guidance and the third is a project-specific sensitivity which reflects travel patterns since the pandemic began in early 2020 and tests the impact of their continuation. The reduced population scenario made the NPV of the project 4% lower, and the increased working from home scenario reduced the NPV by 0.6%. Interestingly, the continuation of higher demand also reduced the NPV compared to the unadjusted results, by 0.6%, which appears counterintuitive.

Proposal engagement history

Great Western Highway improvements: Katoomba to Lithgow was added to the *Infrastructure Priority List* in February 2020 and a Stage 2 submission for the Great Western Highway (Katoomba to Lithgow) Upgrade Program (all sections) was assessed in March 2022. The existing listing, which covers the entire program, recognises that the business case for the East and West sections has been completed and notes that the business case for the Central section is in development.

Recommended for the Infrastructure Priority List: February 2020

Not recommended for Stage 2 on the Infrastructure Priority List: March 2022

The Stage 2 assessment of the program recommended that the proponent consider additional options in the shortlist for the Central section, with further analysis of value for money.

Submitted to Infrastructure Australia as a funded project.

Detailed economic appraisal results

The following table presents a breakdown of the benefits and costs stated in the business case.

Benefits and costs breakdown

Proponent's stated benefits and costs	Present value ($m,2021/22)			% of total for 7% results
Discount rate (real)	**4%**	**7%**	**10%**	
Costs				
Total capital costs (P50)	$1,440.0	$1,265.4	n/a	94.7%
Operating costs	$115.9	$71.6	n/a	5.3%
Total costs[1,2]	**$1,555.9**	**$1,336.0**	**n/a**	**100%**
Benefits				
Freight travel time and operating cost benefits	$73.8	$46.2	n/a	6.1%
Increased tourism spend	$15.3	$10.5	n/a	1.4%
Avoided routine maintenance costs	$337.4	$211.5	n/a	28.0%
Resilience/future proofing benefits	$329.4	$205.7	n/a	27.2%
Network performance benefits	$293.3	$187.3	n/a	24.8%
Safety benefits	$54.4	$34.7	n/a	4.6%
Movement and place/amenity benefits	$31.8	$19.9	n/a	2.6%
Residual value of assets	$113.1	$40.6	n/a	5.4%
Total benefits[1]	**$1,248.5**	**$756.5**	**n/a**	**100%**
Net present value (NPV)[3]	**-$307.4**	**-$579.5**	**n/a[5]**	**n/a**
Benefit-cost ratio (BCR)[4]	**0.80**	**0.57**	**n/a**	**n/a**
Land use benefits	$105.5	$59.3	n/a	7.3%
Total benefits, including land use benefits[1]	**$1,354.0**	**$815.8**	**n/a**	**100%**
Net present value (NPV), including land use benefits[3]	**-$201.9**	**-$520.2**	**-$664.8**	**n/a**
Benefit-cost ratio (BCR), including land use benefits[4]	**0.87**	**0.61**	**0.43**	n/a
Wider economic benefits (WEBs)	**$141.5**	**$88.6**	**n/a**	**9.8%**
Agglomeration	$124.5	$78.1	n/a	8.6%
Output in imperfectly competitive markets	$16.4	$10.2	n/a	1.1%
Increased labour supply	$0.6	$0.3	n/a	0.0%
Total benefits, including land use benefits and WEBs [1]	**$1,495.5**	**$904.5**	**n/a**	**100%**
Net present value (NPV), including land use benefits and WEBs[3]	**-$60.4**	**-$431.5**	**-$605.3**	**n/a**
Benefit-cost ratio (BCR), including land use benefits and WEBs[4]	**0.96**	**0.68**	**0.48**	**n/a**

Source: Proponent's business case
(1) Totals may not sum due to rounding.
(2) Costs reported in this table are based on P50 cost estimates.
(3) The net present value is calculated as the present value of total benefits less the present value of total costs.
(4) The benefit–cost ratio is calculated as the present value of total benefits divided by the present value of total costs.
(5) The economic appraisal did not include sensitivity testing on a discount rate of 10% for core economic benefits as defined by the Infrastructure Australia Assessment Framework (i.e., excluding land use benefits).