QUEENSLAND GOVERNMENT SUBMISSION RESPONSES

R2020 Urban Transport Consultancy – December 2018

Supplementary Submission R2020 Draft Assessment Papers for the 2020 Methodology Review & Urban Transport Consultancy – February 2019

Queensland Government

Urban Transport Consultancy

Queensland response

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1.0 Queensland's Position

- Queensland **supports**:
  - capturing demand variables, supply variables and cost variables in a model to determine state urban transport recurrent and infrastructure expenditure requirements.
  - using the same model for both recurrent expenditure and capital expenditure.
- Queensland **accepts** mean land slope as a measure of topographical costs, but recommends the CGC continue exploring other drivers of costs associated with topography.
- Queensland **does not support** using the consultant's preferred model to assess urban transport expenditure because it is not:
  - policy neutral (actual bus and train passengers are influenced by state policies)
  - contemporaneous (inputs rely heavily on census data which is updated once every five years)
  - reflective of the relationship between population density and per capita costs
  - comprehensive in capturing the complexities of satellite city dependency.
- Queensland **recommends** using an alternative model:

$$E_i = [\beta_0 + \beta_1 \ln(dense_i) + \beta_2 distance_i + \beta_3 slope_i + \beta_4 \text{train}_i + \varepsilon_i] \times 0.25$$

Where:

$$dense_i \ is\ the\ density\ of\ the\ SUA$$

$$distance_i \ is\ the\ average\ distance\ to\ work\ from\ an\ SUA$$

$$slope_i \ is\ the\ mean\ land\ slope\ of\ the\ SUA$$

$$train_i \ dummy\ variable\ for\ the\ presence\ of\ rail\ infrasturcture\ in\ the\ SUA$$

$$\varepsilon_{i,bus} \ is\ the\ number\ of\ bus\ passengers\ in\ the\ SUA$$

2.0 Overview

As part of the 2020 Review, the CGC is reviewing its methodology to assess urban transport expenditure. This comes after Queensland and other states have raised strong concerns with the existing model—it is based solely on the conceptual case that the cost of urban transport services increases with urban centre population size (the existing models can be found in appendix A). There are other cost drivers which are not captured in the existing model and, as a result, the outcome from the assessment distorts the allocation of GST.

As part of the CGC's response to address this concern, it engaged a consultant in 2017 to review its modelling of state urban transport expenditure requirements. Queensland supported this approach.

The consultant identified additional potential drivers in the first stage of its work:

- Population served by an urban transport network
- Employment and journey to work
- Student enrolment and education trips
- Public transport service provision
- Travel cost by car
- Urban congestion
- Urban density
- Urban terrain
- Emerging trends in public transport use

Based on this outcome, Queensland supported the consultant to proceed with stage 2, which involved developing and testing alternative models to determine states urban transport expenditure requirements. The process concluded in October 2018 and the consultant's preferred model is as follows:

$$E_i = \beta_0 + \beta_1 dense_i + \beta_2 distance_i + \beta_3 slope_i + \beta_4 \ln(pax_{i,train}) + \beta_5 \ln(pax_{i,bus}) + \varepsilon_i$$

Where:

$dense_i$ *is the density of the SUA*

$distance_i$ *is the average distance to work from an SUA*

$slope_i$ *is the mean land slope of the SUA*

$pax_{i,train}$ *is the number of train passengers in the SUA*

$pax_{i,bus}$ *is the number of bus passengers in the SUA*

$\varepsilon_{i,bus}$ *is the number of bus passengers in the SUA*

2.1 Should capital expenditure and net operating expenditure use the same model?

Queensland supports the consultant's proposal to use the same model to determine both urban capital expenditure requirement and net operating expenditure requirement. The drivers for capital and net recurring expenditure appear to be broadly identical. Given the current capital model uses the same driver as the recurrent expenditure model, and it has a 50% discount, there is no reason to continue to assess capital expenditure differently. Unless there is strong evidence that the drivers of urban transport capital expenditure are significant and materially different from the drivers of recurrent expenditure, the same model should be used to assess both expenditure requirements.

2.2 Is mean land slope an appropriate variable?

Queensland accepts mean land slope as a measure of topographical costs, but recommends the CGC continue exploring other drivers of costs associated with topography.

The mean land slope variable measures the average gradient of all road and railway lines that exists in the SUA and it aims to capture the additional cost of building a public transport system on an SUA with a complex topography. Based on the information provided by the CGC, the measurement for each SUA is calculated by measuring the gradient of every road and rail in the SUA.

Using mean land slope is an acceptable conceptual proposal-building a public transport network is likely to be cheaper on a flatter SUA. However, construction and maintenance cost of an urban transport network relating to topographical features extends beyond the slope of the street or track. Other topographical features such as the type of soil and the number of waterway crossings could also influence the cost of maintenance and construction of an urban transport network. These factors are not accounted for by the mean land slope variable and should be accounted for through other cost variables.

2.3 Is the model policy neutral?

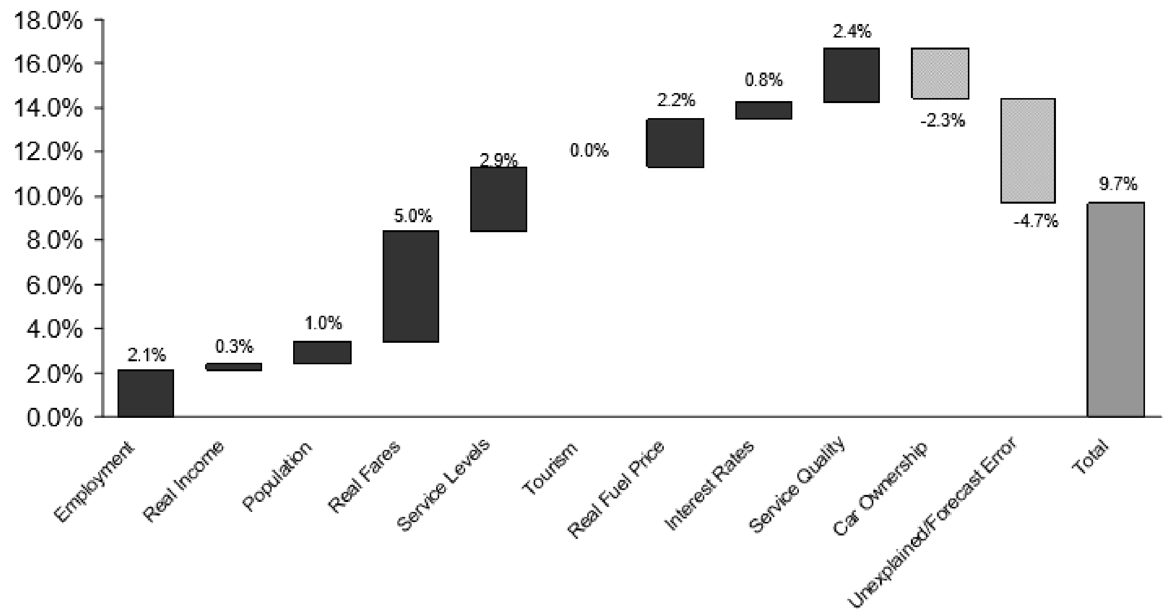
The preferred model is not policy neutral. This issue relates to the variables 'number of train passengers' and 'number of bus passengers'. Public transport policies set by a state have significant influence on the number of bus and train passengers. Over the short term, state policies to increase the level of subsidies (fare price) and concessions as well as policies to improve the reliability, frequency and safety of the network can significantly increase the number of passengers.

A study completed by the Queensland department of transport on the key drivers of public transport patronage growth shows this[1]. In 2004-05, total number of public transport passenger increased by 9.7%. The department of transport identified and quantified a number of exogenous and endogenous factors.

Exogenous	**Endogenous**
Employment	Real fares
Real income	Service levels
Population	Service quality
Tourism	
Real Fuel Price	
Interest Rates	
Car ownership	

Figure 1 shows that, of the factors identified and quantified, the single most important demand driver in the year was the impact of fare level changes which was estimated to increase the number of passengers by 5%. Only 28% of the total percentage increase in passengers was from exogenous factors such as employment, changes in real income, population, real fuel price interest rates and car ownership.

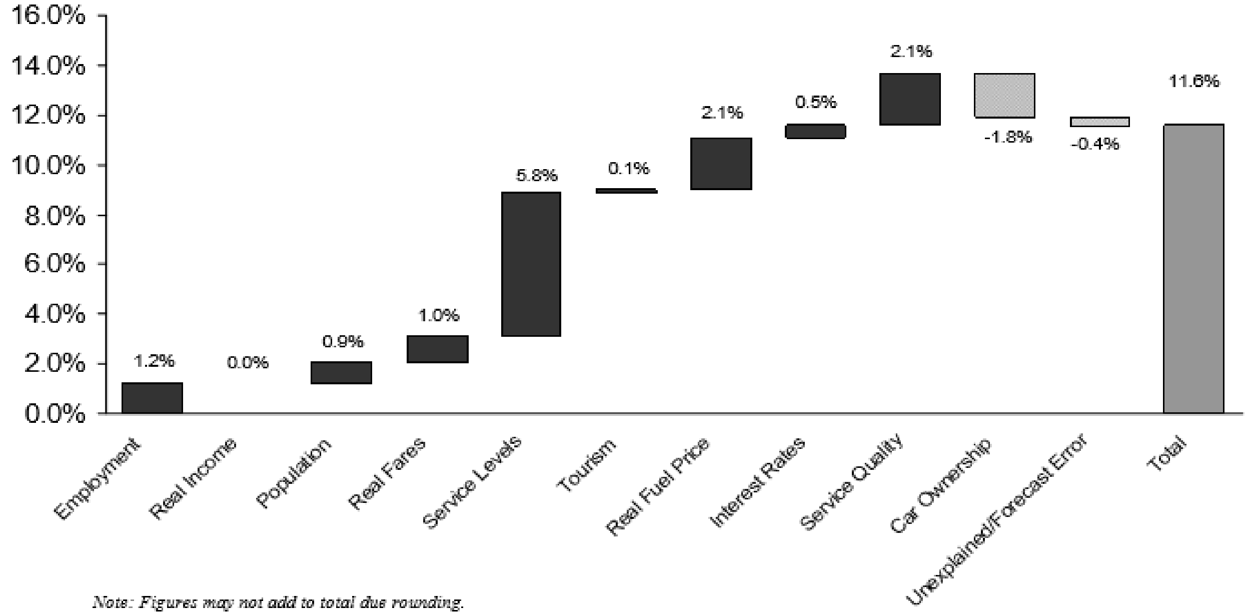
Figure 1. South East Queensland estimated and actual passenger growth by factors 2004-05



[1] Mark Streeting, Robin Barlow, Understanding Key Drivers of Public Transport Patronage Growth- Recent South East Queensland Experience.

Similarly, in 2005-06 total passengers using the public transport network increased by 11.6%. Figure 2 shows the single most important demand driver in this year was the impact of improved service levels which was estimated to increase the number of passengers by 5.8%. The estimated contribution of the quantified exogenous factors was approximately 42%.

Figure 2. South east Queensland estimated and actual passenger growth by factors 2005-06

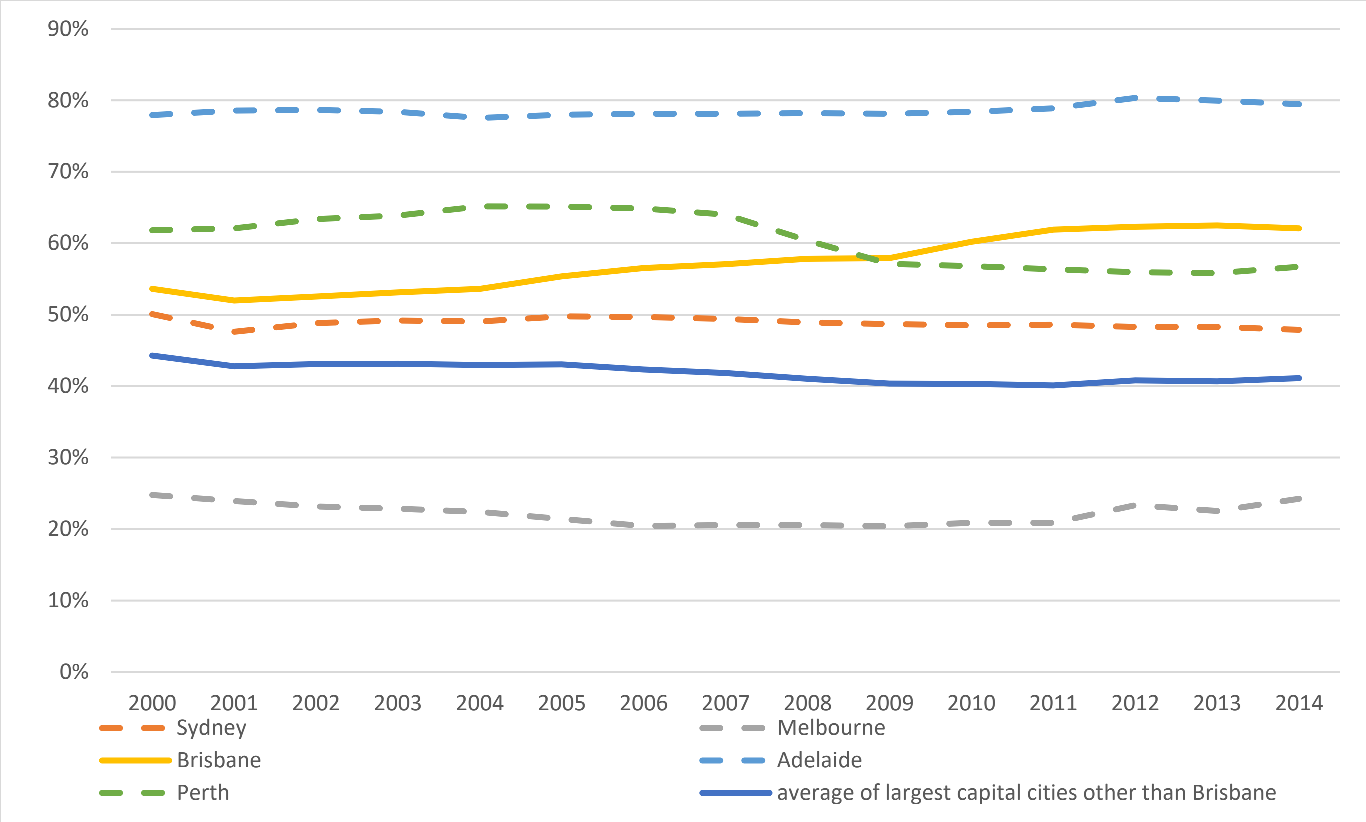


Note: Figures may not add to total due rounding.

Over a longer term, state policies on the level of public transport infrastructure will also impact on the number of passengers. For example, the construction of a new rail line can increase the number of passengers to the public network by making public transport preferable to private transport, and switch bus passengers to train passengers by making trains preferable to buses.

The impact of investment policy on passenger numbers is prominent in Queensland. Over the last two decades, Queensland has invested heavily into the development of its bus network. Increased bus network coverage and reliability has led to a steady growth in bus passengers as a proportion of total passengers.

Figure 3. Bus patronage as a proportion of total public transport patronage 2000-2014



Source: BITRE

Figure 3 shows the proportion of bus patronage as a proportion of total public transport patronage in Brisbane has increased from approximately 52% in 2000 to 62% by 2014. Over the same period the proportion of bus patronage in other capital cities has remained approximately the same or has declined. Excluding Brisbane, the proportion of bus patronage has declined from approximately 44% to approximately 40% in other major capital cities.

Under the consultant's preferred model, Queensland will be disadvantaged by its past policy choice of investing in the bus network because the marginal cost of an additional train passenger is higher than the marginal cost of an additional bus passenger. In fact, a state can optimise its urban transport expenditure requirement under this model by putting in place transport policies that ensures it has approximately 73% train passengers and approximately 27% bus passengers. The proof of this outcome can be found in table 1 to 3 in appendix B.

2.4 Is the preferred model contemporaneous?

If the consultant's preferred model relies on census data, the urban transport assessment will struggle with contemporaneity. The variables 'average distance to work', 'number of train passengers' and 'number of bus passengers' all require inputs from census data. While census data is comparable across states and are unbiased, they are only updated once every five years. In addition, the mean land slope of an SUA is likely to be constant at least over the medium term. As a result, the per capita expenditure requirement of an SUA would remain largely unchanged during the intercensal years even if an SUA experiences significant growth in actual passenger numbers. A large adjustment then occurs after census which could introduce significant volatility to the outcome of the assessment. If the CGC proposes to use the preferred model, it will need to consider what other data source are available to ensure the assessment can reflect the change in state circumstances in a timely manner.

2.5 Does the preferred model accurately reflect the relationship between population density and per capita costs?

The urban transport model should use log population to reflect the effects of economies of scale in delivering urban transport.

While costs relating to the acquisition of land and installation of infrastructure in built-up areas would increase with population density, other costs are lower because transport services benefit from economies of scale in densely populated areas. This should lower per capita costs. For example, rail can be cheaper to operate per capita compared to buses in highly dense cities because it is more efficient to move large volume of passengers. This appears to be the case in cities such as Hong Kong and Tokyo, which are considerably denser than Sydney and Melbourne, but do not appear to incur significantly higher per capita costs.

In the preferred model, lower costs due to economies of scale is not captured, and the impact of density on per capita cost of urban transport may be overstated.

2.6 Satellite cities

Total transport task and travel time should be considered together with employment self-sufficiency to determine satellite city dependency. Employment self-sufficiency as a determinant has merit, but using it solely as a measure for satellite city dependency is too simplistic.

The treatment of satellite cities used by the consultant is determined by employment self-sufficiency. The consultant noted this indicates the extent to which local residents seek employment outside the area in which they live. In regional towns, the containment of employment would be higher. In wider urban areas, a greater proportion of the labour force would work outside the SUA. This approach appears to be consistent with the ABS's criterion to determine if two SA2 regions should be grouped together to form one SUA.

In its response to the draft assessment paper on transport, Queensland has suggested the CGC should reconsider the treatment of satellite cities to reflect the states' true transport task. In particular, the Gold Coast should be assessed together with Brisbane due to a steady increase in transport task between the two SUAs. It continues to hold this view.

3.0 Alternative model

The consultant's preferred model has a strong conceptual foundation, but needs further refinement. In particular, the relationship between population density and per capita cost is more appropriately reflected through a log-level relationship to account for economies of scale.

In addition, 'train passengers' and 'bus passengers' variables should be removed from the preferred model to improve policy neutrality.

The model Queensland prefers is as follows:

$$E_i = [\beta_0 + \beta_1 \ln(dense_i) + \beta_2 distance_i + \beta_3 slope_i + \beta_4 \mathrm{train}_i + \varepsilon_i] \times 0.25$$

Where:

$dense_i\ is\ the\ density\ of\ the\ SUA$

$distance_i\ is\ the\ average\ distance\ to\ work\ from\ an\ SUA$

$slope_i\ is\ the\ mean\ land\ slope\ of\ the\ SUA$

$train_i\ dummy\ variable\ for\ the\ presence\ of\ rail\ infrasturcture\ in\ the\ SUA$

$\varepsilon_{i,bus}\ is\ the\ number\ of\ bus\ passengers\ in\ the\ SUA$

This model captures the key drivers of density, network complexity, higher cost due to topography and higher costs from investing in and maintaining a rail network. It also recognises that the variables included are not perfect proxies and, as a result, a 25% discount is applied.

Another model which is also acceptable but not preferred is as follows:

$$E_i = [\beta_0 + \beta_1 \ln(dense_i) + \beta_2 distance_i + \beta_3 slope_i + \beta_4 \ln(passengers_i) + \beta_4 \mathrm{train}_i + \varepsilon_i] \times 0.25$$

$where$

$dense_i\ is\ the\ density\ of\ the\ SUA$

$distance_i\ is\ the\ average\ distance\ to\ work\ from\ an\ SUA$

$slope_i\ is\ the\ mean\ land\ slope\ of\ the\ SUA$

$passengers_i\ is\ the\ number\ of\ urban\ transport\ passengers\ in\ the\ SUA$

$train_i\ dummy\ variable\ for\ the\ presence\ of\ rail\ infrasturcture\ in\ the\ SUA$

$\varepsilon_{i,bus}\ is\ the\ number\ of\ bus\ passengers\ in\ the\ SUA$

This model includes an additional ‘passengers’ variable to capture the impact of supply on per capita costs. However, state transport policies can still impact on total passenger numbers, making this model less preferred.

4.0 Appendix A

The current model to assess urban transport recurrent expenditure is as follows:

$$E_i = 90.17 * \ln(P_i) + 291.29$$

Where:

i is equal to all cities with a population greater than 20 000

E is the per capita net expense

P is urban population

Under this model, increases in urban centre population increase per capita net expenses at a diminishing rate.

Similar to the transport net operating expenditure assessment, the main driver used to determine states' infrastructure investment is population

$$A_i = P^2 \times 50\%$$

Where:

i is equal to all cities with a population greater than 20 000

A is assets per capita

P is urban population, and

50% is the discount on this assessment.

This model was adopted by the CGC because analysis showed that assessed asset values per capita were driven by the square of urban centre population.

5.0 Appendix B

Table 1 Highest per capita expense (500 passengers)				
Train passengers		Bus passengers		additional cost per capita
Proportion	Number	Proportion	Number	
5%	25	95%	475	99.59
10%	50	90%	450	111.76
15%	75	85%	425	118.70
20%	100	80%	400	123.50
25%	125	75%	375	127.10
30%	150	70%	350	129.93
35%	175	65%	325	132.21
40%	200	60%	300	134.09
45%	225	55%	275	135.63
50%	250	50%	250	136.90
55%	275	45%	225	137.91
60%	300	40%	200	138.69
65%	325	35%	175	139.24
70%	350	30%	150	139.55
75%	375	25%	125	139.57
80%	400	20%	100	139.24
85%	425	15%	75	138.40
90%	450	10%	50	136.71
95%	475	5%	25	133.03

Appendix B – Continued

Table 2 Highest per capita expense (500,000 passengers)				
Train passengers		Bus passengers		additional cost per capita
Proportion	Number	Proportion	Number	
5%	25,000	95%	475,000	270.86
10%	50,000	90%	450,000	283.03
15%	75,000	85%	425,000	289.97
20%	100,000	80%	400,000	294.77
25%	125,000	75%	375,000	298.37
30%	150,000	70%	350,000	301.20
35%	175,000	65%	325,000	303.48
40%	200,000	60%	300,000	305.36
45%	225,000	55%	275,000	306.90
50%	250,000	50%	250,000	308.17
55%	275,000	45%	225,000	309.18
60%	300,000	40%	200,000	309.96
65%	325,000	35%	175,000	310.51
70%	350,000	30%	150,000	310.82
75%	375,000	25%	125,000	310.84
80%	400,000	20%	100,000	310.51
85%	425,000	15%	75,000	309.67
90%	450,000	10%	50,000	307.98
95%	475,000	5%	25,000	304.30

Appendix B – Continued

Table 3 Highest per capita expense (5,000,000 passengers)				
Train passengers		Bus passengers		additional cost
Proportion	Number	Proportion	Number	per capita
5%	250,000	95.00%	4,750,000	327.95
10.0%	500,000	90.00%	4,500,000	340.12
15.0%	750,000	85.00%	4,250,000	347.06
20.0%	1,000,000	80.00%	4,000,000	351.86
25.0%	1,250,000	75.00%	3,750,000	355.46
30.0%	1,500,000	70.00%	3,500,000	358.29
35.0%	1,750,000	65.00%	3,250,000	360.57
40.0%	2,000,000	60.00%	3,000,000	362.45
45.0%	2,250,000	55.00%	2,750,000	363.99
50.0%	2,500,000	50.00%	2,500,000	365.26
55.0%	2,750,000	45.00%	2,250,000	366.27
60.0%	3,000,000	40.00%	2,000,000	367.05
65.0%	3,250,000	35.00%	1,750,000	367.60
70.0%	3,500,000	30.00%	1,500,000	367.91
75.0%	3,750,000	25.00%	1,250,000	367.93
80.0%	4,000,000	20.00%	1,000,000	367.60
85.0%	4,250,000	15.00%	750,000	366.76
90.0%	4,500,000	10.00%	500,000	365.07
95.0%	4,750,000	5.00%	250,000	361.39

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1.0 Overview

This submission provides supplementary information to Commonwealth Grants Commission's (CGC) staff for consideration of the 2020 methodology review following Queensland's response to the draft assessment papers as part of the 2020 Methodology Review (2020 Review), the Commissions visit to Queensland and the staffs Transport and Rural roads discussion papers.

The supplementary submission focusses on:

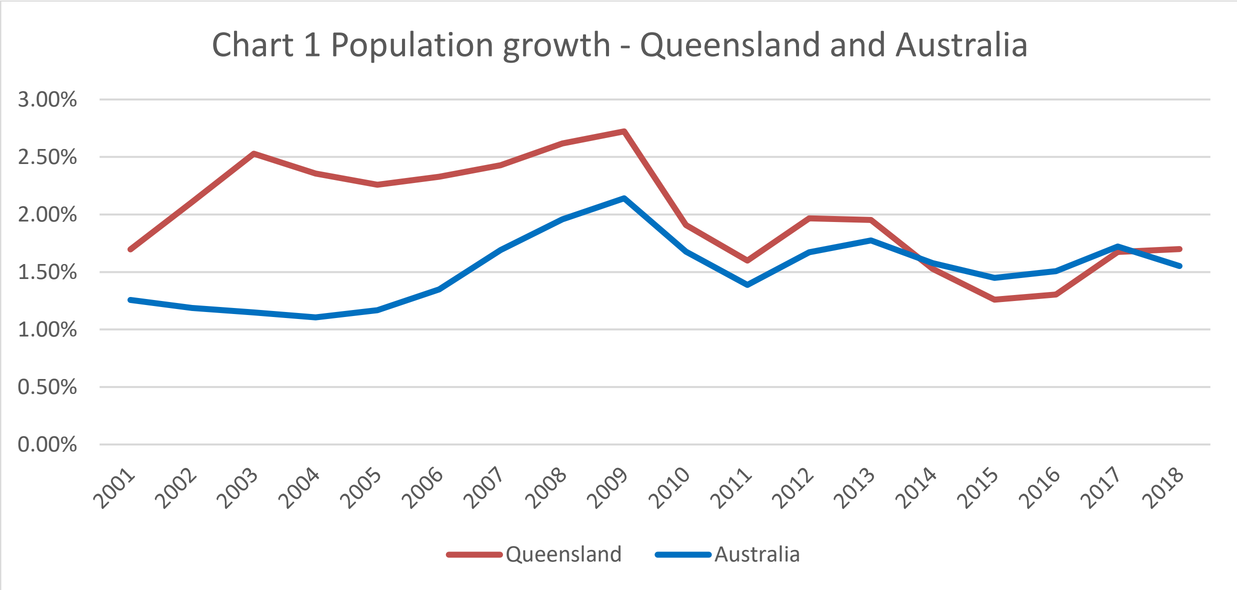
- Population changes – Despite a trend towards urbanisation, Queensland continues to have a large disadvantaged population living in regional and remote areas, as well as a large Indigenous population.
- Regional service delivery costs – Queensland continues to have high regional service delivery costs driven by vast population disbursement and the requirement to 'block fund' services.
- Densification – Some service delivery costs will increase with densification (e.g. urban transport and urban roads), but others should benefit from economies of scale.
- Rural roads assessment – the submission provides Queensland's position on proposed changes to the assessment of rural roads as discussed at the telepresence on Monday, 3 December 2018. That is, Queensland supports the proposed changes and seeks further information on how the CGC would apply similar changes to the urban roads assessment.
- Urban Transport assessment – additional comments on the consultant's report.

2.0 Population changes in Queensland

Queensland's position

- Despite a trend towards greater urbanisation, Queensland continues to have one of the largest populations living in regional and remote areas.
- Queensland has the second largest disadvantaged population living in regional and remote areas.
- Queensland also has the largest number of Indigenous population living in regional and remote areas.

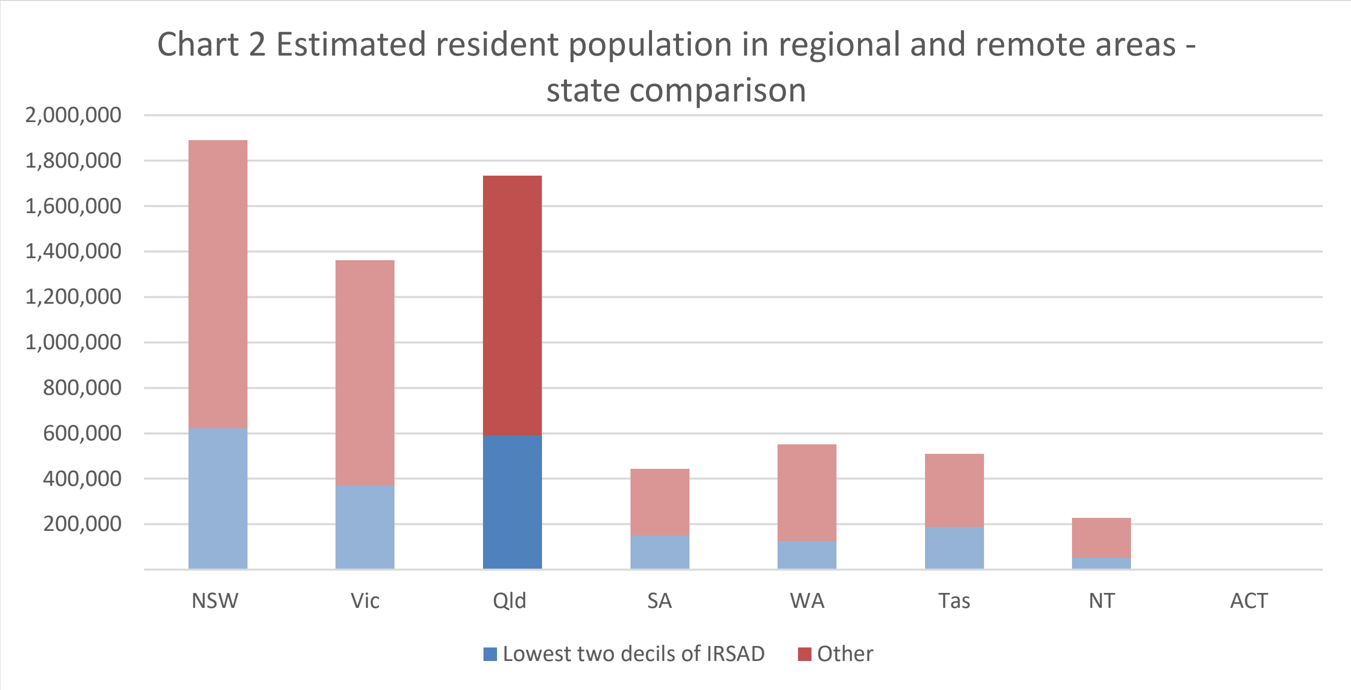
Queensland's population has increased steadily over the last two decades, increasing on average 2% a year. This has been faster than the national average annual growth of approximately 1.52%. Queensland's above average population growth over this period can be attributed to multiple social and economic factors (e.g. 'mining boom').



Source: ABS 3101.0 – Australian Demographic Statistics

Also over the last two decades, Queensland like most states in Australia has experienced increasing urbanisation. On average, Queensland's population living in regional and remote areas has increased by 1.46% over the last 17 years. This is significantly slower than the average annual growth rate of approximately 2.4% experienced by major cities in the State. Consequently, population share of regional and remote areas has declined steadily from almost 40% in early 2000s to only 36% by 2017.

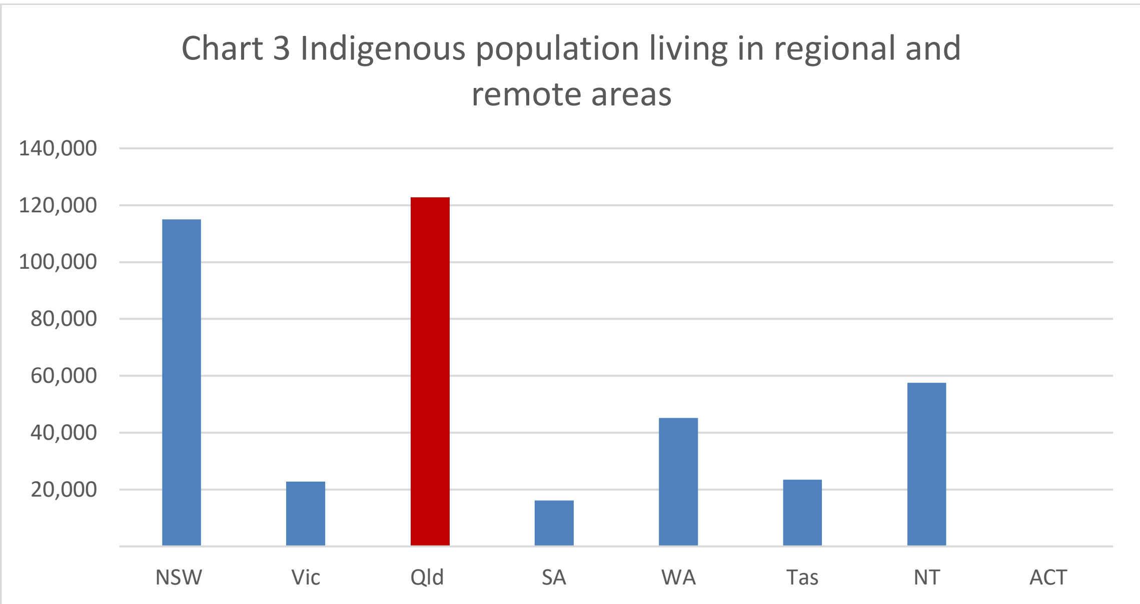
Despite a decline in the proportion of population living in regional and remote areas, Queensland continues to have the largest proportion of its population living in regional and remote areas among the largest five states. It also has the second largest number of residents living in regional and remote areas (1.7 million) of any state and the largest number of residents living in outer regional and remote areas (791,680).



Source: ABS Census 2016

Of the population living in regional and remote locations, more than half a million are from the lowest two deciles of the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD), the second largest in Australia.

Social disadvantage in regional and remote areas is also accompanied by high levels of Indigeneity. Queensland has more than 122,000 Indigenous individuals living in regional and remote areas. This is approximately 19% of the total Indigenous population in Australia. Queensland has the highest number of Indigenous individuals living in regional and remote areas of any state.



Source: ABS Census 2016

Queensland's unique demographic composition have significant implications for the cost of service delivery in regional and remote areas. This is explored in the following section.

3.0 Regional cost

Queensland's position

- Queensland continues to have strong demand for government services in regional and remote areas.
- Per capita expenditure in regional and remote remains high in part because of the need to block fund services.
- Technology does not have a significant impact on the cost of service delivery in regional and remote areas.

In Queensland, high expenditure on government services in regional and remote areas is driven by strong demand from a large population (including a large Indigenous population), and compounded by high levels of social disadvantage. Despite a trend for the population to move toward urban areas, expenditure remains high in part because of the need to block fund services (ie. high cost).

Block funding is any non-individualised funds that purchase goods or services directly from the provider. There is a role for block funding where markets would not otherwise support key services. This could occur when a market is too thin to sustain providers, for example, highly specialised support for rare conditions; services which have substantial upfront fixed costs, and some forms of support for which there are only a few potential customers. In regional and remote areas, a combination of these conditions prevails, making block funding necessary but also costly per capita.

Most Queensland social service departments utilise block funding in regional and remote areas. Queensland Health has 85 block funded hospitals, mostly located in outer regional, remote and very remote locations. The Queensland Department of Housing and Public Works also block fund service providers in regional and regional areas that deliver counselling for drug and alcohol addiction, domestic and family violence and employment assistance.

Some states have suggested that technological improvements over the last decade have enabled new methods of service delivery which reduce service delivery costs in regional and remote areas. Queensland recognises the role technology plays in service delivery but has not experienced any material decrease in service delivery costs. For most services, technology has not lead to a higher service delivery scale, or a significant reduction in travel costs. For example, Telehealth, which allows patients in rural and remote locations to use videoconferencing facilities to speak to health professional from a hospital, has reduced travel requirements in some instances. However, this service is only available from certain locations and is only appropriate for some patients. Patients with other complicated treatment or procedures, or living in locations without Telehealth service still require either the patient or the health professional to travel.

Queensland considers that technology can facilitate service delivery, but will not fundamentally change the way services are being delivered in regional and remote areas at least in the short- to medium-term.

4.0 Densification and its impact on government services

Queensland's position

- Queensland supports the CGC's methodology to recognise higher cost because of higher population density only in services where a strong conceptual case exists.
- The only services where there is strong evidence higher population density leads to higher per capita cost is in urban transport and urban roads.
- Other than urban transport and urban roads, Queensland does not support including population density as an additional disability in other service categories as there is insufficient evidence that it leads to higher per capita costs.

Conceptually, increased population density could increase the cost acquiring land and build infrastructure. It may also increase costs associated with managing crowds and congestion. However, delivering services in densely populated areas may also lead to greater service delivery scale which could lower per capita cost.

Higher cost because of population density in urban transport and urban roads are currently reflected in the CGC's assessment methodology. For urban transport, both the current assessment for recurrent expenditure requirement and capital expenditure requirement assume that population increase leads to higher per capita cost. For urban roads, traffic volume is currently used as a proxy for population density. Queensland supports the conceptual case for these approaches.

Urban transport is more expensive to deliver in denser cities because they require more expensive infrastructure to cope with the transport task. In sparsely populated cities, congestion is not an issue and most of its residents use private transport for commute. The lack of congestion and lower demand for public mass transit services mean buses are the most efficient mode of mass transport. As density increases, so too does the level of congestion. In highly populated cities, buses are no longer sufficient for the transport task, and increasing the number of buses operating in the system only adds to congestion. Rail becomes the most efficient option, but is overall costlier to construct and maintain.

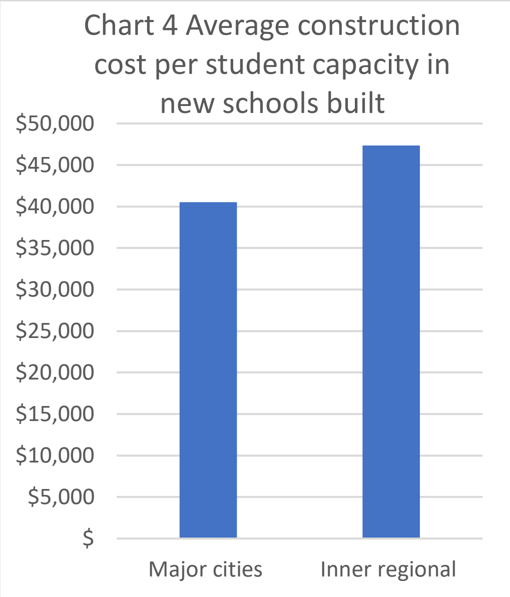
Similarly, population density leads to higher congestion and wear and tear on road infrastructure. Consequently, urban roads that have higher traffic volume are required to be maintained more frequently. They also need to be built with more durable material to ensure they do not fail between maintenance and fitted with more safety infrastructure that also manages traffic. In some cases, existing roads would also have to be widened to accommodate for the increase in traffic.

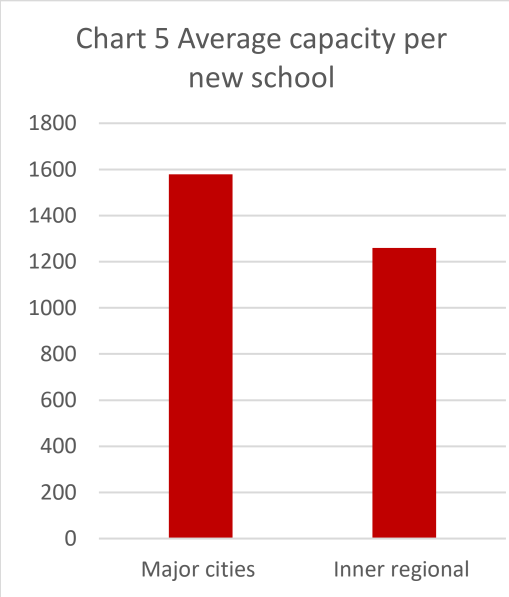
However, the impact of population density on the per capita cost of other government services is not as strong, as they rely less on infrastructure. Unlike urban transport and urban roads, other services are more flexible in their service location and can avoid significant costs associated with acquiring land and building. Queensland does not support including an additional population density as an additional disability in other service categories because there is insufficient evidence that it leads to higher per capita costs. The case study below illustrates education capital costs in Queensland is lower in more densely populated areas.

Case study: Queensland education capital expenditure

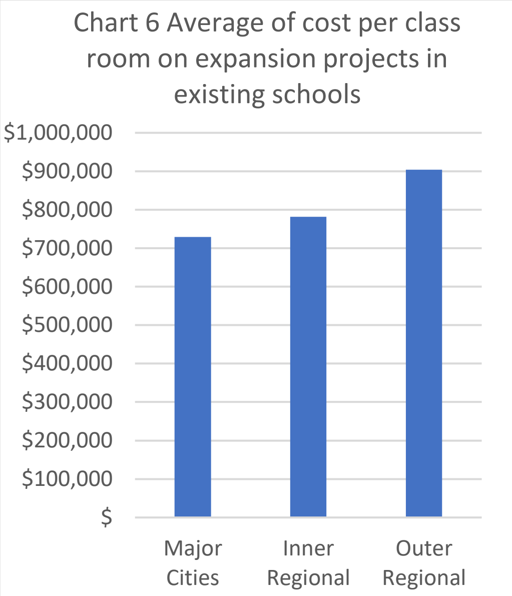
Queensland has undertaken 80 capital projects relating to primary and secondary education over the last three years. Of these, 71 projects were to expand the capacity of existing schools. Only nine projects were to build new schools.

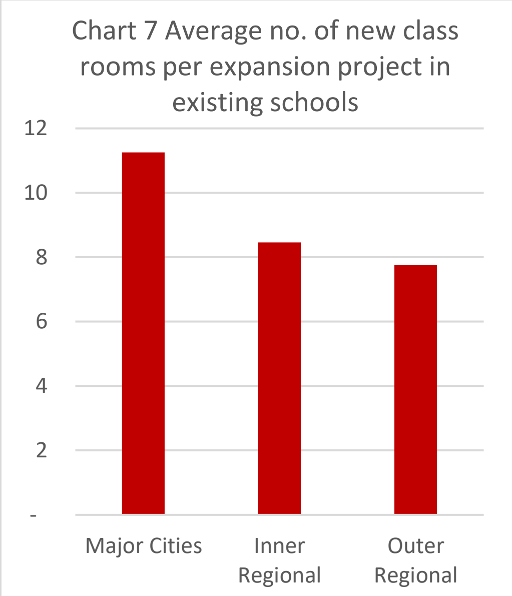
Six of the nine schools were built in inner regional areas with an average capacity of 1,579 students and an average cost of $60.8 million. Three schools were built in inner regional areas with an average capacity of 1,260 students and an average cost of $54.86 million. The average cost per student in schools built in major cities was $40,543 compared to an average cost per student of $47,334 for schools built in inner regional schools.





Of the 71 projects to expand existing schools, 56 of these projects occurred in major cities, 11 in inner regional areas and 4 in outer regional areas. The average expansion in major cities was 11 class rooms and costed on average $7.75 million. This is bigger than the average expansion of 8 class rooms in inner regional and outer regional schools which costed on average $6.42 million. Chart 6 below shows the average cost per classroom for the expansion projects was the highest in outer regional schools while projects in major city schools had the lowest cost per classroom.





Key findings from the data

- Existing schools are being expanded to increase capacity before new schools are built
- There are more capital projects in major cities and inner regional areas to meet a growing demand for services from population increases
- Schools are on average more expensive to construct in major cities, but they are also bigger and have more capacity. As a result, their cost per student is lower compared to schools built in regional and remote areas.
- The average cost per class room appears to increase with remoteness
- There is no evidence to suggest per capita cost increases with population density

Research on the relationship between per capita cost of service delivery and population density also seems to offer mixed conclusions. A study that analysed the impact of both population size and population density on the per capita cost of public goods provided by German states suggests that there is no cost disadvantage for highly urbanised nor sparsely population regions[1]. But an older study of 247 large counties in the U.S.A appears to indicate that population density has a U-shaped relationship to the cost of providing public services[2]. That is, per capita cost of providing public services reduces when population density increases in sparsely populated areas, but increases again as population density continues to increase. However, both studies are dated and focus on one country only.

[1] Thiess Buttner, Robert Schwager and Dan Stegarescu, Agglomeration, 2004, *Agglomeration, Population Size, and the Cost of Providing Public Services: An Empirical Analysis for German States,* Centre for European Economic Research.

[2] Helen F. Ladd, *Population Growth,* 1992, *Density and the cost of providing public services,* Urban Studies, Vol. 29, No. 2

5.0 Rural road length

Queensland's position

Queensland supports the proposed changes to the assessment of the rural road network:

- use the synthetic network as the base of a re-estimated rural road length measure
- adjust the synthetic network to account for roads connecting to significant landmarks
- adjust the synthetic network to account for lane kilometres

Queensland supports improving the urban roads assessment, but does not currently support applying the proposed approach to the rural road assessment.

5.1 Overview

As part of the 2020 Review, the CGC is reviewing its methodology to assess states' recurrent expenditure on rural roads. The existing rural road assessment relies on a synthetic road network developed for the 2010 Review to calculate states' total road lengths. The assessment was updated in 2015 with new data. This network is used because actual road network is affected by policy choice, which makes a direct comparison of total road length between states inappropriate. The CGC is reviewing the methodology it had developed in 2010 for the synthetic network as well as the impact of updated population data on the synthetic network.

Based on the CGC's analysis, it has proposed to retain the 2015 approach on determining rural road length with some adjustments to ensure the assessment better reflects what states do:

- Retain the synthetic network developed in the 2010 Review with the following modifications:
    - Retain the two-step approach, but revise underlying parameters:
        - The fastest connecting route is included between each neighbouring UCLs of population more than 1,000 (previously 4,000).
        - Small UCLs of less than 1,000 population (previously 400 to 4,000) are connected to the two (previously six) closest UCLs of population over 1,000 (previously 4,000)
    - Adjust the synthetic network to account for connections to
        - significant mines and their nearest port,
        - ports and their nearest UCL, and
        - national parks and their nearest UCL.
    - Adjust the total rural road network to account for lane kilometres of roads with more than two lanes

5.2 Use of the synthetic network

Queensland agrees that a synthetic network continues to be preferable to using actual rural road network. This is because the actual road network remains heavily influenced by policy choice. Queensland agrees with the CGC that the task of adjusting networks to include or exclude relevant roads requires significant judgement calls. This only adds complexity and reduces transparency.

5.3 Adjusting the synthetic network to include connections to significant areas

Queensland supports adjusting the synthetic network to include connections to significant areas.

One deficiency with the synthetic network is it only accounts for roads between population centres. While a significant proportion of the road network serves this purpose, roads are also constructed to connect population centres to recreational and commercial areas.

Not including an adjustment for roads to significant areas assumes Queensland's share of roads to significant areas are the same as its share of total roads on the synthetic road network. However, the total length of roads to significant areas provided by the CGC indicates that the distribution of these roads is significantly different to the synthetic network for some states. For example, Queensland has approximately 23% of the total rural road kilometres in the synthetic road network, but almost 40% of the roads to significant areas.

5.4 Adjustment for lane kilometres

Similar to the adjustment for roads to significant areas, Queensland supports an adjustment to account for rural roads with multiple lanes. However, the construction of multi-lane highways could be subject to policy choice. While the CGC's analysis that the current lane kilometre data does not show any signs of policy influence, the CGC should conduct a periodic review of this data is appropriate to ensure the data remain policy neutral.

5.5 Urban road length

Like actual rural road length, actual urban road lengths are not directly comparable between states because of differences in road classification policies between states. While urban population is currently used as a proxy for the length of urban roads, this may be an imperfect measure and better alternatives should be explored.

Queensland supports improving the urban roads assessment, but does not currently support applying the CGC's proposed method of constructing a synthetic road network to urban roads. Queensland welcomes additional information on the CGC's proposed methodology. The synthetic network for rural roads lends itself very clearly to a network with nodes (UCLs) and connections (roads), and the use of Voronoi Polygons allows for a simple and measurable way of determining which nodes are adjacent. These concepts do not appear to be directly applicable in an urban setting without using significant judgement.

6.0 Urban Transport Consultancy – Satellite cities

Queensland has reviewed the consultant's proposal to determine satellite cities using a threshold of employment self-sufficiency. While the proposal has its merits, it is too simplistic to capture the complex interactions that neighbouring SUAs have on public transport demand and network complexity. This section will expand on Queensland's response to the urban transport consultancy paper in relation to the consultant's proposals for satellite cities.

Consultation with Queensland's Department of Transport and Main Roads has indicated that workforce movement between areas is a large component of the total transport task but there are other factors which comprise a significant portion of transport capacity—for example, transport for tertiary students (with major institutions primarily located within Brisbane) and tourism—which the consultant's proposal ignores. Because of this, the only appropriate measure for determining the inclusiveness of satellite cities is to consider all public transport journeys between SUAs. The proposed workforce dependency does not account for all relevant factors.

To do this, CGC may source transport data from states, which would be more dynamic than Census data, and be available for regular updates. While necessary data may not be available for all SUAs, it should be able to be sourced for all relevant candidates for satellite cities in Australia. Adelaide, Hobart, Canberra and Darwin do not have any neighbouring SUAs, and as a result, detailed transport data would only be required for Sydney, Melbourne, Brisbane and Perth, and their surrounding SUAs.

While not related directly to satellite cities, state-sourced transport data may also be an improvement over the 'method of transport to work' sourced from the ABS. In addition to contemporaneity issues raised in Queensland's original submission, Queensland notes that there were 9.2 million commuters on Census day (of which 14% took public transport), and 1 million employed persons who did not work on Census day. With a significant number of employed persons not accounted for in method of transport to work data, Queensland is concerned this data set is not fit for purpose.

Queensland also has concerns with the 60% working outside and 40% working in the capital city thresholds which are used to determine satellite cities. While the rationale has been outlined that workforce dependency reflects a need for transport between SUAs, the basis for selecting these thresholds is not clear and if lower thresholds would more accurately capture the effect of satellite cities on a city's urban transport task. Queensland requests the CGC provide states with the sensitivity analysis for the thresholds.

Further, the consultant's proposal for satellite cities has suggested the application of a hard threshold, with anything exceeding the threshold being considered a satellite city, and anything not meeting the threshold being treated as a separate city. In practice, there would exist a scaling dependency between neighbouring SUAs as populations grow, with public transport demand gradually growing as dependency between SUAs increase. This is particularly critical to Queensland, as both the Gold Coast and Sunshine Coast are two of Australia's fasted growing SUAs (which is also a trait shared by the other satellite SUAs considered by in the consultant's paper), and it is evident that the public transport task is more complex due to the interaction between these SUAs and Brisbane. Using state public transport data as recommended above, would also overcome the issues associated with the hard threshold, as it could capture the varying levels of public transport dependency between SUAs.