CROSS RIVER RAIL PATRONAGE MODELLING
PEER REVIEW

FOR
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EXECUTIVE SUMMARY

Context

The Cross River Rail (CRR) Business Case was submitted to Infrastructure Australia in June 2016. A peer review was completed by Bitzios Consulting on the modelling undertaken for the Business Case following similar peer reviews completed for the 2014 Bus and Train (BaT) proposal and the 2010 CRR proposal. These studies used the same core transport model which has been progressively updated since 2010 and is now referred to as the *CRR Transport Model*. This report provides a peer review of the document: '*Cross River Rail: Patronage Modelling Sensitivity Tests' (PWC, 4 November 2016)*. It restates the elements of the June 2016 Business Case peer review related to modelling methodologies, base model development outputs and modelling limitations carried into the November 2016 work. It then reviews the influences of the changes to modelling inputs made post-June 2016.

Scope

The findings of this peer review provide information of the suitability of the transport model only but should not be relied upon for explaining the adequacy or otherwise of the modelling results for the CRR project in terms of generating investment grade forecasts. This review has considered:

- The inputs, assumptions and modelling methodologies used;
- The creation, calibration and validation of the 2012 base models and the re-validation of the models in 2015;
- The inputs, processes and outputs for the future year base case models (2026 and 2036);
- The CRR 'Central Case' modelling results considering public transport patronage, daily network statistics, station patronage outputs and user benefit results with the updated modelling inputs post-June 2016;
- Sensitivity testing and scenario testing results; and
- Modelling limitations that should be considered when interpreting the results and when considering the impacts and benefits of the CRR proposal.

Key Findings

This peer review has identified that the CRR Transport Models are fit for describing the likely public transport usage changes and associated transport network performance changes associated with the CRR proposal. The key conclusions drawn from this peer review are:

- The base model used for the latest CRR modelling including its calibration, validation and the development of its 2026 and 2036 base cases is sound;
- The 2012 source model was calibrated at a time when trip making was relatively low in the context of the past 10 - 20 years, particularly for employment-based trips to the inner city, and may slightly under-represent long term relationships between population, employment and travel activity. This effect would be expected to marginally under-represent the modelled benefits of the CRR proposal;
- The modelling shows that the primary benefits of the CRR project will be reduced crowding on the rail system, some attraction of trips to the rail system from private vehicles and from the congested and overcrowded bus system. These findings are reasonable based on the location and number of additional services likely with CRR;
- The use of 'blended' costs skims for 24-hour mode choice modelling is likely to marginally under-represent potential modal shifts due to CRR;
- 'External' travel to southern, western and northern growth areas outside of the model boundary may be under-represented because they are based on population growth alone in these areas. This may marginally under-represent the modelled benefits of the CRR proposal;
- The Inner City public transport and road systems are at capacity in the 2036 AM peak periods in the Base Case whilst there is some residual rail capacity in the 2036 CRR case. This residual capacity has a future value that should be captured; and
- A key limitation of the modelling is the exclusion of the effects of excessive bus vehicle congestion on approaches to, and within, the Brisbane CBD. The CRR Transport Model is also limited in the way it continues to assign traffic to the road network once capacity is exceeded. Whilst these effects would be common to the 'without CRR' and 'with CRR' cases, the ensuing additional rail patronage demand would be better catered for in the 'with CRR' case. This means that the latest modelling understates the patronage differences between the 'without CRR' and 'with CRR' cases.

Influences of the post-June 2016 Model Input Changes

Since the Business Case modelling published in June 2016, changes to model input assumptions have been made. These include:

- Revised population and employment forecasts from the Queensland Government Statisticians Office (QGSO);
- Revised public transport fares in accordance with the South East Queensland "Fairer Fares Package"; and
- A commitment to the European Train Control System (ETCS) – Inner City Project meaning that ETCS is now included in the "without CRR" case.

ETCS-alone was not a modelled scenario in the June 2016 work so no directly comparable results exist for the "without CRR" situation to allow conclusions to be drawn regarding the influence of the latest model input changes.

The most relevant scenario for assessing the influences of the above model input changes is made by comparing "*Scenario 1: Cross River Rail wit ETCS – Inner City*" (June, 2016) to "with CRR" (from the recent modelling). This comparison shows that the "with CRR + with ETCS" 2036 AM peak 2 hr rail patronage volumes have increased from 152,000 pax in the June 2016 modelling to 160,300 pax in the latest modelling. This increase is most likely to be attributable to the fare changes which have improved the competitiveness of public transport in general; and longer distance public transport more specifically. The demographics changes between the previous and most recent modelling are relatively minor. The scale of change in modelling results between the June 2016 patronage results and the latest modelling results is reasonable given the changes to the inputs.

Comparing the "with CRR" to the "without CRR" 2036 daily public transport users shows an additional 29,200 pax per day in the June 2016 modelling. In the most recent modelling with ETCS in the "without CRR" case, the additional public transport patronage "with CRR" was reported as 21,800 pax per day. The reduction in the incremental patronage increase due to CRR in the latest modelling is expected, given the benefits of ETCS essentially drawing down on the benefits of CRR alone.

1. INTRODUCTION

1.1 BACKGROUND

The proposed Cross River Rail (CRR) project is a second inner-city Brisbane River crossing for heavy rail. Its purpose is to increase the capacity of the South East Queensland (SEQ) rail network and provide for rail system redundancy. The project follows both the 2011 CRR project and the 2014 Bus and Train Tunnel (BaT) project. The Business Case for the CRR project was submitted to Infrastructure Australia (IA) in June 2016. Post-June 2016, key input assumptions have been updated and incorporated into the models and additional sensitivity testing has been completed.

1.2 THE CRR PROJECT

The CRR project includes two parallel rail tunnels approximately 5.9km long connecting from the Exhibition loop at Spring Hill to the Beenleigh-Gold Coast Line at Dutton Park, including rail stations at Boggo Road (near the busway station), Woolloongabba (near the busway station), Albert Street in the CBD, underground at Roma Street Station and at the Exhibition site, as shown in Figure 1.1.

Source: Queensland Government

Figure 1.1:   2016 CRR Alignment and Stations

1.3 PREVIOUS REVIEWS

This report provides a peer review of the strategic modelling processes and outcomes for the modelling undertaken for the CRR proposal. It follows peer review reports prepared by Bitzios Consulting, namely:

- '*Bus and Train (BaT) Project Transport Modelling Peer Review*' (June 2014), and
- '*CRR Transport Modelling Peer Review*' (June 2016) for the CRR Business Case modelling,

This report summarises the findings of the previous reviews insofar that they are relevant for the latest modelling and augments the findings of the review of the post-June 2016 modelling for the project.

1.4 SCOPE, LIMITATIONS AND RELIANCE

The scope of this review has focussed on the modelling results reported in the '*Cross River Rail: Patronage modelling sensitivity tests*' (PWC, 4 November 2016) whilst including the relevant findings of previous peer review reports primarily related to the development, calibration and validation of base year models and the methodologies used for future year base case and project case modelling.

The findings of this peer review provide information of the suitability of the transport model only and are not to be relied upon by Building Queensland or any third party for explaining the adequacy or otherwise of the models used for CRR in terms of generating 'investment grade' forecasts.

2. BASE YEAR MODELS

2.1 SOURCE MODEL

The source model for the latest CRR modelling was the 'original' 2010 CRR model. The structure of the model is understood to be essentially the same as the 2010 CRR project model and used an 'incremental' mode choice model which pivots off base case patronage forecasts for the future year or project case. The models determine the incremental changes in patronage using changes in public transport user (generalised) 'costs' compared to private vehicle user 'costs' and walking and cycling 'costs'.

As the generalised costs of each mode change relative to the future base case, trips are shifted between modes to create adjusted person-trip matrices by mode. Changes to public transport person-trips and private vehicle-trips are then assigned to their respective networks.

Key features associated with this process which are worth highlighting in the context of benefits assessments for CRR, include:

- **24 hour mode choice modelling**: Aggregating mode-based generalised costs for the model's four time periods prior to applying the mode choice function does not account for the different value of time sensitivities in each period. For a CBD-orientated forecast, the primary market is peak period travel and any dampening of the generalised cost differences during these periods by averaging them across costs for the rest of the day moves the average cost comparison down the mode choice 'S' curve. This will inevitably reduce the incremental change in public transport demand with the project compared to if mode choice calculations were undertaken by peak period within the model.

- **External area influences**: The use of population growth as the sole basis for travel demand growth between areas outside of the Brisbane Statistical Division (Sunshine Coast, Ripley Valley, Coomera/Gold Coast etc.) and the Brisbane CBD may undervalue the potential agglomeration effects of the growth in the CBD and its increasing relative attractiveness for trip-making from these external areas. This is particularly relevant for the Gold Coast line with demand on this line being directly related to the need for CRR.

- **2012 calibration year Influences**: Whilst the economic 'slow down' around 2011-2012 is not expected to affect the modal choice parameters substantially, it may have an influence in the level of trip activity per household or per job. Using, for example, 20-year average trip rates instead would have the effect of increasing trips on all modes and increasing the decongestion benefits and public transport travel time benefits of CRR.

Overall, the above limitations of the strategic modelling would be expected to result in lower estimates of CRR benefits than would be the case if these limitations were accounted for.

2.2 BASE YEAR MODEL UPDATES

The latest CRR model was based on a source model that was re-calibrated and re-validated in 2016, with a base year of 2015.

Most of the modelling processes and parameters developed in the 'original' 2010 CRR model were retained for the 2015 base year model. The key changes reflected in the 2015 base year model input into the current CRR work were:

- The boarding penalties and mode choice model parameters were updated. These parameters have been reviewed by Bitzios Consulting and accepted;

- A crowding model was introduced. This has been reviewed by Bitzios Consulting and accepted, albeit with the caveat that behavioural responses to crowding may change over time;

- Mode choice parameters were updated. These parameters have been reviewed by Bitzios Consulting and accepted; and

- The general cost 'blending' process was modified to be based on person-hours rather than on person-trips, as recommended by Bitzios Consulting in the June 2014 review.

2.3 CALIBRATION AND VALIDATION

The 2015 base year model relies on the original 2010 base year model calibration, which is accepted given it is the most recently available model calibration.

Limited base model re-validation has been completed to create the 2015 base year model, as follows:

- **Traffic** (or 'Highway' using EMME software terminology)**:** to a 2012 base year because this is when a full traffic count data set was available for. Overall, across all screenlines the highway assignment was well validated. The City Circle screenline is identified as having 60,000 more cars per day modelled versus counted, although the Brisbane River screenline has 14,000 fewer modelled than observed. This suggests an over-assignment between the inner northern areas and the CBD although the scale of this difference is not significant to CRR patronage forecasts or to decongestion benefits calculations.

- **Public transport person-trips:** using boarding and alighting data based on year 2015 detailed 'Go Card' ticketing data for bus, ferry and rail systems plus paper ticket records for rail trips. A 5% escalation factor was used for fare evasion and under-reporting effects. A 'step adjustment' method was used to correct the models to a 2015 base year. This method is valid for incremental mode choice models although ideally the adjustment/deduction matrices used for public transport should be added back in to the other modes (private, walk, cycle) in proportion to their relative shares for each O-D movement. It is unclear whether this has been applied. The overall matching to boarding and alighting totals by period and to line loading profiles in peak periods show an excellent match between the modelled and observed data, as expected given the 'adjustments' methodology employed to achieve validation.

The results extracted for the validated 2015 base year models show a public transport mode share of 6.7% (24 hour) with 513,700 public transport trips per day of which 23% are on rail and 63% on bus. This pattern is quite different in the AM and PM peaks where rail usage is about 70% of bus usage. This highlights the importance of peak period congestion and crowding sensitives when modelling rail-based projects.

The modelling shows that average rail travel speeds across the BSD across the day are 40 kph whereas average bus speed are 26 kph. This has been previously checked by Bitzios Consulting against an independent data set and found to be reasonable.

The modelling shows about 25% more rail trips in the AM peak compared to the PM peak and this seems reasonable given the prevalence of education trips in the AM commuter peak. In the critical AM peak, at key inner city stations (South Bank to Fortitude Valley) only 8% of movements are boarding with the majority alighting, as expected, although this excludes the 10,000 transfers in the two-hour period (boarding and alighting) at these stations.

Overall, the 2015 base year models are concluded to be a valid basis for developing future year base case models.

3. FUTURE YEAR MODELLING

3.1 UPDATED DEMOGRAPHICS

Population, employment and enrolment projections are one of the key model inputs that have been revised since the June 2016 Business Case modelling. These have been provided by the Queensland Government Statisticians Office (QGSO) and disaggregated to model zone level by Transport and Main Roads. The changes are relatively minor compared to the June 2016 Business Case modelling (2%-3% for 2036 demographics). In any case, there is no basis upon which to dispute these demographic inputs.

3.2 UPDATED SERVICE PLANS AND FARES

The commitment by the Queensland State Government to implement the ETCS between Milton and Northgate increases the capacity on the western and northern lines to 24 trains per hour from the 20 trains per hour previously assumed in the June 2016 CRR Business Case (base case) modelling. The rail service plans have consequently been updated in the latest 'without CRR' and 'with CRR' modelling to account for the additional capacity provided by the ETCS. The nett result of the assumption of the ETCS in the 'base case' is that other infrastructure investments required to add capacity to the northern lines have been avoided. The updating of service levels has revealed an increase of 4 trains in the 2026 AM peak and 6 trains in the 2036 AM peak compared to an increase of 1 train in 2026 and 3 trains in 2036 for the 'Central Case' when compared to the service strategy used for the Business Case. This seems reasonable given the scope of the approved ETCS project.

The Queensland Government's revised fare policy results in a fare reduction for all public transport users with the change to a new eight-zone system and the fare 'freeze' in 2017. These policy changes appear to have been implemented appropriately and the assumption that fares will most likely rise with CPI in the future is reasonable.

3.3 ASSUMED FUTURE YEAR PROJECTS

The future year base project assumptions include a range of rail, bus and road projects with a mix of 'committed' and 'likely' projects included. It appears that a relatively low investment in future transport infrastructure is proposed through to 2036 and this is considered a reasonable assumption. In any event, the road and rail projects in the network upgrade assumptions list are generally neither competing nor complimentary with the transport markets serviced by CRR and would be expected to have little effect on overall network performance statistics when comparing the base case and the project cases (the 'Central Case' and other sensitivity tests).

3.4 ECONOMIC ASSUMPTIONS

The economic assumptions in the modelling appear appropriate and the value of time and parking charge increases over time are consistent with current trends. Vehicle operating costs are assumed to grow at CPI for the modelling horizon (i.e. out to 2036) and this is a pragmatic assumption given uncertainties around operating costs as technologies and energy sources change. The long term trends are that fuel price has increased with CPI however there are various forecasts for fuel supply and price into the future as well as increasing proportions of electric vehicles that may warrant further sensitivity testing.

There are also various opinions regarding the influence that autonomous vehicles and mobility as a Service (MaaS) will have in the future for either increasing or reducing road network travel times. Whilst the implementation of driver-assisted and fully autonomous vehicle technologies in some locations for some parts of the vehicle fleet is possible by 2036, there is little consensus yet regarding potential impacts on public transport usage. Regardless of the uptake of autonomous vehicles it remains probable that there will continue to be more demand for access to the Brisbane CBD by private vehicles than road capacity can provide for and that public transport will remain a more space and time efficient mode for the mass movement of people to key destinations.

3.5 PUBLIC TRANSPORT PATRONAGE OUTCOMES FOR THE CENTRAL CASE

The latest CRR patronage modelling results which incorporate the state government's ETCS project commitments, updated demographic forecast and an updated fare scheme show that compared to the without CRR case, the CRR project generates approximately 9,000 more passengers per day in 2026 and 23,000 more passengers per day in 2036 compared to the base case. When considering the Greater Brisbane area across an entire day, the relative changes in public transport modal share are relatively small, which is not unexpected given that geographical scale of the model and the diversity of trip patterns outside the Brisbane CBD. These results are similar to, but lower than, previous patronage forecasts associated with a second heavy rail crossing of the Brisbane River primarily due to the influence of the ETCS project assumed in the base case and slightly lower population and employment forecasts.

Whilst accommodated in the modelling to some extent there is a lack of sensitivity in the CRR Transport Model (and most strategic transport models more generally) to excessive congestion, additional delays to bus passengers and overcrowding effects. It is highly probable that the modal shifts reported are lower than the actual patronage increases that would be realised on the rail system. For example, the modelling suggests a doubling of bus patronage by 2036, which could not be accommodated in the Brisbane CBD given current bus access, stopping and storage constraints. Similarly, in peak periods, many radial major road links are shown to be well over capacity at levels which are unlikely to be tolerated. These effects are likely to 'drive' many more travellers to the rail system given its 'right of way' priority access.

Overall, the reported rail-based patronage increases 'with CRR' should be interpreted as lower-bound values given the strategic modelling limitations of excluding excessive bus congestion on approaches to, and within, the Brisbane CBD and due to the ability in the strategic modelling to over-assign traffic to the road network even once capacity is exceeded on multiple links in a corridor. Whilst these effects would be common to the 'without CRR' and 'with CRR' cases, the ensuing additional rail patronage would be better catered for in the 'with CRR' case.

3.6 STATION-SPECIFIC RESULTS FOR THE CENTRAL CASE

The latest CRR modelling reveals:

- A shifting role for Roma Street Station with CRR due to a very large proportion of transfer trips at this station. CRR provides faster and more direct access to this station from the south for interchanging with the Busway and other rail services;
- Reduced growth pressure at Central Station with the Albert Street Station under CRR taking some of its demand. This would be expected to delay the need to for upgrading pedestrian access tunnels to/from Central Station platforms; and
- High levels of interchanging between Busway and CRR at Boggo Road Station and the importance of the pedestrian connection assumptions at this interchange for attracting these transfers.

The station-specific results appear reasonable, are consistent with previous modelling and emphasise the potential roles of CRR as providing an opportunity to mitigate South-East Busway bus congestion effects through the potential for bus/rail interchanging at Boggo Road and/or Woolloongabba Station

3.7 PUBLIC TRANSPORT STATISTICS FOR THE CENTRAL CASE

The primary benefits of CRR are to 'base case' public transport users in improving travel time and travel time reliability on the rail system. This involves a combination of drawing a proportion of longer distance bus trips onto rail and moving private vehicle trips onto public transport. Even relatively small shifts in longer distance private vehicle trips to rail trips also introduces reasonably significant de-congestion benefits. These effects are expected and are reasonable outputs from the modelling. There are also benefits due to reduced over-crowding due to more trains in the 'with CRR' case although the degree to which this translates into an economic benefit is difficult to quantify. Also, as expected, the latest CRR modelling suggests that the project encourages more, longer distance travel onto the rail system, reflecting the travel markets where heavy rail has a greater competitive advantage over the private vehicle.

3.8 PUBLIC TRANSPORT USER BENEFITS WITH THE CRR CENTRAL CASE

The latest modelling results suggest that the majority of public transport user benefits relate to crowding relief, whilst there are in-train travel time savings for selected rail movements to/from the CBD. These results need to be considered in the context of the limitations of the strategic modelling. For example, the modelling is forecasting a doubling in bus patronage between 2015 and 2036 but with no significant bus entry-capacity upgrades, or bus storage upgrades in the CBD. This suggests that either the existing bus fleet will be severely overcrowded, or, if more buses are added, then these buses will face bus congestion on approach to and within the CBD. In both cases, if these effects could be appropriately captured in the modelling, this would inevitably result in a shift of a greater proportion of patronage from bus to rail, and particularly to CRR in the 'with CRR' case given the crowding relief and travel time benefits offered.

3.9 PRIVATE TRANSPORT USER BENEFITS WITH THE CRR CENTRAL CASE

The traffic 'decongestion' benefits provided by the project are a significant component of the benefits provided by CRR. This is not unusual for the modelling of radial public transport projects in congested corridors particularly considering the relationships between traffic flow and delay in congested networks and the delay reductions that occur when traffic flow is even slightly reduced.

3.10 INFLUENCES OF THE POST-JUNE 2016 MODEL INPUT CHANGES

As noted above, three key model inputs have been revised since June 2016. These are:

- Revised population and employment forecasts from the QGSO;
- Revised public transport fares; and
- A commitment to ETCS for the western and northern corridors.

Direct comparisons between the June 2016 and post-June 2016 model outputs for the "without CRR" are complicated by the recent assumption that ETCS is part of the "without CRR" case. ETCS alone was not contemplated in the previous modelling as a scenario and so no comparative results exist for the "without CRR" situation to allow conclusions to be drawn regarding the influence of the latest model input changes.

The most relevant scenario for assessing the influence of the model input changes from the June 2016 work to the more recent work is: "*Scenario 1: Cross River Rail wit ETCS – Inner City*" (June, 2016) compared to "with CRR" (recent modelling). The "with CRR + with ETCS" 2036 AM peak 2 hr rail patronage volumes have increased from 152,000 pax to 160,300 pax. This increase is most likely to be attributable to the fare changes which have improved the competitiveness of public transport in general, and longer distance public transport more specifically. The demographics changes between the previous and most recent modelling are relatively minor. Accordingly, the scale of change between the June 2016 patronage results and the latest modelling is reasonable given the changes to the inputs.

Also, comparing the "with CRR" to the "without CRR" 2036 daily public transport users shows an additional 29,200 pax per day in the June 2016 modelling. In the most recent modelling with ETCS in the "without CRR" case, the additional public transport patronage "with CRR" was reported as 21,800 pax per day. The reduction in the incremental patronage increase due to CRR in the latest modelling is expected, given the benefits of ETCS essentially drawing down on the benefits of CRR alone.

4. SENSITIVITY TESTING AND SCENARIO TESTING

4.1 SENSITIVITY TESTING

The latest CRR modelling has assessed four 'Sensitivity Tests' on key assumptions/input parameters, as follows:

- **Test 1**, value of time growth: at a rate of 0.75% p.a. rather than 1.5% p.a. in the Central Case;
- **Test 2**, vehicle operating costs: using the Transport for NSW values rather than the Australian Transport Assessment and Planning Guidelines (2016) values used in the Central Case;
- **Test 3:** excluding projects that have no funding commitment yet compared to the inclusion of the inclusion of projects reasonably expected to be constructed by 2026 and by 2036 in the Central Case; and
- **Test 4**: assuming half the growth in rail demand compared to the 2026 and 2036 Base Cases and similarly for the 2026 and 2036 Central Cases.

Test 1 essentially reduces the elasticity of modal choice between public transport and private vehicle and between bus and train because the reactions to travel time improvements are effectively dampened. Given that the majority of the effects related to CRR are associated with crowding relief and some switching from bus to train, the very small changes in patronage results in this test are as expected.

The **Test 2** results published in the November 2016 modelling report focus on the changes in private vehicle operating costs rather than the effects on public transport patronage. The results show a substantial saving in vehicle operating costs which would be expected to diminish the usage of public transport, heavy rail and CRR more specifically. The effects of this test are expected to be far greater on the economic benefits of reducing private vehicle travel than they are on the changes in the volume of vehicles under this test.

The **Test 3** results have not been published due to convergence issues with the model. The level of traffic demand in the network is such that there is a clear mismatch between travel demand (or assumed development growth) and network supply. In practice, it is unlikely that the levels of congestion contemplated in this theoretical test would ever be realised. Without additional transport infrastructure and capacity there would be a broad range of land use and transport system responses. As congestion approached these critical levels this would inevitably mean that land use and economic growth would slow. Many of these system responses are not able to be determined using conventional strategic transport models.

Test 4 was not run in the CRR Transport Model. It is agreed that this test is a highly unlikely situation given the level of underlying travel demand growth that inner Brisbane has the potential to generate as per state government's population and employment projections. In fact, as travel demand grows, it is expected that there will be disproportionately much greater growth in 'right of way' public transport (such as rail and busway) because of the significant travel time benefits it provides compared to private vehicles. When also considering the radial nature of the public transport system in Brisbane a much higher rate of patronage growth on radial busway and heavy rail services than regional population and employment growth is entirely plausible, as is a faster rate of growth on the rail system and busways compared to previous the long-run historic growth rate.

4.2 SCENARIO TESTING

One scenario was tested in the latest CRR modelling and this represented the combination of Sensitivity Tests 1 and 2 described above. No commentary is provided on this Scenario Test as it was, from a modelling results perspective, identical to Sensitivity Test 1.

Overall, the sensitivity testing undertaken did not reveal results that would reduce the confidence in the fitness of the CRR Transport Model for the assessment of the CRR proposal.

5. OTHER CONSIDERATIONS

5.1 BENEFITS EXTRAPOLATION

The 2036 Base Case and the 2036 CRR Central Case results reveal that the Inner City public transport system is at capacity on approach to South Brisbane station in peak periods (AM seated load factor > 1.5), as is the Inner City road system. The modelling also shows some residual AM peak rail passenger capacity with CRR in 2036.

On this basis, extrapolation of benefits between 2026 and 2036 out to 2046 would appear to be beneficial (for the CRR project) with the potential for longer term benefits of the project to be significant; although it is recognised that these longer term benefits will diminish when translated to Net Present Values. Alternatively, the relative 'spare' rail passenger system capacity in 2036 could be valued for a more equitable comparison between 2036 'without CRR' and 'with CRR' cases.

6. CONCLUSIONS

6.1 KEY FINDINGS

The latest CRR modelling follows on from the CRR Business Case modelling reported in June 2016, the modelling undertaken for the 2014 Bus and Train (BaT) project and the modelling undertaken for the 2010/11 CRR proposal. The latest modelling includes updates to demographic inputs and to the fare system as well as including ETCS in the "without CRR" case given its recent approval.

In general, the base model used for the latest CRR modelling including its calibration, validation and the development of its 2026 and 2036 base cases is sound. The models are fundamentally based on the CRR Transport Model used for the CRR Business Case and the modelling results for the latest modelling appear reasonable and comparable to the previous modelling undertaken for the project.

The results suggest that with the approval for implementation of the ETCS by state government, the primary benefits of the CRR project are associated with reduced crowding on the rail system, some attraction of trips from private vehicles and some attraction of longer distance trips from the congested and overcrowded bus system. The change sin patronage outputs from the previous (June 2016) modelling to the most recent modelling are reasonable and appear to be associated mostly with fare changes rather than changes to demographic assumptions.

There are limitations with strategic transport modelling in highly congested conditions as expected in 2026 and 2036 in Inner Brisbane which should be seen as 'upside risk' to patronage increases due to CRR. Unlike road network modelling, which uses capacity-constrained assignment of trips to the network, the public transport modelling does not. A key limitation is the exclusion of the quantification of excessive bus vehicle congestion on approaches to, and within, the Brisbane CBD. Longer bus travel times, if considered, would increase the shift to the rail system where shorter travel times and less crowding exists. Also, the CRR Transport Model will over-assign traffic to the road network even once capacity is exceeded on multiple links in a corridor. Whilst these effects would be common to the 'without CRR' and 'with CRR' cases, the ensuing additional rail patronage would be better catered for in the 'with CRR' case. This would inevitably result in greater patronage differences between the 'without CRR' and 'with CRR' cases.

Other key aspects for consideration when interpreting model outputs include:

- the 2012 source model was calibrated at a time when trip making was relatively low in the context of the past 10 - 20 years, particularly for employment-based trips to the inner city, and may slightly under-represent long term relationships between population, employment and travel activity;

- the use of 'blended' costs skims for 24 hr mode choice modelling is more likely to under-represent potential modal shits due to CRR than over-represent them, particularly with peak spreading continuing to occur and with most of the rail-related benefits are realised in the peak morning two hours and the peak afternoon two hours;

- crowding and crowding effects mostly apply in the morning and evening peak periods and dissolving these disincentives to using the 'without CRR' public transport network by using 24 hour blended skims undervalues the importance of peak period capacity effects on constraining peak period public transport demand (and hence magnifying the capacity/crowding relief provided by CRR);

- assumptions regarding 'external' travel to southern, western and northern growth areas outside of the model boundary are critical and trips to/from these areas may be under-represented if based on population growth alone due to the effects of employment growth in the CBD; and

- The Inner City public transport and road systems are at capacity in the 2036 AM peak periods in the Base Case whilst there is some residual rail capacity in the 2036 CRR case. This residual capacity has a future value that should be captured.

6.2 FIT FOR PURPOSE STATEMENT

The modelling methodology, level of validation and modelling results are fit for the purpose of assessing the benefits of the CRR project with due consideration of the limitations of link-based strategic transport modelling in congested urban networks. In this context, the 'with CRR' travel time benefits, the CRR crowding reduction benefits and hence the patronage benefits should be interpreted as lower-bound values.