PUBLIC TRANSPORT *and COVID-19*

HOW TO TRANSITION FROM RESPONSE TO RECOVERY

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KEY CONSIDERATIONS IN TRANSITIONING TO THE NEW NORMAL

The progression of and recovery from COVID-19 will occur in stages, which we have identified in a series of stages from a public transport supply perspective. These are: Stage 0 – Pre-COVID-19; Stage 1 – Lockdown; Stage 2 – Transition and Stage 3 – New Normal.

- The highest priority for public transport during Stage 2 – Transition will be to maintain the **safety of drivers, the frontline workforce and passengers.** Measures such as the removal of cash fares, rear-door boarding, use of Personal Protective Equipment (PPE) and increased cleaning will continue to play an important role for some time.
- COVID-19 will have changed many **people's attitudes towards using public transport and their associated behaviours.** Understanding how, where, when and why people will want to travel in future will be fundamental as a starting point to planning for an effective economic recovery, to both encourage people back to public transport and support the ongoing development of the future transport system to deliver successful city objectives.
- Three transition scenarios with varying degrees of distancing were assessed. They may require **public transport to operate at most between 30% and 50% of total capacity**, with specific issues for different modes.
- In busy metropolitan areas which currently operate with standing room only at peak times, **both demand and supply side measures will be needed during Stage 2 – Transition**. This could include: staged return of the workforce (e.g. *A, B and C teams*), peak spreading, promoting a shift to active transport supported by additional infrastructure and a targeted increase in public transport services.
- **Operational considerations** are important for passenger behaviour at stops, stations and on vehicles and promoting compliance. Changes to boarding and alighting locations, one-way flows, floor markings and additional operational staff may be required. **Timetabling** may need to be adjusted to account for longer passenger loading and unloading times.
- Stage 2 – Transition approaches will need to **be adaptable and flexible**, to respond rapidly as travel patterns and public health advice changes, based on up-to-date travel and health data.
- There are many unknowns and questions over how COVID19 will impact the wider **future of our transport systems**. The huge changes seen in recent months offer an **opportunity to re-evaluate and re-prioritise**. Congestion and emissions have reduced, people have more time with their families and are engaging more with their local places and communities. There is great potential to lock in these benefits, so some good comes from the challenging situations which COVID-19 has created.
- It is critical that people feel safe returning to public transport, so that it remains at the heart of transport systems that create **successful cities and thriving places.**

1. INTRODUCTION

Developed for the Australian context, this white paper builds on WSP's earlier work in North America - ***COVID-19 Transit Operations, Public Transit Responses to Coronavirus Situation*** (March 2020), which sets out the impact of the pandemic on transit operators (particularly in North America), and their responses, with a focus on modifications to services and cleaning procedures. These responses are very much applicable to Australian cities and others around the globe, as we implement measures to control the spread of COVID-19.

In the medium term, as cases become controlled, we know there will be a return to a new kind of 'normal'. The purpose of this white paper is to help inform discussions and guide decisions on the role and operation of public transport to support the recovery of Australian city functions once isolation and physical distancing measures can be progressively relaxed. By leveraging the collective work of WSP teams around the world, we have created a framework for assessing the capacity of different modes of public transport under various recovery scenarios. This will help to ensure that public transport remains a critical part of the transport system, supporting successful cities and thriving places.

Although this white paper has been developed in the Australian context, the capacity calculations and analysis framework are applicable to public transport systems globally.

COVID-19 BACKGROUND AND CONTEXT

COVID-19 is an infectious disease that is caused by the novel coronavirus strain of Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2). This disease was initially identified in December 2019 in Wuhan, China and has since spread globally to over 210 countries in the beginning of 2020. The World Health Organization (WHO) declared the spread of COVID-19 as a pandemic on 11 March 2020.

- COVID-19 symptoms can appear to be similar to the common cold or flu. Reported illnesses have ranged from mild symptoms to severe illness and death. These symptoms may appear 2-14 days after exposure. Symptoms include fever, cough, shortness of breath and possibility of pneumonia in both lungs.
- The virus is thought to spread mainly from person to person between people who are in close contact with one another (within 1.5 – 2 metres) through respiratory droplets produced when an infected person coughs or sneezes, which enter people's bodies via the mouth or nose. This can happen directly, or via touching contaminated surfaces.
- COVID-19 transmission continues to proliferate with a rapid global increase in the reported number of cases.

In response, countries have introduced mitigation strategies, including quarantine of infected and high-risk patients; encouraged self-isolation; 'physical distancing' measures; closure of 'non-essential' services; increased hand-washing and improved hygiene and cleaning practices. In Australia, people who are travelling outside their homes have been told to maintain a distance of 1.5m from all other people who are not part of their household.

Public transport systems are critical to ensure access to essential goods and services, particularly for those who cannot travel by other modes. However, they are also considered a high-risk environment for the spread of COVID-19 due to a number of factors, including:

- Large volume of individuals confined to shared common space for extended periods, with limited ventilation.
- User groups of public transport include the elderly and individuals with mobility impairments, who are at high risk from the virus.
- Numbers of surfaces which many people will touch, which can lead to the spread of the virus (e.g. handrails, doors, buttons, straps, farebox, ticket kiosks, etc.).
- No control or method of pre-screening individuals before boarding public transport.

Our previous white paper provided recommendations for immediate public transport operations to address these issues, to support the safe continuation of transit services.

IMPACT ON PUBLIC TRANSPORT

Continuation of public transport is critical to connect people to jobs, home, schools and essential services, particularly for those who cannot travel by other modes. However, the need for both physical distancing and measures to ensure driver safety impacts the capacity of those services.

As expected, given the Australian Government advice to limit non-essential travel, both public transport ridership and private motor vehicle travel have substantially decreased in the wake of the global pandemic. As Figure 1 shows, public transport usage across Australia started decreasing sharply and steadily in mid-March 2020 as COVID-19 cases rose and governments introduced strict travel restrictions[1]. Since early April 2020, public transport usage is resting at about 80% less daily usage compared to January 2020.

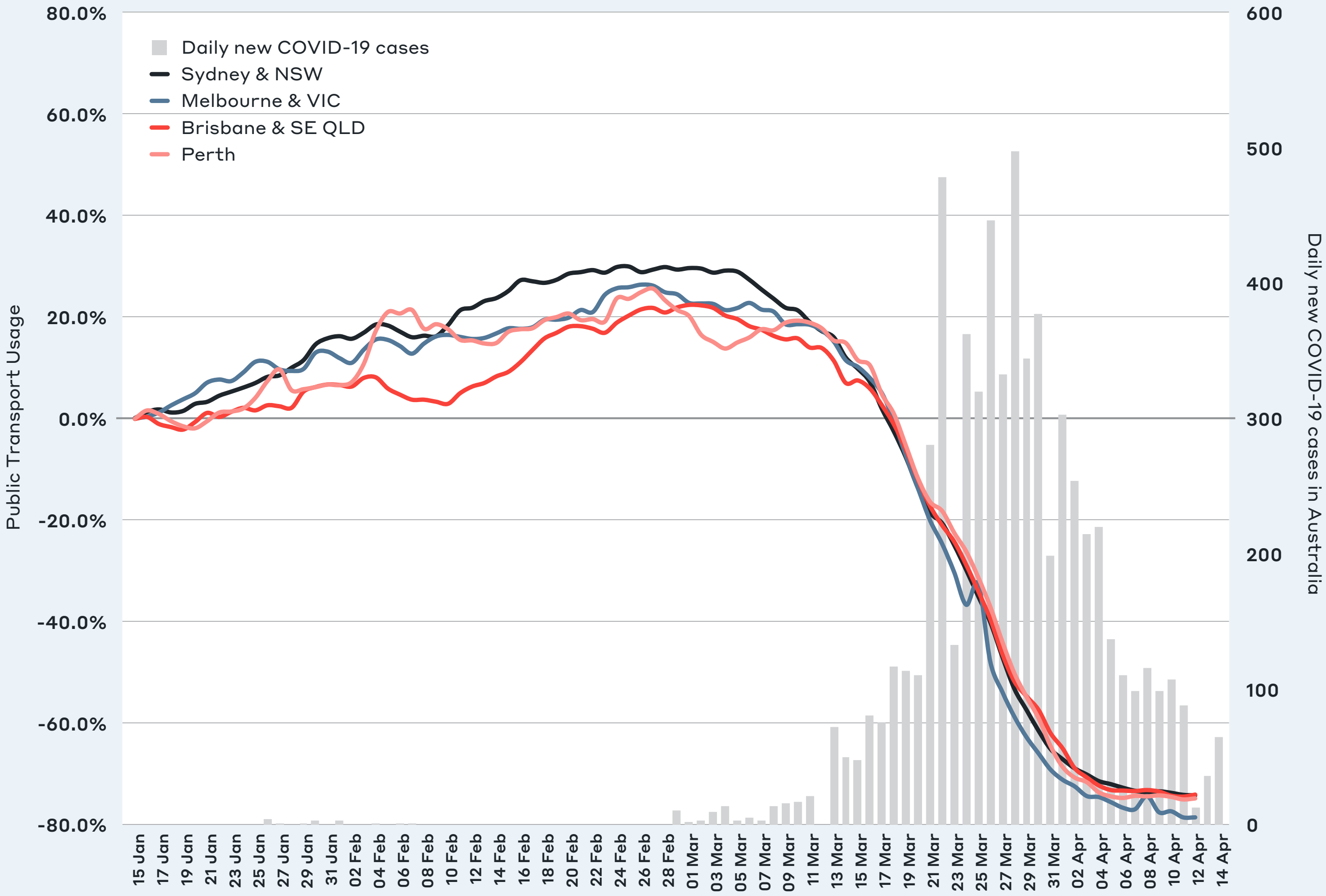


Figure 1 Change in public transport usage in Australia between 15 January and 14 April 2020

Sources Moovit, www.moovit.com, Moovit's app usage of the previous 7 days in each city compared to a typical week before the outbreak began (the week prior to 15 January). COVID-19 Dashboard by the Centre for Systems Science and Engineering (CSSE) at John Hopkins University (JHU)

[1] The increase in travel between the 15 January baseline and early March reflects the geographical context of Australia, where school and summer holiday periods fall in January and cause lower volumes of travel, particularly for work purposes.

IMPACT ON PUBLIC TRANSPORT cont.

As cities begin to recover from COVID-19, patronage numbers are likely to once again increase. It is essential for our cities and places that public transport remains the backbone of the transport system. Post COVID-19, there could be significant changes to travel behaviours. Policy makers have the opportunity to lock in the benefits from some positive habits, such as home working and video-conferencing, that reduce the need to travel. However, other changes, such as a reliance on single occupancy car trips as a way to avoid contact with others, could potentially lead to a significant increase in congestion in the short term. Public transport services and capacity levels must be pro-actively planned to support and encourage passengers to return in a progressive and safe manner.

PAPER OUTLINE

The progression of and recovery from COVID-19 will occur in stages, which can be outlined as follows from a public transport supply perspective:

- **Stage 0 - Pre-COVID-19:** Previous travel patterns prior to COVID-19.
- **Stage 1 - Lockdown:** The situation as of April 2020 across Australian States and Territories with physical distancing measures, restrictions on activity, and business closures. There has been a substantial reduction in public transport patronage, with people only using it for essential journeys. Services are largely running at the same frequencies as in Stage 0 to allow distancing to be maintained. Additional safety measures are in place to protect drivers and passengers (e.g. rear boarding and alighting only).
- **Stage 2 - Transition:** Restrictions on travel will be progressively eased. Shops and most businesses will begin to reopen, supporting safe societal and economic recovery. Prior to widescale immunity, there will still be a range of precautions in place and close monitoring to ensure that COVID-19 does not return. People will gradually return to public transport, provided it is safe to do so and they feel confident that any risks have been mitigated. Transition will take place over different time periods in different places. Progressive relaxation of restrictions, careful monitoring and responsive management of public transport services will be important to endure a secondary outbreak of the virus is avoided. Once there is sufficient population immunity or the virus is eliminated, restrictions can be lifted (Stage 3).
- **Stage 3 - New normal:** COVID19 is no longer a major concern. This may come about through various 'end game' approaches which will vary internationally (e.g. eradication or immunity). Travel patterns will likely have changed from Stage 0 due to behaviour changes associated with societal shifts which happened in previous stages. The new normal will take different forms across places and transport modes.

This paper is focused on Stage 2, transition. We consider the supply side implications for public transport provision, rather than an assessment of returning demand for travel. At this stage, the medium- and longer-term impacts of COVID-19 on travel demand are unclear. Cities which recovered from the SARS virus showed a return to close to previous travel levels. Interventions such as updates to government health and transport policy, the decisions of business leaders, and priorities of individuals mean there is the potential for this demand to be very different in various jurisdictions. There are opportunities to make interventions now which can have lasting positive impacts on the future of travel and our cities.

We recommend decision makers base public transport provision for the transition phase on understanding human behaviour and capacity considerations, whilst remaining adaptable to scaling and adapting service patterns as demand increases and changes. Some principles can be borrowed from planning public transport for special events and civic celebrations with unconstrained and sometimes unpredictable demand (i.e. non-ticketed events).

Section 2 will explore what the capacity impacts of different physical distancing measures for different modes of transport. Section 3 will apply these capacity assessments to public transport networks in a capital city (4.7m. population) and a regional city (0.5m population) in New South Wales, Australia. Section 4 discusses what this may mean for our cities and highlights some important wider issues to be considered. Section 5 provides some conclusions.

2. PUBLIC TRANSPORT CAPACITY DURING TRANSITION

Currently, governments around the world are imposing 'social' distancing'[2] restrictions in response to COVID-19. While in most cases these restrictions do not apply specifically to public transport modes, the principles and the need for distancing during the pandemic and subsequent recovery can form a basis for understanding impacts on capacity.

As the medical needs for distancing may diminish over time, peoples' previous travel behaviours are likely to change for numerous reasons, including their experience of distancing in a pandemic and fear of contracting COVID-19. These changes are likely to be psychological, physical and technological in nature. For example, the abundance of caution relating to the close proximity to others may affect future travel choices towards personalised modes. This may also physically move people away from public transport modes to personal modes of transport. A continued uptake of active modes such as walking, running and cycling would offer positive health and environment benefits, whereas an increase in private car trips could lead to increased congestion on road networks. Additionally, there have been rapid updates and take-up of new technologies which have now increasingly become mainstream (e.g. multiple person video conferencing), as well as increased support for working from home, which may result in less need to travel. These changes are likely to impact every facet of how the community congregated in public spaces and previously used public transport.

[2] Within this paper we use the term 'distancing' rather than social distancing, to reflect the physical distancing between people.

TRANSITION SCENARIOS FOR PUBLIC TRANSPORT

To understand the likely impact of the transition stage on public transport capacity, three scenarios have been identified which consider varying levels of physical distancing. Scenario 1 is based on Australian Commonwealth Government guidance as of 27 April 2020, with progressive relaxation of requirements in Scenarios 2 and 3.

Scenario 1

Strict distancing:

1.5m between people.
No standing.

Scenario 2

Moderate distancing:

No person sitting directly next to, behind, or diagonally across from another. At least 1m distance between people.

Scenario 3

Relaxed distancing:

Allows for a gap between people on each seat row and at least 1m distance between people facing one another.

An additional scenario of one person per four square metres in line with Australian Government restrictions in enclosed spaces was considered. However, this had substantial capacity impacts and was determined to be difficult to control and manage in the public transport context.

All the scenarios outlined above could be enforced through in-vehicle markings and taping as required. Scenario 3 would involve some level of standing on all modes. It should be noted that standing passengers will need to hold onto supports and handrails for safety, so will need to have high levels of confidence that these items are being regularly cleaned and may want increased access to hand sanitisers provided on their trip.

These scenarios also reflect the potential stages of a post COVID-19 period and reflective of likely human behaviours towards public transport use. While the full effects of the social and behavioural aspects of the pandemic are still emerging, it is likely that a period of uncertainty in relation to ongoing transmission will affect people's behaviours and decision-making.

If the virus is confirmed as eradicated locally within island countries such as Australia and New Zealand, there is potential for relatively rapid progression through these scenarios, followed by a return to Stage 3 new normal without distancing restrictions on public transport. This is not included as a separate scenario as it would likely involve some of the scenarios outlined as a precaution while testing confirms eradication, followed by a lifting of all distancing restrictions on public transport. Operational considerations around driver safety, platform, station and stop management, passenger behaviour and so on are discussed in Section 4.

As well as customer safety, ensuring safety of the frontline workforce is critical, to minimise their exposure to the virus. Physical distancing measures can be used to protect staff, including driver shields to separate drivers from customers and changes to boarding and alighting arrangements. These are a matter of urgency and should continue until Stage 3 – new normal. Operational considerations around staff safety are discussed in more detail in Section 4.

VEHICLE CAPACITY ANALYSIS BY MODE

The following pages and figures depict floor plans for various public transport modes from different Australian capital cities and how capacity would be reduced in each of the scenarios. While these are based on one specific type of vehicle for each mode as an illustration, the percentage reduction in capacity is likely to be similar across vehicle types used in other cities, in Australia and internationally. This consistent-format approach provides an analysis framework to understand the capacity and network implications of an extended period of distancing during the COVID-19 transition period. In all examples, we have allowed appropriate distances for minimal interaction with operators to ensure workforce safety.

BUS

Bus services form the cornerstone of most public transport networks around Australia and the globe. For example, Brisbane buses transported over 117 million people in 2018/19 and passenger numbers have shown continued growth since 2016. In restricted capacity and operation, buses will be significantly constrained due to their limited floorspace and tight seating arrangements compared to other public transport modes. To ensure operator safety, the front doors would be closed with rear-door loading and unloading only. A calculation of bus passenger numbers by scenario is shown below.

SCENARIO 1 - STRICT DISTANCING (9% OF TOTAL CAPACITY)

SCENARIO 2 - MODERATE DISTANCING (17% OF TOTAL CAPACITY)

SCENARIO 3: RELAXED DISTANCING (28% OF TOTAL CAPACITY)

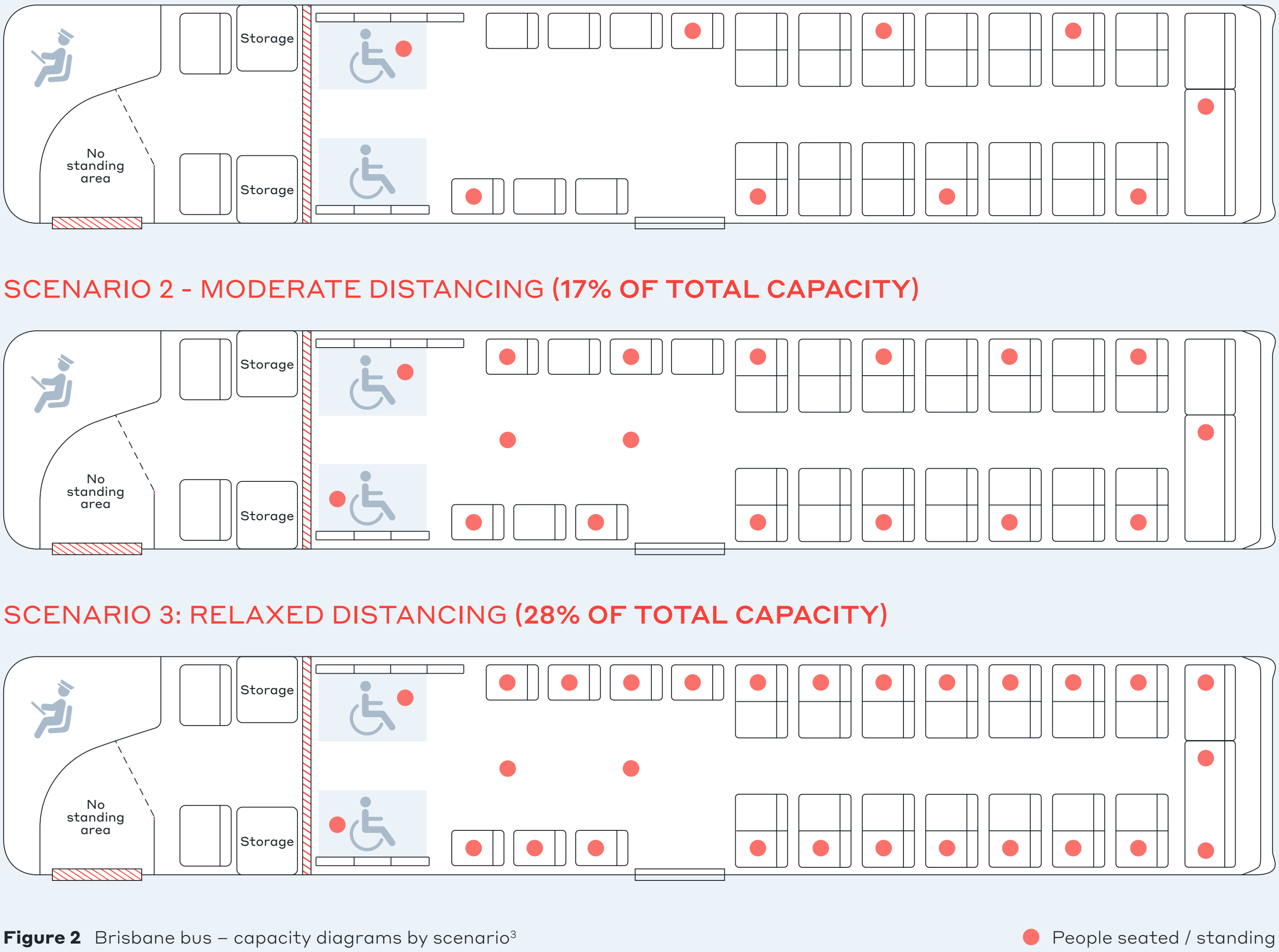


Figure 2 Brisbane bus – capacity diagrams by scenario[3]

[3] Notes: Layout is based on Scania K310 operating in Brisbane

BUS

Distancing measures significantly constrain capacity on bus services. This is mainly due to their narrowness and close seating which restricts the ability for physical distancing between passengers, particularly on raised seating areas at the rear of the vehicles. In the example shown, total capacity (seating and standing) is reduced to between 9% and 28% across the scenarios. This is due in part to the larger number of permitted standees which varies within other jurisdictions.

	TOTAL PASSENGERS	% OF SEATED CAPACITY	% OF TOTAL CAPACITY
Scenario 1 – Strict Distancing	9	16%	9%
Scenario 2 – Moderate Distancing	17	32%	17%
Scenario 3 – Relaxed Distancing	28	53%	28%
Seated capacity	**53**	-	**54%**
Total (seated and standing) capacity	**98**	-	**100%**

Table 1 Brisbane bus – capacity summary by scenario

Bus Design

Trains and light rail vehicles are operated with isolated driver compartments. However, transit buses use split door or open space for the driver area. This is to allow for bus drivers to interact with passengers as part of the fare collection and customer service helping clients with various activities like navigating the system and locking mobility devices. As a result of COVID-19, this interaction has been limited with rear boarding and driver distancing for safety reasons.

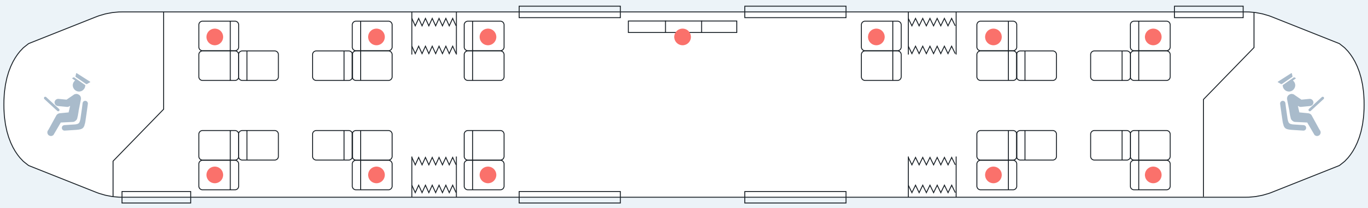
Many agencies across the globe are introducing temporary driver barriers and compartments. In the next generation of vehicle specifications, manufacturers and transport operators may have an increased focus on specifying more enclosed driver areas, to improve resilience in case of any future public health events. Other hygiene considerations include using copper based or stainless-steel stanchions, rather than plastic, and alternative seating materials.

TRAM/LIGHT RAIL

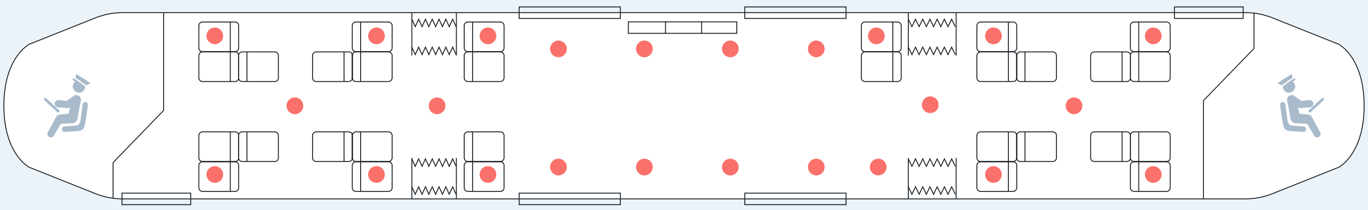
Trams and light rail services have been a feature of Australian cities for over 100 years. While well established in Melbourne, Adelaide and the Gold Coast, light rail services have recently been introduced in Newcastle, Canberra and Sydney.

A major feature of modern trams is the reduction in seating capacity in favour of additional standing room to provide for greater overall capacity. As such, restrictions, and/or natural human behaviour which results in increased distance between customers, is likely to be felt more greatly on these services. A calculation of tram / light rail passenger numbers by scenario is shown below. The following example is based on trams operating in Melbourne, which has the most extensive network in the world and carried over 200 million passengers in 2018-19[4].

SCENARIO 1 - STRICT DISTANCING **(13% OF TOTAL CAPACITY)**



SCENARIO 2 - MODERATE DISTANCING **(27% OF TOTAL CAPACITY)**



SCENARIO 3: RELAXED DISTANCING **(29% OF TOTAL CAPACITY)**

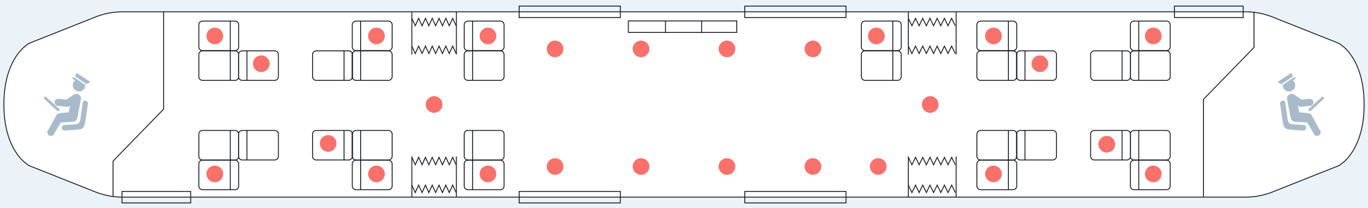


Figure 3 Melbourne tram – capacity diagram by scenario[5]

● People seated / standing

[4] Yarra Trams Annual Report, 2019
[5] Notes : Layout is based on Yarra Tram operated D1 Combino

TRAM/LIGHT RAIL

In the example shown, trams experience a significant reduction in capacity on all scenarios. This is particularly of note in scenario 1 where standing capacity is completely removed, which results in an immediate reduction in over 60% of available capacity.

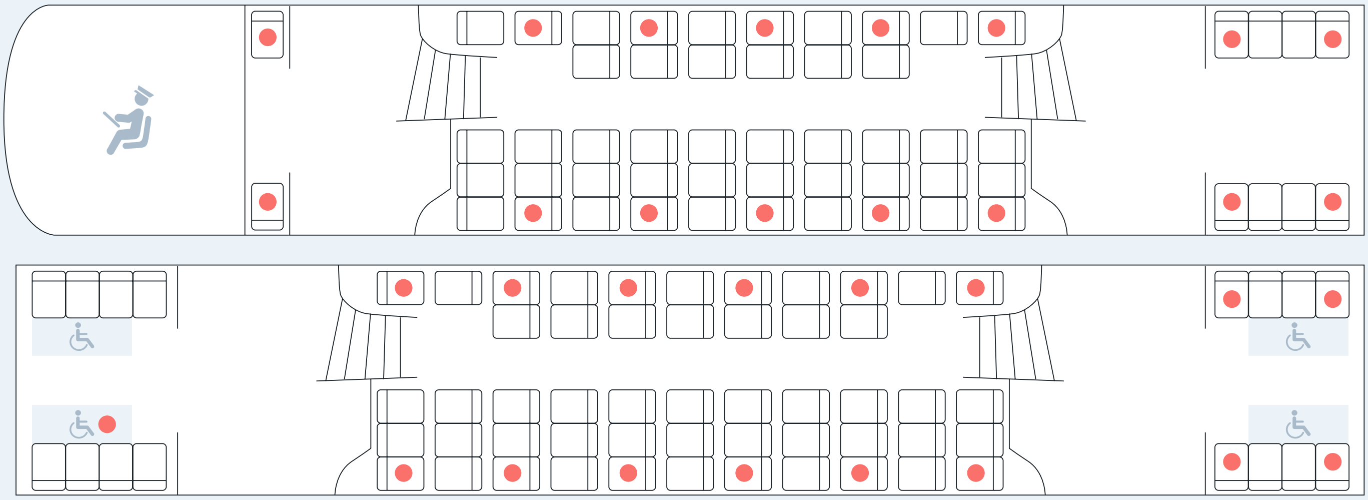
	TOTAL PASSENGERS	% OF SEATING / TOTAL CAPACITY
Scenario 1 – Strict Distancing	12	38% / 13%
Scenario 2 – Moderate Distancing	24	75% / 27%
Scenario 3 – Relaxed Distancing	26	81% / 29%
Seated capacity	**32**	**100% / 36%**
Total (seated and standing) capacity	**90**	**100% / 100%**

Table 2 Melbourne tram - capacity summary by scenario

TRAIN

Trains traditionally have the highest capacity of all public transport modes and benefit from large seating and vestibule areas for standing. In Sydney, trains form a key component of the city's transport network. On an average weekday morning, Sydney train peak demand equates to an average of 125% seated capacity through the central CBD, and each train moves as many as 1,060 people. This equates to over 2 people per square metre. A calculation of train passenger numbers by scenario is shown below.

SCENARIO 1 - STRICT DISTANCING **(20% OF TOTAL CAPACITY)**



SCENARIO 2 - MODERATE DISTANCING **(28% OF TOTAL CAPACITY)**

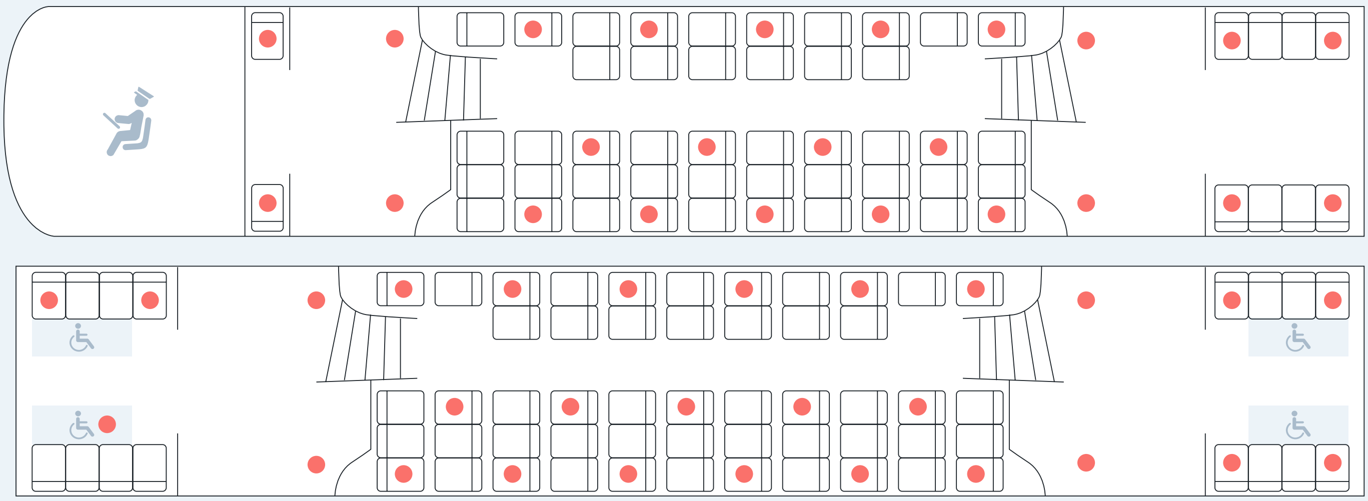


Figure 4 Sydney train - capacity diagrams by scenario[6]

● People seated / standing

[6] Notes : Layout is based on a Waratah 1 Sydney train. An 8-car set would repeat the configurations above to provide full capacity for each train. In addition, the centre sections are double-decker. As such passengers in these sections are counted twice. All figures provided in the summary table are within a full 8-car set.

TRAIN

SCENARIO 3: RELAXED DISTANCING (48% OF TOTAL CAPACITY)

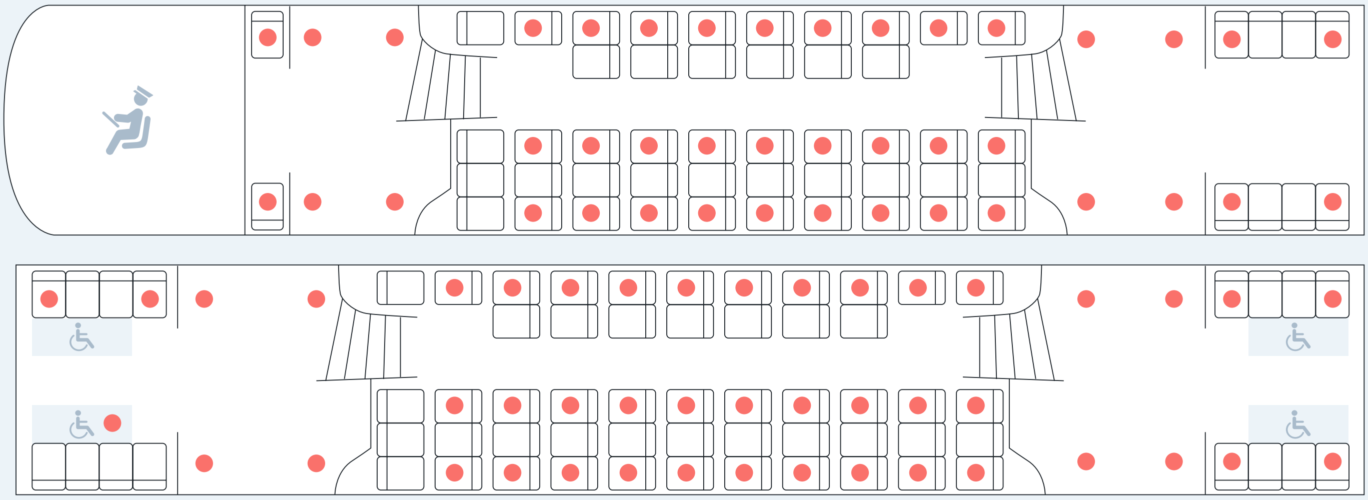


Figure 4 cont. Sydney train - capacity diagrams by scenario — People seated / standing

Even for Scenario 3 – relaxed distancing, capacity is significantly reduced on Sydney train services with capacity running at around 50% compared to normal total (seating and standing) capacity. Whilst this is based on conservative restrictions, it is likely to align with initial passenger reaction to travel on public transport and concerns around close contact with fellow passengers. The seating pattern in Scenario 3 is similar to the approach taken by a number of large commercial airlines internationally, who have restricted passengers booking 'middle seats' on their flights, unless part of a family group, and not allowing passengers to sit near seats for crew members[7].

	TRAILER DRIVER CARRIAGE (X2)	TRAILER CARRIAGE (X2)	MOTOR CARRIAGE (X4)	TOTAL PASSENGERS*	% OF SEATING/ TOTAL CAPACITY
Scenario 1 – Strict Distancing	52	56	128	**236**	**26%/20%**
Scenario 2 – Moderate Distancing	76	80	184	**340**	**38%/28%**
Scenario 3 – Relaxed Distancing	136	144	304	**584**	**65%/48%**
Seated capacity	**202**	**220**	**472**	**894**	**100%/74%**
Total capacity (seated +35%)	**272**	**297**	**637**	**1,206**	**100%/100%**

** Maximum capacity with no wheelchair, mobility scooter, prams or equivalent users.*

Table 3 Sydney train – capacity summary by scenario

[7] https://www.traveller.com.au/middle-seat-on-planes-during-coronavirus-qantas-among-airlines-no-longer-putting-passengers-in-middle-h1nhc4

IMPACT ON THE SUPPLY OF PUBLIC TRANSPORT SERVICES

The previous section has illustrated that distancing practices associated with COVID-19 will have a significant impact on the safe operating capacity of public transport vehicles and will significantly reduce the total capacity of public transport networks across Australia. A summary of the results is below. Across all modes, even with relaxed distancing measures, this will require that **public transport vehicles operate at most between 30% and 50% of total capacity.**

	% OF TOTAL CAPACITY		
	Brisbane bus	**Melbourne tram**	**Sydney train**
Scenario 1 – Strict Distancing	9%	13%	20%
Scenario 2 – Moderate Distancing	17%	27%	25%
Scenario 3 – Relaxed Distancing	28%	29%	48%

Table 4 Summary of capacity by scenario for all modes

What this ultimately means for the supply of public transport will depend on the demand profile of individual networks around Australia during the transition stage. In smaller regional cities where public transport is not as heavily used, the impact may be less pronounced as crowding and full capacity public transport vehicles may not have been an issue prior to the COVID-19 pandemic. For the larger cities, particularly Sydney and Melbourne, certain parts of the public transport network is likely to experience challenges in providing adequate supply with distancing measures, as demand returns when lockdown measures are lifted. The biggest challenge facing all cities will likely be peak-hour commuting services, as they are typically the most heavily used components of Australian public transport networks.

In the following section, we explore – through an illustrative example – how these scenarios could impact public transport service in two cities in New South Wales: Sydney the capital city and the State's largest regional city, Newcastle.

3. CAPACITY ANALYSIS CASE STUDY: NEW SOUTH WALES, AUSTRALIA

The capacity analysis presented in section 2 provides a framework for government authorities and public transport operators to consider the implications of distancing measures on the provision of public transport. However, the actual impact of these measures is highly dependent on the demand for a public transport route or network, and how that demand changes over time.

To illustrate how this framework can be applied to understand the capacity impacts to a specific location, we present a case study of two example bus routes in New South Wales, Australia. Bus transport was chosen for the illustrative examples as it is the most ubiquitous form of public transport in Australia and globally. Two cities – Sydney and Newcastle – were selected to be representative of a large capital city and a smaller regional city, respectively. The principles can be readily applied to other cities and locations, with differing datasets.

PUBLIC TRANSPORT DATA IN NEW SOUTH WALES

Public transport services in New South Wales use the Opal contactless fare collection system. The Opal system is managed by Transport for New South Wales (TfNSW) and provides robust real-time information for all public transport services, including buses, trains, light rail, and ferries. This information is publicly available in real-time using various third-party applications, such as the TripView app (Figure 5).

For buses and trains, the Opal system uses a three-level capacity ranking to indicate how full a public transport service is. This information is shown publicly as 'capacity icons' (Figure 6) and is also readily available as part of the published General Transit Feed Specification (GTFS) and GTFS-Realtime (GTFS-R) data sets. Although developed with Opal data, the capacity indicator framework can be readily applied with other data sets too.

For both examples, we used the publicly available 2016 Bus Occupancy (Aug 2016 to Jan 2017) data set[8] published by TfNSW. Tuesday 9 August 2016 was chosen as a representative average day to provide an illustrative example of pre-pandemic Stage 0 demand. Whilst it is considered that the trends shown are reflective of recent pre-pandemic conditions, capacity demand at stops may have changed. In general, the total number of passenger kilometres by bus has increased across Sydney[9].

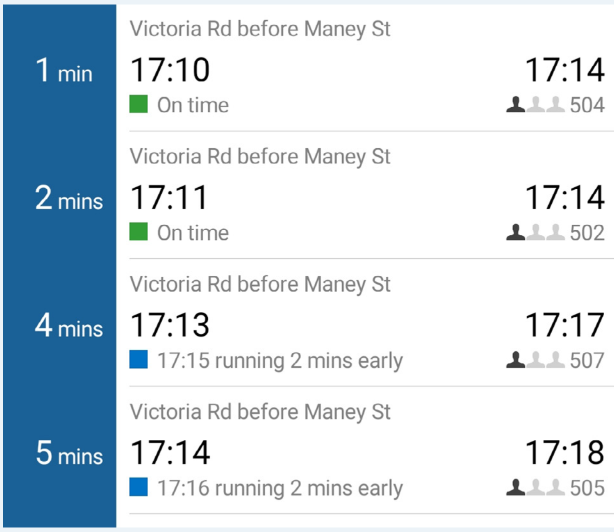


Figure 5 Screenshot of the TripView app showing real-time Sydney CBD bound bus arrivals at a bus stop in Rozelle on 24 April 2020

Capacity icons show how full the service is:

- 1 filled person - seats are available
- 2 filled people - few seats are remaining
- 3 filled people - standing room only

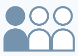
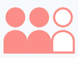
Figure 6 Opal system capacity icons

Source: TfNSW, Key to icons and line codes, https://transportnsw.info/

[8] https://opendata.transport.nsw.gov.au/dataset/bus-occupancy-aug-2016-jan-2017
[9] Australian Infrastructure Statistics—Yearbook 2019, Bureau of Infrastructure, Transport and Regional Economics

APPLYING THE CAPACITY FRAMEWORK

The three-level capacity indicator is a coarse measure of how full buses are operating on the New South Wales network. While actual patronage numbers by stop would be a more precise measurement, this readily available data set is useful for a high-level comparison of public transport demand (i.e. how full each bus is) and supply (i.e. how many total buses they are). Table 5 maps the three capacity indicators against the three distancing scenarios developed in section 2 of this paper.

CAPACITY INDICATOR LEVEL	DESCRIPTION	MEASURE	DISTANCING SCENARIO
	Many seats available	Less than 50% of seating capacity of vehicle	1 – Strict 2 - Moderate
	Few seats available	Between 50% and 100% of seating capacity	3 – Relaxed*
	Standing room only	Greater than 100% of seating capacity	*Not compatible with any level of distancing*

** The upper end of this capacity indicator (e.g. approaching 100% of seating capacity) would not meet Scenario 3 guidelines*

Table 5 Mapping the Capacity Indicator levels to distancing scenarios

Decisions regarding which distancing scenario is appropriate during transition and when, will depend on the conditions in each individual city. Many factors not directly related to transport, including public health and economic recovery considerations, will be incredibly important, as well as implications for fare revenues. Applying a high-level view, we propose two operational approaches that transport providers could enforce during Stage 2 Transition:

- **Transition Operational Plan A:** Operate all transport vehicles at no more than Capacity Indicator 1, which aligns with Strict-to-Moderate distancing practices (WSP Scenarios 1 and 2). This plan would be appropriate for the initial period of Stage 2 Transition where travel restrictions are relaxed, but not fully lifted, and a high-level of caution is required to avoid secondary outbreaks.
- **Transition Operational Plan B:** Operate all transport vehicles at no more than Capacity Indicator 2, which aligns with more relaxed distancing practices (WSP Scenario 3) and avoids crowding and standing-room only vehicles. This plan would be appropriate for the later period of Stage 2 Transition where travel restrictions have been mostly lifted; however, caution is still required to prevent further outbreaks and provide the public with confidence in returning to public transport services.

How long each of these plans may be needed for and the progression between them will vary in different locations, depending on a range of factors including levels of COVID-19 transmission, the number of public transport services and demand for those services. Enforcement and ensuring compliance with different approaches is discussed in Section 4.

The following examples look at Stage 0 pre-COVID-19 demand on two bus routes in New South Wales to understand the implication of these two operational plans as demand starts to return during Stage 2 - Transition. The analysis of Opal Data will be provided in two ways:

1. Along the route during the AM peak period (locational demand profile).
2. At a specific bus stop throughout the day (temporal demand profile).

EXAMPLE 1: BUS ROUTE M52 IN SYDNEY

Sydney is a major metropolitan region in Australia with a population of over 5 million people. It has a robust public transport network comprised of heavy rail trains, metro trains, light rail trains, buses and ferries. Most of the public transport network is oriented around the Central Business District (CBD). For this case study, the M52 bus route was chosen as an example. The M52 operates between the city's second CBD in Parramatta and the Sydney CBD via Victoria Road, a major east-west transport corridor serving the northwest of Sydney. It covers a route length of approximately 25 km, and is shown in Figure 7.

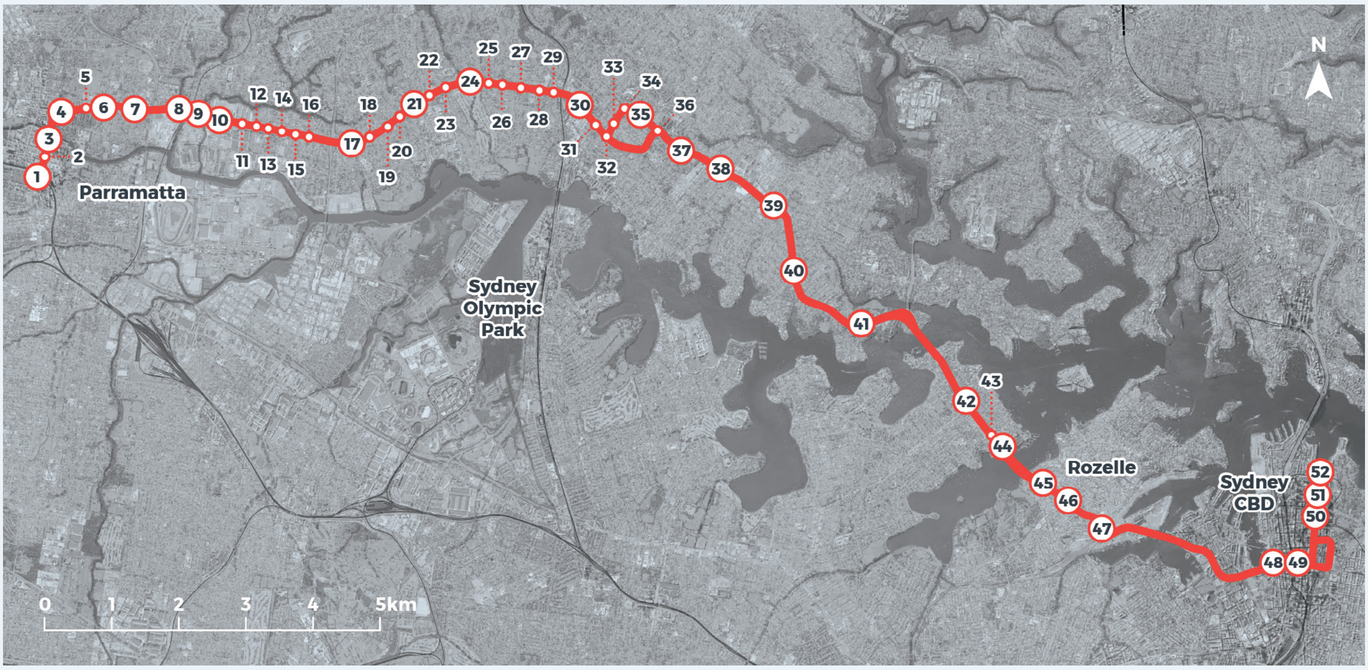


Figure 7 M52 bus route – Parramatta to Sydney CBD

LOCATIONAL DEMAND PROFILE

During the morning peak (07:00 to 09:00), 9 services operate inbound (east towards the Sydney CBD) from Parramatta with an additional 13 services starting from Ryde (mid-route, stop no. 36). The number of services by Capacity Indicator at each bus stop along the route is shown below. Capacity constraints build as services approach the CBD, peaking on Victoria Road in Rozelle (within 5km of the Sydney CBD) (stop number 46).

This profile shows that approximately 50% of buses operate as standing-room only approaching the Sydney CBD, peaking at the Victoria Road after Darling Street bus stop. Thus, to meet distancing requirements, as demand reaches distancing capacities, additional demand will need to be redistributed to other modes or other times of day, or more public transport services provided to increase capacity. As with many commuting services, this route highlights the importance of encouraging those living closer to the CBD, where bus capacity is most constrained, to change their travel patterns during Stage 2 - Transition (e.g. through a switch to active transport, especially cycling).

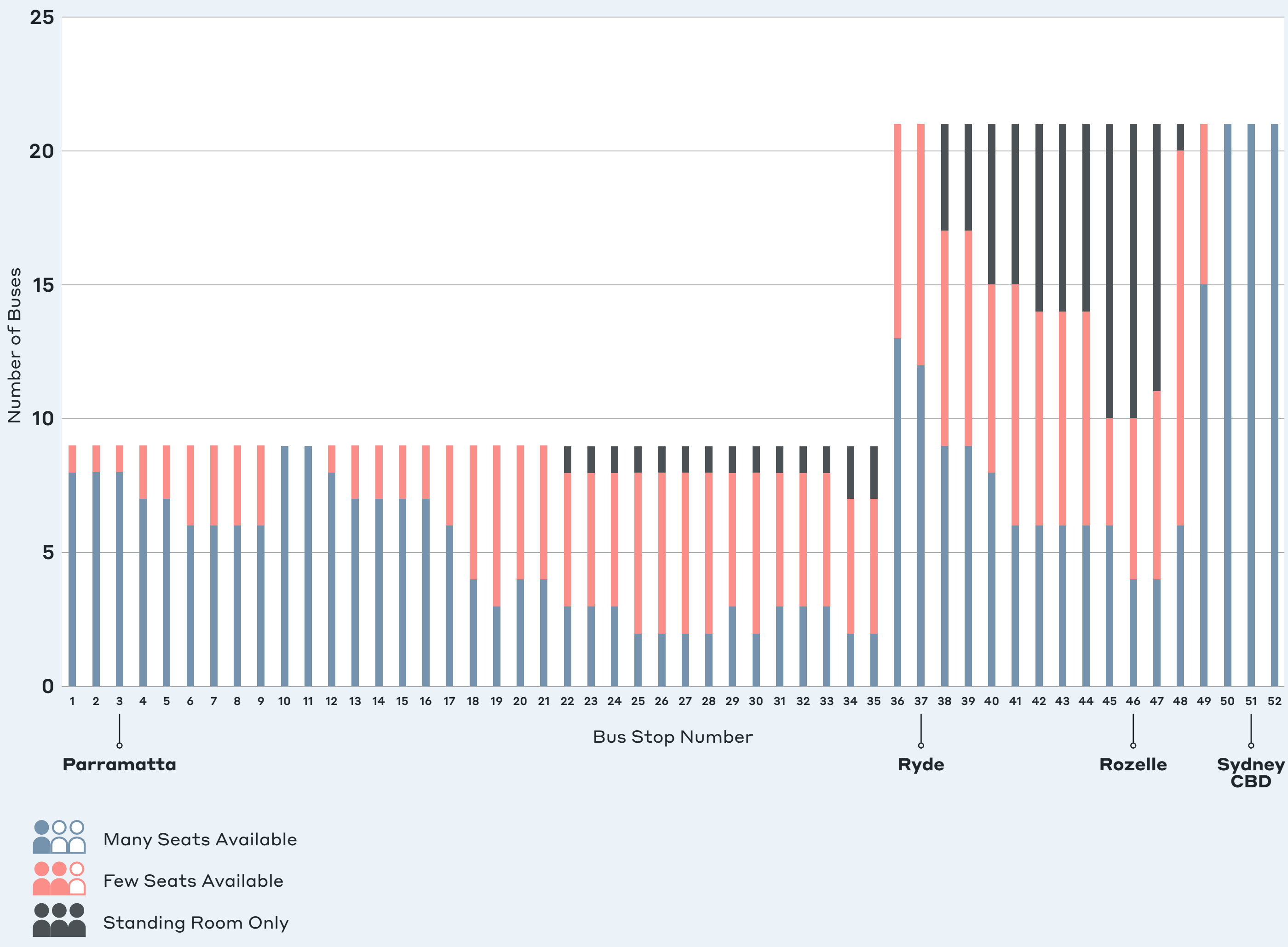


Figure 8 Capacity indicator by stop (Route M52)

TEMPORAL DEMAND PROFILE

The profile below looks at how demand and supply change throughout the day at the heaviest load point on the route – Victoria Road after Darling Street bus stop (stop no. 46). As indicated in the locational demand profile, demand is very high in the AM peak hours, with 50% of buses standing-room only between 7am and 9am. This is not compatible with any of the distancing scenarios. However, demand lessens in the shoulder periods and during the inter-peak. As such, there is an opportunity to shift demand to the shoulder periods, which could accommodate the demand that cannot be accommodated during the peak period with distancing measures in place. This should be considered alongside an increase in services for some locations as noted above.

Figure 9 Capacity indicator by hour band (Stop 46 Victoria Road after Darling Street, Rozelle)

EXAMPLE 2: BUS ROUTE 11 IN NEWCASTLE

Newcastle, Australia is a regional city with a population of approximately 500,000 located about two hours north of Sydney. It has a public transport network comprised of multiple bus routes, one light rail route, and one ferry route.

For this example, the 11 bus route[10], one of Newcastle's busiest and most frequent bus routes, was chosen as an example. Route 11 operates from Newcastle to Charlestown south of the CBD via Jesmond, John Hunter Hospital and the University of Newcastle. It covers a route length of approximately 22 km, and is shown in Figure 10.

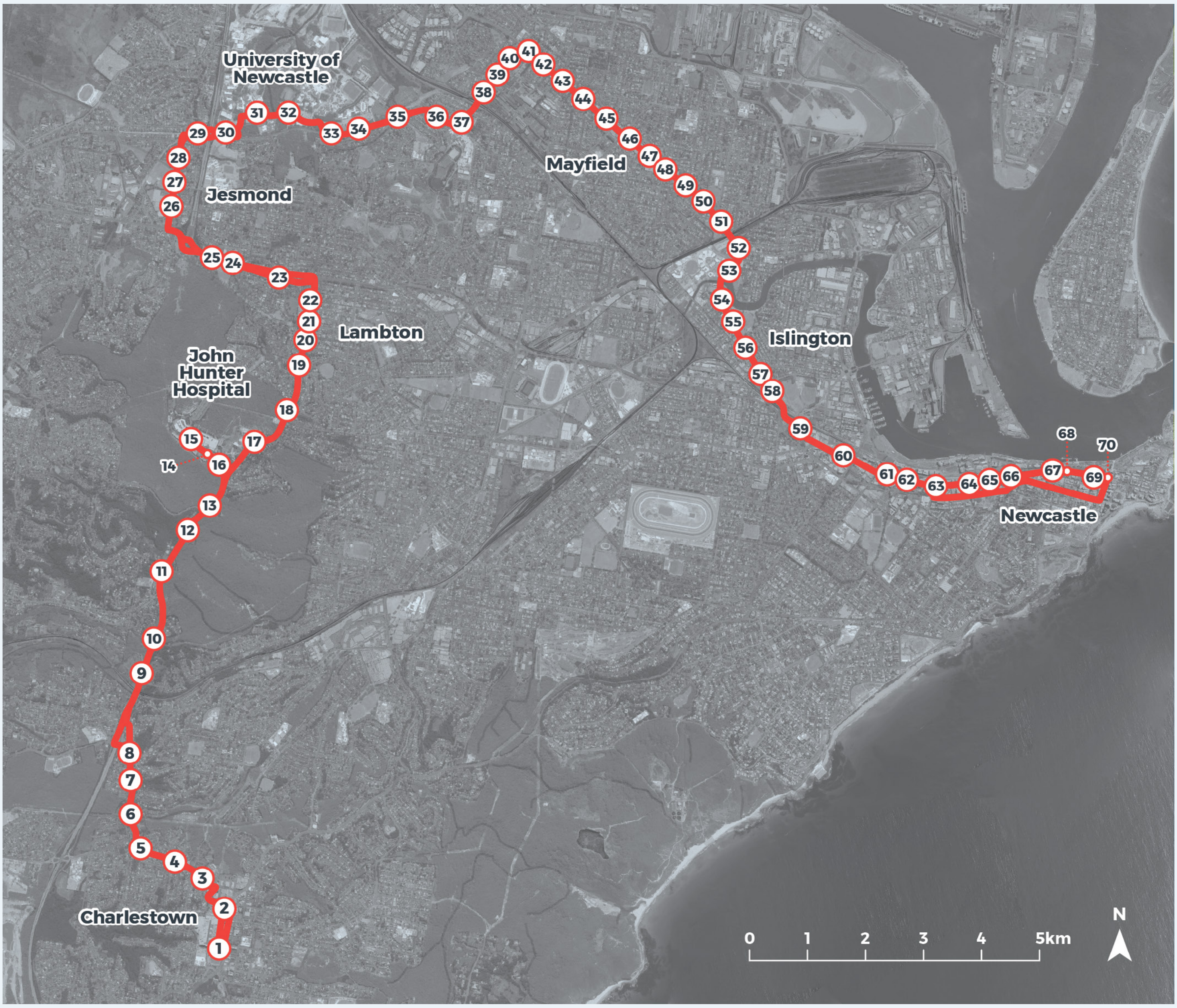


Figure 10 Route 11 (Previous Route 100 used for analysis via Hunter Street shown by dotted line)

[10] The route was formerly known as the 100 and was recently renamed to the 11 following the opening of the city's light rail service in 2019. Route 11 is substantially the same as Route 100 with a small alteration to run parallel south of its previous route into its Newcastle terminus. The 2016 data used for this analysis is for Route 100.

LOCATIONAL DEMAND PROFILE

During the afternoon peak period (16:00 to 18:00), 4 services operate inbound (north towards Jesmond and then east towards the Newcastle CBD) from Charlestown. The number of services by Capacity Indicator at each bus stop along the route is shown below. Capacity constraints build as services approach the University of Newcastle, which is located approximately half-way along the route, and then subside as the buses pass Mayfield and continue to the CBD.

This profile shows that the majority buses operate with many seats available and there are no buses operating as standing-room only along the route. As such, to meet relaxed distancing requirements (Operational Plan B), the existing supply of buses is sufficient, and no operational changes would be required. However, to meet strict distancing requirements (Operational Plan A), some changes to reduce demand or increase capacity around the University and in Mayfield would be required. As with the M52 example in Sydney, there may be opportunities to encourage active transport. Additionally, the return of travel demand to the University is difficult to predict as the University may transition to a longer period of distance learning, which will lessen the demand load during peak hours.

It should be noted that additional distancing measure may be required on routes serving hospitals or other key healthcare facilities to protect frontline workers. This may result in services such as Route 11 needing to maintain Level 1 capacity indicators for longer.

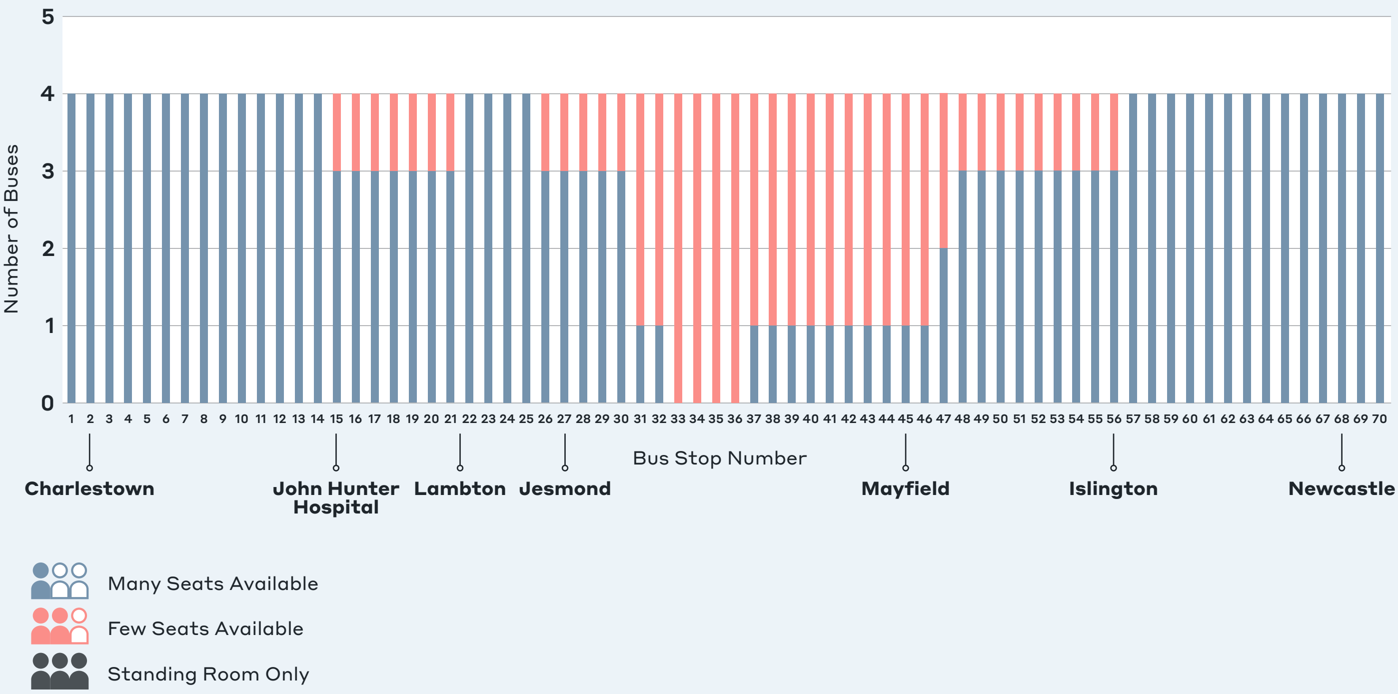


Figure 11 Capacity indicator by stop (Route 11)

TEMPORAL DEMAND PROFILE

The profile below shows how demand and supply change throughout the day at one of the heaviest load points on the route near the University of Newcastle – the University Drive near Ring Road bus stop (stop no. 33). The highest number of buses is in the AM peak period; however, the highest demand is during the PM peak period with all buses having few seats available between 4pm and 6pm. Demand decreases in the PM peak shoulder periods and then drops substantially in the AM peak and evening. As with the locational profile, there are no buses that are standing room only, so some level of social distancing is possible at all times of day even with a full return of demand. Given the large amount of capacity through most of the day, there is also additional opportunity to manage the PM peak period demand through staggered work and study hours. In regional cities, where bus fleets are likely to be more constrained, the required number of buses for school services during the AM and PM peak may mean that increased capacity is harder to achieve at these times.

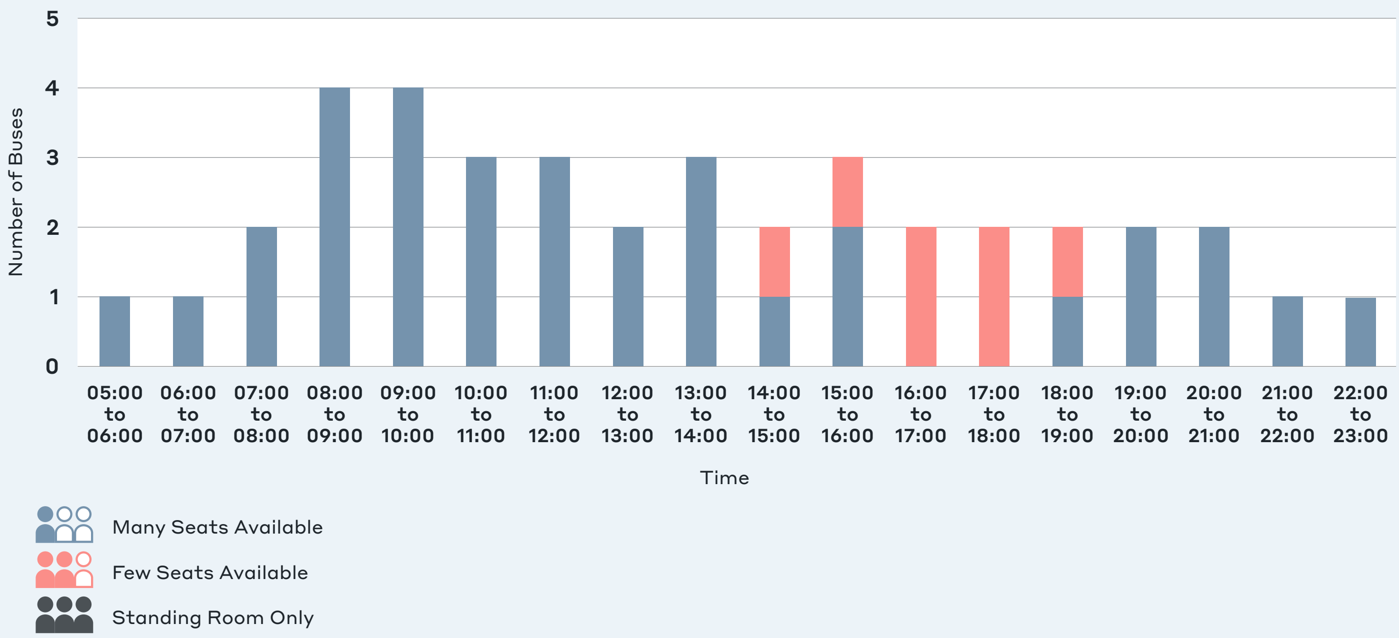


Figure 12 Capacity indicator by hour band (Stop 33 University Drive near Ring Road, Callaghan)

4. CONSIDERATIONS FOR CITY RECOVERY

Although the distancing scenarios outlined will mean public transport operating at a fraction of full capacity in Stage 2 – Transition, it is vital to keep services running. People still need to travel to work and school, and the transport system will play a critical role in supporting economic recovery. Public transport needs to be available and safe, to encourage users to return.

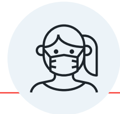
Overall, operating public transport systems with approximately 30% of maximum passenger capacity is enough to maintain distancing within public transport vehicles at Scenario 1, strict distancing. Early information from China, the epicenter of the COVID-19 pandemic, indicates initial policies are in place to operate vehicles at 50% capacity[11], equating to up to Scenario 2, moderate distancing.

In some areas and times, as demand recovers, these capacities may not be sufficient to meet travel demand. In busy metropolitan areas at peak times, demand management measures like peak spreading may not be enough to meet demand, so service levels will likely need to be adjusted to meet people's travel needs. If people's travel needs are not met, there is a risk of them making long-term switches to the private cars and abandoning public transport. This would increase congestion and emissions, as well as reducing the commercial viability of public transport. In areas and times of high demand, additional services may be needed, along with accompanying measures such as priority bus lanes.

Building on the information provided in the previous sections, there are some important issues to consider in supporting city recovery during Stage 2 – Transition.

[11] https://www.sydney.edu.au/news-opinion/news/2020/03/20/covid-19-risk-on-public-transport-what-we-can-learn-from-overseas.html

SAFETY AND OPERATIONS



- **Frontline workforce safety:** We have learnt how critical public transport drivers and supporting staff are through the pandemic. Central to all approaches, is the safety of the workforce operating the transport system, particularly those on the frontline driving vehicles and attending stations and stops. Both physical distancing, cleaning and behavioral measures must always protect the health and safety of these critical staff. This should include measures such as the provision and use of PPE, driver shields to separate drivers from customers, removal of cash fares, and maintaining increased cleaning procedures to minimize their exposure to the virus. More detail on cleaning procedures can be found in WSP's first COVID-19 white paper – *COVID-19 Transit Operations – Public Transport responses to Coronavirus situation.*

- **Platform, station and stop movement:** Management of access to platforms, as well as levels of crowding on platforms, at stops and on vehicles should be closely monitored. This may result in increased delays for customers in concourse areas at stations and may require additional staffing to manage queuing at stops and stations. These measures are likely to cause delays in running services reliably and may necessitate timetable adjustments, however for buses some time may be reclaimed with faster running due to reduced traffic levels. Passenger management may also include one-way entry and exit systems for stations to manage crowds and help maintain distancing. As passenger numbers increase, one-way measures could also be introduced on some vehicle types, although for buses this could increase driver risk with use of the front rather than rear doors and limited separation from passengers.

- **Contactless ticketing:** The move towards contactless ticketing measures is also likely to increase, negating the need to handle cash which could act as a means of transmitting virus. Whilst most major cities have travel card systems in place, smaller and rural communities may not, which could increase financial burden on operators and risks creating a two-tier public transport system.

- **Service planning:** Public transport services can become full quickly across all modes, which could result in issues with customers further along routes being able to board and experiencing long wait times. Further data analysis could identify locations with high demand, where targeted additional services could be temporarily added to supplement existing routes. Using the M52 example from Section 3, this could involve more additional services between Ryde and the Sydney CBD.

CUSTOMER BEHAVIOUR

- **Understanding user needs and behaviors:** To inform the planning and staging of solutions, it is important to first understand how our communities are feeling about returning to the public transport network. Behavioural research to uncover pain-points should be undertaken in the short term, to understand how people's attitudes and decision making has changed the way they travel; and approach public life. This evidence needs to then be embedded into our transport models to ensure we can compensate for this behavioural change in policy making and infrastructure planning.
- **Enforcing new capacities:** New guidelines around the number of people who can ride on public transport needs to be clear and easy to enforce, either by the driver or a third party, and clear roles and responsibilities set out for this. In order to feel safe, people need to be clear where they can and cannot sit and see the guidelines applied consistently throughout their journey. Staff need clear and enforceable guidelines, and potential support with implementing these, at least in the initial period while people adjust. Ultimately, simple to follow guidelines can support self-enforcement by fellow passengers, which may be most effective. Our scenarios have been designed to be simple to understand and practical to implement. Techniques like closing some seats, marking areas with tape have proven successful during the lockdown phase, and can be modified to support recovery. There may need to be removal of advertising 'wraps' on buses which obscure views of the inside, so that customers and operational staff can easily determine if services are full. The application of approaches outlined in this paper will also need to consider mode specific issues (e.g. trams and metros which rely on a large proportion of standing passengers, may need additional floor markings to allow some standing during Scenario 3 at appropriate distances).

INFLUENCING TRAVEL DEMAND

- **Staged return of the workforce:** Encouraging business to adopt a gradual approach to supporting employees to return to working from their usual workplaces will help address capacity shortfalls. This will allow a level of distancing to be maintained on public transport whist supporting economic recovery. Cross government and business coordination forums can help coordinated and consistent engagement. Options for businesses could include some people or teams remaining doing increased working at home, or dividing into A, B and C teams who rotate time in the physical workplace. As well as helping align demand with reduced capacity, the latter has the benefit of increasing resilience in case people in any of the teams are affected by a further outbreak of COVID-19. During lockdown, some countries have introduced 'permit' type systems for leaving your home and travelling (e.g. letters from employers). This could be used to help prioritise public transport capacity for defined essential purposes, particularly during the early part of transition. Solutions like this could be targeted on a location specific basis, depending on the balance of demand with available capacity.
- **Peak-spreading:** This measure involves encouraging people to travel outside of busy periods, so that distancing can be maintained on public transport. It can be one part of a set of measures for the transition phase, but will likely need to be combined with other measures to ensure demand levels can be met by available capacity with distancing in place. With reduced capacities, there is a risk that passengers may be left waiting at stops if services are full at peak times, reinforcing the importance of information and active management of service levels (see below).

USE OF DATA AND INFORMATION

- **A data-driven and responsive approach:** Demand patterns have and will continue to change, potentially in unpredictable and unexpected ways. Just as Stage 1– Lockdown saw rapid change, the same is likely to happen in transition too. Monitoring of services will be important to inform responsive and agile service planning, and keep a balance between reduced capacity and return of demand. In some cases, increases in capacity beyond baseline levels may need to be considered. Data-driven approaches such the use of travel-card information could also be considered to support 'contact tracing' opportunities. With appropriate privacy controls agencies could identify card owners who may have come into contact with an identified COVID-19 case on the public transport network. Service planning will need to be supported by health data to inform when restrictions can be relaxed.

- **Providing information to allow informed decision making and promote customer confidence:** A central pillar of travel demand management is providing people information to inform their decision making around re-timing, reducing or changing the mode of their trip. During Stage 2 - transition information about the transport system will be critical. Real-time information on crowding on services will be important in allowing users to whether, when and how to travel. Equally, regular, clear and consistent messaging at stops and on-board regarding safety practices will improve confidence for people to return to using public transport, and help promote understanding of and compliance with measures which are in place. The transport industry will need to actively promote cleaning and safety measures being introduced, to increase customer confidence and encourage a return to public transport.

COMPLEMENTARY MODES

- **Supporting active transport and micro-mobility:** Active travel such as walking and cycling, as well as micro-mobility (scooters, and bike hire) will play an important role in supporting the public transport network during the transition phase, as it always has. There are opportunities to lock in the benefits from increased numbers of people cycling for leisure around their local areas, and to support ongoing uptake of these modes through fast-tracked tactical infrastructure upgrade projects. This could include reallocation of road-space for active modes, particularly in dense and busy places where footpath widths are inadequate to allow appropriate distancing. Auckland in New Zealand is investing in temporary cycleways and footpath widening in response to COVID-19[12]. People close to the CBD may need additional incentives to walk and cycle to work, to ensure sufficient public transport capacity for those living further afield.

- **The role of on-demand services:** At a time where public transport capacity is reduced by distancing measures, and returning demand is unpredictable, there could be benefits in the increased provision of on-demand services in certain times and locations (e.g. to support peak time travel to busy centres). On-demand services offer both user and operator flexibility. Pre-booking can be used to ensure that services are not overbooked, so distancing requirements can be met, and also allows contact tracing in the event of any health issues.

- **School bus services:** Arrangements for schooling, the return to school and school transport differ between States in Australia. Similar approaches to distancing can be applied for school transport services, with potential to tailor services for different age-groups to separate older and younger students and align with programs for their staggered return to school.

[12] https://at.govt.nz/about-us/news-events/at-welcomes-funding-for-temporary-cycleways-and-footpaths/

THE FUTURE OF THE WIDER TRANSPORT SYSTEM

The COVID-19 pandemic has had a profound and deeply saddening impact around the globe. It has also presented opportunities to explore radical changes to our behaviours and habits, some of which can have a lasting positive impact. The 'new normal' travel patterns will allow us to recast mobility norms, challenging behavioural stereotypes and long held transport presumptions. It is critical to consider wider issues around the future of the whole transport system, and rapidly make deliberate decisions to ensure it remains fit for purpose.

There is great potential for transport authorities, business and individuals to lock in the benefits from new habits formed over recent months. Changes borne out of a necessity to keep society safe, could have a lasting positive legacy. For example, the increase in home-working has allowed remote video-conferencing technologies to be proven, and business leaders have seen their employees can remain productive at home. Individuals have benefited from extra time in their days, and both congestion and emissions have reduced. However, other changes may have negative impacts on the transport system if allowed to continue. For example, travellers becoming used to single occupancy car trips, as a way to avoid contact with others who may potentially be sick, could result in an increase in congestion if continuing in the medium term. Proactive planning and decision making are needed for the future we want our cities to have.

THE FUTURE OF THE WIDER TRANSPORT SYSTEM cont.

Recovery from a modern global pandemic is uncharted territory. While technology now allows us to do more from home, the need for moving goods remains, and people will still need to access many jobs and services in person. Over the coming months, there are many issues and questions to be considered and decisions to be made to shape our future cities in desirable ways.

- **Investment and project prioritisation:** How should transport investment decisions be prioritised in a post COVID-19 world? How has transport changed? How have our predictions about future travel scenarios changed? Which transport projects can and should be fast-tracked to support economic recovery? Can more space be dedicated for active travel modes and reallocated in other ways while vehicle demand is low?
- **Travel demand management:** What travel behaviours do we want to see in the new normal? Will travel demand reduce overall with an increase in home-working, tele-health, virtual entertainment etc.? How can we lock in the personal and societal benefits from changes to our travel patterns? How do we use the change in travel habits to have a positive impact on our cities? What percentage of trips can and should return? How can we 'nudge' the behaviours we want as people come out of the 'lock down' mentality? Can we lock-in some time shifting behaviors to spread peak time demand? Should road pricing be more actively investigated to manage levels of personal car use? If public transport demand drops significantly with increased working at home, what are the impacts on the commercial viability of services and how can this be managed?
- **Modal considerations:** How will sharing based services like ride hailing and micro-mobility hire be impacted by concerns over germs? How can users who have taken up cycling and active travel be encouraged to continue as traffic volumes increase? How do we avoid an increased reliance on single occupancy car trips as people return to work and other activities?
- **Freight and deliveries:** Will the increase in online shopping continue? What will the balance of deliveries be in future between homes and workplaces? If online shopping increases, how do freight and logistics services need to change? Are more freight consolidation centres required? Is more space needed in cities for delivery vehicle movements and drop-off and pick-up locations? Where can this be provided? Should and how can drone deliveries play an increasing role in cities, regional and remote areas in the future?
- **Place:** How can we leverage changes in travel patterns to re-shape space and improve the place experience across our cities? How can changes in urban design support a return to a focus on local community places?

5. CONCLUSIONS

As cities recover from COVID-19 and activities return to normal over the months ahead, that normal will be new. Many behaviours and associated travel patterns will change. What must not change, however, is the role of public transport in meeting the mobility needs for larger proportions of the population, to access employment, goods and services efficiently. Public transport is essential to the future success of cities – their places, their economies and their environment.

During the transition stage, patronage numbers on public transport will once again increase. This paper has provided a framework to understand the capacity implications of distancing measures on public transport. Across all modes, even more relaxed distancing measures will mean that public transport vehicles operate at most between 30% and 50% of total capacity. Work to understand people's changed attitudes to travel on public transport will play a central role in determining how to apply these measures.

What these capacity reductions mean for the supply of public transport will depend on the demand profile of individual networks during the transition stage. In smaller regional cities where public transport is not as heavily used, the impact may be less pronounced as crowding and full capacity public transport vehicles may not have been an issue prior to the COVID-19 pandemic. For the larger cities, particularly Sydney, Melbourne, Brisbane and Perth, certain parts of the public transport network will experience challenges in providing adequate supply with distancing measures, as demand returns when lockdown measures are lifted. The biggest challenge facing all cities will likely be peak-hour commuting services as they are typically the most heavily used components of Australian public transport networks.

We have outlined approaches and practical operational considerations progressively relaxing distancing measures to support a safe and effective transition from lockdown to recovery from COVID-19. Transport providers, city leaders, business operators and many Government departments will all need to work together in a coordinated manner, to balance supply and demand for public transport. Deliberate, considered yet urgent decision making about the wider future of the transport system can help lock in positive changes.

Planning a successful staged return to public transport operations is one component of creating a new normal which has wide-reaching benefits for our cities and their people. We must ensure people feel safe returning to public transport, so it remains at the heart of transport systems that create successful cities and thriving places.

KEY CONTACTS AND CONTRIBUTORS

AUTHORS



Eleanor Short
Senior Principal,
Planning & Mobility
eleanor.short@wsp.com

Taylor Gouge
Associate,
Planning & Mobility
taylor.gouge@wsp.com

Gareth Mills
Associate,
Planning & Mobility
gareth.mills@wsp.com

CONTRIBUTORS

Graeme Steverson
Technical Director – Planning & Mobility
graeme.steverson@wsp.com

Peter Aspinall
Principal Occupational Hygienist
peter.aspinall@wsp.com

Michael Tyrpenou
Principal – Social Strategy and Design
michael.tyrpenou@wsp.com

Naeem Farooqi
Principal Consultant, Advisory, WSP Canada
naeem.farooqi@wsp.com

KEY CONTACTS



Alana Newbrook
General Manager,
Advisory
alana.newbrook@wsp.com

Scott Ney
National Executive,
Planning & Mobility
scott.ney@wsp.com

Brian Smith
Technical Executive,
Planning & Mobility
brian.smith@wsp.com

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Level 27, 680 George Street
Sydney, NSW
2000 Australia

wsp.com