Transport
for NSW

Heavy Vehicle Rest Area Benefits Guidelines

2023

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Terms and Abbreviations

Term	Definition
BITRE	Bureau of Infrastructure and Transport Research Economics
CBA	Cost-benefit analysis
GST	Goods and Services Tax
Guidelines	Heavy Vehicle Rest Area Benefit Guidelines
HPVs	High Productivity Vehicles
ILM	Investment Logic Mapping
NHVR	National Heavy Vehicle Law
OSOM	Over Size Over Mass
PPP	Public Private Partnership
Practitioners	Economic and project development professionals
Rest Area	Formal and informal off-road stopping locations along roads with dedicated parking spaces for use by heavy vehicle drivers
SCT	Service Centre
TCA	Transport Certification Australia
VKT	Vehicle kilometres travelling
VOC	Vehicle operating cost
VOT	Value of time
WIT	Women in Trucking

1 Introduction

This document aims to assist economic and project development professionals (or 'practitioners') in identifying freight benefits related to the provision of new heavy vehicle rest areas, and upgrades to existing rest areas. This will enhance the way in which freight benefits are captured in economic appraisals across the NSW Transport Cluster. The Heavy Vehicle Rest Area Benefit Guidelines (or 'Guidelines'):

- Outline the context in which freight benefits relating to new and upgraded rest areas should be considered
- Outlines key benefits for heavy vehicles relating to new and upgraded rest areas
- Provides guidance for practitioners in monetising quantifiable benefits
- Provides guidance for practitioners in considering non-quantifiable benefits.

This Guideline is intended to support, complement, and enhance the existing guidelines for cost benefit analysis in NSW, including the TfNSW Freight Benefits Guidelines. Where a specific approach is provided by TfNSW, it should take precedence over other guidance assessing NSW freight projects.

1.1 Strategic context

Driver fatigue is one of the top three contributors to fatal crashes on NSW roads. To enable road users to effectively manage fatigue and reduce the rate of fatigue related crashes, TfNSW provides and manages rest areas across the state road network.

Typically, rest areas are formal and informal off-road stopping locations along roads with dedicated parking spaces for use by heavy vehicle drivers. Facilities at rest area sites vary significantly. Commercial service centres or in-town facilities are also used by drivers for rest breaks. Rest areas also support the customer experience of travel, particularly long-distance travel which impact on driver and passenger comfort and behaviour that affect both driver performance and enjoyment of the journey.

The availability and quality of rest areas are important in enabling heavy vehicle drivers to comply with national fatigue-management regulations, as set by the National Heavy Vehicle Regulator (NHVR) through Heavy Vehicle National Law (HVNL). Critical to fatigue management law is a primary duty – a driver must not drive a heavy vehicle on a road while impaired by fatigue. In addition to this, drivers must also comply with certain maximum work and minimum rest limits.

1.2 Why have specific guidance for rest areas?

An economic appraisal assesses the incremental costs and benefits of an initiative. It provides evidence to aid investment decision making. Cost-benefit analysis (CBA) is the preferred evaluation method of the NSW Government and the NSW Transport Cluster. It is a required part of a business case to support funding proposals, in line with NSW Government policy. CBA aims to measure the economic, social and environmental impacts of a particular decision on the NSW community, including individuals, firms and the government. CBA considers both qualitative and quantitative impacts of an initiative and estimates the costs and benefits, wherever practicable, in monetary terms. CBA measures the incremental costs and benefits involved in an initiative, relative to a situation without the proposed action.

Despite playing an important role in managing heavy vehicle driver fatigue, the economic benefits of rest areas are currently not well captured in economic appraisals. Furthermore, where they are captured, approaches adopted tend to vary from project to project, and there is limited guidance on how to capture the economic benefits of rest areas for drivers, particularly for heavy vehicle drivers in a consistent manner.

A more comprehensive approach to evaluating the benefits to heavy vehicles of new and upgraded rest areas will allow road infrastructure projects to be more meaningfully assessed.

1.3 When to consider rest area benefits

The benefits of rest areas for heavy vehicles can emerge from a range of infrastructure related initiatives or interventions and should be considered on any occasion where there is proposed development of a new rest area, or where upgrades to an existing rest area are being proposed.

Proposed initiatives must be thoroughly scoped to enable quantification of benefits. To analyse the benefits of rest areas, a practitioner must have a clear project scope. Key requirements of a project scope are set out in the callout box below.

Project scope information required to conduct analysis

For **new rest areas**:

- Concept design, including:
  - Information regarding alternative facilities that may currently be used, e.g., a different rest area or towns providing similar services
  - Vehicle access arrangements, including curve radius and access lane lengths
  - Freight route speed limit, and rest area access route speed limits
  - Number and size of parking facilities (including decoupling facilities, if any)
  - Availability and number of toilet facilities
  - Details of available facilities, including shelter, table and chairs, lighting, security cameras, outdoor exercise equipment, and any other facilities
- Capital cost projection
- Maintenance cost projection
- The details of commercial arrangements (if applicable).

For **rest area upgrades**:

- Details of proposed improvements, including information regarding current and future state of:
  - Vehicle access arrangements, including curve radius and access lane lengths
  - Freight route speed limit, and rest area access route speed limits
  - Number and size of parking facilities (including decoupling facilities, if any)
  - Availability and number of toilet facilities
  - Details of available facilities, including shelter, table and chairs, lighting, security cameras, outdoor exercise equipment, and any other facilities
- Capital cost projection
- Maintenance cost projection (current and future state)
- The details of commercial arrangements (if applicable).

The benefits of rest areas may apply to various customers across the supply chain, either directly or indirectly. For example, the construction of a new major heavy vehicle rest area in a strategic location is likely to enhance comfort and convenience for a heavy vehicle driver. As the driver is likely to be better rested, it is also assumed there will be improvements to road safety, and freight productivity benefits, as a driver may no longer have to detour to a nearby rest area to meet legislative requirements.

It should also be noted that rest areas may also provide benefits to private vehicles, however the focus of these guidelines is on rest areas that cater specifically to heavy vehicles.

1.4 Identifying appropriate benefits

The identification of benefits relating to rest areas should start at the Investment Logic Mapping (ILM) stage and should be carried through the project lifecycle.[1] Projects, programs and strategies should focus on addressing problems and opportunities, with key outcomes in mind. Understanding the existing problems or opportunities that the initiative is seeking to address allows for outcomes and benefits to be clearly articulated and communicated from the early stages of the project.

An ILM is a visual representation of the drivers (or potential interventions), outcomes and benefits of a strategy, program, or project. The ILM tool assists with early benefit outcome relationship mapping and supports strategic alignment for future prioritisation.

For the purpose of developing this methodology, a benefits map was developed. Like an ILM, the benefits map (see below) aims to link interventions or actions, with derived benefits. Possible interventions are divided into two categories: upgrades to existing rest areas and delivery of new rest areas. It is assumed that all new rest areas will be of high quality. While not shown in the benefits map, an additional area of benefit - commercial benefits - has also been included. This benefit area considers the potential benefits derived by government agencies from the commercial arrangements associated with service centres and rest areas that offer food, and therefore should be considered separately to the benefits derived by the freight industry.

In this context, **high quality rest areas** refer to those with:

- efficient vehicle access through acceleration and deceleration lanes
- an appropriate number and size of parking stops - factors that should be considered include length of stay, number of heavy and light vehicles, current and expected future demand, the distance to the next

[1] Refer to TfNSW's Cost-Benefit Analysis Guide, page 23 for further details on developing an ILM.

rest area, and different types of heavy vehicles e.g., support provision for High Productivity vehicles (HPVs)[2] and Over Size Over Mass vehicles (OSOM) on approved dangerous goods routes[3].

- decoupling facilities (where required), located adjacent to the rest area[4]
- the provision of toilets
- appropriate amenity, which may include all or a selection of shelter, table and chairs, lighting, security cameras, and outdoor exercise equipment.

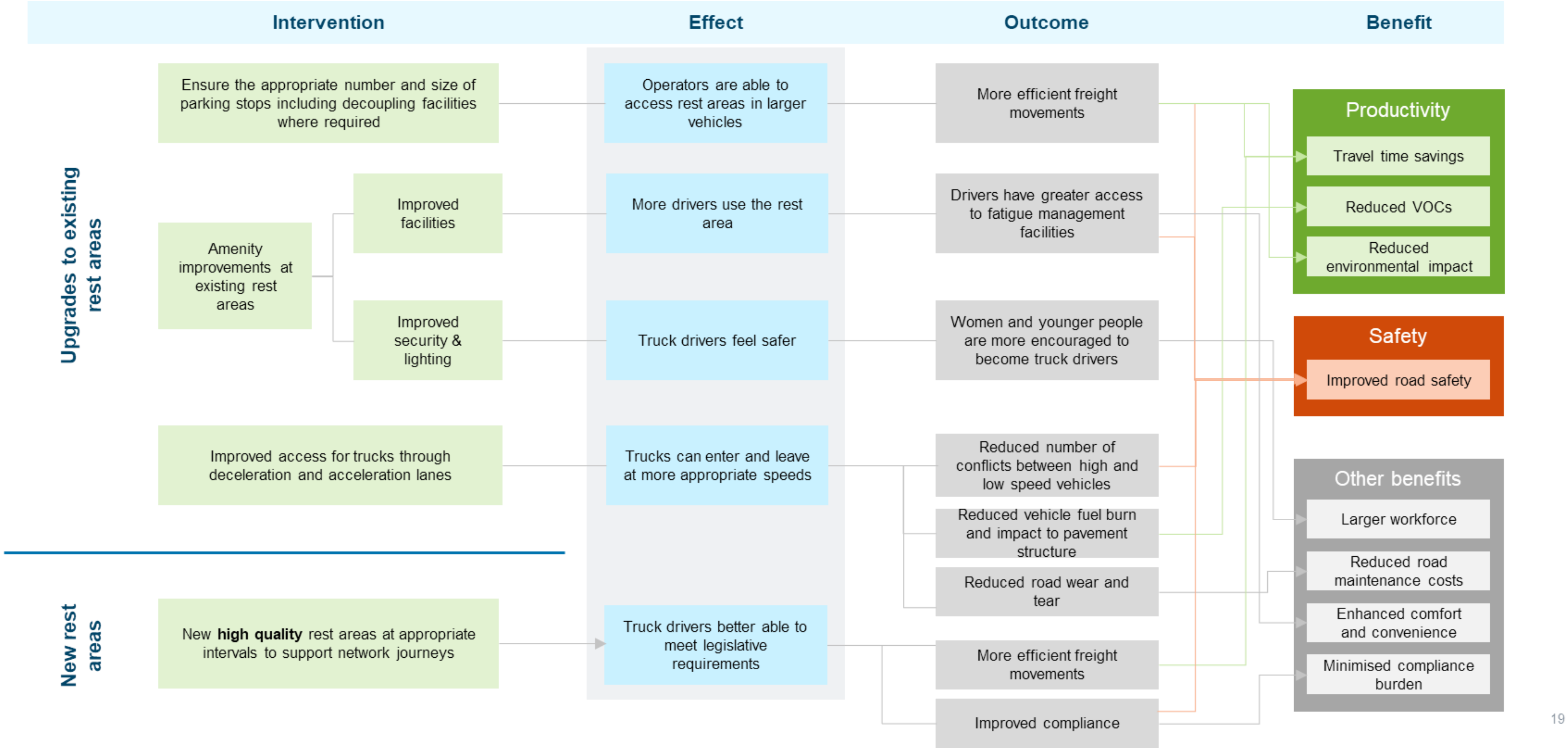
Based on this definition, new rest areas are likely to deliver all possible benefits, as shown below. This map can be adapted to suit an individual practitioner's context and can be used to inform the development of an ILM.

[2] HPVs are truck-and-trailer combinations that provide the ability to shift more freight more efficiently, with greater environmental and safety performance. These vehicles are often larger and heavier than more traditional heavy vehicles.

[3] OSOM operate under permit conditions and usually larger than typical heavy vehicles. As such, they may impact the functionality of the heavy vehicle rest area (e.g., blocking other HV users from the site). Consideration should be given to approaches to help mitigate such issues and minimise impacts to other rest area users.

[4] Decoupling facilities allow heavy vehicle drivers to breakdown and reconfigure their combinations to meet national regulations. These facilities are often most appropriate close to major metropolitan centres or at strategic locations on major routes. According to the Austroads *Guidelines for the Provision of Heavy Vehicle Rest Areas*, decoupling facilities should be located adjacent to the rest area rather than within it to prevent decoupled trailers from taking up space intended to be used for heavy vehicle parking while drivers are resting.

Figure 1: Rest area benefits map



Source: NineSquared (2023)

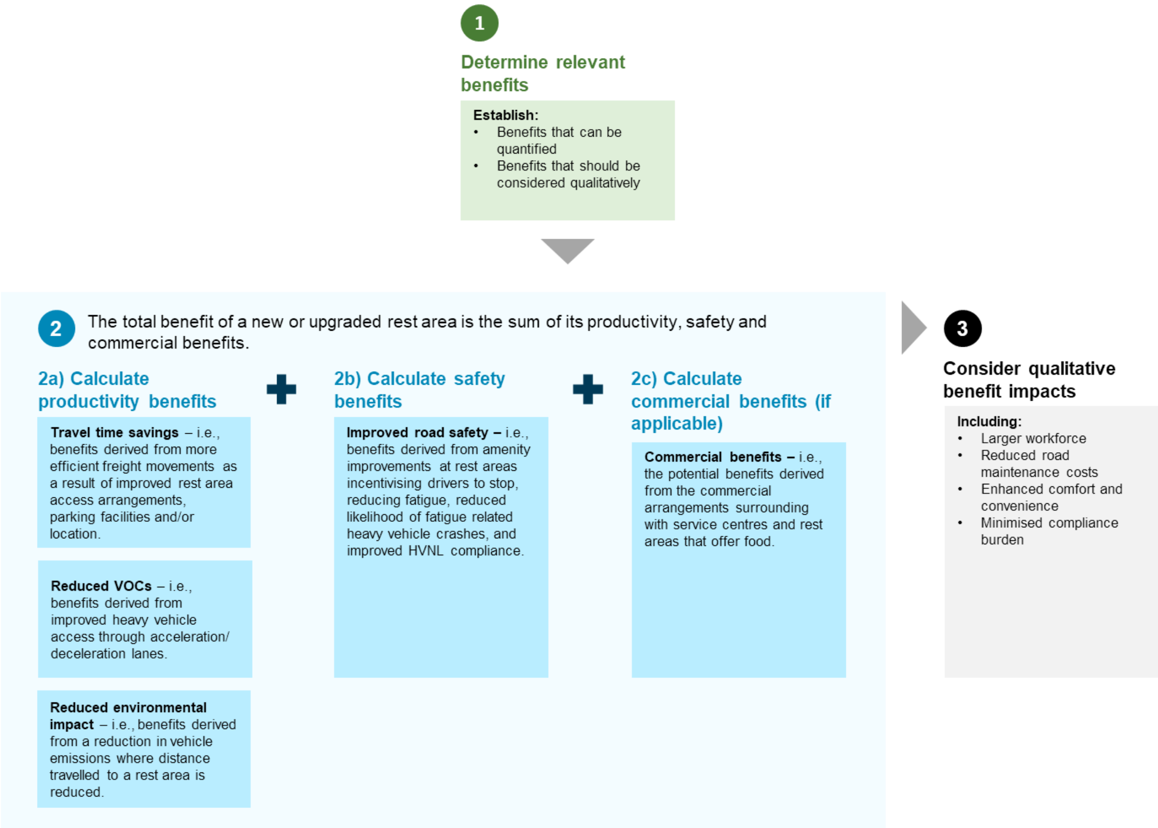
1.5 Benefits quantification methodology overview

The benefits categories determined through the benefits map provide a framework for the following methodology.

To estimate the benefits of an upgrade to or delivery of a new heavy vehicle rest area, a practitioner should follow a few steps, as presented in Figure 2: Methodology overview and outlined below:

1. Determine benefits relevant in the specific project context
2. Calculate the total benefit of project by:
    a. Calculating productivity benefits
    b. Calculating safety benefits
    c. Calculating commercial benefits (if applicable)
3. Considering the impact of qualitative benefits.

Figure 2: Methodology overview



Source: NineSquared (2023)

The remainder of this methodology is set out against each of these benefit categories. General issues that practitioners should consider when using this Guideline are discussed below.

1.6 Considerations for practitioners when using this Guideline

When evaluating and estimating the benefits of new and upgrades to rest areas, the following issues should be considered:

- Each project should be considered holistically in the network context. This avoids potential double counting issues that could arise if especially new developments are considered in isolation and re-distribution effects omitted.
- Amenities are important and better rest stops lead to better outcomes. Options for different concepts for the development or upgrade of rest areas should be tested when developing a project. This will ensure the best possible trade-off between cost and benefits.
- The costs associated with accessing poorly designed rest areas can be high. Access, parking and egress should be designed in a way that avoids tight cornering and reversing as much as possible.

- The current rest area network in many regions appears heavily focused on light vehicles. Enabling heavy vehicle access to sites focused on light vehicles could be a cost-effective way of improving outcomes for industry and road safety.
- Opportunities for commercial facilities at rest areas can improve driver experience and reduce the costs of developing and operating rest areas for government and should be explored where appropriate.
- Heavy vehicle drivers and operators and/or relevant industry bodies should be engaged as part of the process of defining rest area projects, with the level of engagement commensurate with project size.

2 Productivity benefits

Productivity benefits are realised through better access to rest areas. This can be through more efficient route options and/or better access and exit arrangements. Reducing travel distances can provide productivity benefits in the form of:

- Time savings per vehicle through shorter travel times (see Section 2.1)
- Vehicle Operating Cost (VOC) savings per vehicle through shorter travel times and smoother deceleration and acceleration (see Section 2.2)
- Environmental benefits associated with short travel times (see Section 2.3).

2.1 Heavy vehicle travel time savings

Road freight travel time savings refer to the benefits of fast travel times for freight vehicles. This benefit relates specifically to the time value of freight commodities, and therefore is only applicable to loaded trips for road freight vehicles.

Well-designed rest areas can also support more efficient travel times for heavy vehicles by enabling higher access and egress speeds and can reduce the distance an operator needs to travel to take a break.

Therefore, where low quality rest areas are upgraded to meet the standards of high-quality rest areas, or where a high-quality rest area is delivered where there is not currently a rest area, there is the potential to provide travel time savings for heavy vehicle operators.

2.1.1 What problems or constraints caused by rest areas are related to road freight travel time?

The key problems or constraints that relate to road freight travel time include:

- Lack of appropriate access arrangements (e.g., acceleration or deceleration lanes) at rest areas mean that heavy vehicles must slow excessively to make sharp turns into heavy vehicle rest areas.
- Some heavy vehicle rest areas in key locations do not have sufficient space to support decoupling, HPVs, OSOM or dangerous goods vehicles, as a result, operators must drive further than required, or detour to access an appropriate rest area.
- Some heavy vehicle rest areas have space for decoupling/ HPVs/ OSOM/ dangerous goods vehicles, but in low quantities and therefore drivers may need to wait to park, or travel to another rest area.
- A lack of decoupling facilities close to major metropolitan centres limits the use of larger vehicles which can carry larger loads more efficiently.
- Rest areas are not necessarily located at appropriate stopping intervals according to legislative stopping requirements and therefore drivers may have to detour or stop earlier than required to comply.
- Some rest areas are located off main freight routes, with limited alternatives. This means that drivers may have to exit a highway and drive additional distance at low speeds to access a rest area.

2.1.2 What are the interventions that can support heavy vehicle travel time improvements?

There are several interventions that may support travel time improvements for heavy vehicles, as set out in the table below.

Table 1: Interventions relevant to heavy vehicle travel time savings, by intervention category

Upgrades to rest areas	New rest area
• Upgrades to ensure an appropriate number and size of parking spaces, including space for decoupling, HPVs, OSOM and dangerous goods vehicles • Improved access for trucks through acceleration and deceleration lanes	• New high quality rest area delivered at an appropriate interval according to legislative stopping requirements, where: ○ there is not currently a rest area **or** ○ the new rest area would replace a rest area that currently requires a detour off a major highway at slow speeds to access it.

2.1.3 What are the outcomes associated with travel time benefits?

Outcomes associated with improved travel time benefits from rest area improvements and the delivery of new rest areas include:

- More efficient freight operations that will reduce costs for producers, operators and customers.
- Increased utilisation of heavy vehicles to support fast deliveries to customers.

2.2 Reduced heavy vehicle operating costs

Operating a heavy vehicle involves substantial financial costs including refuelling, buying new tyres or getting the vehicle serviced. Vehicle operating costs (VOCs) are the sum of these costs. These costs are influenced by the speed of travel, road condition and environment. For example, fuel is consumed at a higher rate per kilometre when there is a reduction in speed, or an increase in gradient.

High quality rest areas can lower VOCs as they enable the use of higher access speeds, and slow acceleration back onto the highway. They also can reduce the distance an operator needs to travel to take a break, also reducing VOCs.

This benefit is closely linked to the travel time saving benefit discussed previously.

2.2.1 What problems or constraints caused by rest areas are related to heavy vehicle operating costs?

The key problems or constraints that relate to heavy vehicle operating costs include:

- Lack of appropriate access arrangements (e.g., acceleration or deceleration lanes) at rest areas mean that heavy vehicles must slow excessively to make sharp turns into heavy vehicle rest areas. This also means that drivers must accelerate aggressively to re-enter a highway at a safe speed once they have rested. This type of driving behaviour incites higher VOCs through increased fuel burn and wear and tear.
- Some heavy vehicle rest areas in key locations do not have sufficient space to support decoupling, HPVs, OSOM or dangerous goods vehicles, as a result, operators must drive further than required, or detour to access an appropriate rest area.
- Some heavy vehicle rest areas have space for decoupling/ HPVs/ OSOM/ dangerous goods vehicles, but in low quantities and therefore drivers may need to wait to park, or travel to another rest area.
- Rest areas are not necessarily located at appropriate stopping intervals according to legislative stopping requirements and therefore drivers may have to detour or stop earlier than required to comply, requiring additional fuel.
- Some rest areas are located off main freight routes, with limited alternatives. This means that drivers may have to exit a highway and drive additional distance at low speeds to access a rest area, driving up VOCs.

2.2.2 What are the interventions that can support reduced vehicle operating costs?

Table 2: Interventions relevant to reduced vehicle operating costs, by intervention category

Upgrades to rest areas	New rest area
• Upgrades to ensure an appropriate number and size of parking spaces, including space for decoupling, HPVs , OSOM and dangerous goods vehicles • Improved access for trucks through acceleration and deceleration lanes	• New high quality rest area delivered at an appropriate interval according to legislative stopping requirements, where: ○ there is not currently a rest area **or** ○ the new rest area would replace a rest area that currently requires a detour off a major highway at slow speeds to access it.

2.2.3 What are the outcomes associated with reduced VOCs?

Outcomes associated with reduced VOCs because of rest area improvements and the delivery of new rest areas include:

- More efficient freight operations that will reduce costs for producers, operators and customers.

2.3 Reduced environmental impacts

Heavy vehicles account for a disproportionate share of noxious road vehicle emissions. Heavy vehicles constitute approximately 4% of road vehicles in Australia but perform about 8% of road vehicle kilometres travelled (VKT) and account for 23% of all road transport fuel consumed in Australia.[5] The further a heavy vehicle travels, the greater the vehicle emissions produced.

High quality rest areas located close to major freight routes reduce the distance an operator needs to travel take a break and therefore reduce environmental impacts. Where low quality rest areas are upgraded to meet the standards of high-quality rest areas, or where a high-quality rest area is delivered where there is not currently a rest area, there is the potential to reduce environmental impacts.

This benefit is closely linked to travel time saving and VOC benefits.

2.3.1 What problems or constraints caused by rest areas are related to environmental impacts?

The key problems or constraints that relate to environmental impacts caused by heavy vehicles include:

- Some heavy vehicle rest areas in key locations do not have sufficient space to support decoupling, HPVs, OSOM or dangerous goods vehicles, as a result, operators must drive further than required, or detour to access an appropriate rest area.
- Some heavy vehicle rest areas have space for decoupling/ HPV/ OSOM/ dangerous goods vehicles, but in low quantities and therefore drivers may need to wait to park, or travel to another rest area.
- Rest areas are not necessarily located at appropriate stopping intervals according to legislative stopping requirements and therefore drivers may have to detour or stop earlier than required to comply, causing additional fuel burn.
- Some rest areas are located off main freight routes, with limited alternatives. This means that drivers may have to exit a highway and drive additional distance at low speeds to access a rest area.

2.3.2 What are the interventions that can support reduced environmental impacts?

Table 3: Interventions relevant to reduced environmental impacts, by intervention category

Upgrades to rest areas	New rest area
• Upgrades to ensure an appropriate number and size of parking spaces, including space for decoupling, HPVs, OSOM and dangerous goods vehicles	• New high quality rest area delivered at an appropriate interval according to legislative stopping requirements, where: ○ there is not currently a rest area **or** ○ the new rest area would replace a rest area that currently requires a detour off a major highway at slow speeds to access it.

2.3.3 What are the outcomes associated with reduced environmental impacts?

Outcomes associated with reduced environmental impacts because of rest area improvements and the delivery of new rest areas include:

- Progress towards zero emissions and climate change outcomes in line with broader NSW and Australian government policy objectives.

2.4 Guide to quantifying productivity benefits

Due to the strong relationship between travel time savings, reduced vehicle operating costs and reduced environmental impacts and their common inputs, it is recommended that these benefits are evaluated concurrently.

The table below presents the method for calculating productivity benefits. Note, this methodology will derive productivity on a per vehicle level. For assessing proposed upgrades or new rest areas, these need to be annualised to account for all vehicles expected to use that rest area. An example of a productivity benefit calculation is shown in the following section.

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[5] Commonwealth of Australia (2020), *Heavy Vehicle Emission Standards for Cleaner Air: Draft Regulation Impact Statement.*

Table 4: Method for calculating productivity benefits

#	Task	Description
1	**Extract base demand for rest area (s) to be assessed**	To begin, base demand must be established for rest areas to be assessed. Where project specific estimates are available, these should be used, however, in the absence of this information the average demand levels by rest area type presented in Appendix D, Table D1 can be used. Table D1 has been derived from information published in the National Freight Data Hub. The National Freight Data Hub uses telematics data to estimate demand for rest areas across Australia. Using a sample of over 10,000 vehicles sourced from the Bureau of Infrastructure, Transport and Research Economics (BITRE) and Transport Certification Australia (TCA), the dataset contains a snapshot of demand for most rest areas. As VOC savings are vehicle type specific, the regional typical fleet composition presented in Table D2 can be used in the absence of other information.
2	**Calculate per vehicle benefits**	Several benefits can then be calculated by applying the relevant parameters presented in Appendix A and Appendix B: • Time savings per vehicle per shortened access route • VOC savings per vehicle per shortened access route • Environmental benefits per vehicle per shortened access route • VOC savings per vehicle per access • Time savings per vehicle per access (likely very small)
3	**Apply savings to demand**	Per vehicle benefits can be annualised by applying the relevant average demand levels presented in Task 1. If demand is assessed specifically for the proposed upgrade or new facility and can be considered more fit for purpose than the data identified in step 1, these could be used as an alternative. However, to ensure the analysis is representative of the effects at a network level, facilities and their demand should be considered in isolation. This is also why upgrades and new rests stops should be valued differently.
3a	**Values for <u>upgrades to existing rest areas</u>, and extrapolate from base demand**	For valuing an upgrade to an existing facility, demand of the previous type of rest area should be used as the basis for the valuation. This could be a conservative approach as demand could increase if new or improved facilities are provided for drivers. However, this demand may be a re-distribution from existing facilities and therefore poses the risk of double counting. For upgrades, only **VOC** applies. They can be grown with traffic volumes if justifiable. There could be minimal t**ravel time and environmental benefits** which are not included within the calculations.
3b	**Values for <u>new rest areas,</u> and extrapolate from base demand**	For valuing new rest areas, demand of the associated type (as specified in Appendix D, Table D1) of rest area should be used as the basis for the valuation. Implicitly this approach assumes that demand for this rest area is associated with vehicles that diverted from the main route before. The new facility now allows them to remain on the main route and does not redirect traffic from other (existing) rest areas. Following this logic, therefore, the risk of double counting is limited. Benefits can be derived for time and VOC savings for both the shortened route and associated improved access. They can be grown with traffic volumes if justifiable. Benefits can be derived for **travel time, environmental** and **VOC savings for both the shortened route and associated improved access**. They can be grown with traffic volumes if justifiable.

2.5 Productivity benefit calculation example

Hypothetical project description
This hypothetical project involves the construction of a new rest area, in an area where there are no existing facilities. Truck drivers currently needing to take a break around this location must divert from a major highway to access rudimentary rest area facilities off the route. The project in this scenario involves the delivery of a new high quality rest area directly connected to the main highway.

Investment Logic Mapping

The investment logic map below outlines the key problems, outcomes and benefits associated with the project.

Problem/ Opportunity	Project Outcomes	Benefits
• There is no rest area or existing facilities.	• Delivery of a new rest area at an appropriate break interval on major highway.	• Travel time savings (productivity) and environmental. • VOC savings (productivity). • Improved safety through better fatigue management (Section 3.3)

Quantifying productivity benefits

Data gathering

Assume that the practitioner derives the following information.

- There are 1193 annual visits to the rest area.
- Travel time accessing the rest area and returning to the main route under the project case will decrease from 0.144 hours to 0.038 hours. This is a result of the associated travel distance decreasing from 6.34 km to 2.46 km.
- According to TfNSW Economic Parameters, these travel time cost for heavy vehicles is assumed to be $22.36 (dollars/ vehicle hour)
- Environmental costs are the summation of carbon costs, Well- To- Tank (WTT) and air pollution costs.
- According to TfNSW Economic Parameters, these environmental costs sum to $0.1242 (dollars/ hour)
- According to TfNSW Economic Parameters, VOC speed costs decrease from $0.28 to $0.25 (dollars/km)

Productivity benefit calculations are outlined below whilst safety benefit calculations can be found on page 20.

Travel Time Benefits

Base case
= (Travel time (hrs) * route distance cost ($/ vehicle hour)) * annual visits
= (0.144hrs*$22.36) *1193
= $3,841.48

Project case
= (Travel time (hrs) * route distance cost ($/ vehicle hour)) * annual visits
= (0.038hrs*$22.36) *1193
= $1013.72

Incremental travel time benefits
= Base case – project case
= $2827.75

Environmental Benefits

Base case
= ((Carbon cost (dollars/km) +WTT (dollars/km) +air pollution (dollars/km) +) * route distance (km)* annual visits
= ($0.1242* 6.34) *1193
= $939.40

Project Case
= ((Carbon cost (dollars/km) +WTT (dollars/km) +air pollution (dollars/km) +) * route distance (km)* annual visits
= ($0. 1242* 2.466) *1193
=$365.39

Incremental environmental benefits
= $939.40-$365.39
= $574.01

Vehicle Operating Cost (VOC) Benefits
Base case = ((VOC speed cost (dollars/km) * route distance(km)) + (deceleration benefit * 2)) * annual visits = (($0.28 * 6.34) + (0.29*2)) * 1193 = $2.35*1193 = $2806.73 **Project case** = ((VOC speed cost (dollars/km) * route distance(km)) + (deceleration benefit * 2)) * annual visits = (($0.25 * 2.46) + (0.24*2)) * 1193 = $1.09*1193 = $1297.24 **Incremental VOC benefits** = $2806.73- $1297.24 = $1509.24

3 Safety benefits

Safety benefits are realised through improving access to, and the quality of rest areas, as these encourage more drivers to stop and rest, and support improved compliance with the HVNL. This can be through improvements in the network density offering (which enable more efficient route options and/or better access and exit arrangements), and delivery of facilities at rest areas that improve comfort and convenience for drivers. Safety benefits are comprised of:

- Improved road safety as more drivers are encouraged to stop and rest.

3.1 Improved road safety

Driver fatigue is one of the top three contributors to fatal crashes on NSW roads, therefore minimising fatigue is a key factor in improving road safety. Maximising the use of rest areas is critical to achieving this. In this context, improved road safety refers to the benefits of reduced fatal crashes involving freight vehicles.

High quality rest areas support improved road safety as they provide an opportunity for heavy vehicle drivers to conveniently stop and incentivise drivers to take breaks through a variety of amenity related facilities. They also improve road safety, enabling trucks to access and exit rest areas at safe speeds. Therefore, where low quality rest areas are upgraded to meet the standards of high-quality rest areas, or where a high-quality rest area is delivered where there is not currently a rest area, there is the potential to deliver road safety improvements.

3.1.1 What problems or constraints caused by rest areas are related to road safety?

The key problems or constraints that relate to road safety include:

- Lack of appropriate access arrangements (e.g., acceleration or deceleration lanes) at rest areas mean that heavy vehicles enter and exit the highways at unsafe speeds, impacting surrounding traffic.
- Rest areas are not necessarily located at appropriate stopping intervals according to legislative requirements and therefore drivers may have to detour or drive further than is legal to take a break.
- Facilities at rest areas range from basic (i.e., a hardstand with a rubbish bin), to more advanced (i.e., parking facilities with a food outlet, shelter, toilets, table and chairs). Some rest areas also incorporate service centres. The range of facilities at rest areas mean that drivers may choose to bypass some basic rest areas in favour of higher quality facilities, even if they are overdue for a break, increasing the likelihood of fatigue.
- Some rest areas are located off main freight routes, with limited alternatives. This means that drivers may have to exit a highway and drive additional distance at low speeds to access a rest area, increasing time between breaks and increasing the likelihood of fatigue.

3.1.2 What are the interventions that can support road safety improvements?

There are several interventions that may support road safety improvements for heavy vehicles, as set out in the table below.

Table 5: Interventions relevant to heavy vehicle road safety, by intervention category

Upgrades to rest areas	New rest area

• Improved access for trucks through acceleration and deceleration lanes.
• Amenity improvements to enhance comfort and convenience for drivers.
• Transforming a basic rest area into a more sophisticated rest area (e.g., service centre) would constitute an upgrade.
	• New high quality rest area delivered at an appropriate interval according to legislative stopping requirements, where:
	  ○ there is not currently a rest area
	  or
	  ○ the new rest area would replace need to access services in a town by detour off a major highway at slow speeds.

3.1.3 What are the outcomes associated with improved road safety?

Outcomes associated with improved road safety from rest area improvements and the delivery of new rest areas include:

- Drivers are less fatigued, resulting in fewer fatigue related crashes.
- Improved compliance with the HVNL.

3.2 Guide to quantifying safety benefits

To develop a methodology for calculating safety benefits, an empirical model was developed to isolate the effects of rest areas on fatigue related crashes at a network level. This involved mapping driving times between rest areas and crash sites.

The empirical model breaks down rest area sites in NSW into several types[6]:

- **Basic rest area:** limited facilities such as rubbish bins and parking areas
- **Rest area with a toilet:** toilet facilities are located immediate to parking
- **Rest area with food offer and a toilet:** designated rest spaces with food outlet/s and toilet provision
- **Service centres:** larger rest areas, typically featuring refuelling services, alongside food and toilet provision.

Using this approach, the model estimates the typical contribution of each rest area type to road safety, allowing improvements to the rest area network to be modelled by reclassifying an existing rest area or by adding new ones to the respective rest area type. This framework considers each project holistically in the network context. It therefore avoids potential double counting issues that could arise if new developments are considered in isolation and re-distribution effects omitted.

A **standardised calculation sheet** is provided on the TfNSW website to facilitate the calculation of safety benefits.

The Table below outlines the method for calculating safety benefits for both upgrades to existing rest areas and the delivery of new rest areas.

Table 6: Method for calculating safety benefits

#	Task	Description
1	**Upgrade rest area network**	For upgrades, reclassify the rest area(s) from their current type to the type that most appropriately reflects their new features. These features should be identified through the project scope (see project scoping requirements as set out in Section 1.3). For example, if adding a toilet, reclassify the associated basic rest area to one with a toilet. For new rest areas, add a new location to the relevant type. For example, a new service centre which is not on the site of the existing other rest area should be added to the network of service centres.
2	**Recalculate distances from crashes under project case**	Using route planning software, for the four types of rest areas, recalculate the driving time from each crash in the dataset to the respective nearest rest areas in the updated network. This step will result in up to four new driving distances from each crash site: • From basic rest area • From rest area with toilet facilities • From rest area with food offer • From rest area with food offer and toilet facilities • From service centre
3	**Apply empirical model to updated network and distances**	Using the **standardised calculation sheet**, apply the empirical model to the updated driving times to estimate the network-wide safety effect of the proposed improvement or addition to the rest area network. This sheet contains: • Relevant crash location • Driving times from existing rest area network and process for including project case distances • Coefficients and other relevant variable values (to remain constant)

[6] Note, this categorisation is different to the rest area classes outlined in the Austroads *Guidelines for the Provision of Heavy Vehicle Rest Areas* (2019) to enable more granularity in analysis especially regarding amenity.

#	Task	Description
4	**Calculate avoided crashes**	The **standardised calculation sheet** projects the change in crash frequencies resulting from the updated rest area network and associated driving times. It applies their (relative) change from base to project case to the historic crashes to estimate the number of avoided crashes to derive an expected number of annually avoided crashes. Annual avoided crashes can be used as the benefits driver over the design life of the improvement(s) to the rests top network and grown with traffic volumes if justified.
5	**Monetise benefit of avoided crashes**	The TfNSW Guidelines provide societal cost for crashes based on severity. Derived from the fatigue related crash data, the table in Appendix G develops weights for these costs derived from the mix of severities of the historic fatigue related crashes with trucks as primary vehicle. The thus derived average cost of a fatigue related heavy vehicle crash of $267,445 can be applied to the avoided crashes to monetise their benefits.

3.3 Safety benefit calculation example

This example is part of the same hypothetical project as described on page 15.

The approach to calculating safety benefits is set out below.

Safety Benefits
Base case = (Number of crashes in base case * cost of a crash) = (71 * $2,016,700) = $142,380,000 **Project case** = (Number of crashes in base case * cost of a crash) = (71 * $2,016,700) = $61,540,000 **Incremental safety benefit** = $142,380,000-$61,540,000 =$80,840,000

4 Commercial benefits

The supply of fuel and/or food at service centres and rest areas designated by TfNSW is carried out by privately owned businesses. While mobile vendors typically need only to be granted approval by the relevant Council and TfNSW to operate, permanent cafes or fuel stations may involve commercial arrangements with TfNSW. Arrangements could include:

- Rental of existing TfNSW owned premises.
- A Public Private Partnership (PPP) between the proponent and TfNSW made during the planning and development phase. Under this arrangement a proponent could contribute to the cost of development and commit to managing the outlet for a certain number of years.
- Concession arrangements, in which private entities are granted the rights to operate and profit from infrastructure assets for a specific period, while the ownership remains with the government or public sector.

These arrangements are intended to serve as examples only and there may be other arrangements under which service centres or food outlets are delivered and managed.

The provision of service centres or food outlets may also create economic benefit for business owners, workers and the local community. This is particularly the case for rest areas located in rural and regional areas, whereby the rest area offers a source of employment and encourages travellers to stop and spend money, stimulating the local economy.

4.1 Guide to quantifying commercial benefits

The commercial benefits associated with service centres and rest areas that offer food, in terms of revenue and operating expenditure, should be considered as part of economic appraisals. Due to the nature and variety of arrangements, potential benefits are best considered on a case-by-case basis.

Practitioners are cautioned to only consider producer surplus to avoid overstating benefits.

In the absence of information regarding the potential commercial arrangements of a rest area, these benefits should be considered qualitatively.

5 Qualitative benefits

The following qualitative benefits should be considered when evaluating new and improved heavy vehicle rest areas.

5.1 Larger workforce

Labour availability and skills shortages have been a challenge for the freight and logistics industry for several decades. Historically, the profession has typically been seen as laborious, dangerous, and male dominated making it a challenge to attract and retain staff. In September 2022, there were around 2,000 driver vacancies in Queensland alone.[7]

Representation of young people and women within the profession is particularly low. Females make up 3% of truck drivers in Australia, and the average age of a truck driver is 47.[8] Encouraging young people and women to join the profession has been a particular challenge for the industry due to some of the more unfavourable aspects of the job, including long, sedentary work hours, and the requirement to be away from family and home responsibilities for days at a time.

Safety concerns have also been found to contribute to low recruitment and retention rates of female truck drivers. Many of these concerns relate to safety at rest areas, which are often located in isolated locations. While limited analysis has been undertaken in Australia, an online survey of female truck drivers in the US conducted by Women in Trucking (WIT) found that of the 450 professional drivers that completed the survey, 85.5% said that rest areas are unsafe spaces for women.[9]

5.1.1 CBA application

While broadly unquantifiable due to unavailability of data, it is likely that amenity improvements relating to safety, for example improved lighting and security measures at rest areas across NSW could play a role in incentivising women and young people to join the profession. This could support broadening and diversity of the workforce, improve labour availability, and play a role in addressing skills shortages.

These benefits could be considered qualitatively as part of an economic appraisal of upgrades to, or the delivery of new high quality rest areas.

5.2 Reduced road maintenance costs

Trucks are large and heavy and contribute more significantly to road wear and tear than light vehicles. As a small segment of the total vehicle fleet (3%), heavy vehicles impose a disproportionate cost on the network through additional maintenance (wear and tear) and capital requirements (infrastructure strengthening).[10] To compensate for this, heavy vehicle operators pay charges intended to recover the costs of their road use.

Requirements to undertake harsh braking or acceleration to meet road conditions while operating heavy vehicles - e.g., slowing from 100km/hr to 20km/h to make a sharp turn into a rest area off the highway has the potential to create additional wear and tear, beyond what is expected under regular vehicle operation.

5.2.1 CBA application

Improvements to rest area access through the development of improved acceleration or deceleration lanes would remove the need for heavy vehicle operators to brake heavily or accelerate quickly to leave or re-enter a highway. Resultingly, it is likely that delivery of improved access at rest areas could play a role in reducing road maintenance costs around rest areas.

While this benefit could be quantified in the context of an upgraded rest area, it is likely to deliver minor benefits. While travel may be shorter, the upgrade may result in more pavement to maintain which could partially offset those small savings. Consequently, it is recommended that these benefits are considered qualitatively.

5.3 Enhanced comfort and convenience

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7 ABC (2022), Truck Driver shortage prompts haulage company to offer salary of $150k to attract 'good' operators, online at: https://www.abc.net.au/news/rural/2022-09-23/trucking-company-offers-big-salary.
8 Australian Government (2021), Labour Market Insights, Truck Drivers (General), online at: https://labourmarketinsights.gov.au/.
9 Women in Trucking (2022), Women in Trucking Female Driver Safety and Harassment Survey.
10 DIRDCA (2018), Heavy Vehicle Road Reform: Changes to heavy vehicle road delivery – background paper.

Beyond providing a place for rest to reduce fatigue related crashes, rest areas provide comfort and convenience for road users. Comfort and convenience at rest areas is mainly derived from the type and quality of facilities located at that site. Facilities such as drinking fountains, bathrooms, the provision of food, sufficient parking areas for heavy vehicles, shelter, and tables and chairs and the other amenities enhance comfort and convenience for heavy vehicle drivers. Therefore, a basic rest area is likely to deliver lower comfort and convenience benefits than a rest area with the provision of food and a toilet.

The provision of these facilities is also likely to influence a heavy vehicle driver to stop at one rest area over another and may impact on the length that a driver stays at a particular rest area. For example, if a driver is able to purchase food and drink at a rest area, this is likely to incentivise a longer rest period than if only litter bins are on offer. A well-used rest area may also provide opportunities for social interaction, contributing to improved personal wellbeing and mental health.

5.3.1 CBA application

It is generally accepted that the benefits of comfort and convenience offered by rest areas are intangible and hard to quantify directly. As such, benefits relating to comfort and convenience should be considered qualitatively in economic appraisals.

5.4 Minimised compliance burden

As described in Section 1.1, heavy vehicle operators are legislated under the HVNL and associated regulations, administered by the NHVR. Drivers must comply with certain maximum work and minimum rest limits, which prescribe that an operator must drive for no longer than 5.5 hours before taking a break.

The ability for a heavy vehicle driver to comply with the requirements of HVNL relies on the provision of frequent and adequate rest areas, especially along major freight routes. If there is not a rest area at an appropriate time interval to support a driver in meeting their rest requirements, a driver may:

- Stop earlier than required, impacting trip efficiency
- Detour to a town or nearby rest area, increasing trip time
- Pull over in an unsafe shoulder zone
- Breach rest requirements and travel to next available rest area, reducing safety.

The provision of frequent rest areas at appropriate intervals helps to minimise the decisions truck drivers need to make regarding where to rest, and instead supports truck drivers in resting when required, minimising the burden of compliance with HVNL.

5.4.1 CBA application

The benefits associated with minimised compliance burden are intangible and hard to quantify directly. In the absence of accurate and up to date data regarding compliance with HVNL rest requirements in the locality of interest, it is suggested that these benefits are considered qualitatively in economic appraisals.

6 Costs

6.1 Capital costs

The capital costs associated with upgrading or developing a new rest area must be considered in an economic appraisal. These costs should be considered on a case-by-case basis and should be outlined in the project scope. At a minimum, consideration should be given to the costs of:

- Land acquisition
- Construction, including project management– the administrative cost of producing a fixed tangible capital asset
- Infrastructure development e.g., toilets and amenity
- Signage
- Refurbishment and upgrading costs over the life of the asset
- Decommissioning costs.

6.2 Operating and maintenance costs

While amenity improvements at rest areas across NSW are likely to deliver considerable benefits to heavy vehicle operators and the broader community, new facilities including toilets and food services require maintenance, which should be considered as an additional (operating) cost in economic appraisals.

Austroads guidelines for the provision of heavy vehicle rest area facilities[11] outline a number of issues that may require ongoing maintenance. The cost of this maintenance should be considered in an economic appraisal. Issues for consideration are summarised below:

- Water provision – there may be circumstances where access to potable water is limited. In these situations, consideration should be given to the provision of potable water storage facilities and the implications for maintenance of adequate potable water supplies in the storage facility.
- Amenities and facilities – e.g.
  - Toilets require cleaning (potentially frequently)
  - Rubbish bins require emptying
  - Building materials may require maintenance, including removal of graffiti/ other vandalism
- Vandalism and rubbish - Poor user behaviour (littering, rubbish dumping, vandalism of assets such as tables, toilets, lighting, shelters, and visitor information boards) can contribute to ongoing maintenance issues.
- Pavement maintenance.
- Provision of natural shade may require maintenance to ensure that vegetation is safe and suitable for the rest area.
- Updates to visitor information boards.

The costs associated with maintenance will vary on a case-to-case basis and should be outlined in the project scope. In the absence of such project specific cost estimates, the table below sets out the indicative cost of maintenance by rest area work type. These values can be multiplied by an estimated annual quantity to calculate indicative maintenance costs.

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[11] Austroads (2019), *Guidelines for the Provision of Heavy Vehicle Rest Area Facilities,* pg.27.

Table 7: Indicative maintenance costs, by rest area type

Item	Description of work	Average annual visits	Unit	Rate per unit (ex GST)
1.	Maintenance of rest area without roadside toilets	365	Visits	$75.00
2.	Maintenance of minor rest areas with roadside toilets exclusive of filling water tanks	365	Visits	$146.00
3.	Maintenance of major rest area with roadside toilets	465	Visits	$208.00
4.	Miscellaneous			
4a.	Emergency call out during standard hours	-	Visit	$295.00
4b.	Emergency call out after hours	-	Visit	$395.00
4c.	Pump out and disposal of liquid waste product	-	KL	$180.00

Source: TfNSW

Appendix

A. Parameters for time saving and environmental productivity benefits

Item	Variable	Value/formula		Source
Time saving benefit	B_{Time}	$B_{time}(\$/year) = VV * \Delta T\ (hr) * VFT(\$/hr)$		
Environmental benefit	B_{Env}	$B_{Env} = (D_{BC} – D_{PC}) * EC$		
Carbon cost	Cc	*9.15c/VKT*		TfNSW Guidelines for FY24
Well To Tank (WTT)	WTT	*2.47c/VKT*		TfNSW Guidelines for FY24
Air pollution cost	AP	*0.8c/VKT*		TfNSW Guidelines for FY24
Route length to current rest area / town	D_{BC}	Base case variable		To be determined as part of design
Route length with new rest area	D_{PC}	Project case variable		To be determined as part of design
Speed after turn-off from highway	v_i	Segment specific desired speed specific to base and project case routes off the highway		To be determined as part of design
Deceleration profile	$Decel_i$	See next page		
Time to access rest area	T_i	$T_i = D_i / v_i + Decel_i$		NA
Time savings	ΔT	$\Delta T = T_{BC} - T_{PC}$		NA
Value of freight time	VFT	Vehicle Type	VOTT ($/vehicle hour)	TfNSW Guidelines
		Light Rigid	0.98	
		Heavy Rigid	9.06	
		Articulated Truck (4 Axle)	19.48	
		Articulated Truck (6 Axle)	26.79	
		B-Double	39.46	
		A-Double	51.81	

		A B Combination	63.71	
		Double B-Double	77.25	
Vehicle volume per year	VV	To be identified in analysis, e.g., from traffic count data, typical truck size and freight densities. As benchmark guidance, average values by demand by rest area type and a regional freight fleet breakdown can be found on page 62.		NA

B. Parameters for deceleration productivity benefits

Item	Variable	Value/formula					Source
Deceleration benefit	B_{Decel}	$\sum_{d=1000}^{0} VOC(v_{BC}) - \sum_{d=1000}^{0} VOC(v_{PC})$					NA
Distance to stop	d	Used in 10m segments from 1,000m to 0m					NA
Curve radius at turn-off	R	Base and project case variable					To be determined as part of design
Distance from turn-off to bay	DB	Base and project case variable					To be determined as part of design
Travel speed	v	Segment specific desired speed					To be determined as part of design
Target speed at turn-off	TV	TV = -54.833 * 23.998 ln(R)					TMR: Road Planning and Design Manual, Chapter 6
Gravity acceleration	g	9.8 m/s^2					TMR: Road Planning and Design Manual, Chapter 9
Longitudinal deceleration coefficient	c		SPM & semi	B double	Road train 1	Road train 2	Derived from TMR: Road Planning and Design Manual, Chapter 9, Chapter 15 and AustRoads: Guide to Road Design Part 3: Geometric Design
		Below 70 km/h	0.29	0.27	0.25	0.21	
		Below 90 km/h	0.28	0.26	0.23	0.20	
		Above 90 km/h	0.26	0.24	0.21	0.19	
Minimum deceleration distance	DD	DD = Sqrt(2 * g * c * v)					TMR: Road Planning and Design Manual, Chapter 9
VOC by speed bracket	VOC(v)	0 to 10 km/h	114.58 cent/km	50 to 60 km/h	25.99 cent/km		TfNSW Guidelines
		10 to 20 km/h	49.62 cent/km	60 to 70 km/h	24.63 cent/km		
		20 to 30 km/h	36.62 cent/km	70 to 80 km/h	23.63 cent/km		
		30 to 40 km/h	31.06 cent/km	80 to 90 km/h	22.87 cent/km		
		40 to 50 km/h	27.96 cent/km	90 to 100 km/h	22.26 cent/km		

C. Deceleration profile and VOC

Distance to stop (m)	SPM and Semi		B-double		Road Train 1		Road Train 2	
	Speed (km/h)	VOC per 10m in cents	Speed (km/h)	VOC per 10m in cents	Speed (km/h)	VOC per 10m in cents	Speed (km/h)	VOC per 10m in cents
250	100	0.223	100	0.223	100	0.223	100	0.223
240	100	0.223	100	0.223	100	0.223	100	0.223
230	100	0.223	100	0.223	100	0.223	100	0.223
220	100	0.223	100	0.223	100	0.223	100	0.223
210	100	0.223	100	0.223	100	0.223	99	0.229
200	100	0.223	100	0.223	100	0.223	97	0.229
190	100	0.223	100	0.223	100	0.223	95	0.229
180	100	0.223	100	0.223	99	0.229	92	0.229
170	100	0.223	100	0.223	96	0.229	89	0.236
160	100	0.223	99	0.229	93	0.229	90	0.236
150	100	0.229	96	0.229	90	0.229	87	0.236
140	96	0.229	93	0.229	87	0.236	84	0.236
130	93	0.229	90	0.236	87	0.236	81	0.236
120	89	0.236	89	0.236	84	0.236	78	0.246
110	88	0.236	85	0.236	80	0.236	74	0.246
100	84	0.236	81	0.236	76	0.246	71	0.246
90	80	0.236	77	0.246	73	0.246	67	0.260
80	75	0.246	72	0.246	68	0.260	66	0.260
70	71	0.246	68	0.260	66	0.260	61	0.260
60	65	0.260	64	0.260	62	0.260	57	0.280
50	61	0.260	59	0.280	56	0.280	52	0.280
40	54	0.280	53	0.280	50	0.280	46	0.311
30	47	0.311	46	0.311	44	0.311	40	0.311
20	38	0.366	37	0.366	36	0.366	33	0.366
10	27	0.496	26	0.496	25	0.496	23	0.496
0	0	1.146	0	1.146	0	1.146	0	1.146

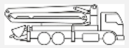
D. Productivity benefits annualisation parameters

In the absence of tailored project specific information, the tables below can be used as guides for annual demand by rest area type and average fleet mix by locality.

Table D1

Rest area type	Visits (Average annual)
Service centre	6,540
Food	6,348
Toilet	1,193
Basic	706

Table D2

Vehicle class	Vehicle example	Inner Regional Australia		Major Cities of Australia		Outer Regional Australia		Remote Australia	
		Fleet share	VOT($ per vehicle hour)	Fleet share	VOT($ per vehicle hour)	Fleet share	VOT($ per vehicle hour)	Fleet share	VOT($ per vehicle hour)
SMP and Semi		80.1%	$13.33	78.9%	$13.34	78.9%	$13.63	82.2%	$14.40
B Double		8.8%	$54.58	10.0%	$54.68	10.6%	$53.81	8.0%	$54.03
Roadtrain 1		6.9%	$63.62	6.0%	$63.33	5.6%	$63.56	6.6%	$63.67
Roadtrain 2		3.0%	$52.00	3.4%	$52.33	1.9%	$51.30	2.4%	$50.85
Special purpose vehicle	 	1.2%	$76.67	1.7%	$78.10	3.0%	$78.26	0.8%	$79.62
Average Weighted Cost ($/ Vehicle Hour)		$22.36		$23.01		$23.34		$22.22	

Source: based on TfNSW Heavy Vehicle by configuration snapshot 2023 and VOTT guideline values presented in Appendix A.

E. High traffic volume model – coefficient table

Model	Road type	Variable	Coefficient	Type
High traffic freight route	Principal Road	Intercept	-8.6405	Direct
High traffic freight route	Principal Road	ln(dense)	-0.1755	Direct
High traffic freight route	Principal Road	COVID	-0.0844	Direct
High traffic freight route	Principal Road	Distance(SCT)	0.0234	Direct
High traffic freight route	Principal Road	Distance(Food)	0.0346	Direct
High traffic freight route	Principal Road	Distance(Toilet)	0	No effect
High traffic freight route	Principal Road	Distance(Basic)	0	No effect
High traffic freight route	Principal Road	Distance(Town)	-0.0465	Direct
High traffic freight route	Secondary Road	Intercept	-8.5511	Direct
High traffic freight route	Secondary Road	ln(dense)	-0.1755	Direct
High traffic freight route	Secondary Road	COVID	-0.0844	Direct
High traffic freight route	Secondary Road	Distance(SCT)	0.0234	Observed on principal roads
High traffic freight route	Secondary Road	Distance(Food)	0.0346	Observed on principal roads
High traffic freight route	Secondary Road	Distance(Toilet)	0	No effect
High traffic freight route	Secondary Road	Distance(Basic)	0	No effect
High traffic freight route	Secondary Road	Distance(Town)	-0.0463	Direct
High traffic freight route	Minor Road	Intercept	-8.5915	Direct
High traffic freight route	Minor Road	ln(dense)	-0.1755	Direct
High traffic freight route	Minor Road	COVID	-0.0844	Direct
High traffic freight route	Minor Road	Distance(SCT)	0.0234	Observed on principal roads
High traffic freight route	Minor Road	Distance(Food)	0.0346	Observed on principal roads
High traffic freight route	Minor Road	Distance(Toilet)	0	No effect
High traffic freight route	Minor Road	Distance(Basic)	0	No effect
High traffic freight route	Minor Road	Distance(Town)	-0.1056	Direct

F. Low traffic volume model – coefficient table

Model	Road type	Variable	Coefficient	Type
Low traffic freight route	Principal Road	Intercept	-7.1420	Direct
Low traffic freight route	Principal Road	ln(dense)	-0.0399	Direct
Low traffic freight route	Principal Road	COVID	0.0063	Direct
Low traffic freight route	Principal Road	Distance(SCT)	0.0234	Observed on high traffic volume principal roads
Low traffic freight route	Principal Road	Distance(Food)	0.0346	Observed on high traffic volume principal roads
Low traffic freight route	Principal Road	Distance(Toilet)	0.0120	Observed on low traffic volume minor roads
Low traffic freight route	Principal Road	Distance(Basic)	0.0064	Observed on low traffic volume minor roads
Low traffic freight route	Principal Road	Distance(Town)	0.0530	Direct
Low traffic freight route	Secondary Road	Intercept	-7.2008	Direct
Low traffic freight route	Secondary Road	ln(dense)	-0.0399	Direct
Low traffic freight route	Secondary Road	COVID	0.0063	Direct
Low traffic freight route	Secondary Road	Distance(SCT)	0.0234	Observed on high traffic volume principal roads
Low traffic freight route	Secondary Road	Distance(Food)	0.0346	Observed on high traffic volume principal roads
Low traffic freight route	Secondary Road	Distance(Toilet)	0.0120	Observed on low traffic volume minor roads
Low traffic freight route	Secondary Road	Distance(Basic)	0.0064	Observed on low traffic volume minor roads
Low traffic freight route	Secondary Road	Distance(Town)	0.0032	Direct
Low traffic freight route	Minor Road	Intercept	-7.2177	Direct
Low traffic freight route	Minor Road	ln(dense)	-0.0399	Direct
Low traffic freight route	Minor Road	COVID	0.0063	Direct
Low traffic freight route	Minor Road	Distance(SCT)	0.0234	Observed on high traffic volume principal roads
Low traffic freight route	Minor Road	Distance(Food)	0.0346	Observed on high traffic volume principal roads
Low traffic freight route	Minor Road	Distance(Toilet)	0.0120	Direct
Low traffic freight route	Minor Road	Distance(Basic)	0.0064	Direct
Low traffic freight route	Minor Road	Distance(Town)	-0.0109	Direct

G. Vehicle and general costs

Cost category	Crash type		
	Fatality	Serious injury	Moderate/ minor injury
WTP costs per casualty			
Average cost per casualty	$8,757,819	$87,645	$11,778
Vehicle costs			
Repairs*	$16,668	$13,929	$13,745
Unavailability of vehicles*	$2,115	$1,876	$991
Towing*	$497	$442	$233
Total vehicle costs*	$19,281	$16,246	$14,969
General costs			
Travel delays**	$93,498	$113,159	$148
Insurance administration**	$59,915	$72,516	$94
Police**	$12,054	$4,142	$62
Property**	$1,942	$2,439	$4
Fire**	$634	$767	$3
Total general costs**	$168,042	$192,933	$310
Total inclusive costs (WTP, vehicle plus general)	$8,945,142	$296,824	$11,778

Source: NGTSM 2015, via TfNSW Economic Parameters

** Values indexed from 2013 prices to January 2023 prices (ABS Series ID A2328771A)*
*** Values indexed from June 2013 to January 2023 prices (ABS Series ID A2325846C)*

H. Typical safety cost per fatigue related crash

Severity rating	Vehicle type	Year										Total persons	Crash cost per person	Cost per casualty and per crash	Total cost of crashes	Cost per crash
		2018		2019		2020		2021		2022						
		Vehicles involved	Persons in crash	Vehicles involved	Persons in crash	Vehicles involved	Persons in crash	Vehicles involved	Persons in crash	Vehicles involved	Persons in crash					
Non-Casualty	**Truck**	21	21	10	10	12	12	21	21	21	21	85	$15,279	$11,778	$2,299,845	$27,057
	Car	2	3	1	1.7	3	5.1	1	1.7	4	6.8	19	$15,279	$11,778	$505,965	$45,996
Injury	**Truck**	63	63	51	51	40	40	69	69	58	58	281	$209, 179	$87,645	$83,407,544	$296,824
	Car	15	26	6	10.2	10	17	16	27.2	15	25.5	105	$209, 179	$87,645	$31,285,249	$504,600
Fatality	**Truck**	7	7	10	10	3	3	6	6	12	12	38	$187, 323	$8,757,819	$339,915,396	$8,945,142
	Car	4	7	2	3.4	1	1.7	2	3.4	8	13.6	29	$187, 323	$8,757,819	$258,514,603	$15,206,741
Total		**112**	**127**	**80**	**86.3**	**69**	**78.8**	**115**	**128.3**	**118**	**136.9**	**557**			**$715,928,604**	**$2,016,700**

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