

# SUMMARY REPORT

**O14: Critical review of design and development practices that relate to access for people with a disability (universal access): Summary report – Year 1 (2019/20)**

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# SUMMARY

This project intended to review practices in relation to implementing and designing for universal access with a particular focus on designing for people with disability. This report is intended to provide a summary of the three major parts of this project which are:

- Part 1: Review of design and development practices that relate to access for people with a disability.
- Part 2: Performance-based concepts and training requirements.
- Part 3: Investigation of accessibility for people with disability and the National Disability Insurance Scheme.

The first part was to identify gaps in guidance relating to the accessibility of the transport network for people with disability and to identify ways to improve practices through the provision of universal access for all. The following were reviewed during the first part:

- Relevant state and national legislation for the provision of universal access.
- TMR's policies and technical guidance for the provision of universal access.
- Austroads technical guidance for the provision of universal access.
- Australian Standards for the provision of universal access.

Key issues and recommendations were:

- The term 'person with disability' is not clearly defined in terms of what it means to a transport network and what is covered by this term. The term 'universal access' is a more inclusive term and should be defined alongside 'people with disability' to ensure designers cater for all users.
- There is no clear framework for universal access. Guidance is scattered across multiple documents and requires complex navigation of reference documents. Consolidation of guidance on a consistent process for the design of universal access and assisting designers in easily locating the required knowledge for design is recommended.
- There were many instances across the reviewed documents where compliance with the standards is the only guidance presented to the reader along with prescribed documents that contain the compliance requirements. Compliance with these standards and guides does not mean that the network element supports dignified access, is appropriately accessible or serves its intended purpose for the user.
- There is a lack of emphasis on the importance of guaranteeing accessibility for all user groups. When presenting or recommending design considerations for people living with disability, the approach should reinforce legal obligations in terms of equal and reasonable access as critical criteria rather than highlight compliance as critical criteria. Furthermore, the light should be shed on the common types of barriers that are faced by people experiencing disability.

The second part was to identify performance-based concepts/strategies that may be used to enhance the design process of the transport network to achieve greater levels of universal access. This also identified TMR's available training courses for the provision of universal access and identified improvements where possible. Training courses by other providers were also identified but were not reviewed.

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From the review of performance-based concepts/strategies, four were identified as being most appropriate for enhancing the design process of the transport network to improve accessibility, there were:

- Cooperative Design
- Living Laboratories
- Usability of Design
- Universal Design.

Some concepts entailed additional steps in the design process, while others were 'ways of thinking'. Some of these could be used in combination with others. The suitability of a concept is situationally circumstantial hence none of these could be determined as the best strategy.

At the time of writing, TMR had one training course available concerning universal access, this course was *RPD308 Pedestrian Crossing Facilities and Tactile Ground Surface Indicators Design*. From the review of the training course materials the following conclusions were made:

- the course aligns with the latest standards, guidelines and legislation in most instances.
- Older guidance is provided in some areas which needs to be updated.
- Dignified and/or politically correct language is not consistently used throughout the material.
- The course is focused on a small group of disability types rather than on all users.
- The course is focused on designing for legal compliance.

The final part was to identify if the National Disability Insurance Scheme (NDIS) is changing the abilities of people with disability by providing funding for assistive technology (mobility scooters, manual and powered wheelchairs) and to identify potential provisions for longitudinal grades where topography eliminates the ability to ensure dignified and defensible access.

From the Australian Bureau of Statistics (2018) data, it was found that the distribution of people with disability in Queensland who used wheeled chair devices were:

- manual wheelchair (MWC) – 24.3%
- powered wheelchair (PWC) – 4.6%
- mobility scooter – 7.5%.

Manufacturer specifications for MWC, PWC and mobility scooters were reviewed against the AS 1428.1 and AS1428.2 size specification of 800 mm x 1300 mm. From the review, it was found that approximately:

- 7% of MWC models exceed 800 mm width.
- 2% of PWC models exceed 1300 mm length.
- 36% of mobility scooter models exceed 1300 mm length.

For the most part, manufacturers do not stipulate a turning circle or maximum safe slope specifications for support devices.

Topography is a known barrier to access for all users; however, it may be more so for people with disability. This barrier may introduce additional risks to travel such as people in wheeled devices tipping their device due to steep terrain. This may also cause increased fatigue and undignified access.

The requirements surrounding longitudinal grades of pathways are limited. TMR's Technical Note 38 states that footpaths may be built at the grade of the road which may result in footpaths exceeding AS1428.1's limit for walkways of 1:14 (~7%).

Services to navigate topographic barriers exist but are not always readily available or suitable for the area. Alternative practices that may provide benefit were found and summarised however, some benefits of these may only be theoretical as there was little literature surrounding this issue and require further investigation and trials. These alternatives include:

- group consultations with users to better understand requirements

- Implementation of slope signage
- Strategic placement of bus stops
- Technological information tools
- Proving user ability can handle compliance.

There was no one size fits all solution. Solutions should be tailored to the situational circumstances of a project and area. Topography remains a relevant issue to people with disability even when looking at the advances from the NDIS. Additional guidance and services should be considered when designing access to new developments that incorporate steep grades.

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# 1 INTRODUCTION

This summary report details the findings for the National Centre of Excellence (NACoE) project O14 - Summary of Critical review of design and development practices that relate to access for people with a disability (universal access). This report summarises the information contained within the three reports produced for each part of this project, these being:

- Part 1: *Critical review of design and development practices that relate to access for people with a disability (universal access): Review of existing policies and guidance.*
- Part 2: *Critical review of design and development practices that relate to access for people with a disability (universal access): Performance-based concepts and training requirements.*
- Part 3: *Critical review of design and development practices that relate to access for people with a disability (universal access): Investigation of accessibility for people with a disability and NDIS.*

## 1.1 BACKGROUND

The Queensland Department of Transport and Main Roads (TMR) has committed to improving the provision of accessible transport infrastructure for all users with a significant focus being placed on access for people with disabilities. TMR has refocused its efforts by publishing the revised Disability Service Plan 2017-2020 and the Disability Action Plan 2018-2022, outlining actions to be taken to enhance accessibility.

The Australian Bureau of Statistics (2019b) Survey of Disability, Ageing and Carers estimates there are currently 906 100 people with a disability in Queensland, representing approximately 17.9% of the Queensland population (ABS 2019a). This means that around 1 in every 5 people in Queensland have a disability, which may affect their mobility.

### 1 in 5 Queenslanders may have a disability



Universal access is the provision of equal access to all users including persons with disability in a fair and dignified way. People with different levels of mobility or disability should be granted the same dignity, comfort, safety, speed and capacity when using road or public transport networks (Ajuria 2005).

Transportation systems should be designed to meet the widest possible range of needs, including those of people with disability and be used to the greatest extent possible by everyone, regardless of their age, ability, mobility or status in life.

Built environments that are inaccessible for a person with disability or which limit their ability, disadvantages them and lowers their quality of life, putting them at a higher risk of social exclusion and negative health and well-being (Haning, Gazey and Woolmer 2012). In 2019, over five million elderly or people living with disability in Australia were vulnerable to being excluded from activities and opportunities, limiting their social, educational, economic and other opportunities (ABS 2019b). Those who are unable to transport themselves by personal or assisted means face the disadvantages of mobility limitations, due to improper measures being taken and/or considered in the design process (Rosenbloom 2007; Whitson 2017). In some cases, designers have directly and indirectly failed to exercise anti-discrimination laws, such as the *Disability Discrimination Act 1992* (Sections 23, 24, and 31).

Concepts of universal access can be applied to both greenfield and brownfield developments. Greenfield sites are undeveloped sites allocated for commercial development or industrial projects. Greenfield



developments are considered flexible in design and may result in enhanced accessibility by implementing universal design concepts from the project's inception. Conversely, brownfield sites refer to land that has been previously developed and may already have infrastructure present. As these sites have been previously developed, they may be limited in changes that can be made for redevelopment to enhance accessibility. Where practicable, retrofitting universal access provisions should always be considered.

There is no one-size-fits-all solution to date for improving universal access design, and compliance does not mean a design will effectively serve its purpose. Standards and guides often act as minimum benchmarks, because appropriate solutions are typically complex and circumstantial, thus designers depend on their best judgement to try and produce user-friendly designs. There are different approaches individuals and organisations use to address and implement universal access, but again the effectiveness depends on a variety of factors.

The standard approach to infrastructure design places compliance with standards as a greater priority over the provision of universal access and the needs of users. Performance-based concepts that have a greater focus on the needs of users do exist and should be investigated to improve awareness of the importance and effective approaches to achieve universal access.

The foundation as to how one would approach infrastructure design comes down to a designers' experience or training. Training can come from formal education or training courses. The culture of compliance as a priority may stem from education and training not providing enough emphasis on the importance of universal access and consideration for people with a disability, the elderly or even people travelling with devices such as prams.

Moreover, the topography of Queensland regions may limit dignified access for some user groups. Steep terrain specifically can become untraversable or cause undignified travel due to the risk it poses to one's safety and the excessive strenuous effort required to reach destinations on steep slopes.

The introduction of the National Disability Insurance Scheme (NDIS) in Queensland has been progressively providing support to people with disabilities. Part of the scheme is to help provide funding for mobility aids and services. The NDIS is potentially changing the capabilities of users by providing people with the support (access to mobility aids) they need to improve their mobility for the first time.

Wheeled chair devices are a commonly used aid for people with mobility impairments to improve their level of access. However, people with wheeled devices run the risk of tipping their device if a slope is too steep for their device, and may also experience undue fatigue, particularly for people with manual wheelchairs. Between 2009 to 2018 there has been an increase of about 9,200 manual wheelchair users; 3,900 powered wheelchair users and 2,900 mobility scooter users (Australian Bureau of Statistics 2019b).

Figure 1.1 Sample of people with disabilities



Source: Williams (2020)

## 1.2 PROJECT AIM

This project aimed to review road industry practices and competencies with a view of achieving the TMR vision of creating a single integrated transport network capable of providing universal access for all users.

People with disability may experience risks and difficulties that other people without disability are unaware of or do not experience. This project is intended to investigate if and where systematic transport network access failures may be occurring for people with disability.

This project was broken down into three key parts, with a separate report being produced for each part. The final stage of the project was to develop a summary report to summarise the contents of the three key parts. The aims for each part of this project are described below.

#### **Part 1: Review of design and development practices that relate to access for people with a disability**

This report aimed to identify access issues and recommend key areas of improvement in planning and design policies, training, and guidance. This is intended to adequately inform and lead designers, planners, engineers, and decision-makers to provide a transport network that to the greatest extent possible delivers safe and dignified universal access.

#### **Part 2: Performance-based concepts and training requirements**

The second report aimed to identify and review current performance-based concepts/strategies used in the design and planning of universal access and determine whether these may assist in ensuring dignified and defensible accessibility for all users. Training courses available to industry professionals and professional competency requirements were also reviewed, gaps were identified, and improvements were recommended.

#### **Part 3: Investigation of accessibility for people with a disability and NDIS**

The third report aimed to identify what provisions need to be put in place when topography results in undignified accessibility for people with disability and to investigate if electric assistance technology and NDIS is changing design user capabilities.

#### **Part 4: Summary report of findings**

The final summary report aimed to summarise the findings and recommendations of the entire project into one document.

## **1.3 OBJECTIVE**

The objective of this project was to identify ways to investigate existing practices and provide recommendations to improve practices in the provision of universal access for all users, including people with disability or movement impairment, and the elderly.

## **1.4 PROJECT SCOPE**

The scope of this project included the following:

- review of existing policies and guidance published by TMR, Austroads and Australian Standards that impact the accessibility of people with a disability within the road network. Identification of gaps or barriers to access for people with a disability and recommend improvements
- identification of performance-based concepts (such as 8 to 80, human-centric design, or universal design) and how these may assist to ensure dignified and defensible accessibility
- review TMR's existing training courses available to industry professionals and professional competency requirements
- identification of what accessibility for people with disability means in the road network
- identification of barriers to access due to topography and provisions needed to ensure dignified and defensible accessibility
- identification of whether electrical assistance technology and the NDIS is changing the capabilities of people with disability.

## 2 REVIEW OF DESIGN AND DEVELOPMENT PRACTICES THAT RELATE TO ACCESS FOR PEOPLE WITH A DISABILITY

This section provides a summary of the report *Critical review of design and development practices that relate to access for people with a disability (universal access): Review of existing policies and guidance* resulting from part 1 of this project. The aim of part 1 was to review the current policies, standards and guidance published by the Department of Transport and Main Roads (TMR), Austroads and Australian Standards that impact the accessibility of people with disability across the transport network.

### 2.1 CRITICAL REVIEW OF EXISTING POLICIES AND GUIDANCE

Universal access is the provision of equal access to all users in a fair and dignified way. This term, by definition, includes any person with disability. This section discusses the critical review of existing policies and guidance published by TMR, Austroads and Australian Standards for designing and delivering universal access across the QLD transport network (roads, pathways and public transport infrastructure). The following actions were taken during this task:

- Review of relevant state and national legislation for the provision of universal access
- Review of TMR's policies and technical guidance for the provision of universal access
- Review of Austroads technical guidance for the provision of universal access
- Review of Australian Standards for the provision of universal access.

#### 2.1.1 LEGISLATION

Four overarching pieces of legislation must be abided by in Queensland in relation to enablement and non-discrimination of people with disability, these are:

- *Disability Discrimination Act 1992*
- *Disability Standards for Accessible Public Transport 2002*
- *Disability Standards for Accessible Public Transport Guidelines 2004 (No. 3)*
- *Human Rights Act 2019 (Qld)*.

The *Disability Discrimination Act 1992* (DDA) provides legislation in Australia that makes it unlawful to discriminate against a person and in this context aims to ensure that people who live with mental, physical, biological (disease), permanent or even temporary disabilities have the same rights to equality and inclusivity as people without disability.

The *Disability Standards for Accessible Public Transport 2002* is provided under subsection 31(1) of the DDA and identifies public transport as a service covered by this Act. The purpose of these standards is to eliminate discrimination against people with disabilities and to enable public transport operators and providers to remove discrimination from public transport services. These standards apply to all people with disabilities, all operators, and the conveyances they use to provide public transport services.

The *Disability Standards for Accessible Public Transport 2002* is accompanied by the *Disability Standards for Accessible Public Transport Guidelines 2004 (No. 3)* which is meant to assist in the understanding and interpreting of the standards.

The *Human Rights Act 2019 (Qld)* is aimed at protecting fundamental human rights, building a culture in the public sector that respects and promotes human rights and helping promote dialogue about the nature, meaning and scope of human rights. The Act protects 23 fundamental human rights and freedoms (Queensland Advocacy Incorporated 2019).

From the review of available legislation, it was found that:

- In the DDA the term 'disability' may be inclusive of all disabilities.
- The DDA states that it is unlawful for a person to discriminate against another person on the grounds of the other person's disability; and that it is unlawful for a person who provides goods or services or makes facilities available, to discriminate against another person on the grounds of the other person's disability.
- It states in the DDA that the Minister may, by legislative instrument, formulate standards, to be known as disability standards, in relation to any area in which it is unlawful under this Part for a person to discriminate against another person on the grounds of a disability of the other person; and refers to
- *Disability Standards for Accessible Public Transport 2002* which provides standards for areas of design and identifies linkages to other standards or documents
- *Disability Standards for Accessible Public Transport Guidelines 2004 (No. 3)* which provides additional guidance on the following areas:
  - enforcement and action plan
  - consultation
  - customer service
  - due diligence and reasonable precautions
  - role of transport authorities
  - assumptions about public transport mobility aids.

## 2.1.2 POLICY FRAMEWORKS

TMR currently publishes two policy frameworks to assist in the delivery of accessibility for people with disability across their transport network. These are the *Disability Service Plan 2017-2020* and *Disability Action Plan 2018-2022*. They discuss past, present and future policies and actions to deliver better access for people with disability.

While neither document provides specific guidance on designing for universal access, they aim to improve access to services across government for people with disability. This results in a more coordinated response across all departments/agencies as well as improving the usability of their passenger transport services for people with disability.

The *Disability Service Plan 2017-2020* identified five priority areas to guide actions, these are:

1. Communities for all
2. Lifelong learning
3. Employment
4. Everyday services (covers transport network)
5. Leadership and participation.

The *Disability Action Plan 2018-2022* identifies 41 actions to improve accessibility across the passenger transport network which are set to be implemented between 2018 to 2022.

## 2.1.3 DESIGN GUIDELINES

In most cases, TMR design guides adopt Austroads guidance for use in Queensland and may only provide supplemental guidance (sections that provide no additional guidance relating to universal access have been omitted). The relevant guideline documents in Queensland are:

- TMR's Road Planning and Design Manual (RPDM) (TMR 2015b)
- TMR's Traffic and Road Use Management Manual (TRUM) (TMR 2019c)
- Austroads Guide to Road Design (AGRD)
- Austroads Guide to Traffic Management (AGTM)
- TMR and Translink's Public Transport Infrastructure Manual (PTIM) (TMR 2015c).

Key points and issues identified among these documents include:

- People with disability are in some instances referred to as special road users and many other terms; however, the term 'people with disability' is not well defined in the reviewed documents. This may result in unintentionally disregarding some forms of disabilities.
- Only certain aspects of road design and traffic management guidance provide suggestions or instruction to accommodate people with disability. When it does refer to people with disability, people with mobility/physical disabilities are usually singled out. Physical disabilities that affect movement are only one type of disability. Other limitations such as hearing, visual and intellectual impairments are unintentionally disregarded.
- Terms such as 'person with impairment', 'person with disability' and 'wheelchair user' are used, and in some cases, only the assistance device itself is named e.g. 'wheelchair'. This creates difficulty when determining which aspects should require consideration for all users, not just the ones stated.
- In some instances, it is stated that consideration should be given for specific disabilities, with most instances providing no additional guidance and occasionally providing reference to additional design considerations for specific types of impairments.
- Detailed information is not provided on why particular user groups with specific impairments require additional design considerations and the types of difficulties these users are likely to experience. Designers often do not have a fully informed understanding, which can lead to inadequate designs for universal access.
- When considering the grade of roads and footpaths, guides do not take into consideration the purpose of the road or accompanying footpath for pedestrian access for those with disability or mobility impairment.
- In some instances, these documents inform users that design compliance should be met using Australian Standards, however, they fail to mention which Australian Standard/s specifically are relevant to the subject.
- Compliance with the standards is often highlighted as critical and provided as the only guidance. It is not mentioned that these standards can be improved upon by trying to cater for all likely users.

## 2.1.4 AUSTRALIAN STANDARDS

Through the review of available materials, users were often referred to several Australian Standards which contain provisions directly considering the requirements of people with disability, including those with visual and hearing impairments. Australian Standards which contained relevant guidance and were reviewed are:

- AS 1428.1-2009: *Design for access and mobility: general requirements for access: new building work*
- AS 1428.2-1992 (R2015): *Design for access and mobility: enhanced and additional requirements: buildings and facilities*
- AS/NZS 1428.4.1:2009: *Design for access and mobility: means to assist the orientation of people with vision impairment: tactile ground surface indicators*
- AS/NZS 1428.4.2:2018: *Design for access and mobility: means to assist the orientation of people with vision impairment - Wayfinding signs*
- AS 1735.12-1999: *Lifts, escalators and moving walks: facilities for persons with disabilities*
- AS/NZS 2890.1:2004: *Parking facilities: off-street car parking*
- AS/NZS 3856.1:1998 (R2016): *Hoists and ramps for people with disabilities – vehicle mounted product requirements.*

Key points and issues identified among these documents include:

- The majority of guidance provided on universal accessible design was from the Australian Standards rather than the design guidelines.
- Some sections of the standards include information and guidance related to people with disabilities and for the most part, set out the minimum design specifications.

- Standards directly influence the access of persons who have mobility and sensory impairments.
- Access assistance for persons with vision and mobility impairments is mainly in the form of physical assistance (e.g. signs), for those with hearing impairments, it is usually in the form of visual assistance.
- Standards and guideline documents pertaining to transport design or management, use a broad or vague term such as ‘people with a disability’ or ‘wheelchair users’. These terms may not be as inclusive as intended.

## 2.1.5 SUMMARY OF OVERARCHING FRAMEWORK AND PRACTICE PROCESS

Unless a person is already familiar with navigating the design process for universal access, it can be difficult to identify what elements are required for universal access or what elements can affect accessibility. This can make it difficult for unfamiliar readers to be aware of any mandatory requirements, as well as where and why they are appropriate and for whom they are intended.

From the review of existing documentation, it was found that there is no formalised framework for the provision of access to people with disability or the provision of universal access to the transport network. Designers could easily miss critical information or requirements, resulting in a design inadequate access standards that limit people with a disability.

Designers are unable to consult one framework that would detail the design process and identify all relevant documents and outline when to apply them. A general framework of design for universal access has been illustrated to show the progression of documents (Figure 2.1); however, it does not show the referrals between documents.

Figure 2.1 Process of design for universal access



## 2.2 STREET GRADIENTS AT GREENFIELD SITES

The guidance for the street gradient design is spread across multiple key documents. Guidance is provided in varying levels of detail; typically grouping information by road pavement, walkways and roadside footpaths. Specifications for walkways are separate from footpaths. The key documents and information that were identified are:

- Austroads Guide to Road Design Part 3 (Austroads 2016a)
  - Road gradients in low-speed areas (60 km/h) where pedestrians may frequent, can have recommended maximum grades ranging from 8% to 10% depending on terrain.
- Austroads Guide to Road Design Part 6A (Austroads 2017)
  - Footpaths should be as flat as possible and mentions that AS 1428.1 has specific standards for pedestrian walkways.
- Australian Standard 1428.1

- AS 1428.1 states that landings (rest areas) are required for long sections of walkways with gradients steeper than 1:33 and a walkway gradient is not to exceed 1:20.
- TMR Technical Note 38 (TMR 2010)
  - Walkways are categorised differently from footpaths and Technical Note 38 states that footpaths can be at the grade of a road.
- Australian Human Rights Commission’s Advisory note on the streetscape, public outdoor areas, fixtures, fittings and furniture (AHRC 2013).

Through this review, no guidance was found specifically for the design of street gradients for greenfield developments. Therefore, the street gradients do not incorporate any decision-making based on universal access design considerations.

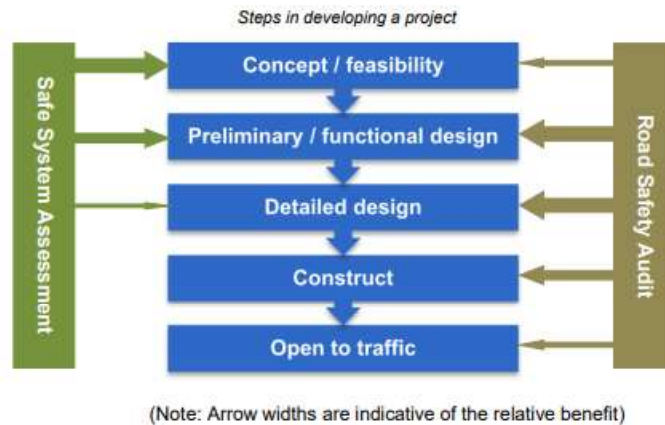
## 2.3 RECOMMENDATIONS

From the review of policies, standards and guidance published by TMR, Austroads and Australian Standards, the following recommendations have been made:

- Throughout most of the reviewed documents, accessibility for people with disability is discussed to some degree; however, the term ‘people with disability’ is usually not clearly defined. The term should be clearly defined as to what it means to the transport network and what is covered under this term. One method of doing so would be to identify design users, based on the most common impairments and provide clarifying information on how the impairment may impact accessibility and typical considerations used to improve access.
- One term that is rarely used in the reviewed documents is ‘universal access’. This term should be clearly defined and used in place of other terms such as ‘people with disability’ or ‘person in a wheelchair’. This term incorporates all users when designing for accessibility, including people with disability, the elderly, people with injuries, people with vision impairment, and more. The term ‘universal access’ should be defined alongside ‘people with disability’ to ensure designers cater for all users.
- The consolidation of all applied guidance into one design guide that emphasises universal access should be investigated. This consolidation may provide a consistent process for the design of universal access and assist designers in easily locating the required knowledge for design, thus reducing the complexity of navigating reference documents. Emphasising universal access in the design process would lead to enhanced accessibility for not only people with disability but for all users of the transport network. It is noted that consultation with designers would be needed to determine if this is a suitable solution.
- From the review of VicRoads’ (2019) *Safe System Assessment Guidelines* document it was identified that ARRB’s Safe System Assessment framework has been implemented in the project process, alongside the existing Road Safety Audit process (see Figure 2.2). Integration of a similar Universal Access (or disability access) Assessment/Audit framework into the design process could enhance accessibility for all users (see Figure 2.3). This would further help to integrate design for universal access and people with disability into the design process to ensure all roadside infrastructure is accessible.
- Consultation should be undertaken with people with mobility and sensory impairments to better understand the difficulties they experience in accessing TMR’s transport network. This will help to pinpoint the attributes of the transport network that do not cater well enough for people with disability and where existing legislation, guidelines and standards do not meet expectations. This process will be most effective if a wide range of disabilities is considered.
- In future, when presenting or recommending the idea that consideration should be given in certain aspects of design to people living with physical impairments, the approach should reinforce legal obligations of equality and inclusivity as critical criteria. This will emphasise the importance that should be placed on guaranteeing accessibility for all user groups. This could be implemented through a policy statement to ensure appropriate outcomes of design.

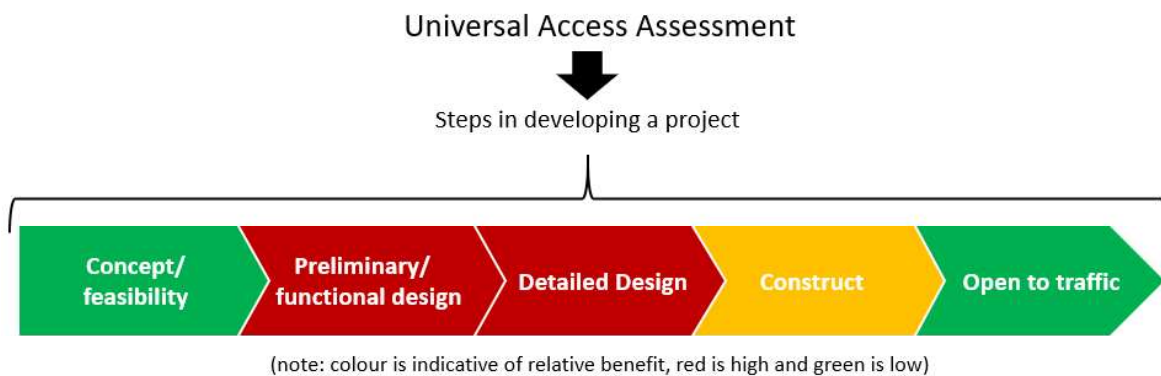
- Design criteria for attributes relating to people with disability should include performance design guidance alongside a set of minimum design guidance. Designers should be encouraged to use the value with the greatest functional outcome or exceed the minimum value when designing for accessibility. This will help to emphasise that the design should cater to the users' needs rather than only complying with the minimum values. This type of guidance is already commonplace throughout the AGRD and AGTM in other areas of design and assists in communicating that compliance does not always indicate a good design.
- It is recommended that a review of international policies, guidelines and standards for the design of accessibility for people with disability is undertaken. This can then be compared against existing Australian practices to determine any areas that may be improved based on international best practice.

Figure 2.2 When to undertake Safe System assessments and road safety audits



Source: VicRoads (2019).

Figure 2.3 Example of possible universal access assessment





## 3 PERFORMANCE-BASED CONCEPTS AND TRAINING REQUIREMENTS

This section provides a summary of the report *Critical review of design and development practices that relate to access for people with a disability (universal access): Performance-based concepts and training requirements* resulting from part 2 of this project. The aim of part 2 was to identify and review current performance-based concepts/strategies used in the design and planning of universal access and to determine whether these may assist in ensuring dignified and defensible accessibility for all users, with a particular focus on people with disability.

It also aimed to review training courses available to industry professionals and where possible gaps or improvements were identified.

### 3.1 HUMAN CENTRED DESIGN

Universal access is successful if it is socially accepted and usable with reasonable (little) effort to the greatest number of people possible, including people with disability. Human-centred design is the approach of prioritising the needs of people first and foremost to which the system serves and therefore this report determined it as the most suitable approach to achieve universal access.

### 3.2 PERFORMANCE-BASED CONCEPTS

There were several human-centred approaches identified when designing for universal access. Some human-centred performance-based concepts were considered as converging and have been canopied under alike concepts. Four concepts were discussed and accompanied with real-life applied case studies; they were:

- Cooperative Design
- Living Laboratories
- Usability of Design
- Universal Design.

#### 3.2.1 COOPERATIVE DESIGN

Cooperative design was identified as an established approach when designing for users with special requirements. It entails full cooperation between development teams and the intended users throughout the development life. Standards specify the minimum 'defensible' values of design components, and cooperative design ensures the assembly of component results in a functional and dignified product.

When working together, accessibility issues are thought to be automatically included and addressed (Ahman & Gulliksen 2014). The belief is that user input generates ideas and shares information or experiences that are new and useful inputs, sometimes generating extremely innovative outcomes that better match user needs and are socially accepted (Ahman & Gulliksen 2014; Steen et al. 2011).

#### 3.2.2 LIVING LABORATORIES

The Living Laboratories (Living Labs) concept has the intended user act as the guarantor for successful development and innovation of the end product through real-life rather than lab-like environments, which theoretically produces a near-perfect product (Thiesan et al. 2009). The approach educates the development team and makes users more comfortable using the product/system and promotes openness, inclusion, innovation and collaboration in creating solutions for people.

Identified challenges in using Living Labs was the ability to identify useful information to support real-life innovation as it required an open and supportive mindset (Niitamo, Westerlund & Leminen 2012; Van Geenhuizen 2018). From the application of this concept in a transportation context, it was difficult to determine how this could be applied effectively. Civil infrastructure design often cannot easily be tested in real-life environments. Prototypes or use of environment imitating technology (e.g. Virtual reality) were identified options but were potentially expensive (Vanfossen 2019).

### 3.2.3 USABILITY OF DESIGN

For the third concept, the term 'usability' refers to the extent to which a design can be used by the intended users to achieve specific goals with effectiveness, efficiency, and satisfaction (Horold, Mayas & Kromker 2014). User requirements are set as the highest priority. A great deal of focus is on overall user experience and satisfaction. A design that is considered useable will meet the following criteria (Soegaard 2019):

- The design will be easy for users to become acquainted with and competent in using the design at first contact.
- The goal of the design should be easy to achieve by users.
- Users should be able to easily recall design on future visits.

From the reviewed case studies it was revealed that there were improvements in efficiencies in the overall process and quality in execution. It was also noted that this approach was not only a technical path of product development but also enhances professional development skills. However, this is not an established approach in civil design.

### 3.2.4 UNIVERSAL DESIGN

Lastly, universal design refers to the design of products and environments that are usable to the greatest extent possible by everyone, regardless of their age, ability or status in life, without the need for adaptation or specialised design (Hallgrímsson 2019). By training architects, engineers and industrial designers to incorporate universal design principles at every level of work, the long-term effects and expectations of people with disability can be addressed without much oversight and advocacy (Hallgrímsson 2019).

Universal design is a highly established way of thinking to approach design and planning for universal access to eliminate barriers in a transport context for people living with a disability. There are already Australian authoritative bodies that encourage the implementation of dignified universal design. This strategy can easily benefit by incorporating the other already discussed strategies; cooperative design, living labs and usability of design.

### 3.2.5 KEY FINDINGS OF PERFORMANCE-BASED CONCEPTS

From the observation of cases and practices explored in this report, it was found that the participation of users can be classified into four categories: user, non-user, observational and no participation. This order of methods is reflective of what is believed to be the most to least effective methods applicable to the design of civil infrastructure.

From the research conducted the facets of each strategy were categorised to be either 'state of mind' or 'design step' strategies. Here 'state of mind' is defined as a way of thinking or an additional consideration through the design planning and construction; 'Design step' is the implementation of additional planning or design steps, usually used to gather information or feedback; they are both used to guide developer assessments and choices.

There are common advantages and disadvantages among the concepts and each of them can be applied to the design and planning of universal access under the right circumstances. Under other circumstances, only some, or none, of the aspects of these concepts may be applicable. Cooperative design was seen in a majority of the performance-based case studies and is therefore recommended but may not always be a possible option. For performance-based concepts, ARRB cannot conclusively declare that one of these

concepts is superior to the others in a transportation context as the potential number of benefits and disadvantages are situationally dependent. Knowledge and value of these types of human-centred design concepts are not widely recognised for transport design of infrastructure and systems. Concepts should be chosen on a case-by-case basis to select the concept which provides the most advantages. Cooperative design and universal design provide the most adaptability and may be beneficial to all project types. However, further awareness surrounding the use and significance of universal access and approaches to universal access is recommended to select the best concept for projects.

### 3.3 REASONABLE NON-COMPLIANCE

Typically, road design guidelines provide values of parameters that are appropriate for the design of roads in greenfield sites. These are referred to as Normal Design Domain (NDD) values (Austroads 2016a; Austroads 2019a); the concept of design domains has been adopted by TMR. Most work on roads nowadays is concentrated on brownfield developments where a range of constraints exist, and NDD values cannot always be applied if an economical outcome is to be achieved (Austroads 2016a; TMR 2013). TMR has offered additional guidance over the last 17 years for designing in brownfield sites which have been progressively introduced into the *Road Planning and Design Manual* (TMR 2015b).

In certain circumstances, time, cost, scope, legacy infrastructure or other considerations or constraints can 'force' non-optimal accessibility. Rightfully there can be a concern that an environment or facility can be universally accessible but would require using values of parameters that are non-compliant (existing outside of the NDD). Legal ramifications, if someone is injured from using designs that use values and parameters outside the NDD, can be a deterrent or be used as a reason to not provide any additional or improved facilities at all. Using values of parameters outside the NDD should be considered if a decrease in parameter value produces a higher benefit and only if the safety of pedestrians and other critical considerations are not compromised. These engineering decisions call for knowledge, experience, insight and a good appreciation of community values.

### 3.4 TRAINING COURSES

As part of this project, TMR and external training courses available to industry professionals and professional competency requirements were reviewed and if possible, potential gaps were identified.

At the time of conducting the research TMR training course, *RPD308 Pedestrian Crossing Facilities and Tactile Ground Surface Indicators Design* was the only course available related to access for people with disabilities. Since that time, two recently released and mandated department-wide TMR courses on 'Access and Inclusion' and the 'Human Rights Act', were released in January 2020. The TMR course was not attended in person; however, the materials were provided for evaluation.

Attendance of external courses was not possible due to time constraints and availability. Therefore, it has not been determined if the courses adequately address the subject and guidance on the topic of universal access with appropriate attention to people experiencing disability. Nor has it been conclusively determined if these external courses are enhanced versions or duplicates of the already existing TMR *RPD308 Pedestrian Crossing Facilities and Tactile Ground Surface Indicators Design*.

#### 3.4.1 CONCLUSION OF TRAINING COURSE REVIEW

Updates should be made to TMR's *RPD308 Pedestrian Crossing Facilities and Tactile Ground Surface Indicators Design* based on recommendations from Report 2 of this project. These updates are to ensure the training course uses politically correct language, demonstrates the latest standards and guidelines, focuses on universal and dignified access, and reinforces the legal ramifications of inadequate designs. The updates recommended could potentially be applied to other training courses provided by TMR where possible.

## 4 INVESTIGATION OF ACCESSIBILITY FOR PEOPLE WITH A DISABILITY AND NDIS

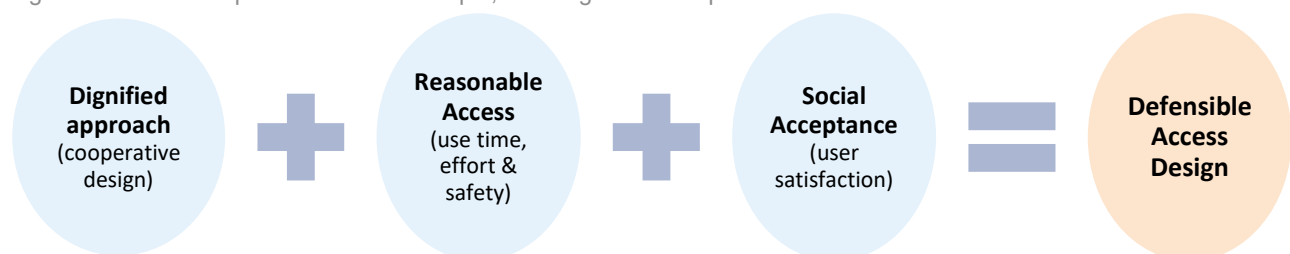
This section provides a summary of the report *Critical review of design and development practices that relate to access for people with a disability (universal access): Investigation of accessibility for people with a disability and NDIS* resulting from part 3 of this project. The aim of part 3 was to identify what provisions need to be put in place when topography results in undignified or unsafe access for people with disability and to investigate if electric assistance technology and the NDIS is changing the capability/ability of design users (people with disability). The overall goal was to improve practices in the provision of universal access for all users, including people with disability or movement impairment, and the elderly.

### 4.1 DEFENSIBLE ACCESSIBILITY

Appropriate accessibility was found to be potentially difficult to implement in areas where existing infrastructure is already established. Many of these existing establishments were built before the current standards and guidance or even some legislation regarding the rights for equality of people with disabilities. Proving that reasonable attention and effort have been made to improving or creating the best reasonably accessible environment for everyone with the available resources can be considered defensible. Social acceptance from people experiencing disability plays a large part in what is considered dignified and reasonable access for people with disability (Withers 2018). The relationship between all three contributes when determining if a design is defensible and therefore believed to be the foundation of defensible access design (Ahman & Gulliksen 2014; Bevan 2009; Van Geenhuizen 2018).

Cooperative design or access audits at multiple stages in the design phases are believed to aid in encouraging designers to be more aware of user needs and aim to produce designs that are reasonably accessible.

Figure 4.1 Developed framework example, showing relationship factors for defensible access



### 4.2 NATIONAL DISABILITY INSURANCE SCHEME & PEOPLE WITH MOBILITY AIDS

The report looked at what the NDIS is and aims to provide, as well as to identify how many people were receiving support for Assistive Technology (AT). It was thought that the introduction of the NDIS would potentially change user capabilities by providing support to people who required AT to improve independence and manoeuvrability away from home transport networks.

The NDIS is a social policy program to provide individualised support packages to eligible people with disability, including financial support for AT, equipment and home or vehicle modifications (Buckmaster 2017). For many people, the NDIS is supplying them with the disability support they need for the first time (NDIS 2020). As of September 2019, there were 55,014 participants supported by the NDIS in Queensland (NDIS 2019b). From the number of approved plans of NDIS Queensland participants (NDIS 2019a):

- 37% potentially experience or live with a disability that potentially inflicts a degree of mobility difficulty (including sensory impairments, excludes intellectual impairments).

- Around 42.4% are receiving NDIS support for disabilities that potentially inflict a degree of mobility difficulty (including sensory impairments, excludes intellectual impairments). It is unknown as to what type of funding is being provided.
- 23.8% have a high level of disability in terms of bodily function (level of function 1 to 5 out of 15).
- 4.6% of participants are receiving support for Assistive Technology (AT).
- 1.4% are receiving support for transport.

Not enough time is thought to have passed since the full rollout of the NDIS nor was there sufficient data to determine if user capabilities were improving in terms of independence and manoeuvrability on away from home transport networks.

### 4.3 PEOPLE WITH DISABILITY & ASSIST DEVICES

The project then looked at determining how many people in Queensland use a wheelchair or mobility scooter assistive technology (AT). Using this information, an attempt was made to identify if user capabilities/abilities have been changed (e.g. persons with manual wheelchairs decreasing).

Data published by the Australian Bureau of Statistics (ABS), showed a progressive rise in the number of powered (electric) and manual wheelchairs since 2009; for mobility scooters, there was a rise between 2009 to 2015 but has since declined which was when the NDIS rolled out but this has not been linked to factors relating to NDIS (ABS 2020). There was an increase in other mobility aids as well. The ABS stated that a combination of devices are used therefore it was unable to be determined if users were switching from one form of device to another.

The overall general increase is suspected to be in some part related to the national and state population growth and respectively the number of people with disability. Hence, there will likely be continuous growth in the number of people who require and use AT, and thereby a growth in the number of people who will experience transport disadvantages.

### 4.4 USER CAPABILITY WITH ASSIST DEVICES

AT changes the capability of people with disability in any environment, it also changes the required user space for manoeuvrability. This report attempts to identify if the sizes of marketed wheelchairs and mobility scooter AT were appropriate for the AS 1428.1 and AS 1428.2 minimum manual wheelchair requirements for accessible pathways for devices that do not exceed 1300 mm x 800 mm. It is noted that these standards do not consider mobility scooter devices.

A review of manufacturer size specifications was undertaken for three devices: manual wheelchairs (MWC), powered wheelchairs (PWC), and mobility scooters. A sample of approximately 50 overall size specifications was gathered for each of the three commercially available device types. The results showed that approximately:

- 7% of MWCs exceed 800 mm width.
- 2% of PWCs exceed 1300 mm length.
- 36% of mobility scooters exceed 1300 mm length.

Devices requiring turning space/radius and maximum safe slopes were also desired for review, but manufacturer user manuals and brochures often did not specify these. This absence of information for users increases the risk of people buying devices that may not be suitable for their commonplace environments.

Manual and powered wheelchair product requirements are provided in AS 3695-1992. For a motorised wheeled device, there are fewer regulatory requirements (Austroads 2019b). There are devices for sale in Australia that do not meet the requirements of the regulation and users thus far unaware of this.

## 4.5 PROVISIONS FOR TOPOGRAPHY BARRIERS

### 4.5.1 GUIDANCE

Steep grades can increase the risk of people with wheeled devices tipping over and people walking losing balance and falling. Grades can ultimately prove dangerous which may lead to potential injuries or a complete denial of access. For this reason, when travelling away from home, many people with disability report having to plan routes for outings; alter planned routes; go more slowly than planned; or wait for a more suitable time to travel. These actions are to avoid barriers such as steep longitudinal grades due to topography.

A review was undertaken for the provision of pathways/footpaths slopes from the following documents:

- AS 1428.1 and AS 1428.2
- Austroads Guide to Road Design (AGRD)
- TMR 'Technical Note 38: Longitudinal Grades for Footpaths, Walkways and Bikeways' (TN38).

Findings included:

- The specified maximum crossfall of 2.5% is appropriate.
- AGRD Part 6A states that where the AS 1428.2 cannot be applied due to topography issues, designers should refer to an Australian Rights Commission's Advisory Note. However, this Note does not provide any further guidance on topography issues.
- TN38 states the maximum grades for footpaths are to be "At the grade of the road", there is no recommendation or guidance on changing the grade to be more suitable for people with disability. Equally maximum grades for walkways are said to not be required.
- AGRD Part 6A and AS1428.2 provide conflicting guidance in regard to ramps and landings.

### 4.5.2 AVAILABLE SERVICES

People who encounter longitudinal grades of footpaths that are not independently traversable (without the help of a carer) will seek alternative methods of transporting or supporting themselves while travelling. In instances where persons with mobility impairments cannot self-propel themselves on steep slopes, the following services or infrastructure were found to be used:

- lifts and ramps with landings
- mobility aids
- carers
- disability reserved parking spaces.
- transport funding
- Taxi Subsidy Scheme (TSS)
- companion care

### 4.5.3 ALTERNATIVES

From the research conducted there is very little literature as to how topography on large scales can be combated outside of the existing guidance of standards and guides. Some solutions in this report look at trying to offer current services more conveniently; others look at designers seeing compliance and design from a more user involved perspective. Lastly, they may even offer informational services to better equip people with information about their planned route to better determine if the destination is accessible using their device or bodily ability.

Alternatives that should be investigated in more depth and potentially trialled include:

- group consultations
- moving walkways
- slope signage
- strategic placement of bus stops
- technological information tools
- proving user ability compliant designs.

There is unlikely to be a one size fits all solution. Solutions should be tailored to the situational circumstances of a project and area. Topography remains a relevant issue to people with disability even when looking at the advances from NDIS.

## 4.6 RECOMMENDATIONS

From the investigations of the NDIS, wheeled device capabilities, and existing and potential provisions for topographical barriers, the following steps should be taken:

- Further investigate the feasibility and benefits of alternative measures for topographic barriers in conjunction with development teams (including engineers, project managers, planners) and disability reference groups.
- An investigation should be undertaken to determine what topographic barriers would be eliminated or reduced (by bypassing them) in urban and regional areas if greater or full subsidised funding into the transport scheme (e.g. public transport and taxi subsidy scheme) were introduced. Further funding would theoretically decrease costs to scheme participants allowing them more freedom to utilise paid transport services more frequently, as well as improve independence (less dependence on others such as family to drive them).
- Further investigate wheeled device's specifications and capabilities (dimensions, maximum safe uphill and downhill slope gradients, etc.). This should also consider modifications to and accessories added to wheeled devices. This would focus on the attributes and capabilities of devices in public use, not commercially available devices. These should then be compared against standards and guidance to determine if the standards are satisfactory.
- Investigate environment attributes (longitudinal grades, crossfall, turning circles, etc) that wheeled device and other assist device users feel comfortable operating at in comparison to existing standards. Users may not feel comfortable operating assist devices at maximum capacity (e.g. wheeled devices operating at maximum slope capacity) and should be investigated. This would allow for the creation of desirable or performance design limits for some design criteria.
- Defining reasonable accessible design should be explored from the intended user's perspective. People with disability sometimes must use alternative (to mainstream) routes, e.g. provided ramps as an alternative to stairs. However, it is not known at what point the accessible design becomes an unreasonable route to use (e.g. route with accessible ramps adds 10 min to original route). User experience plays a major factor in what users consider reasonable. A good experience is based on the time taken to use, the added length of travel, the effort needed, the feeling of safety and the aesthetics.

## 5 WORKSHOPS

As part of this project, a workshop took place on 23 April 2020. The workshop aimed to provide an overview of the content covered in the project tasks to date and open a platform to receive direct feedback primarily from a selection of designers, planners, and management members from TMR, ARRB, Translink and Department of State Development, Manufacturing, Infrastructure and Planning.

A second workshop took place on 18 June 2020 with the same aim as the first workshop. This time the platform was open for feedback from a selection of people who experience disability or members of disability dedicated organisations.

Within the workshops, key points of discussion were:

1. A better definition of the term disability in an engineering transport context is needed.
2. The idea was presented that universal design should be built into the fundamentals and principles of design and procurement for TMR and not be seen as a sense of 'optional' criteria or consideration. Reinforcing the need to consider people with disability in spaces as critical is needed. The private consulting/construction space was mentioned to be most problematic.
3. There is a lot of dependence on minimum Australian Standard parameter values to produce what designers believe is 'best-practice' for universal design. Standards and guidelines are often seen as the default or 'go to' documents for guidance because it gives designers a feeling of safety. Other documents are noted to be easily overlooked because guidance or information is spread across too many sources. When challenged to create something that is universally accessible designers are often not sure of what that means or how that differs from minimum design standards. Therefore, engineering judgement should be used and encouraged to go above and beyond if need be to make a functional end product.
4. Desirable limits and functionality standards should be identified – not always in the form of minimum parameter values but through reiterating the purpose of each facility and detailing who and what type of concerns exist for people with disability and other vulnerable transport users (i.e. children, prams, delivery men with trolleys).
5. Transport networks are critical in popular public areas (e.g. parks and carparks) as well as suburban areas. Longitudinal grades in suburban areas that are creating barriers for people with impairments limit a person with disabilities power to choose where to live. Furthermore, urban areas require more holistic approaches when dealing with road grades.
6. Austroads Guide to Road Design is not historically written for suburban developments and land developments.
7. The lack of consolidated information may be improved upon by using online versions of documents that have embedded links that can direct the user to a referenced document or creating a best practice guide for universal access to consolidate information and guidance.
8. Access auditing is incorporated into project proposals or equivalent documents to address universal access.
9. Consultation with focus groups is agreed as being effective and vital to address and identify universal access issues in design phases.
10. People with visual impairments at pedestrian crossings get a two-way signal (tactile audio and static red man), whereas able-bodied people get four-way signals (green man, flashing red man, countdown lights and static red man). Tactile audio indicates to persons with visual impairments that they may begin to cross the road, but a flashing red man is an equivalent to a static red man and this causes confusion and low levels of confidence because users are unsure of what is happening. Further investigation is required into standards surrounding these situations and potential solutions.
11. Given the situation at the time of this workshop, which involved quarantine restrictions due to the Covid-19 coronavirus outbreak, people were urged to use elbows to push pedestrian crossing buttons. This practice further restricts people who already may have restricted reach due to their condition. In future,



policies to help people with disability during pandemics or similar should be considered, such as automating crossing queues to help people with disabilities.

12. Addressing and monitoring may be needed in regard to the creep in size of manual and powered wheeled devices (including mobility scooters). This may also extend over to the technological improvements and modifications which could change the capabilities of devices.
13. Standards that include consideration of mobility scooter size are presumed to be based on four-wheel mobility scooters. An investigation may be necessary on the suitability of standards for three-wheeled mobility scooters.
14. Crossfalls for persons with visual impairments and wheeled device users can skew the direction of travel, especially at pedestrian crossings. Safe solutions need to be investigated.

As part of the workshops, several documents that relate to or provided guidance on the topic of universal access and vulnerable users were indicated as being potentially insightful. These documents were not reviewed in Part 1 of this project. In future research, these documents may require review, especially if establishing detailed overarching frameworks or establishing solutions to specific access barriers.

- **Safety Intervention and Improvement Guidelines (vulnerable users)** (TMR n.d.) - provides a reference to best practice guidance, for the selection of appropriate facilities for pedestrians (including people with disability).
- **Road Safety Policy** (TMR 2018c) - addresses implementing Safe System principles, processes and practices that have the potential to contribute to better road safety outcomes. The use of this document hopes to integrate further embedding the Safe System approach in all TMR practices, maximising alignment with best practice road safety management.
- **Project Management Practices Guideline (Annexure 1)** (TMR 2018b) - lists documents providing guidance and direction for design and conformance information for disability and accessibility inclusion.
- **Project Management Practices Guideline (endorsed version 1.0)** (TMR 2018a) - provides an outline of project phases and an explanation of overarching environments. The latter includes the relationship between TMR's portfolio, program project structures, governance processes and project management methodologies.
- **Safety Intervention and Improvement Guidelines (Pedestrian Safety at intersections - 2)** (TMR 2019b) - provides guidance to improve pedestrian safety at existing slip lanes and in new designs.
- **Safety Intervention and Improvement Guidelines (Pedestrian Safety at intersections - 1)** (TMR 2018d) - provides a brief discussion on safety countermeasures to reduce pedestrian-vehicle crashes at intersections.
- **Street and Movement Network (PDA guideline no. 06)** (ULDA 2012) - sets out the standards for planning and the design of street and movement networks within priority development areas. It indicates the form, type and arrangement of development that is likely to be acceptable.
- **Springfield Central Park 'n' Ride Carpark Review** (GHD n.d.) - compares compliance and functionality audit findings against the *Disability Discrimination Act* (Cth) 1992 (DDA), the *Disability Standards for Accessible Public Transport* (DSAPT) 2002, the *DDA Access to Premises Standard* 2010 and the *Anti-Discrimination Act* (Qld) 1991.
- **Motorised Mobility Devices Discussion Paper** – sought stakeholder views on options for the adoption of Australian Standard's Technical Specification for Motorised Mobility Devices; and considerations associated with a national registration and licensing system for Motorised Mobility Devices and their users. This forms part of an inquiry into the need for regulation of mobility scooters.
- **The whole of journey** (Australian Department of Infrastructure and Regional Development 2017). This Guide was developed with the direct input of people with disability as well as input from those who will use it, such as transport planners, transport operators, architects, engineers, builders and certifiers. The guide provides advice on how transport development teams and all levels of government can work together with people with disability to make public transport more accessible.

- **Traffic and Road Use Management Manual (TRUM)** (TMR 2019c). The Department of Transport and Main Roads adopted the standards published in Austroads Guides as part of an agreement for national harmonisation. This manual includes guidance on matters that are specific to Queensland and have precedence over the appropriate Austroads guide.

## 6 RECOMMENDATIONS AND NEXT STEPS

Universal access is a concept that is often overlooked, addressed incorrectly, or not addressed to the greatest potential, to benefit all users. Considering all the collated information of this project and feedback provided through the workshops, the following recommendations and discussion for the next steps to be taken by TMR are provided:

- Topography presents very difficult barriers when aiming to achieve universal access and any guidance provided on this topic requires further research or trials of options, such as (but not limited to) those mentioned in Part 3 of this project.

Ideally fixing every location would be the best option; however, this would require a huge amount of resources and sites would have to be prioritised. Options that inform users of potential barriers are likely to be the best starting point as it allows vulnerable road users the ability to better plan and prepare for their journey.

People with disability frequently have to plan their routes ahead of time. Google maps is a tool that is popular to help plan journeys by providing users with route options and basic information about those routes (i.e. public transport available times and distance). This function currently does not exist within the Briometrix Mapping tool, instead, the Briometrix tool offers users (targeted at wheeled device users) with insightful information they may need to make appropriate arrangements for their journey (i.e. steepness of slopes, slope direction). Adopting or creating a mapping tool similar to Briometrix and incorporating a journey planning function is recommended as a step towards helping people plan and avoid topography barriers.

- The lack of consolidated and comprehensive information and guidance on the topic of universal access and persons with disabilities 'forces' designers to depend heavily on Australian Standards and mainstream guidelines (Austroads). This dependence instils a culture where the perception of minimum parameter values in these standards and guidelines is seen as best practice. Universal access is successful if it can be used by the greatest number of people possible; minimum parameter values do not guarantee this.

Designers should be aware of desired functions and outcomes for design objects, along with information as to who is likely to experience disadvantage on specific objects (e.g. steep topography), why they can/are experiencing disadvantage and what can be done to resolve or reduce the implications of these disadvantages. Additionally, the definition of 'universal access' and 'person with disability' should be defined clearly as this was found to be unclear from standards and guidelines and TMR policy documents reviewed in this report.

Knowledgeable and informative content does exist on the topic of universal access but again it is often scattered in non-mainstream design documents. Consolidating this type of information into a singular document such as a 'best practice' guide would make good quality and relevant information (including performance-based concept strategies) on the topic of universal access more easily available. This guide would aim to educate development teams and promote the significance of universal access as a fundamental principle in design.

- Creating a best practice guide would include an overarching framework for dignified and reasonable universal access and identify the need for consultation or engagement with the public to understand at what point the design becomes unreasonably accessible. This is highly important because minimum design parameters do not mean something is reasonably accessible or socially acceptable which leads to undignified designs, as previously discussed in Section 4. After an overarching framework has been established, existing TMR guides, manuals and other information resources should be revised and amended as needed (e.g. TN38 states that maximum grades for walkways are not required). Revise defensibility using the framework. Determine if this information/guidance is reasonable and presented in a dignified way. Then, recommend potential improvements to guidance in TN38.

Part of developing a best practice guide might also include comparing and evaluating current Australian practices to international practices (from countries with a good reputation for developing universal

access). This may be able to identify international practices that are more effective than current Australian practices which could potentially be adopted.

- As an ongoing effort user capability should be monitored. Creeps in size of mobility assist devices (commercially available and in public use) and changes in technology will change user capability. Monitoring any changes in normal or average capability and size should allow TMR to identify if and when provisions are becoming insufficient or problematic. Creating a database to hold information similar to the existing TMR register of mobility scooters is recommended.

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