

# Landscape Modification: an alternative to residential access ramps and lifts

**PEER  
REVIEWED**

Authored by  
Phillippa Carnemolla and Catherine Bridge

**March 2012**

ISBN: 978-0-7334-3060-20



[www.homemods.info](http://www.homemods.info)

## Publication History

1<sup>st</sup> edition Landscape Modification: an alternative to residential access ramps and lifts by Phillippa Carnemolla and Catherine Bridge, March 2012.

Reprinted July 2014

## Contribution of Authors

This is the first edition of the Occasional Paper: Landscape Modification: an alternative to residential access ramps and lifts, replacing the original publication of the same name, authored by Phillippa Carnemolla and Catherine Bridge (2012) for the Home Modification Information Clearinghouse, City Futures Research Centre, UNSW Australia.

## Acknowledgements

This material has been published by the Home Modification Information Clearinghouse within the City Futures Research Centre, Faculty of the Built Environment, UNSW Australia (University of New South Wales).

This material was produced with funding from the Australian Department of Social Services (DSS), and Ageing, Disability & Home Care (ADHC), a part of the NSW Department of Family and Community Services (FACS).

The original research was funded by the Commonwealth of Australia and the New South Wales governments under the former Home and Community Care program.

In producing the material the authors would like to thank Australian Landscape Architect Nell Rickard, whose concept sketches and design guidance for each of the case studies has made a vital contribution to this work.

This document was reviewed by the HMinfo Specialist Review Panel. The review panel for this document consisted of:

Linda Corkery	Associate Professor Program Director UNSW	Research Panel
Dr Elizabeth Karol	Curtin University	Research Panel
Beverley Garlick	Royal Australian Institute of Architects	Industry Panel
Natasha Layton	Occupational Therapist	Research Panel
Jane Bryce	Guide Dogs NSSF	Industry Panel
Sandra Lightfoot-Collins	Home Maintenance & Modifications Service	Industry Panel

## Liability Statement

The Home Modification Information Clearinghouse team gives no warranty that the information or data supplied contain no errors. However, all care and diligence has been used in processing, analysing and extracting the information. The Home Modification Information Clearinghouse will not be liable for any loss or damage suffered upon the direct or indirect use of the information supplied in this document.

## Reproduction of material

This material has been published by the Home Modification Information Clearinghouse within the City Futures Research Centre, Faculty of the Built Environment, UNSW Australia (University of New South Wales).

This material was produced with funding from the Australian Department of Social Services (DSS), and Ageing, Disability & Home Care (ADHC), a part of the NSW Department of Family and Community Services (FACS).

Any table or material published in this Occasional Paper may be reproduced and published without further license, provided that due acknowledgement is made of this source. The preferred acknowledgment style is:

Phillippa Carnemolla and Catherine Bridge (2012) *Landscape Modification: an alternative to residential access ramps and lifts* 1<sup>st</sup> ed. Sydney: Home Modification Information Clearinghouse, University of New South Wales. (July) [online]. Available from [www.homemods.info](http://www.homemods.info)

# Contents

Publication History	2
Contribution of Authors	2
Acknowledgements	2
Liability Statement	3
Reproduction of material	3
<b>Glossary</b>	<b>8</b>
<b>Executive Summary</b>	<b>10</b>
Project Aims	10
Overview of Results	11
Conclusion	11
<b>Introduction</b>	<b>12</b>
<b>Aims</b>	<b>13</b>
<b>Problem Statements</b>	<b>13</b>
<b>Research Methodology</b>	<b>14</b>
Literature Review	14
Analysis	15
Case Study Approach	15
Scope of Work	16
Limitations	16
<b>Foundations for accessible landscape solutions</b>	<b>16</b>
<b>Modification and Redesign Approach</b>	<b>17</b>
Landscape Assessment and Classification	19
The Residential Landscape	21
The home entrance	21
The front garden	21
Landscape theory and landscape modification for accessibility	23
Benefits of a landscape modification approach	24
Issues with Existing Approaches	25

Limitations of a landscape modification approach	26
<b>Reference Guide – assessing for and modifying accessible landscape entrances</b>	<b>27</b>
Stage 1: Site Assessment	29
Stage 2: Accessible Built Environment Elements	32
Space	33
1.2 Inclusive garden design elements	34
Links: Walkways	34
Access – threshold entrance design	37
3.2 Providing vehicle and parking access	37
3.3 Weather Protection	38
3.4 Turning area and door access	38
Elements that can support accessibility	38
<b>Retrofitting accessible landscapes</b>	<b>39</b>
Case-Study Examples	39
Australian Residential Architecture Types	39
Selection criteria for housing styles	40
Final selection of housing styles	43
How the Cases are documented	43
Case 1: Interwar Californian Bungalow	45
Case 2: Strata Title Block	49
Case 3: Queenslander	53
Overview of Case Studies	56
Results	56
<b>Conclusion</b>	<b>57</b>
Further Research	58
<b>References</b>	<b>59</b>
<b>Appendices</b>	<b>66</b>
<b>A: Literature Search Strategy</b>	<b>66</b>
<b>B: Planting Guide for access and enablement</b>	<b>67</b>

Plants and accessibility	67
Accessible Garden elements	67
Planting Schemes	67
<b>C: Australian and International Legislative Context</b>	<b>69</b>

## Figures

Figure 1. How landscape informs design of new residential development	18
Figure 2. How landscape and structure inform the modification of landscape to improve accessibility	18
Figure 3. Application of Accessible Building Model elements to a typical residential house block.	20
Figure 4. Access modification options for accessible home entrances	24
Figure 5. Diagram of approach to modifying accessible landscapes in a residential setting.	28
Figure 6. Access and design considerations for an accessible landscape modification	33
Figure 7. Simple interpretation of how landscape feature elements of berm, bridge and cut & fill can redefine a level access.	36
Figure 8. Landscape accessibility preliminary site assessment	41
Figure 9: Plan of Victorian Terrace showing limited land area at front of property making it inappropriate as a case study for front entrance landscape modification.	42
Figure 10. Case Study 1- Californian Bungalow	45
Figure 11. Accessible Building Elements Diagram for Californian Bungalow	46
Figure 12. Accessible Building Elements Diagram for Californian Bungalow	47
Figure 13: Landscape Design Solution Bungalow- annotated with details	48
Figure 14. Strata Block in original, pre-modification condition	49
Figure 15. Strata Title Block of Units Accessible Entrance Comparisons	49
Figure 16. Strata Title Block of Units Accessible Entrance Comparisons	51
Figure 17. Landscape Design Solution – Strata Title. Bridges, berms and graded walkways.	52
Figure 18. Accessible Building Elements Diagram for Queenslander	53
Figure 19. Queenslander - Accessible Entrance Comparisons	54
Figure 20. Landscape Design Solution with accessible features	54
Figure 21. Close Up of Landscape Modification showing graded walkway	55
Figure 22. Queenslander- View of Berm and Bridge	56

## Tables

Table 1. Accessibility Terminology	8
Table 2. Landscape Terminology	8
Table 3. Figure 8. Landscape accessibility preliminary site assessment.	41
Table 4. Australian Legislation and Standards Regulating Accessibility	69
Table 5. Australian Legislation and Standards Regulating construction within the residential landscape	71

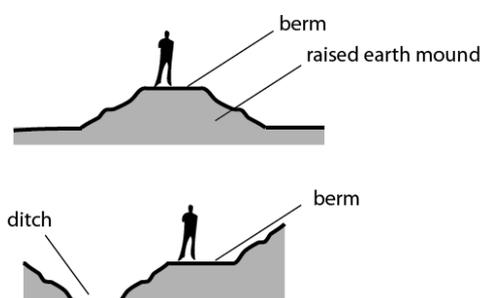
## Glossary

**Table 1. Accessibility Terminology**

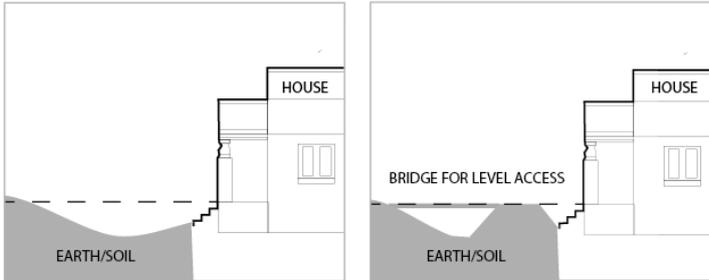
Accessibility term	Definition
<b>Accessible</b>	<i>Having features to enable use by people with a disability.</i> (Standards Australia AS1428, 2009) p6
<b>Accessible Walkway</b>	Any surface on a continuous accessible path of travel with a gradient not steeper than 1 in 20. (Standards Australia, 2009) p8
<b>Landing</b>	<i>A resting place between two points of travel.</i> (Standards Australia AS 1428 :2009 )
<b>Level Entry</b>	Access to building requires no stairs and either a ramped entrance less than 1 in 14 gradient (a ramp to the entrance landing no steeper than 1: 14) or graded walkway at 1 in 20 gradient
<b>Ramp</b>	An inclined surface on a continuous accessible path of travel between two landings with a gradient steeper than 1 in 20 but not steeper than 1 in 14. (Standards Australia AS1428, 2009, p7).

**Table 2. Landscape Terminology**

Landscape terms	Definition
<b>BASIX</b>	Introduced by the NSW Government –BASIX is an online Building Sustainability Index and certification process ( <a href="http://www.basix.nsw.gov.au">www.basix.nsw.gov.au</a> ). Online access to BASIX is free. The user (usually the building designer) enters data relating to the house or unit design - such as location, size, building materials etc. - into the BASIX tool. BASIX analyses this data and determines how it scores against the Energy and Water targets. The design must pass specific targets (which vary according to location and building type) before the user can print the BASIX Certificate.
<b>Berm</b>	The level part of an earthwork, a ledge in the wall of a ditch. Diagram below illustrates how a berm in the context of both a raised earth mound and a ditch.



*Figure above: Illustration showing how the term berm is understood in the context of this report.*

Landscape terms	Definition
<b>Bridge</b>	A construction built between two points of support over an obstacle or ravine to enable passage of a road, railway or pathway. (Davies & Jokiniemi, 2008)
<b>Cut and fill</b>	The process or result of removing material from a place and depositing it near by (Oxford English Dictionary, 2004)
<div style="text-align: center;">  <p data-bbox="560 824 1233 913">Grey shadow represent identical volumes of earth. Cut and fill technique is used to maintain soil volumes by redistributing earth into mounds and ditches.</p> <p data-bbox="502 943 1278 1032">Figure above: Illustration showing how the “cut and fill” method of redistributing earth can be used to redefine land contours for accessibility.</p> </div>	
<b>Grading</b>	<i>In site-works: the formation of masses of earth into the required contoured shape with bulldozers and other mechanical plant, into embankments etc.</i> (Davies & Jokiniemi, 2008)
<b>Hardscape</b>	The man-made elements of landscape architecture, such as paths, structures, walls, etc., as contrasted with vegetation (Oxford English Dictionary, Ed. 2004)
<b>Landscape</b>	All the visible features of an area of land, often considered in terms of their aesthetic appeal: the soft colours of the Northumbrian landscape   a bleak urban landscape (Oxford English Dictionary, Ed. 2004)
<b>Landscape Architecture</b>	The art and practice of designing the outdoor environment, especially designing parks or gardens to harmonize with buildings and roads. (Oxford English Dictionary, Ed. 2004)
<b>Ramp</b>	An inclined surface on a continuous accessible path of travel between two landings with a gradient steeper than 1 in 20 but not steeper than 1 in 14. (Standards Australia, 2009) p7
<b>Sub-floor Ventilation:</b>	The airflow afforded to the areas below the flooring of a house. Poor sub-floor ventilation will have an impact on the air quality internally (dry rot or white ant attack). Refer to the Building Code of Australia (BCA) 2011 Volume 1 F1.12 for requirements.
<b>Walkway</b>	Any surface on a continuous accessible path of travel with a gradient not steeper than 1 in 20 (Standards Australia, 2009)

## Executive Summary

This report explores and analyses the approach to modifying the surrounding landscape of a home in order to improve accessibility through innovative home modification solutions within a community care context.

The ability for a landscape modification approach to effectively resolve accessibility problems to a home is not a new concept, and has been explained and illustrated by Mace (1984). Currently, Home Modification and Maintenance Service (HMMS) Providers solve the issue of an inaccessible home entrance by installing a ramp or a lift and do not offer a modified landscape as an option. Although ramps and lifts effectively provide access, they can also detract from the heritage or aesthetics of a home (Smith, 2006), reduce perceived home value (Behe, Hardy, Barton...Hall, McNeil, 2005) and contribute to a sense of vulnerability to crime (Vincent, Radford, Jarman Rallings, 2009).

Therefore this exploration of landscape modification as an access alternative in home modifications is important for a number of reasons:

1. It provides innovative examination of accessible home modification alternatives by synthesising previously disparate literature from Accessibility and Landscape Architecture resources.
2. Acknowledges that landscape modification is a suitable access solution in very specific housing site applications.
3. Explores ways in which landscape modification can be applied to improve accessibility of residential entrances and gardens.
4. Provides a guide to assessing and modifying a residential entrance and garden.

The report reviews and analyses current literature in the fields of accessibility, landscape architecture, construction and legislation. This analysis is presented as a best-practice guide to landscape modification for homes and considers three case studies that implement an accessible landscape modification concept.

## Project Aims

The research question explored within this report aims to inform Home and Community Care policy and those involved in all aspects of home modifications from policy-making, design to technical implementation about the potential of landscape techniques in providing accessible home entrances. The three main objectives of this paper include the following; the exploration of whether landscape modification could become a viable alternative to a ramp or lift installation; the establishment of considerations that need to be made in order for this approach to be technically viable; and third, analysing reviewed literature into a best-practice reference in order to educate a multi-disciplinary audience on the principles behind landscape modification for accessibility.

## Overview of Results

There is evidence to suggest that landscape modification can successfully overcome inaccessibility in residential homes (Preiser & Ostroff, 2001). The feasibility of modifying the residential landscape is determined not only by the type of homes, in particular the building's relationship to the streetscape, but also site features including available land area, existing site, vegetation, topography, hydrology and soil conditions. Despite these specific limitations, where landscape modification is considered a technically feasible access solution, it brings with it a number of benefits in addition to providing immediate access between garden path and front door. First, a landscape modification can be designed to sensitively blend with existing architecture, thereby maintaining perceived house values and masking perceptions of vulnerability. Second, at the time of modification, accessible design features can be applied throughout an entire site, enabling a holistic approach to access from street to front door and throughout a garden.

## Conclusion

The results from the Literature Review, Analysis and Case Studies in this report imply that landscape modification is a viable approach to home modifications in some housing types; it can therefore be concluded to be an underutilised alternative access solution to ramps and lifts. This further emphasises the need for additional research examining the comparative costs of accessible landscape modifications, consumer responses to landscape modifications and examination of HMMS industry practices and skill base in order to facilitate landscape modification within a community care framework.

## Introduction

Accessibility is a major issue for one in five Australians – whether they personally have mobility limitations, provide care for someone with mobility limitations or care for children and use prams (Coslovich, 2005). The entrance of a home is a significant accessibility feature as it impacts on levels of participation, security, care giving and independence (Smith, 2001; White, Paine-Andrews, Mathews & Fawcett, 1995; Dunn, 1990). To optimise the possibilities of providing accessible entrances to existing homes, this project explores the potential of landscape redesign as a retrofit practice within a home modification<sup>1</sup> context. It is intended as an introductory overview and pre-empted further more targeted research (such as cost analysis).

Where an existing home entrance is inaccessible due to the lack of a level entry, the entrance to a home is most commonly made accessible by the construction and installation of ramps or lifts. However an alternative that appears to be under-utilised is the implementation of landscape re-grading and the incorporation of landscape design elements to create accessible home entrances.

There has been extensive investigation into the modification of a home interior for accessibility (e.g. kitchens, bathrooms, grab rails), (Oram, Cameron and Bridge, 2006; Pynoos, Cohen, Davis & Bernhardt, 1987); research into the installation of ramps and lifts at home entrances (Jung, 2010); as well as substantial examination of accessible outdoor public space and urban landscape (Imrie, 2000; Marcus & Francis, 1998; Preiser & Ostroff, 2001; Seeland & Nicol, 2006). However there has been limited literature exploring how to redesign residential garden landscape and home entrance for accessibility. The ability for a landscape modification approach to effectively resolve accessibility problems to a home is not a new concept, and has been explained and illustrated by Mace (1984), however it has since remained unexplored within a home modification context. This lack of research, in particular the absence of information consolidating landscape and accessibility knowledge, explains in part the limited application of landscape modification as an alternative to ramps and lifts in a residential landscape setting.

The decision to improve accessibility of a home entrance through landscape is impacted by a combination of many features unique to the site and home itself. This research is focussed on understanding the potential for landscape modification as well as the limitations posed by existing site features, e.g. existing grade and available area.

---

<sup>1</sup> The term *modification* is used throughout this occasional paper for the purposes of referring to a building change with the intention of improving accessibility (e.g. home modification). *Modification* is often interchanged with the terms *redesign* or *adaptation*, the semantics of which are discussed in research conducted by Bridge (2006).

The research question asked is;

*What is the practice of landscape modification, how can it improve accessibility and under what circumstance can landscape techniques be successfully applied?*

Being equipped with the technical knowledge to understand the constraints associated with providing accessible level changes at the entrances of homes, which by their nature will each have unique accessibility issues and features, will facilitate a clear direction for the next phase of the targeted research projects.

## Aims

The research question explored within this report aims to inform community care policy regarding home modification provision as well to inform those involved in all aspects of home modifications from policy-making, design to technical implementation about the potential of landscape techniques in providing accessible home entrances. It is therefore written for a multi-disciplinary audience that includes landscape architects, architects, builders, policymakers, landscape contractors, occupational therapists and carers. Integrative research into landscape that bridges human and natural science has been recognised as having considerable value (Tress, Tress, Decamps, & d’Hauteserre, 2001) as an opportunity for inter- or transdisciplinary cooperation and contribution.

The three main objectives of this paper encompass the following; first, determining how home modification practice might incorporate landscape modification as a viable alternative to a ramp or lift installation; second, establishing what considerations need to be made in order for this approach to be viable; and third, analysing reviewed literature into a best-practice reference in order to educate a multi-disciplinary audience on the principles behind landscape modification for accessibility.

## Problem Statements

1. Can landscape modification provide an alternative to a ramp or lift in the provision of accessible entrances to homes?
2. What technical considerations need to be made to successfully implement an accessible landscape solution to an existing home?
3. What is a best practice approach to accessible landscape modification in a residential setting?

## Research Methodology

In order to illustrate the potential of landscape modification to improve access in a residential setting, this study comprises three overlapping research activities:

### 1. Literature Review

A meta-analysis of a diverse range of publications, policy documents, and legislation relating to landscape, accessibility, functional disablement and housing modifications.

### 2. Analysis – Reference guide

The reviewed literature was analysed– consolidating landscape and access knowledge bases, and this analysis is presented as a best-practice guide to landscape modification for a cross-disciplinary audience of architects, designers, occupational therapists and carers.

### 3. Case Study

Developing three typical residential architectural styles into case study solutions. By applying both landscape best practice and ramp installation in every case to allow for a visual comparison to be made. These case studies are used as a benchmark to illustrate and compare how a landscape solution might be designed and implemented utilising the best practice approach synthesised from the reviewed literature.

## Literature Review

The literature reviewed within this report has been presented using a thematic structure similar to a standard narrative literature review as this suited a broad thematic, cross-disciplinary approach that drew on published materials from health and built environment databases. The narrative presentation however draws on a systematic search methodology (see Appendix A for evidence of the search process); thus providing the meta-analysis with greater rigour.

The research synthesis resulting is intended to be replicable by others and is designed to create consensus among scholars while focusing debate in a constructive fashion (Cooper, 1998). Simultaneously, it is a form of qualitative meta-analysis and as such is intended as an integrative publication (interdisciplinary/transdisciplinary). The increasing prevalence, potential and difficulties associated with integrative publications within fields of landscape and environmental science has been recognised and explored in numerous publications (Tress, B., Tress, G., & Fry, 2007 (a) (b); Tress, B., Tress, G., & Fry, 2006; Tress, B., Tress, G., Decamps & d’Hautesserre, 2001). Similar to other integrative publications such as practice guidelines, economic evaluations, and clinical decision analyses this report is based on a retrospective evaluation of the literature currently available and so is subject to both systematic and random error (Cook, Mulrow, & Haynes, 1997). Therefore the focused questions and the comprehensive and explicit search strategy employed in this research were adopted to minimise if not eliminate these known biases.

A traditional systematic review strategy involving criterion-based critical appraisal based on an established hierarchy of evidence was impracticable to implement because of the limited nature of the evidence currently available. The lack of experimental research means that illustrative case studies and the descriptive nature of qualitative interviews become more important (Evans & Benefield, 2001). Further, reporting results using the typical systematic categories of nationality, research rigour etc. were not employed as they have the potential to distract from the key themes without adding significant new understandings. The narrative presentation approach provided is the best fit for research of an exploratory nature positioned within a sparsely researched topic area (Hammersley, 2001). Therefore a meta-analysis of the literature is deemed important despite the lack of experimental studies, because alternative/new approaches to access solutions have wider implications for ageing in place, care provision in the home, and current home modification service provision.

## Analysis

Interpretation of the literature through the lens of design process, and more specifically a product/process model (Lawson, 1997); have shaped the analysis within this report. The conversion of the reviewed literature into a best practice reference adds value to the integrative nature of the publication, and is beneficial to understanding how and why a landscape solution should be implemented from the perspective of home modifications and accessibility. A duality of landscape design analysis and accessibility classification was determined as the best method for landscape modification. This also reflects the fact that the literature reviewed has been multi-disciplinary but not interdisciplinary, as there has been little shared research between the fields of landscape and access.

## Case Study Approach

The case study as a research methodology has been widely utilised in social science literature (Abramson, 1991; Stake, 1995; Yin, 1994). By selecting a single individual, group, or event to explore causation, case studies are based on an in-depth investigation in order to find underlying principles (Shepard, 2001; Yin, 2008). As a research strategy, case studies are an empirical inquiry to investigate a phenomenon within its real-life context, from which both generating and testing hypotheses become possible.

The case study method was deemed an ideal supplementary methodology for this research because of its ability to describe and illustrate a complex situation. This report seeks to better understand how the external access solution of landscape modification can be compared, evaluated and implemented. This establishes landscape modification as a feasible access solution for homes alongside ramps and lifts.

In order to illustrate how accessible landscape modification might be implemented on a wide range of residential types, three case studies of prevalent Australian architectural styles have been explored in terms of their redesign options and outcomes. The case

studies also serve as a visual comparison between landscape and more traditional ramp solutions, enabling visualisation of the benefits of a landscape approach.

## Scope of Work

This paper addresses the potential for landscape modification to become a better recognised access solution option in home modification cases. The ability to improve accessibility of a home entrance through landscape is affected by a combination of many features unique to the site and home itself.

Understanding the types of technical constraints associated with providing accessible level changes at the entrances of homes will facilitate a clear direction for the next of the targeted research projects. The success of a modification solution will depend on a number of site variables defined by the existing building, topography (i.e. grade and feature study), hydrology (i.e. water study) and paedology (i.e. soil study). The significance of these constraints will also impact the direction of the Stage 2 Accessible Landscape analysis.

## Limitations

Although a landscaped accessible solution is acknowledged as being underexplored within the Australian Home Modification setting, this introductory report does not address the reasons behind its limited application in the Australian residential setting. Subsequent research will be required to assess why landscape modification is not currently being implemented within home modification service provision.

This study is introductory and is intended to be the foundation for more targeted research in the area of landscape modification for accessibility. This preliminary approach reflects the limited literature and study within this particular field of research. There are a number of research possibilities that remain to be explored including cost, availability of landscape skills, available land area, cost of appropriate skills and education factors.

## Foundations for accessible landscape solutions

Landscapes are constantly changing, both ecologically and culturally (Marcucci, 1999) and altering the landscape is among the most ancient of human endeavours, relating to our desire to impose order and harmony on the natural world (Mann, 1993). The process of landscape architecture and design has developed over time to become a vital part of the built environment industry and essentially links people, structures, activities and communities (Simonds, 1998). Landscape architecture and modification impacts upon the entire range of public and private experience of landscape which include both the residential home and large estate, and span from shared city centres to parks. Landscape modification is a diverse field on all levels that considers aspects of horticulture, engineering, architecture, public relations, business, and art.

Landscape is an expression of the complex relationship between humans and the natural world and is defined as:

*“all the visible features of an area of land, often considered in terms of their aesthetic appeal” (Oxford English Dictionary, 2004).*

A modified (or designed) landscape is a cultural product (Meinig, 1979) representing ideals and values situated in a unique social, economic and political environment (Boults & Sullivan, 2010). In the 21<sup>st</sup> century, the task of designing a landscape is assigned to the profession of Landscape Architecture. Historically the term ‘landscape architecture’ was used intermittently throughout the 19th century, but it was only in the 20th that it developed the implications of a distinct discipline. Landscape Architecture is defined as *“the art and practice of designing the outdoor environment, especially designing parks or gardens to harmonize with buildings and roads”* (Oxford English Dictionary, 2004). Now an established profession across the world, a number of Registered Professional Bodies govern Landscape Architecture. In Australia the Australian Institute of Landscape Architects (AILA) is the peak national organisation representing the collective interests of the Australian Landscape Architecture professions and oversees the professional recognition of Registered Landscape Architects.

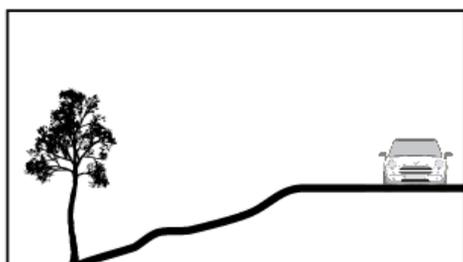
## **Modification and Redesign Approach**

In any understanding of the relationship between landscape, structure and form, we begin with space (Jackson, 1980). The existing landscape and its parameters define the house that is built upon it. This can be understood to mean that at the time of initial development, the built home will be designed to function in the existing landscape and its associated space, height changes, existing soil types, water etc. In any reciprocal relationship, such as when we are improving the accessibility of the entrance to an existing house, the existing building structure (as well as all the landscape parameters that exist in current form) will inform how the landscape needs to be modified. Figure 1 and 2 overleaf illustrate the interplay between existing landscape, structure and modification.

## New residential site development

Existing andscape informs the initial residence design

(Note: The home design in this case is an example of an inaccessible home because of stepped entrance.)



Original landscape and environmental features (pre-development)

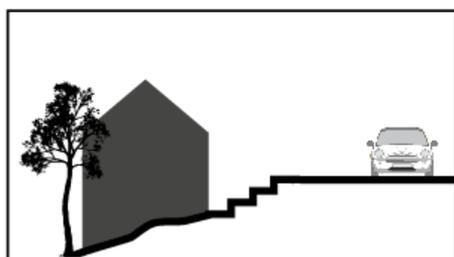


New residential structure with landscape access via stairs

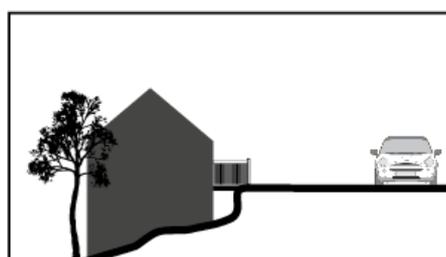
Figure 1. How landscape informs design of new residential development

## Landscape RE-design for accessibility

Both landscape and existing structure inform the accessible landscape design



Existing residential structure  
Existing landscape and environmental features



New accessible landscape development.  
Illustrates some regrading of landscape and a bridge construction to create a level access entry.

Figure 2. How landscape and structure inform the modification of landscape to improve accessibility

## Landscape Assessment and Classification

In any development or structure being built, the landscape becomes both a setting for the development and is an emergent property of the development itself (Syms, 2002). Development can have significant environmental impacts on the landscape. One approach to identifying and managing these impacts, particularly with larger or more ecologically sensitive sites, is with an Environmental Impact Assessment (EIA) (Thomas & Elliot, 2005; Morris & Therivel, 2001). A variety of landscape assessment tools have been developed to objectively assess the impact of a development on the existing landscape. These include landscape characterisation (Knight, 2009), LandScape Information System (LSIS) (Oh, 2001) and viewshed analysis<sup>2</sup> (Fisher, 1996).

The ability to improve accessibility of a home entrance through landscape is impacted by a combination of considerations of features unique to the site and home itself. In the case of the primary home entrance, which is the threshold between the landscape and the interior, an accessible entrance and garden involves providing a continuous unobstructed path connecting all accessible elements within the residential built environment – from the public street to the front door.

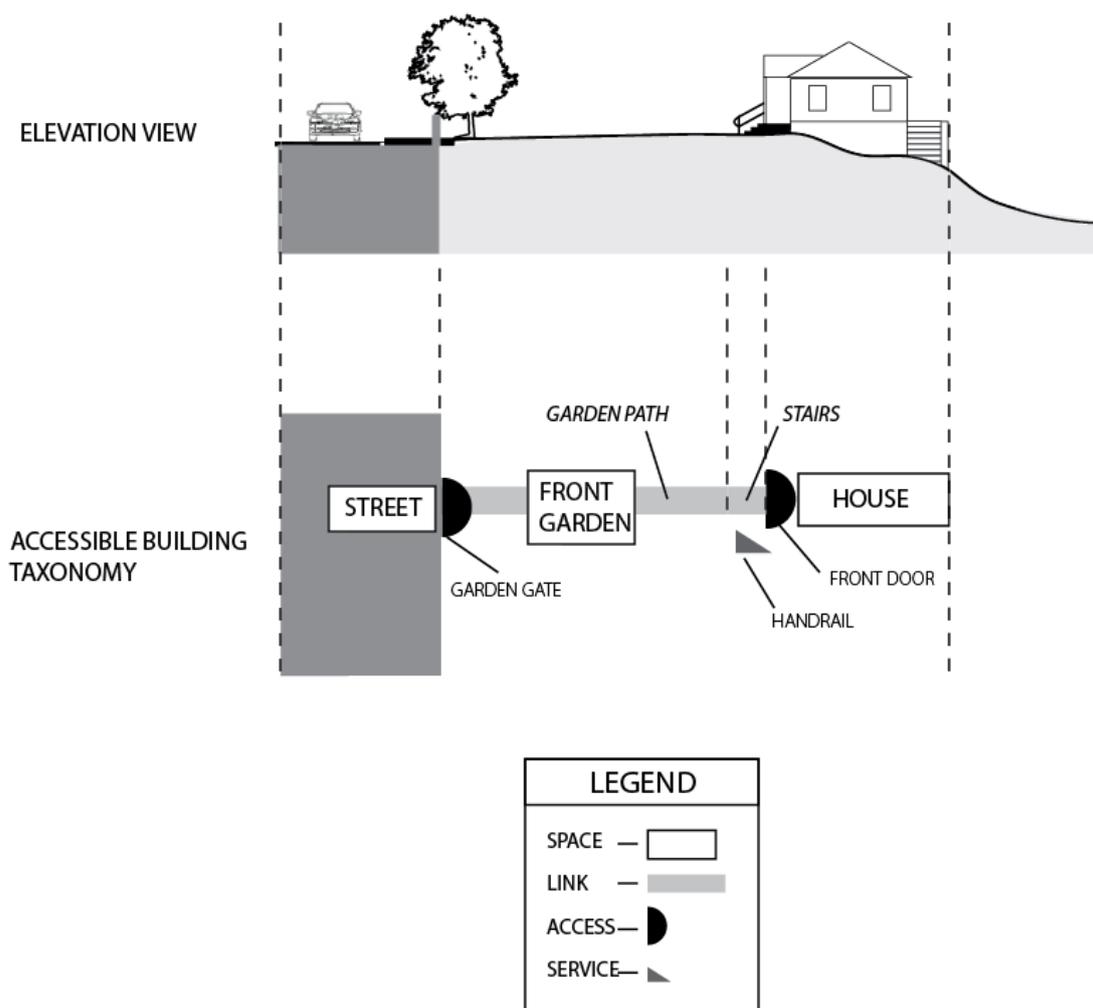
There are a number of different approaches to landscape typology and systems for landscape classification (Lipský, & Romportl, 2007; Vink, 1983). As a result, landscape can be categorised according to a wide number of classification variables ranging from climatic, cultural or land use. These elements play a fundamental role in site assessment and modification, because they each highlight an aspect of the sites limitations and potential. In addition to the ecological, geographical and hydrological classifications, the achievement of accessible landscapes requires an additional classification system to ensure a continuous accessible path of travel.

The access pathway from street to front door can be considered in terms of the *Accessible Building Model* devised by Bridge & Simoff (2000a). Incorporating the *Accessible Building Model* taxonomy of building elements into an accessible entrance can be considered a combination of basic structural relations between links (pathways), access (doorways, gates, entrances) and spaces (garden or room). In order for the entire pathway to be accessible, all elements within it must be accessible – otherwise partial accessibility will result. In

Figure 3, below, the Bridge and Simoff (2000a) taxonomy for Accessible Building Model has been applied to a typical residential housing block with front street access via a front path. Each access element has been coded according to the classifications of Space, Access, Link and Services.

---

<sup>2</sup> A viewshed is an area of land, water, or other environmental element that is visible to the human eye from a fixed vantage point. For more information see <http://en.wikipedia.org/wiki/Viewshed>



**Figure 3. Application of Accessible Building Model elements to a typical residential house block.**

Figure 3 illustrates how individual building and landscape elements might interact in a front garden and provides a framework for evaluating accessible and inaccessible elements. For instance in the diagram above, there are 2 links which are both parts of the pathway to the front door; the garden path (which is level entry) and a stairway leading to the house which can be considered inaccessible. One of the major problems of accessibility in the home is the outside stairs to the main entrance (Pynoos 2002). Entrances to homes are unique by the nature of the home design and the uniqueness of the land that homes are built upon. There is no “standard” entrance, and likewise there will be no “standard” solution to an inaccessibility problem. Retrofitting an accessible solution involves an auditing and evaluation process, to select a best design solution. This paper utilises the framework established by Bridge and Simoff (2000) to develop an auditing process for landscape modification opportunities.

## The Residential Landscape

The residential landscape can be considered as a combination of building and outdoor elements, which might include the garden, external stairs or walkways leading to the home itself and any threshold or connection between the building and garden, and the garden and street/footpath.

### The home entrance

The home entrance is intrinsically linked to privacy, sanctuary and security of the home (Smith, 2001) and the onset of functional limitations or impairment will challenge an occupant's perspective on all three of these aspects (Imrie, 2004). In terms of home entrance design, functional limitations that impact upon entrance accessibility include:

- Wheelchair/mobility aid use
- Ambulatory Mobility impairment
- Visual impairment
- Cognitive impairment
- Temporary impairment through injury

For someone with limited mobility, an accessible, barrier-free entrance to their home plays a part in fostering greater community participation (White, Paine-Andrews, Mathews, & Fawcett, 1995) and impacts upon care giving and independence. Those living with a functional limitation experience a greater sense of vulnerability in the community than those without (Satz, 2008). In addition to providing independence, a home modification, in particular an entrance must provide a sense of security and maintain security levels – an important issue for those living with functional impairment (Dunn, 1990).

### The front garden

A garden is defined as a plot of ground on which plants (flowers, vegetables, fruits, or herbs) are cultivated (Park, 2007) and is a fundamental element of the residential environment. Many Australians continue to desire and live in detached dwellings with garden surrounds, statistics indicate 79% living in detached dwellings, 9% in attached dwellings (duplexes and townhouses) and 12% in apartments (Murray, Ramirez-Lovering, & Whibley, 2008). The accessibility of a majority of these existing homes is questionable because they were designed and built to suit a young healthy adult with complete functional ability (Bakker, 1999; Bridge, 2006; Bridge & Gopalan, 2005). Older Australians are more likely to live in detached dwellings (Roberts, 1997) and are thus more likely to have private gardens and entrances which may become an obstacle to accessibility. This means that a majority of existing homes and gardens exclude the ability for a growing sector of the community to live independently and this exclusion is likely to begin at the front gate and entrance where stairs are a common feature.

Given the accessibility considerations that have been required to modify access to heritage public buildings in Australia (Accessible Arts - Arts and Disability, 2010), it is

not surprising that our heritage private housing stock will also require accessibility consideration. Heritage home styles in Australia usually have steps leading to the front door. Short of relocating to a more accessible home environment, home modifications are one of a number of ways people with functional limitations can adapt to or change the environment to meet their needs (Pynoos, Cohen, Davis, & Bernhardt, 1987)

The role and function of the front garden has been well documented and explains in part why an accessible front garden and home entrance is so important. Research indicates that home gardens are major contributors to quality of life (Oram & Millikan, 2007; Syme, Fenton, & Coakes, 2001), make important social statements (Francis, 1992), and can also play an important role in climate change and sustainability (Ghosh & Head, 2009). They are established as an important and versatile space despite the fact that the few surveys of garden usage have not always shown intensive active usage, especially of the front garden (Halkett, 1976). The front garden is symbolically and functionally different to a rear garden in that the front garden is the public face of a home and a place that often contains garages, vehicles and garbage recycling (Smith, 2001). Thus, the front garden and entrance functions as the transitional space from the public to the private domain.

The front garden also has relevance not only as a transitional space or link, but as a static space to experience nature. The ongoing psychological and restorative benefits of nature and gardens have also been well documented (Stigsdotter & Grahn, 2004; Stigsdotter & Grahn, 2002; Armstrong, 2000; Kaplan, 1995; Kaplan, 1973), including research that directly correlates improved health, reduced stress and other symptoms with access to a home garden (Macintyre, 2003). Horticulture and gardening have been used as a therapy by some rehabilitation hospitals to alleviate stress, increase wellbeing and promote participation in social life (Soderback, Soderstrom & Schaander, 2004). Therefore a garden and home entrance that is inaccessible to its occupant will potentially have an impact on aspects of life as diverse as participation, sustainability, health and self-worth.

Where modifications to a home entrance are required, there is an opportunity to reassess the front garden design in general and make improvements based on participation, accessibility and inclusivity (Soderback, Soderstrom & Schaander, 2004). Modifications to a garden setting incorporating inclusive design should make it safer, comfortable and a passive or active gardening experience for the widest audience possible.

An example of dynamic inclusive garden design is the Beuhler Enabling Garden in Chicago US (Rothert, 2002). This garden (which is approximately one square kilometre in size) opened on July 16, 1999 conveys three key messages;

- that anyone can access and enjoy safe and active gardening,
- that participation in horticulture, gardening and nature is therapeutic, and
- that the design and techniques demonstrated benefit all who garden.

## Landscape theory and landscape modification for accessibility

The discipline of Landscape Architecture has recognised the importance of Universal Design theory and the notion of *equivalent experiences for all* in the outdoor environment. Design guidelines have been published that introduce a variety of inclusive landscape features – more specifically in the realm of public or shared landscapes and urban spaces (Marcus, 1998; Carstens, 1993). Similarly, Universal Design texts also recognise the important role of landscape architecture in the design of inclusive outdoor spaces (Preiser & Ostroff 2001).

One of the benefits of theory is in its ability to communicate across a broad selection of unique situations. It is this feature that theory becomes particularly useful in this study. The consideration of residential landscape modification begins with the acknowledgement that every single residential application will be unique. In order to form an understanding of an overarching approach a theoretical model is useful.

Landscape theories take the form of a variety of theoretical constructs and may include practical, critical and interpretive theoretical approaches. A *practical* theoretical approach in landscape theory includes site planning (Lynch, 1984). Site planning theory incorporates a defined set of principles in assessing a site for development/redevelopment. A simplified version of site planning theory informs the approach to modifying accessible landscape in later chapters of this paper. A *critical* theoretical approach to landscape will challenge established ways of thinking and put forward alternatives. *Interpretive* theory can be developed inductively or deductively. *Inductive* theory is developed by observation, deductive theory utilises a first principles approach to generate hypotheses (Lynch, 1984). Utilising this theoretical language, this paper deductively puts forward theory for analysing residences, landscape and accessibility and then inductively assesses the application of this theory this via the implementation of actual case studies.

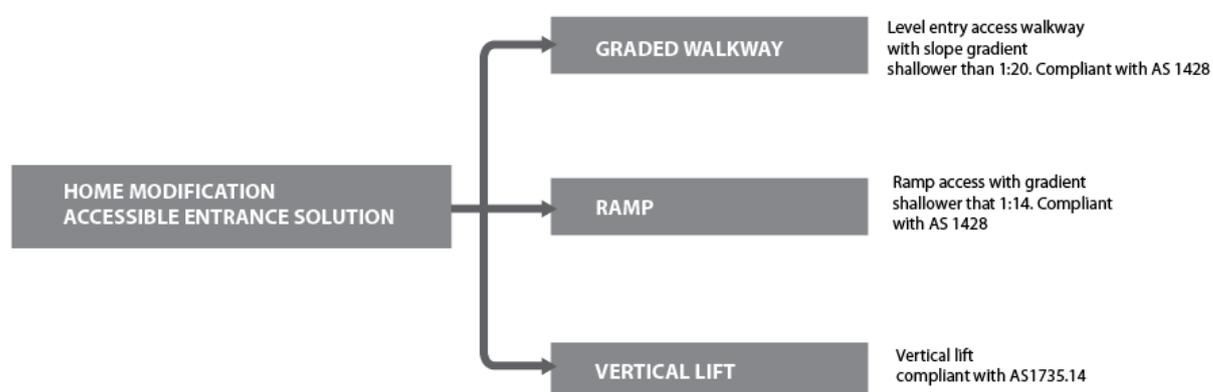
According to Eckbo (2009), good landscape design theory is a theory of form and function – hence both artistic and practical. In terms of Access, the value of the function becomes clear in the context of accessibility, and the value of the artistic can be argued for with the outcomes of research such as Johansson, (2010) and Smith (2006). There is a cumulative effect of all design elements within a landscape. From the viewpoint of modifying landscape for accessibility, the theoretical approach must incorporate and interpret the value of landscape elements (as established in

Figure 3) and the resulting benefits which will include:

1. Level entry access for all who live and visit the home
2. Improved accessibility of the garden
3. Improved functionality of the garden by reducing maintenance.

Successful implementation of landscape modification can result in benefits not only including a more accessible home, but also the less tangible benefits of improved

property value through the provision of a sophisticated and functional accessible landscape and potentially improved quality of life. There are at least three design/construction techniques that can be retrofitted alone or in combination to make inaccessible elements within the building/landscape accessible; install a lift, construct a ramp, or modify the landscape to provide accessible walkways. Each solution has its own applications, limitations, cost variability (both initial and maintenance), and mandatory requirements. Figure 4 overleaf illustrates these three accessible entrance possibilities.



**Figure 4. Access modification options for accessible home entrances**

The provision of a graded walkway via landscape modification, despite being one of three possible options (listed in the diagram above), has not been widely employed in the Australian Home Modification setting. This paper seeks to understand the current evidence base surrounding landscape modification, and establish it as a viable alternative in the literature on home modifications. Subsequent publications will target industry practice with content pitched more at practical technical advice.

## **Benefits of a landscape modification approach**

Being able to modify the landscape to incorporate accessible features can benefit an occupant in a number of ways. A well-designed accessible solution will complement the façade of a building and not detract from its original architecture (Martin, Russell, Australian Heritage Commission & Australian Council of National Trusts, 1999). This is desirable for two reasons: first, it maintains the façade of the home (particularly relevant for heritage homes); second, it manages the issue of accessibility without drawing attention to itself in the way that a ramp or lift may.

A landscape can be modified to remove inaccessible features, provide alternative enabling access-ways and also incorporate a variety of improvements (such as reduce

garden maintenance and improve functionality of front garden). The issue of home and garden maintenance can be the triggers for ageing occupants having to move from their homes (Davey, 2006). The inclusion of lower maintenance plants and ground covers as part of the new landscaping can be a positive change for an occupant who has increasing difficulty with garden maintenance.

## Issues with Existing Approaches

Residents can feel that they do not want a ramp construction at the front of their house for a number of reasons:

- A ramp may be considered a visually unappealing feature; not blending with house façade (Dearnaley, 2011; McKay, 2011).
- Ramps can be perceived as lowering the property's resale value because they are considered un-aesthetic (Behe, 2005; Smith 2006).
- Those with a mobility or functional impairment are more vulnerable to crime and a ramp is a conspicuous advertisement of this vulnerability (Vincent, 2009; Sherry, 2000).
- Where ramps are commissioned privately, without the involvement of Home Modification and Maintenance services, there is an increased risk of non-compliant installations. This results in increased risk to physical safety in general (Australian Human Rights Commission, 2011).

The Australian Human Rights Commission also raised toxicity concerns surrounding the commonly used timber for ramp materials (Australian Human Rights Commission, 2011).

### Ramps as visually unappealing features

Ramp installations and a perception of their poor aesthetics form part of the discourse on ramps throughout the media and publications (Dearnaley, 2011; McKay, 2011) with the perception that *"Ugly access solutions are not good solutions"* (Smith, 2006, p 56). The aesthetics of a ramp has wider implications for the value, success and symbolism of an accessible solution (Johansson, 2010). Carefully designed modifications add to the appearance and value of a home (McFadden, 1993) and can improve the marketability of a home (Schaaque, 1996).

A modification may impact negatively on a property's appearance and value, for example if:

- it is not sensitive to the architecture of a home,
- it does not enhance the immediate landscape, or
- it is implemented in a way that gives the appearance of being institutional and incongruent with a residential setting.

A negative attitude towards ramp modifications on private property can also be inferred from the number of documented legal cases. These include situations where landlords or strata management bodies have disallowed the construction of ramps to enable access to a home - despite the willingness of the tenant to pay for the modifications (Caruso, 1995; Coslovich, 2005).

### **Access, fear and vulnerability**

Research has been conducted into the links between crime and disability and indicates that people with a physical or cognitive impairment are much more vulnerable to crimes (Vincent, 2009; Sherry, 2000; Waxman, 1991). Andre (1989) reports cases of neighbourhoods in America where planned disabled group homes were rejected and sabotaged in a backlash against their construction. Waxman (1991), documents an incident involving the arson of a wheelchair ramp as another example of negative attitudes being expressed specifically towards the mobility impaired and their access requirements.

Such negative attitudes to disability colour a wider picture of fear of disablement and its associated vulnerabilities. An access ramp can provide many important benefits when installed in the front of a residential property (Jung, 2010), however it also signals disability and vulnerability for those who live there. Thus the complexities surrounding the symbolism of a ramp can hinder its intended benefits.

### **Ramps and house value**

There is evidence of a two-fold negative impact that ramps may have on perceived property values. These play into current perceptions of disability and vulnerability and link with the importance of the role of aesthetics in home modifications.

First, literature has established a link between front garden landscape and house value indicating that a designed landscape with established plants impacts positively on perceived home values (Behe et al., 2005; Anderson, 1985). Given the negative perception of the aesthetics of a retrofitted ramp (Dearnaley, 2011; McKay, 2011), it can be directly interpreted that because a ramp installation would have a negative effect on perceived aesthetics of a landscape it could have the effect of reducing perceived property value.

Secondly there is some evidence in the media of a negative attitude towards disability within residential areas (Coslovich, 2005; Foster, 1998). Research directly links perception of lower home values with the locality of group homes for people with a disability. These group homes were blamed for lowering property values, increasing traffic, and changing the character of neighbourhoods (Andre, 1989).

### **Limitations of a landscape modification approach**

There will be cases where a re-landscaped, accessible front entrance solution is not tenable or desirable. First, the feasibility of a home modification hinges on the ability and permission to conduct building works to premises. Home tenure type has a large

part to play in the type of home modifications that can be carried out (Bridge, Kendig, Phibbs, Mathews, & Cooper, 2008). Second, the physical attributes of the site will dictate whether a landscape modification can be carried out to improve accessibility. These attributes, such as: available land area, existing site slope and drainage of the site, are further investigated in later sections of this paper. The nature of the existing site and architecture will also dictate whether a landscape approach is feasible. Very steep sites will require costly and complex solutions to create low gradient walkways and for them the best option may be a lift or ramp.

The gradient requirements for a graded walkway (as regulated by AS 1428) are such that sites require proportionally larger surrounding land areas to achieve the height changes necessary for a level entry. The need for such land area means that a proportion of residences cannot consider an accessible landscape that includes a graded walkway. Thus ramps and lifts will continue to play their important part in providing accessible entrances.

## Reference Guide – assessing for and modifying accessible landscape entrances

Every site is unique and individual evaluations are required to determine whether the integration of a graded walkway is feasible on an existing residential site. In order to improve the accessibility of the landscape of an existing home this report outlines a set of guidelines. These guidelines are intended to bring awareness to the range of considerations, limitations and alternatives for a redesigned residential landscape.

Approaching an existing residential environment with a view to improving the accessibility via landscape modification requires the application of a two-stage assessment process – a site analysis and an accessibility analysis.

- Stage One: SITE ANALYSIS

Stage one is based on an initial Site Assessment which involves assessing the individual site characteristics. A preliminary site assessment is required to determine the feasibility of a landscape modification based upon established landscape criteria. This site assessment analyses existing site characteristics such as *location of entrances relative to streetscape, available land area and gradient* from the standpoint of accessibility requirements as set out in Australian Standards: AS 1428 (2009).

- Stage Two: ACCESSIBILITY ANALYSIS

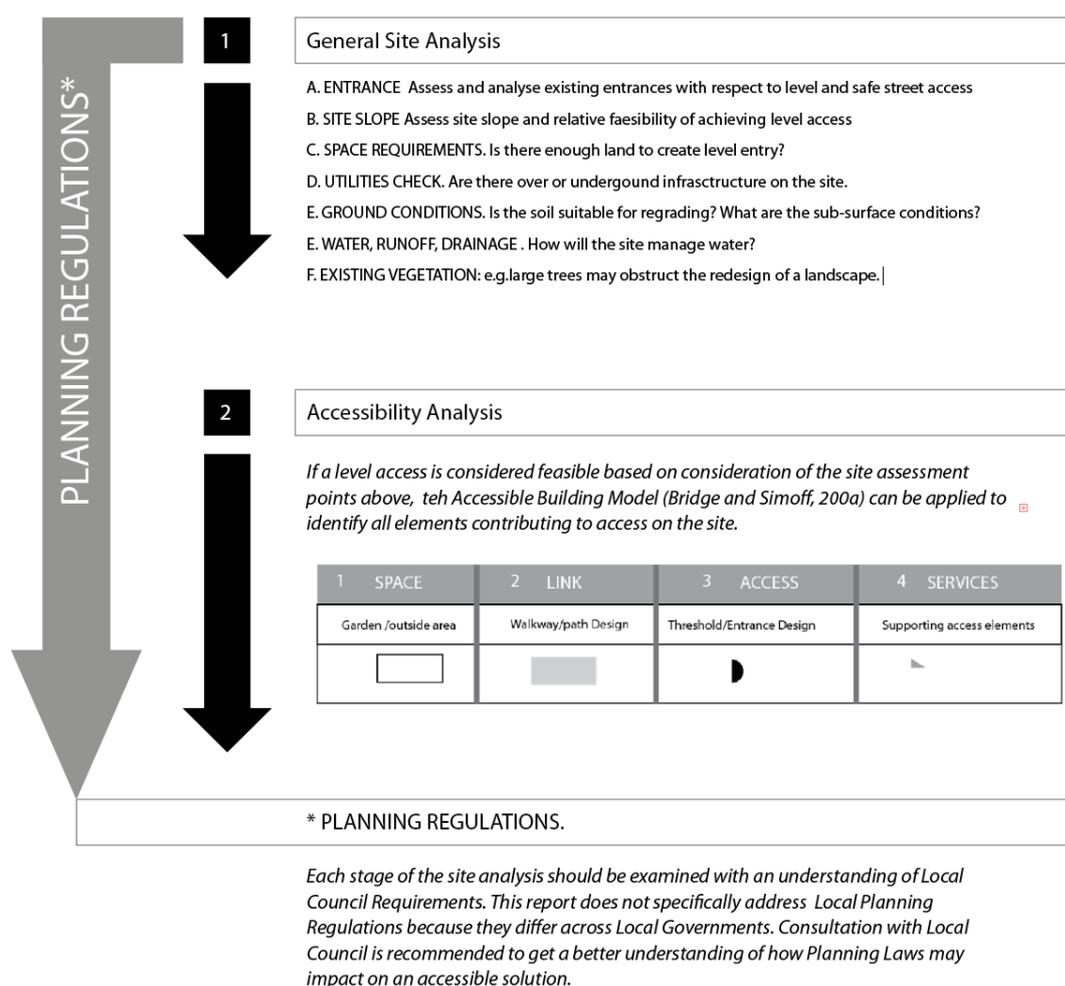
Following the initial *Site Analysis*, the second stage of the assessment overviews how landscape elements interact and affect accessibility. Utilising the taxonomy of the Accessible Building Model (Bridge & Simoff, 2000a) and in line with similar approaches to site analysis in landscape research (Dalton & Hanson, 2010) this type of analysis is a way of breaking down and understanding interaction between spatial and access elements. Tools such as the Accessible Building Model

recognise how all elements within the environment interact to maintain a level of accessibility and contribute to the overall success of an accessible landscape modification.

## Planning Regulations

Planning Regulations have the potential to impact all stages of a landscape site assessment. Figure 5 illustrates the overarching impact of Planning Regulations across the two-stage assessment process. Stage Two of the diagram refers to the access elements that are a part of the Accessible Building Model previously described in

Figure 3.



**Figure 5. Diagram of approach to modifying accessible landscapes in a residential setting.**

*(These two stages and their components are further analysed in the following sections.)*

## Stage 1: Site Assessment

A *site assessment* is a standard procedure in landscape design (Craul, 1992). It is a method for evaluating the relative importance and potential of a range of site inventory factors in the proposed landscape design (Simson & Straus, 1998). In this paper, a preliminary site assessment performs the important role of identifying any obvious site limitations which may prevent an accessible entrance from being designed using the landscape - and will mean that a ramp or lift may be required. If the site assessment indicates that the front garden will sustain an accessible solution, it will help guide decisions throughout the design process. Deficiencies such as soil composition and compaction levels, and drainage problems, etc. may be identified in the assessment and need to be addressed before any accessibility features can be considered. Alternatively, site assessment results may indicate that the site is unsuitable for an accessible landscape approach.

Given the diversity of site conditions and implications, this paper presents a simplified approach to site assessment with regard to accessibility and associated features.

### A. Entrances: Assess and analyse existing Entrances

1. Locate the entrances. There will most likely be more than one entrance point to a house. There may be a front, rear and or side/garage entrance, each will differ in accessibility. In order to modify a home's accessibility these entrances should be identified and analysed in terms of accessibility.
2. Assess level changes at entrances. Utilising the street level and vehicle access and the base level, each entrance point should be analysed in terms of changes in level in relation to the base street level (vehicle access).
3. Review existing hardscape. Assess the existing hardscape (concrete pathways, stairs etc.) leading to each entrance.

### B. Site Slope

The complexities and costs of a landscape solution increase as the gradient of the site increases.

These complexities become apparent when we consider the uniqueness of each application of these accessibility solutions and the associated limitations.

For accessible entrances, the topography and slope are critical to successful design and construction. Level access entry becomes increasingly challenging as the gradient of the site slope increases. Steep sites require careful consideration of the contours for an appropriate design response and acknowledgement that a solution will most likely be less economical.

According to the Australian Commonwealth Government publication *Your Home*<sup>3</sup>, three best practice landscape design strategies used on sites include:

- Balance cut and fill
- Avoid retaining wall being higher than one metre
- Build along contours.

### **C. Spatial Requirements: Assess available Area for landscaped walkway**

Of the three accessible options (ramp, lift, graded walkway), graded walkways require the most land area for a given vertical height change. Reducing the slope of a steep gradient requires land area, and consideration must be given to available space leading to the entrance of a home.

The creation of low gradient walkways requires an amount of land area. In the case of zero land area being available adjacent to an entrance, a lift will be required. The steeper the site, the more land area required to construct low gradient slopes using the variety of landscape methods mentioned.

Using the minimum required gradient requirements for ramps and sloped walkways the following table has been calculated to assist in visualising the types of available distance required for the change in gradient.

For longer distance gradients, horizontal landings are required for both ramps and walkways to provide a rest platform. AS 1428.1 (Australian Standards, 2009) requires that a straight walkway of gradient 1 in 20 requires a landing every 15m. A walkway of gradient 1 in 33 requires landings every 25m along its length. A ramp with gradient 1 in 14 requires a landing every 9m along its length. These landing areas should be taken into account when calculating overall accessible walkway lengths and areas required.

For a landing that continues in the same direction as the preceding ramp or walkway section, the required dimensions are 1m in width and 1.2m in length. For a landing that involves a directional change of up to 90 degrees, a width and length of 1.5m x 1.5m is required by Australian Standard 1428.1 (Standards Australia, 2009). A switchback landing (180 degree turn) must be a minimum of 1540mm wide and 2070mm in length (ibid).

These lengths given are for a single direct slope towards the entrance. Ramps and walkways can incorporate a switchback design (Center for Inclusive Design and Environmental Access, 2010), which makes better usage of a limited space – note the additional space/length requirements for the inclusion of required landings.

---

<sup>3</sup> 'Your Home' is an Australian Commonwealth Government initiative toward sustainable building and development. *Technical Manual for your home – design for lifestyle and the future* is available from <http://yourhome.gov.au>

## **D. Utilities assessment – overhead and underground infrastructure**

All underground services, infrastructure and overhead utility cables such as overhead wires, or underground utilities are best identified early in the site selection and site analysis stage. The costs of mitigating existing environmental conditions can create an unintended design challenge and additional cost; early identification is critical for effective site planning, cost control and later construction work.

## **E. Ground conditions**

Urban soil conditions are a crucial element influencing a landscape modification (Craul, 1992). Ground conditions influence the type of foundations and possible disturbances to the site. Erosion and sediment controls should be in place before design, excavation or regrading begin (Russ, 2009). Soil conditions present different constraints dependent on the design requirements for rock, sand, clay or wetlands. Other factors such as soil contamination and compaction also may impact on how a modification is managed or feasible.

## **F. Water and drainage**

Site drainage and runoff impacts the design of a sustainable and accessible solution. Priority consideration needs to the drainage patterns of a site including:

- overland flow and channel flow pattern (Lloyd, Wong & Chesterfield, 2002)
- ground water management (Hancock, 2000)
- tributary relationships, (Humphry, Sofoulis and Bhattarai Upadhyay, 2011)
- soil erosion, sediment transport and deposition. (Dunstone & Graham, 2005)

There has been considerable research into the application of Sustainable Drainage Systems (SuDS) and water sensitive urban design (WSUD) in both Europe (Bregulla, Powell & Yu, 2010), and Australia (Beecham, 2011; Hails, Bacon & Smith, 2003 ). Beecham (2010) outlines a selection WSUD components that include rainwater tanks, swales, biofiltration swales, bioretention basins, sand filters, infiltration trenches and basins, vegetated filter strips, permeable pavements, wetlands and ponds. The South Australian Government has published the Water Sensitive Urban Design Technical Manual, July 2009 (Department of Planning and Local Government, 2009) which explains and outlines the principles and applications for WSUD.

Protecting the existing buildings from changed drainage conditions as a result of landscape modification is important to minimise future problems with moisture and pests. This highlights the importance of maintaining sub-floor ventilation of a building, particularly when building soil height up against the walls. The Building Code of Australia (2011) clearly regulates sub-floor ventilation of buildings according to climactic zones in BCA Volume1, F1.12. According to BCA (2011) any sub-floor space (i.e. zone below a floor level in a house) must be cross ventilated, contain no dead air spaces and comply with minimum ground clearances to the underside of the floor of

the building. To maintain sub-floor ventilation in a landscape modification, landscape elements and details such as ventilation grates, dry beds and French drains can be incorporated. Ensuring there is no reduction in sub-floor ventilation following a modification will prevent the introduction of water damage to houses as well as assist in termite management.

## **G: Existing Vegetation**

Existing vegetation on site can impact how a redesign can be implemented. In many cases vegetation may obstruct access, or proposed landscape change. Considerations should be given to the following regarding existing vegetation on site;

- Planning restrictions for native vegetation in a Vegetation Protection Overlay. (The State of Victoria, Department of Sustainability and Environment, 2010)
- Planning restrictions for removal of trees with Significant Overlay Area (size and height)<sup>4</sup>
- Costs incurred to remove vegetation (in particular large established trees).

## **Stage 2: Accessible Built Environment Elements**

Once a preliminary Site Assessment confirms a site's suitability for landscape modification to improve accessibility, the accessible pathway requires careful consideration with respect to the full range of elements within the designed solution. These elements within the built landscape can be classified according to Bridge and Simoff (2000)'s Accessible Building taxonomy of links, access, spaces and services. A variety of access requirements and specifications can also be classified according to this range of elements as outlined in Figure 6. Access and design considerations for an accessible landscape modification below.

---

<sup>4</sup>Maroondah City Council in Queensland outlines tree removal planning guidelines on the following link: <http://www.maroondah.vic.gov.au/TreeRemoval.aspx#SLO>

1 SPACE	2 LINK	3 ACCESS	4 SERVICES
Garden /outside area	Walkway/path Design	Threshold/Entrance Design	Supporting access elements
			
1.1 Planting  1.2 Inclusive Garden Design elements	2.1 Walkway gradient 1:20 2.2 Walkway width 2.3 Walkway Surfaces 2.4 Path placement and minimised soil introduction. 2.5 Stairs as an option	3.1 Protect existing sub-floor ventilation of building and consider building interface carefully  3.2 Weather protection for approaching residents 3.3 Turning area and door access 3.4 Providing vehicle connections via adjacent parking facilities	4.1 Lighting contrast 4.2 Handrails/ Grab rails 4.3 Kerbs 4.4 Planting as buffer against falls 4.5 Removal of hazards/obstacles

**Figure 6. Access and design considerations for an accessible landscape modification**

**Source:** The diagram above classifies a full range of access considerations when modifying an existing residential landscape. These considerations are described in more detail in the paragraphs below.

## Space

In terms of a residential front landscape, the important “Space” elements within an accessible solution are the street, the front garden, and the house itself. The links and services connecting these spaces must comply with access requirements. The streetscape and the internal house accessibility are outside the framework of this particular paper, however there are elements within the Front Garden that should be considered in a modification. These include:

### 1.1 Planting of the Front Garden

The long term success and sustainability of an accessible landscape depends upon the specification of appropriate plants, shrubs and groundcover. An accessible landscape will not only provide access pathways that comply with AS 1428, they will also be low maintenance. A low maintenance landscape will incorporate planting that is drought resistant to minimise water usage, require minimum care to maintain plant growth and weed management, and will not easily grow or creep onto walkways becoming an obstruction or hazard.

Within the context of residential landscapes, plants have a significant role to play in establishing a garden that is not only accessible and low maintenance but sustainable. Plants have a significant role to play in the design of sustainable environments, particularly in the area of urban water management, remediation of toxicity, integration with sustainable buildings for energy conservation and air quality (Thomas, Sim, & Poulton, 2001).

Australia is described as the driest continent in the world (after Antarctica) with a runoff rate of 80% of the rain that falls (Gleick, 1993; Patrick, 1994; Walsh, 1993). Modifying a front or back garden affords an opportunity to improve plant types, removing any noxious plants or weeds and planting low maintenance, drought resistant native species. Local councils often support regional conservation and biodiversity of plants and have programs that educate local occupants, providing information about indigenous species and/or their seedlings or seeds (Kelly, 2009).

Further information of sustainable planting, and planting guidelines can be found in Appendix 2.

## 1.2 Inclusive garden design elements

Modifying the front garden landscape of a home affords the opportunity to not only improve direct access, but to improve levels of participation in the garden. This can be achieved through the incorporation of a number of design elements aimed at enabling an outdoor garden experience for all and might include:

- Raised and vertical gardens -providing gardening and horticultural access for those in a wheelchair if unable to kneel to floor level. (Benson, 1999) (Brock & Mefford, 1990).
- Considered selection of sensory plants for the visually impaired (Badertscher, 2002; Benson, 1999; Brock & Mefford, 1990).

## Links: Walkways

Of the linking elements within a residential landscape, walkways, paths and stairs have great relevance. For a walkway to be accessible it must comply with strict requirements as determined by Australian Standards 1428.1 (2009).

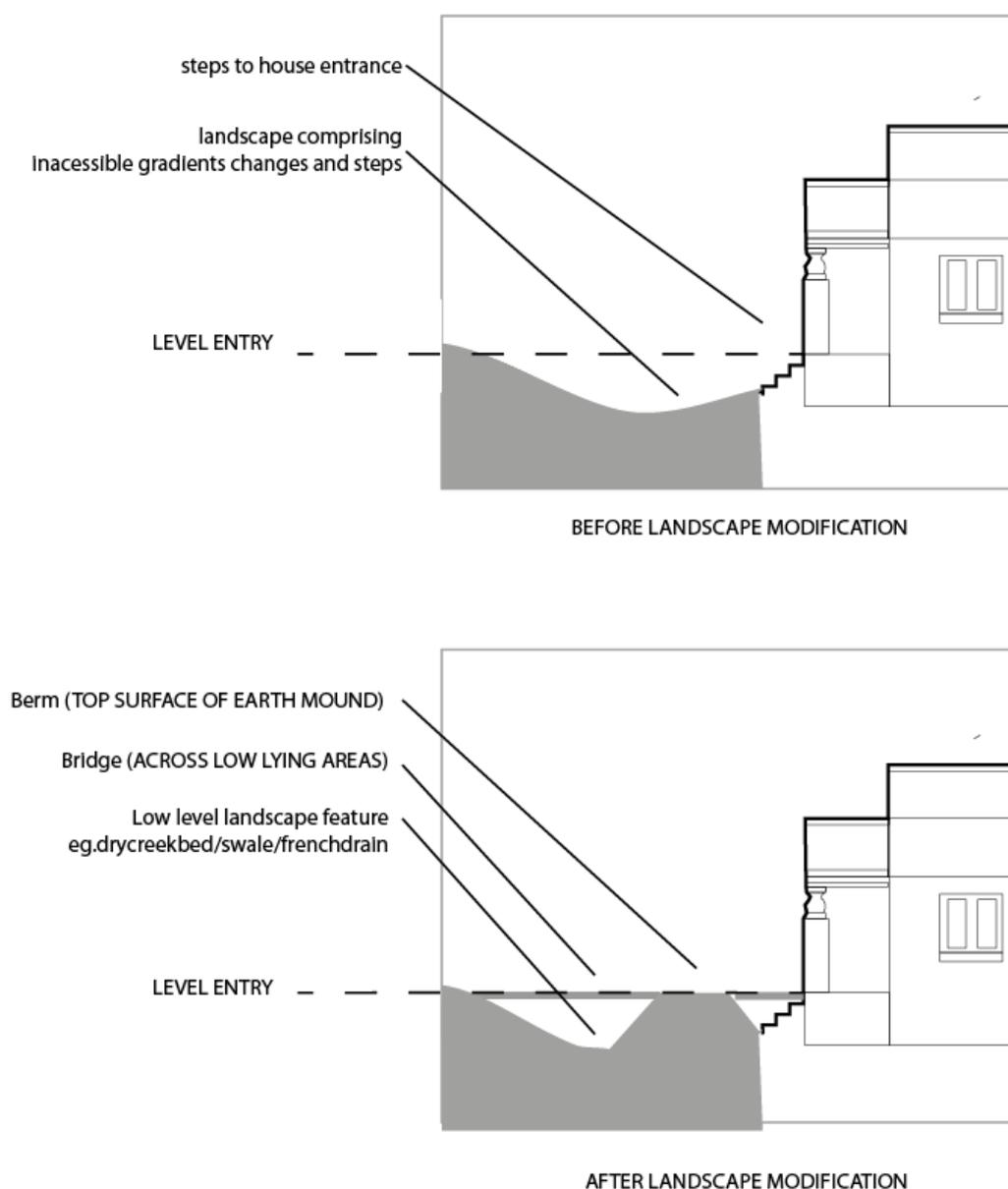
### 2.1 Walkway Gradient

Achieving an accessible graded walkway at an entrance may require the adoption of a variety of landscape architecture and construction techniques, depending on the existing site features. These techniques will enable the site gradients to be adjusted and the existing buildings to be protected. Appropriate gradients may be achieved by incorporating:

- Bridging – where existing terrain is uneven, the construction of a landscape bridge that meets requirements of gradient, railing, width and surface finish can span a distance across to an entrance (Erler, 2005; Preiser & OStroff, 2001).
- Berms, earth fill, cut and fill. Careful regrading of earth, including the incorporation of berms plays an important role in managing access gradient and supporting appropriate site drainage (Nichols & Day, 2010). Berms are significant features in an accessible landscape as they represent the actual walkway surfaces in a modified landscape. Berms are the flattened top surface of a build up of soil or earth.

- French drains & swales. These landscape features are typically low lying zones utilised in association with bridges and berms to manage damp/drainage and air circulation (Bregulla, Powell & Yu, 2010; Fine Homebuilding, 2003; Preiser & Ostroff, 2001)
- Retaining walls. Retaining walls are structures that redefine the feasible land contours of a site by resisting the lateral pressure of soil. (Nichols & Day, 2010; Skinner & National Concrete Masonry Association, 2003; McElroy, 1990; Ambrose, 1997)

The diagram overleaf places a selection of these landscape elements in a single modification setting to clarify how each element interacts in a modified landscape to provide a single level access.



### **Figure 7. Simple interpretation of how landscape feature elements of berm, bridge and cut & fill can redefine a level access.**

The Figure above describes a simplified formula for redefining accessible entrances in order to provide an understanding of the meaning of basic landscape elements. By either lifting or lowering the ground height along a path, a level entry can be created with berms, bridges, and low lying features like swales retaining walls and dry creek beds.

### **Ensuring a walkway is accessible**

For a walkway to be considered accessible and not require handrails, the gradient must be not be steeper than 1:20. According to Australian Standard 1428 *Design for Access and Mobility*, any gradient steeper than 1 in 20 will constitute a *ramp* and as such must include all associated ramped requirements such as handrails and kerbs (Standards Australia, 2009). Any crossfall of a pathway should be avoided as those using mobility aids may have difficulty negotiating crossfall in combination with gradient (Kockelman, Heard, Kweon, & Rioux, 2002). Crossfall, also referred to as cross-slope, is defined as the slope across a width of carriageway (Davies, 2008). Taking into account that some crossfall is required for drainage purposes, minimum crossfall is identified as no steeper than 1:40 in concrete, and 1:33 in bitumen (Standards Australia, 2009). Horizontal rest platforms known as Landings should be provided as per Australian Standards AS1428 (2009) along an accessible route between street and front door. These landings have minimum quantity and size requirements which depend upon the length and design of a walkway. Specific landing requirements are set out in Australian Standards AS1429 (2009). Where a walkway is raised above surrounding ground level, a raised path will need a kerb or an apron on the same level to prevent falling from a height. Australian Standard AS1428 states that elevations of over 1m require a handrail.

### **2.2 Walkway Width**

Unlike public access walkways, residential walkway widths are not dependent upon volumes of pedestrian access (Harris & Dines, 1995), but are instead related to anthropometry, accessibility and safety. Australian Standard AS1428.1 (2009) requires that the width of a walkway must be a minimum of 1000mm (unobstructed by lights, fittings awnings, windows etc.). Carroll (1994) also suggests that the walkway leading to the front door of a house will benefit from widening as it leads to the front door, as this part of the path is where people tend to pass or gather to enter or exit.

### **2.3 Walkway Surfaces**

The surface finish of a walkway is important and must be stable and non-slip. In order to comply with Australian Standards 1428.1, any abutment of surfaces requires a smooth transition (no stepping). This is particularly relevant where concrete sections join on a pathway, and also in the correct laying and maintenance of bricks and pavers so as to minimise tripping. It must be free of loose material for those with mobility

aids, and also must not have any gaps large enough to catch a walking stick or wheelchair tyre.

One example of an appropriate ground cover that meets these requirements is the recent development of resin bonded ground surfaces. These ground surfaces are typically small particulate natural stone or synthetic material bound with a resin. These finishes meet legislative and environmental requirements in that they are porous and allow for drainage of water, they are non slip, crack resistant and retain the natural appearance of stone or aggregate.

## **2.4 Site regrading for walkway – soil introduction**

For the purposes of maintaining local ecology, minimising contamination and minimising waste, the introduction of foreign soils or fill should be avoided where possible (Reed, 2010; Craul, 1992). As a best practice measure, where possible, the amount of soil removed should be balanced with the amount of soil used to create berms in a site modification design.

## **Access – threshold entrance design**

### **3.1 Stairs**

In most cases, the existence of stairs will be the obvious non-accessible element of a built environment. Indeed all of the three case studies in this paper removed stairs. It is worth mentioning however, that although stairs are considered an obstacle to access and increase the likelihood of falls (Yung & Bridge, 2010; Templer, 1995), there are situations where steps are a preferred accessible solution to a gradient, particularly for older people (Christensen & Taira, 1990). An example of this is for people who encounter gait or balance problems on sloped or unstable ground (MacCollum & Hughes, 2005; Birren, 1996). Ensuring stairs are well designed and maintained can reduce the likelihood of stair falls (Templer 1995; Pauls, 1982).

When designing stairs for accessibility, consideration should be given to the proportionality between tread, riser and other dimensional elements. These elements relate to the depth of the stair and its ability to contain the length of the foot, to the height and width of each stair. Jung and Bridge (2009) have conducted extensive research into stair safety and design and can be referred to for recommendations on specific proportions and descriptions of each stair element. The National Construction Codes BCA (2011) also provides guidelines on the design of stairs and appropriate dimensions of stair elements (Volume 1, Part D2.13).

### **3.2 Providing vehicle and parking access**

Vehicle access and parking are considered to be important indicators of housing quality, particularly for older people and those living with a disability (Peace & Holland,

2001). Access from vehicle to front door is required to comply with the minimum criteria of *visible*<sup>5</sup> housing (Imrie, 2006). Ideally access from a garaged vehicle to the house would also be protected from the elements.

A landscape surrounding a house can incorporate level entrance from street for either pedestrian/wheelchair access or level entry for vehicle (Preiser & Ostroff, 2001). If a site is too steep to reduce the gradient to an acceptable level for wheelchair access (1 in 20), then providing level entry via vehicle parking or garage is another way of approaching level entry access to a site. This would also enable the link to a vehicle for passenger loading. When is a passenger loading area required for a person? Some drivers and passengers require special vehicle adaptations that impact upon the relationship between an entrance and parked car (Barrier Free Environments Incorporated, 1993); for example, ramps or lifts mounted to the side of some vans /larger taxis and rear vehicle mounted lifts to load some wheelchairs. The location of parking space is crucial to the accessibility of a site and requires careful considerations (Preiser & Ostroff, 2001).

### 3.3 Weather Protection

As a best practice in accessible design, a front entrance or front threshold will benefit from weather protection (Jacobsen, Silverstein & Winslow, 2002) as well as enough level space to allow for manoeuvring or storage of a mobility aid (Preiser & Ostroff, 2001). Other universal features may include correctly positioned shelving for baggage or shopping, keyless entry, sidelights at doorway and a doorbell intercom.

### 3.4 Turning area and door access

Thresholds and entrances require level area to allow for rest, and manoeuvrability for turning, accessing keys and opening doors (Preiser & Ostroff, 2001).

## Elements that can support accessibility

### 4.1 Lighting Contrast

Lighting has a powerful effect on ambulatory performance, and poor illumination of a walkway will contribute to the likelihood of falls (Bakken, Cohen, Hyde & Abele, 2007). Lighting that defines the pathway edges and reduces glare will improve safety and negotiability (Carstens, 1993). Research on the range of illumination values suitable for safe and independent mobility are tabled in research by Pitch & Bridge (2006) offered best practice guidance in specifying lighting to optimise accessibility.

---

<sup>5</sup> “Visible’ housing was a concept launched by The UK Prince of Wales Advisory Group on Disability in 1985, and grew from an awareness that existing space and amenity standards did not take into consideration the need for ordinary housing to allow for minimal access by those living with a disability and older people. (Peace & Holland, 2001)

## 4.2 Removal of hazards/obstacles on pathways and access points

The removal of obstacles along a pathway is important in ensuring accessibility and safety (Bakken, Cohen, Hyde & Abele, 2007). Australian Standards AS1428 (2009) advises that on any route of access there should be no overhanging obstacles below a height of 2 metres above the path. This would include overhead obstacles as well as trip risks such as untrimmed edges and creeping plants.

# Retrofitting accessible landscapes

## Case-Study Examples

In order to illustrate the application of accessible landscaped walkways three case studies undergo a landscape modification for discussion. These case-study illustrations provide a foundation for better understanding both the possibilities and limitations of applying landscape solutions in a home modifications setting. They also enable direct visual comparisons with a ramp installation solution for the same case study.

Each case study has been selected because of its prevalence as an archetypal Australian housing style (Californian Bungalow, Queenslander, Victorian Terrace) or because of its important representation of ownership structure (Strata title). These cases clearly illustrate the factors contributing to a successful accessible landscape solution, and also illustrate the application's limitations (e.g. available land area is critical).

## Australian Residential Architecture Types

Due to the longevity of our houses, our cities are a conglomeration of both old and new styles. Since European settlement in Australia over two hundred years ago, Australians have built cities with distinctive Architectural Styles, usually derived from other countries. Historically different regions have identifiable architectural characteristics in design partly due to the variations in climate and available building materials (MacMahon, 2001; Troy, 2000). Modern housing design has not been as limited to working with local building materials and has also developed a more distinct Australian style.

Each house has a long life, with many households living under its roof over many generations—each family uses and lives in it differently (Troy, 2000). Being able to assess how particular architectural styles (both modern and heritage) may be suited to a modified accessible landscape will assist in offering more choice for accessible homes - in particular those that may also be sensitive to heritage qualities of the architecture.

## Selection criteria for housing styles

For this report, literature was reviewed in order to consider some prevalent Australian architectural residential styles. An initial assessment of Australian Residential Architecture styles, reveals a long list of styles, both modern and heritage, as outlined by Apperly, Irving, Reynolds, and Mitchell (1994).

When selecting the range of housing types to be included in the case study illustrations, both urban and rural examples were included in acknowledgement of the need for accessibility in not only main cities and thoroughfares, but in less populated or isolated regional areas.

The initial list of housing styles for assessment in preparation for full case study includes:

- Californian Bungalow (Butler, 2003)
- Victorian Terrace (Makio, Shinogi, Sugimoto, Tokuono, & Sugiyama, 2004) 2004)
- Strata Title Small block (Everton-Moore, Ardill, Guilding & Warnken, 2006)
- Sub Tropical high-set timber house : Queenslander (Kennedy, Hockings and Kai, 2005)
- Freestanding house built upon steep block

These residence styles underwent the Stage 1 process as outlined in Figure 5. This is a preliminary assessment measuring relative suitability for an accessible landscape modification. This Preliminary Landscape Site Assessment takes into consideration assessment of entrances, site slope, space, ground conditions and drainage.

The case studies are intended to illustrate the broader possibilities of modifying landscape to improve accessibility. They were selected on the basis of their relevance to changing populations and living arrangements, current housing types and relative feasibility for a landscaped solution. Figure 8 illustrates the preliminary Site Assessment process and its key points and shows how each architectural style performs according to these points.

.

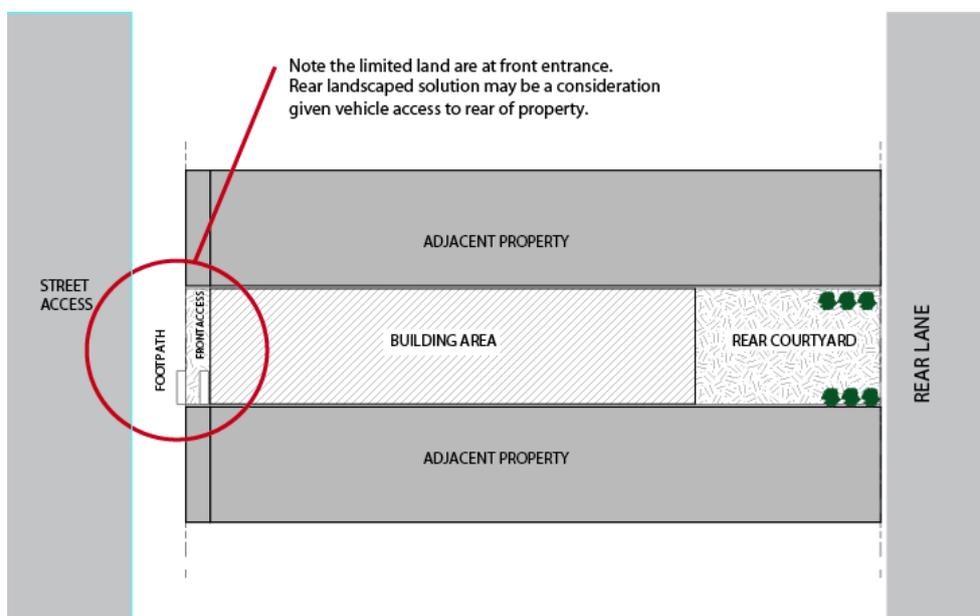
Table 3. Figure 8. Landscape accessibility preliminary site assessment.

Accessibility Site Assessment - assessing for landscape redesign					Suitable for landscape redesign
Archetypal Housing Styles	A ASSESS & ANALYSE ENTRANCES Are Level changes to front entrance <2m	B ASSESS SITE SLOPE Site gradient low-med	C SPACE REQUIREMENTS Is there enough land area to redesign landscape walkway to accessible gradient?	D & E GROUND CONDITIONS AND DRAINAGE Are ground type and water conditions appropriate for earth moving and regrading?	
<b>Californian Bungalow</b> Free standing Brick Home Site area: 1/4 acre block Typically 2-4 steps at entrance Flat/ low gradient block distance from front gate to front door approx 12m Ground conditions suitable for landscape redesign					
<b>Victorian Terrace</b> Brick terrace style house Site area: compact block configuration - no front garden Typically 2-4 steps at entrance Usually Flat/ low gradient block Distance from front gate to front door 0-1m Ground condition at front of site: N/A					
<b>Simple strata title small block</b> Free standing strata title brick block of 6 units Site area: 1 acre block Unit configuration: No internal lift, 2 ground floor units are accessible once inside. Typically 2-4 steps at entrance. Shared foyer. Flat/ low gradient block distance from front gate to foyer entrance approx 12m					
<b>Sub-tropical raised cottage Queenslander</b> Free standing timber house Site area: Minimum 1/4 acre block Built raised for flood protection and ventilation Typically 1m from ground to top step / entrance Flat/ low gradient block distance from front gate to front door minimum 12m					
<b>House built on steep block</b> Timber house - cement slab with steel structural support Site area: 1/4 acre block Typically: 2-4 steps at entrance Very steep block distance from front gate to front door approx 12m					

Figure 8. Landscape accessibility preliminary site assessment

The site assessment process illustrated in the previous Figure reveals that of the five architectural styles reviewed, the three most likely to be appropriate for an accessible landscape modification include the Californian Bungalow, Strata Title Small Block and Sub-tropical raised cottage: Queenslander. These all comply with the main indicators of the site assessment.

The two styles that were deemed generally unsuitable were the Victorian Terrace and the House built on a steep block. The Victorian Terrace was rejected on the basis of limited land area at its entrance. Although some Terrace styles do have garden allotments in front of the front door, many front directly onto the street and have limited site area to work with. Figure 9: Plan of **Victorian Terrace showing limited land area at front of property making it inappropriate as a case study for front entrance landscape modification**. below shows a plan of an Australian built Victorian Terrace design with a small landing between the street and front entrance. Despite its rejection from this particular set of case studies, there may be the option of a re-landscaped level entry rear access.



**Figure 9: Plan of Victorian Terrace showing limited land area at front of property making it inappropriate as a case study for front entrance landscape modification<sup>6</sup>.**

The Plan drawing in Figure 9 illustrates clearly the lack of available area at the front of the site, which disallows installation of both landscape solution or ramp access. In such instances a lift solution may be the only accessible solution.

<sup>6</sup> Based on Victorian Terrace Plan as submitted to Leichhardt Council. Source: City of Sydney Leichhardt Council. (2010). *Development Assessment: 31 TALFOURD STREET GLEBE*. Sydney: Retrieved from [www.cityofsydney.nsw.gov.au/Council/.../100906\\_PDTC\\_ITEM11.pdf](http://www.cityofsydney.nsw.gov.au/Council/.../100906_PDTC_ITEM11.pdf).

## Final selection of housing styles

In order to best represent a selection of typical landscape/architecture styles in Australia suitable for an accessible landscape modification the following case study examples were chosen:

**Sub-tropical high set timber house** (vernacular Queenslander Style). This style was selected because of its prevalence throughout Australia – particularly in rural, semi-rural areas in the northern states (Kennedy, Hockings and Kai, 2005). Housing in these non-metropolitan areas can be more conducive to landscape solutions because of lower density living and larger available land areas.

**Inter-war Californian bungalow.** This style has been chosen because of its prevalence Australia-wide (Butler, 2003; Apperly, Irving, Reynolds & Mitchell, 1989). Californian bungalows were built between 1915-1940. They are typically freestanding single story houses built on suburban blocks with informal lawns and gardens and a timber floor raised for ventilation. Many older people live in this type of house as the style was popular when they first bought a house.

**Strata title entrance.** The Strata system of land title was first introduced into Australia with the introduction of the Conveyancing (Strata) Act in 1961 and most recently updated with the NSW Strata Schemes Management Regulation 2010. Strata title legislation emerged in response to changing trends in urbanisation and an accompanying need to regulate tight clusters of independent owners. It essentially handles the legal ownership of a 'portion' of a building or structure. These 'portions' are known as 'lots' and can be applied to many different properties both residential and commercial. Residential 'styles' appropriate to this study include units, apartments, townhouses and villas. Strata titles are an increasingly common and important ownership arrangement in Australia. Many Australians now choose to both live and holiday in unit accommodation (Everton-Moore, Ardill, Guilding & Warnken, 2006). The sheer volume and predominance of strata living further justifies its inclusion in the case studies.

## How the Cases are documented

The following section of the report documents three selected case studies according to the assessment guidelines developed in the Analysis section of this report. The case studies are important to this study for a number of reasons;

- Provide clear 'before' and 'after' landscape modification images which assist the reader in understanding the scope of a landscape modification
- Establish clear visual comparison between a ramp and lift solution
- Demonstrate the diverse landscape design methods available to make a landscape accessible
- Offer realistic yet virtual experience of the accessible solutions, which would otherwise not be possible because of a lack of availability existing examples of

accessible landscape modification within Australian residences.

### **Comparing Ramps and Landscape solutions**

In each case, two alternative access solutions were designed and documented in Google Sketchup<sup>7</sup>; firstly a ramp access and secondly the modified landscape access solution. It was important to set up this comparison between ramp and landscape modification for a number of reasons. First, built ramp or lift access are the predominant access solutions currently provided to Home Modification clients by Home Modification and Maintenance Service Providers in Australia. The visual comparison between the two access solutions in the following case studies establishes two of the benefits of a landscape modification solution documented earlier in this report;

- Landscape modification enables the consideration of visual or aesthetic improvements possible and sensitivity to the existing building and setting on the site.
- Landscape modification affords the ability to consider the accessibility of the built environment throughout the entire site, not only the immediate entrance of the building.

---

<sup>7</sup> Google SketchUp is a 3D modelling software developed by Google. Its most basic version is available online at [sketchup.google.com](http://sketchup.google.com)

## Case 1: Interwar Californian Bungalow

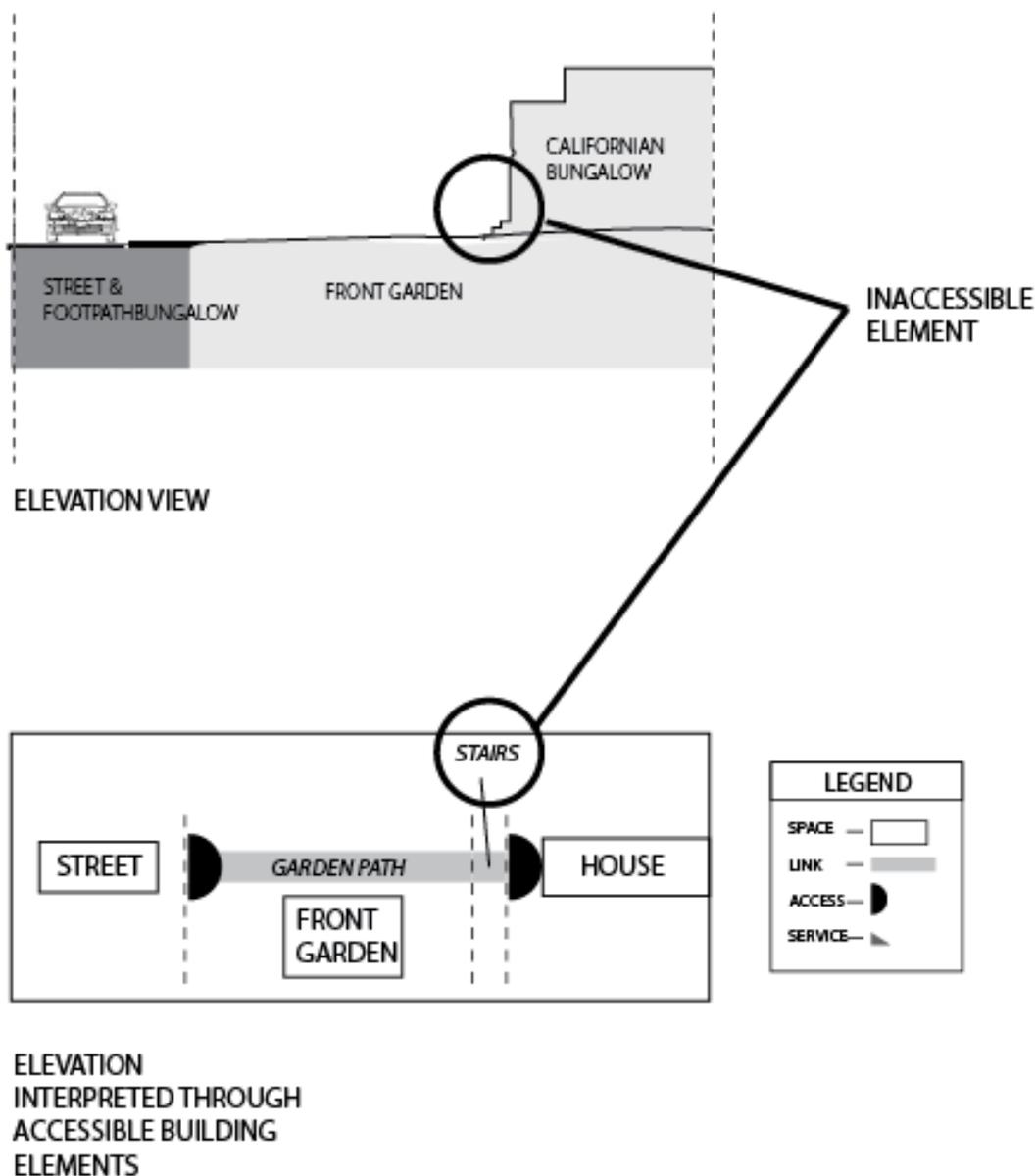
The figure below shows an example of a Californian Bungalow in its original condition that has been modelled into Google SketchUp. The Google SketchUp model represents a home built of brick, with a generous front garden. It has a level entry from footpath into garden path. The concrete path leads to three cement steps that then lead to a small veranda and finally another stair to the front door.



**Figure 10. Case Study 1- Californian Bungalow**

Application of the Accessible Building model reveals that the main access obstacle from street to front door which is the three stairs leading directly to the front of the building. By considering the access from street to front door Figure 10 illustrates the accessibility of the original bungalow via the application of the Accessible Building Model taxonomy. The examination of each building access element in

Figure 10 above confirms that the major inaccessible link is the three stairs to the verandah. This inaccessibility can be overcome by the installation of a ramp over the stairs, which will allow for access, or a landscape modification can reroute the path and provide a graded walkway from the street to front door. These two options for access solutions are compared in Figure 11 which documents the pre-modification scenario with the three inaccessible stairs followed by two accessible modification scenarios. These are first, a ramp (constructed from aluminium) and, second, a landscape redesign which includes a number of accessible features according to the Stage 2 Accessible Landscape analysis.



**Figure 11. Accessible Building Elements Diagram for Californian Bungalow**

The examination of each building access element in Figure 11 above confirms that the major inaccessible link is the three stairs to the verandah. This inaccessibility can be overcome by the installation of a ramp over the stairs, which will allow for access, or a landscape modification can reroute the path and provide a graded walkway from the street to front door. These two options for access solutions are compared in Figure 11 which documents the pre-modification scenario with the three inaccessible stairs followed by two accessible modification scenarios. These are first, a ramp (constructed from aluminium) and, second, a landscape redesign which includes a number of accessible features according to the Stage 2 Accessible Landscape analysis.

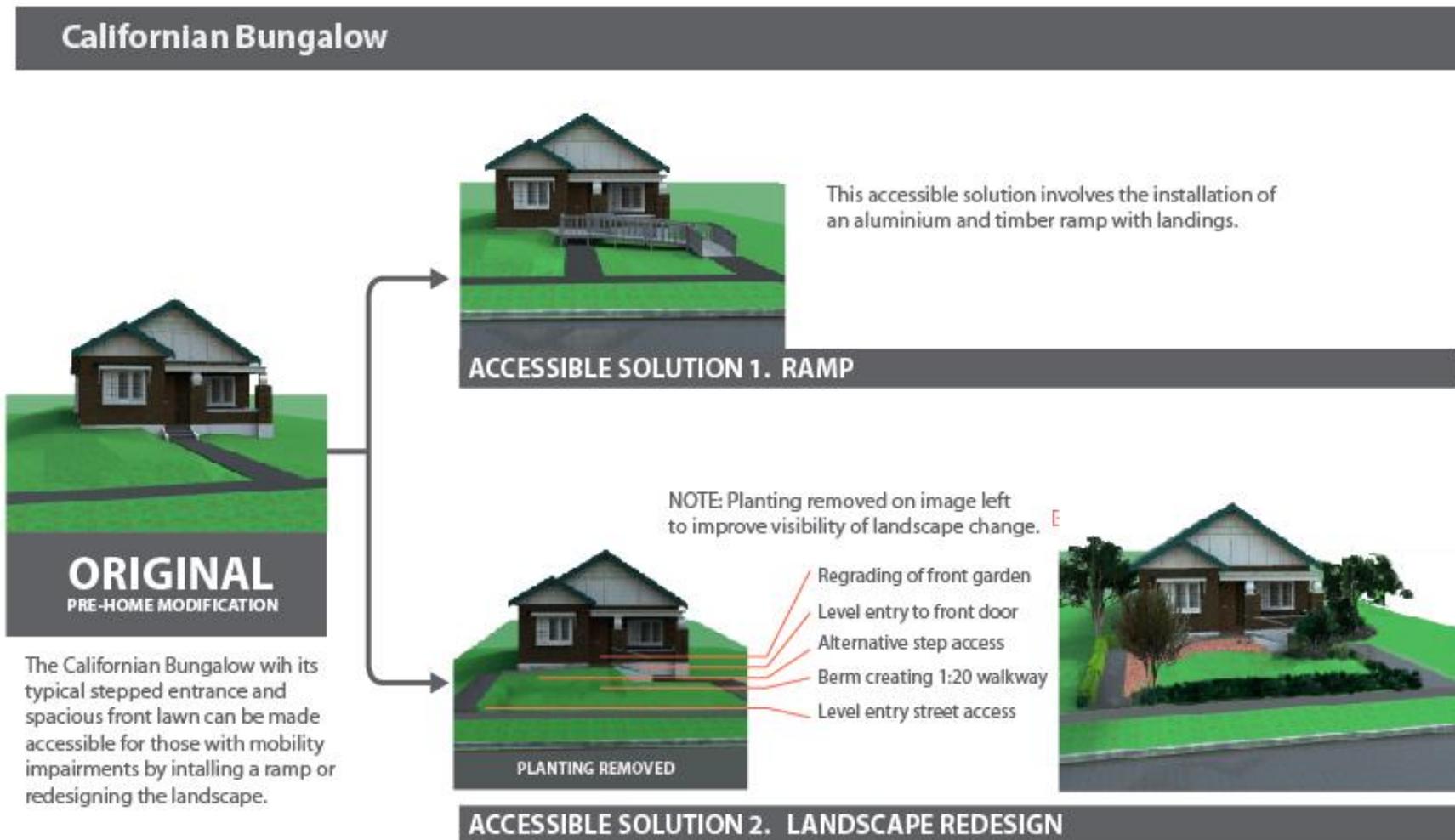
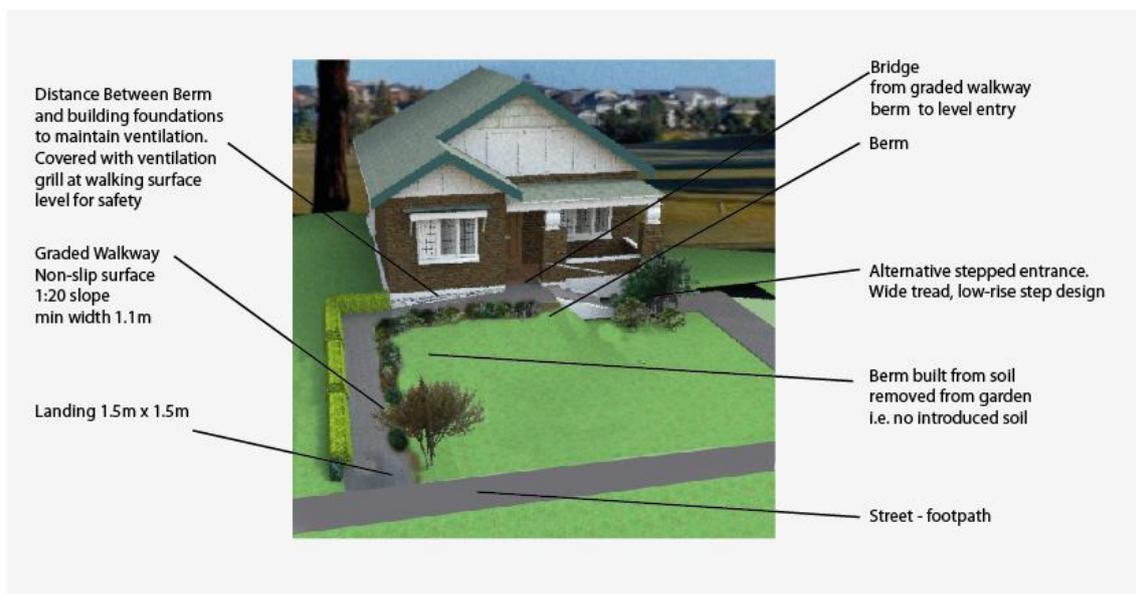


Figure 12. Accessible Building Elements Diagram for Californian Bungalow

The examination of each building access element in Figure 12 above confirms that the major inaccessible link is the three stairs to the verandah. This inaccessibility can be overcome by the installation of a ramp over the stairs, which will allow for access, or a landscape modification can reroute the path and provide a graded walkway from the street to front door. These two options for access solutions are compared in Figure 11 which documents the pre-modification scenario with the three inaccessible stairs followed by two accessible modification scenarios. These are first, a ramp (constructed from aluminium) and, second, a landscape redesign which includes a number of accessible features according to the Stage 2 Accessible Landscape analysis.



**Figure 13: Landscape Design Solution Bungalow- annotated with details**

Figure 13 details the important modified landscape elements that make this landscape design a viable accessible alternative to a ramp or lift. The landscape modification solution involves the use of the entire front garden land area and allows for replanting, alternative access by stairs and sustainable regrading without any foreign soil addition required. Sub-floor ventilation of the existing home is preserved through the incorporation of a grill at the walkway level.

## Case 2: Strata Title Block

In this second case involving a simple strata title small block of units, an important access element is the shared foyer entry. Shared, public entrances to strata buildings are required to be accessible, under the requirements of the *Disability (Access to Premises - Buildings) Standards 2010*. documents the pre-modification scenario with three inaccessible stairs to the shared foyer entry.



Application of the Accessible Building Model reveals that the main access obstacle from street to shared foyer entrance is the two stairs leading directly to the entrance. By considering the access from street to front door Figure 14 examines the accessibility of the original strata block via the application of the Accessible Building Model taxonomy

Figure 14. Strata Block in original, pre-modification condition

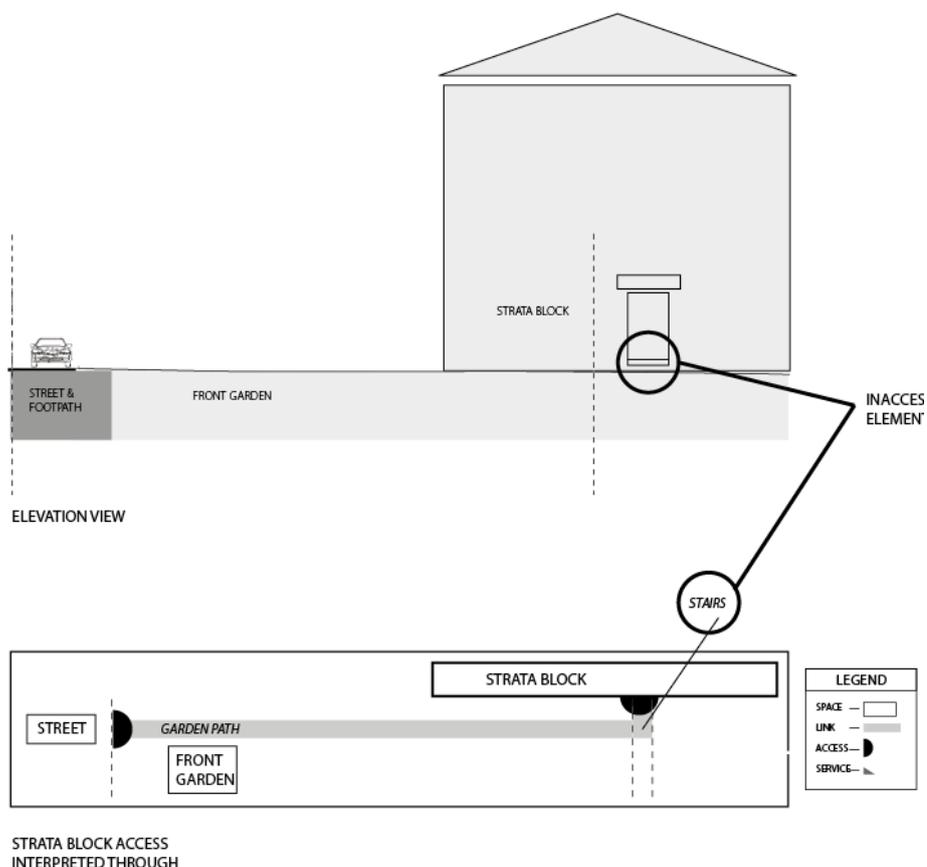


Figure 15. Strata Title Block of Units Accessible Entrance Comparisons

The examination of each building access element in Figure 14 confirms that the major inaccessible link is the stepped entrance. This inaccessibility can be overcome by the installation of a ramp over the stairs, which will allow for access; or a landscape modification can reroute the path and provide a graded walkway from the street to front door. These two options for access solutions are compared in Figure 15 which documents the pre-modification scenario with the inaccessible stepped entrance followed by two accessible modification scenarios; firstly, a ramp (constructed from concrete and steel) and, second, a landscape redesign which includes a number of accessible features according to the Stage 2 Accessible Landscape analysis.

The images in Figure 15 have been developed to illustrate and compare the pre-design front landscape access, the modified landscape solution and a ramp solution. The modified landscape solution incorporates all relevant accessible design and landscape elements as set out in the Stage 2 assessment process. These elements are detailed further in Figure 16.

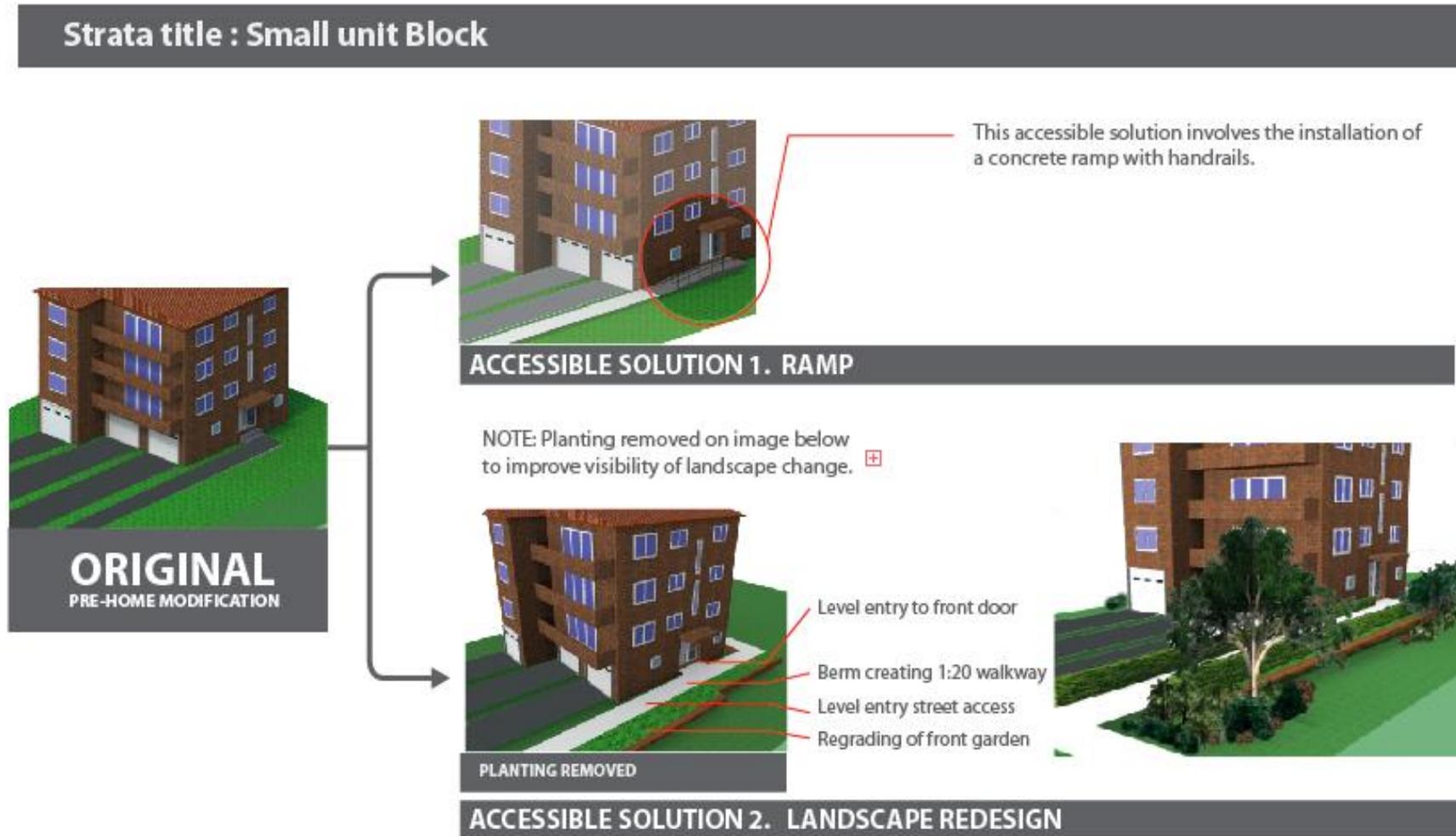
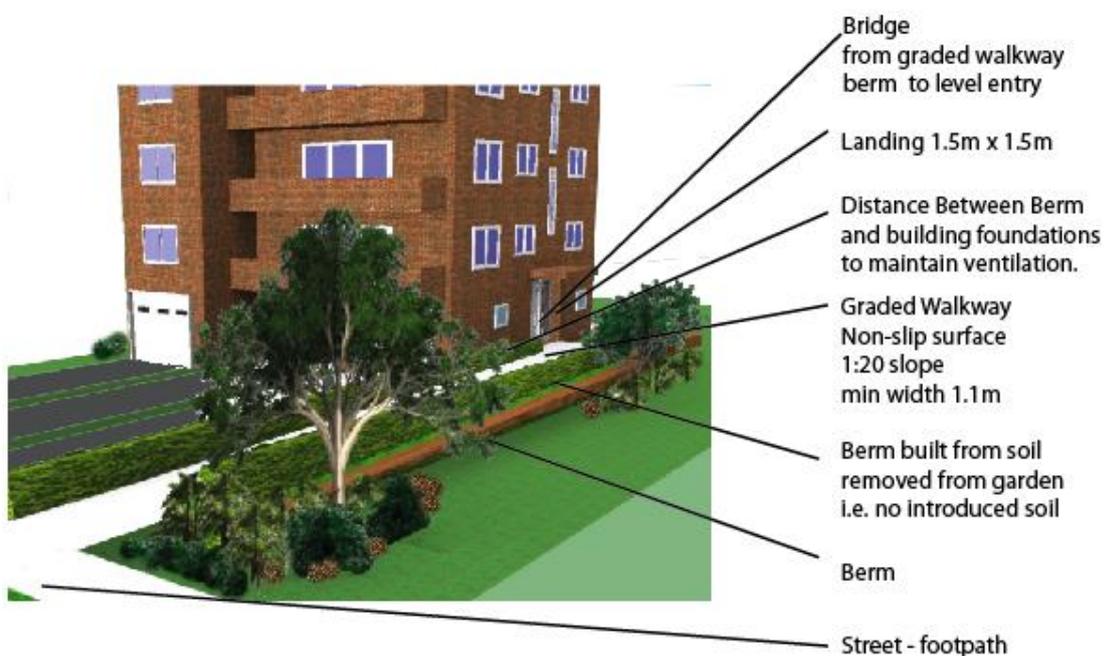


Figure 16. Strata Title Block of Units Accessible Entrance Comparisons

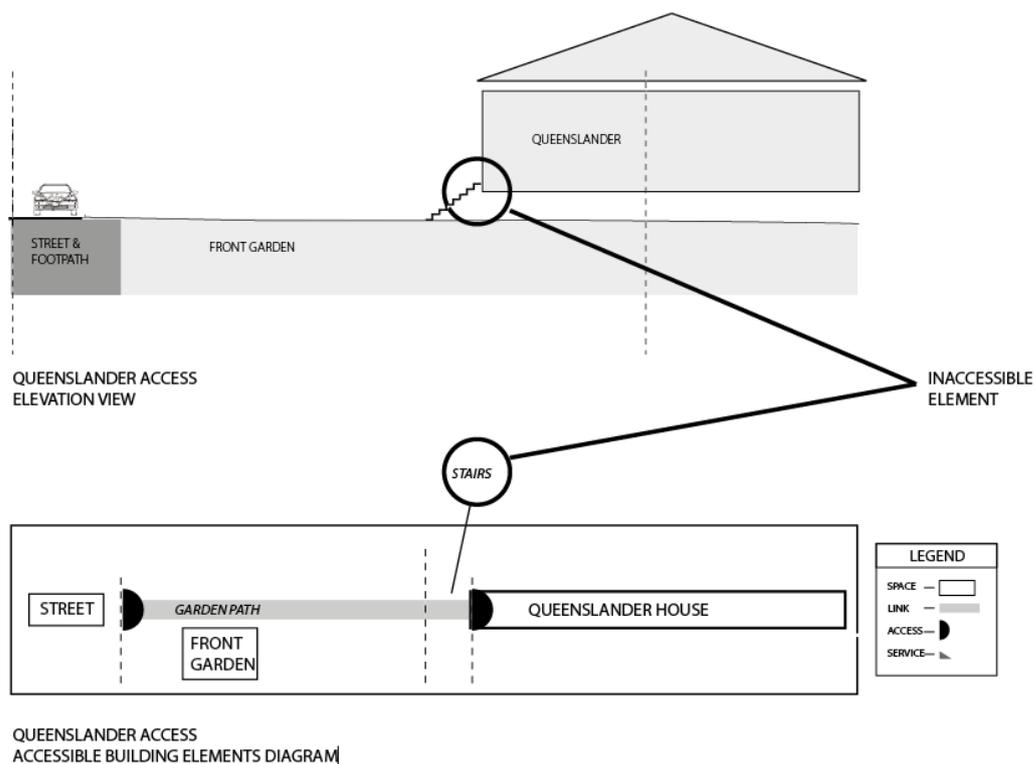


**Figure 17. Landscape Design Solution – Strata Title. Bridges, berms and graded walkways.**

Figure 16 and 17 details the important modified landscape elements that make this landscape design a viable accessible alternative to a ramp or lift. The landscape modification solution involves the use of the entire length of the shared land area without encroaching on existing driveway access. This solution allows for replanting and sustainable regrading without any foreign soil addition. Sub-floor ventilation of the existing building is preserved through a number of features by the incorporation of a lowered garden bed adjacent to the built wall. This bed is to be planted densely to buffer against falls.

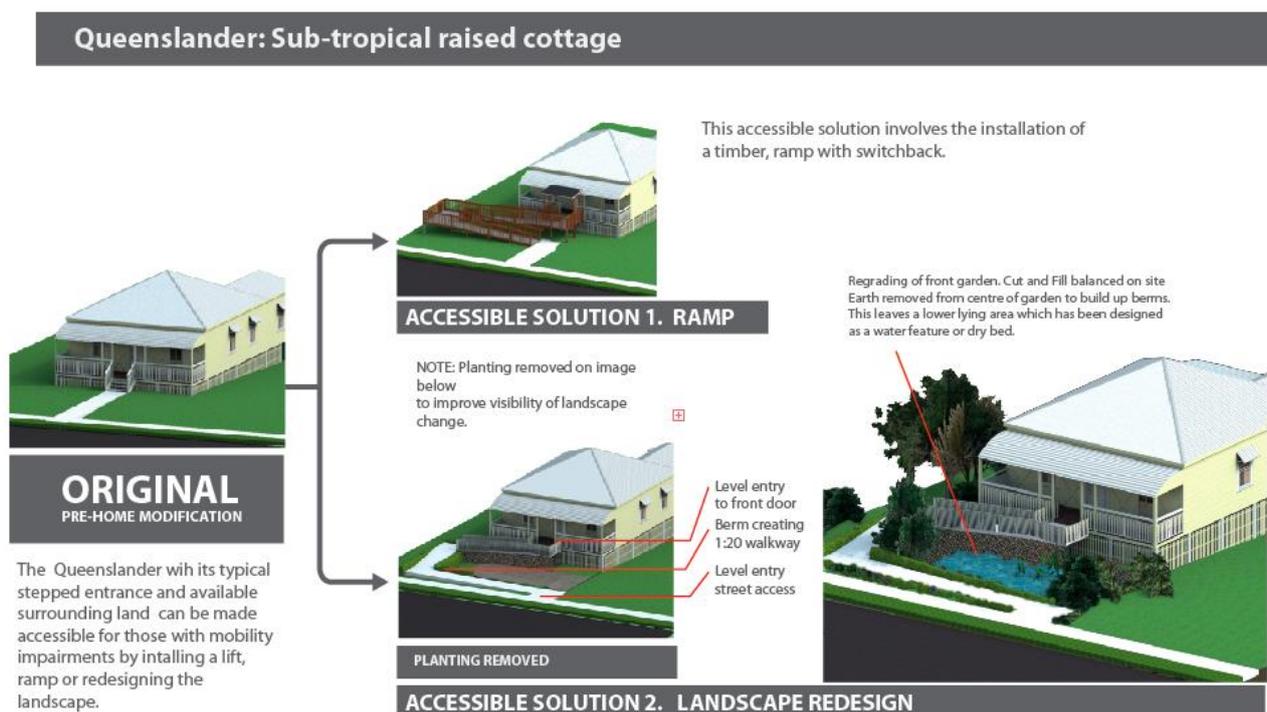
### Case 3: Queenslander

This third case involves a Queenslander style raised cottage. This raised style of cottage typically has a number of steps with no risers leading from ground level up to the entrance of the home. In this particular case there are six steps leading up to the front verandah. The Accessible Elements Diagram in Figure 17 assesses the access path elements on the site in order to determine what aspects of the path to the front door are inaccessible.



**Figure 18. Accessible Building Elements Diagram for Queenslander**

The Accessible Elements Diagram in Figure 18 reveals that the front steps are the single inaccessible element in the path from street to front door



**Figure 19. Queenslander - Accessible Entrance Comparisons**

In order to document how the inaccessible elements can be modified in this particular case, Figure 19 shows the pre-modification scenario with five inaccessible steps to the entry with two accessible modification scenarios; first, a ramp (constructed from timber) and, second, a landscape redesign.

Figure 19 has been developed to illustrate and compare the pre-design front landscape access, the modified landscape solution and a ramp solution. The modified landscape solution incorporates all relevant accessible design and landscape elements as set out in the Stage 2 assessment process. These elements are detailed further in Figure 20.



**Figure 20. Landscape Design Solution with accessible features**

Figure 19 details the important modified landscape elements that make this landscape design a viable accessible alternative to a ramp or lift. The landscape modification solution involves the use of the entire area of land between the house and street. This solution allows for replanting and sustainable regrading without any foreign soil addition through the incorporation of a large submerged bed that can be detailed as a pond or left dry as a dry-bed. Sub floor ventilation of the existing building is preserved through the incorporation of a level bridge built between the uppermost part of the walkway and the floor level entry. At this height, handrails alongside the bridge are designed to fit in with the architectural style and provide a safety buffer against falls over 1m.



**Figure 21. Close Up of Landscape Modification showing graded walkway**

The following two figures illustrate particular details of the landscape modification that are not visible from preceding images. Figure 20 shows a close up of the front of the modified landscape design and Figure 21 shows the actual bridge and berm solution in more detail from a closer and wider angle, revealing how the subfloor ventilation of the building has been maintained.



Bridge  
from graded walkway  
berm to level entry

Berm

Distance Between Berm  
and house foundations  
to maintain ventilation.

### **Figure 22. Queenslander- View of Berm and Bridge<sup>8</sup>**

Figure 22 shows how the bridge spans from the most elevated point of the berm across to form a level entrance. The berm is situated away from building to maintain ventilation.

## **Overview of Case Studies**

The three case studies examined - a Californian Bungalow, Strata Title Small Block and Queenslander - provide a valuable comparison of access solutions between ramp and landscape modification. The landscape modifications were designed to illustrate the diverse techniques available to an access solution and also the span of height differences that can be catered to. Landscape modifications can be successfully implemented as long as the land area and ground conditions are appropriate as per the preliminary site assessment criteria detailed earlier in the report.

## **Results**

In combination with the Literature Review and Analysis, the case studies provide compelling evidence of the viability of landscape modification as an access solution within the context of Home Modification Service provision. The literature review indicates that there are numerous benefits to redesigning an inaccessible home entrance and garden with a landscape modification and bridge/berm approach. These include an accessible solution that:

- Is sensitive to the architectural style of the building, and of surrounding or adjacent buildings enables reconsideration of all aspects of a front garden. A design can be developed to reduce maintenance, encourage participation and gardening with enabling garden features, or to incorporate more sustainable plantings and indigenous species of plant
- Does not impact on the future resale value of the home and may in fact increase value
- Does not flag that the person living in the home has a disability (a downside of a ramp or external lift installation). Ramps and lifts can attract unwanted attention and in some cases attract crime.

It is also clear that although Landscape Design has been excluded as a specific section in any of the relevant legislative documents governing access, individual technical specifications exist for the safe and effective design and construction of accessible landscape re-design solutions that will comply with Australian Standard AS1428.1

---

<sup>8</sup> Notes: All Images modelled in Google SketchUp and rendered using Shaderlight. Plant Species are indicative only and are not true to location or best practice horticulture. Authors' impression taken from Nell Rickard's original sketches. Not to scale

(1990); *Design for Access and Mobility, and the Disability (Access to Premises - Buildings) Standards 2010*.

The three housing case studies enable an illustrative comparison between the original inaccessible garden, a ramped solution and an accessible landscape modification (involving the creation of bridges and berms from on-site soils). This illustrative comparison is a powerful reinforcement of the positive attributes of modifying a landscape using bridge, berms, graded walkways and planting instead of simply adding a constructed ramp. It should be acknowledged that in order for a landscape solution to be possible, a front entrance and garden require larger areas of land to accommodate the walkway slope gradients of 1:20, and therefore will not be a viable solution in all residential cases – particularly in high density urban areas with, for example, Victorian Terraces. For this reason, ramp and lift installations remain an important method of improving access to and from our homes. However, to date, landscape modification has not been included in the menu of options for an accessible entrance. This report justifies the inclusion of a landscape modification solution in the list of alternatives to ramps and lifts for access.

## Conclusion

The review results imply that there is potential for further investigation into graded walkways for accessible home entrances within the provision of Home Modification services and outlines a range of important aspects of successful residential landscape modification. Analysis of the review provides clear processes for assessing and designing accessible landscape modification and the application of these assessment processes.

The case studies included in this report further illustrate the potential of landscape architecture and re-design to establish new accessible housing entrances. The 3D models of each housing style show the ability of a landscape solution (created from bridges and berms of on-site earth) to be an accessible solution that:

- is fully accessible for people who use a wheelchair or mobility aid,
- can be designed to cater specifically for visually impaired people,
- is sensitive to the existing architecture of the home,
- maintains a garden aesthetic,
- provides opportunities for improving a garden's design and reducing ongoing maintenance.

In addition to these benefits, a landscape re-design approach has none of the negative side effects of a ramp or lift installation, such as increasing vulnerability and being an eye-sore in the front garden. This further highlights potential for a landscape re-design solution to be considered as an option when home modifications are being carried out.

This research paper is aimed at developing a better understanding of the specific physical limitations of an existing site with respect to retrofitting accessible entrances.

Its goal is to educate on the principles behind the assessment of a site prior to the selection of a home modification. Although a landscaped accessible solution is acknowledged as being underexplored with the Australian Home Modification setting, this introductory report does not address the reasons behind its limited application in the Australian suburbs. Subsequent research will be required to assess why landscaped walkways are not being installed. There are a number of possibilities that remain to be explored including cost factors, awareness, availability and cost of appropriate landscape skills and education factors. A cost comparison between Ramps and Lifts has been completed (Jung, Bridge & Mills, 2010), however this does not include walkway construction using landscape techniques.

## Further Research

This paper is the foundation research document on Landscape Redesign. It will be followed by the publication of consumer and industry targeted documentation which identifies technical and commercially relevant aspects to accessible landscape redesign. This is intended as a practical alternative to the research-rich referencing used in this publication.

This research highlights the need for further examination and comparisons between the retrofitted access solution options available to interface a home with the outdoors. This initial research provides an overview of the considerations required for landscape alternatives and future research could include a number of more targeted projects. These projects may focus on the following areas:

2. Existing use of landscaping as an accessibility retrofit tool. A review of existing accessibility practices in residential, outdoor environments.
3. Consumer reaction to landscape versus ramps or lifts.
4. Cost comparison between ramp/lift/landscape.

## References

- Abramson, P. (1991). *A case for case studies: An immigrant's journal*: Newbury CA Sage Publications.
- Accessible Arts NSW (2010). Removing the Obstacles: Disability Access and the Arts in Heritage Buildings. Accessible Arts, Arts Access Australia, UTS Shopfront, Arts Law Centre of Australia. Retrieved from <http://www.aarts.net.au/uploads/RTO.pdf>
- Ambrose, J. (1997). *Simplified design of masonry structures* (Vol. 26): John Wiley & Sons
- Anderson, L., & Cordell, H. (1985). Residential property values improved by landscaping with trees. *Southern Journal of Applied Forestry*, 9(3), 162-166.
- Andre, C., & Velasquez, M. (1989). Not in my backyard. *Issues in Ethics*, 2(1) Winter.
- Apperly, R., Irving, R., Reynolds, P., & Mitchell, S. (1994). *A pictorial guide to identifying Australian architecture: styles and terms from 1788 to the present*. Sydney, Angus & Robertson.
- Armstrong, D. (2000). A survey of community gardens in upstate New York: implications for health promotion and community development. *Health & Place*, 6(4), 319-327
- Australian Human Rights Commission. (2011). The good, the bad and the ugly –design and construction for access Retrieved, from [http://www.hreoc.gov.au/disability\\_rights/buildings/good/GBU\\_Complete.htm](http://www.hreoc.gov.au/disability_rights/buildings/good/GBU_Complete.htm) Accessed 19 Jan 2011
- Badertscher, K. (2002). *Improving Quality of Life through the Adaptive Garden Project*. Acta Hort. (ISHS) 639:215-219. Retrieved from [http://www.actahort.org/books/639/639\\_27.htm](http://www.actahort.org/books/639/639_27.htm)
- Bakken, G., Cohen, H., Hyde, A., & Abele, J. (2007). *Slips, trips, missteps and their consequences*: 2<sup>nd</sup> ed. Lawyers & Judges, AZ.
- Bakker, R. (1999). Elderdesign: home modifications for enhanced safety and self-care. *Care management journals: Journal of case management; The journal of long term home health care*, 1(1), 47.
- Barrier Free Environments Incorporated. (1993). *UFAS Retrofit Guide: Accessibility Modifications for Existing Buildings*. New Jersey: John Wiley & Sons.
- Beecham, S (2011) *Using Water Sensitive Urban Design to Achieve Multifunctional Urban Landuse*. Keynote paper presented at 2011 Stormwater Industry Association (SIA) Queensland State Conference.
- Beecham, S. (2010b) *Water Sensitive Urban Design*, Chapter 23 in Daniels, C. B. (2010), Adelaide: Water of a City, Wakefield Press.
- Behe, B., Hardy, J., Barton, S., Brooker, J., Fernandez, T., Hall, C. McNiel, R. (2005). Landscape plant material, size, and design sophistication increase perceived home value. *Journal of Environmental Horticulture*, 23(3), 127.
- Benson, S. (1999). Accessible Gardening: An enabling garden illustrates a wide range of possibilities for gardeners of all ages and abilities. *American Nurseryman*, 190, 44-49.
- Birren, J. (1996). *Encyclopedia of gerontology: Age, aging, and the aged*: Academic press, San Diego.
- Bliss, S. (2005). *Best practices guide to residential construction: materials, finishes, and details*: John Wiley & Sons Inc.
- Bliss, S. (2010). *The JLC guide to decks and porches*. Williston: Hanley Wood.
- Boults, E., & Sullivan, C. (2010). *Illustrated History of Landscape Design*: John Wiley & Sons.
- Bregulla, J., Powell, J., & Yu, C. (2010). *A simple guide to Sustainable Drainage Systems for housing*. UK: National House-Building Council (NHBC)
- Bridge, C. (2006). *Computational case-based redesign for people with ability impairment: Rethinking, reuse and redesign learning for home modification practice*. Doctor of Philosophy, University of Sydney, Sydney.

- Bridge, C., & Simoff, S. J. (2000a). Computer-assisted Evaluation of Access to the Built Environment. In G. Moore, J. Hunt & L. Trevellion (Eds.), *Environment-behaviour Research on the Pacific Rim : proceedings of PaPER98, the 11th International Conference on People and Physical Environment Research*, Faculty of Architecture, University of Sydney, Sydney, Australia, 3-6 December, 1998 (pp. 353-363).
- Bridge, C., & Simoff, S. J. (2000b). Disability access to the built environment: On-line evaluation and information dissemination. In L. Eder (Ed.), *Managing Healthcare Information Systems with Web-Enabled Technologies* (pp. 239-265). Hershey, PA: Idea Group Publications.
- Brock, H., & Mefford, G. (1990). Gardening for All: The Accessible Garden. *PAM Repeater*, p13.
- Bridge, C. and P. Gopalan (2005). *Retrofitting, a response to lack of diversity: An analysis of the Home Modification and Maintenance services funded under the Home and Community Care Program*. National Housing Conference. Perth, Western Australia, Australian Housing Research Institute.
- Bridge, C., Kendig, H., Phibbs, P., Mathews, M., & Cooper, B. (2008). *The costs and benefits of using private housing as the 'home base' for care for older people: secondary data analysis*. AHURI Final Report Series, Final Report No. 115.
- Building Code of Australia (2011) *Volume 1 & 2 of the National Code of Construction (NCC)*. Initiative of Council of Australian Governments. Maintained by Australian Building Codes Board (ABCB). Retrieved from <http://www.bca.saiglobal.com>
- Building Regulations UK (2000) *The Building Regulations 2000: Part K Protection from falling collision and impact* (1998) Office of the deputy Prime Minister.
- Building Regulations UK (2000) *The Building Regulations 2000: Part M. Access to and use of buildings* (2004). Office of the deputy Prime Minister
- Building Regulations UK (2000) *The Building Regulations 2000: Part K. Protection from falling, collision and impact* (2010). Office of the deputy Prime Minister.
- Butler, G. (2003). *The Californian Bungalow in Australia*: Melbourne: Lothian.
- Carroll, J. (1994). Designing residential brick flatwork. *Mag. Masonry Constr.*, 7(11), 506-5
- Carstens, D. (1993). *Site Planning and Design for the Elderly: Issues, Guidelines and Alternatives*. New York: John Wiley & Sons.
- Caruso, F. W. (1995). Fair Housing Modifications and Accommodations in the '90s. *J. Marshall L. Rev.*, 29, 331.
- Center for Inclusive Design and Environmental Access. (2010). *Inclusive Design - a Pattern Book*. New York: W.W. Norton & Company.
- Christenson, M., & Taira, E. (1990). *Aging in the designed environment* (Vol. 8): Routledge.
- City of Sydney Leichhardt Council. (2010). *Development Assessment : 31 TALFOURD STREET GLEBE*. Sydney: Retrieved from [www.cityofsydney.nsw.gov.au/Council/.../100906\\_PDTC\\_ITEM11.pdf](http://www.cityofsydney.nsw.gov.au/Council/.../100906_PDTC_ITEM11.pdf).
- Cook, D. Mulrow, C. & Haynes, B. (1997). Systematic reviews: synthesis of best evidence for clinical decisions. *Annals of Internal Medicine* 126(5): 376-80.
- Cooper, H. (1998) *Synthesizing Research: a guide for literature reviews*, 3rd Ed, London, Sage.
- Coslovich, G. (2005). Prisoner in her own home: no ramp, no life, *The Age*. Retrieved from <http://www.theage.com.au/news/national/prisoner-in-her-own-home-no-ramp-no-life/2005/10/08/1128563036385.html>
- Craul, P. (1992). *Urban soil in landscape design*: John Wiley & Sons Inc.
- Dalton, R., & Hanson, J. (2010). *Feeling good and feeling safe in the landscape*. in "Innovative approaches to Researching Landscape and Health" edited by Thompson, C, Aspinall, P & Bell, S. Routledge, London.
- Davies, N., & Jokiniemi, E. (2008). *Dictionary of architecture and building construction*: Architectural Press.
- Davey, J. (2006). " Ageing in Place": The Views of Older Homeowners on Maintenance, Renovation and Adaptation. *Social Policy Journal of New Zealand*, 27, 128.

- Dearnaley, M. (2011, January 10, 2011). KiwiRail removes 'eyesore' ramps at \$600,000 cost, *NZ Herald*. [retrieved] November, 12 2011] [from] [http://www.nzherald.co.nz/nz/news/article.cfm?c\\_id=1&objectid=10698828](http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10698828)
- Department of Planning and Local Government (2009). *Water Sensitive Urban Design Technical Manual for the Greater Adelaide Region*, Government of South Australia, Adelaide
- Dunn, P. A. (1990). The impact of the housing environment upon the ability of disabled people to live independently. *Disability & Society*, 5(1), 37-52.
- Dunstone, G. & Graham, H. (2005) *Parsons Brinckerhoff: Water Sensitive Urban Design Guidelines*. For Mildura City Council, Melbourne.
- Eckbo, G., & Streatfield, D. (2009). *Landscape for living*: Univ of Massachusetts Pr.
- Evans, J. & Benefield, P. (2001). Systematic Reviews of Educational Research: does the medical model fit? *British Educational Research Journal* 27(5): 527-541.
- Everton-Moore, K., Ardill, A., Guilding, C., & Warnken, J. (2006). The law of strata title in Australia: a jurisdictional stock take. *Australian Property Law Journal*, 13(1), 1-35
- Fisher, P. F. (1996). Extending the applicability of viewsheds in landscape planning. *Photogrammetric Engineering and Remote Sensing*, 62(11), 1297-1302.
- Foster, A., & Roberts, V. (1998). Not in my backyard. *Managing mental health in the community: chaos and containment*, p25.
- Francis, M., & Hester, R. T. (1992). *The meaning of gardens: Idea, place, and action*: The MIT Press.
- Ghosh, S., & Head, L. (2009). Retrofitting the Suburban Garden: morphologies and some elements of sustainability potential of two Australian residential suburbs compared. *Australian Geographer*, 40(3), 319-346.
- Gilderbloom, J., & Markham, J. (1996). Housing Modification Needs of the Disabled Elderly. *Environment and Behavior*, 28(4), 512.
- Gleick, P. H. (1993). *Water in crisis*. Oxford University Press.
- Hails, B; Bacon, Peter E and Smith, Ryan Z (2006) *Practical Application of WSUD Principles in the Field: Three Examples [online]*. In: Delectic, Ana (Editor); Fletcher, Tim (Editor). 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design; Book of Proceedings. [Clayton, Vic.]: Monash University, 2006: 373-379.
- Halkett, I. (1976). *The quarter-acre block: The use of suburban gardens* (Vol. 59): Australian Institute of Urban Studies (Canberra).
- Hammersley, M. (2001) On 'Systematic' Reviews of Research Literatures: A 'Narrative' Response to Evans & Benefield, *British Educational Research Journal*, 27, No(5) Dec., 543-554.
- Hancock, P. (2000) *Water Sensitive Urban Design Sustainable Drainage Systems For Urban Areas Groundwater Management*. Presented at "National Conference On Water Sensitive Urban Design – Sustainable Drainage Systems For Urban Areas", August 30th & 31st 2000 (Melbourne)
- Harris, C., & Dines, N. (1995). *Time-saver standards for landscape architecture*: McGraw-Hill.
- Humphry, J., Sofoulis, Z., and Bhattarai Upadhyay, V. (2011). *Tributaries: A Directory of Social and Cultural Research on Urban Water*. Centre for Cultural Research, University of Western Sydney.
- Imrie, R. (2000). Responding to the design needs of disabled people. *Journal of Urban Design*, 5(2), 199-219.
- Imrie, R. (2004). Disability, embodiment and the meaning of the home. *Housing studies*, 19(5), 745-763.
- Imrie, R. (2006). *Accessible housing: quality, disability and design*: Spon Press.

- Iwaksson, S., & Isacson. (1996). Housing standards, environmental barriers in the home and subjective general apprehension of housing situation among the rural elderly. *Scandinavian Journal of Occupational Therapy*, 3(2), 52-61.
- Jacobson, M., Silverstein, M., & Winslow, B. (2002). *Patterns of Home: the ten essentials of enduring design*: Taunton Press.
- Jackson, J. (1980). *The Necessity for Ruins and other topics*. University of Massachusetts Press
- Johansson, K. (2010). *Receiving home modifications: older persons experiences of an aesthetics of the everyday*. Paper presented at the International Housing Research Conference, 2010, Istanbul.
- Jung, Y., & Bridge, C. (2009). *Stairs - Summary bulletin*. Sydney: Home Modification Information Clearinghouse, University of New South Wales. November 2009 [online]. Available from [www.homemods.info](http://www.homemods.info).
- Jung, Y. M. (2010). Consumer Factsheet. *Ramps or lifts for residential properties: Comparing their costs and benefits* (1 ed.). Sydney: Home Modification Information Clearinghouse, University of New South Wales.
- Jung, Y. M., Bridge, C., & Mills, S. (2010). *Cost-benefit analysis of ramps versus lifts*. Sydney: Home Modification Information Clearinghouse, University of New South Wales. Available from [www.homemods.info](http://www.homemods.info).
- Kaplan, R. (1973). Some Psychological Benefits of Gardening. *Environment and Behavior*, 5(2), 145-162.
- Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of environmental psychology*, 15(3), 169-182.
- Kelly, Andrew H. (2009) Planning at the urban periphery in Australia: issues relating to private residential back and front yards. 1415-1426 . Retrieved from <http://ro.uow.edu.au/scipapers/297>
- Kennedy, R., Hockings, E., & Kai, C. (2005). *The "New Queenslander": a contemporary environmentally sustainable timber house*. Paper presented at the XXXIII IAHS World Congress on Housing "Transforming Housing Environments through Design", Pretoria, South Africa.
- Knight, R. (2009). *Landscape and visual*. Excerpt from "Methods of Environmental Impact Statement" 3<sup>rd</sup> Edition. Morris, P and Therivel, R. (Eds.) Routledge, Oxon
- Kockelman, K., Heard, L., Kweon, Y., & Rioux, T. (2002). *Sidewalk Cross Slope Design - Analysis of accessibility for persons with disabilities*. Paper presented at the 81st Annual Meeting of the Transportation Research Board, Washington DC.
- Lawson, B. (1997). *How designers think: The design process demystified* (3rd ed.). Oxford: Architectural Press.
- Lawton, M. (1985). Competence, environmental press, and adaptation. In P. Windley, T. Byerts & F. Ernst (Eds.), *Theory development in environment and aging*. Washington, DC: The Gerontological Society.
- Lipsky, Z., & Romportl, D. (2007). Classification and typology of cultural landscapes: methods and applications. In K. Ostaszewska, I. Szumacher, S. Kulczyk & E. Malinowska (Eds.), *The Role of Landscape Studies for Sustainable Development*. : University of Warsaw, p. 519 - 535, ISBN 978-83-89502-42-1
- Lloyd, S., Wong, T., Chesterfield, C. (2002) *Water sensitive urban design – a stormwater management perspective*. Cooperative Research Centre for Catchment Hydrology. Melbourne Water Corporation.
- Lynch, K., & Hack, G. (1984). *Site planning* 3rd ed., Cambridge, Massachusetts, USA: The MIT Press.
- MacCollum, D., & Hughes, R. (2005). *Building Design and Construction Hazards: Lawyers & Judges* Pub Co.
- Macintyre, S., Ellaway, A., Hiscock, R., Kearns, A., Der, G., & McKay, L. (2003). What features of the home and the area might help to explain observed relationships between

- housing tenure and health? Evidence from the west of Scotland. *Health & Place*, 9(3), 207-218.
- MacMahon, B. (2001). *The Architecture of East Australia*: Edition Axel Menges, Stuttgart/London
- Makio, H., Shinogi, D., Sugimoto, E., Tokuono, T., & Sugiyama, S. (2004). History and Current Planning Tasks of Terrace Houses in Melbourne. *Mem. Fac. Eng., Osaka City Univ*, 45, 23-28.
- Mann, W. (1993). *Landscape architecture: an illustrated history in timelines, site plans, and biography*: John Wiley & Sons.
- Marcucci, D. (1999). Landscape History as a planning tool. *Landscape and Urban Planning*, 49(1-2), 67-81.
- Marcus, C., & Francis, C. (1998). *People places: design guidelines for urban open space*: John Wiley & Sons, Canada..
- Marcus, C. C., & Sarkissian, W. (1988). *Housing as if people mattered: Site design guidelines for medium-density family housing*: Univ of California Pr.
- Martin, E., Russell, R., Australian Heritage Commission, & Australian Council of National Trusts. (1999). *Improving access to heritage buildings: A practical guide to meeting the needs of people with disabilities*: Australian Council of National Trusts.
- McElroy, W. (1990). *Fences & retaining walls*: Craftsman Book Company, Carlsbad, CA.
- McFadden, J. R., Brandt, J. A., & Tripple, P. A. (1993). Housing for Disabled Persons: To What Extent Will Today's Homes Accommodate Persons with Physical Limitations? *Home economics research journal*, 22(1), 58-82.
- McKay, D. (2011, May 23, 2011). Ramp shows heritage 'failure', *Tasmania News, The Mercury* [Retrieved] November 12, 2011, [from] [http://www.themercury.com.au/article/2011/05/23/232261\\_tasmania-news.html](http://www.themercury.com.au/article/2011/05/23/232261_tasmania-news.html)
- Meinig, D., & Jackson, J. (1979). *The interpretation of ordinary landscapes: Geographical essays*. Syracuse University: Oxford University Press New York.
- Miyake, F. A. (2002). *Linking people with nature by universal design*. In Shoemaker, C.(Ed) *Interaction by Design*. Iowa State Press.
- Morris, P., & Therivel, R. (2001). *Methods of environmental impact assessment*: Taylor & Francis,
- Murray, S., Ramirez-Lovering, D., & Whibley, S. (2008). *ReHousing: 24 Housing Projects*: RMIT Publishing.
- Nichols, H., & Day, D. (2010). *Moving the earth: the workbook of excavation*: McGraw-Hill Professional.
- Oh, K. (2001). LandScape Information System: A GIS approach to managing urban development. *Landscape and Urban Planning*, 54(1-4), 81-91.
- Oram, L., Cameron, J., & Bridge, C. (2006). *Diameter: Evidence Based Research: Selecting Diameters for Grabrails*. Sydney: Home Modification Information Clearinghouse, University of Sydney. 14th March [online]. Available from [www.homemods.info](http://www.homemods.info).
- Oxford English Dictionary. (Ed.) (2004) Oxford English Dictionary (Vols. 24). Oxford University Press.
- Park, C. C. (2007). *A dictionary of environment and conservation*: Oxford University Press, USA.
- Patrick, J. (1994). *Beautiful Gardens with Less Water*: Melbourne, Lothian.
- Pauls, J. (1982). *Recommendations for Improving the Safety of Stairs. Division of building research*: Division of Building Research, National Research Council of Canada
- Peace, S., & Holland, C. (2001). *Inclusive housing in an ageing society: innovative approaches*: The Policy Press.
- Pitch, M & Bridge, C, 2006, 'Lighting your way into home modifications', in W.C. Mann, A. Helal (ed.), *Promoting Independence for Older Persons with Disabilities: Selected Papers*

- from the 2006 International Conference on Aging, Disability and Independence, IOS Press, Amsterdam ; Oxford, pp. 181-192
- Preiser, W., & Ostroff, E. (2001). *Universal Design Handbook*: McGraw Hill, New York.
- Pynoos, J. (2002). Home modifications - a key to ageing in place. *The encyclopaedia of aging. A comprehensive resource in gerontology and geriatrics*: The National Resource Center on Supportive Housing and Home Modification (NRCSHHM).
- Pynoos, J., Cohen, E., Davis, L., & Bernhardt, S. (1987). Home modifications: Improvements that extend independence. *Housing the aged: Design directives and policy considerations*, 277-303.
- Pynoos, J., & Sanford, J. (1995). Home modifications. *The encyclopedia of aging. A comprehensive resource in gerontology and geriatrics*, 2, 466-469.
- Reed, S. (2010). *Energy-wise Landscape Design: A New Approach for Your Home and Garden*: New Society Publications.
- Roberts, M. (1997) *Housing with care: Housing Policies for an Ageing Australia*. Ageing International Winter/Spring, 90-100
- Rothert, G. (2002). *From Vision to Reality: The Chicago Botanic Garden's Buehler Enabling Garden*.
- Russ, T. (2009). *Site planning and design handbook*: McGraw-Hill Professional. New York.
- Satz, A. B. (2008). Disability, vulnerability, and the limits of antidiscrimination. *Wash. L. Rev.*, 83, 513.
- Schaake, C., Mace, R., & Pace, R. (1996). *Residential Remodeling and Universal Design Making Homes More Comfortable and Accessible*: DIANE Publishing.
- Seeland, K., & Nicol, S. (2006). Public green space and disabled users. *Urban Forestry & Urban Greening*, 5(1), 29-34.
- Shepard, J. (2001). *Sociology and You*: McGraw-Hill/Glencoe, Ohio.
- Sherry, M. (2000). *Hate Crimes Against People With Disabilities*. University of Queensland. Retrieved from <http://www.wwda.org.au/hate.htm>
- Simonds, J. O. (1998). *Landscape architecture: a manual of site planning and design*: McGraw-Hill Professional.
- Simson, S., & Straus, M. (1998). *Horticulture as therapy: Principles and practice*: CRC.
- Skinner, T., & National Concrete Masonry Association (NCMA). (2003). *Retaining Walls: A Building Guide and Design Gallery*: Schiffer Pub.
- Smith, M. (2006). The impact of the Disability Discrimination Act on historic buildings. *Journal of Building Appraisal*, 2(1), 52-61.
- Smith, M. (2001). *The front garden: New approaches to landscape design*: Houghton Mifflin Harcourt.
- Soderback, I., Soderstrom, M., & Schaander, E. (2004). Horticultural therapy: the 'healing garden' and gardening in rehabilitation measures at Danderyd hospital rehabilitation clinic, Sweden. *Developmental Neurorehabilitation*, 7(4), 245-260.
- Stake, R. (1995). *The art of case study research*: Sage Publications, Inc. London.
- Standards Australia. (2009). *AS 1428.1 - 2009: Design for access and mobility - New building work*: Standards Australia. SAI Global
- Stigsdotter, U., & Grahn, P. (2002). What makes a garden a healing garden. *Journal of therapeutic Horticulture*, 13(2), 60-69.
- Stigsdotter, U. A., & Grahn, P. (1987). *A garden at your doorstep may reduce stress. Private gardens as restorative environments in the city*. Paper presented at Open Space/People Space Conference, Edinburgh, Scotland, Oct. 30th, 2004. Stokols, D., & Altman, I. (Eds.)
- Swaffield, S. (2002). *Theory in landscape architecture: a reader*: Univ of Pennsylvania Pr.
- Syme, G. J., Fenton, D. M., & Coakes, S. (2001). Lot size, garden satisfaction and local park and wetland visitation. *Landscape and Urban Planning*, 56(3-4), 161-170.

- Syms, P. (2008) *Land Use and Design*, in *Land, Development and Design*, Blackwell Science Ltd, Oxford, UK. doi: 10.1002/9780470690710.ch13
- Tanner, B., Tilse, C., & De Jonge, D. (2008). Restoring and sustaining home: The impact of home modifications on the meaning of home for older people. *Journal of Housing for the Elderly*, 22(3), 195-215.
- Tatman, C. (2011, 4 Jan 2011). Legal threat on Ramp 4 Jan 2011, *Mornington Peninsula Leader*.
- Templer, J. (1995). *The staircase: Studies of hazards, falls, and safer design*: The MIT Press, Victoria.
- The State of Victoria Department of Sustainability and Environment (2010). *Native Vegetation Policy and Planning*. State Government Victoria. ISBN 978-1-74242-182-7 (online - set)
- Thomas, I. G., & Elliott, M. (2005). *Environmental impact assessment in Australia: theory and practice*: Federation Press, NSW.
- Thomas, G., Sim, J. and Poulton. (2001). *Planting Design: an exploration of emerging theoretical frameworks to support sustainable landscape design*, Brisbane: Queensland University of Technology
- Tress, B., Tress, G., D'Écamps, H., & d'Hautesserre, A. M. (2001). Bridging human and natural sciences in landscape research. *Landscape and Urban Planning*, 57(3-4), 137-141.
- Tress, B., Tress, G., & Fry, G. (2006). Publishing integrative landscape research: analysis of editorial policies of peer-reviewed journals *Environmental Science & Policy*, 9(5), 466-475.
- Tress, G., Tress, B., & Fry, G. (2007a). Analysis of the barriers to integration in landscape research projects. *Land use policy*, 24(2), 374-385.
- Tress, G., Tress, B., & Fry, G. (2007b) Integrative landscape research: facts and challenges. *Key topics in landscape ecology*. Cambridge University Press, Cambridge UK, 246-268.
- Troy, P. (2000). *A history of European housing in Australia*: Cambridge Univ Pr. Vincent, F., Radford, K., Jarman, N., Martynowicz, A., & Rallings, M. K. (2009). Hate Crime against People with Disabilities. *A baseline study of experiences in Northern Ireland*
- Vink, A. (1983). *Landscape ecology and land use*. English translation (ed) D.A. Davidson. Longman.
- Walsh, K. (1993). *Water-saving Gardening in Australia*: Reed Books, NSW
- Waxman, B. (1991). Hatred: The unacknowledged dimension in violence against disabled people. *Sexuality and Disability*, 9(3), 185-199.
- White, G. W., Paine-Andrews, A., Mathews, R. M., & Fawcett, S. (1995). Home access modifications: effects on community visits by people with physical disabilities. *Journal of applied behavior analysis*, 28(4), 457.
- Wong, T. (2006). An overview of water sensitive urban design practices in Australia. *Water Practice and Technology*, 1(1), 1-8.
- Yin, R. (1994). Case Study Research: Design and Methods, Applied Social Research Methods Series, Vol. 5. *Thousand Oaks: Sage*, 1(2), 3.
- Yin, R. (2008). *Case study research: Design and methods*: Sage Publications.

## Appendices

### A: Literature Search Strategy

Question component breakdown

Problem	Intervention	Outcome	Comparison	Target population
Inaccessible front entrance	Retrofitted landscaping	Accessibility – ageing in place	Ramp/Lift	Disability/ Aged

A selection of databases (1980–February 2010) for all relevant publications search terms from the following table:

Problem	Intervention	Outcome	Comparison	Target population
Gardens Suburbia Suburban Entrance Front Door Landscape	Home modification Adaptations Architectural Accessibility Environmental modifications Environmental interventions Housing improvements Universal design Elder design Accessible Landscapes Bridging Berming	Access Ageing in place	Ramp lift	Aged/Ageing/ Aging Disability/Disa bled Seniors Older Geriatric Mobility impaired Mobility limitation Impairment

A typical search string appears as follows:

"landscape\*" or "garden\*" or "front entrance" and "universal design" or "home modification" or "bridging" or "berming" and aged or disabled or impair\*

#### (Inclusion Criteria)

In order for material to be eligible for inclusion into this review they had to correspond to all of the following criteria. All material to be eligible for inclusion had to be:

- Written in English
- Attainable through the UNSW or via the World Wide Web (i.e. Google/Google scholar)
- Searched, obtained via and related to specified keywords (outlined above)

- Written post 1978.

## **B: Planting Guide for access and enablement**

### **Plants and accessibility**

A safe, comfortable and participatory garden modification depends upon a carefully planted design. The plant materials selected are critical to the success of a garden, and the Enabling garden defined specific goals for a successful, enjoyable and participatory design solution (Rothert, 2002). These goals encompass:

- Designing for seasonal interest
- Selecting based upon sensory characteristics (Miyake, 2002)
- Attracting birds butterflies and harmless “wildlife”
- Avoiding toxic plants
- Limiting exotics so that plants are easily available to gardeners
- Specifying pest and disease tolerant plants
- Require minimum maintenance.

### **Accessible Garden elements**

**Raised Garden Bed:** A raised garden bed facilitates access to planting areas and provides a recognisable structure in the garden. For those who cannot kneel, a raised garden bed can be designed to be worked at while standing, or for someone who can sit sideways to work a 12 inch (30cm) wide coping can provide a seat within reach of soil. For someone in a wheelchair, a raised bed can be designed with a 6 inch (15cm) coping, or as a “roll under” bed (Benson, 1999).

**Vertical gardens and hanging baskets:** A vertical garden can be designed that incorporates a hinged wall grid with a swing out frame, providing variable height accessibility e.g. living wall gardens. Hanging planting baskets can also be incorporated.

### **Planting Schemes**

The optimum-planting scheme depends upon the site location, rationality and aspect of the landscape. Design of planting schemes should be sensitive to landscape ecology principles (Burchett, 1994; Dramstad, Olson, & Forman, 1996).

### **Understanding the Site and Plant selection**

The site location and the particular soil types and ground conditions on the site will determine what plant species will thrive in an accessible landscape. The rationality will dictate what native species are available to use, and also what non-native plants will survive in the particular regional climate. The aspect of the landscape will determine what sunlight is available to the plants, and will again impact upon what plant types will

survive and thrive. There is a careful balance required between the plants surviving or thriving. Although the plants must not die, they also must not be prone to weed behaviours and overtake other plants or the built environment.

### **Indigenous and Low-water plantings – BASIX ratings**

The NSW Government have introduced BASIX: an online Building Sustainability Index and certification process ([www.basix.nsw.gov.au](http://www.basix.nsw.gov.au)). According to BASIX, planting Indigenous and low water plants will improve the sustainability rating of a building development – specifically in the area of water consumption.

**Indigenous species** is defined by BASIX as:

*a species of vegetation identified in Department of Planning's Indigenous Species List as being indigenous to the location where the proposed development is to be carried out (available at [www.basix.nsw.gov.au](http://www.basix.nsw.gov.au)), or a species of vegetation which the local council for that area deems is an indigenous species in that area.*

**Low water species** is defined by BASIX as:

*a species of vegetation identified as a 'one drop plant' under Sydney Water's Plant Selector Water Drop Rating Scheme (available at [www.sydneywater.com.au](http://www.sydneywater.com.au)), or a species of vegetation which the local council for that area deems is a low water use species in that area.*

*BASIX publish an online table of available [indigenous species/low water use species](#) appropriate for each NSW Local Government area (LGA)<sup>9</sup>.*

---

<sup>9</sup> Source:

[https://www.basix.nsw.gov.au/help/Water/Common\\_areas\\_and\\_Central\\_systems/Landscape/List\\_of\\_indigenous\\_species.htm](https://www.basix.nsw.gov.au/help/Water/Common_areas_and_Central_systems/Landscape/List_of_indigenous_species.htm)

## C: Australian and International Legislative Context

An understanding of the Australian Legislative context sheds light on the regulatory framework surrounding accessibility and landscape modification. To facilitate compliance with laws and to ensure that the built environment meets requirements, a number of organisations provide standards and codes for making environments accessible. These documents are outlined in Table 1 and describe the range of governing standards and codes that each define and specify required outcomes for accessible building elements (walkways, ramps, entrances etc.). The Australian legislative environment surrounding accessibility can be contextualised by examining the international legislative framework, in particular in the UK and US, and an overview of the international legislative context is tabled in the end of this Appendix.

**Table 4. Australian Legislation and Standards Regulating Accessibility**

<b>Legislation/standards and codes regulating accessibility</b>	<b>Description</b>
<b>Australian Standard 1428 – 2009</b>	In terms of accessibility, Australian Standard AS 1428.1 (1990) is Australia's primary legislated guideline for Accessibility. This document is the governing standard for new building works and pertains to all accessibility issues. Sections of AS 1428 that are relevant to landscape and external entrances of buildings include the specifications for design and implementation of walkways, ramps, stairs and include specifications for gradient, handrails, kerbs etc.
<b>Access to Premises Standard- 2011</b>	The Access to Premises Standards (commonly referred to as the 'Premises Standards') were introduced in line with an updated Building Code of Australia (BCA) on 1st May 2011 (Building Code of Australia, 2011). They are intended to clarify how designers, developers, managers and building certifiers can meet their responsibilities under discrimination law to ensure buildings are accessible to people with a disability.

Legislation/standards and codes regulating accessibility	Description
<b>Building Code of Australia – 2011</b>	The Building Code of Australia (BCA) 2011 is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Australian Government and State and Territory Governments. The BCA has been given the status of building regulations by all States and Territories. According to the ABCB, the goal of the BCA is to “ <i>enable the achievement of nationally consistent, minimum necessary standards of relevant, health, safety (including structural safety and safety from fire), amenity and sustainability objectives efficiently</i> ” <sup>10</sup> by The Building Code of Australia (BCA) 2011 is effective from 1 May 2011 and supersedes the BCA 2010. The draft BCA 2011 extends the application of the Access to Premises Standard to all residential apartments rather than only apartments with short-term rental, as the Government has not established a clear definition for short-term rental.
<b>Australian Standard AS 4299 – 1995: Adaptable housing</b>	Presents the objectives and principles of adaptable housing and provides guidelines on planning and design. Adaptable housing is the basis for the development of the accommodation needs of users of all ages and abilities by making provision for future building modifications at minimum cost and disruption to the inhabitants. Includes in Appendix A a checklist for certification of housing units as Adaptable house class A, B or C.

The Standards and Codes governing Accessibility in Australia in Table 1 above contain objectives and performance requirements to achieve required accessibility levels in the built environment. The documents tabled above in Table 1 often refer to each other and are interrelated in their content.

The implementation of landscape change in a residential environment is also subject to a wide range of standards and codes, with each document addressing specific landscape and construction elements, from earthmoving to soil types. A selection of Australian Standards pertaining to landscape modification is outlined in Table 2.

---

<sup>10</sup> Source: Australian Building Codes Board <http://www.abcb.gov.au>

**Table 5. Australian Legislation and Standards Regulating construction within the residential landscape**

<b>Legislation/standards Construction in residential landscape</b>	<b>Description</b>
<b>Australian Standard AS 3798-2007: Guidelines on earthworks for commercial and residential developments</b>	Provides guidance on the specification, execution, and control testing of earthworks and associated site preparation works for commercial and residential developments; and on the interpretation and application of the relevant test methods specified in the AS 1289 series of Standards (AS 1289.1.1-2001 Methods of testing soils for engineering purposes - Sampling and preparation of soils - Preparation of disturbed soil samples for testing).
<b>Australian Standard AS 2159-2009</b>	Piling - Design and installation
<b>Australian Standard AS 2870-2011</b>	Residential slabs and footings
<b>Australian Standard AS 3727-1993</b>	Guide to residential pavements
<b>Australian Standard AS 4419-2003</b>	Soils for landscaping and garden use Specifies requirements for landscape and garden soils. This Standard specifies physical and chemical requirements such as bulk density organic matter, wettability, pH, dispersibility, toxicity, nitrogen drawdown index and permeability for low density, organic and natural soils or soil blends. Documentation requirements include information to be supplied to the consumer and health warnings. Guidance is given on the selection and use of soils.
<b>Building Code of Australia – 2011</b>	The Building Code of Australia (BCA) is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Australian Government and State and Territory Governments. The BCA has been given the status of building regulations by all States and Territories. According to the ABCB, the goal of the BCA is to “enable the achievement of nationally consistent, minimum necessary standards of relevant, health, safety (including structural safety and safety from fire), amenity and sustainability objectives efficiently” <sup>11</sup> by The Building Code of Australia (BCA) 2011 is effective from 1 May 2011 and supersedes the BCA 2010. The draft BCA 2011 extends the application of the Access to Premises Standard to all residential apartments rather than only apartments with short-term rental, as the Government has not established a clear definition for short-term rental.

<sup>11</sup> Source: Australian Building Codes Board <http://www.abcb.gov.au>

The documents included in Table 2 sample the wide range of landscape construction elements which require governance in the form of standards and codes. These documents are performance based with objectives including:

- maintaining Occupational Health and Safety standards during construction,
- safeguarding people from injury due to structural failure or contamination,
- protecting other property from physical damage caused by structural failure or contamination.

The legislative context surrounding accessibility and landscape are not shared ones, hence the need for separate Tables to indicate the range of standards and codes. The BCA is a single document that contains performance guides for both access and landscape, however these are completely separate bodies of information and are not cross-referenced. This further highlights the need for research that establishes the important links between landscape modification and access to inform both accessibility and landscape professions.