Building Design for People with Dementia:

A Comparative Analysis of Planning Quality in Residential Aged Care Units

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STATEMENT OF ORIGINALITY

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision. The thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968 and any approved embargo.

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Martin Quirke, Candidate for PhD

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ABBREVIATIONS, ACRONYMS AND SYMBOLS

ADL — Activities of daily living. A range of ordinary daily activities such as bathing, getting dressed, meal preparation or other simple tasks. These kinds of activities are associated with improved functional and mental wellbeing for people living with dementia.

DDAT — *Dementia Design Audit Tool* (Cunningham *et al.*, 2008, 2011)

DDP — Dementia design principle. The dementia design evaluations undertaken as part of this dissertation make use of nine out of ten of Fleming *et al.*'s evidence-based dementia design principles (Fleming, Forbes and Bennett, 2003; Fleming, 2011). Throughout the thesis individual DDPs are referenced by the numbers 1-10, each prefixed with a pound (#) symbol, i.e. DDP#1 (Safety), DDP#2 (Size) etc.

EAT — *Environmental Audit Tool* (Fleming, Forbes and Bennett, 2003; Fleming, 2011)

NSW — The Australian state of New South Wales. Also, for the purposes of this dissertation, 'NSW' refers to the set of residential aged care units directly recruited from NSW-based aged care organisations. Please note, a set of 'international' exemplars in the study, borrowed from specialist design publications, are named 'international' due to their global significance. Some the units in the international set are physically located in NSW.

Plan-EAT — *Plan (based) Environmental Audit Tool*. Based on the *Environmental Audit Tool* (Fleming, Forbes and Bennett, 2003; Fleming, 2011) Plan-EAT was developed during the current research as a method to undertake dementia design evaluations based on building layout drawings for residential aged care units.

TESS/NH — *the Therapeutic Environment Screening Survey for Nursing Homes* (Sloane *et al.*, 2002).

This dissertation uses the symbol # as part of the identification of numbered items.

The ten dementia design principles (DDPs) referenced in this thesis (Fleming, Forbes and Bennett, 2003; Fleming, 2011) are signified as follows: DDP#1 Safety; DDP#2 Size; DDP#3 Visual Access; DDP#4 Stimulus Reduction; DDP#5 Helpful Stimuli; DDP#6 Wandering and Outdoor Space; DDP#7

Familiarity; DDP#8 Privacy and Social Interaction; DDP#9 Community Links; DDP#10 Domestic Activity.

Unit layout types are numbered, and the prefixes *INT#* and *NSW#* are used to identify these as being from either the international (INT) or NSW floor-plan sets. For example: INT#1(Alexian Village, Milwaukee, Wisconsin) and INT#2 (Alois Alzheimer's Center, Cincinnati, Ohio, USA); NSW#1 (NSW Study Set - Anonymous); NSW#2 (NSW Study Set - Anonymous); etc. The anonymity of the NSW-recruited units is protected by human ethics approval.

ABSTRACT

International literature consistently reports that more than half of people living in residential aged care have a diagnosis of dementia. Research findings in this field concur that well-designed physical environments can increase independence, enhance quality of life, and provide a drug-free means of improving the behavioural and psychological symptoms experienced by people living with dementia. Despite this, there has been limited research into how well the broad stock of existing residential aged care settings supports the needs of residents with dementia.

This dissertation investigates the design quality of existing residential aged care units, with a focus on the impact of architectural planning layouts on overall dementia design quality. Specifically, the dissertation develops new knowledge in terms of three interconnected research aims.

The first research aim is *to evaluate and compare dementia design quality in the layout planning of NSW-based and international best-practice examples of residential aged care units*. To fulfil this aim, the dissertation uses floor-plan layouts to evaluate the dementia design characteristics of ninety residential aged care units from New South Wales (NSW), Australia, and compares these against the characteristics of ninety-four published international best-practice examples.

The second research aim is *to determine whether the dementia-enabling characteristics of floor-plan layouts for residential aged care units in NSW have improved over the last four decades*. This aim is addressed by correlating the dementia design evaluation scores, from the analyses undertaken as part of the first research aim, against the year of construction for each unit.

The third aim of the research is *to investigate the impact of five spatial planning factors on the dementia design properties of Australian and international residential aged care settings*. *The five factors are: the unit floor area, number of bed-spaces provided, floor area per resident, storey location, and whether purpose-built for dementia or not.* The research undertaken for this aim builds on the results of the first two aims by undertaking correlation analyses between the identified attributes and the dementia design evaluation scores for each residential aged care unit.

In order to fulfil the three aims of the research, a new evidence-supported dementia design evaluation methodology is developed. This method, derived from Fleming's (2011)

Environmental Audit Tool, forms the basis of evaluations undertaken of the layout planning of the ninety NSW-recruited residential aged care units, and ninety-four international units, considered to be exemplars of dementia design. This new design evaluation approach produces formal scored measures of dementia design quality across nine established dementia design principles. These evaluations help to identify strengths and weaknesses in the layout planning of individual units and allow comparisons of design quality between sets of units.

The results developed in response to the first aim show that the international exemplars tend to provide higher quality building layouts, with NSW evaluation scores falling behind by a significant margin. The results include the findings that both the NSW and international sets perform well under three of nine established dementia design principles, whilst showing that the most significant differences between the sets occur under four of these principles. There is room for improvement across both sets, but especially so for the NSW unit layouts, having achieved, on average, less than half of the available dementia design quality scores for five of nine dementia design principles.

Results from research undertaken to address the second aim show clear improvements in dementia design quality for NSW units over the evaluated period (1970-2016). The most recently constructed NSW units tend to achieve a significantly higher dementia design quality score than those built at earlier dates. International units, assessed for comparison, started at a much higher level of design quality, but also improved significantly over four decades. Analysis of the rate of design improvements between both NSW and international sets show that the dementia design quality of the broad stock of NSW residential aged care units has typically trailed behind the design quality standards of the international exemplars by about twenty years.

Findings developed in response to the third research aim include evidence that higher quality residential aged care units have fewer resident bed-spaces and, possibly because of this, tend to be physically smaller. A more contradictory finding is that high scoring residential aged units tend to provide more overall floor area per resident. Results also show that higher quality dementia design tends to occur in units that are located at ground floor and be amongst those purpose-built for accommodating people living with dementia.

While the three sets of findings in this dissertation provide valuable information for the aged care sector, the methods and approaches developed to investigate the aims of the research have the potential to be useful for both larger scale evaluations of existing residential care settings, and to inform the design process of future residential aged care settings.

This research was undertaken in accordance with the University of Newcastle's Human Research Ethics Committee Approval No. H-2014-0044.

1 INTRODUCTION

1.1 Context

The present doctoral research was conceived against the backdrop of an approaching global dementia epidemic (Winblad *et al.*, 2016). In 2015, an estimated 47 million people worldwide were affected by various forms of dementia and by 2050 this number is anticipated to reach 131 million (Prince *et al.*, 2015). In Australia, there are over 425,000 people diagnosed with dementia (Brown, Hansnata, and La, 2016), a number that is expected to increase at a rate of about 4% per year and reach 619,000 by the year 2040 (Access Economics, 2009). This prospect brings with it several challenges for society in general, and the aged care sector in particular.

The appropriate design of physical environments has been shown to dramatically improve the wellbeing of people living with dementia (Cabrera *et al.*, 2015; Hoe, Hancock, Livingston, and Orrell, 2006; K. McKee *et al.*, 2004). The right combination of environmental features is capable, for example, of encouraging and supporting important health-promoting activities, such as increased physical exercise and social interaction, more autonomous wayfinding, exposure to beneficial levels of sunlight, and engagement in meaningful activities. In health and residential care settings, the sensitive design of the physical environment has been shown to reduce agitation, falls and incontinence, reduce carer dependency and the use of pharmacological sedation (Barnes, 2002; Fleming, Crookes and Sum, 2008; van Hoof *et al.*, 2015; Hamza, 2017; Lam *et al.*, 2017).

Dementia has long been established as the leading cause of entry into residential care (Sloane et al., 2002). In Australia, like many industrialised nations, people living with dementia now form the majority in residential aged care (Australian Institute of Health and Welfare, 2011, 2012). The continued growth in demand for residential care bed-spaces for people living with dementia is behind a mounting pressure on care organisations to provide high quality physical environments that support people living with dementia. Despite this, and the well-established availability of evidence-based research guidance on how to design for dementia, in Australia there are no meaningful planning controls, building codes or other known statutory requirements for residential aged care settings to be designed to provide support to people living with dementia (Australian Building Codes Board, 2016, 2017).

There are currently around 200,000 residential aged care bed-spaces across Australia (Australian Government Department of Health and Ageing, 2016), and with the Australian government's anticipated increases in the numbers of older people likely to be in need of residential care into the future, the sector is expected to construct around 12,000 bed-spaces nationwide per year until 2022 (that is 1,000 per month, or 230 per week). This annual figure comprises about 5,000 bed-spaces required just to replace the existing older settings coming to the end of their useable lifespan (typically about forty years) and a further 7,000 bed-spaces required to expand the overall volume of residential aged care provision across Australia (Aged Care Financing Authority, 2016) to accommodate the growing number of people expected to be in need of residential care.

In this context, the limited available evidence about the dementia design quality of Australia's stock of around 2,900 residential aged care facilities must be a concern. Without a means of assessing the dementia design quality of these environments, it is impossible to identify priority areas for improvement across the existing stock of residential aged care facilities. Furthermore, a means of measuring quality is important for future, purpose-designed residential aged care settings for people with dementia (Fleming, Fay and Robinson, 2012; Smith *et al.*, 2012). These measures are necessary to ensure that these existing and proposed facilities can enhance the quality of life for most residents.

1.2 Research aims

The overarching goal of this dissertation is to develop an improved understanding of whether, and to what extent, building layouts, as embodied in architectural floor-plans, contributes to the provision of evidence-based design quality in residential aged care environments that support the independence and wellbeing of people living with dementia. To achieve this general goal, the dissertation has the following three interconnected research aims.

- **Aim 1:** to evaluate and compare dementia design quality in the layout planning of NSW-based and international best-practice examples of residential aged care units.

This first aim seeks to determine how NSW-based examples of residential aged care unit plans compare, in terms of dementia design quality, with international examples that have been lauded as best practice.

Australia has an established track record of using evidence-based design for making physical environments for people living with dementia (Fleming and Bowles, 1987). This is recognised through the sustained inclusion of residential aged care exemplar projects from Australia in specialist international design publications (Cohen and Day, 1993; Judd *et al.*, 1998; Utton, 2007; Anderzhon *et al.*, 2012). However, beyond such high-profile examples, little is known about the standards of dementia supportive design in typical residential aged care settings across the country. Furthermore, although significant volumes of research evidence (Fleming, Crookes, and Sum, 2008; Verbeek *et al.*, 2008; Fleming and Purandare, 2010; Marquardt, Bueter and Motzek, 2014; Chaudhury *et al.*, 2017) have been distilled into clear dementia design principles (Marshall, 2001; Fleming, 2011; Waller, Masterson, and Evans, 2017) some researchers have questioned whether this knowledge has effectively translated into design practice (Fleming, Fay, and Robinson, 2012; Fleming and Kelly, 2015). For example, much of the available dementia design evaluation literature focuses on post-occupancy evaluation (Fleming, 2011; Cunningham *et al.*, 2011; Sloane *et al.*, 2002), but offers little by way of formal design evaluation of design proposals, most commonly articulated in floor-plan drawings. There is no known previous research to have tested, using evidence-based dementia design principles, the extent to which floor-plan layouts impact the dementia design quality of residential aged care settings. Furthermore, it is unclear how typical Australian examples (in this case, focussed in the state of New South Wales) compare with international best practice.

- **Aim 2:** to determine whether the dementia-enabling characteristics of floor-plan layouts for residential aged care units in NSW have improved over the last four decades.

Research on designing for dementia has been undertaken for at least forty years (Lawton, 1981; Fleming and Bowles, 1987) but limited implementation of these findings has been recorded over time, in research and specialist international design publications (Cohen and Day, 1993; Judd *et al.*, 1998; Anderzhon *et al.*, 2012; Utton, 2007; International Association of Homes and Services for the Ageing, 2014). Although publications have reviewed the design of residential aged care settings in Australia, these have tended to focus on settings that had been constructed within a short time span immediately prior the publication date. Furthermore, there has not been a single study to formally evaluate, in respect of architectural planning, the changes in evidence-based dementia design quality over time.

- **Aim 3:** to investigate the impact of five spatial planning factors on the dementia design properties of Australian and international residential aged care settings.

This aim addresses a gap in current knowledge about the extent to which many standard architectural planning decisions are likely to influence the suitability of a physical environment for supporting the impairments of people living with dementia. The five planning factors identified in past research as potentially having an impact on dementia design quality are: i) unit floor area; ii) number of resident bed-spaces provided; iii) area per resident; iv) storey location; and, v) whether purpose-built for dementia or not. The first three of these factors are examined in this dissertation to provide clarity about existing research. Past evidence tends to conclude that smaller residential aged care environments lead to improved behaviour and wellbeing amongst residents living with dementia (Annerstedt, 1993; Reimer *et al.*, 2004; Verbeek *et al.*, 2009), whilst there have also been neutral (Verbeek *et al.*, 2010) and also somewhat contradictory evidence in support of larger units (Zeisel *et al.*, 2003). There are also questions from some researchers about the extent to which the recorded positive effects of smaller environments are due in part to other design and social characteristics rather than size alone (Fleming, Crookes, and Sum, 2008; Chaudhury *et al.*, 2017) and suggesting that the number of residents living together is a more significant factor. With this approach comes the argument that physical size is a dependent, if loosely tied, natural result of designing to provide accommodation for a smaller number of people. In response, an aim was set to undertake an interlinked exploration of how the physical and social size of residential aged care units, in themselves, impact the overall quality across the other areas of dementia design, then to cross-check this against the number of residents and the available space per resident.

The fourth factor responds to evidence that the provision of access to outdoor space, and spending time outdoors, has a clear positive affect on the wellbeing of people with dementia (Calkins, Szmerekovsky, and Biddle, 2007; Chalfont, 2007; Gibson *et al.*, 2007; Rappe and Topo, 2007). Residential aged care units located at upper floor levels are expected to have less available outdoor space than might naturally occur for those units located at ground floor. This factor aims to determine whether upper floor units experience a reduction in floor-plan derived dementia design quality, versus ground floor located units, and if so, whether any differences are linked to the availability or quality of outdoor space provided to unit residents.

The fifth and final factor, within the third research aim, requires testing the differences in dementia design quality between units that have been purpose-built for people with dementia and those which have not. The non-purpose-built units include those constructed for general-purpose residential aged care, and pre-existing buildings that have evolved into use for residential aged care purposes. Previous studies have suggested that purpose-built units have a positive effect on the independence and wellbeing of residents (Reimer *et al.*, 2004)

1.3 Key terms and concepts

This section defines several terms and concepts which are used throughout the dissertation. Most of these definitions conform to standards in the field, but a few are more specific to the present research and its methodology.

Cognitive and Spatial Concepts and Terms

'Dementia' is the umbrella name used in this dissertation for a wide range of conditions and diseases that affect the brain, and which present with similar overlapping symptoms. Dementia is usually progressive and is currently incurable (WHO, 2015; Prince *et al.,* 2016). 'Dementia Design Principles' (DDPs) are a set of guidelines that, based on evidence, are deemed to be helpful for improving the independence, quality of life, and well-being of people living with dementia. Although various lists of dementia design principles (DDPs) exist, within the present research references to DDPs typically refer to ten dementia design principles associated with the Environmental Audit Tool (Fleming, Forbes and Bennett, 2003; Fleming, 2011). Individual DDPs within the original ten are most often referenced within this dissertation using the notation DDP#1, DDP#2, DDP#3 etc. These are explained under the abbreviations list within the preface section to the dissertation.

Dementia is known to affect memory and spatial cognition in various ways. As spatial relations are a core topic of the present research, various types of memory and cognition must be briefly defined. All memory creation occurs in the hippocampus, a brain area that tends to be significantly affected by dementia. Short-term memories are converted to long-term memories through the limbic system, which goes through a process of rehearsing each piece of information. Once it has been rehearsed sufficiently is it stored to longer term memory (Guyton and Hall 1991, p. p643) where rehearsal is required less often to retain it (Bird and Burgess, 2008). Although 'memory' can be thought of as simply 'long-term' and 'short-term', there are several types of memory associated with each form (Avers and Williams, 2012). Short-term memory is comprised of working memory, which allows us to hold on to information for 30 seconds or less. To remember information for any longer than this requires mental effort to convert the information to episodic memory where it is memorised as an event. This event needs to be mentally rehearsed several times before it can eventually be committed to being stored in another brain area[1] as long-term memory where it can be retrieved later. Both the conversion to long-term memory and the process of retrieving some types of memory is undertaken by the hippocampus. With the hippocampus being one of the first areas to be affected by dementia, and commonly also the most significantly affected, it is this function of transferring memory (both new learning and recall) that is thought to be the primary cause of memory problems for people living with dementia. An important conclusion from some research is that when people living with dementia may not be able to consciously recall some of their memories, these memories may still be retained in the brain (Bird and Burgess, 2008). Therapies used with people living with dementia, such as cognitive stimulation, reminiscence therapy, and music therapy attempt to find alternative cognitive triggers to help overcome diminished recall (Seeher *et al.*, 2010; World Health Organisation, 2016).

Long-term memory is typically divided into 'declarative' (explicit) and 'procedural' (implicit) memory. Declarative memory, includes information such as facts and events, that can be consciously recalled (Avers and Williams, 2012). Within this are episodic memory, associated with recall of autobiographical events, and semantic memory, which stores information such as facts, ideas, and concepts, for example, the meaning of words or understanding of the function of an object. Procedural memory is unconsciously remembered and includes the implicit memory required for skills employed during activities like riding a bicycle or getting dressed, skills that, once learned, feel automatic. Once the skills are committed to procedural memory, a person does not tend to have to re-learn the procedures each time they are employed (Bird and Burgess, 2008). Loss of recent episodic memory is a common symptom at diagnosis of dementia, but if accompanied by loss of semantic memory, suggests greater severity. Episodic memory loss is harder to test (than semantic) without knowing the person's life very well. It is relied upon for reminiscence therapy. Procedural memory will often remain intact for someone with dementia even when other types of memory have been more substantially eroded. The implication is that people may retain more functional independence to interact with their environment if fixtures and equipment are 'familiar' in their design and placement (Rosenbaum *et al.*, 2000).

[1] It is not completely clear where in the brain that long-term memory is held, but neurologists consider that this most likely occurs elsewhere in the temporal lobe, a region of the brain surrounding the hippocampus.

The specific aspects of cognition that are significant for the present research include 'cognitive load', 'cognitive mapping' and the associated concept of 'visual accessibility'. Cognitive load is the overall thinking demand placed on the brain. The gradually diminishing cognitive ability of people living with dementia places correlating limits on the ability of their brain to process information. This creates a wide range of difficulties, such as overcoming navigation challenges or reduced ability to filter out unhelpful sensory stimulus, such as background noise (Garre-Olmo *et al.,* 2012; Joosse, 2012; Lin *et al.,* 2017). Well-designed dementia environments reduce any excessive cognitive load being placed on occupants. A cognitive map is a memory of the configuration of a spatial network or recall of landmarks and correct route-choice decisions needed to way-find successfully between specific locations in a spatial network (Rainville, Passini and Marchand, 2001; Zimring and Dalton, 2003). Some scholars (Bird and Burgess, 2008) believe that previously established cognitive maps are not necessarily erased from the memory of people living with dementia, but that the limbic system loses the ability to retrieve this information from long-term storage. Visual access refers to the general ability of an observer to see the space around them. In the context of this research, visual access tends to relate to ability to see from one nominated space towards, or into, others. The extent of visual access is affected by the ways that spaces are arranged and the extent of glazed elements within walls and doors. Visual access is a key consideration in the design of floor-plan layouts intended to support occupants with dementia. Visual access is also one of the ten identified DDPs that form part of dementia design evaluations in the present research.

Architectural Terms and Concepts

The present research is focussed on 'Residential Aged Care', which is defined as organised forms of group living for older people, with staff available — commonly on a twenty-four-hour basis — who can provide support with various 'activities of daily living' (ADLs), including meal preparation, dressing and bathing. It includes care settings that might be referred to in other literature as assisted living, care homes, group homes, hostels, and nursing homes. In this research, a 'facility' is a physical building, or complex of buildings, that host residential aged care services. A facility can be formed of just a single care unit, several units in one building, or be spread across a multi-building campus. The term is typically intended to include any communal areas, staff areas, and other ancillary accommodation that is shared between co-located residential aged care units.

A *unit* is a self-contained physical environment within which a group of six or more people live together. In most, but not all cases, residents are provided with private en-suite bedrooms. In a unit, residents share support staff and social spaces such as lounges and dining rooms. Residential aged care facilities are often comprised of several discrete units. These may be located within subdivided areas of a single building, be formed of discrete 'houses' connected to communal servicing spaces, or formed of physically separated buildings spread out over a care campus. Many residential aged care units contain several lounges, sitting rooms, dens and similar types of spaces, but fewer dining spaces.

For the purposes of this research a *unit* is defined as all the areas that share a dining[2] space. In many cases this results in a technically large 'unit' size where several clusters of bedroom areas share a central dining hall. Larger residential aged care facilities that contain multiple units also tend to have more substantial central community spaces capable of hosting a large proportion of residents simultaneously. These central areas include hairdressers, cafés and function rooms, along with staff facilities including administration spaces, professional kitchens and laundries. Whilst these spaces are not considered to be part of any individual unit for evaluation purposes in this dissertation, a proportion of the floor area of these facilities is included in unit areas for area-related analyses in this research. Also, for the present research the definition of 'units' excludes more independent forms of accommodation, such as close care, independent living and sheltered housing, even though many of these are found close to, or within the grounds of, a residential aged care facility. Finally, the term 'unit' is used in the present research to cover settings which might be referred to in other literature as 'house', 'household' or 'wing'.

The 'floor-plan' of a facility or unit is a two-dimensional drawing, to scale, of the relationships between rooms and other spaces. Floor-plans usually include graphic representations of physical features, such as columns and walls, doors and windows, and fixtures such as sanitaryware and cabinetry. Many also show space names, furniture and figured dimensions, all of which are helpful for understanding the sizes and social functions of spaces. The floor-plans used as the basis for dementia design evaluations in this research range from hand drawn sketch layouts to highly technical construction floor-plans. The 'layout' is the three-

[2] This rule is used irrespective of the possibility that some residential aged care facilities may operate with a different means of defining or organising resident groups.

dimensional topological arrangement of spaces in a building, and the unit layout 'type' is a planning arrangement or spatial pattern of rooms that may be repeated (sometimes mirror-imaged) in multiple parts of a facility.

1.4 Methods

This section presents an overview of the methods used to meet the three aims of the dissertation.

The three research aims all rely on a capacity to ascertain the dementia design quality of residential aged care units, based on information that can be observed, measured or inferred from architectural floor-plan drawings. Once the 'dementia design quality' of a plan is determined, it can then be correlated to multiple other factors — such as year of construction, storey height, and whether built specifically for being occupied by people living with dementia — to establish an improved understanding of the dementia design of residential aged care units. Thus, to progress the three aims requires: (i) a method for assessing dementia design quality in architectural plans and (ii) two sets of cases to apply the method to.

In terms of the method, the first research aim requires a new floor-plan based way of assessing dementia design in residential aged care settings. The second aim requires the identification of longitudinal trends in design quality evaluations, and the third aim correlates data for quality with specific functional factors in a design. As no such method exists for assessing dementia design quality using floor plans, a substantial part of this dissertation is dedicated to developing such a method. The development of the new method ('Plan-EAT') commences with the evaluation of, and comparisons between, several existing evidence-based environmental audit tools (see Chapters 3 and 4). This is followed by modification of one of these, the *Environmental Audit Tool* (Fleming, Forbes and Bennett, 2003; Fleming, 2011) to become the first known dementia design evaluation tool intended to be used for evaluation based on architectural floor-plans.

Once the method is developed, it is applied to two sets of cases, to progress the three research aims of the dissertation. The first set of cases comprises ninety NSW units, directly recruited as a representational cross section of the state stock of residential aged care settings (see Chapter 5 for more information). The second set comprises ninety-four 'international' units identified by experts as best practice examples and sourced from specialist design publications (see Chapter 5). Because some of the facilities repeat the planning of units within different houses, wings or buildings, the cases are further distilled into 108 distinct floor-plan 'types', which ultimately form the basis for analysis and comparison (see Chapter 5).

Importantly, the set of 'international' residential aged care units are named in this way because they are examples of dementia design worthy of world-wide recognition of their quality, not because they are from outside Australia. The cases in this set are sourced from specialist design publications and are from various locations in Asia, Australia, Europe and North America. Thus, eight of the ninety-four units in the 'international' set (or three of the thirty-six international unit layout types) are physically located in NSW and they are included in the international set because they have been independently identified as examples of world best practice.

Across the two sets of cases, the design evaluations for the full 108 layout types are used to establish a picture of dementia design quality (see Chapter 6). Because Plan-EAT evaluates plan layouts under nine distinct dementia design principles (DDPs), the results can be used to identify design strengths and weaknesses under each DDP, whether between sets of units, individual units, or against statistical norms. The results of Plan-EAT evaluations are used to fulfil the first aim of the dissertation. Thereafter, these results are used to address the second aim: to determine whether the dementia-enabling characteristics of floor-plan layouts for residential aged care units in NSW have improved over the last four decades (see Chapter 7). This involves the correlation of dementia design evaluation scores for all 184 units, or 108 unit planning types, resulting from the first aim, against the recorded construction dates of these units, spanning over a period of four decades. The NSW units were constructed over forty-six years, between 1970 and 2016, whilst the international units were constructed over thirty-eight years from 1972 to 2010.

For the third research aim, Plan-EAT dementia design evaluation scores from each unit are correlated against other standard architectural unit information, including unit floor area, the number of resident bed-spaces in the unit, floor area per resident, storey location (ground floor or upper floor), and whether the unit was purpose-built for people living with dementia or not (see Chapter 8).

1.5 Limitations and boundaries

There are several practical limitations to the methodological and philosophical approaches taken in this research.

The first practical limitation is one of scale. Although a total of 184 units, and 108 unit-layout types, are evaluated in this dissertation, floor-plans for the designs of ninety-four 'best practice' international units represent only a fraction of known published schemes, whilst the ninety NSW units represent only twenty-one out of 940 residential aged care facilities listed on the Aged Care Service List for NSW (Australian Government Department of Health and Ageing, 2016). As such, and despite the extensive scope of the present research, the overall findings will only provide indicative results for the three aims. Furthermore, while NSW has the largest volume of residential aged care provision in Australia, it can also not be assumed to be representative of the standards of design in other states in Australia.

The literature review undertaken for this dissertation is limited to works published in English. This limitation applies to both reviews of empirical studies and to the design publications used for sourcing floor-plans of international best practice examples included in the study. The design publications do incorporate case studies from non-English speaking countries but tend to emphasise those from English-speaking countries (Australia, UK, USA). The list of dementia design audit tools evaluated in Chapter 3 is based on the available tools identified from literature searches undertaken from 2013 to 2014.

The majority of international best practice examples were identified using two publications (Cohen and Day, 1993 and Anderzhon *et al.*, 2012), and so they may be subject to the bias or convenience of their authors. Although the authors of both publications are respected experts in the field of design for dementia and age-related impairment, the schemes were selected by a small pool of authors and are therefore more susceptible to bias. Neither publication clearly identifies whether evidence-based systematic approaches were used in making the selections.

The way the present research uses floor-plan information as the basis for design assessments, and its reliance on a subset of environmental assessment queries from the EAT (Fleming, 2011), leads to some inherent limits in design evaluation outcomes. The use of the full instrument for its original purpose of post-occupancy design assessment, as undertaken during a 'walk around survey' of a completed building, is naturally going to produce a more nuanced reading of the environment. The limitations associated with a focus on floor plans, as discussed further in sections 4.2 and 5.3, result in the exclusion of some important dementia design features. Therefore, caution is required when interpreting an overall assessment outcome, as it excludes some safety features, stylistic elements of interiors, furnishings, and signage. It also excludes important queries related to how the facility is managed and maintained. This does not diminish the significance of the research outcomes in developing new understanding of how building layouts impact dementia design quality, nor the value of the methods used in the research to help improve the overall ability of residential aged care environments to support residents with cognitive impairments.

The floor-plan based dementia design evaluations used in this dissertation are reliant on the accuracy and completeness of the plans used for assessing the residential aged care unit. They also rely on the correct interpretation of the information in plan drawings by a single assessor, the present author. Potential variations in standards of representation and levels of detail shown in drawings may affect both the ability to answer queries and the correct interpretation of this information.

The dementia design evaluations undertaken as part of this research rely on the interpretation by the author of the pre-existing dementia design audit tools and associated research evidence across a wide variety of design characteristics. This limitation applies primarily to the *Environmental Audit Tool* (Fleming, Forbes and Bennett, 2003; Fleming, 2011) from which a modified version was developed to enable floor-plan based dementia design evaluations to take place.

Further to this, it is important to acknowledge that the findings and conclusions of this dissertation are primarily underpinned by past empirical research evidence base, and subsequent academically-derived dementia design principles and environmental audit tools. The scope of the present research does not, however, include examining the first-hand experiences of people with dementia who occupy the residential aged care environments included in the present study. Such research could be a valuable means of verifying the related collection of dementia design principles embodied in the *Environmental Audit Tool.*

Owing to the ethics-based restriction on the identification of the directly-recruited NSW units and their organisations, the floor-plans for these units are not published and other information about them is presented in ways intended to prevent their identification in the dissertation. There was a concern that reproduction of identifiable floor-plans from NSW units may not always be appropriate, considering the hypothetical possibility that a participant residential aged care organisation may experience negative impacts from any findings that suggested their service could be sub-optimal. This restriction placed some limits on the ways in which research findings could be represented. However, the floor-plans from international best practice examples, with re-publication consent granted for all, enable graphical illustrations to support discussion within the text. The direct recruitment of NSW-based residential aged care facilities, along with the data collection and management undertaken for this, was the subject of a formal human ethics approval process (H-2014-0044).

It should be acknowledged that the evaluation approach taken in this dissertation may not be suitable for all residential aged care settings. Designs intended to suit some specific cultures may not fit with the model and philosophy of design and care from which the established evaluations are derived. For example, design to meet the needs of Australian Aboriginals, who may have lived the majority of their lives outdoors following long established cultural traditions may, at times, differ significantly from design for people from the cultures of European immigrants who arrived to Australia more recently (Pholeros *et al.*, 2017). The use of the evaluation method with cultures like those featured in the 184 cases examined in this dissertation is more likely to produce useful and reliable results.

Design evaluations were carried out by a single researcher (the author of this dissertation), and while they were conducted consistently, there was no means of inter-rater checking or secondary validation put in place.

The design evaluation method used in this research is primarily concerned with information contained in two-dimensional architectural floor-plans. As such, it omits the consideration of some fine scale factors only found in detail or construction drawings and specifications. It is acknowledged that in doing so, this approach limits the overall reliability of the method as a means of predicting the complete or holistic dementia design quality of the residential aged care environments being evaluated. However, as discussed in Chapter 3, alternative methods of evaluation, based on a similar approach, are possible, where the available decision information includes documents that describe more detailed characteristics of the environment, such as surface finishes, fixtures, furniture, and lighting.

1.6 Structure of the dissertation

This section outlines the overall structure of the dissertation and maps how it relates to the three research aims identified earlier in this chapter. A diagram of the structure outlining the chapters and methods used to address each of the three research aims is contained in Figure 1-A.

Chapter 2 provides a background review of literature that sets the context for this research. It includes an epidemiological overview of dementia as a condition with associated impacts for the individual and for society. It progresses to discuss the current Australian residential aged care sector and the implications of anticipated population changes for the design and construction of residential aged care settings. Chapter 2 also provides an overview of various sets of DDPs that have emerged as dementia design research evidence has grown over the last four decades.

Chapter 3 is a more focussed literature review, which commences the process of developing a new method for plan evaluation and to address the first research aim of the dissertation. The chapter commences by undertaking a broad review of seven established dementia design evaluations tools, then moves on to a more detailed comparative analysis for three of these, aiming to determine the most suitable to be adapted for floor-plan based design evaluations. The base tool chosen is the Environmental Assessment Tool (EAT) (Fleming, Forbes and Bennett, 2003; Fleming, 2011).

Chapter 4 describes the modification of EAT to create the first known formal dementia design evaluation tool suitable for evaluation based on architectural floor-plan drawings. This new version of the EAT, thereafter referred to as Plan-EAT, is used to carry out the dementia design evaluations in the subsequent chapters.

Chapter 5 describes the acquisition of information about residential aged care units, intended as subjects for design evaluations carried out in later chapters. It outlines the process of obtaining floor-plans of (n=90) NSW-based residential aged care units by direct recruitment through the care organisations that operate them, and identifies the source of a similar number (n=94) of floor-plans borrowed from specialist architectural design publications. The chapter also describes the approach used to collect non-floor-plan based information, including year of construction, designed purpose and storey location, as used to underpin the analyses undertaken to fulfil research aims two and three.

Chapter 6 is the first to present findings of the research, beginning with the overview of outcomes of floor-plan based dementia design evaluations undertaken using Plan-EAT. These findings include the outcomes of comparisons between the NSW-based and international units, along with the identification of common design strengths and weaknesses from each set under nine of ten established DDPs. A score-ranked list of all residential aged care units evaluated allows the identification of the relative ability of overall building layout types to support residents with dementia. This chapter directly addresses the first aim of the dissertation, to compare dementia design quality in the layout planning of NSW-based and international best-practice examples of residential aged care units.

Chapter 7 presents a correlation analysis between the results of Plan-EAT dementia design evaluations (reported in Chapter 6) against the construction date for each unit. This addresses the second aim, which asks whether the dementia design quality of layout planning in residential aged care units has improved over time.

Chapter 8, which addresses the third research aim, commences by introducing some of the assumptions made about the five various architectural characteristics to be evaluated, by correlation analysis of the extent to which they might influence the overall dementia design quality of residential aged care unit layouts. These analyses include correlations between Plan-EAT scores established in Chapter 6, against the following attributes for each residential aged care unit: the unit floor area, number of resident bed-spaces, area per resident, whether the unit is located at ground or upper floor, and whether the unit was designed for the purpose of supporting people living with dementia or not.

Finally, Chapter 9 summarises and discusses some of the main findings of the research, then offers overall conclusions, followed by some observations about the implications of the findings, and potential future directions for research in this area.

The dissertation has several appendices. Appendix A, B, and C contain evaluations of the three established audit tools (DDAT, EAT, and TESS) to establish the suitability of each for floor-plan based dementia design assessment. Appendix D contains detailed notes on the application of Plan-EAT, the new floor-plan evaluation process derived from Fleming's (2011) *Environmental Audit Tool* — used as the primary method for undertaking the evaluations of building layout reported in Chapter 6. Appendix E contains the combined questionnaire and consent form used in the recruitment of NSW-based residential aged care units — this questionnaire is the source of data about each NSW recruited unit, such as year of construction, and whether purpose-built for dementia, that is used to inform the analyses undertaken as part of the second and third research aims.

The raw data collected from research to address the first aim of the present dissertation are presented in Appendices F and H. These contain expanded tables of outcomes across the full set of thirty-nine dementia design evaluation queries from the Plan-EAT for both the NSW unit layout types (Appendix F) and the international unit layout types (Appendix G). Two appendices (H and J) present summaries of each of the two preceding appendices, including sum totals of point scores under all nine dementia design principles, conversion of point scores to percentage values, and finally the calculated overall Plan-EAT score for all seventy-two NSW unit layout types (Appendix H) and all thirty-six international unit layout types (Appendix

J).A further four Appendices, K, L, M, and N provide various summaries of Plan-EAT and other attributes, including results filter by different sub-categories related to the second and third research aims.

1.7 Research presentations

Rather than publishing the findings of the research throughout the process, as much of the material was commercially and ethically sensitive, interim stages and findings have been presented at specialist social science and gerontology conferences as follows:

Quirke M, Ostwald M, Taylor M, Fleming R, and Williams A (2018) Design for dementia: An analysis of care home layouts, in, *Advancing not Retiring: Active Players, A Fair Future: 51st Annual Conference of the Australian Association of Gerontology*, Melbourne, 21st-23rd November 2018 (comprising an overview of the dissertation).

Quirke M, Ostwald M, Taylor M, Fleming R, and Williams A (2018) An analysis of aged care units: Spatial Arrangements for People with Cognitive Impairments, in, *Ageing in an Unequal World: Shaping Environments for the 21st Century: British Society of Gerontology 47th Annual Conference*, *2018*, Manchester, UK (comprising sections of Chapter 6, Chapter 7, and Chapter 8).

Quirke M, Taylor M, Fleming R, and Williams A (2018) Care home layouts for people with dementia, in, *Dementia Care, Design and Technology: Dementia and Ageing Research Group, 2018*, University of Stirling, Stirling, UK (based on material in Chapter 6).

Quirke M, Taylor M, and Fleming R (2016) Arranging spaces: Improving building layouts for people with dementia, in, *Homes fit for Ageing: Chartered Institute for Housing Conference*, 2016, Bristol, UK (being an overview of the topic and initial findings).

Quirke M, Taylor M, and Williams A (2014) Building layouts for better dementia care: Translating an environmental audit tool to a method of assessing care home layouts, in, *Sharing Care for Older Australians: Working Together: The Australian Association of Gerontology Regional Conference 2014,* Port Macquarie, Australia (Chapters 1 and 2).

1.8 Conclusion

The dissertation develops new knowledge about the way in which the layout planning of buildings, as described in architectural floor-plans, plays a significant role in determining how supportive the environment is for occupants living with dementia. This is an important topic because there are currently no building codes to *ensure* that newly constructed or renovated residential aged care units are designed for dementia. While some advisory documents exist in various states, the lack of an assessment tool means that the capacity to shape dementia design quality is also limited. The anticipated volume of new residential aged care bed-spaces to be constructed over the coming five-to-ten years is significant, being at least 12,000 bed-spaces per year across the country. These new units, and any renovations to existing units, present a significant opportunity to improve the lives of people living with dementia into future decades.

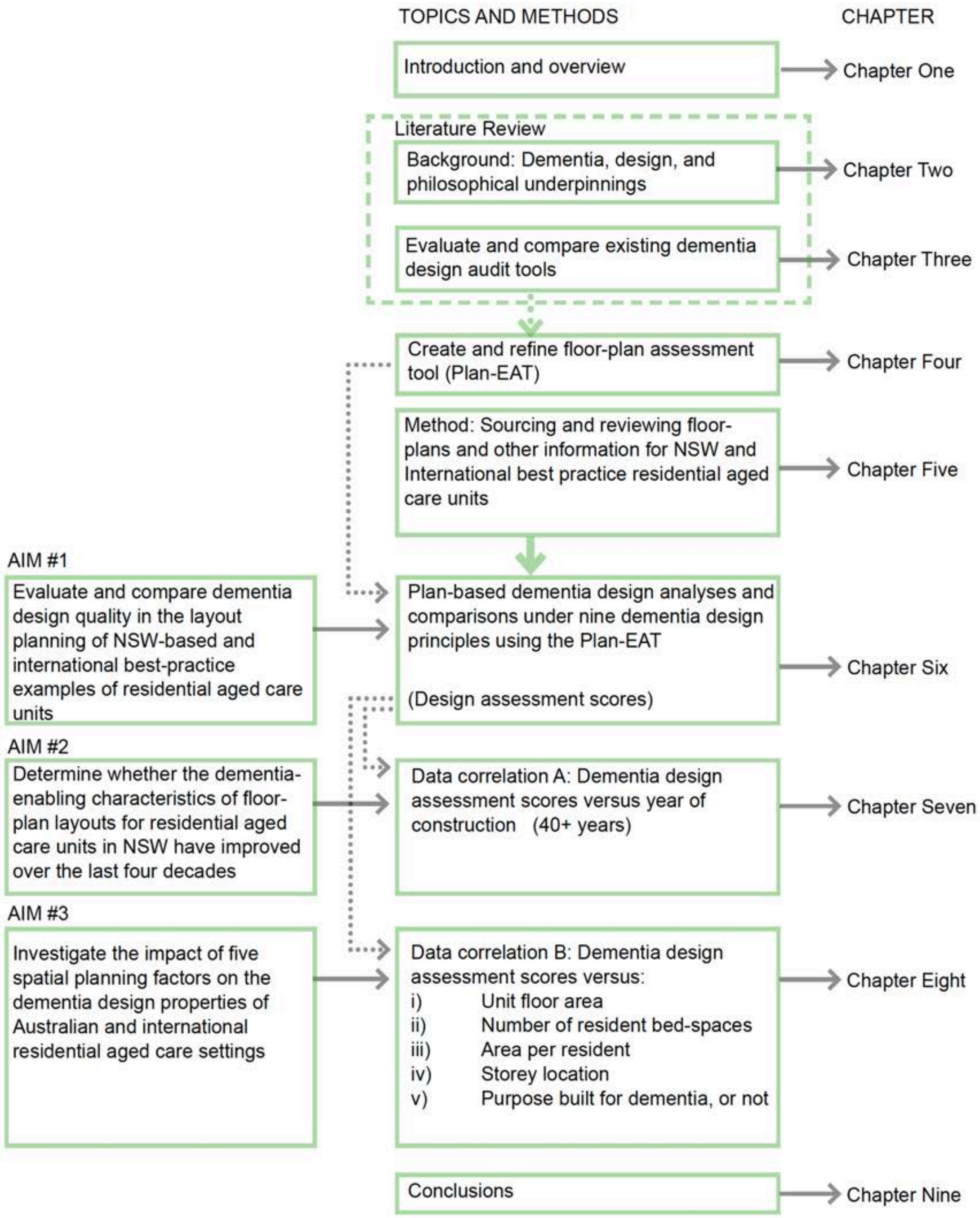

Figure 1-A: Dissertation structure, research aims, and methods

2 BACKGROUND

This chapter provides an overview of the condition, symptoms, and epidemiology of dementia along with a background to dementia's impact upon independence and overall wellbeing. This is followed by a more focussed examination of the cognitive aspects of wayfinding and spatial experience, and a discussion of the research evidence base for dementia-friendly design, or how design can help people to overcome some of the impairments of dementia. This discussion leads into an overview of established dementia design principles (DDPs) that have emerged from the evidence base. The chapter concludes by drawing connections between the literature reviewed and the current status of dementia design quality amongst the existing stock of Australian residential aged care facilities.

2.1 What is dementia?

Dementia is an umbrella term for a wide range of cognitive and neurological disorders, which includes Alzheimer's disease[3], vascular dementia[4], frontotemporal dementia and many others. The many forms of dementia bring about varying combinations of symptoms, commonly including memory loss, confusion and disorientation (Finkel, 2000). Although physiological, pathological, and cognitive symptoms vary from one type of dementia to the next, all types lead, over time, to disabling losses in individual autonomy and to the need for full-time care (Prince *et al.*, 2015; Winblad *et al.*, 2016). In the later stages of dementia there tends to be a gradual loss of motor skills followed by the failure of involuntary physical functions, such as dysphagia (difficulty swallowing) that can lead to asphyxia or aspiration pneumonia (an

[3] Alzheimer's disease, the most common form of dementia, incorporates problems with functioning of the central nervous system. Physiological micro-biology symptoms include a shortage of acetylcholine at nerve synapses.

[4] Vascular dementia tends to be caused by stroke, or a series of mini-strokes, and it can be more common for people with heart disease. The blood clots from strokes cause lack of circulation to parts of the brain which then die. Whether dementia occurs, and what functional or behavioural symptoms result, depends on which parts of the brain are affected.

infection from food or drink 'going down the wrong way') that eventually lead to death (Avers and Williams, 2012; Coppedè *et al.*, 2012)

In 2016, dementia was attributed as the cause of death for 5.7% of males and 11.0% of females in the overall Australian population (Australian Bureau of Statistics, 2017) making it the leading cause of death for females, and the second leading cause of death overall.

In 2018, there were an estimated 425,416 Australians living with dementia (Brown, Hansnata and La, 2016). At any given time, about two thirds of people with dementia remain living in the community, supported by either formal or informal social care, even though for most people the progression of the condition eventually results in a move to full-time formal care. Currently in Australia, about two in ten males, and three in ten females with dementia live in residential aged care facilities (Brown, Hansnata and La, 2016).

Clinical assessment by a medical specialist is needed to formally diagnose dementia. This process serves to not only distinguish which type of dementia the person is likely to have (even though absolute certainty is only possible via post-mortem examination), but also to differentiate dementia from other unrelated conditions that present with some similar symptoms. The loss of memory associated with dementia, for example, can also be caused by trauma, stress, or lack of sleep, while other dementia-like symptoms can be caused by anxiety, depression[5], narcotics and even some types of infection[6]. However, it is important to note that, unlike dementia, most other conditions are temporary and treatable, with the person's cognitive function returning to normality afterwards.

Dr Barry Reisberg's *Global Deterioration Scale* (GDS) (Reisberg *et al.*, 1982) is commonly used by medical practitioners to help grade the cognitive ability of people for whom dementia is a possible diagnosis. The GDS contains seven progressive levels, identified by overlapping behavioural and cognitive symptoms. The two initial levels, No Cognitive Decline (GDS 1) and Very Mild Cognitive Impairment (GDS 2) cover healthy individuals and those with normal age-related cognitive decline. If a person experiences some difficulties with orientation, recall and

[5] Depression, which can cause symptoms such as impaired memory, is common in older people, with suicide at its greatest incidence rate in white males over sixty-five years old (Edwards, 1993).

[6] Delirium, with its dementia-like symptoms, is most commonly caused by kidney infections.

problem-solving, they may be deemed to have Mild Cognitive Impairment (GDS 3). However, it is only when the person reaches Moderate Cognitive Decline (GDS 4) or later, that they are diagnosed with dementia. The four stages of dementia progress are: Mild Dementia (GDS 4), where symptoms include loss of orientation to time and place, loss of the ability to travel independently, failure to recognise familiar people, or problems handling finances; Moderate Dementia (GDS 5), where they may not remember the names of close relatives or their home address; Moderately Severe Dementia (GDS 6), which may include personality changes such as delusional or agitated behaviour, imaginary figures, or obsessive repetitive actions; and, Severe Dementia (GDS 7), where there is loss of verbal communication, reduced movement and disrupted bodily functions.

People living with dementia can usually function independently in the earlier grades of the GDS but become more reliant on help from family or professional careers as their condition gradually deteriorates. With diagnoses of Mild Cognitive Impairment (GDS 3) and, increasingly, Moderate Dementia (GDS 4), people can often remain living within their local community.

The cognitive losses of dementia are associated with neurological degeneration and overall reduction in the mass of grey matter (Winblad *et al.,* 2016). This physiological atrophy is known to begin as early as twenty years prior to the cognitive and behavioural manifestations associated with the condition. Ongoing research aims to find tests for detecting these physiological changes at an earlier stage, with methods currently in development including blood tests (Johnstone *et al*., 2012) and retina scans (Heringa *et al.,* 2013). In the meantime, the medical profession relies on tests of symptomatic behavioural and cognitive functions as the primary means of formal diagnosis.

The hippocampus, as part of the limbic region of the brain, is known to play a key role in problem-solving, the formation and recall of memory, as well as being key to the conversion of short-term memory into long-term memory[7] (Rosenbaum *et al*., 2000; Guyton and Hall, 1991, p 643). This organ also plays a key role in spatial cognition and independent wayfinding.

[7] All memory creation occurs in the hippocampus, a brain area that tends to be significantly affected by dementia. Short-term memories are converted to long-term memories through the Limbic system (Guyton and Hall 1991: 643).

For example, post mortem examination shows that the hippocampus tends to be larger in traditional career taxi drivers (Bird and Burgess, 2008), who commit vast networks of spatial sequences and interconnections to memory for daily use. The disproportional shrinkage of the hippocampus, in most common forms of dementia, means that the decline in the cognitive functions associated with the hippocampus feature heavily in the symptoms observed by medical professionals during diagnostic examination.

Although there are drugs that can temporarily alleviate some symptoms associated with dementia (Alzheimer's Society, 2014), there is not yet a cure, nor any certain way of preventing dementia. Ongoing research working towards a cure or prevention is diverse, covering a multitude of micro-biological processes thought to affect brain function, including the role of immunology, hormones (esp. insulin) and atmospheric toxins (Winblad *et al.*, 2016). Potential 'breakthrough' findings are regularly reported from the results of experiments based on small mammals, or small-scale human trials, but the same findings tend not be repeated in trials amongst larger human populations (King, 2018).

It is difficult to predict whether any individual will develop dementia, but there are several factors that can influence a person's pre-disposition to dementia or the likelihood of some types. These factors include genetics, medical conditions, and lifestyle. For example, genetic factors can mean that groups such as Australian Aboriginals experience significantly earlier onset than the general population (Radford *et al.*, 2015), whilst people with type-2 diabetes are 60% more likely to be diagnosed with dementia (Chatterjee *et al.*, 2016). Women tend to be more prone to dementia than men (Fratiglioni *et al.*, 2000; Matthews *et al.*, 2016) with this risk to women being significantly greater (19%) for vascular dementia (Chatterjee *et al.,* 2016). Lifestyle choices can also be a significant factor, as people already diagnosed with other 'modern' diseases (such as diabetes, heart disease and hypertension) have increased likelihood of a dementia at some point in life. However, the 'healthy' lifestyles already considered protective for conditions such as heart disease, depression, diabetes, osteoporosis, and obesity, are also now known to reduce the risk, or delay the onset, of dementia (Capewell *et al.*, 2009; Prince *et al.*, 2015). Unfortunately, however, once dementia has set in there are no known measures capable of reversing the physiological degeneration that causes the observable loss of cognitive function (Prince *et al.*, 2015).

Measures currently thought to delay or reduce the likelihood of dementia onset include regular physical exercise, a balanced diet, access to sunlight, greater educational attainment, higher degrees of social interaction, and the avoidance of smoking. There is also evidence that many of the same factors that contribute to prevention can also slow the progression of some of the symptoms (Valenzuela, Brayne, Sachdev, and Wilcock, 2011; Winblad *et al*., 2016). From a nutrition perspective, those with low-to-modest levels of calorie intake during adult life are thought to have reduced individual risk of dementia, with further evidence that those who have consumed lower quantities of red-meat, and higher proportions of fish, thought to be at reduced risk (Otsuka, Yamaguchi, and Ueki, 2002).

Some types of dementia are associated with pronounced deterioration of specific brain areas, with the most noticeable changes in ability, or behaviour, tending to be those associated with the most affected areas of the brain. For example, a person with frontotemporal dementia is likely to experience loss of inhibition, or self-control, a cognitive and behavioural function controlled by this area of the brain (Seeher *et al*., 2010, p. 35).

In more advanced stages of dementia, a reduced ability to verbalise thought and emotion often exacerbates a diminishing capacity to understand or interact with the world. This loss of verbalisation can also cause difficulty for carers trying to ascertain a person's needs, thoughts and emotions. Once conventional forms of communication fail, alternatives become necessary. At this stage of disease progression, the observation of behaviour (agitated or otherwise) becomes, by necessity, the main and most reliable indicator of underlying distress being experienced by the individual (Algase *et al*., 2001)

2.2 Dementia and behaviour

Contrary to popular belief, many behaviours associated with dementia, such as wandering and physical aggression, are not always innate to the condition, but are often manifestations of the high levels of stress and distress being experienced by the person. These agitated behaviours are an individual's outward expression of disorientation, frustration, and difficulty in understanding and interacting with their surroundings (Cohen-Mansfield, Marx and Rosenthal, 1989; Cohen-Mansfield, 1997)

Agitated and distressed responses from people living with dementia can vary from passive through to physically aggressive behaviours. This includes one of the most commonly recognised behaviours associated with dementia, wandering. Although wandering can sometimes be a cause of concern for family and staff, it is not necessarily harmful, provided the environment supports it appropriately. In some cases, it can have a therapeutic effect. Wandering is common amongst people whose cognitive impairments fall between GDS4 and GDS7 (Reisberg *et al*., 1982). The efficiency and speed of gait during wandering regresses as cognitive status declines (Martino-Saltzman *et al.*,1991), with the incidence of falls around eight times higher for residents with a dementia versus people without (World Health Organization, 2010).

Although wandering may occur at any stage, more cognitively intact individuals are usually able to explain their movement, whether as a form of exercise or a way to pass the time (Algase *et al.*, 2001). However, people in the later stages of cognitive decline tend to be less able to explain a purpose for their movements as they tend to be less consciously aware of their repeated lapping, pacing or other random travel tendencies (Curyto, Ogland-Hand and Vriesman, 2007).

People with more advanced dementia are also increasingly more likely to experience distress from becoming 'lost', whilst people in earlier stages of dementia can overcome an ever-shrinking cognitive map through retained problem-solving ability. People in more advanced stages of cognitive decline are not only less likely to remember their way in the first instance but are also less likely to be able to work out how to get there. They are less likely to recognise that they need help, or, when they do, may find themselves unable to communicate a request for assistance (Rowe, 2003).

The Algase Wandering Scale (Algase *et al.*, 2001) identifies four types of wandering — random, lapping, pacing and direct — with particular observable behaviour characteristics in the movement patterns associated with each. Each type of wandering on the scale can be linked to the cognitive status of the individual and can also help to identify some of the risks — such as broken bones from falls, or exposure as a result of decamping — that become likely under one type of wandering versus another. Staff and carers can therefore use the scale in combination with observations of residents' walking patterns to obtain guidance in deciding on the appropriate levels of monitoring, interactions, or environmental modifications needed to help the person living with dementia experience minimum distress whilst maintaining optimal levels of independence. In residential aged care settings, this can help staff to allow residents with greater cognitive and physical capacity, or people with reduced risks of falls, to have maximal freedom to find their own way around, both inside buildings and in outdoor spaces[8].

The behavioural problems associated with dementia are often managed in a medicalised manner through pharmaceutical intervention, a practice sometimes referred to as 'chemical restraint.' This drug-based approach is being increasingly challenged, from both human rights and medical perspectives, with some considering these practices to be as inhumane as the use of physical restraints, such as bed-straps. It has been long established, with overwhelming evidence, that physical restraints lead to reductions in resident wellbeing, increased rate of falls, and risk of injuries from falls when they occur. Increased levels of distress created by restraints in itself increases the pace of deterioration of both physical and cognitive abilities (Hofmann *et al.*, 2015). Despite all of this, physical restraints in various forms are still widely used internationally (Kor *et al.*, 2018; Oepen *et al.*, 2018).

Returning to drug-based interventions, the available evidence suggests that polypharmacy, which comes about through well-meaning efforts to manage ever more complex and overlapping health conditions (i.e. residents with multi-morbidities), is not only less effective, overall, than drug-free interventions, but the combinations of side effects from such pharmacological cocktails are likely to be to the detriment of the health of people living with dementia (Banerjee, 2009, 2016; Parsons, 2017). The alternative provision of holistically supportive and enabling environments — both socially and physically — is seen to be most effective in the overall reduction of agitated behaviour (Kitwood, 1997). Research shows that care organisations which engage in a 'person-centred' care model, where social interaction and physical activity are supported and encouraged, tend to record sustained improvements in resident wellbeing (Barnes, 2002; Dickinson, McLain-Kark and Marshall-Baker, 1995; Tappen, 1997; Marquardt and Schmieg, 2009; Kitwood, 1997).

[8] Unfortunately, it is often reported that challenges in staffing and/or management of the physical environment leads to restrictions being placed on the physical environment (such as locked doors) in response to staff concerns for the safety of more vulnerable residents. This compromises the freedom of the more capable and cognitively intact residents.

2.3 Cognition, mental maps, and spatial experience

This section examines the cognitive mechanisms of wayfinding and discusses how design can compensate for the diminishing cognitive abilities of people living with dementia, using well-designed building layouts that provide good visual accessibility and other cues to improve the wayfinding success of people living with dementia.

Maintaining the ability to find their way around, or wayfinding, is a key aspect of retaining independence and wellbeing for people living with dementia (Passini *et al.*, 1998, 2000; Barnes, 2002; Marquardt and Schmieg, 2009; Chang *et al.*, 2010; Innes, Kelly and Dincarslan, 2011; Marquardt, 2011). Designing to enable people living with dementia to find their way takes into consideration occupants' (changing) cognitive abilities in order to achieve 'cognitively ergonomic' design (Li and Klippel, 2010). This can be achieved by first understanding how memory, cognitive maps and wayfinding occur, and then how these mechanisms alter for people living with dementia.

Understanding the immediate environmental conditions is the critical starting point for all activities in space, where a cognitive impression of the surroundings is required before individuals can consider how to interact with them. Achieving this cognitive impression requires a combination of the ability to perceive the environment, or cues within it, and the ability to correlate this information against established knowledge or memory of the meaning of this information and how to respond to it.

Healthy individuals go through a process of forming mental maps of newly encountered environments. On the first attempt to way-find through an unfamiliar environment, the individual must interpret new information (be it signs, a map, physical features, etc.) about the environment and, where necessary, use problem-solving skills to respond to the available cues. With sustained or repeated exposure, more detail is committed to longer-term memory, forming an increasingly complete 'cognitive map' (a mental picture of spaces). As further key spatial information is committed to memory, the person becomes less reliant on their ability to interpret external information, whilst making use of the information held in their cognitive map. This shift places a reduced cognitive load on the brain through the reduced need for the effort required for problem-solving, and reduced levels of sensory awareness required for observation of the aspects of environment not already associated with decision points for wayfinding (Allen, 1999; Golledge, 1999). Providing the person's cognitive map is sufficiently well developed, they require only the additional ability to conceptualise movement through those spaces already committed to memory in order to successfully navigate between two locations (Passini *et al.*, 2000).

Where either the spatial memory and/or problem-solving capacity of the individual is limited — people living with dementia experience both — the size and complexity of the spatial network which can be navigated without the assistance of signs or instructions is reduced. People living with dementia not only tend to experience reduced ability to recall spatial information previously committed to memory, but also experience declining ability to form new memories. The wayfinding challenges for people living with dementia are compounded by progressive decreases in the person's ability to use short-term memory or inferences (e.g. written directions or sequential door numbers) for problem solving and decision making in wayfinding tasks (Passini *et al.*, 1998)

The erosion of the ability to recall cognitive maps leads to a reduced capacity to mentally visualise the layout of the environment (Golledge, 1999), thereby inhibiting the formulation of a route plan. As a result, people with dementia gradually experience more difficulty in finding their way around, starting with larger, more complex, repetitive, or less legible environments (Garlick, 2008; Carlson *et al.*, 2010), and eventually leading to loss of ability to successfully conduct wayfinding tasks within even the most familiar environments, such as the person's own home (Marquardt *et al.*, 2011).

The experience of getting lost in unfamiliar places has a disabling effect on the individual, increasing their stress levels, potentially triggering agitated behaviour, and reducing the individual's sense of autonomy. Quality of life for people living with dementia is therefore heavily dependent on spatial orientation in support of independent wayfinding (Gonzalez-Salvador *et al.*, 2000; Hoe *et al.*, 2006).

Those who have little or no memory of a building layout — just as might be the case for a first-time visitor — are reliant on the sensory cues provided by the environment to find their way around. They are reliant on a combination of visual access — the ability to see from one part of the building to another — and other sensory cues, whether audio, olfactory, or visual in nature, to provide the orientation that helps them find their way (van Hoof, Kort, Duijnstee, *et al.*, 2010). The main differences between new visitors and people living with dementia is that the people living with dementia are less likely to have the capacity to work out which way to go Conversely, where there is excess sensory information available in the environment, people living with dementia may have difficulty deciphering the helpful information from unhelpful information (Cohen-Mansfield and Werner, 1995).

Environments with greater levels of visibility between spaces, or good visual access, help individuals understand spatial configuration. The visibility of other cues, such as signage, furniture and equipment, can help people to understand the purpose of spaces and their associated social and behavioural conventions (Ritchie, Sim and Edgerton, 2011; Jonsson *et al.*, 2014; Eijkelenboom *et al.*, 2017). Fortunately, people living with dementia tend to retain a larger proportion of their implicit memory, allowing them to recognise and respond to familiar cues. They can often, for example, identify the social function of a space if it contains familiar types and styles of furniture and fixtures. Where these features are unique, they can also help improve memorisation and recall of individual spaces, as well as the location of those spaces within the overall spatial network. Both of these aspects of visual information are considered to be important as functional and therapeutic features of all environments likely to be occupied by people living with dementia (Peatross, 1997; Diaz Moore and Ferdous, 2013).

2.3.1 Decision points and visual cues

'Decision points' are key stages or locations in the process of navigating along a wayfinding route. They occur at spatial intersections that require the person to choose correctly between at least two alternative routes of travel away from each intersection. Efficient use of cognitive mapping for wayfinding requires the ability to recall sufficient spatial information to recognise specific locations within the overall spatial network, whether a street network or building layout, as well the correct choice of direction to take away from each junction leading to the intended destination (Haq and Zimring, 2003). From a cognitive loading perspective, the fewer decision points to navigate along a route, the more likely that wayfinding will be successful for people who lack a mental map of the environment or possess reduced problem-solving skills. Simpler building layouts with fewer intersecting circulation routes are likely to be easier to navigate.

Complex building layouts with repeated similar features can be more difficult to navigate and memorise (Li and Klippel, 2010; O'Malley, Innes and Wiener, 2017), whereas developing cognitive maps for settings with unique physical characteristics is easier. Features such as the physical shape of the space(s), the availability of views, or the presence of unique 3D objects (e.g. artworks or furniture), can be memorised as nodes or landmarks (Lynch, 1960; Carlson *et al.*, 2010; O'Malley *et al.*, 2016), making it easier to establish these locations in memory, whether as destinations in themselves or as decision points or way-markers on a given route.

The ability to identify, interact with, or infer the intended purpose of many traditional physical features means that even at advanced stages of dementia, many people still know how to use a door, doorbell, chairs, traditional faucets, light switches and so on (Judd, Marshall, and Phippen, 1998; Passini et al., 2000). As an extension of this, the visual cues provided by 'familiar' objects can help with wayfinding, understanding the intended function of spaces, and retaining the ability to interact with household objects, along with other functions that help people to retain functional independence. The addition of signage at decision point locations, such as where corridors meet or upon exiting a lift or communal space, can help people without a strong cognitive map (such as visitors and people living with dementia) to find destinations such as toilets and exit points (Golledge, 1999; Ulrich *et al.*, 2008; O'Malley *et al.*, 2016).

Although signage is not considered to be as effective for improving wayfinding as well-designed architectural features, distinct spaces and signature 3D objects (Passini *et al.*, 2000; Arthur and Passini, 2002), there is some evidence that, where direct visual access is not available, sign-posting can help to improve independent wayfinding for people living with dementia (Gärling, Böök and Lindberg, 1986; Rainville, Passini and Marchand, 2001). More recent research indicates that carefully designed signage (including using recognised icons and being well positioned) can usefully clarify or reinforce architectural cues (Kelly, Innes, and Dincarslan, 2011; Fleming, Crookes, and Sum, 2008).

As people living with dementia become increasingly reliant on direct visual access, building layouts that permit direct visual connection between key spaces become more valuable to help them find their way between places in their environment (Marquardt, 2011; Passini *et al.*, 2000; Judd, Marshall, and Phippen, 1998). The tendency for aged care residents to have more success in finding their way towards common lounge rooms than they do with the reverse journey (McGilton, Rivera and Dawson, 2003) shows how the differences in spatial characteristics impact wayfinding. Communal spaces such as lounges and dining rooms tend to be larger, more centrally located off main circulation routes, and more visually accessible overall. Communal spaces also tend to provide additional sensory cues that are visual, audio or olfactory in nature. Meanwhile bedrooms tend to be amongst repeated near-identical spaces, with reduced visual access, and little by way of other cues — except where a deliberate strategy is in place to help resident wayfinding to their own room.

The ability to find, and independently use, the toilet plays a significant role in preserving both the dignity and sense of autonomy for aged care residents, a potentially challenging wayfinding task that may often need to occur in a hurry. This makes both the location and visibility of the toilet (or the toilet door) especially important from key areas such as communal dining and lounge area, and from private bedroom spaces. Although some research suggests that the family of residents do not consider the provision on an en-suite WC to be of high importance in selecting an aged care provider (Popham and Orrell, 2011), clinical research shows clear evidence that the ability of a resident to see a toilet, especially from their bed, reduces incontinence by as much as 70% (Namazi and Johnson, 1992; Ritchie, Sim and Edgerton, 2011).

2.4 Design for dementia

Over the past three decades, a sizeable volume of research has shown that appropriately designed physical environments can have positive effects on the mood, stress levels, behaviour and overall quality of life of people living with dementia (Lawton and Zarit, 2001; McKee, Houston, and Barnes, 2002; Smith, Mathews, and Gresham, 2010). Physical settings that encourage meaningful (ordinary) activities, support autonomous wayfinding, and promote casual social interactions tend to lead to increased levels of independent ability and increased participation in activities of daily living (Reimer *et al.*, 2004; Verbeek *et al.*, 2008). There is also evidence that appropriately designed environments can lead to reductions in agitated behaviour, the use of pharmacological and physical restraint, the frequency of falls, incidence of incontinence and overall reductions in resident dependency on care staff (Fleming and Bowles, 1987; Lawton and Zarit, 2001; Price, Hermans and Grimley Evans, 2001; Fleming and Purandare, 2010; Chaudhury *et al.*, 2017).

Several systematic reviews of research on designing for dementia have been published, with most coming to similar conclusions (Price, Hermans and Grimley Evans, 2001; Fleming, Crookes and Sum, 2008; Verbeek *et al.*, 2008; Fleming and Purandare, 2010; van Hoof, Kort, Duijnstee, *et al.*, 2010; Marquardt, 2011; Zimmerman *et al.*, 2013; Daly Lynn *et al.*, 2017). The sizeable base of existing research evidence has informed the development of a series of DDPs as well as the production of formal dementia design evaluation tools. The first known evidence-informed dementia design principles were published in 1987 on behalf of NSW Department of Health (Fleming and Bowles, 1987), whilst the first dementia design evaluation tool, the Multiphasic Environmental Assessment Procedure, was published the following year (Moos and Lemke, 1988). Further audit tools and lists of DDPs have been developed over the subsequent decades.

Although the available sets of DDPs and formal design evaluation tools follow a variety of approaches, most are primarily underpinned by empirical research (Fleming and Purandare, 2010; Fleming, Crookes, and Sum, 2008; Zimmerman *et al.*, 2013; Verbeek *et al.*, 2008; Marquardt, 2011; Soril *et al.*, 2014; Lawton and Zarit, 2001). However, their approaches are also informed by evolving human rights-based care philosophies, building regulations, technological developments and individual author perspectives (see Figure 2-A). Whilst these resources have historically been generated for formal care and mental health settings, over the past decade there has been expansion of these into use in more domestic and public settings. More recent research findings, whilst reinforcing existing evidence, have added more nuanced refinements to pre-existing dementia design guidance. There is now acknowledgement, for example, of the need for environments to be future-proofed; of the need for more allowance to be given for the varying and changeable needs of individuals with multiple impairments (in addition to dementia). There has also been the limited development of dementia design guidance that is tailored to different types of physical environments — such as housing, hospitals, and public parks — as well as some differences being identified in optimal residential aged care environments for people at different stages of dementia (Fleming and Bennett, 2015).

It is likely that, given the choice, most older people would prefer to remain living in their own homes within a familiar physical and social community for as long as possible, a view also shared by their families (Innes, Kelly and Dincarslan, 2011).

It has been established that physical home adaptations, such as bathroom or kitchen modification, or the installation of stair-lifts, can make a significant difference to the health, independence and quality of life of people with physical impairments, usually allowing them to live at home for longer (Alpin and de Jonge, 2013; Satsangi, Mccall and Greasley-Adams, 2015; Brown *et al.*, 2017). This practice is also providing significant economic benefit to society with, for example, the UK's National Health Service (NHS) reporting a fivefold (and greater) positive return on investment through savings from prevented hospitalisations and illness after making adaptations to the homes of people assessed as being at risk of poor health (Leng, 2011). In parallel with this, there is a growing body of research which shows that housing and housing adaptations designed to accommodate dementia can also allow people to remain living 'at-home' for longer (Brown *et al.*, 2017). A key aspect of this is the availability of environmental support to facilitate independent participation in activities of daily living (ADLs) such as personal care and basic domestic chores. The layout of the home has been shown to be a significant determinant of the likelihood of the resident engaging in ADLs (Marquardt, 2011; Marquardt *et al.*, 2011).

Entry to residential care for people aged sixty-five and over is most commonly triggered by a significant event, such as a fall or significant illness where the person is initially hospitalised (Harrison *et al*., 2017; Mitchell *et al*., 2017). Admission to hospital tends to accelerate any pre-existing long-term trajectory towards residential care. There is further strong evidence that people living with dementia have worse hospital outcomes, including stays that are more than twice as long (Waller, Masterson and Finn, 2013; Prince *et al.*, 2016; Reynish *et al*., 2017). They are prescribed only half as much pain relief as people without dementia, and experience accelerated further deterioration of cognitive ability during hospital stays (Guijarro *et al.,* 2010; Scrutton and Brancati, 2016). People living with dementia also experience approximately 20% higher re-admission and almost 60% increased likelihood of mortality within one year of initial hospitalisation (Harrison *et al.,* 2017; Reynish *et al.,* 2017).

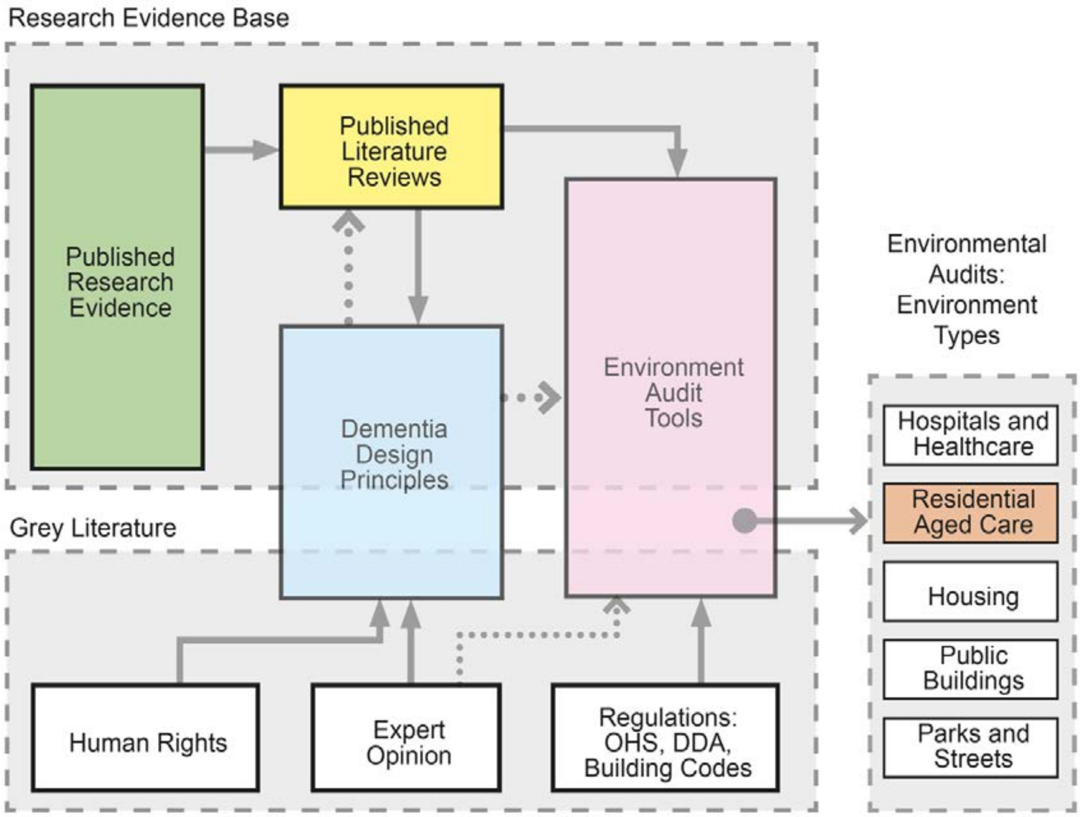

Figure 2-A: Factors of influence for dementia design principles and audit tools

The prospect of returning home after hospitalisation is often hampered by reduced independent ability resulting from the injury or illness, where the challenges of overcoming any impairments can be amplified if the design of the person's own home does not provide sufficient physical or cognitive prosthesis (Lawton 1975; Brown *et al.,* 2017; Powell *et al.,* 2017). Although appropriate and helpful adaptations to the person's home are usually possible, the adaption process can rarely be carried out by the time hospital discharge needs to occur. So, there is often little choice but for the person to move, at least temporarily, into residential care.

In Australia, around three-quarters of people living with dementia are living in the community, rather than in formal care, and this number continues to grow. It is a sign of combined success in the fields of medicine, public health and social care that there is a developing trend for admission to residential aged care to be postponed until more advanced stages of declining health conditions. However, for people living with dementia this delay can itself contribute to making both the move into, and then the life within, a residential aged care facility more challenging. When moving into long-term care, residents lose the long-term learned familiarity of their own home which may have helped them compensate for their diminishing memory and problem-solving skills. Yet they immediately face the prospect of navigating their way around a building which is unfamiliar, significantly larger, and more complex. This leads to greater dependency on the physical environment to provide the cognitive prosthesis required by residents to maintain the capacity for autonomously undertaking those ordinary activities of everyday life — known in themselves to help maintain the functional capacity of the individual.

2.4.1 Dementia design principles

Evidence from empirical research and literature reviews has been distilled into a series of DDPs which not only provide a basis for broad design guidance, but also offer frameworks against which formal dementia design evaluations can be undertaken. As research evidence has developed and become more nuanced over the past three to four decades, so has the interpretation of this evidence within evolving dementia design principles. This section provides a brief non-exhaustive introduction to the dementia design principles, from the first known list produced by Fleming and Bowles (1987) through to the influential schema by Marshall (2001), before returning to subsequent developments and the current dementia design principles from Fleming and Bennett (2017a) as they stand after thirty years of research, development, application, and testing.

Although there are many sets of DDPs in existence, the discussion in this section is limited to those linked to the formal design evaluation tools reviewed as part of the present research (see Chapter 3). As a result, some of more notable and more recent publications are not discussed (Marquardt and Schmieg, 2009; van Hoof, Kort, Duijnstee, *et al.*, 2010; Eijkelenboom *et al.*, 2017; Waller, Masterson and Evans, 2017).

2.4.1.1 Fleming and Bowles CADE Principles

The first known list of DDPs is featured in the 1987 *Australian Journal on Ageing* article 'Units for the Confused and Disturbed Elderly'. Compiled by Richard Fleming and John Bowles (Fleming and Bowles 1987, p. 26-27) the list was initially developed as a brief to assist in the design of 'Units for the Confused and Disturbed Elderly' (CADE) for the NSW State Government. It included the following advice:

1. *'The units will be small, housing 8 residents'.*
2. *'They will provide all the normal domestic facilities, e.g. kitchen, laundry, garden, single room and these will be accessible to the residents who will be encouraged to use them to their full capabilities'.*
3. *'The units will be in the middle of communities so that the residents will at least have the opportunity to observe everyday life and whenever possible to take part in it'.*
4. *'The decor of the units will be designed to reduce un-necessary stimulation. The staff will manage the units in such a way that confusing or disturbing stimuli, such as loud music or continuous use of the T.V. is avoided. Doors that lead to staff areas, e.g. cleaner's cupboard will be painted in 'regressive' colours, they will merge with the background'.*
5. *'Important stimuli will be enhanced, e.g. each room will have an individual colour scheme to assist recognition'.*
6. *'The units have been planned to allow the residents total visual access to all important areas, i.e. no matter where the resident stands (except in his ·own room with the door closed) he can see the kitchen, the dining room, the lounge, the exit to the garden and the bathroom. The lounge and dining room are divided by a waist high unit which will act as sideboard and entertainment centre. This plan should reduce confusion and allow the resident to make his way to wherever he needs to be. It will also allow staff to be visible to the residents at all times, so reducing anxiety and following behaviour'.*
7. *'The furniture will be arranged in social groupings located in such a way that it allows easy access to the two garden exits. These will lead out to a path around the garden and back to the unit. This disguised 'race track' will ensure that the residents can walk freely without being brought to a stop by a wall or a locked door at the end of a corridor'.*
8. *'The furniture, fittings and colour schemes will be chosen to reflect the decor of the 40s and 50s, the time that the residents will remember most clearly. They will not be irritated or confused by being obliged to relate to 1980's fashions. The decor will need to be changed every 10 years so that it remains in tune*

with the memories of the residents of the time'. (Fleming and Bowles 1987; pp 26-27)

Most of these principles remain relevant today, but with some additions and nuanced refinements, as research has continued to develop new knowledge. Towards the end of this section, discussion returns to the work of Fleming and Bennett (2017a) and the latest iteration of DDPs.

Figure 2-B: Floor-plan of CADE unit at Riverview Lodge, NSW (1990)

One example of the NSW Government's CADE units is Riverview Lodge (1991) located in Wingham, NSW, Australia (Judd, Marshall, and Phippen 1998) (Figure 2-B). It comprises a mirrored pair of residential aged care units which were designed in accordance with Fleming and Bowles (1987) DDPs. The two-unit building is single storey with an L-shaped plan. Shared entry and administrative areas occupy the outer-corner of the L, and the residential aged care units are located within the arms of the building. Each unit contains central living and dining areas, with complete visual access across the space. The main space is overlooked by a household kitchen and is surrounded on two sides by eight resident rooms which open directly into, and overlook, the communal space. A third side opens onto sheltered veranda spaces, leading to a shared courtyard garden. Riverview Lodge is one the 'international exemplar' units included in dementia design evaluations undertaken as part of this dissertation, discussed in Chapter 6.

2.4.1.2 Marshall's Schema

The next most notable set of DDPs, sequentially, was proposed in 2001 by Professor Mary Marshall, founder of the Dementia Services Development Centre (DSDC), University of Stirling. Marshall's dementia design schema (Marshall, 2001, pp. 15-17), which was aimed at residential care environments, became well known through wide dissemination in academic, trade, and mainstream media publications. Her schema refined the earlier guidelines by Fleming and Bowles (1987) through the addition of new principles and adjustments to the existing principles based on developments in research over the intervening fourteen years. Notable developments in the evidence base, as reflected in Marshall's list, include: the change from an emphasis on colour to object-based orientation techniques; the refinement of visual access principles away from seeking absolute visibility across the environment to selective visibility and the support of visual cues (i.e. there was a focus on the ability to see the things that people living with dementia need to see in a given circumstance, and cues to help find and identify various destinations), and the suggestion of the addition of signage to improve orientation and wayfinding where direct visibility is not available. It also clearly acknowledged the disabling impact of noise and the therapeutic and holistic health benefits afforded through the provision of access to outdoor space (Marshall, 2001). Marshall's (2001) schema later informed the University of Stirling's *Dementia Design Audit Tool* (DDAT) (Cunningham *et al.*, 2011), which is evaluated in detail in Chapter 3. Her schema recommended that dementia inclusive environments should:

1. *'Be small in size'*
2. *'Control stimuli, especially noise'*
3. *'Enhance visual access, i.e. ensure that the resident can see what they need to see from wherever they spend most of their time'*
4. *'Include unobtrusive safety features'*
5. *'Have rooms for different functions with furniture and fittings familiar to the age and generation of the residents'*
6. *'Have single rooms big enough for a reasonable amount of personal belongings'*
7. *'Be domestic and home-like'*
8. *'Have scope for ordinary activities (unit kitchens, washing lines, garden sheds)'*
9. *'Provide a safe outside space'*
10. *'Provide good signage and multiple cues where possible, e.g. sight, smell, sound'*
11. *'Use objects rather than colour for orientation'* (*Marshall, 2001, pp. 15–17)*

2.4.1.3 Adapting the Ward

Two years after Marshall's schema was published, Fleming, Forbes and Bennett (2003) produced a list of ten revised DDPs within a dementia design guide associated with a program to renovate small NSW state-run environments used for the long-term accommodation of people living with dementia. These design principles were published in the NSW Department of Health's *Adapting the Ward for People with Dementia* (Fleming, Forbes and Bennett, 2003, pp. v–vii). This publication incorporated the first known dementia design evaluation tool to be developed outside of the USA. Unlike the earliest formal environmental audit tools in this list, Fleming *et al.* moved away from the more prescriptive nature of the 1987 set towards principles which could be adapted to suit a variety of different environments. Their revised (2003) list proposed that dementia-enabling care environments should:

1. *'Be safe and secure'*
2. *'Be small'*
3. *'Be simple and provide good 'visual access'*
4. *'Reduce unwanted stimulation'*
5. *'Highlight helpful stimuli'*
6. *'Provide for planned wandering'*
7. *'Be familiar'*
8. *'Provide opportunities for both privacy and community'*
9. *'Provide links to the community'*
10. *'Be domestic' (Fleming, Forbes and Bennett, 2003, pp. v–vii).*

The ten design principles from *Adapting the Ward* (Fleming, Forbes and Bennett, 2003) were adjusted in their application over the following years to help guide the design of long-term residential aged care settings. By the time Fleming (2011) published the findings of a study using both the EAT and the Therapeutic Environmental Screening Survey (Sloane *et al.*, 2002) to examine thirty residential aged care settings, some subtle modifications were made to how some items on the list of DDPs were articulated. Whilst there had been no change to DDP#1, DDP#2, DD#3, DDP#6, and DDP#7, others had been modified to improve or clarify the intent behind them, with DDP#10, for example, explaining that to "Be domestic" means to "*provide opportunities for engagement in the ordinary tasks of daily living*" (Fleming, 2011, p. 109). The modified list from Fleming 2011 is set out below:

1. *'Be safe and secure'*
2. *'Be small'*
3. *'Be simple and provide good visual access'*

4. *‘Have unnecessary stimulation reduced’*
5. *‘Have helpful stimuli highlighted’*
6. *‘Provide for planned wandering’*
7. *‘Be familiar’*
8. *‘Provide opportunities for a range of social interactions from private to communal.*
9. *‘Encourage links with the community’*
10. *‘Be domestic in nature providing opportunities for engagement in the ordinary tasks of daily living’ (Fleming, 2011, p. 109).*

The wording of the list was modified again as Flemings’ DDP started to be used in wider contexts, and different types of environments, including in the *Environmental Audit Tool* (Fleming, Bennett and Forbes, 2013). This set of DDPs also informed the associated design audit instrument the *Dementia Friendly Community – Environmental Assessment Tool (DFC-EAT) (2017)*.

2.4.1.4 Universal Dementia Design Principles

The growing volume of evidence about the need for design that encourages social links between where people live, and their local community is increasingly reflected in what is best practice in design for ageing and dementia. The acknowledgement that the majority (c.75%) of people with dementia live at home in the community (Brown, Hansnata and La, 2016) also signals the need for all physical environments, including local shops, theatres, parks and streetscapes, to be dementia inclusive. Fleming *et al*'s 2013 iteration of DDPs (Fleming, Bennett and Forbes, 2013), which is used as the primary basis for the present research, suggest that all environments for people living with dementia should:

1. *‘Unobtrusively reduce risks - safety’*
2. *‘Provide a human scale - size’*
3. *‘Allow people to see and be seen – visual access features’*
4. *‘Reduce unhelpful stimulation – stimulus reduction features’*
5. *‘Optimise helpful stimulation – highlighting useful stimuli’*
6. *‘Support movement and engagement - Provision for wandering, circulation and access to outside area’*
7. *‘Create a familiar space - Familiarity’*
8. *‘Provide opportunities to be alone or with others – Privacy and Community*
9. *‘Provide links to the community -Community Links’*
10. *‘Providing opportunities for engagement with ordinary life -Domestic activity’ (Fleming, Bennett and Forbes, 2013, p. 2)*

The overarching principles have remained effectively the same over recent revisions, with sensitive rewording of the principles allowing them to be implemented in an ever more universal manner. Each revision of the Environmental Audit Tool has been published as part of a handbook which provides a series of explanatory notes under each of the ten DDPs as to how they should be interpreted or implemented.

The most recent (2017) iteration of these DDPs occurs within a handbook for the 'High Care' version of the EAT (Fleming and Bennett, 2017a). The biggest single change within this list is the distinct change to the wording of DDP#10 — which is primarily about ensuring design is supportive of staff, and reflective of care philosophies in residential aged care 'high care'. The full 2017 list of DDPs is as follows:

1. *'Unobtrusively reduce risks'*
2. *'Provide a human scale'*
3. *'Allow people to see and be seen'*
4. *'Manage levels of stimulation - Reduce unhelpful stimulation'*
5. *'Manage levels of stimulation - Optimise helpful stimulation'*
6. *'Support movement and engagement*
7. *'Create a familiar place'*
8. *'Provide a variety of places to be alone or with others – in the unit'*
9. *''Provide a variety of places to be alone or with others – in the Community'*
10. *'Design in response to vision for a way of life'* (Fleming and Bennett, 2017a)

2.5 Australian residential aged care settings

In excess of half of Australian aged care residents have a formal diagnosis of dementia (Australian Institute of Health and Welfare, 2012) with up to 90% of residents in some facilities estimated to be cognitively impaired (Rosewarne and Opie, 1997). Despite this, there is only limited available information about the suitability of the broad stock of Australian aged care settings to provide accommodation for people living with dementia, whilst a majority (around 80%) of care home residents have physical impairments that are accommodated through the design of the physical environment, in some circumstances through direct assistance with mobility from staff (Access Economics Pty Limited and Access Economics, 2003). In Australia, this provision of physically accessible environments is mandated through national planning and construction codes (Australian Building Codes Board, 2016), underlined by the Disability Discrimination Act (Government of Australia, 1992) and Australian Standards on design for disability (Standards Australia, 2009, 2010, 2015). Even though residential aged care buildings have their own dedicated building classification within the National Construction Code (Class 9c) (Australian Building Codes Board, 2016), there are no clauses within the code to ensure the inclusion of design features to support the majority of people in residential aged care who are living with dementia (Castell, 2008a, 2008b, 2014). Also, even though residential aged care facilities are required to be certified under the Aged Care Act (The Commonwealth of Australia, 1997) this instrument does not appear to have identifiable clauses to ensure that residential aged care environments are not unnecessarily disabling for residents with dementia.

Recent records on the suitability of Australian residential aged care settings for supporting the impairments of people living with dementia are limited. A search of the literature found nine small scale studies of dementia design quality since 2010, with the largest of these (Smith *et al.*, 2012) assessing fifty-six units. These studies are discussed in more detail in section 2.5 and in Table 2-A. Prior to these, the best available information on the status of environments for residential aged care was from 2003, when around 15% of Australian residential aged care bed-spaces were formally designated for dementia care (Access Economics Pty Limited and Access Economics, 2003) and only 4-6% of bed-spaces were located in dementia-specific special care units (SCUs) (Access Economics Pty Limited and Access Economics, 2003). On the face of this information, in 2003, a majority (estimated 79%-85%) of aged care residents were not provided with surroundings that supported optimal wellbeing for people with dementia.

A total of twelve previous studies were identified that evaluated some aspect of the design of Australian residential aged care settings. Each of these and their research themes are listed in Table 2-A. Although they provide some useful insight into the overall dementia design characteristics of Australian residential aged care settings, relatively small samples in most instances, and the lack of reporting of actual design assessment scores, limits the reliability of these papers as measure for the overall cross section of building stock.

The largest and most helpful of these previous studies, carried out by Smith *et al.* (2012) was used as a formal means of testing the Environmental Audit Tool (EAT) (Fleming, 2011) where seventy-two queries are posed under ten sub-scales that align with an evolving set of ten DDPs (Fleming and Bowles, 1987; Fleming, Forbes and Bennett, 2003; Fleming, 2011). Scores are awarded under each of the ten DDPs, then averaged as a percentage value for overall score of dementia design quality.

The findings from Smith *et al.* (2012) provide a picture of design quality in Australian residential aged care that is generally mixed, but mildly positive. The fifty-six facilities in the study scored an EAT average of 57.3%, suggesting room for improvement in dementia design quality. However, considering the differences encountered between units purpose-built for dementia, which scored an overall EAT average 70.1%, versus the non-purpose-built units who scored an average of 47.8%, two causes for concern are raised. The first concern is the prospect that even those residential aged care units specifically designed to accommodate people living with dementia still, in theory at least, have significant room for improvement. The second more serious concern is around the evidence from Smith *et al.* to suggest that there is especially poor design quality of non-purpose-built residential aged care settings in Australia. If true, it is likely that tens of thousands of Australian aged care residents with dementia are expected to spend their daily lives occupying physical settings that are likely to be negatively impacting their health, wellbeing and overall quality of life. These findings make a good case for investment in renovations or alterations to existing facilities, whilst also adding weight to the proposition, implicit in the present dissertation, that all future residential aged care environments should be designed to accommodate the needs of dementia patients.

Other past studies of design quality in Australian residential aged care settings varied in their research themes. All that attempted to correlate resident wellbeing against the effects of enhanced design quality found positive correlations between the two (Edwards, McDonnell and Merl, 2012; Smith *et al.*, 2012; Chenoweth *et al.*, 2014; Fleming *et al.*, 2014; Richards *et al.*, 2015). Although evidence-based dementia design quality was assessed as part of the research undertaken for most of these studies, the design assessment scores were only reported in a small proportion of these. One study followed the changes in resident wellbeing when moving from a large, 72-bed, traditional setting to a number of smaller 15-bed cottages (Smith, Mathews and Gresham, 2010), whereas another tested the changes in resident quality of life as a result of the addition of a dining-room conservatory and upgrade of resident-accessible gardens (Edwards, McDonnell and Merl 2012). One study was limited to the effects of environmental temperature on resident wellbeing (Tartarini, Cooper and Fleming, 2018). Finally, two related studies (Lee, Ostwald and Lee, 2017; Lee, Ostwald and Yu, 2017) evaluated and compared the floorplan layouts of NSW residential aged care facilities against theoretical exemplars using space syntax techniques. Whilst these two studies loosely reflect some of the approaches taken in the present research — such as comparison of building layouts to international exemplars — the methods used and discussion on findings were only loosely linked to broad aspects of established dementia design principles (esp. visual access). Further information about, and assessment of, these studies are presented in Table 2-A.

Table 2-A: Past design evaluation studies of Australian residential aged care environments

Publication (date)	**Research Theme**
Smith, Mathews, and Gresham, (2010)	The study followed the move of high care residents from a traditional 72-bed facility into a series of purpose-built cottages housing fifteen residents each. It included before and after evaluations of residents' wellbeing alongside design evaluations of both settings, making use of the EAT (Fleming, 2011), SCEAM (Parker *et al.,* 2004) and TESS-NH (Sloane *et al.*, 2002). Findings showed that the decline previously associated with physical moves did not occur and showed clear improvements in some aspects of resident wellbeing. However, the authors were unable to determine how much of this related to the physical environment versus the improvement in care after staff were provided with training in person-centred care. Design assessment scores were not reported.
Moore *et al*., (2011)	Design assessment of nine residential aged care facilities located in Queensland, Victoria, and Tasmania. An assessment based on an existing health services tool (Victorian Department of Human Services, 2006) identified an average of 34% room for improvement, focussed mainly in areas such as external spaces, lighting, signage, and orientation. The best performing category was maintenance and cleaning – both post-occupancy items rather than design related.
Edwards, McDonnell, and Merl (2012)	Before-and-after evaluations of occupant behaviour showing improvements to quality of life amongst residents in a 'dementia unit' of a single NSW residential aged care facility around the addition of a conservatory extension, and significant improvement works to adjoining outdoor spaces.

Publication (date)	Research Theme
Fleming *et al*., (2012)	The study examined a combination of five NSW residential aged care facilities built within the preceding two years, and five Tasmanian facilities built or renovated within the preceding five years. It comprised an assessment of the design of the facility using the EAT (Fleming, 2011) together with interviews with the architects and managers for each facility. The ten facilities scored an average of 67.9% on the EAT. However, the five out of ten facilities where the manager was aware of the dementia design principles scored an average of 74.0%, which was significantly higher than the 61.8% average for the facilities where the manager had reduced knowledge of the design principles. No clear correlations could be drawn between the EAT score outcomes and claims of knowledge about dementia design from the architects. Somewhat ironically, the architect with the most modest level of claim to dementia design awareness achieved the second highest scoring facility.
Smith *et al*., (2012)	In a study intended to validate the EAT (Fleming, 2011) against the TESS-NH, twenty-four purpose-built and thirty-two non-purpose-built environments from the *perCEN* study were examined (Chenoweth *et al.,* 2014). The results indicate that purpose-built units have far superior design assessment scores across the majority of the EAT sub-scales (or DDP domains), including having only half as many residents, and are twice as likely to provide good community links. The average overall EAT score for the non-purpose-built units was 47.7%, whilst the average for the purpose-built units was 70.1%. The findings of the study suggest that there is room for improvement in the physical environments of most purpose-built units, and significant room for improvement across residential aged care settings that are not designed and built for the purpose of accommodating people living with dementia. This study acknowledged that there may be merit in re-evaluating the relative weight of the sub-scales within the EAT to place emphasis on the DDPs that appear to make more significant differences to overall design quality. The average score profiles from purpose-built and non-purpose-built units have subsequently been used as a ‘norm’ (or benchmark) in the industry use of the EAT.

Publication (date)	Research Theme
Chenoweth *et al*., (2014)	A randomised control trial of the effects of a combination of improvements to person-centred care, and person-centred environments involving thirty-eight existing residential aged care facilities (located with 500km of Sydney). Twenty facilities were allocated physical changes, but less than half implemented the changes within the study timeframe. There were improvements to resident wellbeing for the facilities with changes to care, as well as to those with changes to environment. The expected additional improvements in wellbeing within facilities that received both kinds of enhancements did not statistically materialise. The sites used for the study were selected based on pre-assessment — choosing only to work with facilities that were known to have room for improvement. Assessment used the EAT (Fleming, 2011), but did not report on the actual design quality score outcomes for the facilities included in the study.
Fleming *et al*., (2014)	Although this study involving thirty-five residential aged care facilities did not publish design quality assessment outcomes themselves, it reported the correlation between residents' self-reported quality of life and the EAT (Fleming, 2011) sub-scales of: wandering (DDP#6), familiarity (DDP#7), privacy and social interaction (DDP#8), and opportunities for engaging in ordinary activities (DDP#10). (See Abbreviations, Acronyms and Symbols section for full list of DDPs)
Fleming and Bennett (2015)	A convenience sample of thirty NSW residential aged care facilities were assessed by novice evaluators using both the newly developed EAT-HC (Fleming and Bennett, 2017a) and the established TESS-NH (Sloane *et al.*, 2002). The results did not report on the design quality scores obtained, but instead on matters such as inter-rater agreement, and validity testing against the pre-existing instrument (TESS-NH).
Richards *et al*., 2015	Compared one traditional and one non-traditional residential aged care environment for correlations between 'occupational engagement' of residents with overall design characteristics. The study used a modified version of the Residential Environment Impact Survey (Fisher *et al.,* 2008) and concluded that the non-traditional unit, with an open-plan layout and accessible garden, led to better overall quality of interactions and quality of life for residents and staff.

Publication (date)	Research Theme
Lee, Ostwald, Lee (2017)	Spatial analysis and comparisons of floor-plan layouts for a total of six residential aged care facilities; two based in NSW, two Korean examples, and two hypothetical 'exemplar' layouts, allegedly reflecting "best practice" (Eastman, 2013). The research method uses computational techniques of Space Syntax (Hillier and Hanson, 1984), which has shown, in other building types, powerful ways of understanding wayfinding, visual access, and other aspects of human behaviour. Although this study does not draw a clear link to the existing evidence base for dementia-specific spatial characteristics, there appears to be immense potential for their application to the assessment of spatial configuration in dementia environments.
Lee, Ostwald, Yu (2017)	Spatial analysis of three residential aged care facilities: two published schemes (International Association of Homes and Services for the Ageing 2014) located in NSW were compared with an international exemplar (from Eastman, 2013). This conference paper was a preparatory study for the preceding entry (Lee, Ostwald and Lee, 2017).
Tartarini , Cooper and Fleming (2018)	An evaluation of the effect of indoor temperature on occupants of six residential aged care facilities. The method and outcomes of this study have limited relevance to the aims of the current study.

2.6 Conclusion

Dementias are a wide group of cognitively disabling conditions, affecting perception, memory and problem-solving abilities. Anxiety and confusion arising from this can lead a person to become agitated and display distressed behaviour. Fortunately, evidence has shown that design of the physical environment can provide cognitive prosthesis that helps people living with dementia maintain overall health, wellbeing and independence whilst reducing the behavioural symptoms associated with dementia — avoiding the need for pharmacological interventions.

Although more than half of Australian aged care residents have dementia, the current suitability of residential aged care settings for supporting residents with dementia is not clearly established. The few previous studies that report on the dementia design quality amongst Australian residential aged care facilities suggest significant differences in the design quality of, and associated improvements to resident wellbeing from living in, purpose-built units versus non-purpose-built units. Overall, there appears to be significant room for improvement across the existing stock in all but more recent purpose-built and exemplar schemes.

3 DESIGN EVALUATION TOOLS

3.1 Introduction

This chapter evaluates and compares existing dementia design audit tools to determine which is most suited to addressing the three aims of the present research project, all of which rely on identifying the dementia design quality evident in layout planning in residential aged care units. A search of the literature identifies seven established dementia design evaluation tools suitable for residential aged care settings, although all of these are intended for post-occupancy environmental evaluations. In this chapter, these tools are reviewed to evaluate their suitability for being adapted to the objectives of the present research into architectural plans.

Three instruments are shortlisted, reviewed in more detail, then finally subjected to an item-by-item evaluation of their audit question sets. A key component of this process is the categorisation of questions by design document type (i.e. Plan, Detail, and Manage), so that suitability for the specific purpose of floor-plan based evaluation can be determined. This chapter begins to identify which aspects of existing tools (and associated literature) are useful for fulfilling the three aims of the dissertation.

3.2 Method

3.2.1 Overview of design evaluation instruments

For the purposes of the present research, initial searches for design evaluation tools were carried out in 2013 and 2014 through *Web of Science, Scopus, Science Direct* and *Google Scholar* using combinations of search terms, including 'dementia' 'design*', 'environment*', 'assess*', 'audit', 'evaluat*', 'tool' and 'survey'. The titles and abstracts from search results were downloaded and filtered to identify evaluation tools and articles that referred to them. As many of the references uncovered were journal papers that also cited other evaluation tools, further searching (using the identified tool name, for example) was required to obtain copies of original instruments. The main inclusion criteria for download and further review of articles and instruments was that they were written in English and readily accessible, from library, inter-library or internet sources.

A total of seven dementia design evaluation tools were identified as potentially suitability for use in addressing the three research aims of this dissertation. These tools are, in chronological order, as follows:

- *Multiphasic Environmental Assessment Procedure* (MEAP) (Moos and Lemke, 1988)
- *Professional Environmental Assessment Protocol* (PEAP) (Weisman *et al.,* 1996)
- *Therapeutic Environmental Screening Survey for Nursing Homes* (TESS-NH) (Sloane *et al*., 2002)
- *Sheffield Care Environment Assessment Matrix* (SCEAM) (Parker *et al.,* 2004)
- *The Dementia Design Audit Tool* (DDAT) (Cunningham, Marshall, *et al.,* 2008)
- *The Environmental Audit Tool* (EAT) (Fleming, 2011; Fleming, Bennett and Forbes, 2013)
- *Is your care home dementia friendly?* EHE Environmental Assessment Tool (The King's Fund, 2014)

The seven instruments were evaluated and compared for their suitability for re-purposing as reliable methods for evaluating the dementia design quality of residential aged care units, using floor-plan drawings. Only the requirements for suitability to building type, and the ability to access a copy of each instrument were essential criteria. Other criteria considered as part of the detailed assessment of the instruments are listed below[9]. The outcomes of this initial review are outlined in Table 3-A.

A. Building Type: Is the tool intended, or suitable, for evaluating the design of residential aged care settings.
B. Age: This criterion uses a cut-off publication date of the year 2000. Instruments older than this are less likely to reflect the current evidence base, philosophies, and models of care.
C. Availability: Is it possible or easy to obtain a copy of the instrument?
D. Usability: This criterion includes the consideration of the balance between a technical instrument that provides detailed evaluation, (but is likely to be time consuming to

[9] Where insufficient information was available under individual criterion, it was marked as a fail.

undertake) versus a less detailed and less exhaustive instrument that may be easier (and less time consuming) to use for dementia design assessments). As a secondary matter, is the language in evaluation queries relevant, and readable?

E. Validly testing: Has the instrument been tested against the behaviours, experiences, and health outcomes of people living with dementia?
F. Inter-rater reliability: Has the instrument been tested for whether multiple users concur in understanding and responding to the assessment queries?
G. Previous use: Has the instrument been reported as having been used for design assessment in previously published research?
H. Plan Review: Is there any published evidence of the use or suitability of the instrument for floor-plan based design assessment.

None of the seven tools had previously been used or identified as suitable for evaluation during design stages, and none of the instruments were known to have been used for floor-plan based evaluations. This led to the initial conclusion that at least one of these existing tools would need to be modified to create the design evaluation tool required to undertake the first aim of this research: *to evaluate and compare dementia design quality in the layout planning of NSW-based and international best-practice examples of residential aged care units.*

Although not acknowledged in any of the literature, it seems likely that some of the tools are used on a casual basis to inform the appraisal of design proposals — it is known that the DDAT and EAT are used to inform the dementia design consultancy services offered by the University of Stirling and the University of Wollongong. Both the MEAP (Moos and Lemke, 1988) and the PEAP (Weisman *et al.,* 1996) were immediately excluded due to a combination of their ages and the difficulty in obtaining copies of each instrument. This left five instruments that were less than fifteen years old (at the time of review) for consideration.

The EAT had been subjected to the longest and most clearly documented path of development, testing and refinement, including validity testing and inter-rater testing (Fleming, 2010, 2011; Smith *et al.*, 2012). It had already formed the basis of several design assessment studies in Australia, and especially in NSW (Smith, Mathews and Gresham, 2010; Fleming, Fay and Robinson, 2012; Smith *et al.*, 2012; Chenoweth *et al.*, 2014; Fleming *et al.*, 2014).

The TESS-NH, considered the 'gold' standard by a number of established experts in the field, had formed the basis for testing the reliably of other tools as they were developed (Barnes, 2002; Smith, Mathews and Gresham, 2010; Fleming, 2011; Fleming and Bennett, 2015).

Table 3-A: Summary of existing environmental evaluation tools

Tool [date order]	Author(s) and Year	Purpose/questions/ domains	Strengths	Limitations	A: Purpose	B: Age	C: Availability	D: Usability	E: Validity	F: Inter-rater	G: Previous	H: Plan	Sum
Multiphasic Environmental Assessment Procedure (MEAP)	Moos and Lemke, 1988	Large residential settings for elderly adults. Questions unknown.	Good inter-rater reliability (c.70%). Used in multiple studies (mostly co-authors of this tool).	Three decades old. No longer in use. Based on a clinical/institutional model of long-term residential care. Scoring reported as positively biased towards larger facilities.	✗	✗	✗	✗	✓	✓	✓	✗	3
***Professional Environment Assessment Protocol* (PEAP)**	Weisman *et al.*, 1996	Special care units for older people with dementia. Questions unknown.	Used in at least six studies. Correlates well with TESS-NH. Good inter-rater reliability (69%-85%).	Two decades old. Original tool not obtainable for direct review.	✗	✗	✗	✗	✓	✓	✓	✗	3
***Therapeutic Environmental Screening Survey for Nursing Homes* (TESS-NH)**	Sloane *et al.*, 2002	Long-term residential care facilities. 63 queries; 15 domains	Reliability and validity studies available. Used in at least five studies. Developed from the PEAP. Considered to be the 'Gold Standard' of evaluation by some scholars.	A high proportion of queries (twelve out of eighty-four) are not clearly scored.	✓	✓	✓	✓	✓	✓	✓	✗	7
Sheffield Care Environment	Parker at al. 2004	All care environments. 318 queries;	Subjective questions are validated against objective	High volume of queries may be time consuming.	✓	✓	✗	✓	✗	✗	✓	✗	4

Tool [date order]	Author(s) and Year	Purpose/questions/ domains	Strengths	Limitations	A: Purpose	B: Age	C: Availability	D: Usability	E: Validity	F: Inter-rater	G: Previous	H: Plan	Sum
Assessment Matrix **(SCEAM)**		11 domains (including one section on staff)	measures (e.g. lighting lux levels). Acknowledges the effect of staff and care practices on resident quality of life, by including evaluation sections for these.	Not known to be validated.									
Dementia Design Audit Tool **(DDAT)**	Cunningham *et al*., 2008/2011	Care Homes and supported living. 345 queries Eleven sections. (10 space types + 1 general design principle section)	Development based on a heavily cited systematic literature review. Room-based approach permits very detailed feedback. Weighting of queries is identified by being 'Essential' or 'Recommended'. Linked to a formal dementia design accreditation program.	Large number of queries, so time-consuming to undertake. No validity testing known. Limited useful evaluations available. Dementia design knowledge or training required prior to use. Omits some types of spaces (e.g. kitchens)	✓	✓	✗	✓	✗	✓	✓	✗	5
Environmental Audit Tool **(EAT)**	Fleming, 2011	Home-like environments for people living with dementia. 72 queries; 10 domains	Developed from an earlier tool (Fleming *et al*., 2003). Simple questions and simple scoring.	Less detailed than some other tools. Many of the review and validation studies involved	✓	✓	✓	✓	✓	✓	✓	✗	7

Tool [date order]	Author(s) and Year	Purpose/questions/ domains	Strengths	Limitations	A: Purpose	B: Age	C: Availability	D: Usability	E: Validity	F: Inter-rater	G: Previous	H: Plan	Sum
			Content verified by several literature reviews. High inter-rater reliability (97%). Validity tested (86.8%) versus the TESS-NH. Assessment domains align with established dementia design principles.	the primary author of the tool.									
***Enhancing the Healing Environment* (EHE) Assessment Tool**	The Kings Fund, 2014	Care Homes (1 of 5 versions in the EHE series) 59 queries; 7 domains	Refined using extensive user testing of a previous version for hospital wards. Good inter-rater reliability (68.7%). Widely used in the UK. Simple questions linked to clear dementia design principles.	No known published validity or reliability tests. No known publication of evaluation outcomes.	✓	✓	✓	✓	✗	✗	✗	✗	4

The SCEAM and the DDAT were deemed to be similar in many ways, such as their detailed content and volume of questions. However, the DDAT was referenced in a greater number of past publications and has a slightly greater degree of reported use and user testing.

Some instruments, such as the *Environmental Audit Tool* (EAT) (Fleming, Forbes and Bennett, 2003; Fleming, 2011) and Enhancing the Healing Environment (EHE) (The King's Fund, 2014) are relatively short, freely available and easy to use by the general public, whereas others, such as the *Dementia Design Audit Tool* (DDAT) (Cunningham *et al.,* 2011), and the SCEAM (Parker *et al.*, 2004) are more detailed and technical in nature, and tend to require either prior knowledge of the field of dementia design or training with the tool before use.

After considering factors such as age, lack of validation and frequency of citation in the literature, four of the seven instruments were discounted. The remaining three instruments — the DDAT (Cunningham, Marshall, *et al.,* 2008), the EAT (Fleming, Forbes and Bennett, 2003; Fleming, 2011) and the TESS-NH (Sloane, *et al.*, 2002)— were subjected to a more detailed comparative analysis, described in the following section, to determine their suitability for adaptation for floor-plan based dementia design evaluations.

3.2.2 Detailed review of the TESS, DDAT, and EAT

This section describes detailed evaluations of, and comparisons between, three dementia design evaluation tools — EAT (Fleming, 2011), DDAT (Cunningham *et al.,* 2011), and TESS-NH (Sloane *et al.*, 2002) — as a precursor to choosing one to adapt to fulfil the aims of the present dissertation. The review describes and compares the development, primary characteristics and scoring mechanisms of each of the three instruments.

3.2.2.1 Therapeutic Environment Screening Survey

The Therapeutic Environment Screening Survey for Nursing Homes (TESS-NH) was formulated in the USA by a multi-disciplinary team from at least nine organisations (Sloane *et al.*, 2002). Developed from the PEAP (Weisman *et al.,* 1996), and including some of the same authors, the TESS has established a strong reputation, with some referring to it as the 'gold standard' of dementia design assessment methods (Smith *et al.*, 2012; Fleming 2011). The TESS-NH is the longest established of the three instruments examined in detail in this chapter.

The TESS-NH (Sloane, *et al.*, 2002) is structured as a total of eighty-four queries under fourteen domains[10]. Sixty-three (85%) of these queries are scored, with scoring ranging from a single point per query to four points. The fourteen domains in the TESS-NH are as follows:

1. *'Unit autonomy'*
2. *'Outdoor access'*
3. *'Privacy'*
4. *'Exit Control'*
5. *'Maintenance'*
6. *'Cleanliness'*
7. *'Safety'*
8. *'Lighting'*
9. *'Visual and tactile stimulation'*
10. *'Noise'*
11. *'Socialization spaces and seating'*
12. *'Familiarity and homelikeness'*
13. *'Orientation/cueing'*
14. *'Global Rating'* (Sloane *et al.,* 2002 pp. S73-S74)

Sloane *et al.*, (2002) also proposed that the Special Care Unit Environmental Quality Scale (SCUEQS), a subset of the TESS-NH questionnaire, could provide an indicative cross section of the main instrument, and therefore act as a summary scale. The SCUEQS retains seventeen of the original eighty-four query items, but only one query item (Q.16) which is relatable to floor-plan information:

> *"Is there a kitchen located within the area that is available for activities and / or for resident / family use? (sink, stove /micro, fridge, countertop)"*

3.2.2.2 The Dementia Design Audit Tool

First published in 2008 and revised in 2011 (Cunningham *et al.,* 2011), the *Dementia Design Audit Tool* (DDAT) comprises an extensive list of up to 345[11] detailed questions which are

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[10] There are discrepancies between journal article and instrument manual publications (Sloane *et al.*, 2002)making it difficult to determine the total number of audit query items and the boundary between some adjacent domains. Up to 85 questions are available, but only 63 appear to contribute to evaluation scoring.

[11] Some sections of DDAT can be completed more than once where several variations occur in the design of a type of space that tends to be repeated (e.g. bedrooms). Also, in some instances, spaces such as examination rooms (Unit 5) or hairdressers (Unit 6) can be absent and therefore omitted from the audit. This leads to variation in the total number of audit questions applicable to an environment.

divided into eleven groups organised by nine room types commonly found in a residential aged care setting (e.g. Bedroom, Assisted Bathroom, Garden, Hairdresser etc.), plus two further sections covering Meaningful Activity (Unit 4), and General Principle (Unit 11). The DDAT, sometimes referred to as the *'Stirling Tool',* was developed at the University of Stirling's Dementia Services Development Centre (DSDC). The full list of domains, or 'Units' in the DDAT are as follows:

> *Unit 1: 'Entrance, corridors, wayfinding, and lift'*
> *Unit 2: 'Lounge area'*
> *Unit 3: 'Dining room'*
> *Unit 4: 'Meaningful occupation'*
> *Unit 5: 'Examination room'*
> *Unit 6: 'Hairdressing room'*
> *Unit 7: 'Bedrooms'**
> *Unit 8: 'En-suite provision'**
> *Unit 9: 'Communal toilets/ bathrooms'*
> *Unit 10: 'External areas'*
> *Unit 11: 'General principles'* (Cunningham *et al.*, 2011, pp. 3–4)

**Assessment of bedroom and en-suite designs can be duplicated where there are variations in the design of these repeating items occur.*

The detailed room-by-room approach makes the DDAT evaluation highly repetitive. For example, the 'Essential' requirement for visible contrast between floors and wall surfaces applies to all interior spaces. However, this approach reduces emphasis on the importance of some overall factors, such as building layout, including the benefits of providing of direct visibility between major spaces — a feature known to be a key factor in autonomous wayfinding for people living with dementia. Where questions ask about being able to locate one space from another, signage is accepted as equal to direct visibility, despite evidence that the latter is less likely to be helpful, except as a means of assistance where direct visibility is not possible or practical (Passini *et al.*, 1995, 2000)

The technical nature of DDAT means that it can be used to undertake extensive and detailed design reviews, a characteristic of the instrument likely to be valuable to professionals engaged in the design and management of aged care environments, but because of this it is more difficult for others to use without first receiving training. In many cases, the correct interpretation of questions requires the user to possess relatively detailed knowledge of other DSDC 'Design for Dementia' publications on the topics of interiors (Fuggle, 2013), lighting (McNair, Cunningham, Pollock, and McGuire, 2011), or signage (Raeburn, Quirke, and

Palmer, 2017), but this prerequisite knowledge is not clearly articulated in the DDAT itself, so several queries remain open to interpretation by the person carrying out the audit. An example of this includes query no 7.20:

> *Where there is a door from the garden/balcony/roof terrace/roof garden the lighting inside is bright enough*[12] *to compensate for impaired vision when returning from a bright outdoor space.* (Cunningham *et al.*, 2011, p. 25)

Each of the DDAT query items is designated as either an 'Essential' or 'Recommended' item, determined, according to its authors, on the relative strength of evidence for each feature in the 2008 systematic literature review, *'A review of the empirical literature on the design of physical environments for people with dementia'* (Fleming, Crookes, and Sum 2008)[13]. However, an attempt by the present author to correlate the DDAT question set with Fleming's review did not find full correlation between the reported evidence base and the audit query designation.

Each query item in the DDAT, when answered in the affirmative, is awarded a single point. 'Essential' (E) and 'Recommended' (R) items are tallied respectively and converted to percentages of the maximum available scores under each of the two categories. These values are then combined using a weighting ratio for each (32% for Essential and 68% for Recommended) with the final output value represented as a percentage score (%).

The space-specific nature of the DDAT also means that spaces not nominated in the audit tool are not included in design evaluations. The DDAT does not, for example, include an evaluation section for kitchens, a type of space present in most housing types and now widely incorporated in resident-accessible areas of residential aged care settings. The inclusion of dementia-accessible kitchens is now considered a key aspect of helping to maintain individual

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[12] The lighting levels required to feel 'bright' enough will vary significantly from one person to the next. Someone in their mid 60s will tend to require about twice as might light as someone in their 30s.

[13] A copy of Fleming *et al*'s (2008) *'A review of the empirical literature on the design of physical environments for people with dementia'* is included alongside the DDAT when sold by the University of Stirling. This literature review had the same lead author as *Adapting the Ward* (2003), and the *Environmental Audit Tool* (2011); both referred to frequently throughout this dissertation.

ability and independence for people living with dementia, whilst providing specific forms of therapeutic benefit, and is supported by robust evidence.

The point-per-item, together with the 'Essential' versus 'Recommended' designation of query items, makes it clear where the authors of the DDAT believe important spaces and components of residential aged care environments are located. Based on the spread of the 110 'Essential' queries from the DDAT across the eleven domains, the DDAT places the greatest emphasis on external spaces (31/110), followed by sanitary spaces (*En-suite*=20/110 or 5.8% of overall score, and *Communal Toilets/Bath Spaces* = 17/100 or 4.9% of the overall score), then circulation spaces via Unit 1: '*Entrances, Corridors, Lifts, and Stairs'* (14/110 or 4.1% of the overall score). Unit 4 (Meaningful occupation) and Unit 11 (General principles) contain only two and one essential question, respectively.

Although the 'Recommended' items are individually less important in the DDAT, the tool contains twice as many 'Recommended' audit items as 'Essential' audit items. The units with the largest number of recommended items are Unit 1 'Entrances, corridors. etc' (42/235 or 12.2% of the overall score), followed by Unit 10 'External area' (33/235, or 9.6% of the overall score), with the lowest volume of 'Recommended' items found again under 'Meaningful activity' and 'General principles'.

Analysis of the overall DDAT score per assessment 'unit' provides a sense of where the it places the most emphasis in design, including for example the observation that the combined units (Unit 7 and Unit 8) for Bedrooms and En-suite spaces represent 21.7% of the overall DDAT score value. Table 3-B explores the observations from this section in further detail.

Table 3-B: The Dementia Design Audit Tool scoring system

Dementia Design Audit Tool	Available points			Percentage contribution		
Units:	(E)	(R)	T	E%	R%	T%
Unit 1: ***Entrance, corridors, wayfinding, and lift***	14	42	56	4.1%	12.2%	16.2%
Unit 2: ***Lounge area***	4	25	29	1.2%	7.2%	8.4%
Unit 3: ***Dining room***	7	20	27	2.0%	5.8%	7.8%
Unit 4: ***Meaningful occupation***	1	8	9	0.3%	2.3%	2.6%
Unit 5: ***Examination room***	3	16	19	0.9%	4.6%	5.5%
Unit 6: ***Hairdressing room***	3	13	16	0.9%	3.8%	4.6%
Unit 7: ***Bedrooms****	8	29	37	2.3%	8.4%	10.7%
Unit 8: ***En-suite provision****	20	18	38	5.8%	5.2%	11.0%
Unit 9: ***Communal toilets/bathrooms***	17	22	39	4.9%	6.4%	11.3%
Unit 10: ***External areas***	31	33	64	9.0%	9.6%	18.6%
Unit 11: ***General principles***	2	9	11	0.6%	2.6%	3.2%
Total	*110	*235	*345	32%	68%	100%

(E)= Essential / (R)=Recommended / (T)= Total
* Some sections of DDAT for rooms that tend to repeat, such as bedrooms, can be duplicated so the overall number of queries may vary from one audit to the next.

3.2.2.3 The Environmental Audit Tool

The Environmental Audit Tool (EAT) (Fleming, Forbes and Bennett, 2003; Fleming and Kelly, 2015) contains a list of seventy-two query items organised under ten established DDPs. The full set of EAT queries is listed in Appendix A. Unlike the DDAT, the EAT does not provide an exhaustive, detailed evaluation but is instead intended to give an accessible, research-informed overview of key indicators of dementia design quality. The simple format of the tool and its use of plain English questions means that, unlike either the DDAT or TESS, audit users do not need to have extensive training nor aged care sector experience to make use of the tool. The validity of the EAT has been tested against the TESS-NH (86.8%) and the EAT has been found to have high inter-rater reliability consistency, including amongst novice evaluators, reported as 97% (Fleming, 2011, pp. 108–112). It has been available in a digital application format, called BEAT-D (since 2012) and currently forms part of a major Australian Government funded national knowledge exchange program to improve quality in the residential aged care sector (Fleming and Bennett, 2017b). The EAT, in the form assessed in the present research (Fleming, Bennett, and Forbes 2013), was developed in association with the Australian Government Department of Health (Fleming, Forbes, and Bennett 2003). Its validity is reinforced by the findings of at least two significant literature reviews (Fleming *et al.*, 2008; Fleming and Purandare 2010), and informed by two decades of prior research and practice by the lead author. It has been extensively tested against other dementia design assessment instruments (Fleming, 2011; Smith *et al.*, 2012; Fleming and Bennett, 2015).

The EAT question set originated in a NSW Ministry of Health publication *Adapting the Ward for People with Dementia* (Fleming, Forbes, and Bennett 2003). The name of the publication is a little misleading, as the wards in question were units where people with dementia were accommodated for long periods, and their use was more like residential than acute care. This had in turn emerged from development work related to the 1980's NSW program to design and construct a series of units for the Confused and Disturbed Elderly (CADE) (Fleming and Bowles 1987).

Both of Fleming *et al*'s literature reviews in this area (Fleming, Crookes and Sum, 2008; Fleming and Purandare, 2010) were the most systematic reviews of evidence for dementia design to have been undertaken up until the publication date of each. Both used the Forbes method (Forbes, 1998; Forbes *et al.*, 2009) to evaluate the validity and reliability of available evidence to inform dementia design. The earlier of these two systematic literature reviews (Fleming, Crookes, and Sum 2008) also still forms the primary evidence base for the University of Stirling's DDAT (Cunningham *et al.*, 2008; Cunningham *et al.*, 2011).

The number of questions under each DDP of the EAT vary significantly, from one to fourteen queries. Meanwhile as the points allocated vary from one question to the next, so too do the available points from individual DDPs, ranging from two to twenty-two points. Despite this variation, each DDP is formally allocated an equal 10% share of the overall EAT score weighting. Calculation of the final score involves generating a score percentage for each DDP, then calculating an average of the percentages across all ten DDPs (10x10%=100%) as the final overall score. Table 3-C contains the breakdown of EAT score calculations, and a brief analysis of assessment point scores and how they are (unevenly) distributed. To date, researchers have been able to distinguish between stronger and weaker evidence (Fleming, Crookes and Sum, 2008; Fleming and Purandare, 2010; van Hoof, Kort, van Waarde, *et al.*, 2010; Daly Lynn *et al.*, 2017)) but not to the point of finely determining the contribution of individual features when measured against each other.

Table 3-C: The Environmental Audit Tool scoring system

EAT points and scoring system					**Analysis contribution**		
DDP No.	Dementia design principle (DDP)	Value	No. Qs.	Points	Avg. value per Q.	O/A share of points	Avg. value /point
DDP#1	*Safety*	10%	14	22	0.71%	19.6%	0.45%
DDP#2	*Size and scale*	10%	1	3	10.0%	2.7%	3.33%
DDP#3	*Visual access*	10%	10	19	1.00%	17.0%	0.53%
DDP#4	*Stimulus reduction*	10%	8	8	1.25%	7.1%	1.25%
DDP#5	*Useful stimuli*	10%	9	9	1.11%	8.0%	1.11%
DDP#6	*Movement and engagement*	10%	9	9	1.11%	8.0%	1.11%
DDP#7	*Familiarity*	10%	6	12	1.67%	10.7%	0.83%
DDP#8	*Privacy and social interaction*	10%	5	12	2.00%	10.7%	0.83%
DDP#9	*Community links*	10%	2	2	5.00%	1.8%	5.00%
DDP#10	*Domestic activity*	10%	8	16	1.25%	14.3%	0.63%
	Totals	100%	72	112		100%	
The above analysis of scoring suggests that the strongest individual queries in the EAT are query No: 2.1 (=10%), No's 9.1 and 9.2 (each = 5%) and No's 8.1 – 8.5 (2% each). Conversely the points awarded suggest that DDP#1, DDP#3, and DDP#10 are the most important. See table 3-C.							

Although the variation in the points awarded to individual questions begins to emphasise the relative importance of specific design features within each DDP, this is undermined by the equal weighting of all ten DDPS (each DDP is worth 10% of the overall score). This has the effect that the points scored for individual queries under some DDPs have distinctly different real values from queries under other DDPs. For example, a sum of the points available under three of the dementia design principles: DDP#1 Safety (twenty-two points), DDP#3 Visual Access (nineteen points), and DDP#10 Domestic Activity (sixteen points), makes up over half of the points score available in the original EAT (57 out of 112). Meanwhile, another set of three DDPs also allocated 30% of the overall score comprise: DDP#2 Size and Scale (three points), DDP#4 Stimulus Reduction (eight points), and DDP#9 Community Links (two points), combining to represent just under twelve percent of the full potential points tally (thirteen out of 112 points).

Table 3-D: Summary review of TESS-NH, DDAT, and EAT

Comments and Conclusions
Therapeutic Environmental Screening Survey (Sloane *et al*., 2002)
Score Basis: Varying pre-defined points awarded per query item. Many items not allocated a score.
Suitability: Suitable for individual evaluation, but it is unclear how to make formal comparison evaluations between multiple settings.
Conclusion: The TESS-NH is of limited use for the purposes of this research project, largely because of its lack of applicability to floor-plans. Although evaluation of detailed technical design information could be undertaken, the tool is more suitable for evaluations that focus on post-occupancy facility management.
Dementia Design Audit Tool (Cunningham *et al*., 2011)
Score Basis: One point is awarded per query item. The assessment is comprised of one third 'Essential' and two-thirds 'Recommended' query items. The scoring system requires calculation to determine the percentage based final score. All 'Essential' items are required to be passed for the associated dementia design accreditation to be awarded.
Suitability: Extensive question set containing 345 detailed and often technical query items organised under eleven domains, most as nominated space types. Useful for comparisons between specific room types, but less helpful to inform overall layout design. Only a single known study has reported on dementia design standards established using the DDAT (Hadjri, Faith and McManus, 2012), but due to its use being limited to 'essential' questions (approximately one-third of the available query items), and undertaken by untrained staff from each residential aged care setting evaluated, this study did not establish either substantial or reliable findings. The large number of queries means design evaluations are likely to be time consuming.
Conclusion: There is a modest proportion of plan-based questions, but a high number (compared to other tools), so a floor-plan based evaluation tool based on a sub-scale of the DDAT is feasible. Where larger volumes of detailed design and technical specification documents are available, the DDAT may be an appropriate tool for document-based design evaluation.
Environmental Audit Tool (Fleming 2011)
Score Basis: Variable points available per query item and per domain. Overall score determined by the average of percentage scores under each of ten equally weighted dementia design principles.
Suitability: Clear and consistent comparison and scoring by 'design principle'. NSW-based design 'norms' have been established (Smith *et al.,* 2012). More than half of audit queries and scoring can be related to floor-plan based design characteristics. The EAT query set lacks detail compared to DDAT, but uses more accessible language, has a clearer evidence base, validity and acceptance of its usefulness, demonstrated by its use in large-scale rigorous research (Low *et al.,* 2013; Chenoweth *et al.,* 2014).
Conclusion: The EAT is the most suitable of these tools for floor-plan based design evaluation — so it will be modified for this purpose in the following chapter.

EAT score norms developed from the findings of Smith *et al.*'s (2012) analysis of fifty-six NSW-based care units allow the design evaluation profile of each newly evaluated setting to be compared against a benchmark. This allows assessors to identify strengths and weaknesses in individual units or groups of units, relative to the broader stock of residential aged care settings, and helps identify areas, or DDPs, where there is greatest room for improvement. The EAT has been directly compared against the TESS-NH (Smith *et al.*, 2012), showing comparable outcomes. The EAT has also been directly compared with the DDAT (Kelly, Innes and Dincarslan, 2011), but the data on correlations or differences were insufficiently reported to make any conclusions from that study about the merits of one instrument over the other.

An overall summary conclusion from the detailed review of three instruments (TESS-NH, DDAT, and EAT) is presented in Table 3-D.

3.3 Analysis of audit tools by design stage

The full question sets from the three instruments were sorted into three categories, labelled ‘Plan’, ‘Detail’ and ‘Manage’. Which of the three categories or stages a question was allocated into depended on which of three types of documents could typically be relied upon to provide the (best) answer to that question. The association of document types with three categories created associations with three broad stages in the design process. The categories are defined as follows.

- **Plan** Any audit queries that can be answered using information typically identifiable in architectural floor-plan drawings. Since floor-plans are one of the earliest design documents to be produced, this category can also be loosely associated with the initial stages of the design process.

- **Detail** Any audit queries that can be answered using information from all other (non-floor-plan based) detailed design and construction-related documents. This includes drawings, schedules and specifications.

- **Manage** Any audit queries that require information contained in operational management and maintenance documents. As they relate to the functioning of the completed and occupied environment, they can also be considered as ‘post occupancy’ evaluation items.

Assessment and categorisation of all questions from all three instruments was undertaken by the author, a qualified architect with professional experience of the residential aged care sector in the UK and Australia. This familiarity with the building type and architectural documentation conventions made the evaluation and categorisation process straightforward. Where a query was deemed to rely on, or be capable of being answered, using either of more than one document type, per the Plan/Detail/Manage categories set out above, the query was then allocated against the earlier of any applicable stages of the design process, in order of priority. 1.‘Plan’, then 2. ‘Detail’, then 3. ‘Manage’.

A summary of the score analyses from these is presented in Table 3-E (for an overall comparison), Table 3-F (for the DDAT) and Table 3-G (for the EAT). The overall evaluation outcome of comparing the three instruments is also presented in pie charts within Figure 3-A, whilst the full appraisal and categorisation of all individual queries from each instrument are documented in three separate tables within appendices the dissertation, as identified in the list below:

Appendix A	*the Environmental Audit Tool* (Fleming, 2011; Fleming, Bennett and Forbes, 2013)
Appendix B	*the Therapeutic Environmental Screening Survey for Nursing Homes*, (Sloane *et al.*, 2002)
Appendix C	*the Dementia Design Audit Tool* (Cunningham *et al.*, 2011)

Table 3-E: Comparative evaluation of the TESS-NH, DDAT, and EAT

	TESS-NH	***DDAT*****	***EAT***
Total No Qs.	63 (+12*)	345	72
#Qs ‘Plan’	10	95	39
#Qs ‘Detail’	29	226	24
#Qs ‘Manage’	24	24	9
‘Plan’ Score	16.4%	28.1%	59.9%
‘Detail’ Score	44.3%	64.9%	28.4%
‘Manage’ Score	39.3%	7.0%	11.7%

*****Only scoring queries are counted (TESS-NH has twelve non-scoring queries)
** DDAT requires a conversion to achieve the final % values indicated here.

The most significant overall finding is that more than half, 59.9%, of the total score value from the EAT fell under the ‘Plan’ category, compared with 28.1% for the DDAT and 14.7% for the TESS-NH. This assessment confirms that the EAT is the most favourable for adapting to become a floor-plan based design evaluation method.

Table 3-F: DDAT score breakdown by design stage categorisation

	'ESSENTIAL' ITEMS			**'RECOMMENDED' ITEMS**			**COMBINED**			**O/A**
	Plan	Detail	Manage	Plan	Detail	Manage	Plan	Detail	Manage	
UNIT 1	3	10	3	10	28	2	13	38	5	16.2%
UNIT 2	1	4	0	11	12	1	12	16	1	8.4%
UNIT 3.	4	5	0	6	9	3	10	14	3	7.8%
UNIT 4.	1	0	0	6	2	0	7	2	0	2.7%
UNIT 5.	0	4	0	4	11	0	4	15	0	5.5%
UNIT 6.	0	4	0	5	7	0	5	11	0	4.6%
UNIT 7.	0	6	1	6	20	4	6	26	5	10.7%
UNIT 8.	1	18	2	2	14	1	3	32	3	11.0%
UNIT 9.	0	17	1	1	20	0	1	37	1	11.3%
UNIT 10.	12	18	1	17	12	4	29	30	5	18.6%
UNIT 11.	0	2	0	5	3	1	5	5	1	3.2%
TOTAL	22	88	8	73	138	16	95	226	24	100%
SCORE VALUE*	5.6%	22.4%	2.0%	22.5%	42.6%	4.9%	28.1%	64.9%	7.0%	

***'ESSENTIAL' ITEMS ARE WEIGHTED AT 32% OF THE OVERALL SCORE AND 'RECOMMENDED' ITEMS ARE WEIGHTED AT 68%.**

Table 3-G: EAT score breakdown by design stage categorisation

	Points				**Score**		
	Plan	Detail	Manage	Total	Plan	Detail	Manage
DDP#1	4	17	1	22	18.2%	77.3%	4.6%
DDP#2	3	0	0	3	100%	0.0%	0.0%
DDP#3	19	0	0	19	100%	0.0%	0.0%
DDP#4	3	5	0	8	37.5%	62.5%	0.0%
DDP#5	5	4	0	9	55.6%	44.4%	0.0%
DDP#6	9	0	0	9	100%	0.0%	0.0%
DDP#7	0	6	6	12	0.0%	50.0%	50.0%
DDP#8	12	0	0	12	100%	0.0%	0.0%
DDP#9	1	1	0	2	50.0%	50.0%	0.0%
DDP#10	6	0	10	16	37.5%	0.0%	62.5%
Plan-EAT					59.9%	28.4%	11.7%

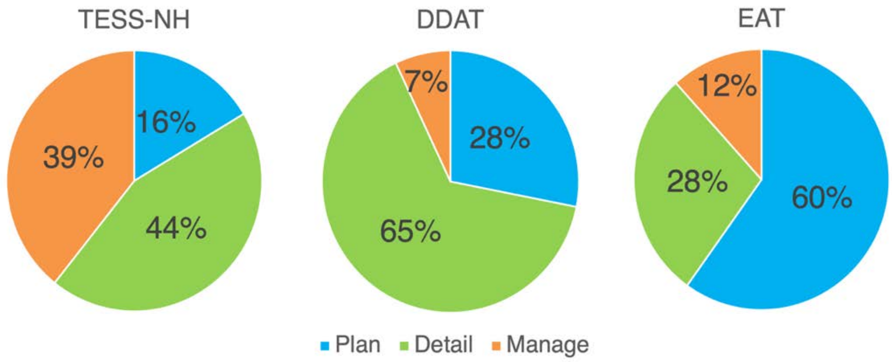


Figure 3-A: Categorisation of DDAT, EAT, and TESS-NH queries

This analysis of the three tools suggests that if a complete set of design documents is available (including schedules, specifications and all typical architectural drawings) then the DDAT may provide the most relevant evaluation and feedback. Where design evaluation can be based on a complete set of construction stage documentation it may be possible to return query responses on up to 93% of the DDAT evaluation, 88% of the EAT, and 83% of the TESS-NH based on this information. The TESS, determined as the least suitable overall for design-stage evaluations, instead places comparatively high importance on post-occupancy related questions, allocating 39% of scoring the post occupancy 'Manage and Maintain' phase (compared to the DDAT =7% and EAT =12%).

3.4 Conclusion

The three aims of this research rely on the development of a formal method of floor-plan based design evaluation. After a review of seven established dementia design evaluation tools, and the conclusion that a floor-plan based evaluation method would need to be created, a series of detailed analyses were undertaken to determine the most suitable from three of these instruments to be modified to suit the required purpose.

The findings confirmed that all three instruments can, through a subset of questions, with minor modifications, be used to undertake floor-plan based evaluation. Analysis showed that the EAT is the most suitable for this purpose, with 59.9% of its score base (from thirty-nine of seventy-two queries) possibly able to be determined using floor-plan drawings. This compared with 28.1% (ninety-five of 345 queries) for the DDAT, and 16.4% (five of thirty-five queries) for the TESS- NH.

Having determined that Fleming's (2011) *Environmental Audit Tool* (EAT) was most suitable for modification to meet the aims of the present research, this is taken forward through Chapter 4, where it is modified and developed to become the method used to carry out dementia design evaluations of the architectural layouts of NSW and international residential aged care units.

4 METHODOLOGICAL DEVELOPMENT: PLAN-EAT

4.1 Introduction

This chapter describes the modification of the *Environmental Audit Tool* (Fleming, 2011) for the purpose of undertaking floor-plan based dementia design evaluations. This modified version of the EAT, 'Plan-EAT', provides the method used to fulfil the first of the three research aims of this dissertation: to evaluate and compare dementia design quality in the layout planning of NSW-based and international best-practice examples of residential aged care units. Plan-EAT is the first known evidence-based instrument created for this purpose. The results from the application of Plan-EAT are then used to develop responses to the second and third aims of the dissertation.

4.2 Method

The evaluation process undertaken in Chapter 3 sorted the queries from EAT, as well as the DDAT and TESS-NH, into three categories depending on the type of document that could be used to answer each question. All queries that could be answered using floor-plan information were sorted into the first of these categories, named 'Plan'. Meanwhile all other design construction documentation was sorted into a category named 'Detail', and finally all queries related to the post-occupancy operation, management and maintenance were sorted into a category named 'Manage'.

The subset of thirty-nine out of the seventy-two original EAT queries that were sorted into the 'Plan' category forms the basis of the method used to evaluate floor plans in addressing the first aim of the present research. The subset of EAT queries contributes 59.9% of the EAT score base, as calculated in (in the previous chapter). This question sub-set named 'Plan-EAT' is listed in Table 4-A, whilst the full list of original EAT queries, the designation they were allocated, and explanatory notes are presented in the Appendices A and D.

The Plan-EAT query sub-set retains thirty-nine of the seventy-two original EAT queries. However, the number and proportion of queries retained under each of the ten dementia design principles (DDPs) differs from one DDP to the next. No questions are retained, for example, under DDP number 7 'Familiarity', so this DDP is completely omitted from Plan-EAT. Conversely, all questions are retained under four of the DDPs: DDP#2 Human scale, DDP#3 Visual access, DDP#6 Wandering and Outdoor Space, and DDP#8 Privacy and Social

Interaction. The other five DDP’s retain various proportions of EAT query items as depicted in Figure 4-A and Table 4-B.

Table 4-A: Plan-EAT — Floor-plan based dementia design evaluation query list

Q. No.	Plan-EAT query item	Points
DDP#1: Unobtrusively reduce risks – SAFETY		
1.05	Is the garden easily supervised from the point(s) where staff spend most of their time?	2
1.13	Is the lounge room easily supervised from the point(s) where the staff spend most of their time?	2
	Points subtotal	4
DDP#2: Provide a human scale – SIZE		
2.01	How many people live in the unit?	3
	Points subtotal	3
DDP#3: Allow people to see and be seen – VISUAL ACCESS		
3.01	What proportion of confused residents can see their bedroom door from the lounge room?	4
3.02	What proportion of confused residents can see the lounge room as soon as they leave their bedroom?	4
3.03	What proportion of confused residents can see the dining room as soon as they leave their bedroom?	4
3.04	Can the exit to the garden be seen from the lounge room? (If there is more than 1 lounge room answer with reference to the one most used by most confused residents).	1
3.05	Can the dining room be seen into from the lounge room? (If there is more than 1 dining room or lounge room answer with reference to those used by most confused residents).	1
3.06	Can the kitchen be seen into from the lounge room? (If there is more than 1 lounge room answer with reference to the one used by most confused residents).	1
3.07	Can the kitchen be seen into from the dining room? (If there is more than 1 dining room answer with reference to the one used by most confused residents).	1
3.08	Can a toilet be seen from the dining room? (If there is more than 1 dining room answer with reference to the one used by most confused residents).	1
3.09	Can a toilet be seen from the lounge room? (If there is more than 1 lounge room answer with reference to the one used by most confused residents).	1

Q. No.	Plan-EAT query item	Points
3.10	Can the lounge room be seen into from the point(s) where staff spend most of their time?	1
	Points subtotal	19
DDP#4:	Reduce unhelpful stimulation – STIMULUS REDUCTION FEATURES	
4.05	Are deliveries of food, linen etc. taken across public areas such as the lounge or dining room?	1
4.07	Is the front entry to the unit easily visible to the residents?	1
4.08	Is the service entry (where food, linen etc is delivered to) easily visible to the residents?	1
	Points subtotal	3
DDP#5.	Optimise helpful stimulation – HIGHLIGHT USEFUL STIMULI	
5.01	Is the dining room looked into from the lounge room or clearly marked with a sign or symbol?	1
5.02	Is the lounge room either looked into from the dining room or clearly marked with a sign or symbol?	1
5.05	Is the kitchen either looked into from the lounge or dining room or clearly marked with a sign or symbol?	1
5.06	Are toilets visible as soon as the toilet/bathroom door is opened?	1
5.07	Is there a lot of natural lighting in the lounge room?	1
	Points subtotal	5
DDP#6:	Support movement and engagement – PROVISION FOR WANDERING CIRCULATION AND ACCESS TO OUTSIDE AREA	
6.1a	Is there a clearly defined and easily accessible (i.e. no locked exit) path in the garden that guides the resident back to their starting point without taking them into a blind alley? (If answer to 1a is YES answer 1b,1c,1d,1e,1g and 1g)	1
6.1b	Does the external path allow the resident to see into areas that might invite participation in an appropriate activity other than wandering?	1
6.1c	Is the path within a secure perimeter?	1
6.1d	Can this path be easily and unobtrusively surveyed by staff members?	1
6.1e	Are there chairs or benches along the path where people can sit and enjoy the fresh air?	1
6.1f	Are there both sunny and shady areas along the path?	1
6.1g	Does the path take residents past a toilet?	1
6.2a	Is there a clearly defined path inside that takes the resident around furniture and back to their starting point without taking them into a blind alley? (If answer to 2a is YES answer 2b)	1
6.2b	Does the internal path allow the resident to see into areas that might invite participation in an appropriate activity other than wandering?	1
	Points subtotal	9
DDP#7:	Create a familiar space – FAMILIARITY* (Note: No floor-plan based queries under this DDP)	
	Points subtotal	0
DDP#8:	Provide opportunities to be alone or with others - PRIVACY AND COMMUNITY	

Q. No.	Plan-EAT query item	Points
8.01	Are there small areas (nooks) that provide opportunities for casual interaction and quiet chats?	3
8.02	How many of these areas or nooks have views of pleasant or interesting scenes (outside, the living room, the nursing station)?	3
8.03	Do the shared living areas support small group activities (4-6 people) without re-arranging the furniture?	2
8.04	Does the dining room provide opportunities for residents to eat in small groups (2-4)?	2
8.05	Does the dining area provide opportunities for people to eat alone?	2
	Points subtotal	12
DDP#9:	Provide links to the community – COMMUNITY LINKS	
9.1	Is there an area or room somewhat removed from the main dining room where families can share meals with their relatives? (If answer to 1 is YES answer 1a)	1
	Points subtotal	1
DDP#10:	Providing opportunities for engagement with ordinary life - DOMESTIC ACTIVITY	
10.01	Have access to a kitchen?	2
10.07	Have constant and easy access to a lounge?	2
10.08	Have constant and easy access to a dining room?	2
	Points subtotal	6
	Max Plan-EAT points count	62
*	This table omits the explanation of how points are awarded for individual query items. This information is included with the full EAT query list contained in Appendix A .	

The variations in the numbers of questions under each DDP of Plan-EAT (compared to the EAT) may also have some effect on the reliability of the evaluation outcome under some of the more depleted DDP query sub-sets. For example, DDP groups such as DDP#2, DDP#3, DDP#6, and DDP#8, have retained a high proportion of the original EAT query sets into Plan-EAT, so are considered very reliable. Whereas others, such as DDP#1, DDP#4, and DDP#10, where large reductions in the number of query items occurred, could be considered less reliable as a reflection of the original EAT evaluation.

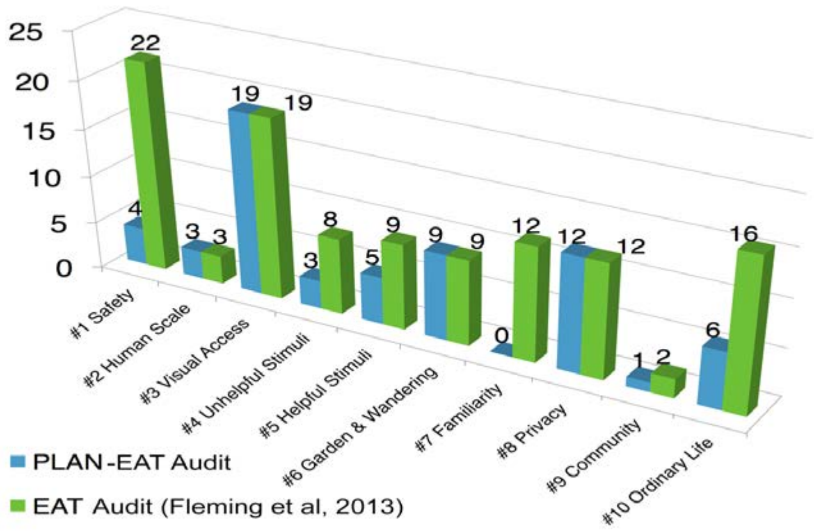


Figure 4-A: EAT versus Plan-EAT -points per DDP

The overall EAT score is calculated as an average of the percentage scores obtained under each DDP. This system gives all DDPs an equal influence on the overall score, irrespective of the number of questions or maximum points available under each. This logic is retained for Plan-EAT scoring, but the necessary omission of DDP#7 (Familiarity) in the overall Plan-EAT score is calculated as an average of the percentage scores across the nine remaining DDPs. So, whilst the EAT scores are based on ten DDPs x 10% =100%, scoring under Plan-EAT is nine DDPs x 11.11% = 100%.

With the changes to the question set in the Plan-EAT versus the EAT, including uneven rates of depletion of questions between DDPSs, there is not only a change in the relative value of individual queries within a given DDP but also uneven changes in how the points scored by these individual queries effectively contribute to the overall Plan-EAT scores. The removal of DDP#7 and subsequent re-distribution of remaining DDPs resulted in a default increase of 11.1% in relative value of each DDP (see Table 4-B). Within DDPs, such as DDP#2, DDP#3, DDP#6, that have retained the full set of EAT queries within Plan-EAT, there is only this minor change in the contribution of query items and their allocated points. However, in other DDPs, such as DDP#1, DDP#4, and DDP#5, where there has been a large reduction in the number of questions, the simultaneous reduction in the number of questions slightly increasing the overall value of the DDP has led to sometimes significant increases in contribution that many queries make to both DDPs and overall Plan-EAT design evaluation scores. The following is a worked example showing the effect of this for DDP#1 (Safety).

Under the EAT, DDP#1 (Safety) has twenty-two points available from fourteen questions, meaning each point is worth 0.5% of the overall EAT score (i.e. 10% divided between twenty-two points). Alternatively, the fourteen questions are worth an average of 0.7% of the overall EAT score each (10% divided by fourteen). However, with DDP#1 retaining only two questions (query nos. 1.05 and 1.13) in Plan-EAT, the effective contribution of available queries to overall score has increased eight-fold from 0.7% (under EAT) to 5.6% (under Plan-EAT) each (11.1% divided between two queries). Meanwhile the effective value of each of the four remaining points increases by more than five-fold, from 0.5% to 2.8% (11.1% divided between four points). With DDP#1 experiencing one of the most dramatic of these shifts in query value, this occurs to a different extent in several DDPs, as shown in Table 4-B.

At a more detailed level, the awarding of points for individual query items for Plan-EAT mirror how they are awarded under the EAT. However, the use of EAT queries for floor-plan evaluations requires some modifications to the way in which some questions are applied for this purpose (e.g. signage versus visual access). The relevant queries, and the protocols used in their use with floor-plans, is included in Appendix D.

One consequence of the uneven loss of questions, is that the reliability of the affected DDPs under the Plan-EAT is reduced. DDP's #2, #3, #6, #8, which retained all original queries can be considered fully reliable However, the variable reductions in the number of assessment queries retained under other DDPs (including DDPs #1, #4, #5, #7, #9, and #10) means that evaluation outcomes for these DDPs may be less robust. See Table 4-B for a breakdown and analysis of the change in applicable questions. However, in acknowledging these variations in the Plan-EAT query set, it is important to also note that the Plan-EAT tool and plan assessment method is not proposed as an alternative or replacement for EAT, but as a method to assist the design process for new facilities, or to generate an approximated measure of the dementia design quality of existing settings based on the most commonly available form of documentation.

4.2.1 Plan-EAT scoring system

Table 4-B: Scoring system analysis of EAT versus Plan-EAT

		EAT scoring					Plan scoring					Changes	
DDP:	**Dementia design principle**	**#Qs**	**Max. points**	**O/A EAT value**	**Avg. score value per Qs**	**Score value per point**	**No. Qs**	**Score Value per Qs**	**Max points**	**O/A Plan-EAT value**	**Score value per point**	**Change per Q. (Avg.)**	**Change per point**
DDP#1	***Safety***	14	22	10%	0.7%	0.5%	2	5.55%	4	*11.1%	2.8%	x7.8	x6.2
DDP#2	***Size and scale***	1	3	10%	10.0%	3.3%	1	11.10%	3	*11.1%	3.7%	x1.1	x1.1
DDP#3	***Visual access***	10	19	10%	1.0%	0.5%	10	1.10%	19	*11.1%	0.6%	x1.1	x1.1
DDP#4	***Stimulus reduction***	8	8	10%	1.3%	1.3%	3	3.70%	3	*11.1%	3.7%	x3.0	x3.0
DDP#5	***Useful stimuli***	9	9	10%	1.1%	1.1%	5	2.20%	5	*11.1%	2.2%	x2.0	x2.0
DDP#6	***Movement and engagement***	9	9	10%	1.1%	1.1%	9	1.21%	9	*11.1%	1.2%	x1.1	x1.1
DDP#7	***Familiarity***	6	12	10%	1.7%	0.8%	0	N/A	N/A	*0.0%	N/A	N/A	N/A
DDP#8	***Privacy and social interaction***	5	12	10%	2.0%	0.8%	5	2.20%	12	*11.1%	0.9%	x1.1	x1.1
DDP#9	***Community links***	2	2	10%	5.0%	5.0%	1	11.10%	1	*11.1%	11.1%	x2.2	x2.2
DDP#10	***Domestic activity***	8	16	10%	1.3%	0.6%	3	3.70%	6	*11.1%	1.9%	x3.1	x3.3
	Score Totals/Averages	72	112	100%	2.5%	1.5%	39	4.7%	62	100%	3.1%	x2.5	x2.3
		Qs	Tot.		Avg.	Avg.	Tot.	Avg.	Tot.		Avg.	Avg.	Avg.

4.2.2 Pilot testing Plan-EAT

Once the Plan-EAT query list was developed (subsequent to the evaluations processes in Chapter 3), a sample of ten residential aged care unit floor-plans were evaluated to trial the method. Questions arising from this were discussed with the lead author of the EAT. Variations in how the questions are posed for plan evaluations was considered — to be reworded as different questions, in effect — but it was more appropriate to produce supporting notes to clarify alternative interpretations, whilst keeping the original EAT queries. This could help maintain the relevance of the original EAT irrespective of the context, whether plans only, detailed design, or occupied environment. As an example of this, there are two EAT queries (5.01 below, and 5.02) that suggest it is equally acceptable to provide either direct visual access or signage for resident wayfinding purposes.

5.01 ‘*Is the dining room looked into from the lounge room or clearly marked with a sign or symbol?’*

Whilst floor-plan information can be used to determine the presence of direct visual access between nominated spaces, it alone is unlikely to provide enough information to determine either the presence or appropriate quality of signage. So, when these questions are used as part of the Plan-EAT there is an accompanying note explaining the modification of the application of the query, and for the purposes of floor-plan based evaluations signage as an optional solution is ignored.

The pilot application helped to define the plan evaluation processes, including assumptions made, protocols of both drawing interpretations and query applications, as well as attempts to define the approach to be taken in inevitable scenarios when questions cannot be answered using the available floor-plan drawing information. The process helps to refine the plan interpretation protocols set out in Chapter 5.

Although the primary reason for developing these protocols was to ensure consistency across the array of Plan-EAT design evaluations undertaken in the present research, this also considers the ‘repeatability’ of the research or the possible subsequent use of the method by others. The following short table (Table 4-C) is an excerpt from Appendix D, showing a few examples of the types of drawing review protocols developed as part of the pilot.

Table 4-C: Plan-EAT floor-plan evaluation protocols

Query no.	Plan-EAT query item	Protocols / Comments
1.05	*Is the garden easily supervised from the point(s) where staff spend most of their time?*	Determining the likely location of staff during a floor-plan based evaluation requires some assumptions by the person undertaking the evaluation. Staff location can differ somewhat depending on the care model and staff ratios etc. to be employed in the environment being evaluated. For example, in traditional 'general' care settings, where the care model is based on the traditional medical or institutional model, staff will tend to be based in and around a formal Nurse Station. Conversely, In the more contemporary 'household' based care models, staff may not have a clear or fixed base to work from and are more likely to be located amongst residents, near common dining and lounge spaces, or around a resident-accessible kitchen area. Assumptions for evaluation based on drawings therefore respond to the drawn representations of spaces in combination with the labels provided for each space. Where possible, prior to Plan-EAT evaluations being undertaken, it would help to first determine the model of care in the environment to be evaluated.
3.02	*What proportion of confused residents can see the lounge room as soon as they leave their bedroom?*	The phrase "as soon as they leave…" is evaluated based on a floor area visible by a resident standing outside their bedroom, but who still have contact with the door handle. For consistency, during the current research, the view point is required to be within 1m x 1m square space immediately in front of the relevant bedroom door. Visibility to the largest or most centrally located lounge from this location (the same lounge as for other evaluation queries) must be into to the lounge room itself, or as a minimum to the surface of the lounge room door. Although many residential aged care units are provided with more than one lounge or sitting space, which can be valuable to residents, these secondary spaces are not considered as part of this evaluation item.
5.01	*Is the dining room looked into from the lounge room or clearly marked with a sign or symbol?*	Signage is not normally indicated in any way on floor-plan drawings, so plan based evaluation for the Plan-EAT is based on the provision of a line of sight between the lounge room and dining room. Although signage is known to be helpful in wayfinding tasks for people living with dementia, research evidence suggests that direct

Query no.	Plan-EAT query item	Protocols / Comments
		visibility is much more effective for this purpose. Signage may help where direct vision is not possible, such as in existing buildings, and helps to provide clarity of location where direct visibility exists.
5.07	*Is there a lot of natural lighting in the lounge room?*	Floor-plans typically show window and door widths but it will not normally be possible to understand the full extent of glazing, and the extent to which they can admit natural light to the space, without additional drawings, such as elevations or section drawings to indicate heights of these items. Plans will not tend to confirm whether doors are glazed or not. In some cases, roof-light or clerestory (high level) windows may also be missing from the drawing information. Evaluations under this query make use of a rule of thumb threshold to determine whether natural light levels are likely to be enough. The Building Code of Australia requires glazing to a habitable space to be a minimum of 10% of the floor area. Based on an assumption that the average external opening is 1.2m high (say a 900mm high sill and 2100mm total height) and the loss of about 100mm glazing to solid framing items in every linear metre, each 1 linear meter of opening should provide about 1m^2 of light-admitting glazing. To achieve a 10% glazing to floor area ratio, the threshold for this item is set at a requirement for a minimum of one linear metre of wall opening for every ten square metres of floor area in the room. Where roof-light windows are indicated these can be assumed to offset glazing in the vertical plane at an area ratio of approximately 200% (significantly higher levels of natural is light is typically available through roof-lights windows).

4.3 Conclusion

This chapter described the formation of Plan-EAT, a floor-plan based dementia design assessment method developed using a sub-set of queries from the EAT (Fleming, 2011). This modified version of the EAT (see Table 4-C) forms the basis of the primary method used to assess the dementia design quality of layout planning for NSW and international residential aged care units, and in doing so helps to address the first research aim of this dissertation.

The process, which made use of the conclusions from Chapter 3, evaluated a subset of the queries from the EAT, developed, defined and adapted assessment scoring mechanisms for Plan-EAT and discussed the implications for various aspects of the Plan-EAT evaluations resulting from differences in the way queries are distributed across the dementia design principles in the Plan-EAT compared to the EAT.

This chapter concluded with descriptions of a small pilot study which was used to refine the ways in which audit queries are interpreted and applied, together with defining primary assumptions to be made when undertaking design evaluations based on floor plan information alone, particularly how these are different from design evaluations undertaken in a conventional post-occupancy mode.

5 DATA COLLECTION: RESIDENTIAL AGED CARE UNITS

5.1 Introduction

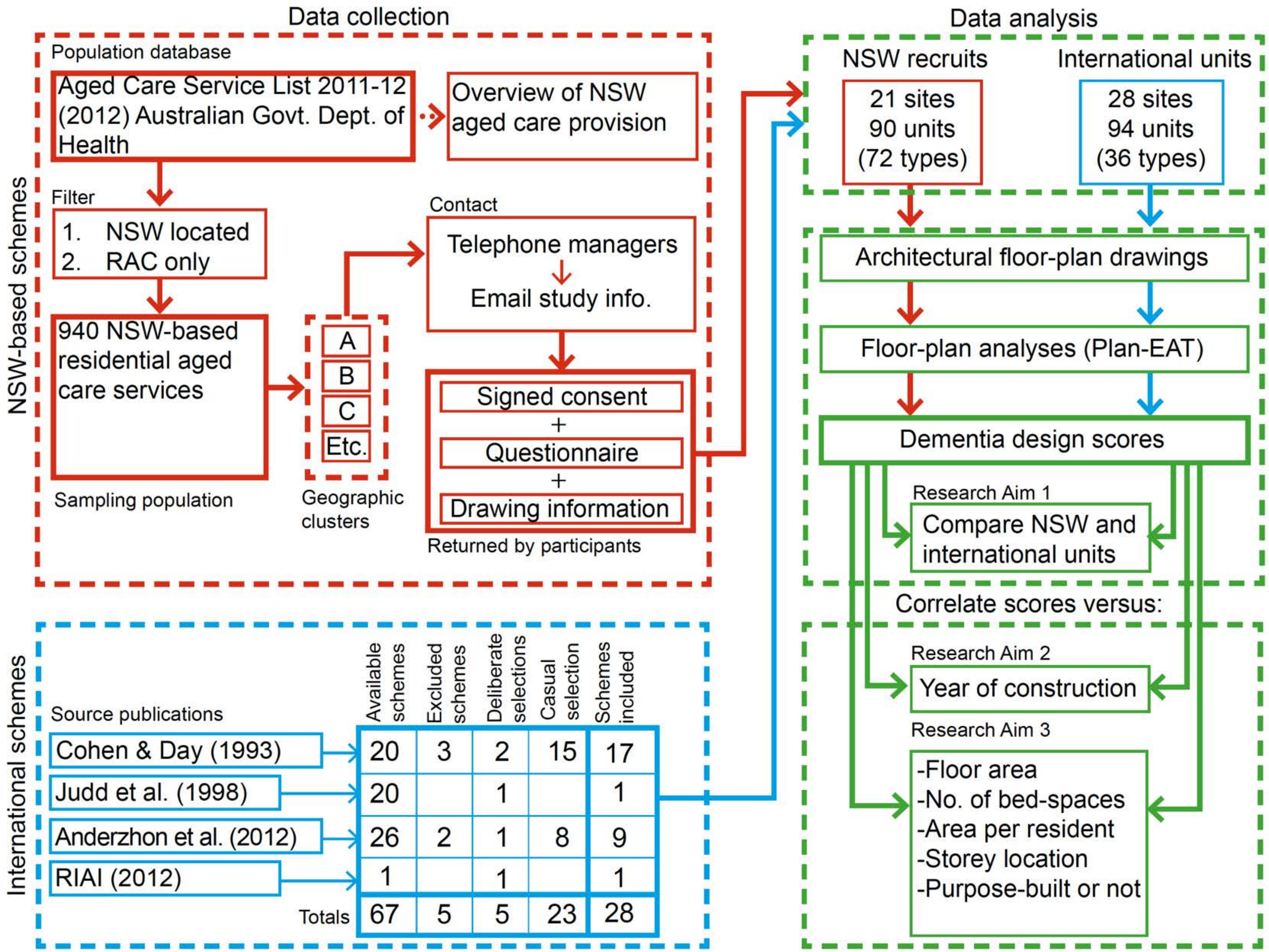
This chapter describes the identification and recruitment processes undertaken to obtain floor-plan drawings and other information about residential aged care units needed for investigations that address the three aims of this research. This data collection included direct recruitment from a variety of NSW-based aged care organisations and the selection of a similar number of units, representing international best-practice in dementia design, borrowed from specialist architectural publications. Whilst most of the international units are borrowed from two publications intended to cover a substantial time frame of four decades, a small number of units are handpicked from four publications based on their reputation in the literature.

The floor-plans of each residential aged care unit are the key source of data required to undertake the primary design evaluation for the first research aim. Additional data about each residential aged care unit — including year of construction, unit floor area, storey location and number of residents — were also collected for use in addressing the second and third aims of this dissertation. This information was collected using a brief questionnaire within the consent form for participating care organisations, as per Appendix E.

5.2 Method 1: Data collection

The process of collecting and organising data for this research is outlined in summary in Figure 5-A. This data comprised equal representations of ninety NSW-based residential aged care units that were recruited directly from the care organisations that run them, and ninety-four international best practice examples, sourced from design publications. The following sections describe the recruitment processes for both sets, including in the case of the international units some that were specially included in the study.

The NSW residential aged care portion of the 2012 edition of the Aged Care Service List (Australian Government Department for Health, 2012) was used as a population from which to sample for recruitment of NSW-based care organisations. However some key statistics from the 2016 edition (Australian Government Department of Health and Ageing 2016) are used to help place the results of present research findings in a more recent content of changing landscape of NSW (and Australian) residential aged care.



Source publications	Available schemes	Excluded schemes	Deliberate selections	Casual selection	Schemes included
Cohen & Day (1993)	20	3	2	15	17
Judd et al. (1998)	20		1		1
Anderzhon et al. (2012)	26	2	1	8	9
RIAI (2012)	1		1		1
Totals	67	5	5	23	28

Figure 5-A: Unit recruitment and data analysis processes

5.2.1 Recruiting NSW-based units

The direct recruitment of NSW-located residential aged care units occurred between late 2013 and late 2014. This process made use of the 2011-2012 Aged Care Service List (Australian Government Department for Health, 2012), an annually published list of all types of registered Australian aged care services, including Home Care, Day Care, Innovative Pools, Transition Care and NATSIP[14]. The 2011-2012 Aged Care Service List was downloaded in MS Excel format, and filtered to identify only residential aged care facilities located within NSW. The resulting list of 940[15] NSW-based residential aged care facilities formed the population from which potential participating organisations were considered for recruitment. This list was then shuffled, using the randomise function in MS Excel, and the resulting list of aged care facilities contacted in small sequentially ordered batches until recruitment ceased.

At the start of the recruitment process, an average of three-to-four units per average residential aged care facility was assumed, and the initial recruitment target was set for around thirty facilities, or around one-hundred units. The recruitment process, described in greater detail below, was ceased at a point in time when it appeared that one-hundred units would be reached. However, some subsequent late-stage attrition reduced the final number of recruited NSW units to below this level. In the end, twenty-one NSW-based residential aged care facilities agreed to participate, providing drawings and other information collected through a questionnaire, providing a total of ninety residential aged care units for evaluation.

5.2.1.1 Contact protocol for NSW care organisations

The following process was taken for recruitment of NSW-based residential aged care facilities:

- Each service was contacted in the order determined by the randomised list of NSW-based residential aged care facilities.

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[14] Only two of the total thirty-two NATSIP services nationwide are in NSW. None were selected for recruitment in this research.

[15] The number of registered residential aged care facilities has increased in subsequent editions of the Aged Care Service List

- Each residential aged care service was telephoned directly, using a publicly available contact phone number (from the ACSL if possible, but otherwise from the organisation's website, or google search).
- A request was made to speak to the manager or other senior staff member.
- The research proposal was verbally explained using a similar script each time.
- Where appropriate, an offer was made to meet with the facility manager to explain the research further.
- If there was interest in participation, or a request for more information, then an email with the Participant Information Sheet and Participant Consent Form* was sent to the email address supplied by the care organisation (*per University of Newcastle Human Ethics Committee approval no H-2014-0044).
- Further phone calls were made if specifically directed to speak to others, or where the relevant manager was unavailable for the initial call. If so, steps 2-5 above were repeated with the new contact.
- Follow up phone calls, one-to-two weeks after initial telephone conversation were made, and information was sent by email, to confirm willingness to participate and request completed consent form and questionnaire be returned along with copies of any floor-plans available.
- The above steps were repeated, queries were responded to, and meetings attended as required.
- Awaited participant signed and completed consent form, and drawings if directly available. Provided confirmation of receipt and thanks.
- The information provided was checked, then saved to a password-protected location, in accordance with ethics approval.

5.2.1.2 Recruitment outcomes

Up until recruitment ceased, when the target number of recruited units was reached, a total of fifty-six residential aged care facilities from the 2011-2012 Aged Care Service List (Australian Government Department for Health, 2012) had been directly contacted by telephone. Thirty-six (64%) of those contacted showed an interest in participating, so were sent follow-up written information by email, including the participant information sheet and a combined questionnaire with consent form (see Appendix E). For the other twenty facilities contacted (36%), it was either not possible (from several attempts) to speak to a decision maker, or communication did not continue after initial contact. No service articulated any decision to decline participation at this stage.

Of the thirty-six (36/56 = 64%) managers who received follow-up written information and a formal invitation to participant in the research, thirty-one (31/56 = 55%) referred the invitation to state or national managers for consideration. In fifteen instances (15/56 = 27%) meetings were held to discuss further. Fourteen facilities (14/56 = 25%) did not communicate any further after receiving written information, and two (2/56 = 3.5%) decided, after some initial interest and follow-up discussions, not to participate in the research.

Although the average time input per service recruited to the project was higher than anticipated (about four hours per recruited service), there was also a higher than anticipated conversion rate (per statistics in the previous paragraph) between the number of services contacted and their subsequent consented participation in the present research project. Consequently, the recruitment process only made use of a short section of the contact list generated from the (2012) NSW Aged Care Service List.

During the recruitment and data collection process there were several occurrences which had not been anticipated. There was resistance from some organisations to releasing plans of older facilities and/or the facilities that they themselves perceived as sub-optimal care settings. This was despite the ethics-approval-backed anonymity guaranteed to each of the participating NSW facilities, and clear explanations that the contact process for the research was deliberately attempting to obtain a rounded and realistic cross-section of the existing stock of residential aged care facilities, and this should naturally include facilities of a variety of types and ages. In some instances, drawings for alternative existing residential aged care facilities were also offered by the contacted care organisations and some others offered to provide information about proposed facilities currently (at that time) being designed. Recruitment protocols had not excluded this, but just as notably had not included this type of information, so they were accepted. The 'proposed' facilities were subsequently evaluated based on the design drawings provided during the recruitment process, and these settings have been constructed in the intervening period (2014-2017). This sub-group, where assessment was based on proposals rather than completed buildings, represents seventeen of the ninety NSW residential aged care units in the present research project.

5.2.2 Sourcing international units

The inclusion of international exemplar units in the study provided an opportunity to establish benchmarks of best practice dementia design, against which the NSW set could be compared. As no methodically assessed and evidence-based study previously existed to measure and distinguish between the standards of dementia design quality in international residential aged care units, this was the first opportunity for research to attempt to develop these kinds of evidence-derived benchmarks for design quality.

The key part of the process of sourcing floor-plans of residential aged care settings was the identification of suitable source publications. Literature searches used the online library catalogue for the University of Newcastle's physical library collection, the Australia-wide 'Bonus' service (a university inter-library borrowing service), and further searches of limited available electronic publications and archives in this area. Searches[16] carried out in late 2012 and early 2013 used combinations of search terms such as 'Architect*' 'Design', 'Dementia', 'Ag*ing'. The search initially prioritised books over other types of material. A visual scan was undertaken of the content of all available books identified in searches and expanded to include additional books or sources that were not identified through the first search but were co-located or catalogued in the same part of the Dewy-decimal system. Any that did not include floor-plans of longer-term residential aged care settings were excluded, with the content of remaining books then compared. A short-list of four books, shown to have the most appropriate content, was identified (Cohen and Day, 1993; Judd, Marshall, and Phippen 1998; Utton, 2007; Anderzhon *et al.,* 2012). After further examination, two of these (Cohen and Day, 1993; Anderzhon *et al.,* 2012) were subsequently selected as primary sources for floor-plan drawings to represent international exemplars of residential aged care unit design. The reasons for these selections are explained below.

All four books, authored by recognised dementia design experts, review collections of residential aged care settings from around the world, all using a case study approach that incorporates text-based description of each setting supported by photographs and floor-plan drawings. Most include written descriptions of circulation, common spaces, bedroom

[16] The search for published plans of international residential aged units occurred between October 2012 and March 2013, so may exclude some more recent publications on this topic.

provision, gardens, and a range of more detailed features such as security access, kitchen design and furnishings. In many cases, more technical information such as the type of heating system, staff ratios and construction costs are included. However, they contain little by way of clear detailed analysis of the building layout. The process of review used to decide on the inclusion of the settings for publication (and the exclusion of others) is not clearly identified in the texts.

All acknowledge that both the physical environment and care provision are important for residential aged care environments to be successful at supporting the overall wellbeing of residents. Although most schemes within the identified publication are presented as examples of high-quality design for physical care environments with an emphasis on dementia, it is assumed that a limited number of unusual settings are included as a means of showing a diversity in alternative approaches to care used in various cultures and countries of the world — not necessarily concluding that all achieve a similar level of outcome in terms of resident wellbeing.

It was not possible to include all schemes from all four publications in the study. Resource limitations (primarily time) required the selection of a smaller pool of settings to examine. The research aim of charting changes in the dementia design quality of residential aged care settings over time led to the selection of two of the four books. Cohen and Day (1993) was selected for being the oldest of the four, whilst Anderzhon *et al.*, (2012) was the most recent book of this type available (at the time of selection in 2013). The differences in publication dates ensure that the international units included in this research have the potential to identify broad changes in residential aged care design over a long time period of circa forty years. These two books also possess no known cross-over amongst writers, editors and other contributors — although this point of difference may have provided more value insight were the two publications from similar time periods.

The same inclusion and exclusion parameters were used for the international (published) units as for the directly recruited NSW-based units. For example, only long-term residential schemes were included, whilst day centres, hospitals and similar settings were excluded. However, some of the included schemes are long-term residential aged care units within hospital complexes and residential aged care units with a day centre attached.

Table 5-A: List of international residential aged care facilities

Source Facility	Location	Year	#units	Publication source
Alexian Village	Milwaukee, Wisconsin, USA	1980	1	Cohen & Day (1993) p. 146
Alois Alzheimer's Centre	Cincinnati, Ohio, USA	1987	1	Cohen & Day (1993) p. 30
Alzheimer's Care Centre	Gardiner, Maine, USA	1988	1	Cohen & Day (1993) p. 42
Alzheimer's Disease Residential Center	California Pacific Medical Center, USA	1994	1	Cohen & Day (1993) p. 61
Brightwater Onslow Gardens	Subiaco, Western Australia	2001	4	Anderzhon *et al*. (2012) p. 46
Butterfly Concept	(Unbuilt)	1985	1	Cohen & Day (1993) p. 168
Childers Place	Amarillo, Texas, USA	2007	3	Anderzhon *et al*. (2012) p. 264
Corine Dolan Centre	Heather Hill, Chardon, Ohio, USA	1989	2	Cohen & Day (1993) p. 66
De Hogeweyk: Typical unit	Weesp, The Netherlands	2009	23	Anderzhon *et al*. (2012) p. 148
Elderkare	Beloit, Wisconsin, USA	1991	1	Cohen & Day (1993) p. 153
Friendship House	Cedar Lake Home Campus, Wisconsin, USA	1976	8	Cohen & Day (1993) p. 76
Hale Kako'O	Honolulu, Hawaii, USA	1992	1	Cohen & Day (1993) p. 158
Helen Bader Center	Milwaukee, Wisconsin, USA	1993	2	Cohen & Day (1993) p. 162
Himawari Group Home	Ofunato-shi, Iwate, Japan	1996	1	Anderzhon *et al*. (2012) p. 66
John Douglas French Center	Los Alamitos, California, USA	1987	6	Cohen & Day (1993) p. 165
Leonard Florence Center	Chelsea, Massachusetts, USA	2010	10	Anderzhon *et al*. (2012) p. 214
Minna Murra	Toowoomba, Queensland, Australia	1986	1	Cohen & Day (1993) p. 86
Namaste Alzheimer Center	Colorado Springs, Colorado, USA	1990	4	Cohen & Day (1993) p. 170
New Perspective Group Home no.4	Mequon, Wisconsin, USA	1990	1	Cohen & Day (1993) p. 96
NPO Group Fugi	Fujisawa, Kanagawa, Japan	2007	2	Anderzhon *et al*. (2012) p. 76
Orchard Centre	Alzheimer's Ireland, Blackrock, Dublin, Ireland	2009	1	Niall McLaughlin Architects (2010) p. 68
Park Homes at Parkside	Hillsboro, Kansas, USA	2006	2	Anderzhon *et al*. (2012) p. 254
Riverview Lodge	Wingham, NSW, Australia	1990	2	Judd *et al*. (1998) p. 58
Southwood Home	Hammondville, NSW, Australia	2007	6	Anderzhon *et al*. (2012) p. 14
Stonefield Home	Middleton, Wisconsin, USA	1991	1	Cohen & Day (1993) p. 174
Weikslag Krabbenlaan	Baarn, The Netherlands	2010	2	Anderzhon *et al*. (2012) p. 136
Weiss Institute	Philadelphia Geriatric Centre, Philadelphia, USA	1972	3	Cohen & Day (1993) p. 130
Woodside Place	Oakmount, Pennsylvania, USA	1991	3	Cohen & Day (1993) p. 138
	28 Facilities		94	

Although there were five international residential aged care facilities (containing 30 units) specially selected for inclusion in the study (discussed below), and a small number of units excluded for technical reasons (also discussed below), all other 'international' residential aged care units included in the study were selected in no particular order from the two main source books. Of the 94 'international' units in the study, fifty-two originate from the USA, twenty-six from Europe and thirteen units come from Australia. Only three units are located in Asia and Africa and South America did not have any facilities represented in the two source books.

The over representation from the USA, and the relative representation from Europe is likely to have had some impact on the outcomes of the research, possibly biasing the results of international analyses towards the design trends for residential aged care settings in North America over other continents.

5.2.2.1 Special Exclusions

A total of six schemes from these two publications were excluded from the selection pool of these two main source publications. Four case studies from Cohen and Day (1993) were also excluded based on being non-residential care building types[17], whilst two residential aged care facilities from Anderzhon *et al.*, (2012) were also excluded. Tjilpi Pampaku Ngura (2000) Pukatja, Ernabella, South Australia (Anderzhon *et al.*, 2012, p. 36), and Wintringham (1996) Port Melbourne, Australia (Anderzhon *et al.*, 2012 p.26) were identified as having especially unconventional, culturally specific layouts. Notably they both rely on externalised circulation between multiple pavilions spread across each site. They are identified by the case study authors (Anderzhon *et al.*, 2012, p. 24-43) as examples of culturally sensitive design in response to the primarily outdoor-based life of residents who include Aboriginal Australians, the long-term homeless, outback farmers, and others likely to have lived most of their life outside. Residential aged care settings that address such specific cultural requirements deserve further in-depth study, but unfortunately lie outside the scope of the current study.

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[17] These excluded non-residential projects were: The Pathways Project, Florida (housing); the Saint Ann Day Care Centre, Wisconsin (day care); the Therapeutic Garden, Sunset Haven for the Aged, Ontario (garden only); and Cedar Acres Adult Day Centre, Wisconsin (day care).

5.2.2.2 Special Inclusions

Most international schemes included in the present study were chosen in no specific order from two main source publications; Cohen and Day (1993), and Anderzhon *et al.*, (2012). However, five schemes representing 30 residential aged care units were specially selected for inclusion. These were sourced from four different publications, are listed in Tables 5-2 and 5-3 and were selected for the reasons set out below.

The first of the five additional special selections included is the *Butterfly Concept* plan illustrated in Cohen and Day (1993, p. 168). It is included by virtue of having been designed by the respected architects and authors of the publication from which it was sourced. This unit would be expected to perform well against settings from the same era.

Table 5-B: List of specially selected international units

Facility name	No Units	Layout Types*[18]	Source Publication
The Butterfly Concept Plan, USA	1	1	Cohen and Day (1993) p. 168
Woodside Place, USA	3	2	Cohen and Day (1993) p.138
Riverview, NSW	2	1	Judd *et al*., (1998) p. 58
Orchard Centre, Ireland	1	1	Niall McLaughlin Architects (2010) p. 68
De Hogeweyk, Netherlands	23	1	Anderzhon *et al*., (2012) p. 148
	30	6	

The second special selection, Woodside Place, Pennsylvania, illustrated in Cohen and Day (1993, p. 138) is included due to frequent reference to it in the wider literature reviews undertaken for the present research (Danes, 2012; Hoglund *et al*., 1994; Kovach *et al*., 1997; Nagy, 2002; Regnier and Denton, 2009; Saxton *et al*., 1998; Verbeek *et al*., 2008; Zeisel *et al*., 1994).

Riverview Lodge, Wingham, NSW, (Judd, Marshall, and Phippen 1998, p. 58) is the third specially selected scheme included. It is an example of the NSW Government's ground-breaking *Units for the Confused and Disturbed Elderly (CADE)* developments in the 1980s.

[18] Unit layout types are defined by the spaces and residents that share a dining space. Further explanation is provided in section 1.3

The floor-plan containing two mirrored-plan units, used for evaluation in this thesis, was first known to be published in a journal article by Fleming and Bowles (1987) in the *Australian Journal on Ageing*. It was subsequently re-published in the book '*Design for Dementia'* (Judd, Marshall, and Phippen 1998). The scheme was selected due to its association with a significant stage in the progression of dementia design, with the NSW Government's CADE program being the earliest known development program of new-build residential aged care settings, documented as research-informed, dementia-specific, and non-clinical, care environments.

The fourth special selection is the Orchard Centre, Dublin (Niall McLaughlin Architects 2010, p. 68) a respite centre and headquarters for Alzheimer's Ireland, which was designed by London-based Irish architect Niall Mclaughlin. Floor-plan drawings used for evaluation were borrowed from a chapter by McLaughlin in an annual publication, the *Architectural Association of Ireland Annual Awards, 2010* (Niall McLaughlin Architects 2010). This was the only non-ageing or dementia specialist publication used to source a residential aged care unit floor-plan. Although McLaughlin was not previously known for dementia-related design, the Orchard Centre is regarded as a high-profile example designed by a generalist architect, rather than an example by a specialist, nor was it necessarily widely recognised by dementia design experts. The Orchard project was selected for inclusion in the present research after the inclusion at the *Venice Biennale Architettura* 2016 of a co-designed installation about dementia design led by McLaughlin, called *Losing Myself* (McLaughlin, 2016).

Table 5-C: List of publication sources for international exemplar units

Publication source	No. of	No. of units	% units
Cohen and Day (1993)	17	38	40.4%
Judd *et al*., (1998)	1	2	0.2%
Niall McLaughlin Architects (2010)	1	1	0.1%
Anderzhon *et al*., (2012)	9	53	56.4%
Total	28	94	

The fifth of five specially selected international residential aged care units included in the present research is the well-known De Hogeweyk facility, located on the outskirts of Amsterdam, The Netherlands (Anderzhon *et al*., p. 148). The design evaluation for De Hogeweyk is based on the 'typical' unit plan illustrated by Pozzoni Architects, in Anderzhon *et al*., (2012). This unit is evaluated on the assumption that it represents a typical household from the overall development[19]. De Hogeweyk has had a high level of international attention in recent years (Paranagamage and Chrysikou 2017; Chrysikou, Tziraki, and Buhalis 2018; Brown *et al.*, 2017; De Mello 2016; Glass 2014). It is famed for including a working grocery store, café, and cinema, with residents encouraged to move freely around the development, and to live normal urban lifestyles whilst living in small group households.

For selection of the main group of international units to be evaluated the more recent publication, *Design for Aging: International Case Studies of Building and Program* (Anderzhon *et al.,* 2012) was the source of floor-plans, representing fifty-three residential aged care units across nine facilities, hosting a total of around 510 residents. Meanwhile, Cohen and Day's (1993) '*Contemporary Environments for People with Dementia'* provided floor-plan drawings for thirty-eight residential aged care units, across seventeen different facilities, hosting 108 residents. Finally, one scheme each was borrowed from both Judd, Marshall, and Phippen (1998), and Niall McLaughlin Architects (2010). Table 5-A provides an overview of the sources of the ninety-four international units included in the present research.

As previously noted, two of the 'international, best practice' cases also happen to be in NSW. These are Riverview Lodge, comprising two units, and Southwood Home, comprising six units. Despite their location, these NSW-based cases will continue throughout this dissertation to be considered as being amongst the 'international' (exemplar) set and not part of the 'NSW' set.

Table 5-A provides a full list of the international best practice examples of residential aged care schemes, including the number of units included in this study from each facility and the publication from which drawings to be evaluated were sourced

5.2.3 Additional data collection

Whilst the first research aim is addressed by undertaking dementia design evaluations of the floor-plans from residential aged care units and then comparing these, the second and third research aims build on the outcomes of the first aim and are addressed by correlating the

[19] Design evaluation of De Hogeweyk in this dissertation is based on the floor-plan example illustrated by Pozzoni Architects in Anderzhon *et al*. (2012). It is possible that this unit drawing may not be accurately representative of the full array of twenty-three dementia living units at de Hogeweyk.

dementia design evaluation score outcomes from the first aim against a range of further attributes related to each unit. This section describes the methodology used to collect this additional information.

Table 5-D: Research aims and methods

No.	Research aim	Method	Relevant data
1	To evaluate and compare dementia design quality in the layout planning of NSW-based and international best-practice examples of residential aged care units.	A	**Floor-plan Drawings** - Evaluated using Plan-EAT
2	To determine whether the dementia-enabling characteristics of floor-plan layouts for residential aged care units in NSW have improved over the last four decades.	B	**Year of Construction** - Date correlated against Plan-EAT evaluation score profiles
3	To investigate the impact of five spatial planning factors on the dementia design properties of Australian and international residential aged care settings The five factors are as follows:		- The datasets for each of the characteristics (3(i) to 3(v)) listed below, are separately correlated against Plan-EAT scores, from 1 above.
3(i)	**Unit floor area**	C	
3(ii)	**Number of bed-spaces**	D	
3(iii)	**Area per resident**	E	
3(iv)	**Storey location**	F	
3(v)	**Purpose-built for dementia**	G	

The main types of information required to address each component of the research aims are outlined in the Table 5-D. Some of this additional information, such as unit floor area (Aim 3a) and number of resident bed-spaces (Aim 3b), is obtained through further interrogation of the floor-plan drawings used for the Plan-EAT evaluations of dementia design quality (as described in Chapter 6). Other information, such as construction date (Aim 2) and whether the unit was purpose-built (Aim 3d), was obtained from participant questionnaire responses for the NSW recruits and design publication text for the international units. The participant questionnaire related to the NSW units is included in Appendix E.

5.3 Method: Data evaluation protocols

5.3.1 Defining units and unit layout types

Although the study contains 184 separate identifiable units, repetition of some layout types means that the study contains fewer 'types' of unit layout. The filtering process to identify distinct floor-plan types across the two sets of floor-plans involved two steps.

Some identical repeats were easily identifiable, whereas others required more exhaustive testing to confirm whether or not they were identical or merely similar. The most obvious identical repeats were the units from publications, where a single floor-plan was provided but where the text reported the presence of multiple repeats of the same unit type. Examples of these include a 'typical' unit from De Hogeweyk (Anderzhon *et al.*, 2012, p. 148), where a total of twenty-three units are reported; the Leonard Florence Centre, where two layouts (north and south houses) are each repeated over subsequent upper floors, achieving a total of ten units comprised of the two units types occurring five times each; and Friendship House, where there are a total of four instances of each of two unit types.

The identification of unit layout types involved some visual sorting of drawings. Units with clearly unique layouts were deemed to be distinct unit layout types. However, with a high volume of similar repeated units in many facilities, more detailed evaluation was required in some instances. This evaluation was primarily determined through evaluation using the Plan-EAT, which helped to identify where minor differences in layouts might (according to the Plan-EAT) have a meaningful impact on the wellbeing of occupants.

Where drawings were available for all units in a facility, they were examined in full, irrespective of how similar the layouts appeared to be. This process found some instances where some of the subtlest of differences in layout affected evaluation scores. Where a difference in dementia design assessment outcomes, or more specifically, differences in Plan-EAT score profiles resulted (see table within Appendix F for the NSW units and in Appendix G for international units) they were identified as different layout types for the purpose of the present research. There were other cases where more obvious (if still minor) differences in layout drawings resulted in identical Plan-EAT score profiles. In some instances, mirrored unit layouts achieved identical evaluation score profiles, and so were classified as being the same layout type. A full record of the responses to all thirty-nine Plan-EAT queries for each of the 108 units layout types are contained in two appendices. One each for the NSW set (Appendix F) and the international set (Appendix G). Summaries of the scores grouped under nine DDPs, which in turn contribute to a calculated overall Plan-EAT score for each unit, are contained in two further tables, located with Appendix H for the NSW units and Appendix J for the international units.

Where drawings for multiple units in same facility were available, each identifiable unit was evaluated. Conversely, where only one example drawing was available for a facility reported to contain multiple similar or identical units, then all units were, for the purposes of this research considered to be of the same unit layout type, and the evaluation output data repeated in the evaluation database for purposes of overall statistical analysis, for example, the twenty-three units represented by one typical example unit layout for De Hogeweyk (Anderzhon *et al.*, 2012, p. 148). The final list of identified international unit layout types is set out in Table 5-A. An equivalent list for the seventy-two NSW unit layout types is not included here, for purposes of protecting participant anonymity (per University of Newcastle ethics approval no:H-2014-0044.

First, all available drawings for unit layouts were individually evaluated using Plan-EAT (so some of the examples cited in the preceding paragraph were assessed only once to cover several repeats). Second, units from separate drawings or from different parts of the same drawing could only be classed as the same type once it had been determined that separate units were the same in all of the following attributes: 1. Floor-plan drawings were visually identical, or near identical, and 2. the units had identical score profiles across the full set of Plan-EAT questions. Only where both aspects were matching were any of the units considered to be repeats of the same layout 'type'. This two-stage process showed that even nuanced and seemingly minor differences in floor-plan could result in different Plan-EAT score profiles, and therefore necessitated defining them as different layout 'types' from the perspective of Plan-EAT and the present research. Examples of instances where this occurred included the impact of altered visibility to a toilet door when it was changed from one wall of the toilet space in one unit, to another wall of an otherwise identical toilet space in another unit.

When identical repeated (including mirrored) unit layouts were removed from the full set of 184 units, a total of 108 floor-plan 'types' remained.

5.3.2 Construction dates

Although there have been some small-scale past studies of dementia design quality in Australian residential aged care settings (Smith *et al.*, 2012; Chenoweth *et al.*, 2014) there are no known studies nationally or internationally to plot changes in dementia design quality over time. In most cases the known studies either focus on new facilities, a comparison between non-purpose-built (usually older) and purpose-built (usually newer) facilities or do little by way of acknowledging the age of the facility as a possible contributory factor to design quality.

The construction dates for all units in the present research were determined in order to be correlated against dementia design quality scores as a means of plotting the changes in design quality of both NSW and International best-practice residential aged care units over the forty-year time period covered by both datasets. The construction dates of the international units were obtained from the same publication as the international unit floor-plan drawings. The NSW unit dates were obtained either from the date of the drawings or by confirmation with the participating care organisation. In the case of some facilities (mostly the older ones) a lack of absolute certainty required an estimate of approximate date from the available information.

5.3.3 General floor-plan evaluations

Evaluations of unit floor plans include both the dementia design evaluations, using the newly developed Plan-EAT, as well as direct interrogations of the drawings to determine information such as unit floor areas and number of resident bed-spaces provided. However, as the quality, scale, and level of detail in the drawings obtained varied somewhat, from sketch plans through to technical construction drawings, consistent evaluations were dependant on developing a set of assumptions, conventions, and processes for how the available information would be interpreted as consistently as possible across both the NSW and international sets, irrespective of the drawing source.

The drawings supplied for the NSW units tended to contain more detail than those obtained from publications for the international units. The NSW floor-plans were typically at a level of detail somewhere between those used for development application and those used for construction purposes. However, the smaller pool of authors for the international floor-plans made them more likely to be consistent — even if not necessarily as complete or as accurate a representation of the unit being described. All the floor-plans in Anderzhon *et al.* (2012) were produced by Pozzoni Architects using standardised 'sketch' graphics. The drawings from Cohen and Day (1993) also tended to be consistent in the clarity and conventions of the drawings and the information presented. This consistency is considered beneficial for the reliability of the design evaluations of the international cases.

Most floor-plan drawings from the directly recruited NSW organisations were provided in PDF file type, using common construction industry formats, and including standard drawing scales (1:50, 1:100, 1:200 etc.) and sheet sizes (A1, A2, A3, etc.). The majority were drawn to enough detail for the required purposes of Plan-EAT, most often including room labels, furniture and enough fidelity in the line-work to distinguish some important types of objects from each other. For example, to make the critical differentiation between doors (which provide physical access, but not always providing visual access) and windows (which can provide light and visual access, but not physical access).

There were varied levels of quality in graphics and level of detail contained in the drawings from both the NSW participants and from publication sources[20]. For example, one set of drawings provided for NSW units consisted of basic fire-escape diagrams — so omitted some detail which may have been helpful, whilst several plans for international units were hand-drawn sketches at large scale. Conversely some other NSW drawings were highly detailed technical construction drawings — but sometimes omitted to indicate furniture. This variability created the challenge of how to ensure that evaluations, including floor area measurements, were undertaken in the same way. This led during the initial piloting to the development of a set of protocols, which included how drawing graphics should be interpreted, how they should be scaled (for area measurements), and how the Plan-EAT queries should be applied.

Without venturing into a complete and exhaustive description of all processes within this chapter, the standard architectural conventions and assumptions are used where possible, but where they are not (or they could be applied in more than one way) the conventions which are tabulated in detail in Appendix D were used. Some examples are as follows:

1. Loose furniture, where indicated on drawings, is typically utilised only for identifying the purpose or function of a space. In-place furniture is often different in style and laid

[20] Although floor area measurements were provided alongside published plans, measurement checks of unit areas from the published drawings carried out by the present author found that these were reported inaccurately. So, to ensure consistency across the entire dataset of floor-plans, direct measurements of floor-plan drawings, using CAD software, was undertaken for both sets of unit layouts.

out differently than shown in drawings. Some exceptions occur, with some examples identified below.

2. Only fixed or built-in appliances and cabinetry indicated on plans were used for answering specific queries about the location or role of furniture. Some assumptions are needed, however, to determine the likely positions of familiar furniture. E.g. EAT query no 1.05 *“Can the dining room be seen into from the lounge room?”* requires the visibility of dining room furniture to be known or assumed — if not, then the space is unlikely to be recognised.

3. Where WCs are not drawn, and the identified toilet space is a simple ‘convex’[21] space, then some benefit of doubt is given where the door opens against a wall, that the toilet pan is likely to be easily visible from the doorway of the space. This protocol applies to EAT query no 5.06 *“Are toilets visible as soon as the toilet/bathroom door is opened?”*

4. Patios and substantial deck or terrace areas were considered as ‘Garden’ spaces. No strict lower area size limits were set for this determination, but judgements were made to gauge whether outdoor spaces provided enough amenity for the number of residents likely to use them, in a variety of different ways. That is, whether the outdoor space(s) have enough capacity to be used for a range of typical activities (e.g. outdoor dining, gardening, clothes drying, etc). The provision of space is a different matter than the design or provision of furniture to support various activities. Garden access is assumed to require level access and be on the same floor level as the unit being assessed. Residents who can ordinarily move independently around the interior of the unit should not be required to use a lift, stairs, or staff assistance to get to the garden or available outdoor spaces.

5. Where an in-household ‘kitchen’ or ‘servery' is depicted in a way that indicates resident exclusion from the space, it is assumed to be inaccessible. Where drawing notes include the label ‘servery’ (vs kitchen), then an institutional system of preparing and delivering food was assumed. It was also assumed that residents are not ordinarily provided with access to the servery. Spaces labelled as ‘Kitchen’, ‘Tea Station’ or

[21] A convex space is one within which the entire space, including its perimeter, can be seen from any point inside the space (Ostwald and Dawes, 2018).

similar, which are also drawn as open-plan, or which suggest they are easily accessible to residents, are assumed to be accessible to residents.

6. Where the exact extent of communal areas, such as dining or living spaces, are not clearly defined on plan drawings as being bounded by walls other physical demarcation devices, they are deemed to exclude any adjacent area that would otherwise have formed a corridor space. This criterion was also a factor in determining if the space was provided with enough natural light (defined as a ratio of external glazing versus floor area) and impacted questions about the inter-visibility of nominated spaces from each other (e.g. Lounge – Bedroom).

7. All openings in walls between circulation spaces and communal spaces such as lounges, dining rooms, and hairdresser spaces, etc, are assumed to be clear openings or glazed, permitting visual access and light transmission between adjacent spaces. Doors to lounge and dining spaces are assumed to have glazed panels to help residents find and identify these spaces. Resident-accessible external doors are assumed to be fully glazed. Windows are assumed to have glazed panels that extend to at least 1m in height. This assumption on height is linked to the item immediately below. See examples illustrated in Figure 5-C and Figure 5-B.

8. External glazing is deemed to provide enough natural light penetration when there is at least 1 linear metre of external glazing indicated within enclosing external walls in each room for every 10 m^2 of floor space.

9. Doors are assumed to be hinge (swing) operated in most cases — identified by a swing arc drawn in floor plans. Sliding doors can be more difficult to determine, so need to be assessed based on context in each case. Examples for both are indicated in Figure 5-C and Figure 5-B.

10. Central communal areas (as distinct from those pertaining to an individual unit) often provide additional amenity, such as family rooms, hairdressers and cafés. They were treated as being available but not necessarily always independently accessible by all residents.

Some drawings did not contain figured dimensions, scale bar, known page size, or other convenient or conventional sources of dimensional referencing required to determine drawing scale and floor areas etc. In these and other circumstances, the processes set out in the following section were used to interpret and interrogate the available information in as consistent and accurate a way as possible.

5.3.4 Floor area measurement

The third aim of the present research includes the objective (Aim 3(i)) to evaluate the impact of floor-area on the dementia design quality of residential aged care units. This was evaluated

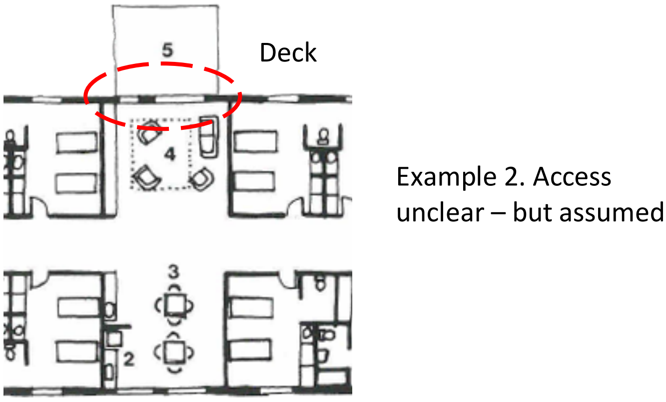

Figure 5-C: Sliding doors - Friendship House (1976) (Cohen and Day 1993, p. 76)

by correlating Plan-EAT scores for each unit, from Research Aim 1 (Chapter 6) against overall unit floor area and following this a similar aim (3(iii)) correlates the relationship between design evaluation scores against the floor area provision per resident for each unit.

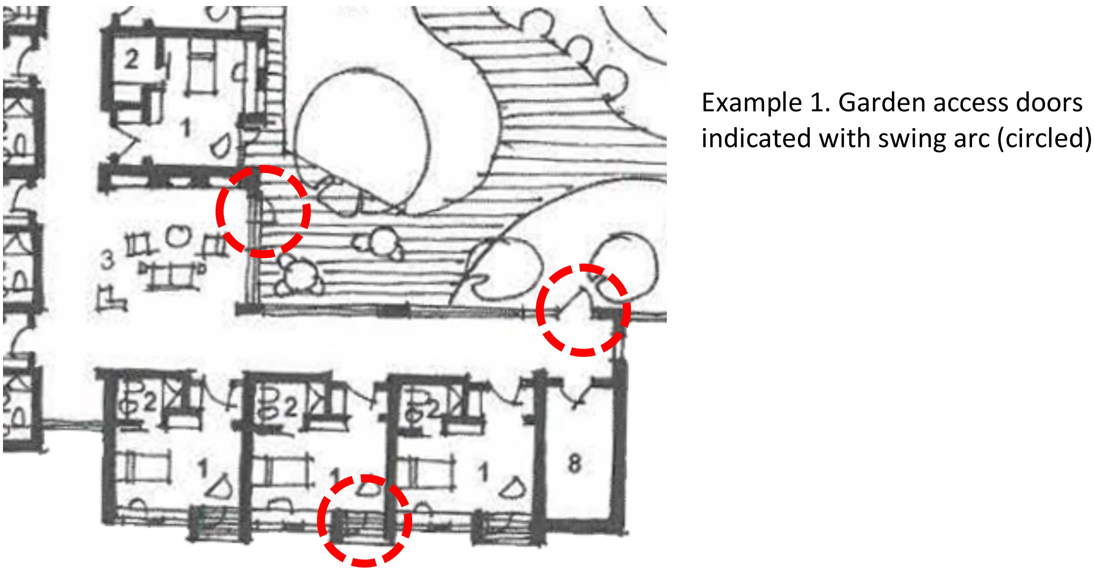

Figure 5-B: Swing doors - Childers Place (2007) (Anderzhon et al. 2012, p. 264)

In stand-alone units, the floor area was taken as the complete enclosed building envelope, whilst for any unit[22] that formed part of a multi-unit facility, the representative unit area was calculated as a sum of the floor area of the unit itself, plus a proportional share of the floor area occupied by service operational functions located outside the unit itself, such as administration, back-of-house services, communal facilities, and staff rooms. Examples of these zones for three of the international units are presented in Figures 5D, 5-E, 5-F, 5-G, 5-H, and Figure 5-I. One of these, Southwood Home (2007), contains five different staff and service zones, comprising a total of 1300m^2 floor area. For the purpose of unit type floor area, this services floor area is divided equally amongst the six units in the scheme (ignoring the differences in the number of residents per unit in the two-unit layout types). This one-sixth share of the service area is added to the average measured floor from each unit layout type, so in this the two layout type areas are as follows:

Area measurements from all drawing types and both NSW and international sets were made in a consistent way[23]. Drawing information was filtered to floor-plan drawings (only) and various file formats (including .pdf, .dxf, .dwg, .tiff etc) were converted to the raster-based file formats of Portable Network Graphics (.png), and Joint Photographic Experts Group (.jpeg). Raster files were imported to Autodesk Revit, a CAD program capable of working to millimetre accuracy at full scale. Imported graphics (floor-plan drawings) which did not contain embedded scales were scaled up to full size (real-life) using some of the most reliable identifiable objects represented in the drawing. The reliability of scaling operations, and therefore order of priority in application to floor-plans are as follows:

A. The longest available numerically annotated dimension line.

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[22] For the purposes of this research a residential aged care ‘unit’ was defined, per the ‘key terms’ section of Chapter 1, as those areas sharing a dining space.

[23] Although floor area information was often reported within the publications from which the international drawings were sourced, direct area measurements of published drawings suggested inaccuracies and inconsistencies in the way these were measured. This further justified the area measurement protocols initiated across the full set of available floor-plan drawings.

B. The 'scale-bar' graphic, usually included in floor-plan drawings.

C. The scaled size of standardised drawing 'sheets' [24].

D. Building outline scaled against measurements from online maps or satellite photography[25]

E. Scaled from furniture and other standardised objects indicated in the drawings[26].

Where enough figured dimensions were included on the drawings, only method 'A', above, was normally required for scaling. Where these were not available, then a combination of the next most relevant and reliable methods was used, with checks from other methods undertaken to help improve the accuracy of scaling. Despite these structured protocols, there is likely to be some, even if limited, degree of inaccuracy in the final scaling of drawn information. Awareness of this potential discrepancy as a variable is important when considering the reliability of area-based findings from the present research. Table 5-E shows an example of overall areas calculation for (Southwood Home) to be read in conjunction with the areas drawings in Figure 5-D and Figure 5-G. Other example drawings showing areas measurements are presented for Woodside Place (Figures 5-E and 5-F), and for Brightwood Onslow (Figures 5-I and 5-H)

Table 5-E: Unit area composition - example

	Service area (1300m^2)	Measured unit footprint	Formal unit area
	A	B	Sum: A+B
Southwood Home (n=5)	216.5m^2	848.5m^2	1065m^2
Southwood SCU (n=1)	216.5m^2	580m^2	796.5m^2

[24] Architects typically use the 'A' series of paper sizes meaning that drawing scale can potentially be determined from this. For example, an A1 drawing sheet will be sized 841mm x 594mm.

[25] Not all buildings in the study could be located on Google Earth or Google Maps and the accuracy of mapping and aerial photos varies. Furthermore, measurements for smaller buildings are less likely to be reliable than for larger buildings.

[26] Scale can be determined approximately if standard sizes of elements have been used and drawn accurately. For example, beds tend to be 2.0m long, and car parking spaces tend to be 5.0m long.

Figure 5-D: Southwood Home (2007) (Anderzhon et al. 2012, p. 14)

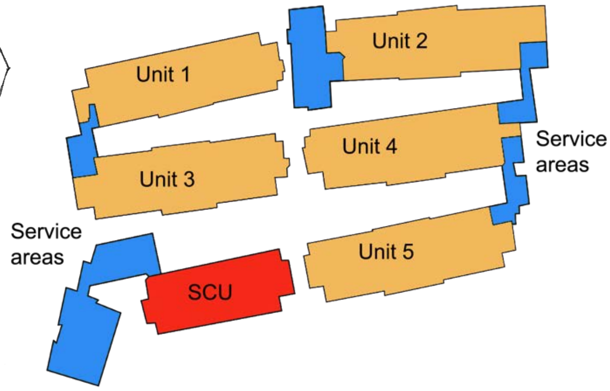

Figure 5-D: Units and areas - Southwood Home

Figure 5-H: Woodside Place (1991) (Cohen and Day 1993, p. 138)

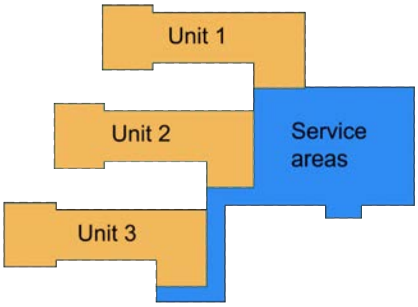

Figure 5-H: Units and areas – Woodside Place

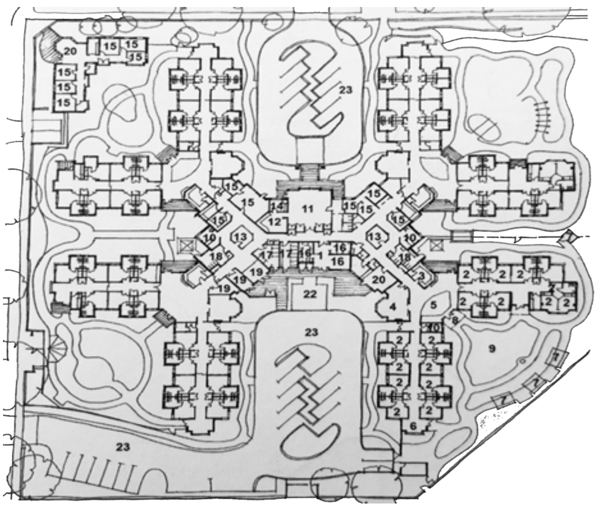

Figure 5-F: Brightwater Onslow (2001) (Anderzhon et al. 2012, p. 46)

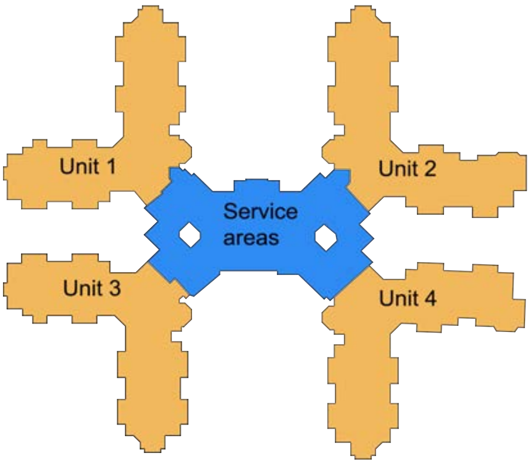

Figure 5-F: Units and areas – Brightwater Onslow

5.4 Conclusion

In the year 2015-2016, there was a total of 68,228 residential aged care bed-spaces available in NSW, with these bed-spaces located across 940 registered residential aged care and multipurpose facilities (Australian Government Department of Health and Ageing, 2016). The NSW provision represented 34.2% of the Australian total provision of residential aged care, broadly mirroring the proportion of older Australians who live in NSW[27] (Australia Bureau of Statistics, 2016). The listed residential aged care facilities varied significantly in size, from the six bed-spaces at Waratah Respite Centre, Coffs Harbour, to the 333 bed-spaces at Sir Moses Montefiore Jewish Home, Hunters Hill. According to the 2015-2016 list, the median number of resident bed-spaces in NSW-based residential aged care facilities was 64, whilst the average NSW facility hosts 77, indicating an upward trend in the size of NSW residential aged care facilities (Australian Government Department of Health and Ageing, 2016). This was an increase from the NSW average of 72 residents per facility in 2012 (Australian Government Department for Health, 2012). Unfortunately, there is insufficient information available within the Aged Care Service Lists (2012, 2016) or elsewhere, to determine the number of resident bed-spaces available within individual residential aged care units across the country

The 1851 resident bed-spaces within the NSW-recruited units represent approximately 2.7% of the 68,228 bed-spaces provided across the (2016) stock of NSW residential aged care provision (Australian Government Department of Health and Ageing, 2016) and the twenty-one directly recruited NSW residential aged care facilities represent 2.2% of the 940 facilities registered in NSW in the same year. Although this study sample is small and does not use formal robust statistical sampling sizing and methods, it is considered to be sufficiently large to be representative.

[27] In 2016 NSW was home to 33.6% of the population of people aged seventy or over, but only 31.9% of the overall population (Australia Bureau of Statistics, 2016).

6 COMPARING NSW AND INTERNATIONAL UNIT LAYOUTS

6.1 Introduction

This chapter addresses the first research aim of this dissertation: to evaluate and compare dementia design quality in the layout planning of NSW-based and international best-practice examples of residential aged care units. To address this aim, 184 residential aged care units, featuring a total of 108 layout types, were subjected to design evaluations. Plan-EAT was used to establish the dementia design quality of the layout planning of ninety directly recruited NSW-based residential aged care units (via seventy-two layout types), and a further ninety-four units (via thirty-six layout types) as international best-practice examples.

The set of ninety NSW units were located within twenty-one directly-recruited residential aged care facilities across the state. Thus, there was an average of 4.3 units per facility. The capacity of these facilities ranged from forty to 160 resident bed-spaces, with an average of eighty-seven bed-spaces per facility; ten higher than the NSW average (in 2016) of seventy-seven bed-spaces (Australian Government Department of Health and Ageing 2016). The overall set of participating NSW residential aged care units can provide accommodation for up to 1851 residents[28]. The average participating unit hosts twenty-one bed-spaces, and the median hosts eighteen — reflecting a slight trend towards larger resident numbers in the unit.

The set of ninety-four international units comes from a range of global locations, including Asia, Australia, Europe and North America. The designation of 'international' units (as defined in Chapter 1, section 1.3 *Key terms and concepts*) refers to residential aged care facilities considered by experts to be of a globally recognisable design standard, not their location — hence some Australian and NSW-based units occur within the international set. Between them, the international units included in this research can host up to 1353 residents. This means that the average number of residents per international unit is fourteen, with a median of twelve, also suggesting a slight upwards trend in sizes of units through the international set.

[28] Occupancy rates are shaped by natural turn-over and maintenance cycles, meaning that actual numbers of residents are likely to be below the maximum capacity.

6.2 Method

The method used to carry out the research reported in this chapter is described in detail in Chapter 5. In general, floor-plan evaluations were undertaken using Plan-EAT, which incorporates a series of thirty-nine queries organised under nine established dementia design principles (DDPs) (Fleming, Forbes and Bennett, 2003; Fleming, 2011). Points awarded for query responses contribute to a percentage score under each DDP. Subsequently, an average of the DDP percentage scores for each layout type is used to produce an overall Plan-EAT dementia design quality score for the unit, a measure also represented as a percentage value. The average scores were also calculated across all ninety units, or seventy-two layout types, in the NSW set, and all ninety-four units, or thirty-six layout types, in the international set. For this exercise the DDP and Plan-EAT values for repeated units were also repeated in the dataset used to calculate the statistics for the overall set of units — as this gives more accurate average and median values from the population sample considered. These calculated scores for each DDP and overall Plan-EAT are then used as points of comparison between the two sets, then these two 'average' score profiles are subsequently treated as the 'norms' of dementia design quality across the two sets, helping to identify areas of strength in the characteristics of each evaluated unit, as well as helping to highlight any aspects of the unit layout types where there may be room for improvement.

The reporting of results in this chapter includes Tables Q, R, and S, incorporating the DDP and Plan-EAT evaluation score outcomes for the NSW and international sets of units, and the production of lists of unit layout types (in Tables Q and R) — listed in numerical order as allocated during the process of anonymizing the NSW participants (NSW#1, NSW#2, etc.) and repeated for consistency in tables etc. with the international units (e.g. INT#1, INT#2, etc.). They include the presentation and discussion of a selection of international unit layouts alongside their Plan-EAT DDP score profiles, and some comparisons between the overall findings of the present analyses and those of a previous study of dementia design quality in NSW residential aged care facilities (Smith *et al.*, 2012).

6.3 Results

This section describes and discusses the results of Plan-EAT evaluations for the 108 unique plan layout types. Whilst some key points and summary results are incorporated here within the text, along with several tables and graphs, more detailed evaluation results are contained in the Appendices to the dissertation (see Appendix F, G, H and J).

The full dataset of attributes and evaluation results for each unit layout type across all three research aims amounts to a list of sixty items. As a result, the full total record of 6,480 data points recorded across both NSW and international sets are, by necessity, spread across several tables in this chapter. Raw data, such as the point-scores from each of the individual Plan-EAT evaluation queries, is presented in Appendices F, G, H, and J. Summary information, such as DDP percentages and overall Plan-EAT scores (and in other chapters, floor areas or year of construction) are presented in smaller more accessible information tables within the relevant chapter sections.

The summary finding of the first research aim, which is the main focus of this chapter, required reporting across a minimum of twelve main attributes: the scores for each of the nine DDPs together with the overall Plan-EAT Dementia design evaluation score, then the layout types identifier (e.g. NSW#1, INT#2 etc.), and the overall designation of the unit (i.e. whether in the NSW or international set) Table 6-C presents simple averages of these values, allowing comparison between the NSW and international sets. These values are also presented visually as a score profile graph in Figure 6-A.

6.3.1 Results Overview

The DDP percentages and overall Plan-EAT score for each of the individual NSW layout types are presented in Table 6-A. As the seventy-two layout types represent a total of ninety participating NSW units, the number of units represented by each numbered layout type is identified (e.g. layout type NSW#3 represents three recruited units). Whilst Table 6-A presents summary evaluation score outcomes on a DDP and Plan-EAT basis, the detailed results of evaluations from the thirty-nine individual Plan-EAT query items for the NSW set are presented in Appendices F and H.

The equivalent DDP and Plan-EAT evaluation outcomes for the thirty-six international unit layout types are presented in Table 6-B. The rank order by Plan-EAT score for the thirty-six international layout types is also indicated. In this case, the layouts are identified by both the layout type number (INT#1, INT#2, etc.) and unit (or facility) name as they were identified on the publications from which they were borrowed (Cohen and Day 1993; Judd, Marshall, and Phippen 1998; Niall McLaughlin Architects 2010; Anderzhon *et al.,* 2012) and as per the NSW table, this table also identifies the number of units represented by each layout type; for example INT#10, Childers Place (Anderzhon *et al.*, 2012, p. 264) encapsulates three international residential aged care units. In addition, as in the NSW set, Table 6-B presents summary assessment outcomes for the international set on a DDP Plan-EAT level. Similarly, the results of analyses from the full suite of thirty-nine Plan-EAT queries for the international units are presented in Appendices G and J.

Table 6-A: Plan-EAT score profile - NSW unit types

Layout Type	No. Units	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT	NSW Rank
NSW Avg.	90	46.7%	40.0%	40.2%	42.2%	74.0%	37.0%	61.2%	77.8%	79.3%	55.4%	
NSW Med.		50.0%	33.3%	42.1%	33.3%	80.0%	33.3%	58.3%	100%	66.7%	60.0%	
Std. Dev.		35.6%	23.5%	20.6%	32.3%	23.9%	24.2%	21.1%	41.8%	20.5%	16.9%	
NSW#01	2	50%	67%	42%	100%	80%	67%	92%	100%	67%	73.8 %	6
NSW#02	1	0%	0%	42%	67%	60%	22%	100%	100%	67%	50.9%	45
NSW#03	4	75%	33%	74%	100%	100%	78%	92%	100%	100%	83.5%	1
NSW#04	1	25%	67%	21%	0%	40%	0%	67%	0%	50%	29.9%	66
NSW#05	1	25%	67%	42%	33%	40%	0%	67%	0%	50%	36.0%	60
NSW#06	1	25%	67%	26%	33%	20%	0%	8%	0%	33%	23.7%	70
NSW#07	1	25%	33%	53%	0%	100%	11%	25%	0%	67%	34.9%	61
NSW#08	1	50%	33%	74%	33%	100%	11%	25%	0%	67%	43.7%	52
NSW#09	1	0%	33%	42%	67%	60%	78%	67%	100%	67%	57.0%	38
NSW#10	3	50%	33%	42%	67%	60%	67%	83%	100%	50%	61.3%	30
NSW#11	1	50%	67%	42%	67%	60%	67%	83%	100%	50%	65.0%	18
NSW#12	1	25%	0%	16%	33%	40%	11%	50%	100%	67%	38.0%	57
NSW#13	1	25%	33%	21%	33%	40%	0%	50%	100%	50%	39.2%	55
NSW#14	1	0%	33%	21%	0%	80%	11%	33%	100%	67%	38.4%	56
NSW#15	2	100%	33%	42%	33%	100%	33%	58%	100%	67%	63.0%	27
NSW#16	1	100%	33%	42%	33%	100%	33%	58%	100%	67%	63.0%	28
NSW#17	1	100%	33%	42%	33%	100%	44%	58%	100%	67%	64.2%	23
NSW#18	1	100%	0%	32%	0%	100%	33%	75%	100%	67%	56.3%	39
NSW#19	1	0%	0%	32%	33%	60%	22%	75%	100%	67%	43.2%	53
NSW#20	1	0%	0%	32%	33%	40%	11%	42%	0%	67%	24.9%	68
NSW#21	1	0%	0%	16%	33%	40%	44%	75%	100%	67%	41.7%	54
NSW#22	1	50%	0%	47%	0%	100%	22%	58%	100%	100%	53.1%	41
NSW#23	1	0%	0%	21%	33%	100%	44%	92%	100%	67%	50.8%	46
NSW#24	1	0%	33%	5%	33%	20%	11%	50%	100%	83%	37.4%	59
NSW#25	1	0%	67%	11%	33%	60%	11%	50%	100%	83%	46.1%	50
NSW#26	1	0%	100%	21%	33%	60%	11%	50%	100%	83%	51.0%	44
NSW#27	1	75%	67%	42%	33%	100%	33%	58%	100%	100%	67.6%	12
NSW#28	2	75%	67%	32%	33%	100%	33%	58%	100%	100%	66.5%	15
NSW#29	1	75%	67%	26%	33%	100%	33%	58%	100%	100%	65.9%	16
NSW#30	1	0%	0%	11%	67%	60%	22%	100%	100%	100%	51.0%	43
NSW#31	1	100%	0%	32%	33%	100%	44%	100%	100%	100%	67.7%	10
NSW#32	1	25%	67%	37%	33%	80%	67%	75%	100%	67%	61.1%	31

Layout Type	No. Units	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT	NSW Rank
NSW#33	1	25%	67%	32%	33%	80%	22%	75%	100%	67%	55.6%	40
NSW#34	1	75%	67%	53%	0%	80%	78%	50%	100%	67%	63.2%	26
NSW#35	1	75%	33%	79%	100%	80%	56%	75%	100%	67%	73.8%	7
NSW#36	1	75%	33%	79%	100%	100%	56%	75%	100%	67%	76.1%	3
NSW#37	2	75%	33%	79%	100%	100%	56%	75%	100%	67%	76.1%	4
NSW#38	1	50%	33%	47%	0%	100%	44%	58%	100%	100%	59.3%	34
NSW#39	1	50%	33%	47%	0%	100%	44%	58%	100%	100%	59.3%	35
NSW#40	1	100%	33%	47%	0%	100%	44%	58%	100%	100%	64.8%	19
NSW#41	1	100%	33%	47%	0%	100%	44%	58%	100%	100%	64.8%	20
NSW#42	1	100%	33%	37%	0%	60%	44%	58%	100%	100%	59.2%	36
NSW#43	1	100%	33%	63%	0%	40%	44%	58%	100%	100%	59.9%	33
NSW#44	1	0%	67%	0%	33%	40%	22%	25%	0%	33%	24.5%	69
NSW#45	1	25%	33%	11%	33%	60%	44%	50%	100%	67%	47.0%	49
NSW#46	1	25%	67%	42%	67%	40%	33%	17%	100%	33%	47.1%	48
NSW#47	2	25%	33%	16%	33%	60%	44%	50%	100%	100%	51.3%	42
NSW#48	1	100%	67%	37%	0%	100%	44%	58%	100%	100%	67.4%	13
NSW#49	1	75%	33%	21%	0%	60%	78%	58%	100%	100%	58.4%	37
NSW#50	1	75%	100%	63%	33%	60%	22%	50%	100%	67%	63.4%	25
NSW#51	1	50%	33%	68%	33%	80%	44%	67%	100%	100%	64.0%	24
NSW#52	1	50%	33%	68%	33%	80%	56%	67%	100%	100%	65.3%	17
NSW#53	1	50%	33%	58%	33%	80%	44%	83%	100%	100%	64.7%	21
NSW#54	1	50%	67%	74%	33%	80%	44%	83%	100%	100%	70.2%	9
NSW#55	2	50%	67%	63%	100%	80%	22%	67%	100%	100%	72.1%	8
NSW#56	2	50%	33%	63%	100%	80%	11%	67%	100%	100%	67.1%	14
NSW#57	1	50%	67%	32%	67%	60%	33%	33%	100%	100%	60.2%	32
NSW#58	1	75%	67%	32%	67%	60%	33%	33%	100%	100%	63.0%	29
NSW#59	1	50%	67%	16%	67%	20%	89%	100%	100%	100%	67.6%	11
NSW#60	1	50%	67%	5%	33%	20%	33%	33%	100%	100%	49.1%	47
NSW#61	4	0%	33%	16%	33%	60%	22%	50%	0%	67%	31.3%	65
NSW#62	1	0%	33%	32%	33%	60%	22%	50%	0%	67%	33.0%	64
NSW#63	2	0%	33%	37%	33%	60%	22%	50%	0%	67%	33.6%	63
NSW#64	1	0%	33%	32%	33%	60%	22%	58%	0%	67%	33.9%	62
NSW#65	1	50%	33%	47%	0%	100%	11%	58%	0%	100%	44.5%	51
NSW#66	1	0%	0%	37%	0%	60%	0%	50%	0%	100%	27.4%	67
NSW#67	1	25%	33%	42%	0%	80%	0%	58%	0%	100%	37.6%	58
NSW#68	1	0%	33%	16%	0%	40%	0%	8%	0%	33%	14.5%	72
NSW#69	1	75%	100%	84%	0%	100%	11%	42%	100%	67%	64.3%	22
NSW#70	1	0%	0%	5%	33%	80%	0%	0%	0%	67%	20.6%	71
NSW#71	2	100%	33%	47%	67%	100%	56%	75%	100%	100%	75.3%	5
NSW#72	2	100%	33%	47%	67%	100%	89%	75%	100%	100%	79.0%	2

The data indicates that the international units scored higher on average for dementia design quality than units recruited directly from NSW-based care organisations. These results are presented and discussed in the following sections, which look more closely at the differences between the sets, as well as a few circumstances where exceptions to the general trend occur.

On average, the Plan-EAT quality rating for the international set was 68.4%, with a median of 74.0%. In comparison, Plan-EAT quality rating for the NSW set was 55.4%, and a median of 60.0%. This means there is 13% difference between the averages for the two sets, and a 14% difference between the medians. As the median Plan-EAT scores for both sets are above the average this suggests there are more units that scored above the average value for dementia design quality than there are below these values — or in other words, there is a greater spread of scores amongst the layout types with the most room for improvement.

To assist in interpreting this result, a comparison of both sets together shows only one third of units in the international set scored below the median of the NSW Plan-EAT results, whereas only one third of the NSW schemes achieved a score that surpasses the median for the international set. In line with this trend, only nine of the seventy-two NSW-recruited layout types scored within the top 25% (or top twenty-seven types) — that is, layouts with Plan-EAT scores of 70.0% or above. However, if we temporarily ignore the formal categorisation of units into their ‘NSW’ and ‘international’ sets we find that the top twelve units overall (out of 184) and top four unit layout types (out of 108), when ranked by Plan-EAT score order, are physically located within the state of NSW, with the floor-plans sourced equally (six units each) from the NSW-recruited and international published sources. Furthermore, six of the top ten layout types overall (representing fifteen units), and nine of the top seventeen layout types (representing twenty units) are also physically located in NSW.

The lowest rated unit in the NSW set was NSW#68, with an average result across the nine DDPs of 14.5%. The highest rated unit in the NSW set was NSW#3, with an average result across the nine DDPs of 83.5%. The NSW unit that was closest to the average of its set was NSW#33 (55.6%). In contrast, the lowest rated unit in the international set was INT#19, John Douglas French — upper floor (1987) (Cohen and Day, 1993, p. 165), with an average result across the nine DDPs of 26.7%. The highest rated unit layout type in the international set was INT#30, the special care unit at Southwood Home (2007) (Anderzhon *et al.*, 2012, p. 14). Across the two sets, NSW#68 (14.5%) had the lowest overall rating of all cases and Southwood Home – SCU had the highest rating (86.0%). The unit closest to the average rating for both sets combined (62.0%) was NSW#10 with a Plan-EAT score of 61.3%.

Overall, this suggests that whilst a majority of NSW-based residential care units perform sub-optimally — having significant room for improvement — a small proportion of designers and care organisations in the NSW residential care sector possess a good combination of knowledge and motivation to voluntarily implement dementia design at standards of evidence-based design quality that is amongst the best in the world. These findings also suggest a need for caution before relying on examples of residential aged care unit layouts from publications as precedents for design, since the Plan-EAT evaluations scores show they are not necessarily of the highest quality in dementia design.

Table 6-B: Plan-EAT profiles - international unit types

	No. Units	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT	INT Rank
Intl. Avg.	94	72.6%	66.7%	55.7%	48.9%	81.1%	55.8%	60.0%	84.0%	91.1%	68.4%	
Intl. Med.		75.0%	66.7%	52.6%	66.7%	80.0%	67.7%	58.3%	100%	100%	74.0%	
Std. Dev.		25.4%	32.8%	24.3%	27.1%	20.8%	26.8%	17.1%	36.8%	18.4%	13.6%	
INT#01	1	75%	0%	21%	67%	40%	56%	75%	100%	67%	55.5%	30
INT#02	1	25%	0%	11%	33%	60%	67%	67%	100%	67%	47.7%	33
INT#03	1	100%	0%	37%	67%	100%	78%	92%	100%	83%	72.9%	12
INT#04	1	100%	33%	47%	67%	100%	44%	92%	100%	100%	75.9%	7
INT#05	1	100%	33%	53%	33%	80%	89%	58%	100%	83%	70.0%	18
INT#06	1	100%	67%	53%	33%	80%	89%	58%	100%	83%	73.7%	11
INT#07	2	100%	33%	53%	33%	80%	89%	58%	100%	83%	70.0%	19
INT#08	1	100%	33%	79%	33%	80%	33%	50%	0%	100%	56.5%	29
INT#09	1	75%	67%	16%	100%	40%	67%	100%	100%	83%	71.9%	14
INT#10	3	50%	33%	53%	100%	60%	89%	83%	100%	100%	74.2%	10
INT#11	2	25%	67%	63%	0%	40%	44%	75%	100%	100%	57.1%	28
INT#12	23	75%	100%	32%	67%	100%	67%	58%	100%	100%	77.6%	4
INT#13	1	50%	67%	47%	67%	100%	67%	58%	0%	67%	58.0%	27
INT#14	4	75%	33%	84%	33%	100%	22%	33%	100%	100%	64.6%	26
INT#15	4	75%	33%	84%	33%	100%	78%	33%	100%	100%	70.8%	16
INT#16	1	75%	67%	89%	0%	80%	22%	67%	100%	100%	66.7%	24
INT#17	2	100%	67%	79%	33%	100%	33%	42%	100%	100%	72.7%	13

	No. Units	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT	INT Rank
INT#18	1	75%	100%	95%	67%	80%	33%	50%	100%	100%	77.7%	3
INT#19	4	25%	33%	42%	33%	40%	0%	33%	0%	33%	26.7%	36
INT#20	2	25%	33%	42%	33%	40%	22%	33%	100%	33%	40.3%	34
INT#21	5	100%	100%	84%	0%	80%	56%	58%	100%	100%	75.3%	8
INT#22	5	100%	100%	84%	0%	80%	56%	58%	100%	100%	75.3%	9
INT#23	1	100%	67%	37%	67%	60%	78%	83%	100%	100%	76.8%	6
INT#24	2	25%	33%	16%	100%	60%	11%	67%	100%	67%	53.2%	31
INT#25	2	25%	33%	79%	67%	60%	33%	92%	100%	100%	65.4%	25
INT#26	1	100%	67%	47%	67%	80%	44%	100%	0%	100%	67.2%	23
INT#27	2	50%	67%	89%	67%	80%	0%	58%	100%	100%	67.9%	22
INT#28	2	100%	67%	84%	67%	100%	78%	100%	0%	100%	77.3%	5
INT#29	2	100%	100%	100%	67%	80%	44%	42%	0%	83%	68.5%	21
INT#30	1	100%	100%	63%	67%	80%	89%	75%	100%	100%	86.0%	1
INT#31	5	100%	67%	63%	67%	80%	89%	58%	100%	100%	80.4%	2
INT#32	1	75%	33%	26%	67%	20%	78%	75%	0%	67%	49.0%	32
INT#33	2	50%	100%	58%	33%	100%	22%	58%	100%	100%	69.1%	20
INT#34	3	50%	0%	68%	33%	60%	22%	58%	0%	67%	39.9%	35
INT#35	2	50%	67%	32%	33%	80%	100%	83%	100%	100%	71.7%	15
INT#36	1	50%	67%	32%	33%	80%	89%	83%	100%	100%	70.4%	17

The percentage point scores by each unit layout under the nine DDPs vary significantly from one layout type to the next. Whilst noting that *all* the DDPs recorded results at their maximum level (i.e. 100%) for at least one unit-layout type, and that seven of the nine DDPs recorded at least one entry at minimum level (i.e. 0%), two DDPs recorded above-zero lowest scores. DDP#5 recorded its lowest score as 20%, and DDP#10 recorded its lowest score as 33%. The highest scoring layout by overall Plan-EAT score did not achieve the highest score across all DDPs, similarly the lowest scoring unit overall did not achieve the lowest score across all the DDPs.

Table 6-C: Average Plan-EAT scores of NSW and international units

	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT
International Avg.	73%	67%	56%	49%	81%	56%	60%	84%	91%	68%
NSW Avg.	47%	40%	40%	42%	74%	37%	61%	78%	79%	55%

Looking across the average score results of the full nine DDPs, for both the international and NSW sets, it becomes clear that some DDPs tend to score better than others (see Table 6-C). Both sets score above 70% for DDP#5, DDP#9, and DDP#10, whereas both sets score below 50% for DDP#4. Having already established from the overall Plan-EAT scores that the NSW units achieve on average a 13% lower score than the international units, a closer review of the two sets, by DDP, shows that the differences between the two sets are not consistent. Whilst scores from the NSW set trails the international set by significant margins for DDP#1 (73%-47%=26%), DDP#2 (67%-40%=27%), DDP#3 (56%-40%=16%), and DDP#6 (56%-37%=19%), it comes much closer for DDP#4 (49%-42%=7%), DDP#5 (81%-74%=7%) and DDP#9 (84%-78%=6%).

Surprisingly, the NSW set even surpasses the international set for DDP#8 (Privacy and Community), with the NSW set scoring 61% with the international set achieving a score of 60%. Within this DDP the NSW units average slightly higher scores on three of the five available queries (8.01, 8.04 and 8.05) that pertain to the availability of space and provision such as small 'nooks' for quiet interactions (Q8.01), the ability for residents to dine in small groups (Q8.04) and the ability to dine alone (Q8.05). This difference may be explained through a range of factors including the comparatively large floor area of the NSW units providing more opportunity for secondary spaces, whether these are secondary dining, lounge spaces, or casual seating afforded by more generous circulation spaces, the absence of furniture in some cases and reduced scale of drawing for many international units inducing evaluation to err on the side of caution where there was uncertainty over whether a given layout addressed DDP#8 query items

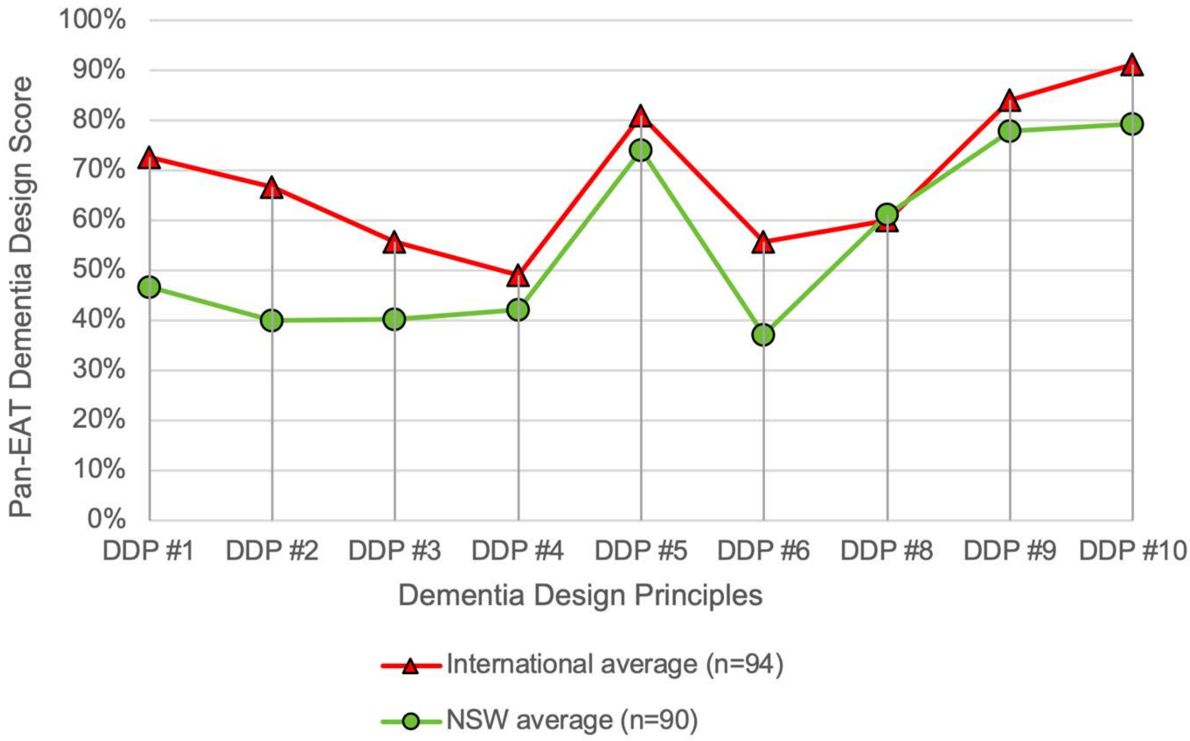

Figure 6-A: Plan-EAT score profile of NSW versus international residential aged care units

Overall, whilst the score profiles across the two sets of units suggest the greatest areas for improvement in the layout planning of residential aged care unit layouts are within DDP#3, DDP#4, and DDP#6, the areas where the NSW units have the greatest room for improvement relative to the international set are within DDP#1, DDP#2, DDP#3 and DDP#6. Suggesting that designers of layout plans for NSW residential aged care units should place greatest additional emphasis on meeting the Plan-EAT query items under DDPs one to four and DDP six.

Combining the results of Plan-EAT evaluations from both sets allows the identification of stronger (and weaker) layout types. Table 6-D contains a combined list of all 108 layout types in the present research. These are listed in rank order by Plan-EAT score, where some units from the NSW set perform amongst the best of the international exemplars. As the participation by NSW-recruited residential aged care services needs to remain anonymous, the international units are used to illustrate examples of high scoring layout types – potentially suitable as precedents to inform the layout planning of newly proposed residential aged care units.

Table 6-D: Unit layout types ranked by Plan-EAT score

Rank (of 108)	Unit Type:	Unit	Plan-EAT
1	INT#30	Southwood Home (1/2) Special Care Unit, NSW	86.0%
2	NSW#03	(Anon.)	83.5%
3	INT#31	Southwood Home (2/2), NSW	80.4%
4	NSW#72	(Anon.)	79.0%
5	INT#18	Himawari Group Home	77.7%
6	INT#12	De Hogeweyk	77.6%
7	INT#28	Park Homes	77.3%
8	INT#23	Minna Murra	76.8%
=9	NSW#36	(Anon.)	76.1%
=9	NSW#37	(Anon.)	76.1%
11	INT#04	Alzheimer's Disease Residential Center	75.9%
=12	INT#21	Leonard Florence Center (1/2)	75.3%
=12	INT#22	Leonard Florence Center (2/2)	75.3%
=12	NSW#71	(Anon.)	75.3%
15	INT#10	Childers Place	74.2%
=16	NSW#01	(Anon.)	73.8%
=16	NSW#35	(Anon.)	73.8%
18	INT#06	Brightwater Onslow (2/3)	73.7%
19	INT#03	Alzheimer's Care Center	72.9%
20	INT#17	Helen Bader Center	72.7%
21	NSW#55	(Anon.)	72.1%
22	INT#09	Orchard Centre	71.9%
23	INT#35	Woodside Place (1/2)	71.7%
24	INT#15	Friendship House (2/2)	70.8%
25	INT#36	Woodside Place (2/2)	70.4%
26	NSW#54	(Anon.)	70.2%
=27	INT#05	Brightwater Onslow (1/3)	70.0%
=27	INT#07	Brightwater Onslow (3/3)	70.0%
29	INT#33	Weikslag Krabbenlaan	69.1%
30	INT#29	Riverview Lodge	68.5%
31	INT#27	NPO Group Fugi	67.9%
32	NSW#31	(Anon.)	67.7%
33	NSW#27	(Anon.)	67.6%
34	NSW#59	(Anon.)	67.6%
35	NSW#48	(Anon.)	67.4%
36	INT#26	New Perspective Group Home ‘no.4’	67.2%
37	NSW#56	(Anon.)	67.1%
38	INT#16	Hale Kako'O	66.7%
39	NSW#28	(Anon.)	66.5%
40	NSW#29	(Anon.)	65.9%
41	INT#25	Namaste Alzheimer’s Center (2/2)	65.4%
42	NSW#52	(Anon.)	65.3%
43	NSW#11	(Anon.)	65.0%

Rank (of 108)	Unit Type:	Unit	Plan-EAT
44	NSW#40	(Anon.)	64.8%
44	NSW#41	(Anon.)	64.8%
46	NSW#53	(Anon.)	64.7%
47	INT#14	Friendship House (1/2)	64.6%
48	NSW#69	(Anon.)	64.3%
49	NSW#17	(Anon.)	64.2%
50	NSW#51	(Anon.)	64.0%
51	NSW#50	(Anon.)	63.4%
52	NSW#34	(Anon.)	63.2%
53	NSW#15	(Anon.)	63.0%
54	NSW#16	(Anon.)	63.0%
55	NSW#58	(Anon.)	63.0%
56	NSW#10	(Anon.)	61.3%
57	NSW#32	(Anon.)	61.1%
58	NSW#57	(Anon.)	60.2%
59	NSW#43	(Anon.)	59.9%
60	NSW#38	(Anon.)	59.3%
61	NSW#39	(Anon.)	59.3%
62	NSW#42	(Anon.)	59.2%
63	NSW#49	(Anon.)	58.4%
64	INT#13	Elderkare	58.0%
65	INT#11	Corine Dolan Center	57.1%
66	NSW#09	(Anon.)	57.0%
67	INT#08	Butterfly Concept	56.5%
68	NSW#18	(Anon.)	56.3%
69	NSW#33	(Anon.)	55.6%
70	INT#01	Alexian Village	55.5%
71	INT#24	Namaste Alzheimer's Center (1/2)	53.2%
72	NSW#22	(Anon.)	53.1%
73	NSW#47	(Anon.)	51.3%
74	NSW#30	(Anon.)	51.0%
75	NSW#26	(Anon.)	51.0%
76	NSW#02	(Anon.)	50.9%
77	NSW#23	(Anon.)	50.8%
78	NSW#60	(Anon.)	49.1%
79	INT#32	Stonefield House	49.0%
80	INT#02	Alois A.C.	47.7%
81	NSW#46	(Anon.)	47.1%
82	NSW#45	(Anon.)	47.0%
83	NSW#25	(Anon.)	46.1%
84	NSW#65	(Anon.)	44.5%
85	NSW#08	(Anon.)	43.7%
86	NSW#19	(Anon.)	43.2%
87	NSW#21	(Anon.)	41.7%
88	INT#20	John Douglas French Center (2/2)	40.3%
89	INT#34	Weiss Institute	39.9%

Rank (of 108)	Unit Type:	Unit	Plan-EAT
90	NSW#13	(Anon.)	39.2%
91	NSW#14	(Anon.)	38.4%
92	NSW#12	(Anon.)	38.0%
93	NSW#67	(Anon.)	37.6%
94	NSW#24	(Anon.)	37.4%
95	NSW#05	(Anon.)	36.0%
96	NSW#07	(Anon.)	34.9%
97	NSW#64	(Anon.)	33.9%
98	NSW#63	(Anon.)	33.6%
99	NSW#62	(Anon.)	33.0%
100	NSW#61	(Anon.)	31.3%
101	NSW#04	(Anon.)	29.9%
102	NSW#66	(Anon.)	27.4%
103	INT#19	John Douglas French Center (1/2)	26.7%
104	NSW#20	(Anon.)	24.9%
105	NSW#44	(Anon.)	24.5%
106	NSW#06	(Anon.)	23.7%
107	NSW#70	(Anon.)	20.6%
108	NSW#68	(Anon.)	14.5%

In the remainder of this section, the design evaluation outcome from ten of the best performing international facilities (containing eleven unit-layout types) is discussed and illustrated. This discussion highlights some of the main factors from wide-ranging findings with respect to research questions and the extent to which spatial arrangements, as depicted in floor-plan drawings, are likely to impact upon occupants with dementia.

6.3.1.1 Southwood, NSW, Australia

Southwood (2007) (Anderzhon *et al.*, 2012, p. 14) is a large, predominantly single level residential aged care development located in Hammondville, NSW, Australia. Its planning possesses six units, each with between eight and fifteen resident bedrooms per unit (See layout drawing in Figure 6-D). The units are separated by gardens and outdoor corridors and pathways, with some staff-only building areas connecting some of the units. For the purposes of the present study, Southwood has been evaluated as possessing two planning types: ‘Southwood Home’ (INT#31) and ‘Southwood SCU’ (INT#30). The Southwood SCU layout type (INT#30) scored the highest Plan-EAT outcome of all unit layout types in the present research. It performs well above both the NSW and international average scores under all DDPs, except for a minor shortfall versus the international average for DDP#5, Highlighting

Useful Stimuli, where, despite a high score (80%), it fails to surpass the international average for DDP#5 (81.1%). The Southwood SCU layout performs particularly well compared to the international average for DDP#1 (Safety), DDP#2 (Size), and DDP#6 (Support Movement and Engagement), where it records DDP scores more than 25% above the international average (See Figure 6-C). The Southwood Home layout (INT#31) also performs very well, being the second highest scoring international layout, and the third highest overall. Southwood Home equals or exceeds the averages for the international and NSW sets, except for DDP#5 (Highlighting Useful Stimuli), where it scores just below the international average (80% versus 81.1%) and DDP#8, Privacy and Community, where the layout scores below both international and NSW averages (58% versus 60% and 61.2%) (See Table 6-B and Figure 6-B). These differences between the two unit-layout types at Southwood relate to differences in the number of residents living in the two types (query no. 2.01), differences in the ability for residents to dine in small groups (query no. 8.4) or the ability for residents to dine alone (query no. 8.5). See section 4.2 for the full list of Plan-EAT queries, and Appendix G for the full list of query scores for both Southwood layout types as well as those for all other international layout types.

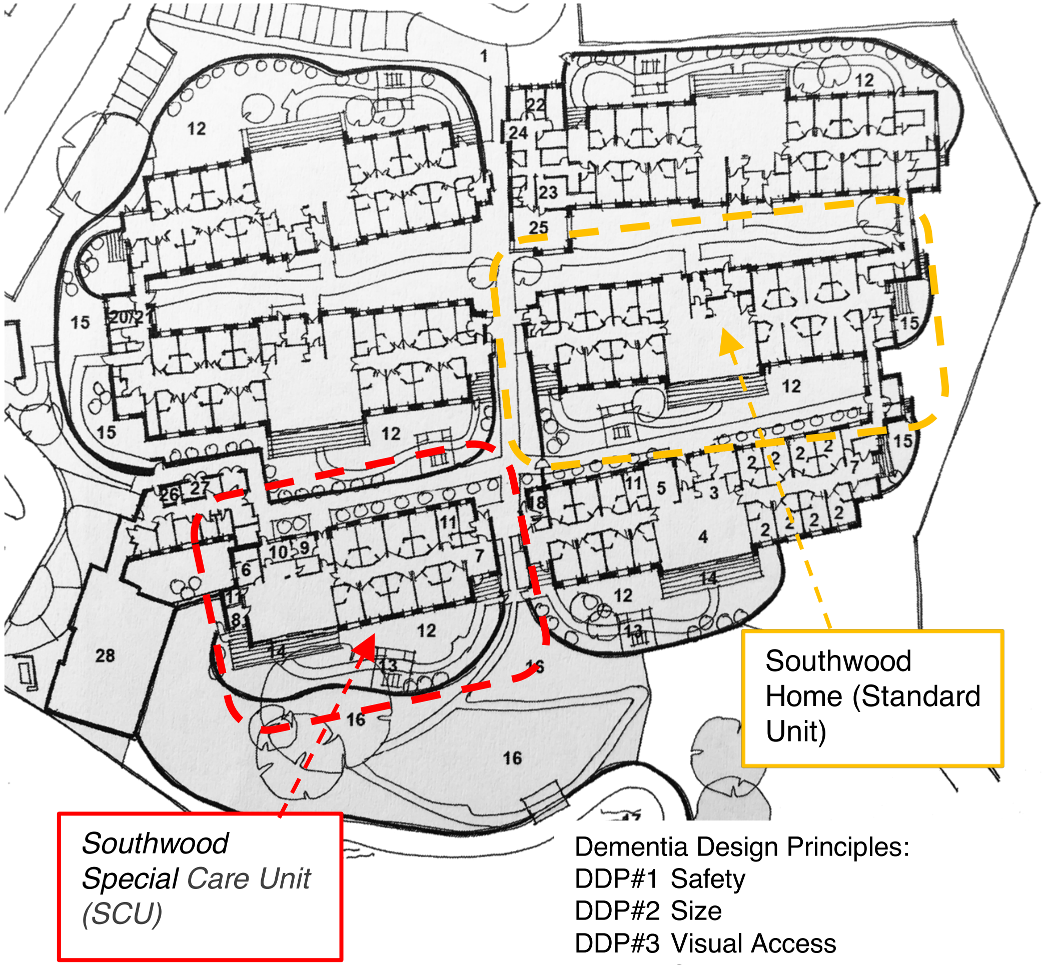

Figure 6-D: Southwood Home and SCU (2007) (Anderzhon et al. 2012, p. 14)

Dementia Design Principles:
DDP#1 Safety
DDP#2 Size
DDP#3 Visual Access
DDP#4 Stimulus Reduction
DDP#5 Helpful Stimuli
DDP#6 Wandering and Outdoor Space
DDP#8 Privacy and Social Interaction
DDP#9 Community Links
DDP#10 Domestic Activity

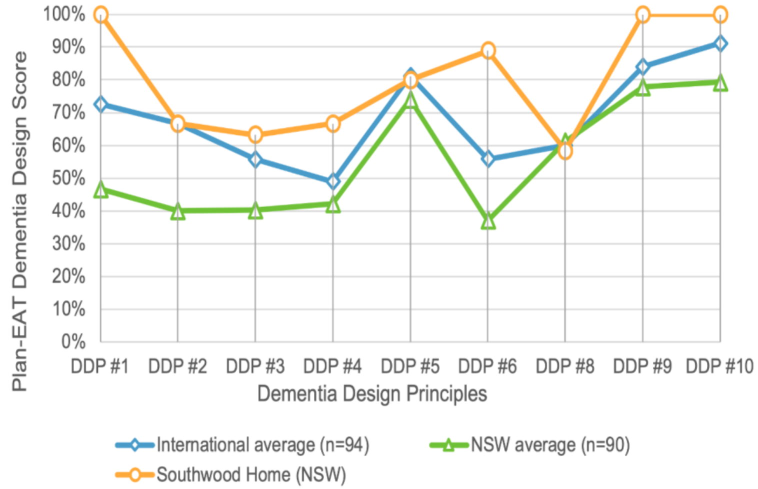

Figure 6-B: Southwood Home Plan-EAT Profile

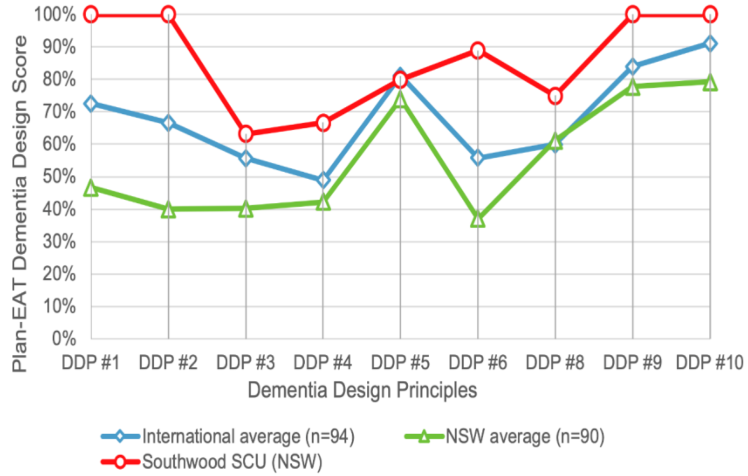

Figure 6-C: Southwood SCU Plan-EAT Profile

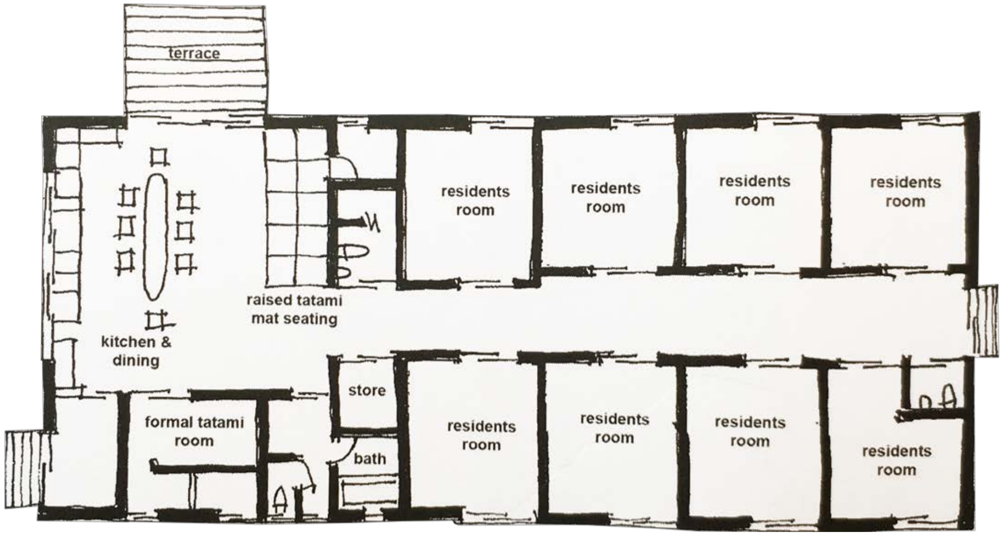

Figure 6-H: Himawari Group (1996) (Anderzhon et al. 2012, p. 66)

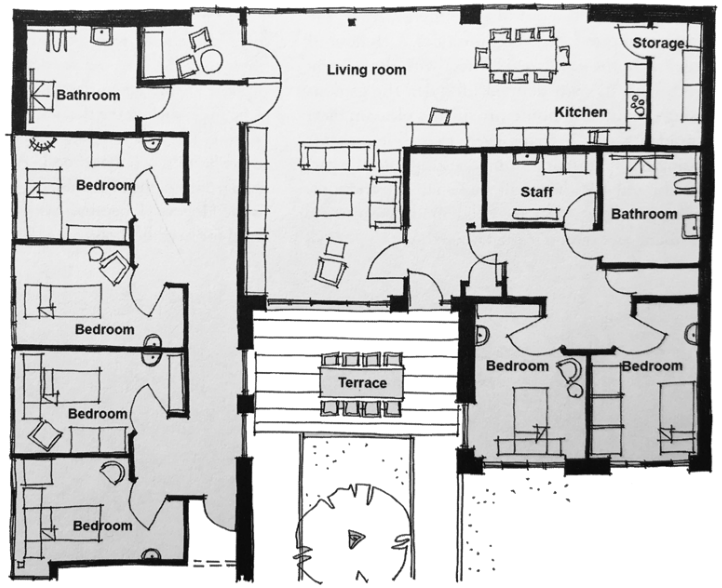

Figure 6-E: De Hogeweyk Typical Household (2009) (Anderzhon et al. 2012, p. 148)

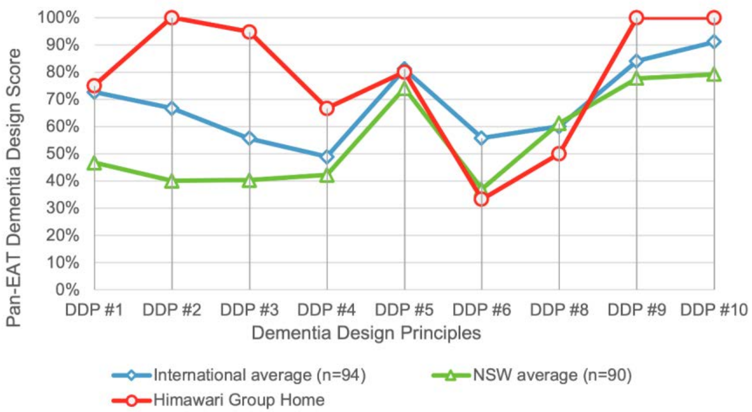

Figure 6-F Himawari Group Plan-EAT profile

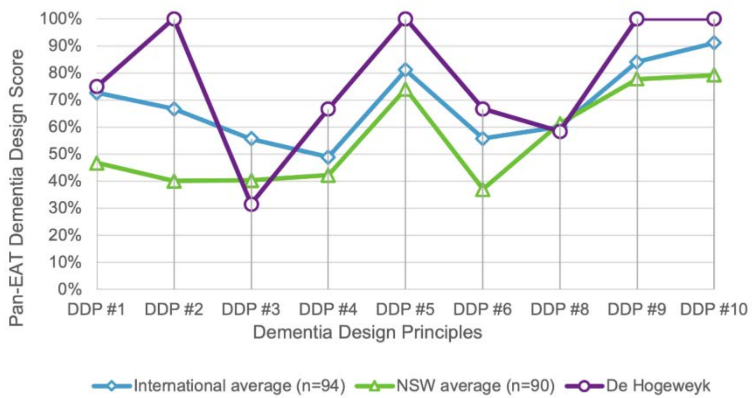

Figure 6-G: De Hogeweyk Plan-EAT profile

6.3.1.2 Himawari, Japan

Himawari (1996) is a small single level detached unit, located in Ofunato-shi, Iwate, Japan (Anderzhon *et al.*, 2012, p. 66). Its simple layout planning (Figure 6-H) consists of a total of eight single resident bedrooms, located half-and-half either side of a short, but relatively wide, corridor running between one of three main entry points, and a kitchen, dining, and raised tatami mat seating area. This main social space contains a single large table for the group, and access is provided from this space to toilet and bathing spaces, a formal tatami room and, via glazed sliding doors, to the terrace deck (described as having views over water). Apart from the deck, the floorplan drawing for Himawari does not indicate the provision of a resident garden or outside walking path. None of the bedrooms are provided with en-suite bathrooms, but at least three shared toilet spaces are provided throughout the unit for use by the eight residents. The Himawari layout type (INT#18), performs very well across most DDPs (see Figure 6-G), especially DDP#2 *(Size)* and DDP#4 *(Stimulus Reduction Features),* where it outperforms the average international Plan-EAT score by over 30%. The less successful areas for the Himawari layout are in DDP#6 *(Provision for Wandering)* and DDP#8 *(Privacy and Community),* where it scores slightly below the NSW average scores. The reductions in score under DDP#6 can be mostly explained by the absence from the drawings of any information about the garden (so evaluation could neither review nor award scores under related questions). The slightly suppressed score for Himawari under DDP#8 is related in part to the exceptionally small floor area of the unit (279m^2 compared to an international average of 623m^2) and relatively small floor area per resident between the eight residents in the unit (34.9m^2 per resident bed-space compared to international averages of 57.5m^2), which meant limited capacity to provide secondary spaces. The single large communal dining table — whilst arguably a familiar item in a familiar item of family living — prevents residents forming smaller dining groups (Q8.04) or eating alone (Q8.05).

6.3.1.3 De Hogeweyk, the Netherlands

The floor plan from De Hogeweyk (2009) (Anderzhon *et al.*, 2012, p. 148) is a ‘typical’ unit representing one of twenty-three similar units from an internationally recognised scheme located in Weesp, on the outskirts of Amsterdam, The Netherlands. The scheme is best known for being designed as an urban village, with its own supermarket, café, cinema and other uses that invite the surrounding community to visit the development, and to support the residents to live as normal a life as possible. Planned as a series of interlinking and well landscaped courtyards, the residents can move independently and safely around the development, free of safety concerns such as vehicular traffic. The residential units (see Figure 6-E) are planned for a group of six people living together, each with their own bedroom. Unlike many of the units in this study, the bedrooms, which are set out in pairs, are not provided with en-suite bathrooms. Instead residents share two communal bathrooms. The communal social spaces of kitchen, dining, living and a small south-facing outdoor terrace are set out in an open-plan manner with good visual access between them. Perhaps due to the number of residents, these communal spaces are of a scale typical to a conventional house, whereas these types of spaces for other units in the present research tend to be much larger in scale. A small enclosed 'snug' to the side of the main living room provides for more intimate conversations or quiet activities. The primary observable weakness from the Plan-EAT score profile (per Figure 6-F) of this unit layout type is the lack of visual access between resident bedroom doorways and the communal spaces (a topic which is subject to Plan-EAT queries 3.01, 3.02 and 3.03).

6.3.1.4 Parkside, USA

Parkside (2006) Hillsboro, Kansas, USA (Anderzhon *et al.*, 2012, p. 254) comprises a layout (Figure 6-J) of twelve single en-suite bedrooms set out around and overlooking the kitchen, dining, lounge and several alternative lounge and activity spaces. A generous outdoor deck space is accessible immediately off the main dining and lounge space. A walkway wrapping around the main social areas provides a circulation space that connects all the functions of the unit, including all bedrooms. The doors to most bedrooms are either set back from the main social spaces, but adjacent to one of two quiet lounges, or shielded somewhat behind a small enclosed block containing two small consulting or quiet activity spaces. The kitchen, which overlooks all the main spaces of the unit, is designed to allow staff to have casual surveillance of resident activities, whilst also inviting resident participation in kitchen activities. A double-sided fireplace in the heart of the main lounge area provides a focal point that helps residents understand the function of the space. The main communal toilet is located and orientated so it can be seen from most of the central communal areas. The Parkside layout (INT#28), representing two units, scored exceptionally well (Table 6-B), ranking as the seventh ranked layout overall, with an EAT score of 77.3%. It performed well above the NSW and international averages across all DDPs except DDP#2 *(Size)*, and DDP#9 *(Community Links)*. Under DDP#2 Parkside scored 67% whilst the international average is 66.7% (see Figure 6-I). The layout missed out by one point from achieving maximum score under this DDP, due to there being more than ten residents living in the unit. Parkside did not achieve any score under the single Plan-EAT enquiry DDP9 (query no 9.01) (Appendix G) which asks:

> *"Is there an area or room somewhat removed from the main dining room where families can share meals with their relatives?"*

Although the layout at Parkside (Figure 6-J) generously provides several options for sitting and activity spaces within and closely adjacent to the central communal area of the unit, the analysis of the Parkside layout for the purposes of Plan-EAT evaluation determined that the available spaces lacked the ability to provide the visual and audio privacy that would best support private family dining, believed to be the intention of this query item.

6.3.1.5 Minna Murra, QLD, Australia

The layout of Minna Murra (1986), Queensland, Australia (Cohen and Day, 1993, p. 86) is based on spaces laid out along a circulation route that wraps around a glazed internal garden courtyard. There are no en-suite bathrooms; instead there is one shared bathroom per cluster of three bedrooms. A series of bay widows and seats line the exterior of the main circulation route and there are multiple points through which a resident can always access the central courtyard and still be visible. The Plan-EAT evaluations of the Minna Murra unit layout (INT#23) gave an overall score of 76.8% giving it eighth position out of the 108 layout types. Analysis by DDP (Figure 6-K) showed Minna Murra performing above international average across DDP#1, DDP#4, DDP#6, DDP#7, DDP#8, DDP#9 and DDP#10 (and close to average under DDP#2). However, it underperforms compared to the international average under DDP#3 *(Visual Access)*, and DDP#5 *(Highlighting Useful Stimuli)* because it failed to score under Plan-EAT queries 3.04, 3.08, 3.10, as well as 5.01, and 5.02. For example: (Q.3.04) the lack of visibility from the lounge (bottom right corner of the drawing in Figure 6-L) toward the main garden access; or (Q3.08) the lack of visibility to a toilet from the dining space — although they are helpfully placed close by, they face the wrong direction to be easily seen; or (Q3.10) that the lounge room cannot be easily seen into from the position where staff spend most of their time (in this case we have assumed that staff spend most of their time close to the central open-plan kitchen and adjacent dining / activity spaces; or (Q5.01) the dining room is not 'looked into' from the lounge room; and finally from the reciprocal requirement (Q5.02) that the lounge room is not looked into from the dining room

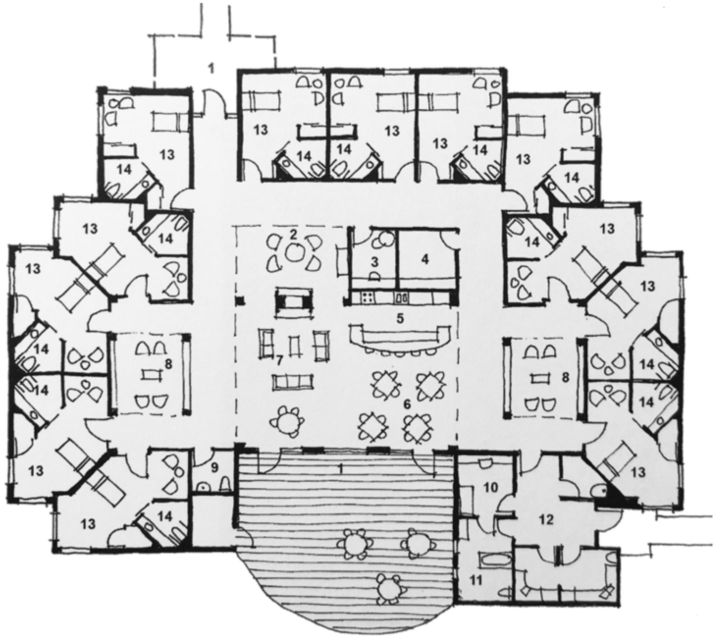

Figure 6-J: Parkside (2006) (Anderzhon et al. 2012 p.254)

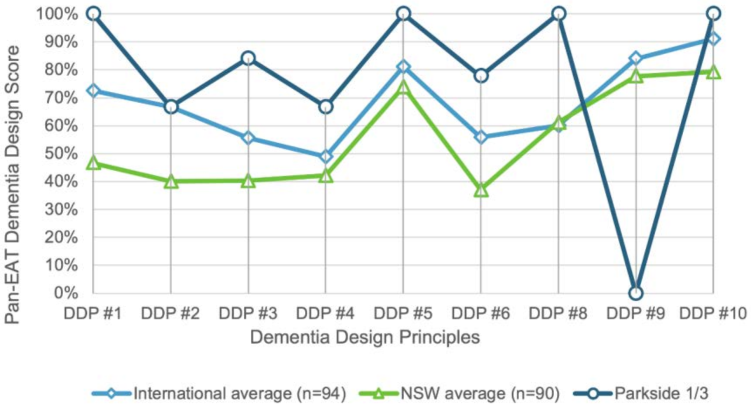

Figure 6-I Parkside Plan-EAT profile

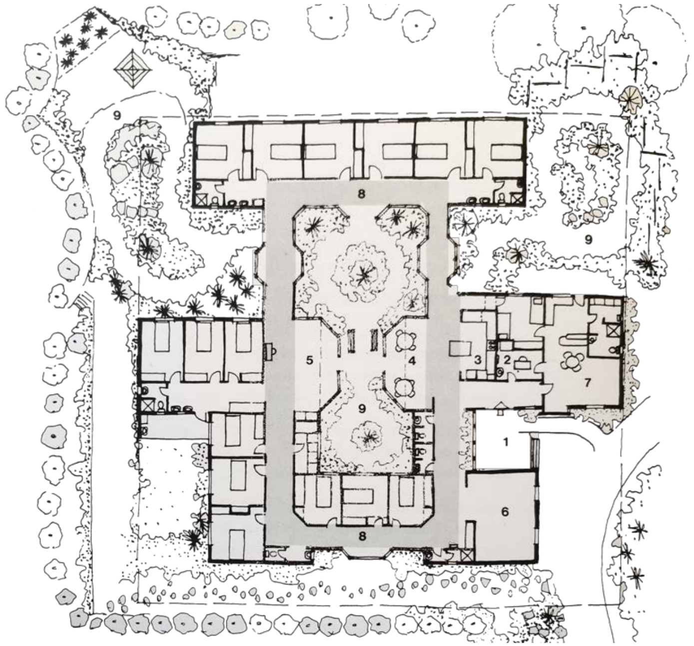

Figure 6-L: Minna Murra (1986) (Cohen and Day 1993 p254)

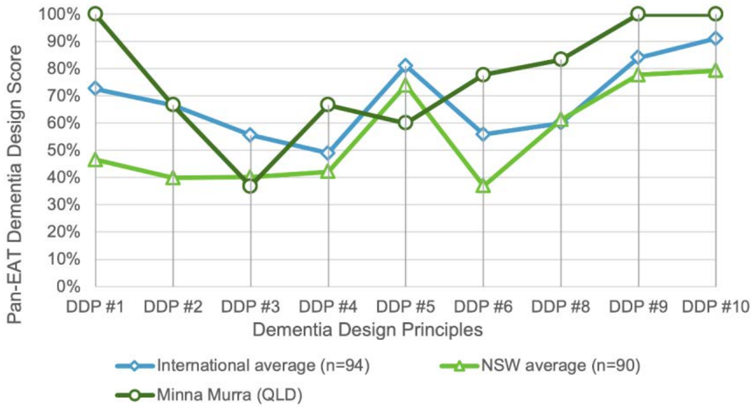

Figure 6-K: Minna Murra Plan-EAT profile

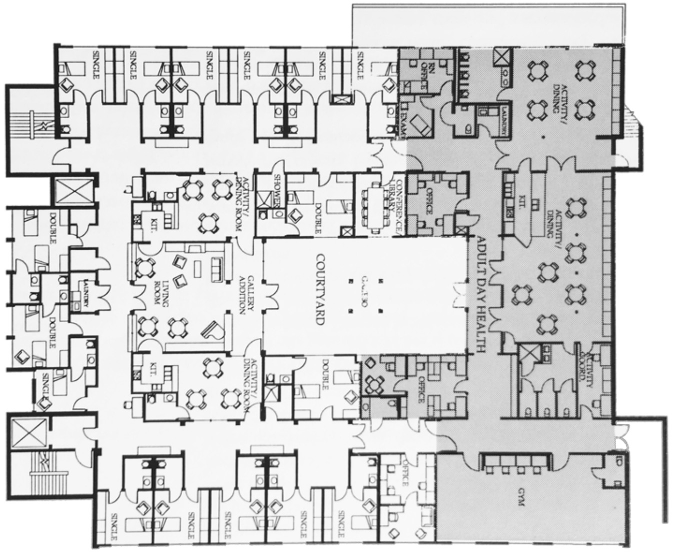

Figure 6-M: California Pacific (1994)
(Cohen and Day 1993, p. 61)

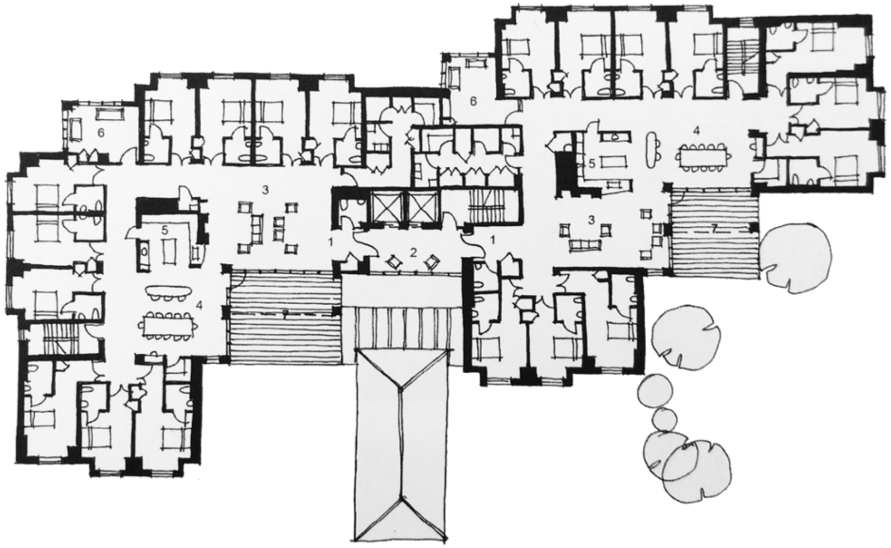

Figure 6-N: Leonard Florence Center (2010)
(Anderzhon et al. 2012, p. 214)

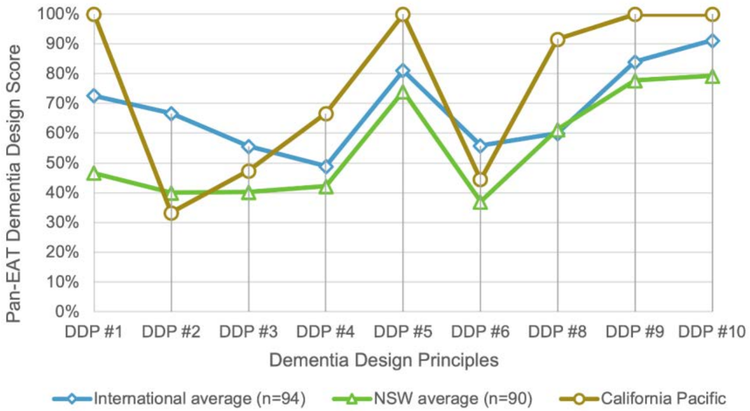

Figure 6-P: California Pacific Plan-EAT profile

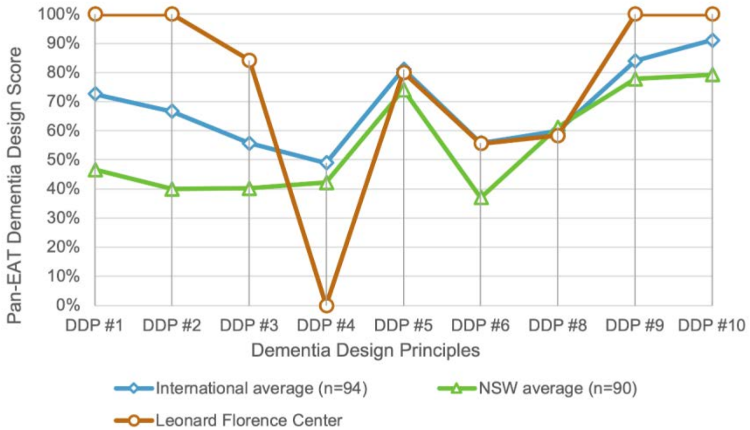

Figure 6-O: Leonard Florence Center Plan-EAT profile

6.3.1.6 The California Pacific Medical Centre, USA

The California Pacific Medical Centre, California, USA, hosts the Alzheimer's Disease Residential Center (1994) (Cohen and Day, 1993, p. 61). Its layout (see Figure 6-M) combines a twenty bed-space residential aged care unit with a day care centre organised upon a continuous loop corridor, wrapping around a modest courtyard garden space. The residential end of the building has a single communal lounge and main activity space, but with two separate kitchen-dining spaces, each set up to host up to twelve people dining. There are eight bed-spaces within twin rooms which do not have en-suite facilities, and twelve single bedrooms that are provided with en-suite bathrooms. The residents of the centre also have access to several large communal spaces of the day-centre including a large gym, and two large activities and dining halls. The California Pacific plan layout type (INT#04) Plan-EAT score profile (per Figure 6-P) performs especially well under DDP#1 (Safety), DDP#5, DDP#8, DDP#9 and DDP#10, but less well for DDP#2 (due to the number of bed-spaces) , DDP#3 (visual access to toilets, and to/from bedrooms is weak), and DDP#6 (there is a lack of landscaping or paths shown on the drawings within the garden spaces).

6.3.1.7 The Leonard Florence Center, USA

The Leonard Florence Center (2010) Chelsea, Massachusetts, USA (Anderzhon *et al.*, 2012, p. 214) was deemed to contain two similar but physically different mirrored unit types (INT#21 and INT#22) each representing five units (over stacked floors) hosting 10 bed-spaces per unit (Figure 6-N). Bedrooms wrap around centrally located social spaces that are easily seen as resident leave their bedrooms (even if the reverse is not quite the case for some bedrooms). An open plan kitchen serves an adjacent dining area which has both a large group dining table and small tables for smaller parties or dining alone. The kitchen also overlooks the lounge, the south facing sheltered outdoor deck spaces, and allows staff to survey much of the circulation space in the unit. A handful of 'nooks' and secondary lounge spaces provides choice for quiet activities, whilst supporting higher quality personal interactions that may not be suited to the main social space. The Leonard Florence layout types (INT#21 and INT#22) have identical Plan-EAT score profiles (per Figure 6-O), performing well under DDP#1, DDP#2, DDP#3, DDP#9 and DDP#10, with areas of weakness under DDP#4 (Stimulus Reduction Features), which include for example that the front door is too easily visible from the lounge room for those who might wish to exit, and there is a high likelihood of unhelpful stimuli as deliveries are likely to be transported across or immediately adjacent to main social spaces.

6.3.1.8 Alzheimer's Care Center, Maine, USA

Alzheimer's Care Center (1988), Maine, USA (Cohen and Day, 1993, p. 42) has a layout that is planned using a 'wandering path' that wraps around a large social space containing one of two lounge seating areas and a single dining space to cater for all thirty residents. See Figure 6-R. This central space also, also acts as a day centre for 6-10 day-time visitors. Splayed corners from the central communal space improve the view into and out of the central spaces, helping with wayfinding, and providing light and views to the garden. The garden provides a looped walking path, planters, and a sheltered seating area located close to the main garden access doors. Immediately adjacent indoor spaces are glazed where they face the garden, helping to ensure access to views and the orientating effect for residents of being aware of the time of day and time of year etc. Two alternative lounge spaces are located adjacent to the bedrooms along a north-south running corridor which leads to exit points at its ends. The bedrooms are all twin rooms, containing two single beds each, and sharing a small WC (in a 'Jack-and-Jill' fashion) between each pair of bedrooms. There is limited visibility to secondary lounge spaces as soon as residents leave their bedrooms, but they are otherwise likely to need to depend on signage to find their way to the central communal spaces. Kitchen and staff spaces are located together on the opposite side of the building to the resident bedrooms, with the configuration suggesting that residents do not get to participate in the kitchen-related activities of daily living. The Plan-EAT score profile (Figure 6-T) of this layout type (INT#03) performs relatively well compared to the international average under DDP#1, DDP#4, DDP#5, DDP#6, DDP#8, and DDP#9 This score profile has come about due a wide range of dementia-enabling features, with some examples as follows: The garden and main social spaces can be easily supervised by staff, service entries and access routes are not likely to be disruptive to residents, there is good quality natural light in the main social spaces, and good visibility in some circumstances where this provides helpful stimulus — for example seeing into the dining area from the lounge, or seeing the toilet pan from the toilet doorway. There is good provision of both indoor and outdoor paths for walking; the multiple lounge spaces accommodate a range of different simultaneous groups and activities, and there appears to be space where families can share a meal (away from the main spaces). The Alzheimer's Care Center (Maine) underperforms under DDP#2 and DDP#3, due to the high number of residents living in the unit, and poor visual access for the purposes of wayfinding between some key social spaces, kitchen, bedrooms and toilets.

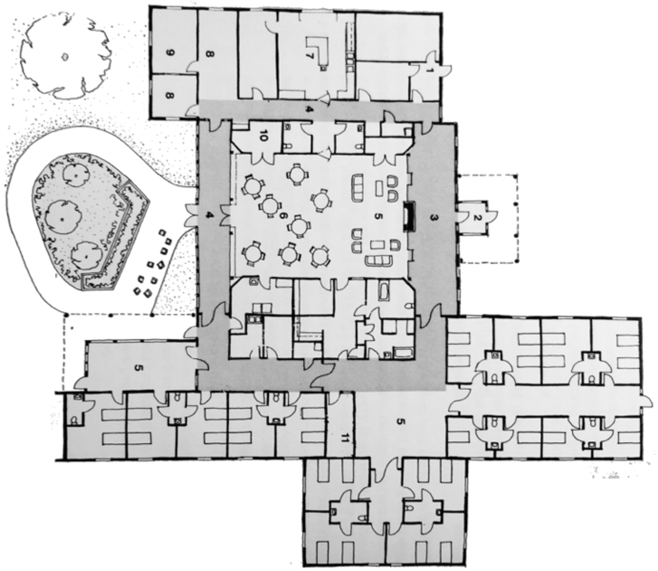

Figure 6-R: Alzheimer's Care Center, Maine (1988)
(Cohen and Day 1993, p. 42)

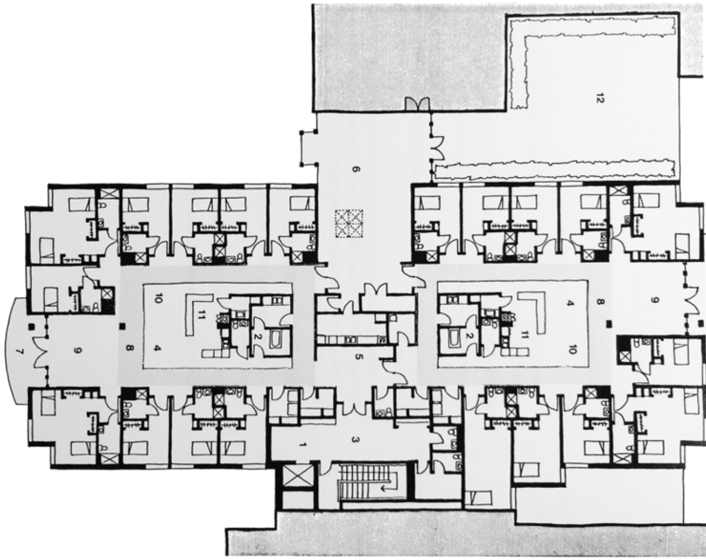

Figure 6-Q: Helen Bader Center (1993)
(Cohen and Day 1993, p. 162)

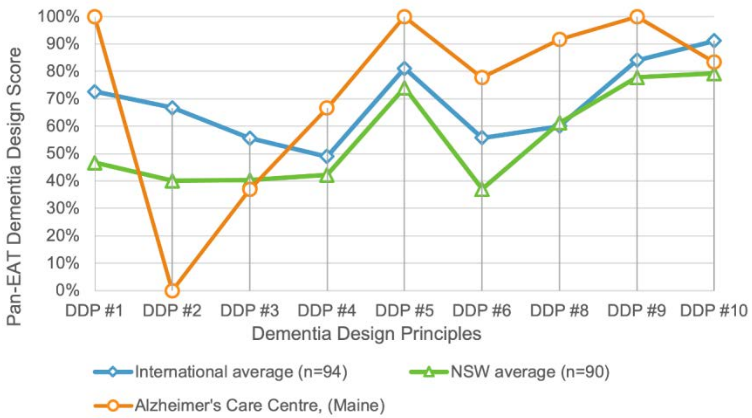

Figure 6-T: Alzheimer's Care Centre Plan-EAT profile

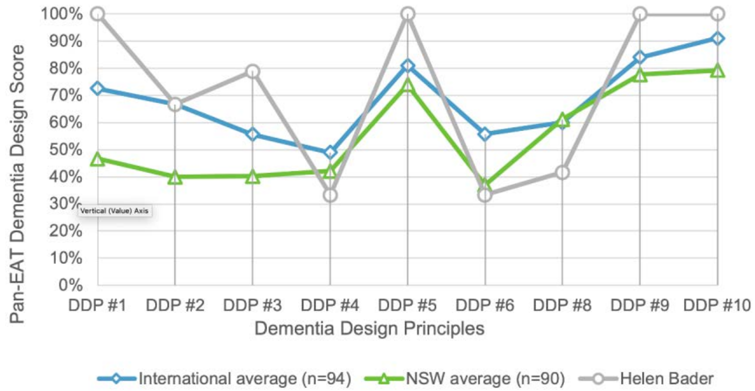

Figure 6-S: Helen Bader Center Plan-EAT Profile

6.3.1.9 The Helen Bader Center, USA

The Helen Bader Center (1993) in Milwaukee, Wisconsin, USA (Cohen and Day, 1993, p. 162) features two similar mirrored units, each hosting twelve bed-spaces comprised of eight single bedrooms, and two twin bedrooms (Figure 6-Q). Bedroom are located off a compact circulation path which loops around a centrally located block of toilets, bathrooms and utility spaces, next to an open-plan kitchen and adjacent dining spaces. There is high degree of visual access in the unit, especially between the main social spaces. The location of these spaces and the kitchen also ensure that staff are provided with a high level of visual overview of the unit, including most circulation spaces and onto a small balcony space. The key spaces of kitchen and dining are immediately visible to residents upon exiting their bedrooms. Although a smaller balcony/terrace space is immediately accessible to residents, it is too small for many activities or for hosting larger groups. However, larger communal multipurpose room and adjacent courtyard garden space are located between the two units. However, their position makes them difficult for staff to undertake casual surveillance of residents using them independently. The documentation suggests that the larger outdoor space has not been provided with features that support sitting, walking, or other meaningful activities — making them less likely to be used by residents. The Helen Bader Center performs well across most DDPs (see Figure 6-S) but below the average for DDP#4, DDP#6, and DDP#8. It achieves a full 100% under DDP#1, DDP#5, DDP#9, and DDP#10.

6.3.1.10 Brightwater Onslow, WA, Australia

Brightwater Onslow (2001), Subiaco, Western Australia (Anderzhon *et al.*, 2012, p. 46) is a facility comprised of four similar L-shaped units, per the drawing in Figure 6-U, and three layout types (INT#5, INT#6, and INT#7). Each of the three layout types is based on two short corridors of bedrooms at right angles to each other. From the analysis of drawings (which are small scale sketches) one layout type contains eight bed-spaces in both corridors, and the other layout type has seven bed-spaces in one corridor and eight in the other. Where the bedroom corridors meet, a central communal area containing a main lounge, kitchen and dining areas are located either side of the main circulation route, with access available from here to outdoor spaces and out of the unit towards central areas that connect the four units to shared services (such as administration areas, laundry, and multipurpose group activity spaces). The three layouts at Brightwater Onslow fall into two Plan-EAT score profiles (a third type has drawing variations but the same score as one of the others). The Plan-EAT score profile for the higher scoring of these is depicted in the graph within Figure 6-V.This layout type (INT#06) performs at or above the average levels under all DDPs except DDP#4 *(Stimulus Reduction Features)* which scores only 33% against an international average for DDP#4 of 48.9%. It performs well above average under DDP#1 (Safety) where it scores 100% versus the 72.6% international average; DDP#6 *Support Movement and Engagement),* where it scores 89% versus an international average of 55.8%; and DDP#9 *(Community Links),* where it scores 100% compared to an international average of 84.0%. The only difference between Plan-EAT score profiles of this layout against the second score profile at Brightwater Onslow occurs under DDP#2, where the score achieved is only 33% — this is caused by an additional bed-space in these layout types (INT#05 and INT#07), reducing the points awarded for the number of residents living in the unit.

Even though the Plan-EAT score profile for groups of units can help to identify areas of strength and areas with room for improvement across the groups, the DDP scores can vary considerably from one individual layout type to the next. This tendency for significant variation remains true even when the top performing unit layout types are compared directly across the nine applicable DDPs. For example, Park Homes at Parkside (2006) ranked seventh of 108 layout types yet scored zero under DDP#9; a DDP for which all other top ten units discussed

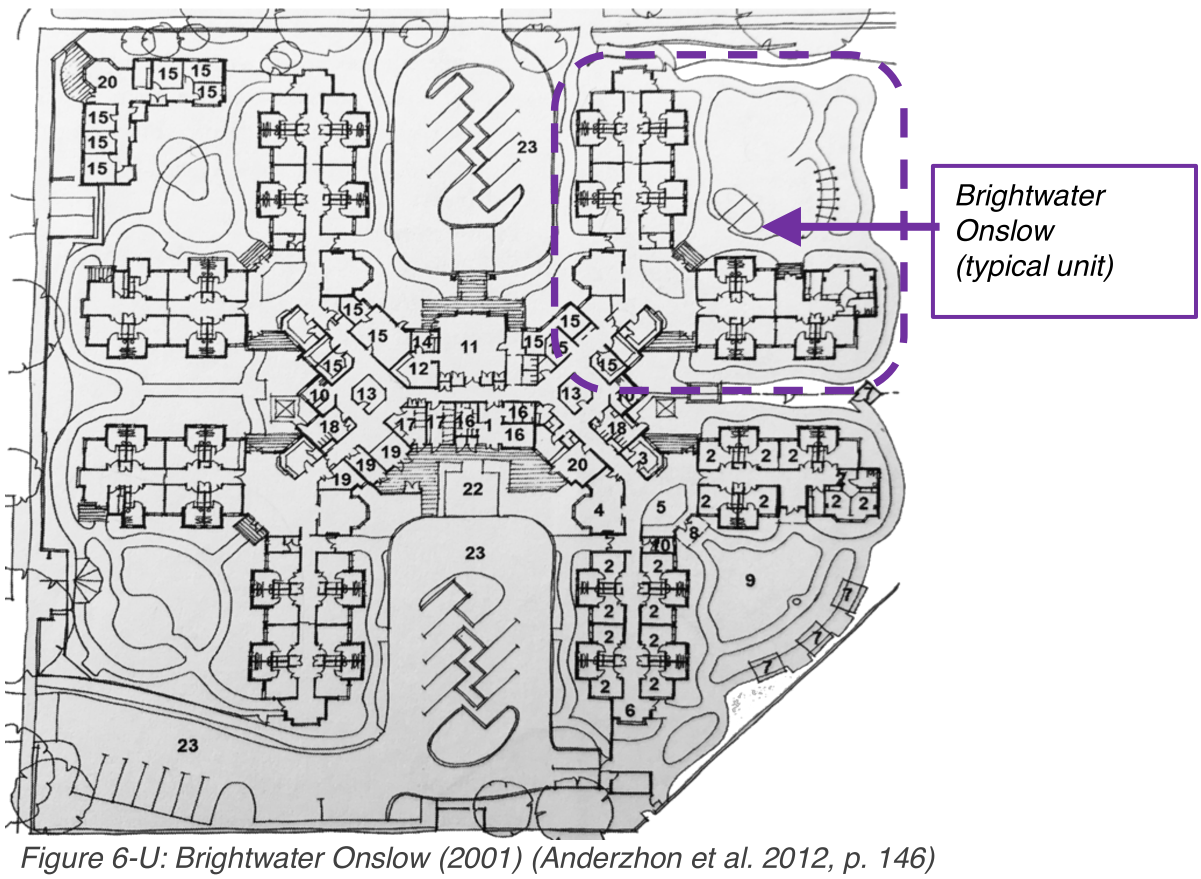

Figure 6-U: Brightwater Onslow (2001) (Anderzhon et al. 2012, p. 146)

in their section achieved 100%. Similarly, the Alzheimer's Care Centre, Maine (1988) ranked nineteenth of 108 scored zero under DDP#2 whilst Southwood SCU (2007), De Hogeweyk (2009), and the Leonard Florence Center (2010), all score 100%.

Dementia Design Principles (DDPs):

DDP#1 Safety	DDP#6 Wandering and Outdoor Space
DDP#2 Size	DDP#7 Familiarity (omitted from Plan-EAT)
DDP#3 Visual Access	DDP#8 Privacy and Social Interaction
DDP#4 Stimulus Reduction	DDP#9 Community Links
DDP#5 Helpful Stimuli	DDP#10 Domestic Activity

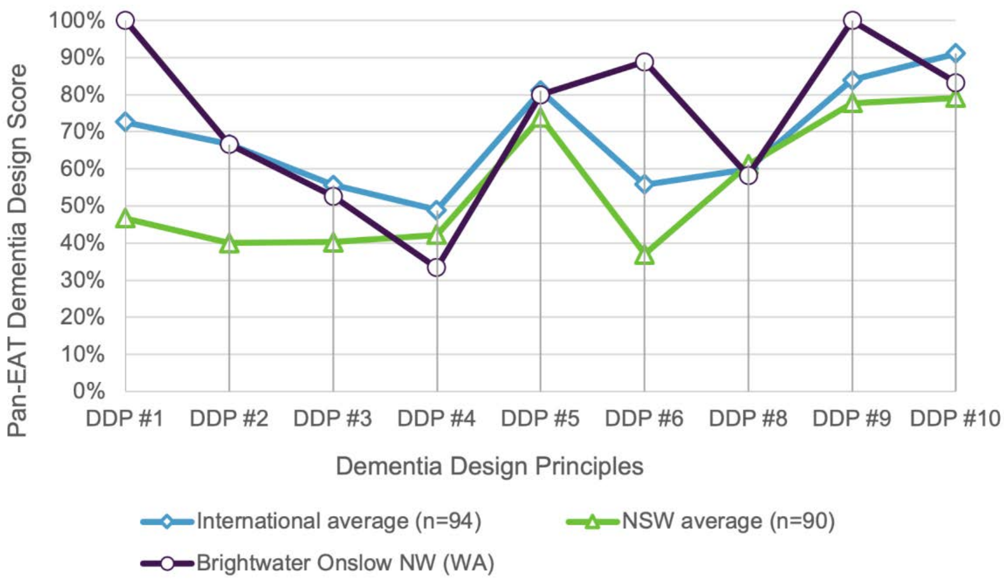

Figure 6-V: Brightwater Onslow Plan-EAT profile

6.3.2 Plan-EAT score trends

The largest known previous attempt to systematically evaluate and benchmark dementia design quality within existing residential aged care facilities is Smith *et al*. (2012). That study visited and audited fifty-six Australian residential care settings (twenty-four purpose-built and thirty-two non-purpose-built) using both the EAT (Fleming, 2011) and the TESS-NH (Sloane, *et al*., 2002). The scoring obtained from these objective evaluations was then used to establish a series of design 'norms' against which future design evaluations could be compared. These norms have since been used as benchmark measures when depicting design evaluations using the EAT, or its digital equivalent in the BEAT-D iDevice application (Fleming, 2015). For the purposes of the present research, the same principle is adopted as a means of allowing meaningful comparison between Plan-EAT scoring sub-sets from the floor-plan layouts evaluated during this project (Figure 6-A).

Plan-EAT was developed as a subset of questions from Fleming's EAT — those questions that could be applied meaningfully to floor plan information (Chapters 3 and 4) and resulted in a variable reduction in the number of questions and associated point scores available under some DDPs. Whilst four DDPs (DDP#2, DDP#3, DDP#6, DDP#8) retained all EAT queries and points, all other DDPs were reduced, with DDP#1, for example, being reduced from twenty-two to four points (a ratio of 0.18), and DDP#10 being reduced from sixteen to six points (a ratio of 0.375). These differences, as presented in Table 6-E mean that there will always be some limitations to the insight that is possible by comparing EAT and Plan-EAT score outcomes.

Table 6-E: EAT versus Plan-EAT points

Points per DDP	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Total[29]
EAT	22	3	19	8	9	9	12	2	16	100
Plan-EAT	4	3	19	3	5	9	12	1	6	62
Ratio	0.18	1	1	0.375	0.56	1	1	0.5	0.375	0.62

The comparison between the present dissertation's application of Plan-EAT and Smith *et al.*'s (2012) application of EAT reveals the following. For DDP#1 the NSW Plan-EAT results (47%) are below Smith *et al.*'s (71%) by a sizeable margin (24%), whereas the results for DDP#2 (Smith =33% / NSW =40%) and DDP#3 (Smith = 47.1% / NSW = 40.2%) are much closer (7% for both). Continuing with this approach the differences between the present results for the NSW set, and those reported by Smith *et al*. (2012) are much greater under five DDPs (DDP#2 = 24%, DDP#4=18%, DDP#6 = 23%, DDP#9 = 22%, and DDP#10 = 47) than they are under the other four (DDP#2 = 7%, DDP#3 = 7%, DDP#5 = 3%, and DDP#8 = 5%). When these findings, presented numerically in Table 6-F(and graphically in Figure 6-W) are compared with the preceding Table 6-E, there is obvious correlation between the DDPs with the largest reductions in points (from EAT into Plan-EAT scoring) and those with the largest differences

[29] Note: Twelve points from DDP#7 (Familiarity) omitted

in score outcomes from evaluations of NSW-based residential aged care settings from Smith *et al*. versus the present study.

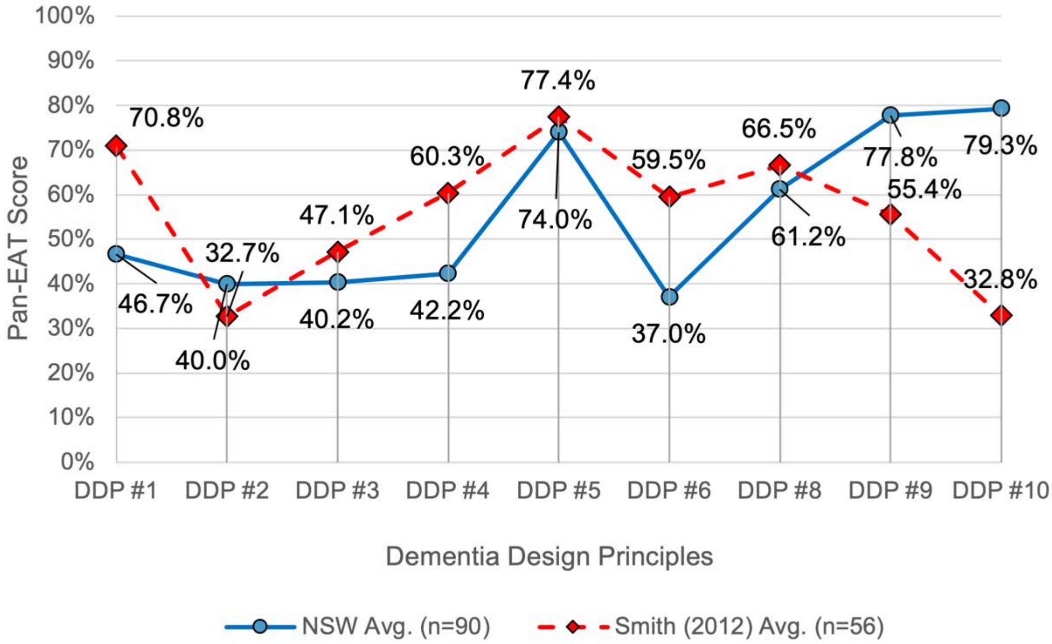

Figure 6-W: Plan-EAT profile NSW versus Smith et al. (2012)

Two exceptions to this correlation occur. One occurs under DDP#5, where there were only minor differences (3%) between the average score from Smith *et al*. (77%) and the NSW set (74%) despite a sizeable reduction in available points from the EAT to the Plan-EAT (EAT=9 points / Plan-EAT =5 points / Ratio = 0.56). The other occurred under DDP#6, where all nine original EAT queries and points were retained in Plan-EAT, but there was a large (23%) difference between the average results from Smith *et al*. (60%) and the results for the NSW set (37%) from the present research. As the full report of individual assessment items from Smith *et al*. (2012) is not available, it is difficult to determine the reasons for this difference. The most plausible speculation is that the differences arises from either (if not a combination of) incomplete information in some of the drawings used for Plan-EAT evaluations, or a more relaxed application of query items by assessors carrying out Smith *et al*'s post-occupancy evaluations.

Table 6-F: Plan-EAT scores for NSW versus published sources

No. Units	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT
NSW Avg. (n=90)	46.7%	40.0%	40.2%	42.2%	74.0%	37.0%	61.2%	77.8%	79.3%	55.4%
Smith *et al*. (2012) (n=56)	70.8%	32.7%	47.1%	60.3%	77.4%	59.5%	66.5%	55.4%	32.8%	57.3%
Difference	-24.1%	7.3%	-6.9%	-18.1%	-3.4%	-22.5%	-5.3%	22.4%	46.5%	-1.9%

6.3.3 Performance of the specially selected international units

As part of the process of recruiting international units, a subset of five residential aged care units were specially selected for inclusion in the study. The reasons for their inclusion, discussed previously in section 5.2, relate primarily to the frequency of their citation in past literature — suggesting that these units may possess higher levels of dementia design quality than others within the overall set of international units. This short section tests this by comparing how these units fare against the overall set of ninety-four international residential aged care units.

The overall average Plan-EAT score for the five units (69.2%) is close overall to the average for the international set (68.4%) and differed only modestly on a DDP by DDP basis, as can be seen in Figure 6-W and Table 6-H. The stronger and weaker DDPs for each of the unit layout types is shown in Table 6-G, but looking closer, the most notable findings are as follows:

The Butterfly concept, despite achieving the lowest score of the five schemes under four of the nine DDPs (DDP2 = 33%, DDP#4 = 33%, DDP#6=33%, DDP#9 = 0%), also achieved the equal-highest scores under two others (DDP#1 =. 100% and DDP#10 = 100%)

Riverview Lodge had weaknesses identified under three specific DDPs (DDP#6 =. 44%, DDP#8 = 42%, and DDP#9 = 0%) whilst achieving a full score, or near full score, on the other six DDPs.

The Orchard Centre scored poorly under DDP#3 Visual Access (=16%) and DDP#5 Helpful Stimuli (=40%) but is the strongest of the five schemes under DDP#4 Stimulus Reduction, and DDP#8 Privacy and Social Interaction.

The most noteworthy weakness, according to Plan-EAT, in the layout for De Hogeweyk occurs under DDP#3 Visual Access, which can be traced back to the reduced scores from specific query items related to lack of visibility (or lines of sight) between the main social spaces (dining and lounge) and individual resident bedroom doors.

Woodside place performs especially well under DDP#6 (=100%) scoring well above the next best score (of 66.6%) under this DDP as achieved by the Orchard Centre and De Hogeweyk. The weaknesses of. Both Woodside place layouts are under DDP#1 Safety (=50%), DDP#3 Visual Access (=32%), and DDP#4 Stimulus Reduction (=33%). See Table 6-H.

More specifically, (per Figure 6-X) the average score of the special set units surpassed the international average by a margin of 9% under DDP#6 *Wandering and Outdoor Space*, and DDP#8 *Privacy and Social Interaction*, but falls short of the international average, by a margin of (Plan-EAT score) 17%, under DDP#9 *Community Links.* However, as the average Plan-EAT values from such a small subset tell us little except to suggest that, collectively at least, the five special units are not exceptional for dementia design quality.

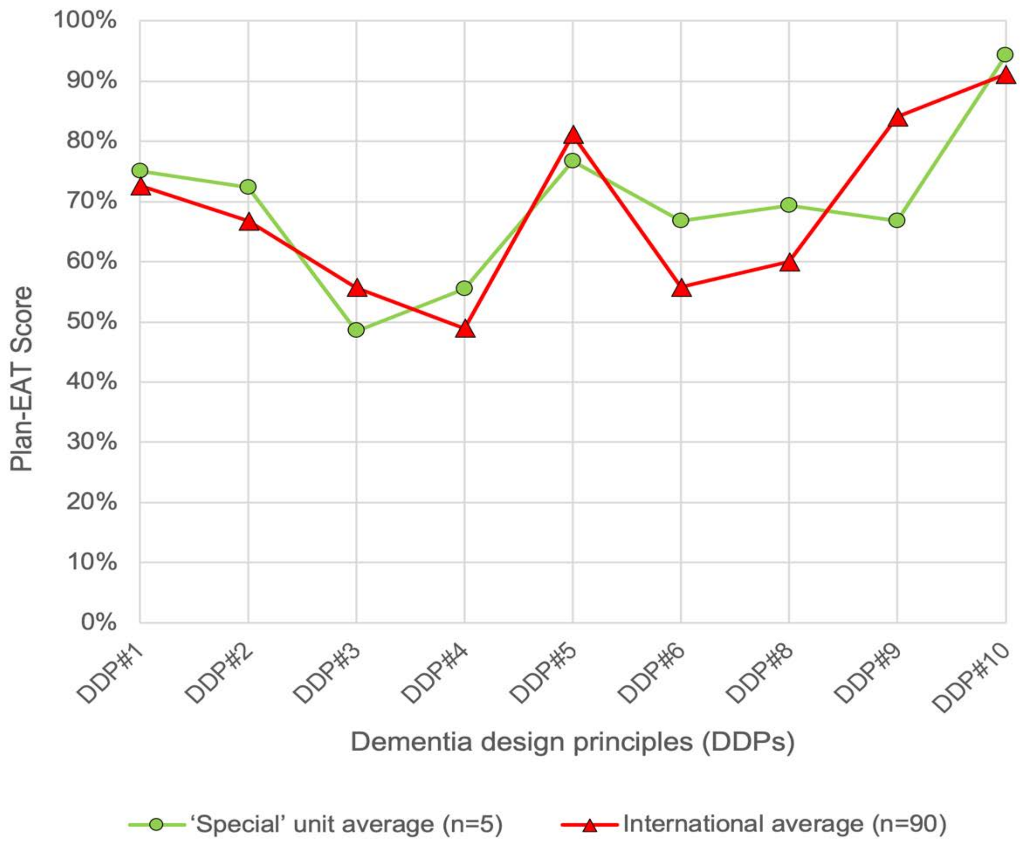

Figure 6-X: Specially selected units versus international average

Comparing the Plan-EAT score for individual units against the international average provides more insight showing, for example, that the Butterfly Concept (56.5%) was the only one of these five units with an overall Plan-EAT score lower than the international average (68.4%). Meanwhile, Riverview lodge (68.5%) is only marginally (0.01%) above the international average, whilst the Orchard Centre (71.9%) and both layout types for Woodside Place (71.7% and 70.4%) achieve scores modestly above the average for the international set. The best performing of the five, the typical unit from the now well-known De Hogeweyk (77.6%), exceeds the international set average by a margin of 9.2% (or design quality that is, in relative terms, 13% better than the average for the international set). When all unit layout types in the present research are ranked by Plan-EAT score, the typical De Hogeweyk layout is sixth of 108 residential aged care unit layout types when the international and NSW sets are combined, and it is the fourth highest-scoring of thirty-six layout types within the international set.

Table 6-G: Strengths and weaknesses of specially selected units

Unit Type	Unit Name	Stronger DDPs	Weaker DDPs
INT#08	Butterfly concept	1, 3	2,4,6,8,9
INT#09	Orchard Centre	4,8	3,5
INT#12	De Hogeweyk: typical unit	2,4,5,6,9	3
INT#29	Riverview Lodge	1,2,3,4	6,8,9
INT#35 & INT#36	Woodside Place	6,8,9	1,3,4
	Average of 'special' units	4,6,8	3,5,9

The most notable findings are as follows:

The Butterfly concept, despite achieving the lowest score of the five schemes under four of the nine DDPs (DDP2 = 33%, DDP#4 = 33%, DDP#6=33%, DDP#9 = 0%), also achieved the equal-highest scores under two others (DDP#1 =. 100% and DDP#10 = 100%)

Riverview Lodge had weaknesses identified under three specific DDPs (DDP#6 =. 44%, DDP#8 = 42%, and DDP#9 = 0%) whilst achieving a full score, or near full score, on the other six DDPs.

The Orchard Centre scored poorly under DDP#3 *Visual Access* (=16%) and DDP#5 *Helpful Stimuli* (=40%) but is the strongest of the five schemes under DDP#4 *Stimulus Reduction,* and DDP#8 *Privacy and Social Interaction.*

The most noteworthy weakness, according to Plan-EAT, in the layout for De Hogeweyk occurs under DDP#3 *Visual Access*, which can be traced back to the reduced scores from specific query items related to lack of visibility (or lines of sight) between the main social spaces (dining and lounge) and individual resident bedroom doors.

Woodside place performs especially well under DDP#6 (=100%) scoring well above the next best score (of 66.6%) under this DDP as achieved by the Orchard Centre and De Hogeweyk. The weaknesses of. Both Woodside place layouts are under DDP#1 *Safety* (=50%), DDP#3 *Visual Access* (=32%), and DDP#4 *Stimulus Reduction* (=33%).

Table 6-H: Plan-EAT score analysis for 'special' units

Unit Name	#Units	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT
International Avg.	90	73%	67%	56%	49%	81%	56%	60%	84%	91%	68%
'Special' unit avg.	30	75%	72%	49%	56%	77%	67%	69%	67%	94%	69%
Butterfly Concept	1	100%	33%	79%	33%	80%	33%	50%	0%	100%	57%
Orchard Centre	1	75%	67%	16%	100%	40%	67%	100%	100%	83%	72%
De Hogeweyk: (Typ.)	23	75%	100%	32%	67%	100%	67%	58%	100%	100%	78%
Riverview Lodge	2	100%	100%	100%	67%	80%	44%	42%	0%	83%	69%
Woodside Pl: (1/2)	2	50%	67%	32%	33%	80%	100%	83%	100%	100%	72%
Woodside Pl: (2/2)	2	50%	67%	32%	33%	80%	98%	83%	100%	100%	70.4

6.4 Conclusion

This chapter set out to address the first research aim of this dissertation through evaluation and comparison of dementia design quality in the layout planning of ninety NSW-based and ninety-four international best-practice examples of residential aged care units, represented by 108 distinct unit layout types.

The results of floor-plan based evaluations of dementia design quality using Plan-EAT, a tool derived from the Environmental Audit Tool (Fleming, 2011), as recorded overall dementia design quality in the layout planning of NSW, scoring 55%, falling behind the international set of unit layouts, scoring 68%, by Plan-EAT score difference of 13%, and suggesting that there is significant room for improvement in both sets — but especially so for the NSW set.

The design evaluations, undertaken through thirty-nine queries, also provided more specific measures of design quality for all 108 layout types under nine (of ten) established dementia design principles (Fleming, Forbes and Bennett, 2003; Fleming, Bennett and Forbes, 2013). Averages of the full sets of individual DDP scores helped to establish a score profile (or norm), which helped to better identify individual and collective areas of strength and weakness — or areas with room for improvement. These profiles identified, for example, that both international and NSW unit layouts tend to be strong under DDP#5, DDP#9 and DDP#10. Also, that international exemplars have the most room for improvement under DDP#4 and DDP#6, whilst NSW has significant room for improvement under DDP#1, DDP#2, DDP#3, DDP4, and DDP#6. Whilst the scores for the two sets of units come close under four DDPs of DDP#4, DDP#5, DDP#8, and DDP#9, NSW falls behind by the greatest margins under DDP#1, DDP#2, DDP#3 and DDP#6.

A ranked list of unit layout types by Plan-EAT score helped to identify that a small proportion of Australian residential aged care units are, and have historically been, amongst the best in the world; a point emphasised by the top four layout types (out of 108) and six of the top ten layouts evaluated in this research being physically located within the state of NSW.

Through the evaluation of 108 unit-layout types using Plan-EAT, it has been possible to identify unit layout types most likely to support people living with dementia. Conversely this has also helped identify layout types, and associated characteristics, that are less likely to be supportive of occupants with dementia – with both helping guide the identification of appropriate precedent layouts to inform the design of future residential aged care settings. Since the NSW units were required by human ethics to remain anonymous, various characteristics of a series of the best performing international units were discussed, using floor plan illustrations alongside the Plan -EAT score profile for each.

7 CHANGES IN DEMENTIA DESIGN QUALITY OVER TIME

7.1 Introduction

This chapter addresses the second aim of this dissertation which is *to determine whether the dementia-enabling characteristics of floor-plan layouts for residential aged care units in NSW have improved over the last four decades*. The investigation described in this chapter is primarily based on the correlation of the dementia design evaluation (Plan-EAT) scores of the 108 residential aged care unit layout types (reported in Chapter 6), against the construction date of each unit. While the results developed to answer the first aim, as discussed in Chapter 6, had begun to allude to a trend of design improvement over time, the present chapter examines the nature and extent of this improvement in more detail.

The useful life cycle of the average residential aged care facility is forty years (Aged Care Financing Authority, 2016, p. 125) so the present research set out to cover this time period. Conveniently, the gradual build-up of dementia design research evidence, evolution of DDPs, and the subsequent dissemination of this knowledge can be traced through the literature over the last thirty years. This date-based correlation analysis is therefore intended to trace the progressive changes to the rate and extent of application of DDPs to the design and construction of NSW and international residential aged care units. Although not a specific aim of this chapter, the comparisons against the best practice international units, which commenced in Chapter 6, continue throughout this chapter to provide context and basis for various observations. A short section of this chapter also includes comparisons between the sub-sets of international units drawn from the two main source publications, Cohen and Day (1993) and Anderzhon et al. (2012).

While the focus of the present chapter is changing quality over time, examinations of the changes in some specific architectural design characteristics over time are retained for discussion in Chapter 8. These include, for example, changes in the number of resident bed-spaces, or floor area per unit over time.

7.2 Method

For the purposes of the present chapter, Plan-EAT quality ratings (% scores) for all cases were charted by year in scatter graphs, and linear trend-lines (least-boxes method) generated for each set. These graphs (Figure 7-A through to Figure 7-E) and their outcomes are used as the primary basis for the findings presented in the following section.

7.3 Results

The construction dates of residential aged care units in the study spanned over more than four decades, from 1970 to 2016 for the NSW set, and from 1972 to 2010 for the international set. The median construction date for the NSW set was 2008, whilst the average was 2004 (a standard deviation of 11.8 years). As identified in Chapter 6, the median Plan-EAT score for the NSW set was 60% and, the average was 55.4% (with a standard deviation of 13.6% in Plan-EAT score value). Thus, in the NSW data there is a downward skew in construction date and a downward skew in Plan-EAT score. This means there is a larger spread of construction dates for the units built before the median construction date, and a larger spread of Plan-EAT score for the unit layout types that scored below the median for dementia design quality.

Table 7-A: Summary of construction year and Plan-EAT scores

Unit set	Year: Start	Year: End	Span (Yrs.)	Year: Med	Year: Avg.	Year: SD	Plan-EAT Med.	Plan-EAT Avg.	Plan-EAT: SD
NSW	1970	2016	46	2008	2004	11.8	60%	55.4%	16.9%
International	1972	2010	38	2007	1998	12.3	74%	68.4%	13.6%

The median construction date for the international units was 2007 and the average year was 1998 (with a standard deviation of 12.3 years). The median Plan-EAT score for the international set was 74.0% and the average was 68.4 (with a standard deviation of 13.6%). Thus, in the international data there is also a downward skew in both construction date and Plan-EAT score. This is like the NSW set, but with a slightly greater spread of dates and Plan-EAT scores below the median value for each (see Table 7-A).

The scatter graphs of Plan-EAT scores versus construction dates for both NSW and international sets were used to calculate two linear trend lines (one for each set) that rise from left to right (Figure 7-A) These trend lines confirm that there have been long-term improvements in dementia design quality, with the international set having an average decadal improvement rate of 7.2%. This is based on the formula: y= 0.0072x -13.605 where x represents the year and y represents the Plan-EAT score. Meanwhile the NSW set recorded an average decadal improvement rate of 6.6% [y=0.0066x – 12.707]. Although both trend lines are positive, the results show that the rate of design quality improvement of the NSW set (6.6%/decade) remains behind the rate of improvement of the present sample of international units (7.2% per decade), by a margin of approximately 0.6% per decade. The modest sample sizes — thirty-six international unit layout types and seventy-two NSW unit layout types — and the looseness of the regression (R^2)[30] values from the scatter graph points (R^2=0.2127 for the NSW trend line and R^2=0.4227 for the international trend line) mean that although individual unit scores of Plan-EAT are accurate, the trend lines have more limited veracity because of the way they have been constructed. Nevertheless, the implication of the trends determined here is that the international set has improved by 28.8% over four decades (increasing from an average of 57.9% in 1970 to an average of 86.7% in 2010, whereas the NSW set has almost doubled its Plan-EAT design quality score during the same timeframe, increasing the average Plan-EAT score by 26.4% (from 29.5% to 55.9%). So, whilst there have been significant overall improvements in dementia design quality of layout planning as reflected in Plan-EAT scores, NSW units remain, on average, over twenty years behind the international set. However, these trend lines do not tell the full story with several instances in this overall research dataset, of older units performing exceptionally well and, in the case of the NSW set, many recent units performing less optimally.

Despite the extent of improvements over time, the forty-one of fifty-eight (70.7%) NSW units (thirty-five of seventy-two NSW unit layout types (48.6%)) completed in the decade 2007-2016 did not equal the lowest scoring of the forty-seven international units constructed in the same timescale, NPO Group Fugi (2007) (Anderzhon *et al.*, 2012, p. 76) – a Plan-EAT score of 67.9%. This finding echoes the result reported in Chapter 6, that although there are some world class unit layouts in NSW, there is significant room for improvement in dementia design quality amongst the broader stock of 'ordinary' NSW residential aged care facilities. Although the preceding section established that there has been broad improvement in both NSW and

[30] Regression values (R^2) are a measure of how good a fit the data points are against the trend line. with values closer to 1 suggesting a higher level of correlation, and those closer to 0 suggesting a very low level of correlation.

international sets over time, the spread of the data points indicated on the scatter graph in this section (Figure 7-A) shows that this has not been a straight forward process.

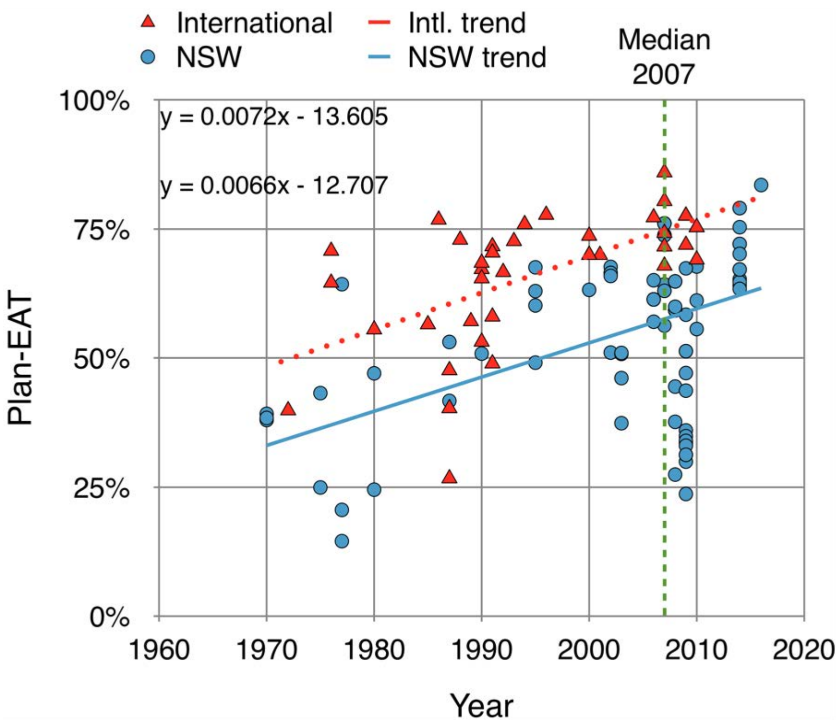

Figure 7-A: Plan-EAT score by year of construction

7.3.1 Comparisons between publication sources

If we consider, for example, that the score for the international units increased from a median Plan-EAT score of 64.6% for the units borrowed from Cohen and Day (1993) to a median Plan-EAT score of 77.6% for those borrowed from Anderzhon *et al*. (2012), see Table 7-B, this suggests a 13% improvement on average, or improvement factor of 1.2 occurring in the nineteen years between the two publications (or 23 twenty-three years between average construction dates of 1985 versus 2008). However, the highest individual score from Cohen and Day (1993) was achieved by Minna Murra (1986), located in Toowoomba, Queensland (Cohen and Day 1993, p. 86). It scored 76.8% in present Plan-EAT analyses, thereby achieving an overall ranking of 8th place amongst the full suite of 108 layout types evaluated. The highest overall scoring (and first ranked) unit in the study, the special care unit at Southwood Home (2007), Hammondville, NSW (Anderzhon *et al*., 2012, p. 14), which achieved a Plan-EAT score of 86.0%, only surpasses Minna Murra (76.8%) by a measure of 9.2%.

Table 7-B: Anderzhon et al. versus Cohen and Day - Overview

	#Units	Median Year	Avg. Year	Median Plan-EAT	Avg. Plan-EAT
Anderzhon *et al*. (2012)	53	2009	2008	77.58%	76.20%
Cohen and Day (1993)	38	1987	1985	64.60%	57.51%

As the preceding paragraphs have begun to suggest, there is a distinct difference in the distribution of dementia design evaluation scores between the two main source publications (Cohen and Day, 1993; Anderzhon *et al.*, 2012). The scores from the fifty-three units from Anderzhon *et al*. (2012) ranged from 67.9% (INT#27: NPO Group Fugi) to 86.0% (INT#30: Southwood SCU), giving a spread of only 18.1%. Meanwhile the thirty-eight units from *Cohen and Day* (1993) ranged from 26.7% (INT#19: John Douglas French Center) to 76.8% (INT#23: Minna Murra) giving a score spread of 50.1%. However, comparing the average design evaluation scores of the best performing 10% of units from both books, there was a difference in Plan-EAT evaluation outcome of only 7.2%, This suggests that part of the improvements in average Plan-EAT scores from international best practice units over recent decades has been due in part to improvement in the consistency in design quality — as evidenced by the reduced spread of Plan-EAT scores in these research findings. However, it is important to acknowledge that there are other factors that may have changed over time that are not accounted for in the above evaluations. These include factors such as floor area and number of residents per unit, which will be discussed in Chapter 8.

Table 7-C: Plan-EAT scores - Anderzhon et al. versus Cohen and Day

	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT
Anderzhon *et al.* (2012)	82.1%	86.2%	54.2%	52.2%	89.1%	65.6%	61.5%	96.2%	98.7%	76.2%
Cohen and Day (1993)	57.9%	37.7%	56.4%	42.1%	71.1%	42.4%	57.9%	71.1%	81.1%	57.5%
Change	24.2%	48.5%	-2.2%	10.1%	18.0%	23.2%	3.6%	25.1%	17.6%	18.7%

A series of simple further exercises looking at the changes in design quality on a DDP basis shows that the rate of improvement has been different over time from one DDP to the next. Starting with a continuation from the immediately preceding section, a simple comparison between the average DDP scores of the units borrowed from Cohen and Day (1993) versus those from Anderzhon *et al.* (2012) shows large variation. The largest change in score occurred under DDP#2, where the average Plan-EAT score increased from 37.7% to 86.2% (a significant 48.5% uplift, or an increase by a factor of 2.29). In stark contrast there was no recorded improvement under DDP#3, which recorded a slight *decrease* in design quality (indicated by a loss of 2.2% in Plan-EAT score), as well as lower than average (18.7%) improvements under DDP#4 (10%) and DDP#8 (3.6%). See Table 7-C.

7.3.2 Changes in design quality by dementia design principle

Returning to the NSW set, DDP scores were plotted against construction dates for all 90 NSW units, placed on a scatter graph, and trend lines for changes over time calculated for each DDP (Figure 7-B). Again, whilst the preceding section identified an overall improvement in Plan-EAT score at a rate of 6.6% per decade, the rate of improvement in dementia design quality as measured by the nine individual DDPs varies somewhat. At the upper end of the scale a substantial decadal improvement (11.2%) was recorded by DDP#1. Improvements for some DDPs remained relatively consistent with the overall Plan-EAT trend of 7% decadal

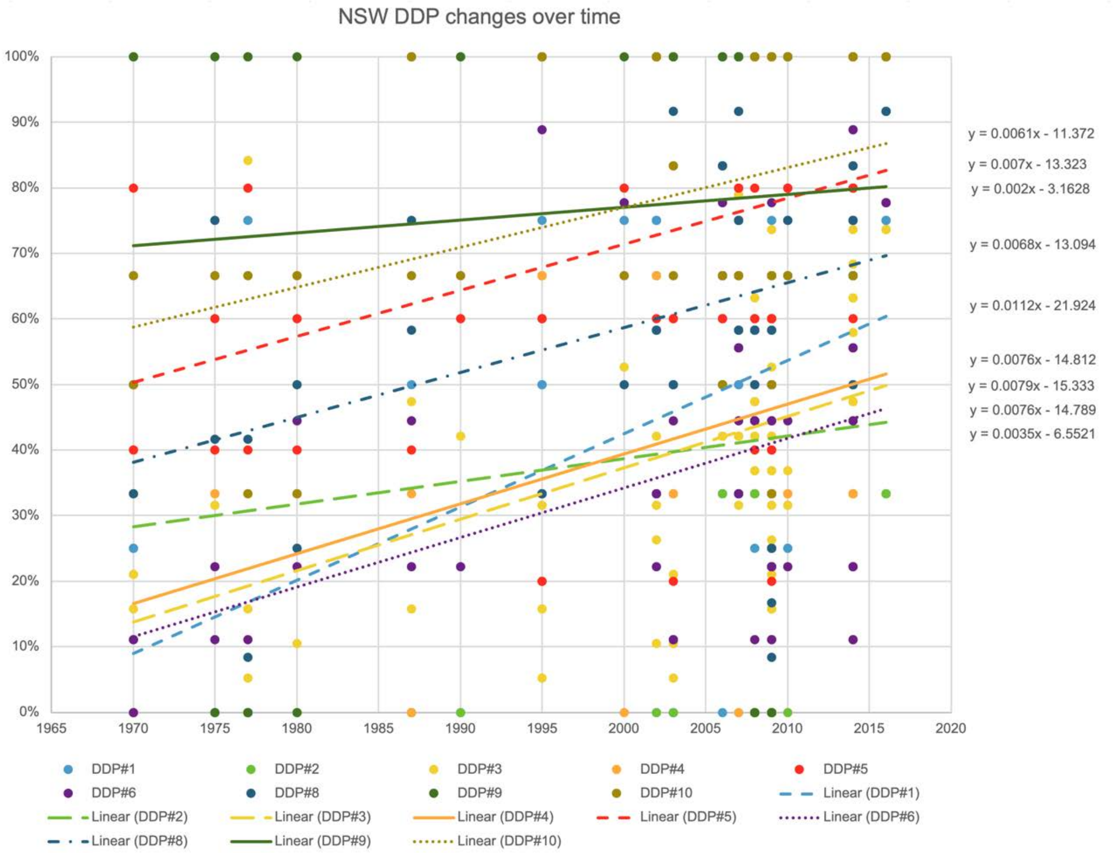

Figure 7-B: Changes by DDP over time - NSW

improvement (DDP#3=7.9%, DDP#4= 7.6%, DDP#5=7.0%, DDP#6=7.6%, DDP#8=6.8%, and DDP10=6.1% decadal improvements). However, only relatively minor improvements were recorded under DDP#2 (3.5% per decade) and DDP#9 (2.0% per decade). With DDP#9 always scoring an average above 70%, it has limited scope for improvements compared to some other DDPs. DDP#2 however, despite mild improvements over time has moved from being a mid-performing DDP up until the mid-1990's, to become the weakest trending DDP. This contrast significantly with the international set where DDP#2 has moved from being the weakest DDP in the 1970's to be a top-three DDP by 2010, trending to an average score above 90% (See Figure 7-C).

Plotting the DDP scores over time for all international units in the same way (Figure 7-C) shows some similarities to the NSW set, with the rate of change of four DDPs keeping roughly in line with the overall decadal 7.2% rate of improvement in dementia design quality (DDP#1=7.4%, DDP#5=5.6%, DDP#6=8.4%, DDP#10=6.5% decadal improvements), two DDPs had significant decadal improvements (DDP#2=20.9%, DDP#9=11.3%), and two had minor improvements (DDP#4=4.3%, DDP#8=3.8%). A most surprising finding was the loss in

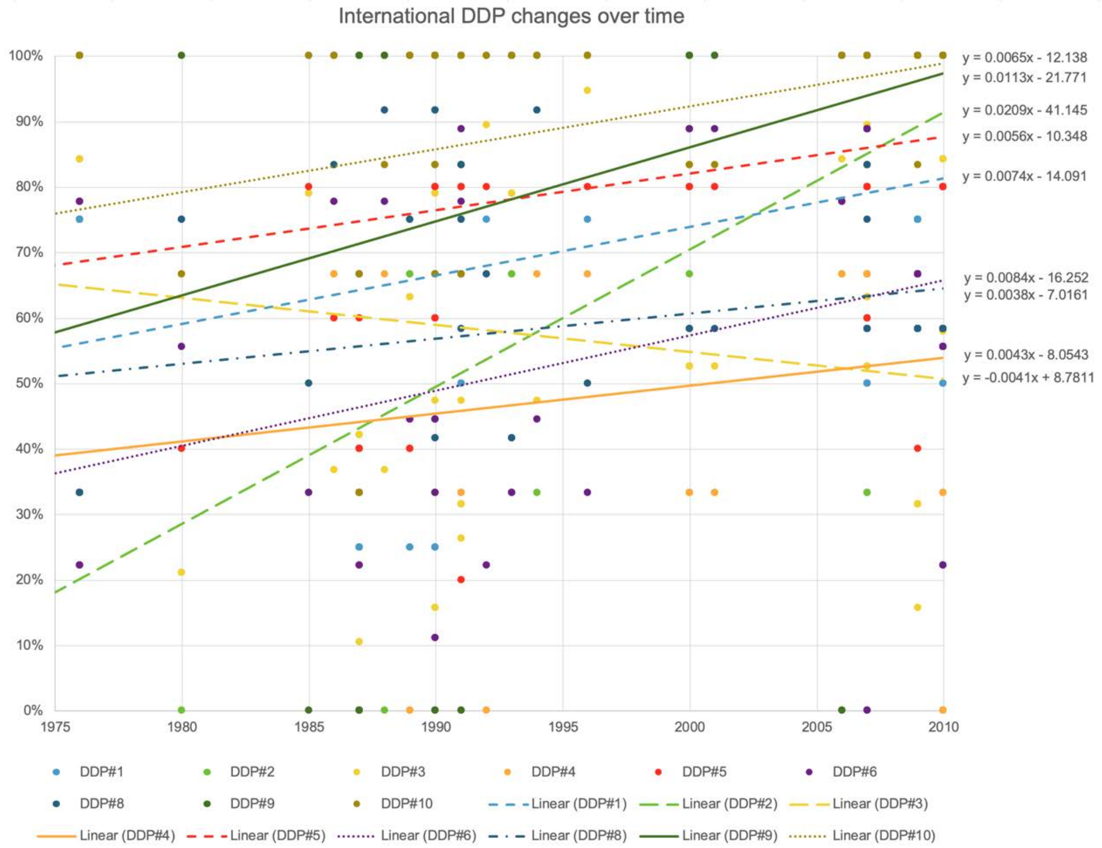

Figure 7-C: Changes by DDP over time - international

dementia design quality in the layouts of the international units under DDP#3, Visual Access, where an average score reduction of 4.1% per decade was calculated.

To investigate the recorded loss of design quality under DDP#3, further analysis was undertaken using a similar scatter graph method to plot the points scored under individual Plan-EAT questions (3.01 to 3.10) versus the year of construction. This approach was initially undertaken, using a calculated percentage of the 'points' awarded versus the number of points scored. However, a second scatter graph analysis sing the raw point scores for each question was also undertaken to account for the relatively greater impact of question numbers 3.01, 3.02, and 3.03 – as these three queries are each capable of scoring up to four points, whilst the other seven queries are limited to a single point. See Figure 7-D versus Figure 7-E. The trend lines from the points versus year scatter graph (Figure 7E) make it clear that the questions contributing the most to the reductions in DDP score recorded over time in the international set are 3.02, 3.03 and 3.08.

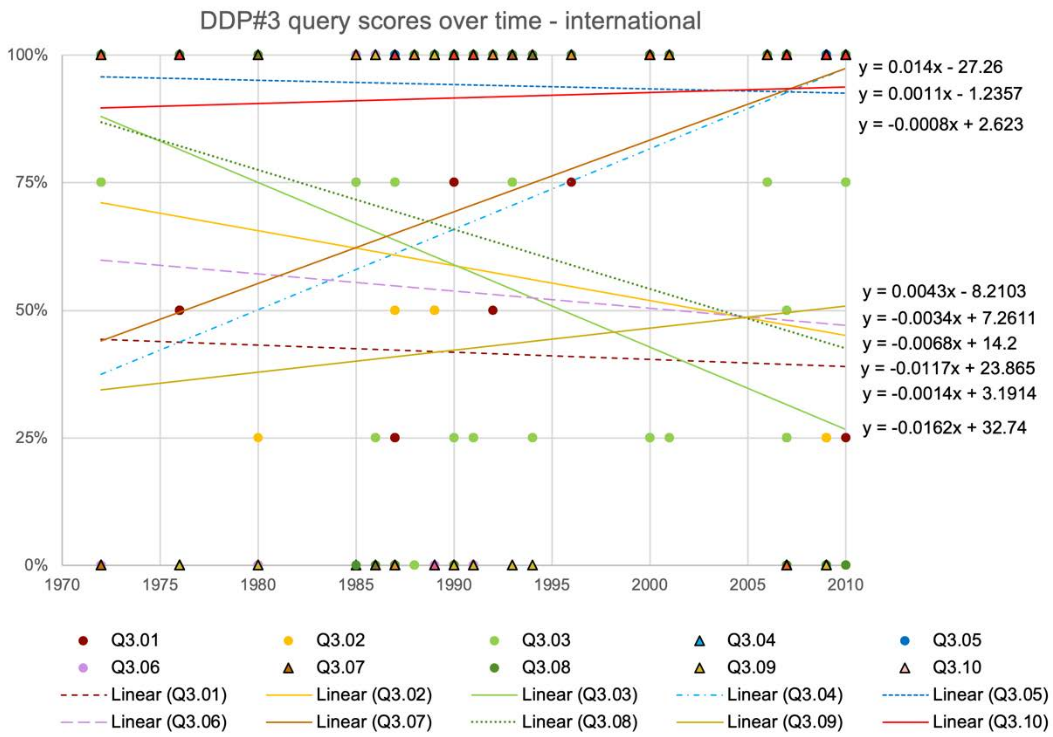

Figure 7-D: DDP#3 query (%) scores over time - international

It is worth noting that only questions that recorded improvements were question numbers Q3.04 (+15.8% per decade), Q3.07 (+14.0% per decade) and Q3.09 (+4.3% per decade). Three questions, Q3.01 (-1.4% per decade), Q3.05 (-0.8% per decade) and Q3.10 (+1.1% per decade), remained about the same, and a total of four of the ten questions under DDP#3 recorded reductions in score over the four decades evaluated. These reductions in design quality range from the 3.4% decadal loss calculated for query 3.06, through to 6.8% decadal loss under 3.02, to the 11.7% lost by Q3.08, and the 16.2% loss calculated for Q3.03.

Whilst it may be worthwhile to undertake further research aimed at uncovering the reasons behind the regression of dementia design quality under DDP#3 *Visual Access* in the international units included in the present research. These findings help identify specific points for improvement in residential aged care unit layouts, all of which can be addressed at the earliest stages of the design process – specifically the need to improve the visibility of the communal dining room and lounge room from the area immediately in front of resident bedroom doors, and the visibility of the door to a communal toilet for residents whilst they are occupying the dining room. These measures are clear from the wording of the four questions:

Q3.02 *What proportion of confused residents can see the lounge room as soon as they leave their bedroom?*
Q3.03 *What proportion of confused residents can see the dining room as soon as they leave their bedroom?*
Q3.06 *Can the kitchen be seen into from the lounge room?*
Q3.08 *Can a toilet be seen from the dining room?*

7.3.3 Comparing NSW and international change

Findings from the preceding sections show that changes in dementia design quality over the last four decades have varied from one DDP to the next, and within this, the change has again been different for the NSW set as for the international set of residential aged care units evaluated as part of the current research.

A tabulation of the decadal rates of change in scores under each of the nine DDPs for both sets (See Table 7-D) and then the calculated differences between the two sets, helps to show where the greatest differences in the rates of improvement of layout planning design of the two sets have occurred. Whilst these show that DDP#5, DDP#6, and DDP#10 have all been improving at similar rates with both sets, the NSW set has been improving at a slightly faster rate for DDP#1 (3.8% more per decade), DDP#4 (3.3% more), and DDP#8 (3.0%). The most significant differences between the rate of improvement of the two sets occur under three DDPs: DDP#2 Human Scale, DDP#3 Visual Access, and DDP#9 Community Links. Amongst these, the rate of improvement amongst the NSW set surpasses the international set only under DDP#3, which is by a sizeable margin of 12.0%, resulting in part from the 4.1% decadal reduction in international design scores as the NSW set recorded a decadal rate of improvement of 7.9%. Meanwhile, significant rates of improvement for the international set under DDP#2 (20.9% per decade), and DDP#9 (11.3% per decade) saw the international set improve under these DDPs at rates of 17.4% (DDP#2) and 9.3% (DDP#9) per decade greater than average decadal scores for the NSW set (DDP#2=3.5%/ per decade, and DDP#9=2.0% per decade).

Table 7-D: Decadal rates of DDP score change

	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	O/A Avg.
NSW	11.2%	3.5%	7.9%	7.6%	7.0%	7.6%	6.8%	2.0%	6.1%	6.6%
INT	7.4%	20.9%	-4.1%	4.3%	5.6%	8.4%	3.8%	11.3%	6.5%	7.1%
Difference	3.8%	-17.4%	12.0%	3.3%	1.4%	-0.8%	3.0%	-9.3%	-0.4%	-0.5%

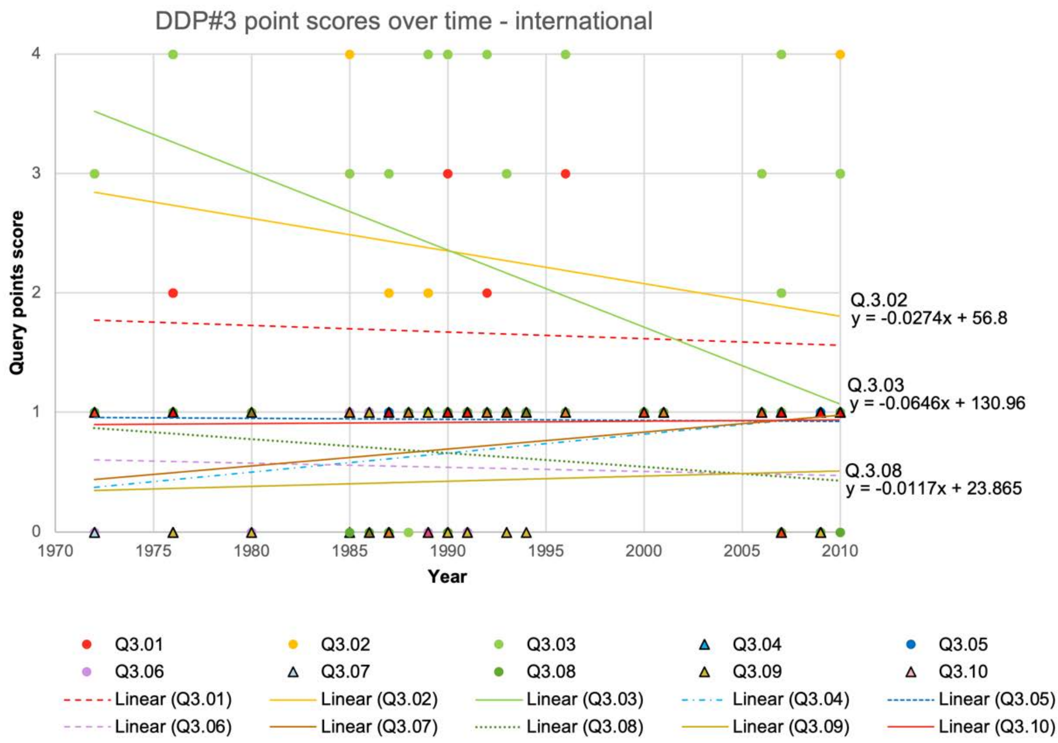

Figure 7-E: DDP#3 query point-scores over time - international

7.4 Conclusions

The findings of the present chapter are that the dementia-enabling characteristics of layout planning in both NSW and international exemplar residential aged care units have improved over the last four decades, and accordingly it can be concluded that the construction date of a residential aged care unit could be considered a significant predictive factor in the dementia design quality of residential aged care settings.

The analyses conducted for this dissertation suggest that there have been similar rates of overall improvement in dementia design quality within layout planning of both the NSW and international sets of residential aged care units. Correlations between the year of construction and dementia design quality indicate that layout planning in NSW has improved by an average of 6.6% per decade, whilst the international units improved by an average of 7.2% per decade.

Despite substantial improvements in dementia design quality over the four decades, the average design quality scores for the NSW set of unit layouts have trended behind those of the international best practice examples by more than two decades. Also, despite tightening of the spread of assessment scores over time, most of the NSW units (71%) constructed over the ten years from 2007 to 2016 have achieved Plan-EAT scores lower than that of the weakest international exemplar constructed during the same period.

Furthermore, the rate of improvement for some DDPs in the NSW set have been faster than others. Whilst some, such as DDP#5 *Helpful Stimuli*, DDP#6 *Wandering and Outdoor Space*, and DDP#10 *Domestic Activity*, have come close to keeping pace with the improvements seen in international exemplars, whereas others such as DDP#2 *Human Scale,* and DDP#9 *Community Links* have experienced a comparatively poor rate of improvement over time. Although Chapter 6 identified that some DDPs had significant room for improvement across both international and NSW sets (e.g. DDP#3, DDP#4, DDP#6) the findings from the present chapter suggest that it may be prudent for NSW designers to place greatest additional emphasis on making improvements to design quality where the rates of improvement in NSW units over recent decades have been lower than those of the international set.

8 THE INFLUENCE OF ARCHITECTURAL ATTRIBUTES ON DEMENTIA DESIGN QUALITY

8.1 Introduction

This chapter reports on investigations that address the third research aim of this dissertation: *to investigate the impact of five spatial planning factors — that is; unit floor area, number of resident bed-spaces, area per resident, storey location, and whether purpose-built for dementia or not — on the dementia design properties of Australian and international residential aged care settings*. It addresses this aim by undertaking correlation analyses between the floor-plan based dementia design evaluations scores for residential aged care units (developed in Chapter 6), against the five nominated architectural attributes for these same units.

Before progressing, it must be noted that these five architectural factors cannot be assumed to explain an overall quality rating. Often architectural attributes are by-products of factors such as the project site, the program or brief (being the formal list of the client's requirements) and the budget. Some of these attributes may have an impact on the nine DDPs but this is not necessarily the case. Therefore, this section proposes a preliminary analysis of these five attributes to determine if there is evidence that they have a correlation (positive or negative) with quality ratings developed using Plan-EAT. However, the presence or absence of a correlation cannot be taken as providing certainty of any causal or reciprocal relationship. Any correlation is at best an indicator of a link between attributes, as multiple factors shape the architectural characteristics of a unit. Not all will directly impact on quality ratings, but potentially raise questions to be addressed in further research beyond the present dissertation.

The relationship between the five architectural attributes and the DDPs is also a complex one. For example, one of the most commonly recited maxims for dementia design is that residential aged care environments should be 'small'. However, the existing evidence base is not clear on whether this effect is caused by the attribute of being socially small due to limiting the number living together in a single unit or being physically small in terms of floor area. There is a natural, and somewhat inescapable tendency for a link between the two factors. For example, it would seem unlikely, even if entirely feasible, for a unit intended to host, say, ten people to be larger in floor area, than one intended for thirty people. Whilst there is evidence that improvements to well-being tend to occur when a smaller number of people live together, none of the established research has managed to decouple this from the physical unit size. Similarly, the previous evidence of improved wellbeing for people living with dementia linked to reduced physical size of the environment have not tended to investigate this attribute as distinct from the number residents.

Thus, in this chapter an examination is undertaken to tease apart these somewhat interdependent characteristics. The first part of this (Aim 3(i)) is undertaken through testing whether there is correlation between Plan-EAT scores for unit layouts and the physical 'size' of the unit as measured by floor area. The second part (Aim 3(ii)) carries out a similar test of correlation between dementia design quality scores and the number of residents per unit. Thereafter the third part (Aim 3(iii)) investigates the overlap between the two issues, testing whether there is any correlation between floor-plan based dementia design quality and the amount of floor area provided per resident. This becomes, in-effect, a quasi-evaluation of the impact of mild crowding or living density for people living with dementia.

Moving away from the closely interlinked themes of the first three investigations in this chapter, the fourth section in this chapter (Aim 3(iv)) tests whether there is any tendency for differences in layout design quality to result from the storey location of each unit. This line of enquiry is derived from two considerations. Firstly, some research argues for the importance of high quality and easily accessible outdoor space in promoting physical and mental wellbeing (Chalfont, 2007; Hernandez, 2007; Whear *et al.*, 2014). Secondly, consideration of the high incidence of physical impairment amongst those living in residential aged care, and the tendency for multifaceted overlaps in health conditions for people with dementia (Banerjee *et al.*, 2009) place even greater need for upper floor units to cater for diverse needs. Thus, the provision of easy access to outdoor space from residential aged care units is considered highly important, suggesting that ground floor located units are preferable. However, land and cost factors mean that many aged care settings need to be built over two or more storeys, whilst technical and financial considerations also make the provision of some features, such as easy access to outdoor space for upper storey units more difficult to achieve. Thus, it is less likely that there will be enough outdoor space for upper floor units, but we cannot assume that this will necessarily be the case.

The fifth and final analysis (3(v)) in the chapter echoes Smith *et al.*'s (2012) work on the design quality analysis of fifty-six NSW residential aged care facilities, by comparing the statistical uplift in dementia design quality scores in unit layout types that have been purpose-built for people living with dementia, versus those that have not, but instead intended for general aged care purposes.

8.2 Method

This research aim contains five related but distinct sub-aims. Although similar, the methods used to undertake the research for each sub-aim differ slightly. The five methods are described below, with some references to more detailed descriptions of specific components which are found in later sections (such as protocols for measuring floor areas, described in method section 5.3.4). In some instances, analysis for the sub-aims show differences between the NSW and international unit sets, thereby extending the outcomes of the first aim of the present research Chapter 6) and analysis of how some characteristics have changed over time, extends some of the outcomes of the second research aim from Chapter 7.

8.2.1 Method 3(i) – Unit floor area

Floor areas for all residential aged care units in the study measured using the standard protocols described in section 5.3.4. The full list of unit floor areas is included in Appendices K and L, whilst a summary is presented in Table 8-A. The measured floor areas were correlated against the Plan-EAT scores for each unit, as recorded in Chapter 6. The resulting data points were then plotted on a scatter graph and linear trend lines generated — one each for the NSW and international sets.

8.2.2 Method 3(ii) – Number of residents

The number of residents per unit was determined by counting the number of bed-spaces indicated in the floor-plans used for Plan-EAT evaluations. The number of residents per unit is recorded in full in Appendix K for the NSW set, and Appendix L for the international set and are summarised in the present chapter in Table 8-B. The number of bed-spaces for each unit is then correlated against Plan-EAT scores, with the resulting values charted on a scatter graph (Figure 8-B and Figure 8-A). Trend lines are then calculated, split by NSW and international units. These results are then used to determine the extent to which these support the pre-existing evidence in the literature that the number of residents living together impacts environmental quality.

8.2.3 Method 3(iii) – Floor area per resident

The ratio of floor area per resident is calculated by dividing the floor area for each unit by the number of resident bed-spaces in the unit, both sourced as described above. The floor area, number of residents, and ratio of floor area per resident are all listed in full in Appendices K and L. An overview summary of floor area ratios is presented in Table 8-C of this chapter. Again, these values are correlated against the dementia design evaluation score for each unit.

8.2.4 Method 3(iv) – Storey location

The method used to address this research sub-aim tests the extent of difference between the DDP and Plan-EAT score outcomes for the unit layout types identified as being located on the ground floor compared to those located on an upper floor level. Following a theme used in other parts of this research, this analysis also considers the differences between the NSW and international set, as well as within the international set.

8.2.5 Method 3(v) – Purpose-built versus non-purpose-built

This method uses information provided from participant questionnaires (Appendix E), for the NSW set, and either published text or tables for the international set. This information is listed with respect to all units within Appendices K and L, with a summary also presented in Table 8-A of this chapter.

8.3 Results

Again, as this overall research aim investigates the potential impact of five specific architectural characteristics on the overall dementia design quality of layout planning in residential aged care units. These five elements are addressed one by one in the following sections.

8.3.1 Results 3(i) – Floor area

The average floor area for the 184 units was 694.5 m^2. Although the minimum and maximum values for floor areas and numbers of residents for both the NSW and international sets are close (see Table 8-A), suggesting some similarity between the two sets, there are also some significant differences. For example, the 807 m^2 median floor area of NSW units is a significant

48% larger than the 544 m^2 median floor area for international units. The average floor area values provide a similar insight, with the NSW average being 41% larger than the international mean. Furthermore, the median Plan-EAT score for the international units, at 74%, was found to be 14% higher than the median NSW Plan-EAT score, 60%. Although the smaller international units clearly achieved higher Plan-EAT scores, when we consider the findings about design quality in previous sections of this dissertation, this simplistic correlation alone does not provide enough evidence to speculate about the effect of floor area on the dementia design quality of residential aged care unit layouts. As the introduction to this chapter noted, architectural attributes and dementia design ratings are not necessarily directly connected, and any relationship needs to be carefully tested.

Table 8-A: Unit floor area summary

Floor areas	Minimum	Median	Mean	Maximum
International:	279 m^2	544 m^2	623 m^2	2,280 m^2
NSW	291 m^2	807 m^2	915 m^2	2,925 m^2

At first glance, the results suggest that floor area increase has an inverse relationship with dementia design quality. This rate of design quality regression over the entire set of 184 units was determined with a trend formula of [y=71.07% - 0.0001x] where x represents unit Plan-EAT score, and y represents the unit area in m^2, equating to the loss of one percent of Plan-EAT score for every additional 100 m^2 extra floor area occupied by an individual unit. However, analysing the NSW and international sets separately (Figure 8-A and Figure 8-B), the relative flatness of the NSW trend-line suggests that floor area has a limited effect on the Plan-EAT scores of the NSW units but regresses at a rate of 2% per additional 100 m^2 of overall unit floor area (with the trend-line formula of y=78.04% - 0.0002x).

Smaller sized international units sustain much higher evaluation scores compared to the NSW units, but this difference between the two sets diminishes as unit floor areas get larger (see Figure 8-B). International units under 600 m^2 achieved an average Plan-EAT score of 72.45%, whilst the same size range from the NSW set averaged just 39.65%. Meanwhile, international units over 1,000 m^2 manage an average score of 58.13%, versus 54.11% for NSW units of similar size (not tabulated).

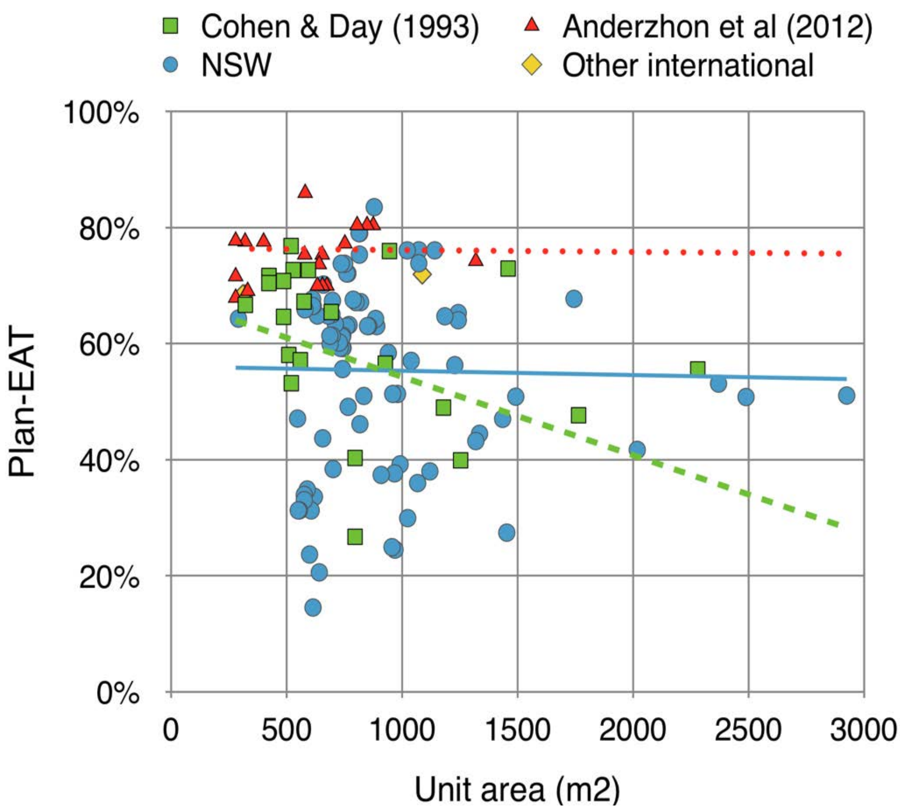

Figure 8-B: Plan-EAT and area by source

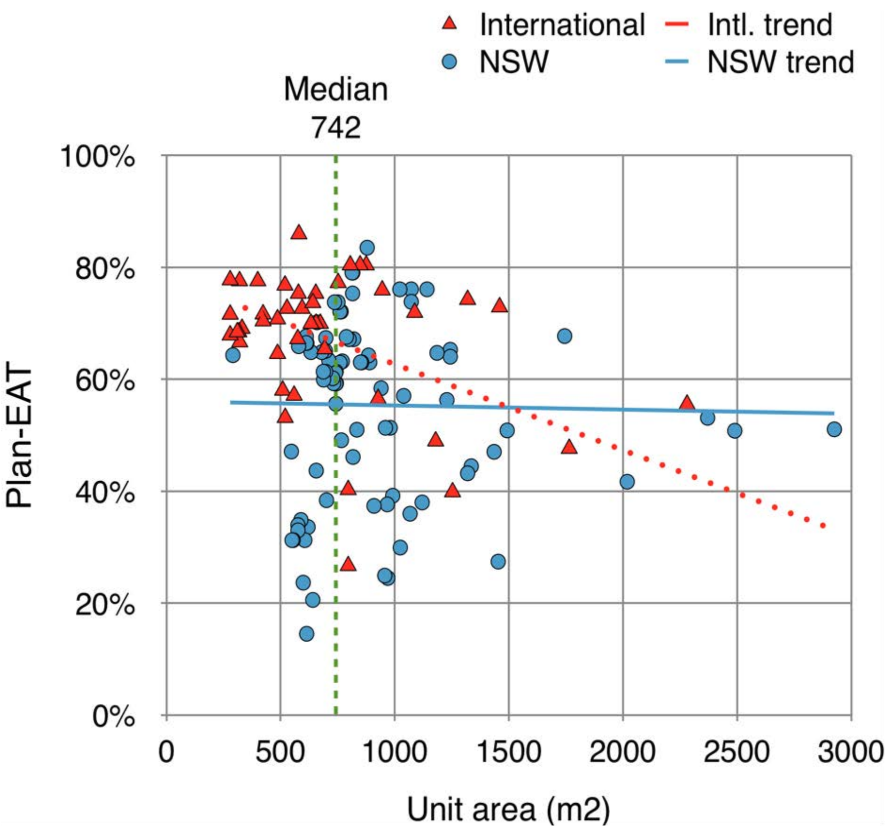

Figure 8-A: Plan-EAT score versus unit area

On further analysis, organising the international units by publication source show a significant difference between the design quality of unit layouts from Anderzhon et al. (2012) versus those of Cohen and Day (1993) (Figure 8-A). Whilst it is not possible to know whether any of the differences between the two sets of units are attributable to the selection processes used by the authors of each book, the available evidence would suggest that there have been drastic improvements in the design standards of the best international units over the two-decade intervening period. Whilst the trend line for design scores from Anderzhon *et al*. (2012) (y= -3.263-6x + 0.7644) remains steady at Plan-EAT score of around 75% (noting that there are no units from this publication sized over 1400 m^2), the trend line from Cohen and Day (1993) (y= -0.0001x + 0.6776) shows a sharp fall in design score as unit floor area increases. Comparing the trend line for the NSW units (y= -7.384E-6x + 0.5605) versus those from Anderzhon *et al*. (2012) suggests that NSW units typically fall short of the Anderzhon *et al*. set, by more than 20%, at any given floor area (See Figure 8-B).

One further factor worth considering as having an indirect influence on the apparent improvement in design quality, is the change in overall physical size of the average residential aged care unit over time. Although partly related to sections 8.3.2 and 8.3.3 below, a correlation of unit floor area against year of construction per Figure 8-C found an average overall reduction in the floor area of NSW residential aged care units by 9.5m^2 per year, and an average overall reduction in floor area of international units by 5.5m^2 per year.

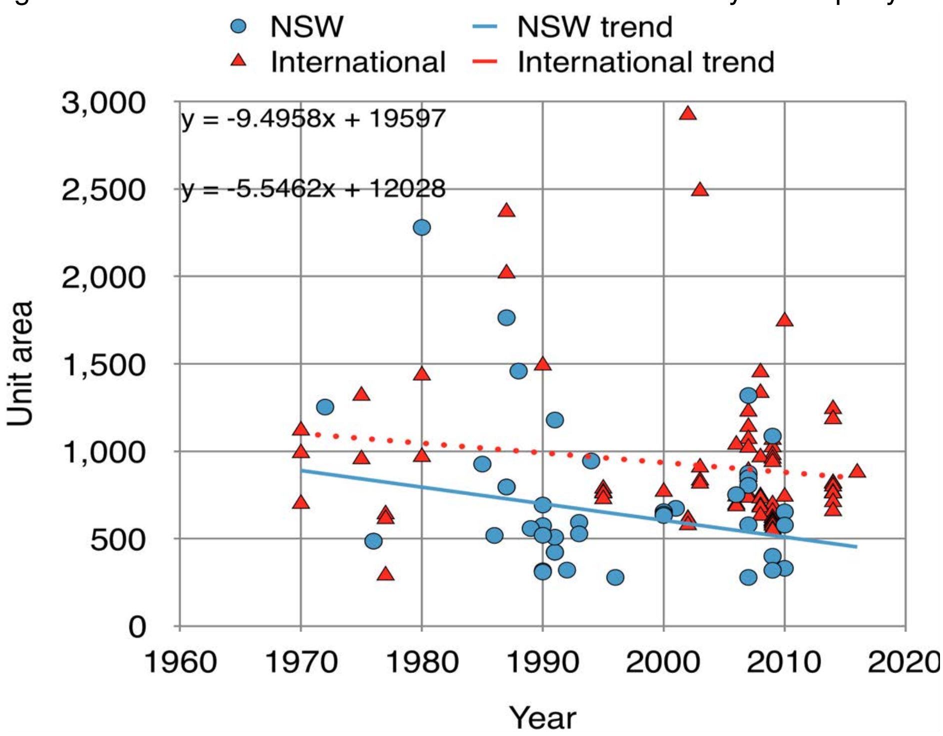

Figure 8-C: Unit area versus year of construction

8.3.2 Results 3(ii) – Number of resident bed-spaces

The results of the previous section suggest that floor area has only a modest impact on the dementia design quality, and thus arguments about need for aged care spaces to be physically small must be questioned. However, as some literature defines a 'small' unit as one with fewer residents, it is important to test whether the number of resident bed-spaces provided in the unit has any correlation with Plan-EAT evaluation scores. The results of the analyses provide evidence to support the proposition by a number of scholars (Reimer *et al.*, 2004; Fleming, Crookes and Sum, 2008; Verbeek *et al.*, 2009) that a small number of bed-spaces is likely to lead to higher quality ratings for residential aged care units.

The median number of residents per unit in the NSW set is 18 and the average is 20.7 residents. The median number of bedrooms per NSW unit is 16 and the average is 18.2, with 85% on average of these being single rooms (median = 15 and average per unit = 15.3). Most facilities have 100% single rooms with 100% en-suite provision, with only a handful of other (usually older) facilities tending to employ a high provision of shared bedroom rooms and/or shared bathrooms. Shared bathrooms were also notably more common within the international units from countries where English is not the first language.

Table 8-B: Overview of resident bed-spaces per unit

No. bed-spaces	Minimum	Median	Mean	Maximum
International:	6	12	14.0	76
NSW	7	18	20.7	73

Since the results of the previous section suggest that floor area, by itself, had relatively little impact on the dementia design quality of the NSW layouts, a similar lack of association was anticipated for correlations against number of residents. However, the data shows a clear downward trend in design score for NSW units at a rate of 0.35% per additional resident bed-space (trend line formula: y = 0.0035x -0.6256) as shown in Figure 8-E. Meanwhile, international units reduce in Plan-EAT score at a rate of 0.9% per additional resident: [y = 0.0087x + 0.8098]. (see Figure 8-E)

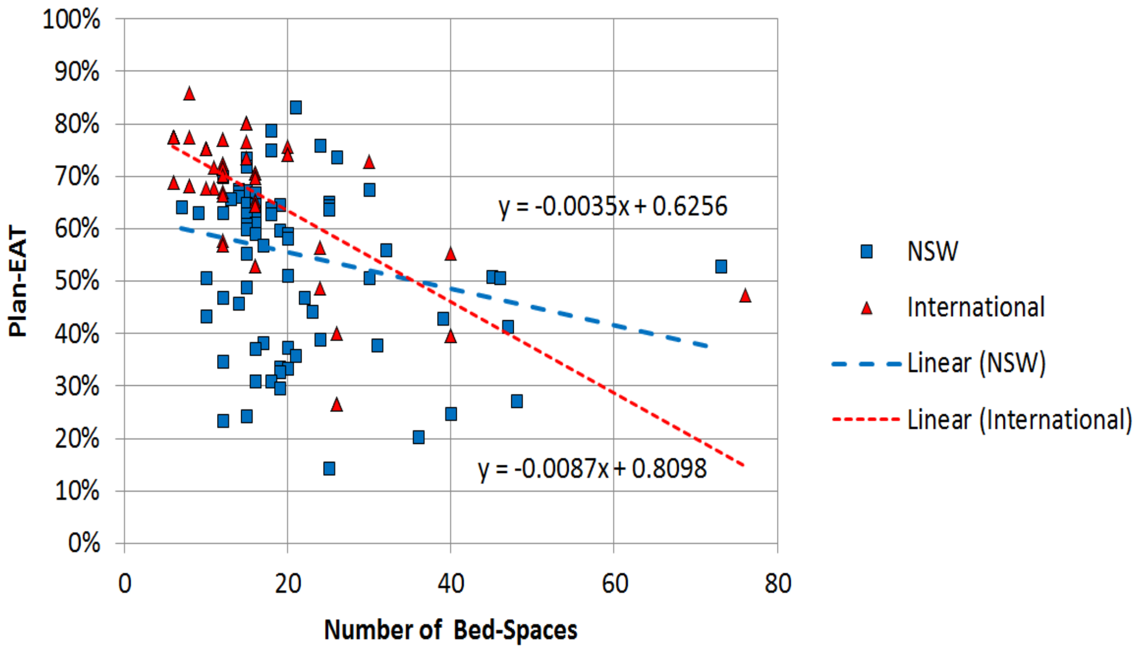

Figure 8-E: Plan-EAT by number of bed-spaces

When the units are divided into the NSW and international sets, the number of resident spaces appears to have only about half as much effect on dementia design quality as for the international units. See Table 8-D. This may be explained in part by the much higher Plan-EAT scores for the international units versus NSW units in settings with lower numbers of residents, whilst there is much less difference between Plan-EAT scores for the two sets in units where the number of residents is higher. If calculations of the trend lines are accepted, then the difference between the international and NSW sets diminishes until the number of bed-spaces in a unit reaches thirty-five or more.

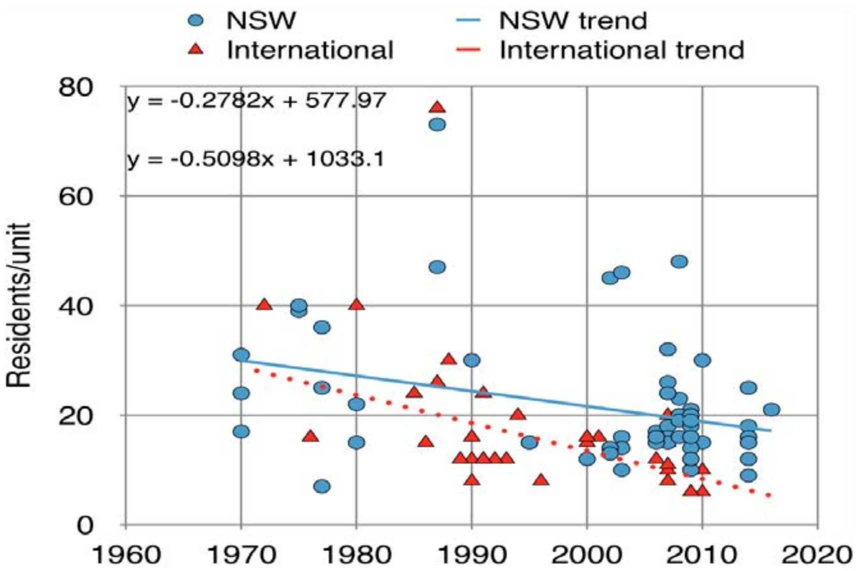

Figure 8-D: Bed-spaces provision versus year of construction

One final factor identified as a potential impact on the trends established above is the effect of the changing number of residents per unit over time. This factor was tested with controlled regression analysis in this research but may be worthwhile considering in future research. A scatter graph and trend line analysis of data points defined by year of construction and number of resident bed-spaces showed a gradual overall reduction of unit size (by number of residents) from a mean of just of thirty (for both NSW and international sets) in 1970 , to an average forty years later in 2010, of less than twenty bed-spaces in the NSW set, and less than ten bed-spaces per unit in the international exemplars. See figure 8-E

8.3.3 Results 3(iii) – Floor area per resident

As another approach to evaluation under the heading of the unit 'size', a combination of the two preceding sections, this section investigates whether the ratio of space provision per resident correlates in any significant way to the overall Plan-EAT design evaluation score. The ratio of floor area per resident was calculated based on internal space provision within the unit itself, plus an apportioned area for any communal facilities (shared between multiple units), service and staff-only/back-of-house areas.

The results of this analysis (Table 8-C) indicate that that floor area provision per resident varied dramatically across the two sets. The international unit layouts ranged from 23.2 m^2 to 99.6 m^2 per resident with an average of 69.0 m^2 and a median of 8.0 m^2. The NSW set ranged from 21.1 m^2 to 95.1 m^2 with both the average and median of 44.0 m^2. In both cases the similarity between average and median rates of floor area provision suggests that floor areas within each separate set are evenly distributed, above and below the average in each case. The significant 25 m^2 (or 57%) difference in floor area provision per resident between the two sets is particularly notable (i.e. international exemplar units provide on average 1.57 times more space per resident). Up to now the extent to which the provision of additional floor area per resident contributes to dementia design quality has remained unclear.

Table 8-C: Unit floor area provision per resident

Area/ resident	All	International	NSW	Difference:	
Maximum	99.6 m^2	99.6 m^2	95.1 m^2	4.5 m^2	(4.7%)
Minimum	21.1 m^2	23.2 m^2	21.1 m^2	2.1 m^2	(9.9%)
Median	59.0 m^2	68.0 m^2	44.0 m^2	24.0 m^2	(54%)
Mean	57.0 m^2	69.0 m^2	44.0 m^2	25.0 m^2	(57%)

There is a strong positive correlation between the rate of floor area provision per resident and increasing design quality (Pan-EAT) scores (Figure 8-F). This correlation equates to a 0.58% increase in design score for each additional m^2 per resident for the international units (correlation trend line formula: y = 0.0058x +0.4079) and around 0.40% design score uplift per additional m^2 per resident (trend line formula: y = 0.004x + 0.339) for the NSW set.

Whilst the findings confirm that better design quality outcomes arise from having fewer residents living together, and that providing more floor area per resident also tends to help, these lead naturally to two obvious follow-up questions. How should additional floor-space per resident be allocated? Where state or nationwide mass provision of residential aged care is concerned, what is likely to be the optimal size and layout type of residential aged care units for optimal return on investment for floor area provision?

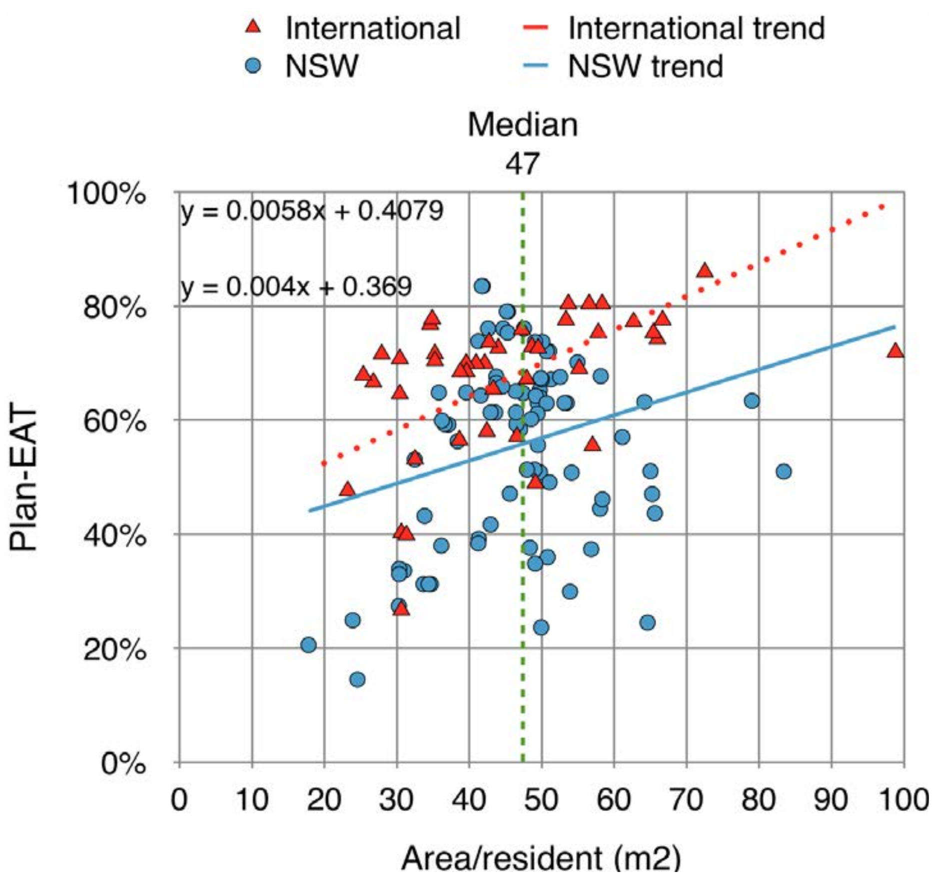

Figure 8-F: Plan-EAT score versus area per resident

Whilst the research required to address many follow-on questions is beyond the scope of the current research, it is possible using the numerical analysis presented previously, to begin to develop a sense of the efficiency of the unit layout types – a factor which may help to inform decision making where the capital costs of unit are factor. A correlation of Plan-EAT scores against the floor area per resident ratios (m^2/resident), enabled the production of numerical space efficiency values (calculated as: Plan-EAT score (%) per floor area (m^2) per number of resident bed-spaces) to represent how efficiently each unit has translated the per-resident floor area provision into improved dementia design quality in its layout planning. The list of NSW results from this analysis, reproduced in Table 8-D, show that the most effective NSW unit layout type (NSW#03) produces 1.78% Plan-EAT score improvement for every additional square metre per resident (by bed-space count). This unit layout type is also the highest scoring of the NSW set by Plan-EAT (83.5%). The median outcome for the NSW set is 1.13% Plan-EAT per square metre per resident, whilst the weakest of the seventy-two layout types is NSW#44 scoring 0.35% Plan-EAT score per area per resident bed-space. This particular unit shows that floor space is not necessarily a pre-determinant of quality, as this layout type (NSW#44) averages a Plan-EAT of only 24.5% despite providing an average of 70.9 m^2 per bed-space.

By comparison, the results of similar calculations for the international units, shown in Table 8-E, achieve better quality outcomes whilst providing an average of over 50% more floor area per residents. They also achieve better rate of conversion of floor area into Plan-EAT dementia design assessment scores. The best performing international unit, Friendship House – courtyard unit type (INT#15) provides only 30.4m2 per resident bed-space but having obtained a Plan-EAT score of 70.8%, achieves an efficiency rating of 2.33% per square meter per bed-space. This is followed closely by Himawari Group Home (INT#18) at a rate of 2.23%, Minna Murra at 2.22%, and NPO Fugi at 2.14%. It is only when we get to the seventh ranked (in the international list) Riverview Lodge with a rate of 1.55% per square metre per resident, do the international units move below the best performing NSW unit layout type (NSW#3 = 1.78% per m^2 per bed-space). It seems worthwhile to note that some of best performing units by Plan-EAT alone fare relatively poorly in this exercise. For example Southwood SCU (INT#30), which scored the highest in the Plan-EAT evaluations (as reported in Chapter 6) at 86.0%, is ranked number thirty-four of thirty-six international layout types where the provision of 99.6sqm per resident results in an dementia design efficiency rate of 0.86% per square metre per resident bed-space; a value below the NSW median of 0.99% per square metre per resident bed-space.

The results of this correlation show that whilst there is value in considering the efficiency of unit layouts to maximise the dementia design quality of residential aged care, there is a need for caution in its application. This can be most obviously explained by comparing the first and second listed NSW units listed in

Table 8-D. Where there is a small difference in the design efficiency values of the first (NSW#03 = 1.78) and second (NSW#22 = 1.64) units, there is a significant difference (30.4%) in the overall Plan-EAT values for the first (83.5%) and second (53.1%). In relative terms the overall dementia design quality in the layout planning of the first unit is 57% better than the second unit. However, this example may be further put into context if we refer to the findings from Research Aim 3(ii) on the correlations between design quality and the overall number of residents living in the unit. In this case the first unit, NSW#3, has 21 residents, whilst the second, NSW#22, has 73 residents.

Table 8-D: Area per resident versus Plan-EAT scores - NSW units

'Efficiency ' Rank NSW	NSW unit type	Area/ bed-space	Plan-EAT	Score/m^2 /resident
1	NSW#03	46.9 m^2	83.5%	1.78%
2	NSW#22	32.5 m^2	53.1%	1.64%
3	NSW#35	56.8 m^2	73.8%	1.30%
4	NSW#36	59.5 m^2	76.1%	1.28%
5	NSW#18	44.1 m^2	56.3%	1.28%
6	NSW#40	51.7 m^2	64.8%	1.25%
7	NSW#37	61.5 m^2	76.1%	1.24%
8	NSW#53	53.2 m^2	64.7%	1.22%
9	NSW#72	65.1 m^2	79.0%	1.21%
10	NSW#19	35.8 m^2	43.2%	1.21%
11	NSW#55	60.3 m^2	72.1%	1.19%
12	NSW#52	55.5 m^2	65.3%	1.18%
13	NSW#71	65.1 m^2	75.3%	1.16%
14	NSW#51	55.5 m^2	64.0%	1.15%
15	NSW#43	52.2 m^2	59.9%	1.15%
16	NSW#38	51.8 m^2	59.3%	1.15%
17	NSW#42	52.3 m^2	59.2%	1.13%
18	NSW#56	59.7 m^2	67.1%	1.12%
19	NSW#59	60.5 m^2	67.6%	1.12%
20	NSW#32	54.9 m^2	61.1%	1.11%

'Efficiency', Rank NSW	NSW unit type	Area/ bed-space	Plan-EAT	Score/m^2 /resident
21	NSW#31	60.9 m^2	67.7%	1.11%
22	NSW#11	58.5 m^2	65.0%	1.11%
23	NSW#41	58.5 m^2	64.8%	1.11%
24	NSW#69	58.3 m^2	64.3%	1.10%
25	NSW#10	56.1 m^2	61.3%	1.09%
26	NSW#48	61.8 m^2	67.4%	1.09%
27	NSW#01	67.8 m^2	73.8%	1.09%
28	NSW#17	59.3 m^2	64.2%	1.08%
29	NSW#58	58.7 m^2	63.0%	1.07%
30	NSW#57	56.5 m^2	60.2%	1.06%
31	NSW#16	59.6 m^2	63.0%	1.06%
32	NSW#49	55.4 m^2	58.4%	1.05%
33	NSW#54	67.0 m^2	70.2%	1.05%
34	NSW#33	55.0 m^2	55.6%	1.01%
35	NSW#64	33.6 m^2	33.9%	1.01%
36	NSW#63	34.1 m^2	33.6%	0.99%
37	NSW#34	64.2 m^2	63.2%	0.98%
38	NSW#62	33.6 m^2	33.0%	0.98%
39	NSW#70	21.1 m^2	20.6%	0.98%
40	NSW#15	64.7 m^2	63.0%	0.97%
41	NSW#21	42.9 m^2	41.7%	0.97%
42	NSW#20	25.8 m^2	24.9%	0.97%
43	NSW#27	70.8 m^2	67.6%	0.96%
44	NSW#23	54.1 m^2	50.8%	0.94%
45	NSW#12	40.5 m^2	38.0%	0.94%
46	NSW#28	71.0 m^2	66.5%	0.94%
47	NSW#39	65.4 m^2	59.3%	0.91%
48	NSW#47	56.9 m^2	51.3%	0.90%
49	NSW#29	73.7 m^2	65.9%	0.89%
50	NSW#02	58.9 m^2	50.9%	0.86%
51	NSW#13	47.0 m^2	39.2%	0.83%
52	NSW#60	59.1 m^2	49.1%	0.83%
53	NSW#66	34.0 m^2	27.4%	0.81%
54	NSW#61	39.2 m^2	31.3%	0.80%
55	NSW#09	71.8 m^2	57.0%	0.79%
56	NSW#46	59.5 m^2	47.1%	0.79%
57	NSW#25	58.4 m^2	46.1%	0.79%
58	NSW#14	49.3 m^2	38.4%	0.78%
59	NSW#30	73.4 m^2	51.0%	0.70%

‘Efficiency’ Rank NSW	NSW unit type	Area/ bed-space	Plan-EAT	Score/m^2 /resident
60	NSW#45	69.5 m^2	47.0%	0.68%
61	NSW#65	65.8 m^2	44.5%	0.68%
62	NSW#50	95.1 m^2	63.4%	0.67%
63	NSW#24	56.8 m^2	37.4%	0.66%
4	NSW#67	57.3 m^2	37.6%	0.66%
65	NSW#05	57.4 m^2	36.0%	0.63%
66	NSW#26	83.4 m^2	51.0%	0.61%
67	NSW#07	60.7 m^2	34.9%	0.57%
68	NSW#08	79.5 m^2	43.7%	0.55%
69	NSW#68	29.2 m^2	14.5%	0.50%
70	NSW#04	61.2 m^2	29.9%	0.49%
71	NSW#06	61.5 m^2	23.7%	0.38%
72	NSW#44	70.9 m^2	24.5%	0.35%

Another example of the need for careful consideration of this approach is the finding that the highest performing unit, by Plan-EAT score within the present research (the special care unit at Southwood Home, Hammondville) scored poorly by the efficiency measure. This unit scored 86.0% under Plan-EAT after providing floor area at a rate of 99.6 m^2/resident, arriving at an efficiency ratio of 0.86. This placed the SCU at Southwood home in rank position 34 out of 36 international unit types for efficient use of floor area to dementia design quality.

Table 8-E: Area per resident versus Plan-EAT scores – international units

‘Efficiency rank’ INT	Unit type	International unit name	Area/ bed-space	Plan-EAT	score/m^2/ bed-space
1	INT#15	Friendship House: 2/2 - courtyard	30.4 m^2	70.8%	2.33%
2	INT#18	Himawari Group Home	34.9 m^2	77.7%	2.23%
3	INT#23	Minna Murra	34.6 m^2	76.8%	2.22%
4	INT#27	NPO Group Fugi	31.7 m^2	67.9%	2.14%
5	INT#14	Friendship House: 1/2 - terrace	30.4 m^2	64.6%	2.12%
6	INT#02	Alois Alzheimer's Centre	23.2 m^2	47.7%	2.05%
7	INT#29	Riverview Lodge	44.3 m^2	68.5%	1.55%
8	INT#16	Hale Kako'O	43.4 m^2	66.7%	1.54%
9	INT#03	Alzheimer's Care Centre	48.6 m^2	72.9%	1.50%
10	INT#08	Butterfly Concept	38.6 m^2	56.5%	1.46%

'Efficiency rank' INT	Unit type	International unit name	Area/ bed-space	Plan-EAT	score/m^2/ bed-space
11	INT#26	New Perspective Group Home no.4	47.9 m^2	67.2%	1.40%
12	INT#13	Elderkare	42.4 m^2	58.0%	1.37%
13	INT#07	Brightwater Onslow Gardens: 3/3 - SE & SW	51.8 m^2	70.0%	1.35%
14	INT#06	Brightwater Onslow Gardens: 2/3 - N.W.	55.1 m^2	73.7%	1.34%
15	INT#24	Namaste Alzheimer Center: 1/2 - East	40.2 m^2	53.2%	1.32%
16	INT#05	Brightwater Onslow Gardens: 1/3 - N.E.	53.7 m^2	70.0%	1.30%
17	INT#25	Namaste Alzheimer Center: 2/2 - West	51.1 m^2	65.4%	1.28%
18	INT#34	Weiss Institute,	31.3 m^2	39.9%	1.27%
19	INT#35	Woodside Place: 1/2 - West and middle	57.2 m^2	71.7%	1.25%
20	INT#28	Park Homes at Parkside	62.7 m^2	77.3%	1.23%
21	INT#36	Woodside Place: 2/2 - East	57.2 m^2	70.4%	1.23%
22	INT#17	Helen Bader Center	59.1 m^2	72.7%	1.23%
23	INT#11	Corine Dolan Centre	46.6 m^2	57.1%	1.23%
24	INT#12	De Hogeweyk: typical unit	67.8 m^2	77.6%	1.14%
25	INT#31	Southwood Home: 2/2 - Typical	71.0 m^2	80.4%	1.13%
26	INT#04	Alzheimer's Disease Residential Center	71.0 m^2	75.9%	1.07%
27	INT#10	Childers Place	71.3 m^2	74.2%	1.04%
28	INT#33	Weikslag Krabbenlaan	67.5 m^2	69.1%	1.02%
29	INT#20	John Douglas French Center: 2/2 - Ground	39.4 m^2	40.3%	1.02%
30	INT#32	Stonefield Home	49.1 m^2	49.0%	1.00%
31	INT#01	Alexian Village	57.0 m^2	55.5%	0.97%
32	INT#22	Leonard Florence Center: 2/2 - North	77.8 m^2	75.3%	0.97%
33	INT#21	Leonard Florence Center: 1/2 - South	85.4 m^2	75.3%	0.88%
34	INT#30	Southwood Home: 1/2 - SCU	99.6 m^2	86.0%	0.86%
35	INT#09	Orchard Centre	98.8 m^2	71.9%	0.73%
36	INT#19	John Douglas French Center: 1/2 - upper	39.4 m^2	26.7%	0.68%

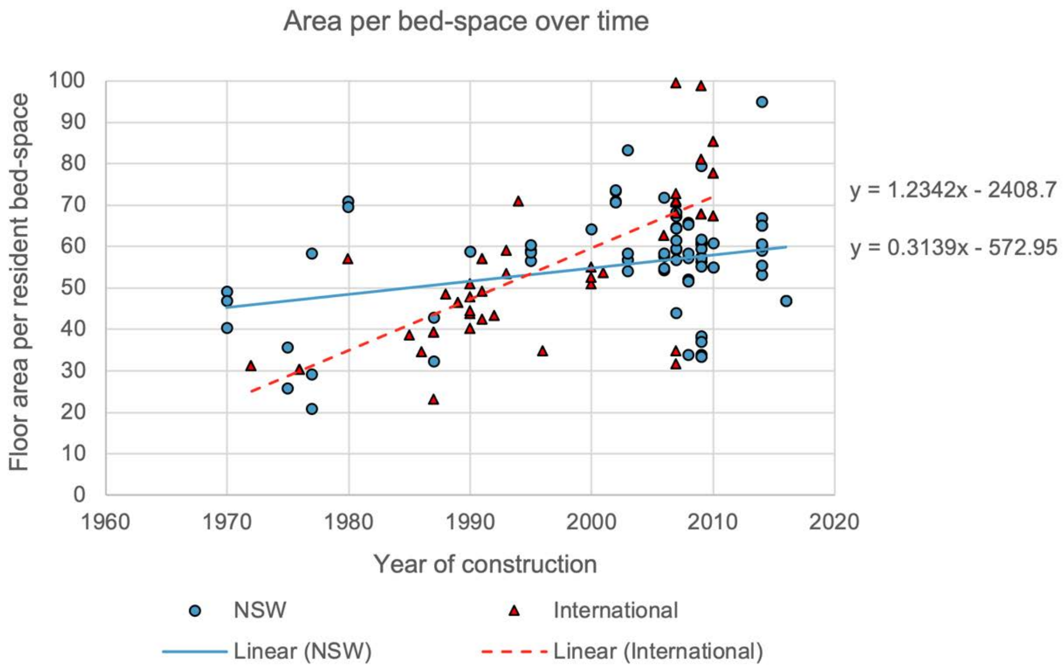

Figure 8-G: Floor are provision per resident over time

A further consideration, as a potential future expansion of this research is to consider the impact of the broader trend to reduce the number of residents in residential aged care units over time. This could consider controlling for time (on construction date) in the evaluations of the effect of the number of bed-spaces on design quality, or conversely, the contributory effect of the gradually increasing provision of floor area per bed-space over time as a factor in the improvement in design quality. An analysis using the current data shows an increase in floor are per resident bed-space for the international set of 12.3m^2 per decade and 3.1m^2 within the NSW set (see Figure 8-G)

8.3.4 Results 3(iv) – Storey location

Urban residential aged care facilities are likely to face different challenges to rural ones in achieving high quality dementia design. One of the primary differences is likely to be the ability to be sited on sufficiently large or affordable sites. A direct consequence of the combination of land cost, physically restricted site sizes and higher construction costs may be an increased frequency of residential aged care facilities being constructed densely over several storeys. There is also an associated potential reduction in the available space for the provision of quality outdoor space. Although it is unclear whether designing for dementia becomes more difficult overall at upper storeys, it is considered possible that challenges such as physical access and the provision of sufficiently sized, well-designed and oriented, accessible outdoor spaces may require more effort from designers and developers than a similar unit might at ground level. This section examines this issue by comparing storey location (ground or upper) with dementia design quality rating, developed using Plan-EAT. Fifty-five of the ninety NSW units (61%) are located at ground floor level, with the remaining thirty-five (39%) located on an upper floor. The international set contained seventy-five ground floor (80%) and nineteen upper floor units (20%).

Table 8-F: Ground floor versus upper floor units

	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT
International ground floor (n=75)	73%	67%	51%	56%	84%	62%	62%	89%	94%	70.9%
International upper floor (n=19)	71%	67%	73%	19%	68%	33%	53%	63%	81%	58.7%
NSW ground floor (n=55)	53%	41%	44%	46%	79%	43%	65%	85%	80%	59.6%
NSW upper floor (n=35)	37%	38%	35%	36%	67%	27%	55%	66%	78 %	48.8%

The review of drawings for the NSW set indicated that eleven of thirty-three (33%) upper floor units lacked provision, on the same floor level, of a directly accessible and suitably sized[31] outdoor space such as a terrace, large balcony or roof garden. A surprising finding was that drawings for sixteen of the fifty-seven (28%) ground floor units included no graphical indication of the provision of accessible outdoor space. It is possible that some of these are simply due to the omission of external/landscaping information from the drawings provided for evaluation by participating care organisations. Considering the overwhelming weight of evidence of the health benefits that can be obtained for people living with dementia, and for the staff in care settings from spending time outdoors (Rappe and Topo, 2007; Marshall, 2011; Whear *et al.,* 2014; Gonzalez and Kirkevold, 2015; Nejati, Rodiek and Shepley, 2016) this apparently

[31] Small balconies not capable of hosting group social events, or meaningful activities, were discounted. The minimum threshold of enough communal outdoor space was set at $4m^2$ per resident.

frequent lack of provision of outdoor spaces in NSW residential aged care settings is a concern. Further research to verify the status of outdoor space provision in Australian residential aged care units would be justified.

The results of this correlation study indicate similar and significant overall difference between the ground-floor and first floor units in both the NSW and international sets (See Table 8-F and Figure 8-H). The seventy-five ground-floor international units achieved an average Plan-EAT score of 70.9%, whilst the nineteen upper floor international units achieved 58.7%, giving a clear difference of 12.2% between ground and upper floor units. The fifty-five ground floor NSW units achieved an average Plan-EAT score of 59.6%, whilst the thirty-five upper floor located units achieved an average of 48.8%, leaving a 10.8% difference between the NSW ground and upper floor sub-groups (Table 8-F).

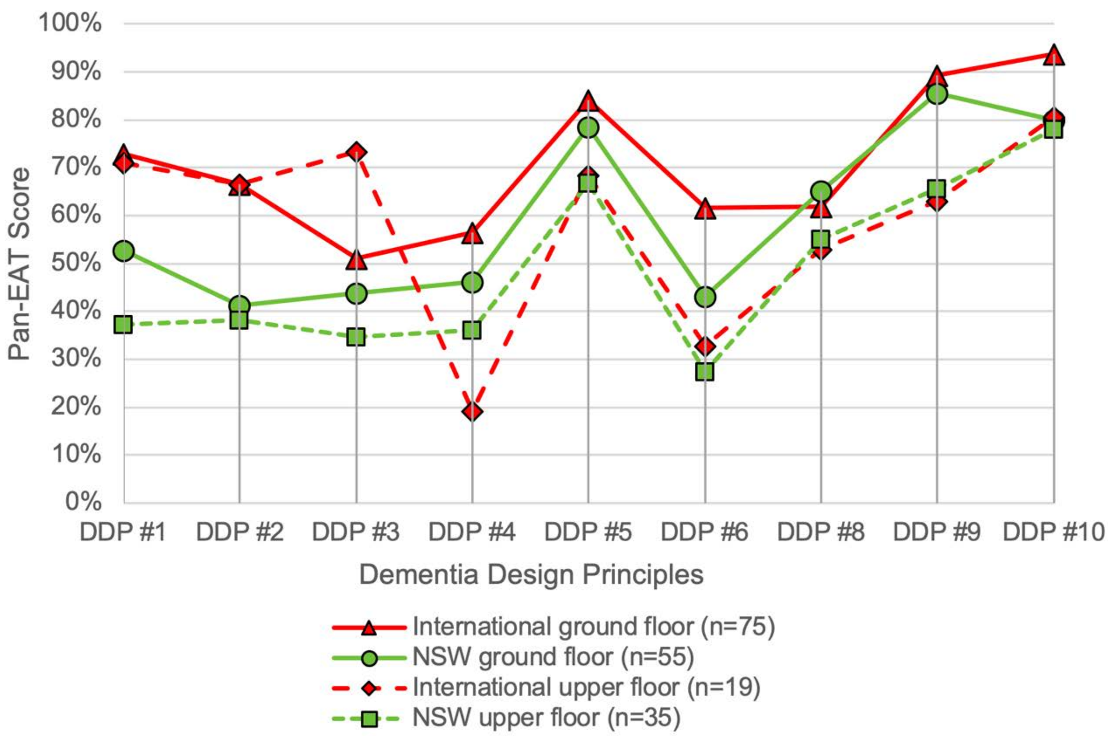

Figure 8-H: Ground floor and upper floor units

8.3.5 Results 3(v) – Purpose-built versus non-purpose-built units

The section examines the extent to which being purpose-built, or not, influences the overall dementia design quality in the planning of the unit. This investigation was undertaken using a correlation analysis between Plan-EAT scores for each unit, obtained during investigations for

Research Aim 1, measured against whether each unit was declared as being purpose-built for people living with dementia or not. For the NSW units this designation was identified by participating care organisations in a participant questionnaire (Appendix E), and for international units, from tables or body text within the publications where the unit floor-plan drawings were obtained. The year of construction for the average non-purpose-built NSW unit was 1996, but 10 years earlier, 1986, for the international set. The average purpose-built NSW unit was built in 2010, but the average date for international units was eleven years earlier in 1999. Purpose-built units (excluding separate shared service areas) have an average area of 663m2 and are therefore 392m2 smaller than non-purpose-built units that average 1055m2. This difference is less pronounced between the purpose-built and non-purpose-built units within the NSW set (235 m2) compared to the international set (525m2), however it should be noted that there are only eight non-purpose-built units amongst the international set, so they represent a small proportion of the study population.

About three-quarters (134/184=73.9%) of all residential aged care units evaluated in the present study were identified as having been purpose-built. This included fifty of the ninety (55.6%) NSW units and eighty-six of the ninety-four (91.5%) international units.

Across the full 184 units in the present study, purpose-built units have an average 14.6 bed-spaces, which is 10.7 less than the broad average of 25.3 bed-spaces for the non-purpose-built units. The purpose-built units from the NSW set host an average of 18.2 resident bed-spaces, whilst the purpose-built units from the international set host a significantly smaller number of residents per unit, with an average of only 12.6 bed-spaces per unit. By comparison, the NSW non-purpose-built set host an average of 23.6 bed-spaces (29.6% more than the NSW purpose-built average) whilst the international set averaged 34 bed-spaces per unit (169.8% more than the international purpose-built average). This unexpected average resident group size in the international non-purpose-built units is explained in part by the combination of having only eight non-purpose-built international units in the set, with one of these, the Alois Alzheimer's Centre (INT#02), being exceptionally large, with seventy-six resident bed-spaces. When this oversized unit is excluded, the average for the seven remaining units reduces to 28 bed-spaces – still (18.6%) larger than the NSW non-purpose-built subset.

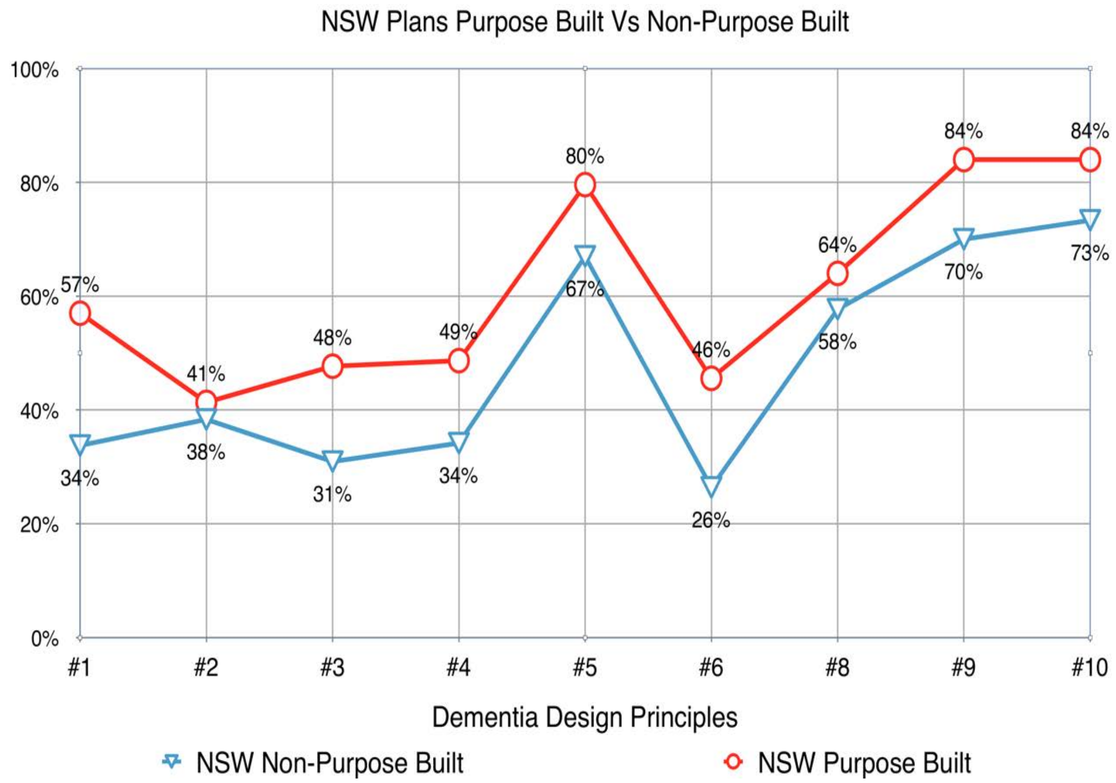

Figure 8-I: Purpose-built versus non-purpose-built

Plan-EAT dementia design evalaution scores were compared between the purpose-built and non-purpose-built units of both the NSW and international sets. As might have been expected, international 'purpose-built' units have the highest average Plan-EAT score (71%) followed by the NSW purpose-built subset (Plan-EAT average = 61%). Both subsets of purpose-built units scored better than their non-purpose-built counterparts, with the NSW non-purpose-built subset scoring higher on average (48%) than the equivalent international subset average (36%). See Figure 8-G, Figure 8-J and Figure 8-J.

Table 8-G: Purpose-built versus non-purpose-built units

	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT
International purpose-built (n=86)	77%	71%	58%	50%	85%	59%	62%	87%	96%	71%
International non-purpose-built (n=8)	31%	25%	36%	38%	43%	21%	43%	50%	42%	36%
NSW purpose-built (n=50)	57%	41%	48%	49%	80%	46%	64%	84%	84%	61%
NSW non-purpose-built (n=40)	34%	38%	31%	34%	67%	26%	58%	70%	73%	48%

Although it was slightly unexpected for the NSW-based non-purpose-based schemes (n=40) to score slightly more positively than their international counterparts (n=8). This can be explained (as above) by the small group size of non-purpose-built international units, being comprised of only three unit layout types, and being skewed towards an increased number of bed-spaces (averaging thirty-four per unit) and larger floor area (1103m2) by the inclusion of the unusual Alois, Ohio (Cohen and Day, 1993, p. 30) a converted school, which contains seventy-five bed-spaces over 1764 m2, and by virtue of all units in the subset being older

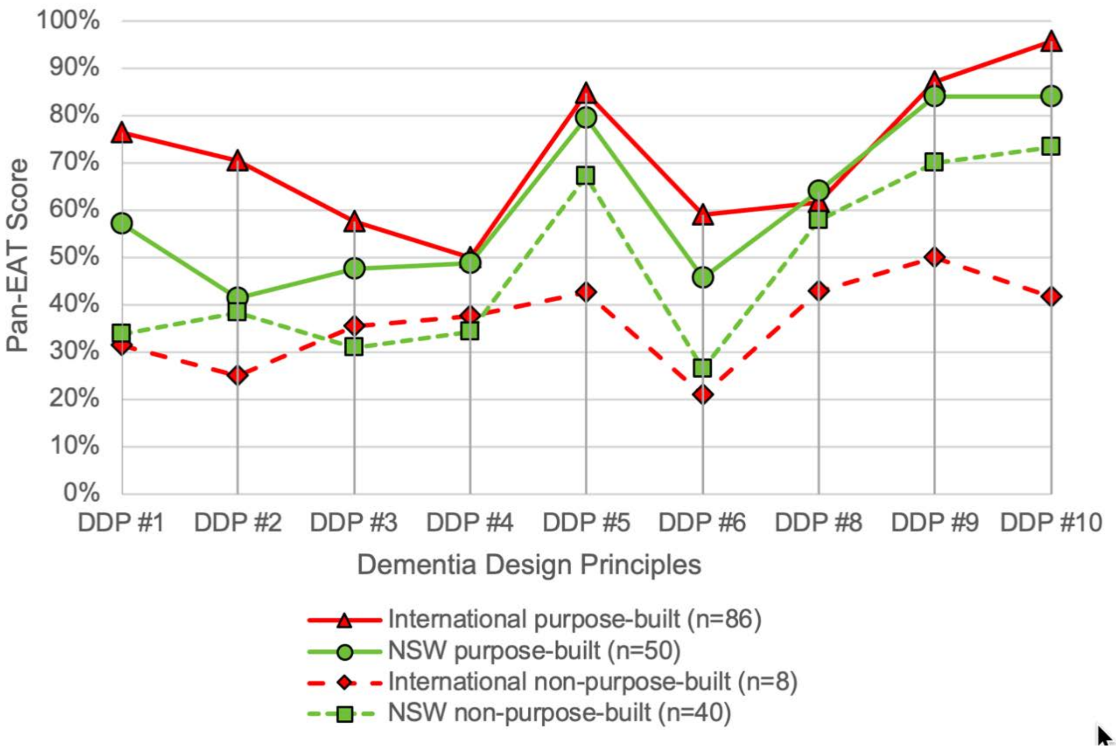

Figure 8-J: Purpose-built and non-purpose-built units

units, with an average construction year of 1986, borrowed from Cohen and Day (1993) with the oldest source of floor-plan drawings used in the present research. A similar proportion of purpose-built NSW units were located on the ground floor (54.6%) and upper floor (57.1%). However, this difference was more significant within the international set, with almost all (94.7%) of ground floor units being purpose-built, whilst four in five (79%) of the international upper floor units were purpose-built.

8.4 Conclusion

The preceding sections of this chapter presented valuable findings after evaluations of the effects on dementia design quality of residential aged care unit layouts against five, separate, but sometimes interlinked attributes.

The units with the highest dementia design quality in floor-plan layouts have the following attributes:

- They tend to have been built more recently, especially in the last decade
- They tend to be smaller units, especially in the case of international units
- Have fewer residents bed-spaces per unit
- Provide more floor area per resident
- Are located at ground floor
- Have been purpose-built for accommodating people living with dementia

Although not an aim, the research also showed that higher scoring units tended to have a much higher proportion of single-occupancy (i.e. private) bedrooms. There was not a clear indication from the available information whether the availability of en-suite bathroom facilities makes any difference to overall dementia design quality. However, it is noted that en-suites were not provided amongst some of the highest scoring units from countries where English is not the first language, and not provided amongst the lowest scoring units from countries where English is the first language.

9 CONCLUSION

9.1 Revisiting the aims

In this dissertation, a dataset of 184 residential aged care unit plans was interrogated across a range of criteria, which are significant either for the purposes of planning future residential aged care standards, or for developing new knowledge about dementia design. Analyses initially revolved around established DDPs and assessing them using plan-based analysis, before engaging in a further investigation that correlated the results of dementia design analyses against other measures related to each unit. The main plan-based dementia design evaluation method employed in this dissertation is a modified version of Fleming's (2011) Environmental Audit Tool.

As Chapter 3 reveals, a review of existing dementia design evaluation literature concluded that there were no known formal dementia design evaluation instruments designed, or identified as suitable, for floor-plan based evaluation. A broad review of several existing instruments identified that there was potential for three of these — the DDAT, the EAT, and the TESS-NH — to be modified for this purpose. A follow-up analysis and comparison of these determined that the EAT was the most suitable for modification to floor-plan based evaluations. Following from this, the dissertation (Chapter 4) described the modification and refinement of the EAT, including its scoring mechanism, to become Plan-EAT. This would become the floor-plan based dementia design evaluation method subsequently used for the evaluation of the 184 residential aged care units included in the present study.

In this concluding chapter, the three major aims of the dissertation are revisited, and the outcomes are summarised. Thereafter these results are discussed, and some opportunities for future research are considered.

9.2 Research Aim 1: Comparing NSW and international unit layouts

The first aim was to evaluate and compare dementia design quality in the layout planning of NSW-based and international best-practice examples of residential aged care units. Whilst the NSW-based units were recruited directly, the international best practice examples were selected from specialist design publications. Undertaking the dementia design evaluation research required the development of the first known plan-based dementia design evaluation tool.

Plan-EAT evaluation was used to analyse the layouts of the units under nine previously established DDPs. Assessment results produced an overall score for each unit, and sub-scores under each of the nine applicable DDPs. The resulting score profile for each unit made it possible to determine the strengths and weaknesses of each unit layout. These scores, measuring the evidence-based dementia design quality in the layout planning of residential aged care units, also permitted comparisons between individual units, between sets, and against average scores for a given circumstance.

Analysis of Plan-EAT evaluation results (Chapter 6) focussed on exploring the similarities and differences between the (directly recruited) NSW units and the international exemplar units, borrowed from specialist design publications. This showed that although the international units tended to have higher quality design than the NSW units overall, the extent of difference between the two sets can vary significantly from one dementia design principle to the next.

- The NSW set averaged 55.4% under the Plan-EAT whilst the international set averaged 68.4%. Although this result indicates differences in the overall design quality of the average international and NSW unit layouts, it also indicates that there is significant room for improvement to dementia design quality in the layout-planning of residential aged care units.

- Review of the results under individual DDPs showed significant differences in average scores from one DDP to the next, as well as differences between the International and NSW sets. Findings included that NSW layouts tend to be strong under DDP#5 *Helpful Stimuli*, DDP#9 *Community Links,* and DDP#10 *Domestic Activity*. They showed that the NSW units have significant room for improvement under DDP#1 *Safety*, DDP#2 *Human Scale*, DDP#3 *Visual Access*, DDP#4 *Stimulus Reduction*, and DDP#6 *Wandering and Outdoor Space,* and that International exemplars have the most room for improvement under DDP#4 *Stimulus Reduction*, DDP#6 *Wandering and Outdoor Space*. The scores for both sets of layout-types come close under four DDPs of DDP#4 *Stimulus Reduction*, DDP#5 *Helpful Stimuli*, DDP#8 *Privacy and Social Interaction*, and DDP#9 Community Links. The NSW falls behind by the greatest margins under DDP#1 *Safety*, DDP#2 *Human Scale*, DDP#3 *Visual Access*, and DDP#6 *Wandering and Outdoor Space*.

- A ranked list of unit layout types by Plan-EAT score helped to identify that a small proportion of Australian residential aged care units are, and have historically been, amongst the best in the world; a point emphasised by the top-four unit layout types (out of 108) and six of the top ten, layout evaluated in this research being physically located within the state of NSW.

- The process of scoring plan-layout quality allowed the identification of layout types more likely to be supportive of people living with dementia – therefore useful as design precedents. Since the NSW units were required by human ethics to remain anonymous, floor plan illustrations from some the best performing international units were presented, with their design characteristics discussed with respect to strengths (and weaknesses) identified in the Plan -EAT score profile for each.

The expansive tables of raw results from the research undertaken for Chapter 6, which are all appended to this dissertation, were subsequently used as base information for further analyses undertaken as part of address research aims 2 and 3 in subsequent chapters.

9.3 Research Aim 2: Changes in dementia design quality over time

Activities to address the second aim of this dissertation, to determine whether the dementia-enabling characteristics of floor-plan layouts for residential aged care units in NSW have improved over the last four decades, were reported in Chapter 7. This mainly revolved around correlating the date of construction for residential aged care units against the dementia design quality of their layout planning, as determined by Plan-EAT scores obtained as an outcome from Research Aim 1. The main findings from this research aim show that the design of building layouts for residential aged care have changed over four decades in the following ways:

- The layout planning of both NSW residential aged care units and international best practice exemplars have improved significantly since the 1970's. The NSW set improved in dementia design quality by 6.6% in Plan-EAT score per decade, whilst the international set improved by 7.2%.

- However, improvements in the dementia design quality scores of directly recruited NSW unit layouts have remained behind those of international exemplars by over twenty years.

- Historically, some of the world-best residential aged care units have been in Australia, (including NSW). However, these high performing units have tended to be exceptions, with most of the residential aged care stock having significant room for improvement in design quality.

- The rate of design quality improvement has been more significant under some dementia design principles than others with seven of the nine DDPs having an increase of average score of more than 6% per decade. DDP#1 *Safety* has had the greatest amount of improvement in the NSW set, achieving an increase in score of 11% per decade.

- The decadal rate of design quality improvement in the two sets of units was similar (i.e. less than 4% difference) under six of the nine dementia design principles. However, a significantly greater rate of improvement occurred in the NSW set under DDP#3 *Visual Access,* where a reduction in design quality over time amongst the international set led to a difference in improvements rates of 12%. Conversely, a relative lack of improvement in the NSW set led to 17.4% per decade difference under DDP#2 *Human Scale,* and a 9.3% difference under DDP#9 *Community Links.*

Over time, many residential aged care facilities have grown to become larger complexes or even extensive campuses catering for larger numbers of older people, and thus increasingly responding to more diverse needs and interests of residents. This increase in scale and numbers, together with best practice in both design and care models, has led to the tendency for larger schemes to be made up of several smaller, independent, but repeated, units, often with near identical floor-plans. This tendency to repetition has also been evident in the sets of drawings evaluated for this research.

9.4 Research Aim 3: The impact of spatial planning factors

This last research aim, investigating the impact of five spatial planning factors on the dementia design properties of Australian and international residential aged care settings, was divided into five parts. The method for each involved variation on correlation analyses of specific factors against the Plan-EAT dementia design evaluation scores obtained as outputs from Research Aim 1 (Chapter 6). Three of these, i) unit floor area; ii) number of resident bed-spaces provided; and iii) area per resident, are interlinked due to the semi-dependent relationships between them. The final two sub-aims: iv) storey location; and, v) whether purpose-built for dementia or not, were undertaken as relatively independent analyses. While the present research concurs with past research that the relationship between dementia design quality and specific architectural design elements is not necessarily a straightforward one, the best scoring units were found to have the following characteristics:

- They are physically smaller, with scores for unit layout design quality tending to decrease at a rate of 2% for every m^2 of increasing floor area.
- They have fewer residents per unit, with the dementia design quality scores for the layouts of NSW residential aged care units reducing by 1% for every three additional residents. Layout design quality reduces at a rate of almost 1% per additional resident amongst the international exemplar units. However, this may be linked to the gradual reduction in the average numbers of resident bed-spaces per unit, reducing at a rate of five residents per decade amongst the NSW set, whilst design quality improves for other reasons over time.
- They provide more floor area per resident, with dementia design quality scores (Plan-EAT) increasing by 0.4% for each additional square meter (m^2) of floor space per resident bed-space. This rate is 0.6% for the international exemplars.
- Ground floor located units tend to outperform upper floor units by an overall margin of more than 10%, with the most room for improvements for the upper floor units, versus the ground floor units, occurring under dementia design principle number 1 (DDP#1) *Safety,* and dementia design principle number 9 (DDP#9) *Community Links.*
- Purpose-built NSW unit layout types tend to achieve an average of 10% higher dementia design quality score than the NSW units not built for purpose. This difference more than doubles under dementia design principle number 1 (DDP#1) but makes little difference to scores under dementia design principle number 2 (DDP#2) *Human Scale.*

9.5 Discussion

The broad findings of this research provide mixed news for designers, and people working in the dementia care sector. For example, whilst a small number of NSW-based settings are amongst the best quality dementia design in the world, the broader stock of residential care environments, even when recently constructed, do not provide optimal levels of cognitive prosthesis for majority of aged care residents who depend on this for their overall wellbeing. Although the present research concludes that dementia design standards in NSW residential aged care settings have steadily improved over time, the wide prevalence of sub-optimal design quality is still a subject of concern. But why does this occur? Are the poor rates of dementia design implementation a product of the lack of available information, lack of awareness amongst decision makers, or conscious lack of prioritisation against competing demands during the design process. The present research does not directly shed any light on these three, leading to the need for further studies to help identify the cultural, technical, or financial inhibitors that are currently preventing more widespread implementation.

The present research has identified that a handful of Australian schemes have tended, historically, to feature amongst the best performing international units in a given period, with this continuing recently, as a small proportion of units in the NSW set have also performed especially well against the international exemplars. It is unclear whether these minority of high performing units (despite the broadly sub-optimal performance of the wider stock of NSW residential aged care provision) reflects Australia's leadership in the development and application of evidence-based design, or whether this is a form of self-fulfilment (i.e. Australian schemes developed using Australian dementia design principles, scoring well on an Australian-developed design assessment tool). Of course, this discussion is one which lies beyond the scope of the present dissertation.

Certainly, past research on the topic of poor implementation by Fleming *et al.* (2012) suggested that when the design of newly constructed settings were found to be suboptimal (with EAT evaluation outcomes ranging from 57.4% to 79.9% and an average of 67.9%), the dementia design knowledge level of the commissioning aged care facility manager was a primary determinant of dementia-supportive design outcomes in the completed building. Unexpectedly, the study drew no association with the architects' self-reported knowledge of DDPs. This finding suggests that the problem may not be related to knowledge of evidence-based dementia design principles *per se*, but that is reliant on key actors in the building procurement process holding this knowledge base and the motivation to act upon it.

Although the results of the research have led to a combination of both wide-ranging and specific findings, a significant underlying ambition of the project is that it leads to some measures that will have meaningful impact. The design and care industries are likely to benefit most from research outputs that simplify or demystify the process of designing well for dementia. Just as the books used as source material for the present research serve an important function, the identification of case studies as working examples could be more useful, as they may be more easily digested and implemented than a list of design principles that compete against other factors in the design process. Although the directly recruited NSW schemes cannot be illustrated in detail — due to the need to protect the identity of participants — the drawings of international units from published sources provide illustrative examples of settings with different strengths and weaknesses, in dementia design, from a Plan-EAT evaluation.

Perhaps the most significant outcome of this research project has been the development of a new technique and format of dementia design evaluation. The application of the new technique has helped improve existing knowledge of various factors that contribute to the dementia design quality of residential aged care units, creating the potential for improving the design quality of these environments into the future. Plan-EAT has enabled design evaluation to be carried out in a new way. It has introduced a concept of evaluation based on design documentation; an approach not identified in published material on dementia design before now. This, in turn, enables formal design evaluation and guidance during design stages, which is also new in the dementia design field. Although the specific method used in this research has focussed on design evaluation based on floor-plans, thereby limiting the range and depth of the design feedback that is possible where much more information is available, this has enabled formal design evaluation to occur at the very earliest stages of the design process. The method used to develop Plan-EAT could in future be used to modify an established dementia design evaluation instrument for the formal purpose of design evaluation based on a wider range of more detailed design and construction information.

The forthcoming introduction of the new Aged Care Quality Standards in 2019 is anticipated, through Standard 5 *Organisation's Service Environment* to bring about a significant increase in interest in dementia design for residential aged care setting across Australia. This may mean that design evaluation methods such as the Plan-EAT and EAT become increasingly valuable as tools to help the aged care sector address the new requirements.

9.6 Future research

Chapter 3 clarified that some existing dementia design evaluation tools are capable of being changed (to varying degrees) to facilitate plan-based dementia design evaluation. The evaluation process undertaken in Chapter 3 also established that modified versions of existing evaluation tools could be used to enable design evaluation to be undertaken at various stages during the design process, from early sketch plans through to fully detailed construction documentation. Future research that developed and tested such tools would be one avenue of logical progression from the present research.

Up until this point all known dementia design evaluation instruments were only configured for first-hand evaluation of physical environments at post-occupancy stage (i.e. needing the building to be completed and in use). They are clearly helpful to identify strengths and weakness in existing environments, especially in advance of renovations, by helping designers and building owners to prioritise adaptations and improvements most likely to enhance resident wellbeing. This research project has developed the first known dementia design evaluation tool for use at early stages of the design process — it is the first of its kind formally intended for assessing dementia design quality in advance of construction.

Plan-EAT is seen to have potential for two significantly useful purposes in helping improve fundamental aspects of design in dementia care environments. One, as a means of better establishing the dementia design quality of Australia's existing stock of residential aged care settings, and the other as a tool to help improve the design quality of design proposals as they develop, for the large volume of new residential aged care settings expected to be constructed in the next few years – anticipated to be 12,000 bed-spaces per year until 2022 (Aged Care Financing Authority, 2016)

Considering the relatively unknown quality of dementia design across Australia's three thousand residential aged care services, floor-plan evaluation using Plan-EAT could form a resource-efficient means of establishing an overview of the dementia design quality of large numbers of existing residential aged care settings. Of course, in an ideal world a detailed first-hand design assessment of all physical settings would be preferable but considering the near impossible nature of this task considering the geographic spread of the three thousand services (hosting around 200,000 bed-spaces across an estimated 11,000 to 12,000 units) and the likely time input and cost, this is unlikely to be justified. However, an alternative of evaluating floor-plans for a significant cross section of the existing stock of Australian residential aged care settings is more likely to be an efficient means of establishing how well these formal care settings cater for the increasing proportions of their occupants who are living with dementia.

As the creation of Plan-EAT now allows formal design evaluation and feedback to occur earlier in the design process, its use by architects and building commissioners is anticipated to improve the likelihood of achieving high quality dementia design in the subsequently constructed building. Feedback which encourages design improvement received at earlier stages of the design process is, due to low cost implications, expected to have more likelihood of being implemented. With the positions of costly elements such walls and other structure being designed at early stages, but having significant impact on spatial experience, this is seen as a key stage of dementia design evaluation.

The available evidence suggests that the design of Australian residential aged care settings is sub-optimal for supporting people living with dementia. The research exploring the reasons for lack of translation of this well-established and widely disseminated evidence into design and construction practice is limited.

It is likely that there are several potential contributory factors to sub-optimal design outcomes of residential aged care settings that could benefit from further research. For example, the impact of variable design knowledge and/or priorities amongst residential aged care designers and commissioning clients deserves further investigation. Alternatively, an exploration of reduced dementia design quality due to the absence of building codes, or care licensure standards, to require that residential aged care environments are designed for dementia could be investigated.

Ultimately, the building layout form only part of the creating of a dementia supportive environment. Aside from the other aspects of architectural design, the quality of the residential aged care environment is also dependant of the quality of care provided, and how well the activities undertaken make use of the therapeutic features provided in the design. A good layout is still depended on detailed design, whilst the user of the building, especially staff and management need to also understand the benefits of various design features to the wellbeing of residents with dementia, and therefore how to optimally make of use therapeutic features in environment, such as activities in the garden to the greatest benefit to residents overall wellbeing. The environment can only ever hope to be the catalyst to support and encourage wellbeing, setting the right conditions for the delivery of high-quality care, and for providing optimal support to maximise the autonomy of residents with dementia.

9.7 Conclusion

Developing a method for early stage dementia design evaluation of proposals for aged care residential units resulted in a floor-plan evaluation instrument based on the *Environmental Audit Tool* (EAT) (Fleming, 2011). The floor-plan based dementia design evaluation method from Chapters 3 and 4 was developed for auditing the layouts of existing residential aged care facilities and answering one of the three specific research aims of this dissertation. However, this new method also enables formal dementia design evaluation during the design phases for new residential aged care facilities, giving both a means of providing architects and building designers with feedback on their proposals and allowing non-expert commissioners and planners a standardised means to verify the evidence-informed dementia design quality of both existing and proposed facilities.

REFERENCES

Access Economics (2009) *Making choices: Future dementia care: projections, problems and preferences*, *Making Choices: Future dementia care: projections, problems and preferences*. Available at: http://www.fightdementia.org.au/common/files/NAT/20090400_Nat__AE_FullMakingChoices.pdf.

Access Economics Pty Limited and Access Economics (2003) *The Dementia Epidemic: Economic Impact and Positive Solutions for Australia*, *Access Economics Pty Limited, Canberra*. Canberra. Available at: https://www.dementia.org.au/sites/default/files/20030300_Nat_AE_FullDemEpEconImpPosSolutions.pdf.

Aged Care Financing Authority (2016) *Fourth report on the Funding and Financing of the Aged Care Sector*, *Aged Care Financing Authority Report*.

Algase, D. L., Beattie, E. R. A., Bogue, E.-L. and Yao, L. (2001) 'The Algase wandering scale: Initial psychometrics of a new caregiver reporting tool', *American Journal Of Alzheimer's Disease And Other Dementias*, 16(3), pp. 141–152. doi: 10.1177/153331750101600301.

Allen, G. L. (1999) 'Spatial abilities, cognitive maps, and wayfinding', in Golledge, R. G. (ed.) *Wayfinding behavior: Cognitive mapping and other spatial processes*. John Hopkins University Press, pp. 46–80.

Alpin, T. and de Jonge, D. (2013) 'Understanding the dimensions of home that impact on home modification decision making', *Australian Occupational Therapy Journal*, 60(2). doi: 10.1111/1440-1630.12022.

Alzheimer's Society (2014) 'Drug treatments for Alzheimer's disease'. Available at: https://www.alzheimers.org.uk/sites/default/files/migrate/downloads/factsheet_drug_treatments_for_alzheimers_disease.pdf (Accessed: 28 October 2018).

Anderzhon, J. W. *et al.* (2012) *Design for Aging: International Case Studies of Building and Program*. Wiley.

Annerstedt, L. (1993) 'Development and consequences of group living in Sweden', *Social Science & Medicine*, 37(12), pp. 1529–1538. doi: 10.1016/0277-9536(93)90187-9.

Arthur, P. and Passini, R. (2002) *Wayfinding: People, Signs and Architecture*. 2nd edn. Oakville, Ontario: McGraw-Hill.

Australia Bureau of Statistics (2016) *Australian Demographic Statistics: Key Figures*. Commonwealth of Australia. Available at: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3101.0Dec 2016?OpenDocument (Accessed: 7 October 2018).

Australian Building Codes Board (2016) *National Construction Code*, *National Construction Code*. Available at: http://www.abcb.gov.au/ncc-online/NCC/2016-A1?vol=56a3b1a8-d528-471b-be8a-5527c2d7db47#56a3b1a8-d528-471b-be8a-5527c2d7db47 (Accessed: 28 July 2018).

Australian Building Codes Board (2017) 'Understanding the NCC - Building Classifications'. Available at: https://www.abcb.gov.au/-/media/Files/Resources/Education-Training/Building-classifications.pdf.

Australian Bureau of Statistics (2017) 'Underlying Causes of Death, Australia, 2016'. Canberra: Australian Government Publishing Service. Available at: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3303.02016?OpenDocument.

Australian Government Department for Health (2012) *Aged Care Service List 2011/2012*. Available at: https://agedcare.health.gov.au/ageing-and-aged-care-overview/about-aged-care/aged-care-service-providers-in-australia.

Australian Government Department of Health and Ageing (2016) *Australian Aged Care Service List 2015/2016*. Available at: https://agedcare.health.gov.au (Accessed: 28 July 2018).

Australian Institute of Health and Welfare (2011) *Dementia Among Aged Care Residents: First Information from the Aged Care Funding Instrument*. Canberra. Available at: http://www.aihw.gov.au/publication-detail/?id=10737419025.

Australian Institute of Health and Welfare (2012) *Dementia and Australia*. doi: 10.1177/153331759801300107.

Avers, D. and Williams, A. K. (2012) 'CHAPTER 8 - Cognition in the aging adult', in *Geriatric Physical Therapy (THIRD EDITION)*. Saint Louis: Mosby, pp. 121–152. doi: 10.1016/b978-0-323-02948-3.00017-1.

Banerjee, S. (2009) *The use of antipsychotic medication for people with dementia: Time for action*. London. Available at: http://psychrights.org/research/digest/nlps/banerjeereportongeriatricneurolepticuse.pdf (Accessed: 10 December 2018).

Banerjee, S., Samsi, K., Petrie, C. D., Alvir, J., Treglia, M., Schwam, E. M. and del Valle, M. (2009) 'What do we know about quality of life in dementia? A review of the emerging evidence on the predictive and explanatory value of disease specific measures of health related quality of life in people with dementia', *International Journal of Geriatric Psychiatry*. John Wiley & Sons, Ltd., 24(1), pp. 15–24. doi: 10.1002/gps.2090.

Banerjee, S. (2016) 'Multi-morbidity in Dementia: A 21st Century Challenge', *The 11th UK Dementia Congress*. Brighton. Available at: https://dta.com.au/wp-content/uploads/2017/08/Multi-morbidity-in-Dementia-A-21st-Century-Challenge-Presentation.pdf (Accessed: 1 November 2018).

Barnes, S. (2002) 'The design of caring environments and the quality of life of older people', *Ageing and Society*, 22(6), pp. 775–789. doi: 10.1017/s0144686x02008899.

Bird, C. M. and Burgess, N. (2008) 'The hippocampus and memory: insights from spatial processing', *Nature Reviews Neuroscience*, 9(3), pp. 182–194. doi: 10.1038/nrn2335.

Brown, L., Hansnata, E. and La, H. A. (2016) *Economic Cost of Dementia in Australia*.

Brown, M., Tolson, S., Ritchie, L., Sharp, B., Syme, K., James, K. and Tolson, D. (2017) *Being Home: Housing and Dementia in Scotland*. Hamilton, Scotland, Scotland.

Cabrera, E. *et al.* (2015) 'Non-pharmacological interventions as a best practice strategy in people with dementia living in nursing homes. A systematic review', *European Geriatric Medicine*, 6(2). doi: 10.1016/j.eurger.2014.06.003.

Calkins, M., Szmerekovsky, J. G. and Biddle, S. (2007) 'Effect of Increased Time Spent Outdoors on Individuals with Dementia Residing in Nursing Homes', *Journal of Housing For the Elderly*. Taylor & Francis Group , 21(3–4), pp. 211–228. doi: 10.1300/J081v21n03_11.

Capewell, S., Allender, S., Critchley, J., Lloyd-Williams, F., O'Flaherty, M., Rayner, M. and Scarborough, P. (2009) 'Modelling the UK burden of cardiovascular disease to 2020'. Cardio & Vascular Coalition and the British Heart Foundation. Available at: http://dro.deakin.edu.au/view/DU:30020504 (Accessed: 10 December 2018).

Carlson, L. A., Hölscher, C., Shipley, T. F., Dalton, R. C., Conory Dalton, R. and Dalton, R. C. (2010) 'Getting lost in buildings', *Current Directions in Psychological Science*, 19(5), pp. 284–289. doi: 10.1177/0963721410383243.

Castell, L. (2008a) 'Adapting building design to access by individuals with intellectual disability', *Construction Economics and Building*, 8(1).

Castell, L. (2008b) 'Building access for the intellectually disabled', *Building acees for the intellectually disabled*, 26(3/4), pp. 117–130. doi: 10.1108/02632770810849463.

Castell, L. (2014) 'Building access for people with intellectual disability, dubious past, uncertain future', *Facilities*, 32(11/12), pp. 675–684. doi: 10.1108/F-03-2012-0017.

Chalfont, G. E. (2007) 'Wholistic Design in Dementia Care: Connection to Nature with PLANET', *Journal of Housing for the Elderly*. Taylor & Francis Ltd, 21(1/2), pp. 153–177. Available at: http://search.ebscohost.com/login.aspx?direct=true&db=sih&AN=28544085&site=ehost-live.

Chang, Y.-J., Peng, S.-M., Wang, T.-Y., Chen, S.-F., Chen, Y.-R. and Chen, H.-C. (2010) 'Autonomous indoor wayfinding for Individuals with cognitive impariments', *Journal of Neuroengineering and Rehabilitation*, p. 13. doi: 10.1186/1743-0003-7-45.

Chatterjee, S. *et al.* (2016) 'Type 2 Diabetes as a Risk Factor for Dementia in Women Compared With Men: A Pooled Analysis of 2.3 Million People Comprising More Than 100,000 Cases of Dementia', *Diabetes Care* , 39(2), pp. 300–307. doi: 10.2337/dc15-1588.

Chaudhury, H., Cooke, H. A., Cowie, H. and Razaghi, L. (2017) 'The Influence of the Physical Environment on Residents With Dementia in Long-Term Care Settings: A Review of the Empirical Literature', *The Gerontologist*, 00(00), pp. 1–13. doi: 10.1093/geront/gnw259.

Chenoweth, L. *et al.* (2014) 'PerCEN: A cluster randomized controlled trial of person-centered residential care and environment for people with dementia', *International Psychogeriatrics*, 26(7), pp. 1147–1160. doi: 10.1017/S1041610214000398.

Chrysikou, E., Tziraki, C. and Buhalis, D. (2018) 'Architectural hybrids for living across the lifespan: lessons from dementia', *Service Industries Journal*. Taylor & Francis, 38(1–2), pp. 4–26. doi: 10.1080/02642069.2017.1365138.

Cohen-Mansfield, J. (1997) 'Conceptualization of Agitation: Results Based on the Cohen-Mansfield Agitation Inventory and the Agitation Behavior Mapping Instrument', *International Psychogeriatrics*, 8(SupplementS3), pp. 309–315. doi: doi:10.1017/S1041610297003530.

Cohen-Mansfield, J., Marx, M. S. and Rosenthal, A. S. (1989) 'A Description of Agitation in a Nursing Home', *Journal of Gerontology*. Oxford, United Kingdom, Oxford: Oxford University Press, UK, 44(3), pp. 0-M77.

Cohen-Mansfield, J. and Werner, P. (1995) 'Environmental influences on agitation: An integrative summary of an observational study', *American Journal of Alzheimer's Disease and Other Dementias*, 10(1), pp. 32–39. doi: 10.1177/153331759501000108.

Cohen, U. and Day, K. (1993) *Contemporary Environments for People With Dementia*. Baltimore: John Hopkins University Press.

Coppedè, F., Bosco, P., Fuso, A. and Troen, A. M. (2012) 'Nutrition and dementia', *Current Gerontology and Geriatrics Research*, 2012. doi: 10.1155/2012/926082.

Cunningham, C. *et al.* (2008) *Dementia Design Audit Tool*. 1st Editio, *Dementia Design Series*. 1st Editio. Greenwich, NSW: University of Stirling.

Cunningham, C. *et al.* (2011) *Dementia Design Audit Tool*. 2nd Editio, *Dementia Design Series*. 2nd Editio. Stirling, UK: University of Stirling.

Curyto, K. J. P., Ogland-Hand, S. M. P. and Vriesman, D. K. B. (2007) 'Linking Behaviors and Interventions: The Impact of the Dementia Living Center in Its Home and Community', *Alzheimer's Care Quarterly April/June*, 8(2), pp. 134–147.

Daly Lynn, J. *et al.* (2017) 'A systematic review of electronic assistive technology within supporting living environments for people with dementia', *Dementia*, pp. 1–65. doi: 10.1177/1471301217733649.

Danes, S. (2012) 'Design for Dementia Care: A Retrospective Look at the Woodside Place Model', *Journal of Housing for the Elderly*, 26(1–3), pp. 221–250. doi: 10.1080/02763893.2012.658272.

Diaz Moore, K. and Ferdous, F. (2013) 'Spatial Configuration and Social Life for People Experiencing Dementia', in *ARCC Spring Research Conference*, pp. 685–691.

Dickinson, J. I., McLain-Kark, J. and Marshall-Baker, A. (1995) 'The effects of visual barriers on exiting behavior in a dementia care unit', *The Gerontologist*. Oxford, United Kingdom, Oxford: Oxford University Press, UK, 35(1), pp. 127–130. Available at: http://search.proquest.com/docview/210997452?accountid=10499.

Eastman, P. (2013) *Building Type Basics for Senior Living*. 2nd edn. Hoboken, NJ: John Wiley & Sons Ltd.

Edwards, A. J. (1993) *Dementia: Perspectives on Individual Differences*. Springfield, Missouri: Plenum Press.

Edwards, C. A., McDonnell, C. and Merl, H. (2012) 'An evaluation of a therapeutic garden's influence on the quality of life of aged care residents with dementia', *Dementia*. doi: 10.1177/1471301211435188.

Eijkelenboom, A., Verbeek, H., Felix, E. and van Hoof, J. (2017) 'Architectural factors influencing the sense of home in nursing homes: An operationalization for practice', *Frontiers of Architectural Research*. doi: 10.1016/j.foar.2017.02.004.

Finkel, S. (2000) 'Introduction to behavioural and psychological symptoms of dementia (BPSD).', *International Journal of Geriatric Psychiatry*, 15(1:S2-4).

Fisher, G., Arriaga, P., Less, C., Lee, J. and Ashpole, E. (2008) 'Residential Environment Impact Survey'. Available at: http://www.uic.edu/dept/moho/ REISinformation.html.

Fleming, R. (2010) 'The use of environmental assessment tools for the evaluation of Australian residential facilities for people with dementia', *Translating dementia research into practice*. Sydney: Dementia

Collaborative Research Centre, University of New South Wales, p. 43. Available at: https://www.dementiafriendly.org.au/sites/default/files/resources/evaluation_of_environmental_assessment_tools_-_the_environmental_audit_tool.pdf.

Fleming, R. (2011) ‘An environmental audit tool suitable for use in homelike facilities for people with dementia’, *Australasian Journal on Ageing*. Blackwell Publishing Ltd, 30(3), pp. 108–112. doi: 10.1111/j.1741-6612.2010.00444.x.

Fleming, R., Goodenough, B., Low, L.-F., Chenoweth, L. and Brodaty, H. (2014) ‘The relationship between the quality of the built environment and the quality of life of people with dementia in residential care’, *Dementia*, 15(4), pp. 663–680. doi: 10.1177/1471301214532460.

Fleming, R. (2015) ‘BEAT-D (mobile application)’. Wollongong: Dementia Training Australia. Available at: https://itunes.apple.com/us/app/beat-d/id527112326?mt=8 (Accessed: 20 December 2017).

Fleming, R. and Bennett, K. A. (2015) ‘Assessing the quality of environmental design of nursing homes for people with dementia: Development of a new tool’, *Australasian Journal on Ageing*, 34(3), pp. 191–194. doi: 10.1111/ajag.12233.

Fleming, R. and Bennett, K. A. (2017a) ‘Environmental Assessment Tool - Higher Care (EATHC) Handbook’. Wollongong: Dementia Training Australia, p. 88. Available at: https://www.dementiatrainingaustralia.com.au/wp-content/uploads/2017/02/EAT-HC-handbook.pdf.

Fleming, R. and Bennett, K. A. (2017b) ‘Environmental Design Resources’. Dementia Training Australia.

Fleming, R., Bennett, K. A. and Forbes, I. (2013) *The Environmental Audit Tool Handbook*. Wollongong: Dementia Training Australia (formerly Dementia Training Study Centres). Available at: https://www.enablingenvironments.com.au/uploads/5/0/4/5/50459523/eat_handbook_july_13.pdf (Accessed: 10 December 2018).

Fleming, R. and Bowles, J. (1987) ‘Units for the Confused and Disturbed Elderly: Development, Design, Programming and Evaluation’, *Australian Journal on Ageing*, 6(4), pp. 25–28. doi: 10.1111/j.1741-6612.1987.tb01001.x.

Fleming, R., Crookes, P. and Sum, S. (2008) ‘A review of the empirical literature on the design of physical environments for people with dementia’, *Faculty of Health and Behavioural Sciences - Papers (Archive)*. Available at: http://ro.uow.edu.au/hbspapers/2874.

Fleming, R., Fay, R. and Robinson, A. (2012) ‘Evidence-based facilities design in health care: a study of aged care facilities in Australia’, *Health Services Management Research*, 25(3), pp. 121–128. doi: 10.1258/hsmr.2012.012003.

Fleming, R., Forbes, I. and Bennett, K. A. (2003) ‘Adapting the ward for people with dementia.’, in *Adapting the ward for people with dementia*. Sydney, NSW: NSW Department of Health, pp. 109–116.

Fleming, R. and Kelly, F. (2015) ‘Communicating design research: improving the deisgn of environments of people with dementia’, in Rodgers, P. . and Yee, J. (eds) *The Routledge Companion to Design Research*. Routledge, pp. 374–385. doi: 9780415706070.

Fleming, R. and Purandare, N. (2010) ‘Long-term care for people with dementia: environmental design guidelines’, *International Psychogeriatrics*, 22(Special Issue 07), pp. 1084–1096. doi: doi:10.1017/S1041610210000438.

Forbes, D., Morgan, D. G., Bangma, J., Peacock, S. and Adamson, J. (2009) ‘Light Therapy for Managing Sleep, Behaviour, and Mood Disturbances in Dementia (Review)’, *Cochrane Database of Systematic Reviews*. Wiley Online Library, p. 30. Available at: www.thecochranelibrary.com.

Forbes, D. A. (1998) ‘Strategies for managing behavioural symptomatology associated with dementia of the Alzheimer type: a systematic overview.’, *The Canadian journal of nursing research= Revue canadienne de recherche en sciences infirmieres*, 30(2), pp. 67–86.

Fratiglioni, L. *et al.* (2000) ‘Incidence of dementia and major subtypes in Europe: A collaborative study of population-based cohorts. Neurologic Diseases in the Elderly Research Group’, *Neurology*. Stockholm Gerontology Research Center and Division of Geriatric Medicine, NEUROTEC, Karolinska Institutet, Sweden., 54(11 Suppl 5), pp. S10-5. Available at: http://europepmc.org/abstract/MED/10854355.

Fuggle, L. (2013) *Designing interiors for people with dementia*. Edition 4. Stirling, UK: University of Stirling, UK.

Garlick, B. (2008) 'Is the design of assisted care housing in Australia good enough?', in Garlick, B., Jones, D., and Luscombe, G. (eds) *Beyond Beige:improving architecture for older people and people with disabilities*. Canberra: The Royal Australian Institute of Architects, pp. 167–179.

Gärling, T., Böök, A. and Lindberg, E. (1986) 'Spatial Orientation and Wayfinding in the Designed Environment: A Conceptual Analysis and Some Suggestions for Postoccupancy Evaluation', *Journal of Architectural and Planning Research*, (Vol. 3, No. 1), pp. 55–64. Available at: http://www.jstor.org/stable/43028787?seq=1#page_scan_tab_contents (Accessed: 5 June 2017).

Garre-Olmo, J., López-Pousa, S., Turon-Estrada, A., Juvinyà, D., Ballester, D. and Vilalta-Franch, J. (2012) 'Environmental Determinants of Quality of Life in Nursing Home Residents with Severe Dementia', *Journal of the American Geriatrics Society*, 60(7), pp. 1230–1236. doi: 10.1111/j.1532-5415.2012.04040.x.

Gibson, G., Chalfont, G. E., Clarke, P. D., Torrington, J. M. and Sixsmith, A. J. (2007) 'Housing and Connection to Nature for People with Dementia', *Journal of Housing For the Elderly*, 21(1–2), pp. 55–72. doi: 10.1300/J081v21n01_04.

Glass, A. P. (2014) 'Innovative Seniors Housing and Care Models: What We Can Learn from the Netherlands', *Seniors Housing & Care Journal*, 22(1), pp. 74–81.

Golledge, R. G. (1999) 'Human wayfinding and cognitive maps', in *Wayfinding behavior: Cognitive mapping and other spatial processes*. Baltimore: John Hopkins Press, pp. 5–45.

Gonzalez-Salvador, T., Lyketsos, C. G., Baker, A., Hovanec, L., Roques, C., Brandt, J. and Steele, C. (2000) 'Quality of life in dementia patients in long-term care', *International Journal of Geriatric Psychiatry*. John Wiley & Sons, Ltd., 15(2), pp. 181–189. doi: 10.1002/(SICI)1099-1166(200002)15:2<181::AID-GPS96>3.0.CO;2-I.

Gonzalez, M. T. and Kirkevold, M. (2015) 'Clinical use of sensory gardens and outdoor environments in norwegian nursing homes: a cross-sectional e-mail survey.', *Issues in mental health nursing*, 36(1). doi: 10.3109/01612840.2014.932872.

Government of Australia (1992) *Disability Discrimination Act 1992*. Attorney-General's Department. Available at: https://www.legislation.gov.au/Details/C2014C00013 (Accessed: 11 May 2017).

Guijarro, R. *et al.* (2010) 'Impact of dementia on hospitalization', *Neuroepidemiology*, 35(2), pp. 101–108. doi: 10.1159/000311032.

Guyton, A. C. and Hall, J. E. (1991) 'Behavioral and motivational mechanisms of the brain—the limbic system and the hypothalamus', *Textbook of medical physiology*, pp. 678–687.

Hadjri, K., Faith, V. and McManus, M. (2012) 'Designing dementia nursing and residential care homes', *Journal of Integrated Care*. School of Planning, Architecture and Civil Engineering, Queen's University Belfast, Belfast, United Kingdom, 20(5), pp. 322–340. doi: 10.1108/14769011211270765.

Hamza, N. (2017) 'Reducing Agitation in Dementia Patients: A role for environmental design'.

Haq, S. and Zimring, C. (2003) 'Just down the road a piece: The development of topological knowledge of building layouts', *Environment and Behavior*, 35(1), pp. 132–160. doi: 10.1177/0013916502238868.

Harrison, J. K. *et al.* (2017) 'Predicting discharge to institutional long-term care following acute hospitalisation: A systematic review and meta-analysis', *Age and Ageing*, 46(4), pp. 547–558. doi: 10.1093/ageing/afx047.

Heringa, S. M., Bouvy, W. H., van den Berg, E., Moll, A. C., Kappelle, L. J. and Biessels, G. J. (2013) 'Associations Between Retinal Microvascular Changes and Dementia, Cognitive Functioning, and Brain Imaging Abnormalities: A Systematic Review', *Journal of Cerebral Blood Flow & Metabolism*. SAGE PublicationsSage UK: London, England, 33(7), pp. 983–995. doi: 10.1038/jcbfm.2013.58.

Hernandez, R. O. (2007) 'Effects of Therapeutic Gardens in Special Care Units for People with Dementia: Two Case Studies', *Journal of Housing for the Elderly*, 21(1–2), pp. 117–152. doi: 10.1300/J081v21n01.

Hillier, B. and Hanson, J. (1984) *The Social Logic of Space*. Cambridge: Cambridge University Press. Available at:

http://www.spacesyntax.com.

Hoe, J., Hancock, G., Livingston, G. and Orrell, M. (2006) 'Quality of life of people with dementia in residential care homes', *The British Journal of Psychiatry*, 188(5), pp. 460–464. doi: 10.1192/bjp.bp.104.007658.

Hofmann, H., Schorro, E., Haastert, B. and Meyer, G. (2015) 'Use of physical restraints in nursing homes: a multicentre cross-sectional study', *BMC Geriatrics*. BMC Geriatrics, 15(1), pp. 1–8. doi: 10.1186/s12877-015-0125-x.

Hoglund, J. D., Dimotta, S., Ledewitz, S. and Saxton, J. (1994) 'Long-term care design: Woodside Place--the role of environmental design in quality of life for residents with dementia', *Journal of Healthcare Design*, 6, pp. 69–76.

van Hoof, J., Kort, H. S. M. S. M., van Waarde, H. and Blom, M. M. M. (2010) 'Environmental Interventions and the Design of Homes for Older Adults With Dementia: An Overview', *American Journal of Alzheimer's Disease and Other Dementias*, 25(3), pp. 202–232. doi: 10.1177/1533317509358885.

van Hoof, J., Kort, H. S. M. S. M., Duijnstee, M. S. H. S. H., Rutten, P. G. S. G. S. and Hensen, J. L. M. L. M. (2010) 'The indoor environment and the integrated design of homes for older people with dementia', *Building and Environment*, 45(5), pp. 1244–1261. doi: 10.1016/j.buildenv.2009.11.008.

van Hoof, J., Rutten, P. G. S., Struck, C., Huisman, E. R. C. M. and Kort, H. S. M. (2015) 'The integrated and evidence-based design of healthcare environments', *Architectural Engineering and Design Management*, 11(4), pp. 243–263. doi: 10.1080/17452007.2014.892471.

Innes, A., Kelly, F. and Dincarslan, O. (2011) 'Care home design for people with dementia: What do people with dementia and their family carers value?', *Aging & Mental Health*, 15(5), pp. 548–556. doi: 10.1080/13607863.2011.556601.

International Association of Homes and Services for the Ageing (2014) *Architecture for an Ageing Population*. Edited by D. Faith. Mulgrave, VIC: The Images Publishing Group.

Johnstone, D., Milward, E. A., Berretta, R., Moscato, P. and Perez-Mato, M. (2012) 'Multivariate Protein Signatures of Pre-Clinical Alzheimer's Disease in the Alzheimer's Disease Neuroimaging Initiative (ADNI) Plasma Proteome Dataset', *PLoS ONE*. Edited by J. El Khoury. Public Library of Science, 7(4), p. e34341. doi: 10.1371/journal.pone.0034341.

Jonsson, O., Östlund, B., Warell, A., Dalholm Hornyánszky, E. and Hornyánszky, E. D. (2014) 'Furniture in Swedish Nursing Homes: A Design Perspective on Perceived Meanings within the Physical Environment', *Journal of Interior Design*, 39(2). doi: 10.1111/joid.12028.

Joosse, L. L. (2012) 'Do Sound Levels and Space Contribute to Agitation in Nursing Home Residents with Dementia?', *Research in Gerontological Nursing*, 5(3), pp. 174–184. doi: 10.3928/19404921-20120605-02.

Judd, S., Marshall, M., Phippen, P., Marshall, M. and Phippen, P. (1998) *Design for Dementia*. London: Journal of Dementia Care, Hawker Publications.

Kelly, F., Innes, A. and Dincarslan, O. (2011) 'Improving care home design for people with dementia', *Journal of Care Services Management*, 5(3), pp. 147–155. doi: 10.1179/175016811X13020827976726.

King, A. (2018) 'The search for better animal models of Alzheimer's disease', *Nature*, pp. S13–S15. doi: 10.1038/d41586-018-05722-9.

Kitwood, T. (1997) 'The experience of dementia', *Aging & Mental Health*. doi: 10.1080/13607869757344.

Kor, P. P. kin, Kwan, R. Y. C., Liu, J. Y. W. and Lai, C. (2018) 'Knowledge, Practice, and Attitude of Nursing Home Staff Toward the Use of Physical Restraint: Have They Changed Over Time?', *Journal of Nursing Scholarship*, 50(5), pp. 502–512. doi: 10.1111/jnu.12415.

Kovach, C., Weisman, G., Chaudhury, H. and Calkins, M. (1997) 'Impacts of a therapeutic environment for dementia care', *American Journal of Alzheimer's Disease*. Sage PublicationsSage CA: Thousand Oaks, CA, 12(3), pp. 99–110. doi: 10.1177/153331759701200302.

Lam, F. M., Huang, M.-Z., Liao, L.-R., Chung, R. C., Kwok, T. C. and Pang, M. Y. (2017) 'Physical exercise improves strength, balance, mobility, and endurance in people with cognitive impairment and dementia: a systematic review', *Journal of Physiotherapy*. Korea Institute of Oriental Medicine. doi: 10.1016/j.jphys.2017.12.001.

Lawton, M. P. (1975) 'Competence, environmental press and the adaptation of older people.', in Windley, P. G. and Ernst, G. (eds) *Psychology and the built environment.* New York: Wiley, pp. 132–138.

Lawton, M. P. (1981) 'Sensory Deprivation and the Effect of the Environment on Management of the Patient with Senile Dementia', *Clinical aspects of Alzheimer's disease and senile dementia*. Raven Press New York, pp. 227–251.

Lawton, M. P. and Zarit, S. H. (2001) 'The physical environment of the person with Alzheimer's disease', *Aging & Mental Health*, 5(SUPPL. 1), pp. S56–S64. Available at: http://www.scopus.com/inward/record.url?eid=2-s2.0-0034968742&partnerID=40&md5=470479372cbdb8fa12062bfeb4d8ebfa.

Lee, J. H., Ostwald, M. J. and Lee, H. (2017) 'Measuring the spatial and social characteristics of the architectural plans of aged care facilities', in *Frontiers of Architectural Research*. Elsevier B.V., pp. 431–441. doi: 10.1016/j.foar.2017.09.003.

Lee, J. H., Ostwald, M. J. and Yu, R. (2017) 'Investigating Visibility Properties in the Design of Aged-Care Facilities', in *International Conference of the Association for Computer-Aided Archtectural Design Research in Asia (CAADRIA)*. Hing Kong, pp. 365–374. Available at: http://papers.cumincad.org/data/works/att/caadria2017_016.pdf (Accessed: 3 November 2018).

Leng, Gi. (2011) 'Public health and housing : We can get it right', *Getting to Grips with Integration: Making Housing Count*. Housing Learning and Improvement Network. Available at: https://www.housinglin.org.uk/_assets/Resources/Housing/Support_materials/Information_Packs/IP1_Briefing2_Public_Health.pdf.

Li, R. and Klippel, A. (2010) 'Using space syntax to understand knowledge acquisition and wayfinding in indoor environments', in *Cognitive Informatics (ICCI), 2010 9th IEEE International Conference on*, pp. 302–307. doi: 10.1109/coginf.2010.5599724.

Lin, L.-W., Weng, S.-C., Wu, H.-S., Tsai, L.-J., Lin, Y.-L. and Yeh, S.-H. (2017) 'The Effects of White Noise on Agitated Behaviors, Mental Status, and Activities of Daily Living in Older Adults With Dementia', *Journal of Nursing Research*, p. 1. doi: 10.1097/jnr.0000000000000211.

Low, L. F. *et al.* (2013) 'The Sydney Multisite Intervention of LaughterBosses and ElderClowns (SMILE) study: Cluster randomised trial of humour therapy in nursing homes', *BMJ Open*, 3(1), pp. 1–8. doi: 10.1136/bmjopen-2012-002072.

Lynch, K. (1960) *The image of the city*. Cambridge, Mass: MIT press.

Marquardt, G., Johnston, D., Black, B. S., Morrison, A., Rosenblatt, A., Lyketsos, C. G. and Samus, Q. M. (2011) 'Association of the spatial layout of the home and ADL abilities among older adults with dementia', *American Journal Of Alzheimer's Disease And Other Dementias*. United States: Sage Publications : Thousand Oaks, Calif., 26(1), pp. 51–57. Available at: http://journals.sagepub.com/doi/abs/10.1177/1533317510387584.

Marquardt, G. (2011) 'Wayfinding for People With Dementia: A Review of the Role of Architectural Design', *Health Environments Research & Design Journal (HERD)*. Vendome Group LLC, 4(2), pp. 75–90. Available at: http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=59995108&site=ehost-live.

Marquardt, G., Bueter, K. and Motzek, T. (2014) 'Impact of the Design of the Built Environment on People with Dementia: An Evidence-Based Review', *Health Environments Research & Design Journal (HERD)*, 8(1), pp. 127–157. doi: 10.1177/193758671400800111.

Marquardt, G. and Schmieg, P. (2009) 'Dementia-friendly architecture: environments that facilitate wayfinding in nursing homes', *American Journal Of Alzheimer's Disease And Other Dementias*. United States: Sage Publications : Thousand Oaks, Calif., 24(4), pp. 333–340. doi: 10.1177/1533317509334959.

Marshall, M. (2001) 'How it helps to see dementia as a disability', *Care Homes and Dementia: Journal of Dementia Care*. Edited by S. Benson. London: Hawker Publications, 6, pp. 15–17.

Marshall, M. (2011) 'Designing balconies, roof terraces, and roof gardens for people with dementia', *Journal of Care Services Management*. Stirling, UK: Maney Publishing, 5(3), pp. 156–159. doi:

10.1179/175016811x13020827976762.

Martino-Saltzman, D., Blasch, B. B., Morris, R. D. and McNeal, L. W. (1991) 'Travel Behavior of Nursing Home Residents Perceived as Wanderers and Nonwanderers', *The Gerontologist*, 31(5), pp. 666–672. doi: 10.1093/geront/31.5.666.

Matthews, F. E. *et al.* (2016) 'A two decade dementia incidence comparison from the Cognitive Function and Ageing Studies I and II', *Nature Communications*, 7, p. 11398. doi: 10.1038/ncomms11398.

McGilton, K. S., Rivera, T. M. and Dawson, P. (2003) 'Can we help persons with dementia find their way in a new environment?', *Aging & Mental Health*. Routledge, 7(5), pp. 363–371. doi: 10.1080/1360786031000150676.

McKee, K., Parker, C., Barnes, S., Morgan, K., Tregenza, P. and Torrington, J. (2004) 'Supporting successful ageing in residential homes - The role of the physical environment', *Psychology and Health*, 19(SUPPL. 1), pp. 111–112.

McKee, K. J., Houston, D. M. and Barnes, S. (2002) 'Methods for assessing quality of life and well-being in frail older people', *Psychology and Health*, 17(6), pp. 737–751. doi: 10.1080/0887044021000054755.

McLaughlin, N. (2016) *Losing Myself, Venice Biennale Architecttura 2016*. Available at: http://www.niallmclaughlin.com/projects/losing-myself/ (Accessed: 10 December 2018).

McNair, D. G., Cunningham, C., Pollock, R. and McGuire, B. (2011) *Light and lighting design for people with dementia*. 2nd edn, *Dementia Design Series*. 2nd edn. Sydney, NSW: Hammond Press. doi: 10.1111/ajag.12003.

De Mello, K. K. (2016) *Healing Through Design: The Psychological Effects of Design on the Elderly*. University of Hawai'i at Mānoa.

Mitchell, R., Harvey, L., Draper, B., Brodaty, H. and Close, J. (2017) 'Risk factors associated with residential aged care, respite and transitional aged care admission for older people following an injury-related hospitalisation', *Archives of Gerontology and Geriatrics*. Elsevier, 72(February), pp. 59–66. doi: 10.1016/j.archger.2017.05.012.

Moore, K. J., Hill, K. D., Robinson, A. L., Haines, T. P., Haralambous, B. and Nitz, J. C. (2011) 'The state of physical environments in Australian residential aged care facilities.', *Australian health review : a publication of the Australian Hospital Association*, 35(4), pp. 412–7. doi: 10.1071/AH10932.

Moos, R. and Lemke, S. (1988) *Multiphasic Environmental Assessment Procedure (MEAP): Manual*. Palo Alto, CA: Stanford University Press.

Nagy, J. W. (2002) 'Kitchens That Help Residents Reestablish Home', *Alzheimer's Care Quarterly*, pp. 74–77. Available at: http://journals.lww.com/actjournalonline/Abstract/2002/03010/Kitchens_That_Help_Residents_Reestablish_Home.15.aspx (Accessed: 10 December 2019).

Namazi, K. H. and Johnson, B. D. (1992) 'Pertinent autonomy for residents with dementias: Modification of the physical environment to enhance independence', *American Journal Of Alzheimer's Disease And Other Dementias*, 7(1), pp. 16–21. doi: 10.1177/153331759200700105.

Nejati, A., Rodiek, S. and Shepley, M. (2016) 'Using visual simulation to evaluate restorative qualities of access to nature in hospital staff break areas', *Landscape and Urban Planning*, 148. doi: 10.1016/j.landurbplan.2015.12.012.

Niall McLaughlin Architects (2010) 'The Alzheimer's Respite Centre', in O'Regan, J. and Deary, N. (eds) *AAI Awards 2010: New Irish Architecture 25*. Cork: Gandon Editions, pp. 51–65. Available at: http://www.niallmclaughlin.com/wp-content/uploads/2014/07/AAIAwards2010-reduced.pdf.

O'Malley, M., Innes, A., Muir, S. and Wiener, J. M. (2016) '"All the corridors are the same" : A qualitative study of the orientation experiences and design preferences of UK older adults living in a communal retirement development', *Ageing and Society*. Available at: http://usir.salford.ac.uk/41500/3/A%26S%252016-178-vFINAL%5B1%5D.pdf (Accessed: 10 December 2018).

O'Malley, M., Innes, A. and Wiener, J. M. (2017) 'How do we get there? Effects of cognitive aging on route memory', *Memory & Cognition*. Memory & Cognition. doi: 10.3758/s13421-017-0763-7.

Oepen, D., Fleiner, T., Oliva Y Hausmann, A., Zank, S., Zijlstra, W. and Haeussermann, P. (2018) 'Falls in hospitalized geriatric psychiatry patients: High incidence, but only a few fractures', *International Psychogeriatrics*, 30(1), pp. 161–165. doi: 10.1017/S1041610217001831.

Ostwald, M. J. and Dawes, M. J. (2018) *The Mathematics of the Modernist Villa: Architectural Analysis Using Space Syntax and Isovists*. Volume 3. Edited by K. Williams. Birkhäuser. doi: 10.1007/978-3-319-71647-3.

Otsuka, M., Yamaguchi, K. and Ueki, A. (2002) 'Similarities and Differences between Alzheimer's disease and Vascular Dementia from the Viewpoint of Nutrition.', *Annals of the New York Acadmey of Sciences*, 977(1), pp. 3–9. doi: https://doi.org/10.1111/j.1749-6632.2002.tb04811.x.

Paranagamage, P. and Chrysikou, E. (2017) 'Critique of Built Environment Practices in Care and Extra-Care Settings for People Across the Ageing Lifespan', in *Living and Sustainability: An Environmental Critique of Design and Building Practices, Locally and Globally*. London: London Southbank University, p. 8.

Parker, C. *et al.* (2004) 'Quality of life and building design in residential and nursing homes for older people', *Ageing and Society*. Cambridge, United Kingdom, Cambridge: Cambridge University Press, 24, pp. 941–962. doi: 10.1017/S0144686X04002387.

Parsons, C. (2017) 'Polypharmacy and inappropriate medication use in patients with dementia: an underresearched problem', *Therapeutic Advances in Drug Safety*, 8(1), pp. 31–46. doi: 10.1177/2042098616670798.

Passini, R., Rainville, C., Marchand, N. and Joanette, Y. (1995) 'Wayfinding in dementia of the Alzheimer type: Planning abilities', *Journal of clinical and experimental neuropsychology*, 17(6), pp. 820–832.

Passini, R., Rainville, C., Marchand, N. and Joanette, Y. (1998) 'Wayfinding and dementia: Some research findings and a new look at design', *Journal of Architectural and Planning Research*. Locke Science Publishers, 15, pp. 133–151.

Passini, R., Pigot, H., Rainville, C. and Tétreault, M. H. (2000) 'Wayfinding in a nursing home for advanced dementia of the Alzheimer's type', *Environment and Behavior*, 32(5), pp. 684–710.

Peatross, F. D. (1997) 'The Spatial Dimension of Control in Restrictive Settings', in *Space Syntax International Symposium*. London, p. 16.

Pholeros, P., Bennett, K. A., Welke, A. and Arch, M. (2017) *Indigenous Aged Care Design Guide*. Wollongong.

Popham, C. and Orrell, M. (2011) 'What matters for people with dementia in care homes?', *Aging & Mental Health*. Routledge, 16(2), pp. 181–188. doi: 10.1080/13607863.2011.628972.

Powell, J., Mackintosh, S., Bird, E., Ige, J., Garrett, H. and Roys, M. (2017) *The role of home adaptations in improving later life*. Bristol: Centre for Ageing Better. Available at: https://www.ageing-better.org.uk/sites/default/files/2017-12/The role of home adaptations in improving later life.pdf.

Price, J. D., Hermans, D. G. and Grimley Evans, J. (2001) 'Subjective barriers to prevent wandering of cognitively impaired people', *The Cochrane Database of Systematic Reviews*, 1.

Prince, M. *et al.* (2015) *World Alzheimer Report 2015: The Global Impact of Dementia An AnalysIs of prevalence, Incidence, Cost and Trends*. London. Available at: https://www.alz.co.uk/research/WorldAlzheimerReport2015.pdf (Accessed: 10 October 2018).

Prince, M., Comas-Herrera, M. A., Knapp, M., Guerchet, M. and Karagiannidou, M. M. (2016) 'World Alzheimer Report 2016 Improving healthcare for people living with dementia coverage, QualIty and costs now and In the future'. Available at: https://www.alz.co.uk/research/WorldAlzheimerReport2016.pdf (Accessed: 10 December 2018).

Radford, K. *et al.* (2015) 'Prevalence of dementia in urban and regional Aboriginal Australians', *Alzheimer's & Dementia*, 11(3), pp. 271–279. doi: 10.1016/j.jalz.2014.03.007.

Raeburn, C., Quirke, M. and Palmer, L. (2017) *10 Tips on Signage for Dementia*. Stirling: Dementia Services Development Centre.

Rainville, C., Passini, R. and Marchand, N. (2001) 'A Multiple Case Study of Wayfinding in Dementia of the Alzheimer Type: Decision Making', *Aging, Neuropsychology, and Cognition*. Psychology Press, 8(1), pp. 54–71.

doi: 10.1076/anec.8.1.54.846.

Rappe, E. and Topo, P. (2007) 'Contact with Outdoor Greenery Can Support Competence Among People with Dementia', *Journal of Housing for the Elderly*. Taylor & Francis Ltd, 21(3/4), pp. 229–248. doi: 10.1300/J081v21n03-12.

Regnier, V. and Denton, A. (2009) 'Ten new and emerging trends in residential group living environments', *NeuroRehabilitation*. IOS Press, 25(3), pp. 169–188. doi: 10.3233/nre-2009-0514.

Reimer, M. A., Slaughter, S., Donaldson, C., Currie, G. and Eliasziw, M. (2004) 'Special Care Facility Compared with Traditional Environments for Dementia Care: A Longitudinal Study of Quality of Life', *Journal of the American Geriatrics Society*. Blackwell Science Inc, 52(7), pp. 1085–1092. doi: 10.1111/j.1532-5415.2004.52304.x.

Reisberg, B., Ferris, S. H., de Leon, M. J. and Crook, T. (1982) 'The Global Deterioration Scale for assessment of primary degenerative dementia.', *The American Journal of Psychiatry*. US: American Psychiatric Assn, 139(9), pp. 1136–1139.

Reynish, E. L., Hapca, S. M., De Souza, N., Cvoro, V., Donnan, P. T. and Guthrie, B. (2017) 'Epidemiology and outcomes of people with dementia, delirium, and unspecified cognitive impairment in the general hospital: prospective cohort study of 10,014 admissions', *BMC Medicine*. BMC Medicine, 15(1), p. 140. doi: 10.1186/s12916-017-0899-0.

Richards, K., D'Cruz, R., Harman, S., Stagnitti, K., D 'cruz, R., Harman, S. and Stagnitti, K. (2015) 'Comparison of a traditional and non-traditional residential care facility for persons living with dementia and the impact of the environment on occupational engagement', *Australian Occupational Therapy Journal*, 62(6). doi: 10.1111/1440-1630.12243.

Ritchie, L., Sim, D. and Edgerton, E. (2011) *Dementia Friendly Living Environments: An Empirical Investigation of Design Solutions in Dementia Care Homes*, *School of Health, Nursing and Midwifery*. University of West Scotland. Available at: http://ethos.bl.uk/OrderDetails.do?did=1&uin=uk.bl.ethos.556069.

Rosenbaum, R. S., Priselac, S., Kohler, S., Black, S. E., Gao, F., Nadel, L. and Moscovitch, M. (2000) 'Remote spatial memory in an amnesic person with extensive bilateral hippocampal lesions', *nature neuroscience*, 3, pp. 1044–1048. Available at: http://www.nature.com/neuro/journal/v3/n10/full/nn1000_1044.html.

Rosewarne, R. and Opie, J. (1997) *Care needs of people with dementia and challenging behaviour living in residential facilities*, *AGPS: Canberra*.

Rowe, M. A. (2003) 'People with dementia who become lost: preventing injuries and death', *AJN The American Journal of Nursing*, 103(7), pp. 32–39.

Satsangi, M., Mccall, V. and Greasley-Adams, C. (2015) *Understanding the Housing Needs of Older Owner-Occupiers*. Available at: http://www.stirling.gov.uk/__documents/housing/local-housing-strategy/recent-housing-research/older-owner-occupiers-report.pdf.

Saxton, J., Silverman, M., Ricci, E., Keane, C. and Deeley, B. (1998) 'Maintenance of Mobility in Residents of an Alzheimer Special Care Facility', *International Psychogeriatrics*. Cambridge University Press, 10(2), pp. 213–224. doi: 10.1017/S1041610298005328.

Scrutton, J. and Brancati, C. U. (2016) 'Dementia and comorbidities Ensuring parity of care', (April).

Seeher, K., Withall, A., Brodaty, H. and Brodaty, P. H. (2010) *The Dementia Research Mapping Project : The 2010 Update*. Sydney: Dementia Collaborative Research Centre, University of New South Wales.

Sloane, P. D. *et al.* (2002) 'Therapeutic Environment Screening survey of nuring homes (TESS-NH)', *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 57(2), pp. S69–S78. doi: 10.1093/geronb/57.2.S69.

Smith, R., Fleming, R., Chenoweth, L., Jeon, Y.-H., Stein-Parbury, J. and Brodaty, H. (2012) 'Validation of the Environmental Audit Tool in both purpose-built and non-purpose-built dementia care settings.', *Australasian journal on ageing*. Blackwell Publishing Ltd, 31(3), pp. 159–63. doi: 10.1111/j.1741-6612.2011.00559.x.

Smith, R., Mathews, R. M. and Gresham, M. (2010) 'Pre- and Postoccupancy Evaluation of New Dementia Care

Cottages', *American Journal of Alzheimer's Disease and Other Dementias*, 25(3), pp. 265–275. doi: 10.1177/1533317509357735.

Soril, L. J. J. *et al.* (2014) 'Effective use of the built environment to manage behavioural and psychological symptoms of dementia: A systematic review', *PLoS ONE*, 9(12). doi: 10.1371/journal.pone.0115425.

Standards Australia (2009) *AS/NZS 1428.1.1-2009 (Amendment 1) Australian Standard: Design for access and mobility Part 4.1: Means to assist the orientation of people with vision impairment— Tactile ground surface indicators*, *AS/NZS 1428.4.1-2009*. Sydney, NSW: Standards Australia. Available at: Australian Standards.

Standards Australia (2010) *AS 1428.5-2010 Australian Standard: Design for access and mobility Part 5: Communication for people who are deaf or hearing impaired*, *AS 1428.5-2010*. Sydney, NSW, Australia. Available at: Australian Standards.

Standards Australia (2015) *AS 1428.2-1992 Australian Standard Design for access and mobility Part 2 : Enhanced and additional requirements — Buildings and facilities (Reconfirmed 2015)*. Sydney, NSW.

Tappen, R. M. (1997) *Interventions for Alzheimer's disease: A caregiver's complete reference*. Health Professions Press Baltimore.

Tartarini, F., Cooper, P. and Fleming, R. (2018) 'Thermal Comfort for Occupants of Nursing Homes : A Field Study', (April).

The Commonwealth of Australia (1997) *Aged Care Act 1997*. Available at: https://www.legislation.gov.au/Details/C2018C00141.

The King's Fund (2014) 'Is Your Care Home Dementia Friendly? : the EHE environmental assessment tool', *The King's Fund*, p. 11. Available at: https://www.kingsfund.org.uk/sites/files/kf/field/field_pdf/is-your-care-home-dementia-friendly-ehe-tool-kingsfund-mar13.pdf.

Ulrich, R. S. *et al.* (2008) 'A Review of the Research Literature on Evidence-Based Healthcare Design', *HERD: Health Environments Research & Design Journal*. SAGE PublicationsSage CA: Los Angeles, CA, 1(3), pp. 61–125. doi: 10.1177/193758670800100306.

Utton, D. (2007) *Designing Homes for People with Dementia*. Edited by M. Marshall, S. Judd, and P. Phippen. London: Journal of Dementia Care, Hawker Publications.

Valenzuela, M., Brayne, C., Sachdev, P. and Wilcock, G. (2011) 'Cognitive Lifestyle and Long-Term Risk of Dementia and Survival After Diagnosis in a Multicenter Population-based Cohort', *American Journal of Epidemiology*. Oxford University Press, 173(9), pp. 1004–1012. doi: 10.1093/aje/kwq476.

Verbeek, H., van Rossum, E., Zwakhalen, S. M. G., Kempen, G. I. J. M. and Hamers, J. P. H. (2008) 'Small, homelike care environments for older people with dementia: a literature review', *International Psychogeriatrics*, 21(02), pp. 252–264. doi: doi:10.1017/S104161020800820X.

Verbeek, H., van Rossum, E., Zwakhalen, S. M. G., Ambergen, T., Kempen, G. I. J. M. and Hamers, J. P. H. (2009) 'The effects of small-scale, homelike facilities for older people with dementia on residents, family caregivers and staff: design of a longitudinal, quasi-experimental study', *BMC geriatrics*. BioMed Central Ltd, 9(1), p. 3. doi: 10.1186/1471-2318-9-3.

Verbeek, H., Zwakhalen, S. M. G. G., van Rossum, E., Ambergen, T., Kempen, G. I. J. M. J. M. and Hamers, J. P. H. H. (2010) 'Dementia Care Redesigned: Effects of Small-Scale Living Facilities on Residents, Their Family Caregivers, and Staff', *Journal of the American Medical Directors Association*, 11(9), pp. 662–670. doi: http://dx.doi.org/10.1016/j.jamda.2010.08.001.

Victorian Department of Human Services (2006) *Improving the environment for older people in Health Services: an audit tool.* Melbourne: National Ageing Research Institute.

Waller, S., Masterson, A. and Evans, S. C. (2017) 'The development of environmental assessment tools to support the creation of dementia friendly care environments: Innovative practice', *Dementia*, 16(2), pp. 226–232. doi: 1471301216635829 [pii].

Waller, S., Masterson, A. and Finn, H. (2013) *Improving the patient experience Developing Supportive Design for People with Dementia: The King's Fund Enhancing the Healing Environment Programme*. Edited by E.

Stanley. London: King's Fund.

Weisman, G., Lawton, M. P., Sloane, P. S., Calkins, M. and Norris-Baker, L. (1996) 'The professional environmental assessment protocol', *Milwaukee, WI: School of Architecture, University of Wisconsin at Milwaukee*.

Whear, R., Coon, J. T., Bethel, A., Abbott, R., Stein, K. and Garside, R. (2014) 'What Is the Impact of Using Outdoor Spaces Such as Gardens on the Physical and Mental Well-Being of Those With Dementia? A Systematic Review of Quantitative and Qualitative Evidence', *Journal of the American Medical Directors Association*, 15(10), pp. 697–705. doi: 10.1016/j.jamda.2014.05.013.

WHO (2015) *First WHO Ministerial Conference on Global Action Against Dementia*. Geneva. Available at: http://apps.who.int/iris/bitstream/10665/179537/1/9789241509114_eng.pdf (Accessed: 10 December 2018).

Winblad, B. *et al.* (2016) 'The Lancet Neurology Commission Defeating Alzheimer's disease and other dementias: a priority for European science and society', *The Lancet Neurology*, 15(15), pp. 455–532. doi: 10.1016/S1474-4422(16)00062-4.

World Health Organisation (2016) *Integrated care for older people with frailty*.

World Health Organization (2010) *Global recommendations on physical activity for health*, *Geneva: World Health Organization*. doi: 10.1080/11026480410034349.

Zeisel, J. *et al.* (1994) 'Best practices: An Environment Behavior (E-B) model for Alzheimer special care units', *American Journal of Alzheimer's Care and Related Disorders & Research*. Cambridge University Press, 9(2), pp. 4–21. doi: 10.1177/153331759400900202.

Zeisel, J., Silverstein, N. M., Hyde, J., Levkoff, S., Lawton, M. P. and Holmes, W. (2003) 'Environmental correlates to behavioral health outcomes in Alzheimer's special care units', *The Gerontologist*, 43(5), pp. 697–711.

Zimmerman, S. *et al.* (2013) 'Systematic review: Effective characteristics of nursing homes and other residential long-term care settings for people with dementia', *Journal of the American Geriatrics Society*, 61(8), pp. 1399–1409. doi: 10.1111/jgs.12372.

Zimring, C. and Dalton, R. C. (2003) 'Linking Objective Measures Of Space To Cognition And Action', *Environment and Behavior* , 35(1), pp. 3–16. doi: 10.1177/0013916502238862.

APPENDIX A: APPRAISAL OF THE ENVIRONMENTAL AUDIT TOOL

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
DDP#1: *Unobtrusively reduce risks - safety*					
1.01	*Is the garden secure, i.e. are residents prevented from getting over/under fence or out of the gate without the assistance of a staff member?*		✓		This question assumes the presence of a fence as a given. The importance of detail in fence design (incl. height and opening mechanism etc.) means detailed design is the key. The fence may still be indicated in floor-plans, but its climb-ability will be unknown from floor-plan information alone.
1.02	*If the front door leads out of the unit is it secure?*		✓		This item is related to hardware, locking mechanisms, and other detailed design and specification items
1.03	*Are all side doors leading out of the unit secure?*		✓		This item is related to hardware, locking mechanisms, and other detailed design/ specification items
1.04	*Are bedroom windows restricted in the extent to which they open so that residents cannot climb out*		✓		This item is related to hardware, locking mechanisms, and other detailed design/ specification items
1.05	*Is the garden easily supervised from the point(s) where staff spend most of their time?*	✓			The answer given to this query may depend on assessor knowledge (or assumptions made) about care model and staff ratios to be employed in the unit. In traditional 'general' care models, staff will tend to be based in or near a Nurse Station. However, in more recently developed 'household' model of residential aged care provision staff may not have as clear a base: they may instead spend most of their time amongst residents, near common spaces, or working from an open accessible kitchen area.
1.06	*Is there a way to keep residents who are not safe with knives and/or appliances out of the kitchen?*		✓		This query is related to detailed design of kitchen access, through door hardware and/or cabinetry detailing.
1.07	*If the kitchen is used by residents is there a lockable knife draw in the kitchen?*		✓		This query is related to detailed design and specification of kitchen cabinets and hardware.

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
1.08	*If the kitchen is used by residents is the cooker a gas cooker?*		✓		The cooker position is likely to be indicated on floor-plans, but the type is likely to be defined in detailed drawings (such as services schematics) or in specifications.
1.09	*If the kitchen is used by residents is there a master switch that can be turned off quickly?*		✓		This is unlikely to be indicated in normal floor-plans but may be indicated in detailed services/schematic drawings.
1.10	*Is the temperature of the water from all taps accessible to residents limited so that it cannot scald?*		✓		Temperature controls are technical specification items.
1.11	*If residents are involved in meal preparation are the pots and pans used small enough for them to lift easily?*			✓	These items are not typically specified through the building design process, but by occupational health specialists and/or by care managers.
1.12	*Are all floor areas safe from being slippery when wet (water or urine)?*		✓		This is technical specification Item.
1.13	*Is the lounge room easily supervised from the point(s) where the staff spend most of their time?*	✓			Like query 1.01, the design assessor needs to know about care model and nature of staff activity to know where they will spend most time. Where doubt exists can we assume this to mean Kitchen (in household care model) or Nurse Station (in traditional care model).
1.14	*Are all areas used by residents well lit?*		✓		Without light meters and defined target light levels, this query is subjective. Older people need a lot more light than younger people. This question does not differentiate between natural and artificial light, even though research evidence would suggest that natural light is preferable to artificial light. Floor-plan based evaluation of natural light provision may be possible but would require the use of 'rules of thumb' predetermining ratios between length of glazed walls versus served floor area. At detailed design stage, well-designed bright artificial light (even to assist during day time) could be beneficial.

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
	Query Count for DDP#1	2	11	1	
DDP#2: *Provide a human scale - size*					
2.01	*How many people live in the unit*	✓			For plan evaluation, the 'Unit' is considered as all areas/rooms/residents that share a Dining Room. (See the full definition in Chapter 1). This definition sometimes results in very large 'units' for hostel-type accommodation.
	Query Count for DDP#2	1	0	0	
Dementia Design Principle 3: Visual Access					
3.01	*What proportion of confused residents can see their bedroom door from the lounge room?*	✓			It likely that geometric evaluation may give different results than a real-world answer (e.g. if only visible from 1% of the lounge room's floor area, or if only a few mm of the door leaf is visible). Note reciprocation of results from Q 3.2.
3.02	*What proportion of confused residents can see the lounge room as soon as they leave their bedroom?*	✓			Further definitions required for technical drawing analysis (as per comment on Q 3.1). How far from the bedroom door threshold can be considered 'as soon as they leave…'? One or two steps? A 2m radius? Since bedrooms are located along corridors, the skew angle of vision means that this dimension of tolerance may be critical for accurate testing of sight lines on floor-plan drawings
3.03	*What proportion of confused residents can see the dining room as soon as they leave their bedroom?*	✓			As query 3.2
3.04	*Can the exit to the garden be seen from the lounge room? (If there is more than 1 lounge room answer with reference to the one most used by most confused residents).*	✓			Visibility query is to the access point, NOT the garden itself. Assessment of 'sketch' design may potentially assume door access within indicative glazing. This may be more difficult to determine where sliding doors rather than swinging doors are used – as the conventional graphical representation of sliding doors makes them appear like windows, where egress is not possible.
3.05	*Can the dining room be seen into from the lounge room? (If there is more*	✓			Need to define technical cut off limits for 'seen in to'. I.e. Minimum proportion of the

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
	than 1 dining room or lounge room answer with reference to those used by most confused residents).				viewers room to count/ and proportion of 'viewed' room to be visible. etc.
3.06	*Can the kitchen be seen into from the lounge room? (If there is more than 1 lounge room answer with reference to the one used by most confused residents).*	✓			As 3.5
3.07	*Can the kitchen be seen into from the dining room? (If there is more than 1 dining room answer with reference to the one used by most confused residents).*	✓			As 3.5
3.08	*Can a toilet be seen from the dining room? (If there is more than 1 dining room answer with reference to the one used by most confused residents).*	✓			It is understood that the intention here is to provide a view to the toilet door (or sign outside). Whilst the WC itself may not to be directly visible from common rooms, the visibility to other cues (such as WHB, tiled surfaces etc.) may be of some benefit.
3.09	*Can a toilet be seen from the lounge room? (If there is more than 1 lounge room answer with reference to the one used by most confused residents).*	✓			As 3.5
3.10	*Can the lounge room be seen into from the point(s) where staff spend most of their time?*	✓			Assessor will need to know, or make assumptions, about staff activity to know where they will spend most time. Where this information is not available this will be taken to mean the Kitchen (in household care model) or the Nurse Station (in traditional care model).
	Query Count for DDP#3	10	0	0	
DDP#4: Reduce unhelpful stimulation – stimulus reduction features					
4.01	*Does the doorbell attract the attention of the residents?*		✓		[Note negative scoring item]

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
4.02	*Is the noise from the kitchen distracting for the residents?*		✓		Detailed specification and/or care model may remove larger, unfamiliar, and noisier machines. It should be possible for any food preparation that requires larger noisy machines to occur in a central (back of house) kitchen. Glazed elements between spaces may allow mitigation of noise pollution without adversely affecting desirable visual access. [Note negative scoring item].
4.03	*Are doors to cleaner's cupboards, storerooms and other areas where residents may find danger easily seen (i.e. not hidden or painted to merge with the walls?)*		✓		Plan placement may help, but detailed design and specification of finish and materials etc. are more critical. [Note negative scoring item].
4.04	*Is the wardrobe that the resident uses full of a confusing number of clothes?*		✓		Design of robes can allow for hidden locked compartments so only limited range of seasonally appropriate clothes are made available daily. Management by staff is also important, but more difficult if design does not assist (by allowing some items to be 'hidden' on rotational/seasonal basis). [Note negative scoring item].
4.05	*Are deliveries of food, linen etc. taken across public areas such as the lounge or dining room?*	✓			Assessor needs to be able to establish, or must estimate, the path taken by deliveries. [Note negative score]
4.06	*Is there a public address, staff paging or call system in use that involves the use of loud speakers, flashing lights, bells etc.?*		✓		[Note negative score]
4.07	*Is the front entry to the unit easily visible to the residents?*	✓			Plan Assessment assumes this query means that front door should not be visible from Common Rooms, and no more than a small proportion of any regularly used resident corridor, etc. [Note: Negative score]
4.08	*Is the service entry (where food, linen etc. is delivered to) easily visible to the residents?*	✓			Assessment assuming delivery access door should be not be visible from Common Rooms, and no more than a small

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
					proportion of any regularly used resident corridor etc. [Note negative score].
	Query Count for DDP#4	3	5	0	
DDP#5: Optimise helpful stimulation – highlighting useful stimuli'					
5.01	*Is the dining room looked into from the lounge room or clearly marked with a sign or symbol?*	✓			Signage not assessable from plan drawings but, in any case, considered a fall-back resort when architectural wayfinding is not possible. Where possible, direct visibility is preferred, and should be achievable in new design proposals. Physical modifications to improve direct visibility should be considered for existing facilities. Signage may help where direct vision is not possible and help to reinforce where direct visibility exists.
5.02	*Is the lounge room either looked into from the dining room or clearly marked with a sign or symbol?*	✓			As 5.1.
5.03	*Do bedrooms have a sign, symbol or display that identifies them as belonging to a particular individual?*		✓		It is possible that physical features such as memory boxes could be indicated in plan drawings but is more likely to be covered in detailed design drawings and/or specifications.
5.04	*Are the shared bathrooms and/or toilets clearly marked with a sign, symbol or colour coded door?*		✓		
5.05	*Is the kitchen either looked into from the lounge or dining room or clearly marked with a sign or symbol?*	✓			The term 'looked into' assumed to include glazed panels or doorways.
5.06	*Are toilets visible as soon as the toilet/bathroom door is opened?*	✓			Sanitary ware usually indicated on floor-plans. 'Sketchy' plans could be assumed to have scope for altering WC position as design progresses. Perhaps include text within any evaluation feedback advising of this assumption.
5.07	*Is there a lot of natural lighting in the lounge room?*	✓			Plan drawings typically show window and door widths but not heights. Overhead glazing such as roof lights may not be

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
					indicated. Section or elevation drawings would be required to evaluate precisely. For plan-only evaluation it may be worth setting a rule of thumb for acceptable threshold for this. Option a) if >=10% of room perimeter shown as glazed element to outdoors. Option b) Allow min 1m linear distance of glazed element per 10 m^2 floor area.
5.08	*Is the artificial lighting bright enough in all areas?*		✓		Detail and Specification item. However, also relies on appropriate and correct maintenance after occupation commences.
5.09	*Is the lighting free of glare, e.g. from bare bulbs, off shiny surfaces?*		✓		As 5.8
	Query Count for DDP#5	5	4	0	
DDP#6: Support movement and engagement -Provision for wandering, circulation and access to outside area'					
6.1a	*Is there a clearly defined and easily accessible (i.e. no locked exit) path in the garden that guides the resident back to their starting point without taking them into a blind alley? (If answer to 1a is YES answer 1b,1c,1d,1e,1g and 1g)*	✓			Conflicts between avoiding blind alleys and creating areas that invite participation. Requires careful design. E.g. seating turned to face the path in a viable direction of travel.
6.1b	*Does the external path allow the resident to see into areas that might invite participation in an appropriate activity other than wandering?*	✓			
6.1c	*Is the path within a secure perimeter?*	✓			How secure the perimeter is will be difficult to fully establish from a line drawn on a floor-plan. Further detailed design/information would be required, but plan evaluation could work based on assuming that if an enclosing element is indicated that if will be easily possible for detailed design to ensure the area is secure. Fence/landscape upgrades required if

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
					assessing an existing facility; feedback notes should advise on assumptions, and link to required upgrade action (if necessary).
6.1d	*Can staff members easily and unobtrusively survey this path?*	✓			This depends on where staff are located, so is related to Q1.5. Also need to establish a minimum proportion of path to be visible from specified locations (e.g. 75% of path visible from Lounge & Kitchen)
6.1e	*Are there chairs or benches along the path where people can sit and enjoy the fresh air?*	✓			Loose furniture placement under control of staff management but external furniture often fixed in place according to design information. Indication of seating could easily be shown in early design drawings, so possible to include in plan evaluation.
6.1f	*Are there both sunny and shady areas along the path?*	✓			Requires indication of cardinal orientation, mature trees and shade structures which may not always be shown on early floor-plans. May require taking an educated view on the information provided, then providing feedback to cover where any doubt is raised.
6.1g	*Does the path take residents past a toilet?*	✓			A refinement s question may be ‘Is a toilet both visible and accessible from the walking path?’ This gives a greater flexibility of interpretation. However, well placed and well-designed signage would be beneficial to improve visual cueing of the toilet.
6.2a	*Is there a clearly defined path inside that takes the resident around furniture and back to their starting point without taking them into a blind alley? (If answer to 2a is YES answer 2b)*	✓			This could be indicated in floor-plans but may depend upon furniture being laid out the same way whilst in use. Furniture in architectural plans is often seen as indicative only, but this approach needs to change when designing dementia environments. Management responsibility to ensure furniture arrangements retain the required characteristics (returning furniture to social supporting layouts after temporary re-arrangements for special events etc.)
6.2b	*Does the internal path allow the resident to see into areas that might invite participation in an*	✓			Will depend on having access to sufficiently detailed floor-plan. Earlier sketches may not be clear.

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
	appropriate activity other than wandering?				
	Query Count for DDP#6	9	0	0	

DDP#7: Create a familiar space - Familiarity

7/01	*Are there any colours in the furnishings or the decoration that would not have been familiar to the majority of residents when they were 30 years old?*		✓		
7.02	*Are there any taps, light switches, door knobs that are to be used by residents that are of a design that would not have been familiar to the majority of residents when they were 30 years old?*		✓		
7.03	*Are there any pieces of furniture in the lounge room or the dining room that are of a design that would not have been familiar to the majority of residents when they were 30 years old?*		✓		
7.04	*Are there any pieces of furniture in the bedrooms that are of a design that would not have been familiar to the majority of residents when they were 30 years old?*			✓	Relies primarily on future management
7.05	*How many residents have their own ornaments, photos in their bedroom?*			✓	Management item, but detailed design may help to make this easier to manage.
7.06	*How many residents have their own furniture in their bedroom?*			✓	Management item, but detailed design may help to make this easier to manage.
	Query Count for DDP#7	0	3	3	

DDP#8: **Provide opportunities to be alone or with others – Privacy and Community**

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
8.01	*Are there small areas (nooks) that provide opportunities for casual interaction and quiet chats?*	✓			These spaces have the potential to be defined by furniture elements as much as walls etc. so this can be influenced by all three stages. Plans should at least allow spaces that enable these nooks to be created.
8.02	*How many of these areas or nooks have views of pleasant or interesting scenes (outside, the living room, the nursing station)?*	✓			The EAT handbook suggests that artwork may be a suitable focus. However, as per above comments on signage, Artwork and signage should be seen more as 'middle ground' supporting elements, with views to landscape or 'architectural' vistas preferred as main visual stimulus where possible. Artwork and signs should only act as main visual item where views of other pleasant space(s) are not possible.
8.03	*Do the shared living areas support small group activities (4-6 people) without re-arranging the furniture?*	✓			As per 6.2a
8.04	*Does the dining room provide opportunities for residents to eat in small groups (2-4)?*	✓			If enough furniture information is absent from floor-plans, then evaluation may need to assume layout is a 'fail', or provide feedback notes that clarify the assumptions made whilst assessing drawings)
8.05	*Does the dining area provide opportunities for people to eat alone?*	✓			As 8.4. Requires a generous oversupply of dining places in the dining rom.
	Query Count for DDP#8:	5	0	0	
***DDP#9:* Provide links to the community -Community Links**					
9.1	*Is there an area or room somewhat removed from the main dining room where families can share meals with their relatives? (If answer to 1 is YES answer 1a)*	✓			It assumed that this should be visually removed from main common rooms, even if physically adjacent.
9.1a	*Is this room/area domestic and familiar in nature, to reassure family members and friends and encourage them to visit and to*		✓		Although impacted by the floor-plan, this aspect will depend significantly on detail design and styling of decoration, furniture, lighting etc.

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
	participate in the care of the resident?				
	Query Count for DDP#9:	1	1	0	
DDP#10: **Providing opportunities for engagement with ordinary life -Domestic activity**					
10.01	*Have access to a kitchen*	✓			Assumed that if a room labelled 'Kitchen' is provided within a unit, then residents can access this at times (or under controlled circumstances). Complete lack of resident access may point to poor detailed design or care management practices. Rooms labelled 'Servery' are assumed to be staff access only and expected only to occur in older facilities using traditional care practices.
10.02	*Have a significant involvement in main meal preparation*			✓	Management item, but detailed design may help to make this easier to manage.
10.3	*Have a significant involvement in making snacks or drinks*			✓	Management item, but detailed design may help to make this easier to manage.
10.04	*Have a significant involvement in keeping bedroom clean and tidy*			✓	Management item, but detailed design may help to make this easier to manage.
10.05	*Have a significant involvement in personal laundry*			✓	Management item, but detailed design may help to make this easier to manage.
10.06	*Are involved in gardening*			✓	Management item, but detailed design may help to make this easier to manage.
10.07	*Have constant and easy access to a lounge?*	✓			It is assumed that these rooms are always left unlocked . Detailed design and management also contribute here.
10.08	*Have constant and easy access to a dining room?*	✓			It is assumed that these rooms are always left unlocked . Detailed design and management also contribute here.
	Query Count for DDP#10:	3	0	5	
	Overall Query Count Summary				
DDP# 1	*Unobtrusively reduce risks – safety*	2	11	1	
DDP# 2	*Provide a human scale – size*	1	0	0	
DDP# 3	*Allow people to see and be seen – visual access*	10	0	0	

The Environmental Audit Tool (Fleming 2011)		Plan	Detail	Manage	Researcher Comments/Notes
DDP# 4	*Reduce unhelpful stimulation - stimulus reduction features*	3	5	0	
DDP# 5	*Optimise helpful stimulation - highlighting useful stimuli*	5	4	0	
DDP# 6	*Support movement and engagement - Provision for wandering, circulation and access to outside area*	9	0	0	
DDP# 7	*Create a familiar space – Familiarity*	0	3	3	
DDP# 8	*Provide opportunities to be alone or with others - Privacy and community*	5	0	0	
DDP# 9	*Provide links to the community - Community links*	1	1	0	
DDP# 10	*Providing opportunities for engagement with ordinary life - Domestic activity*	3	0	5	
	Total EAT Question Count	39	24	9	Overall Total = 72

APPENDIX B: APPRAISAL OF THE THERAPEUTIC ENVIRONMENTAL SCREENING SURVEY FOR NURSING HOMES

	TESS-NH (Sloane et al. 2002)	Plan	Detail	Manage	Researcher Comments/Notes
	UNIT DESIGNATION				
1	*Non-Dementia-Specific Care Area (NDSCA) = 1 Dementia-Specific Care Area (DSCA) =2*	✓			The intended designation of the units may not be indicated on any design documents but may on floor-plan drawings. It is questionable whether the designation of the unit should be something that makes any difference to design audit outcome but may inform an understanding of how well the physical environment supports a given care model or stage of dementia.
MAINTENANCE					
2a	*Activity/Dining Areas: 'Well Maintained' = 2 + 'In need of some repairs' = 1 + 'In need of extensive repairs' = 0*			✓	
2b	*Halls: 'Well Maintained' = 2 + 'In need of some repairs' = 1 + 'In need of extensive repairs' = 0*			✓	
2c	*Resident Rooms: % of rooms = 'Well maintained' x 2 points + % of Rooms 'In need of Some repair' x1 point + % rooms needing 'extensive repairs' X0 Points.*			✓	
2d	*Resident Bathrooms: % of rooms = 'Well maintained' x 2 points + % of Rooms 'In need of Some repair' x1 point + % room needing 'extensive repairs' X0 Points.*			✓	
CLEANLINESS					
3a	*Activity/Dining Areas: 'Very Clean' = 2 + 'Moderately Clean' = 1 + 'Poor Level of Cleanliness' = 0*			✓	

	TESS-NH (Sloane et al. 2002)	Plan	Detail	Manage	Researcher Comments/Notes
3b	*Halls: 'Very Clean' = 2 + 'Moderately Clean' = 1 + 'Poor Level of Cleanliness' = 0*			✓	
3c	*Resident Rooms: % of Rooms = 'Very Clean' x2 + % of Rooms = 'Moderately Clean' x1 + % of Rooms = 'Poor Level of Cleanliness' = 0*			✓	
3d	Resident Bathrooms: % of Rooms = 'Very Clean' x2 + % of Rooms = 'Moderately Clean' x1 + % of Rooms = 'Poor Level of Cleanliness' = 0			✓	
ODORS [sic]: Extent that odors of bodily excretions (urine and faeces) present:					
4a	Public Areas: Rarely (0-5%) = 2 + Some (6-74%) = 1 + Throughout (75-100%) = 0			✓	
4b	Resident Rooms: Rarely (0-5%) = 2 + Some (6-74%) = 1 + Throughout (75-100%) = 0			✓	
SAFETY					
5	Rate Floor surface in hall if slippy or uneven: NONE= 2 + ALMOST NONE= 1 + SOME = 0		✓		Also impacted by maintenance in long run.
HANDRAILS					
6a	*Extent of Handrails in Hallways: Extensive = 2/Somewhat = 1/Little or none = 0*		✓		Possibly indicated in plans (if detailed). Details such as height, diameter, junctions are all important, so this relates closer to detail and specification aspects.
6b	*Extent of Handrails in Resident Bathrooms: Extensive = 2/Somewhat = 1/Little or none = 0*		✓		Possibly indicated in plans (if detailed). Details such as height, diameter, junctions are all important, so this relates closer to detail and specification aspects.
CALL BUTTONS					
7a	*% Bedrooms with Call button x1*		✓		This item is most likely to be indicated on detailed drawings (electrical services drawings/room data sheets etc.)

	TESS-NH (Sloane et al. 2002)	Plan	Detail	Manage	Researcher Comments/Notes
7b	*% Bathrooms with Call button*		✓		This item is most likely to be indicated on detailed drawings (electrical services drawings/room data sheets etc.).
CONTROLLED EXITS					
8	*% Exits controlled for unauthorized resident exit x1 \ (Include exits gates from outdoor areas/Exclude access doors to outdoors)*		✓		
FRONT DOOR					
9	*Front door controlled for resident exit. No= 0/yes = 1*		✓		
LIGHTING					
10a	*Lighting in Hallways: Ample =2/Good=1/Inadequate =0*		✓		It is unclear whether this refers to natural light, artificial light, or a combination of the two. Expected light level (in Lux) is not clarified. Requires light meter for in-person evaluations, and technical specification information for evaluation based on documents. [Note: Different Score in Sloane *et al.* (2002) - Max = 3].
10b	Lighting in Activity/Dining Areas: Ample =2/Good=1/Inadequate =0		✓		See note for 10b
10c	Lighting in Resident Rooms: % of rooms= Ample x2/% rooms = Good x1/% =Inadequate =x0		✓		See note for 10b
GLARE					
11a	Glare in Hallways: Little or None =2/In a few areas =1/In many areas =0		✓		Relies on detailed design and specification of both lighting and surface materials.
11b	Glare in Activity/Dining Areas: Little or None =2/In a few areas =1/In many areas =0		✓		As 11a.
11c	Glare in Residents Rooms: % of Rooms with Little or No Glare =2/% of Rooms with Glare In a few areas =1		✓		As 11a.

	TESS-NH (Sloane et al. 2002)	Plan	Detail	Manage	Researcher Comments/Notes
	/% of Rooms with Glare In many areas =0				
LIGHTING					
12a	Even Lighting in Hallways: Even Throughout=2/Mostly Even =1/Uneven, Many Shadows Throughout =0		✓		Detailed design and technical specification item.
12b	Even Lighting in Activity/Dining Areas: Even Throughout=2/Mostly Even =1/Uneven, Many Shadows Throughout =0		✓		Detailed design and technical specification item.
12c	Even Lighting in Residents Rooms: % Rooms with Even Throughout x2/% Residents rooms with Mostly Even light x1/% Rooms with Uneven light or Many Shadows Throughout =0		✓		Detailed design and technical specification item.
LIGHT METER READINGS					
Hallway 1					
13a	1) Brightest area (min 1m from window)				[Not formally scored]
13b	2) Darkest area				[Not formally scored]
13c	3) Center of hallway				[Not formally scored]
Hallway					
13d	*1) Brightest area (min 1m from window)*				[Not formally scored]
13e	*2) Darkest area*				[Not formally scored]
13f	*3) Center of hallway*				[Not formally scored]
Activity/Dining Area 1					
13g	*1) Brightest area (min 1m from window)*				[Not formally scored]
13h	*2) Darkest seating spot*				[Not formally scored]
13j	*3) Center of area*				[Not formally scored]
Activity/Dining Area 2					
13k	*1) Brightest area (min 1m from window)*				[Not formally scored]
13m	*2) Darkest seating spot*				[Not formally scored]
13n	*3) Center of area*				[Not formally scored]

	TESS-NH (Sloane et al. 2002)	Plan	Detail	Manage	Researcher Comments/Notes
PHYSICAL APPEARANCE/HOMELINESS/PERSONALIZATION					
14	*Predominant Configuration is: No Hallways; Rooms Open to Common Area =2/Short Hallways = 1/Long Hallways = 0*	✓			This item is directly resulting from plan configuration.
15	*Extent to which Activity/Dining areas contain furniture, decorations, and other features that give them a homelike (residential as opposed to institutional) atmosphere)? >74% = 3/50-74% = 2/25-49% = 1/<25% = 0*		✓		This item is partly influenced by floor-plan, but the most significant aspects relate to detailed design and specification of fittings and decoration etc.
16	*Is there a kitchen located within the area that is available for activities and/or for resident/family use? (sink, stove /micro, fridge, countertop): Full Availability = 2/Selected appliances available =1/No access to alliances or no kitchen available =0*	✓			Predominantly a plan-based item but accessibility of specific appliances might require detailed design information.
PERSONALISATION					
17	*% Rooms with at least THREE personal pictures/mementos for each resident x1*			✓	
BEDROOM FURNITURE					
18a	*% of Rooms: Non-Institutional Furniture x1*		✓		Also relies on longer-term management.
18b	*% of Rooms: Individual Heating Controls x1*		✓		As per 18a.
18c	*% of Rooms: Individual Air-Con Controls x1*		✓		As per 18a.
18d	*% of Rooms: Telephone or Tel. connection x1*		✓		As per 18a.
STIMULATION					

	TESS-NH (Sloane et al. 2002)	Plan	Detail	Manage	Researcher Comments/Notes
19a	*Are opportunities for TACTILE stimulation easily available for residents in activity/dining areas and hallways? Extensively =3/Quite a bit = 2/Somewhat = 1/None= 0*		✓		
19b	*Are opportunities for VISUAL stimulation easily available for residents in activity/dining areas and hallways? Extensively =3/Quite a bit = 2/Somewhat = 1/None= 0*		✓		
ORIENTATION/CUEING					
20a.1	*% Resident Rooms with doors routinely left open x1*			✓	Requires management policy and daily attention by staff.
20a.2	*% Resident rooms with resident name on/near door (5cm High Text) x5*			✓	As per 20a.1.
20a.3	*% Resident Rooms with current picture of resident on/near door x1*			✓	As per 20a.1.
20a.4	*%Rooms with old picture of resident on/near door x1*			✓	As per 20a.1.
20a.5	*% Rooms with objects of personal significance on/near door*			✓	As per 20a.1.
20b.1	*% Resident Rooms with (Own) Bathroom Doors open and toilet visible from resident bed (or toilet/commode in room and visible from bed) x2/% Resident Rooms (own) Bathroom doors open, but toilet not visible from bed x1 [Note: B1 and B2 combined]*	✓			This query needs correct plan configuration to be available. Post-occupancy management can then be helpful to optimise use.
20b.2	*% Residents Room (own) Bathrooms with picture, graphic, or sign (to indicate*		✓		This item could, in some cases, be implemented after occupancy occurs.

	TESS-NH (Sloane et al. 2002)	Plan	Detail	Manage	Researcher Comments/Notes
	bathroom) visible from bed x1				
20c	*Cue to any Activity/dining area from outside Resident Bedroom Entrance: % Rooms Entrances from which an Activity/Dining area is visible x2/% Rooms Entrances from which VISUAL CUE of Activity/Dining area is visible x1*	✓			This item is directly resulting from plan configuration — but detail and specification may contribute by helping residents to recognise the purpose of the space.
BEDROOM					
	#Private Bedrooms				[Item not scored directly. Count used for percentages etc.]
21	*% of Bedrooms that are private (as opposed to Shared)*	✓			Indicated either by the number of beds indicated on drawings, and if furniture is not shown, then plan-based evaluation may be able to take some insight from the dimensions of bedroom spaces.
22	*What access to a toilet is available to occupants or resident rooms? % with Private toilet (x3)/% Semi-private toilet (x2)/% Shared toilet (x1)/No direct toilet (0)*	✓			
23	*Is there a bathtub and/or shower in resident bedroom bathrooms (per A-C options in Q22): a) % Bathrooms =Yes x1 /% Bathrooms = No x0*	✓			
24	*Are Residents routinely able to lock doors to resident rooms, apartments, or suites? % Rooms Lockable from Inside x2/% Rooms Lockable from Outside x1/% Rooms not lockable x0*		✓		Mainly requires detailed design and specification information but relies on future management.
25	*During the observation interval, what was the status of the television in*			✓	Constant daytime monitoring required.

	TESS-NH (Sloane et al. 2002)	Plan	Detail	Manage	Researcher Comments/Notes
	the main activity/dining area? On all the time for an activity = 4/No Television present = 3/TV was off all of the time = 2/TV was on some of the time = 1/TV was on all the time				
Frequency of Noises during the observation interval					
26	*Resident screaming or calling out: None = 2/Some = 1/Major Distraction = 0*			✓	Constant daytime monitoring required. Requires staff awareness training to understand the causes and act to remove the underlying cause of distress.
26	*Staff screaming or calling out: None = 2/Some = 1/Major Distraction = 0*			✓	Requires staff awareness training.
26	*TV/ Radio Noise: None = 2/Some = 1/Major Distraction = 0*			✓	Constant daytime monitoring required.
26	Loud Speaker or Intercom: None = 2/Some = 1/Major Distraction = 0		✓		Managers/Staff could choose to minimise use, but it is preferable if design and selection avoids any more than the essential numbers of noise generating equipment.
26	Alarm or Call Bells: None = 2/Some = 1/Major Distraction = 0		✓		As per above.
26	Other Noises (machines/outdoor noises etc.): None = 2/Some = 1/Major Distraction = 0			✓	Training, and constant monitoring by staff is required.
PLANTS					
27	To what extent are plants present in Activity/Dining Areas? Extensive = 2/Somewhat = 1/None = 0			✓	Possibly specified during building procurement but requires ongoing management & maintenance.
27	To what extent are plants present in Residents Rooms? : % Resident Rooms with Extensive plants = 2/% with Some Plants = 1/% with NO Plants = 0			✓	Interior plants may potentially be specified during building procurement but tending to be unlikely except in major communal spaces. They rely more heavily on ongoing management & maintenance.
OUTDOOR AREAS					

	TESS-NH (Sloane et al. 2002)	Plan	Detail	Manage	Researcher Comments/Notes
28	Is there an outdoor area directly accessible to residents? A) Outdoor area adjacent; residents may go out on their own = 3/Outdoor area adjacent but staff must insecure door and accompany residents = 2/Outdoor area present, but away from the area = 1/No Outdoor area present = 0	✓			Accessibility should be clear from plan drawings but needs management input to ensure doors are left unlocked as much as possible during use.
OVERALL ATTRACTIVENESS/FUNCTIONALITY OF OUTDOOR AREAS					
29a	Overall, how ATTRACTIVE are outdoors areas? Very Attractive = 2/Somewhat Attractive = 1/Not Attractive = 0/No Outdoor Areas = 0		✓		This is a subjective question. Depends more on detail & specification, than it does on floor-plan, but also needs longer-term management and maintenance.
29b	Overall, how FUNCTIONAL are outdoors areas? Very Functional = 2/Somewhat Functional = 1/Not Functional = 0/No Outdoor Areas = 0		✓		As per 29a.
30	To what extent does the appearance of ALL residents in public areas reflect attention to individual identity and pride (hair styled/combed; extras such as jewellery, watches, belts; street clothes when up and about)? >75% Well-groomed = 2/25-74% Residents Well Groomed = 1/<25% well groomed			✓	Needs staff awareness training.
ACCESS TO PUBLIC TOILET FROM THE MAIN ACTIVITY AREA					
31	*Public toilet visible from the area = 2/Public Toilet within 8m (25 feet) of the*	✓			

TESS-NH (Sloane et al. 2002)	**Plan**	**Detail**	**Manage**	**Researcher Comments/Notes**
area = 1/Main Activity Areas have no public toilet nearby =0				
TOTAL NUMBER of QUESTIONS	10	29	24	#Qs Related

APPENDIX C: APPRAISAL OF THE DEMENTIA DESIGN AUDIT TOOL

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
Unit 1	Entrance, corridors, wayfinding and lift				
1.01	*The entrance to the unit is clean*			✓	
1.02	*The entrance to the unit is welcoming*		✓		Detail (and Manage) This is a subjective construct, so the response may differ depending on the culture and experience of the observer.
1.03	*The entrance to the unit is tidy*			✓	
1.04	*The entrance to the unit is well lit*		✓		This item is understood to be about artificial lighting so is a detailed design item. Natural light is addressed in query no. 1.14.
1.05	*There is good access for those with physical or mobility problems including wheelchair users. Observe: Handrails; lift; ramp; height and accessibility of door handles; disabled parking spaces near building*	✓			Ramps and lifts should normally be shown on plan drawings. Handrails may be shown on more detailed plans, but later embellished by specification and detailed drawings.
1.06	*There is seating to provide opportunities for rest*	✓			Furniture provision and positions are more likely to be shown on plans than other documents but are often omitted.
1.07	*The door entry system is discreet. Observe: Alerting staff but not ringing out to disturb residents/ patients/people with dementia*		✓		
1.08	*The colour of the carpet/floor covering contrasts with the colour of the furniture*		✓		
1.09	*The colour of the carpet/floor covering contrasts with the colour of the walls*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
1.10	*The skirting contrasts with both the floor and walls*		✓		
1.11	*The flooring is consistent in colour/tone throughout including threshold strips*		✓		
1.12	*Large-patterned carpets have been avoided*		✓		
1.13	*Strong wallpaper patterns have been avoided*		✓		
1.14	*The space has good levels of natural lighting*	✓			Difficult to evaluate precisely based on floor-plans alone. This is impacted by global location, orientation, area of glazing, roof overhangs, and the use of glazing types, shading devices, and blinds. Evaluation based on plan information only would require a 'rule of thumb' for indicative proportions of glazed wall vs floor area.
1.15	*Glare from natural lighting can be managed*		✓		Dependant on the specification of glazing, shades, and blinds.
1.16	*The space has good levels of artificial lighting*		✓		Detailed design involving lighting engineer
1.17	*The lighting can be controlled according to the time of day*		✓		Detailed design involving lighting engineer
1.18	*Ceilings, floors, floor coverings, window curtains and soft furnishings are sufficiently sound absorbent to support communication*		✓		
1.19	*All corridors lead to meaningful places. Observe: Dead ends have been avoided or made interesting*	✓			This item should be observable on plans but may require rooms and other spaces to have labels and/or furniture indicated for clarification of intended uses for each space.
1.20	*Corridors are wheelchair accessible*	✓			This should account for enough width for comfortable passing, but also consider the extent of ramps and stairs that may help or hinder movement.

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
1.21	*Corridors are of varying widths*	✓			
1.22	*Corridors have interesting items on the walls in. order to provide focal points of interest*		✓		Whether these display items are documented or not may depend on the building type and contract. Sometimes installed after occupancy commences by occupants.
1.23	*There is seating at frequent intervals to provide opportunities for rest*		✓		Seating itself may not be shown on plans. Dimensions of spaces might inform on the possibility of these being added.
1.24	*There are comfortable handrails to give both physical assistance and a sense of direction/distance*		✓		Plans may indicate handrails, but detail design, internal elevation drawings, and specification are needed to determine whether they are set at the correct height, colour, shape, detail at junctions, and ergonomically formed etc.
1.25	*Corridors are well lit*		✓		This item is assumed to be about artificial lighting and is therefore primarily subject to detailed design to ensure minimum/optimal light levels. This query itself is subjective in nature as it does not specify specific target lighting levels (lux). Recommended lighting levels for various spaces are tabulated in another University of Stirling publication (McNair *et al.* 2011), but not clearly referred to in the Dementia Design Audit Tool.
1.26	*Corridors are evenly lit*		✓		Partly detailed lighting design and partly window/door positioning and spacing. Most corridors tend to be internalised and then not have windows for natural light, so the evaluation will tend to relate more closely to detailed artificial lighting and specification.
1.27	*Nurse alarm call systems are discreet, alerting staff but not otherwise disturbing residents*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
1.28	*Edges to steps are clearly delineated for safety. Observe: Nosings are clearly contrasted with the treads and riser*		✓		
1.29	*Doors open easily with minimal physical effort*		✓		
1.30	*Doors open against the wall to allow a full view of rooms*	✓			
1.31	*Doors to lounges are unlocked*			✓	Requires training and active awareness from staff
1.32	*Doors to dining rooms are unlocked*			✓	Requires training and active awareness from staff
1.33	*Doors to safe outdoor areas are unlocked*			✓	Requires training and active awareness from staff
1.34	*Doors to bedrooms are not directly opposite, facing each other*	✓			
1.35	*The colour of the door handles contrasts with the colour of the doors*		✓		
1.36	*Handles are comfortable and easy to use*		✓		
1.37	*The flooring is consistent in colour/tone throughout including threshold strips*		✓		
1.38	*Staff facilities are located where they do not cause noise for residents. Observe: Nurses station; staff sitting room*	✓			Location should be observable in plans if labelled. This item is affected by the types of noise generating equipment used in staff areas, so the problem is also influenced by detailed design and post-occupancy management.
1.39	*Service areas such as laundry are located where they do not cause noise for residents*	✓			This question assumes that laundries are large and noisy commercial types of laundry. Residents are typically not involved in this aspect of household activities, but research has shown that ordinary activities such as doing personal laundry or meal preparation activities can bring therapeutic benefits to the individual.

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
1.40	*Doors to staff facilities are well concealed. Observe: Doors are the same colour as the walls; skirting or handrail extends along the door with no or minimum door furniture*		✓		
1.41	*There is clear signage to help wayfinding for everybody*		✓		Sometimes signage strategy floor-plans are produced, but this needs more detailed accompanying information to assesses whether it is 'clear'. Wider research suggests that architectural wayfinding is cognitively preferable to signage, with signage used only to reinforce this.
1.42	*There is a contrast between the colour and tone of the writing on the sign and the colour and tone of the background of the sign*		✓		
1.43	*There is a relevant, easy to understand picture or graphic image as well as words on each sign '*		✓		
1.44	*There is a contrast between the colour and tone of the background of the sign and the colour and tone of the door/ wall*		✓		
1.45	*Signs are fixed to the doors they refer to, not to adjacent wall surfaces, except where they are needed for directions*		✓		
1.46	*The bases of all signs offering wayfinding for residents are around 4 feet/ 1.2 metres from the ground. Measure*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
1.47	*There is extensive use of glass to show what is behind doors and walls and to increase visibility. Observe: Glass is not covered by curtains*	✓			Plans should show any glazed areas of walls. However, open plan configurations may require less glazing (or none) to obtain good visibility; so, absence of glazing is not necessarily negative (Queries about vision between specific spaces would form a useful highlight). Glazing in doors may not be clear on plans, so may require some assumptions to be made during design evaluations.
1.48	*There are landmark objects such as memorabilia to aid wayfinding*		✓		These items may not be shown on typical plans, but more likely to be indicated on detailed drawings. In many cases they will not be designed or placed until after occupation of the building.
1.49	*The [lift] interior is calming i.e. the lining is pastel coloured, not reflective or shiny*		✓		
1.50	*The [lift] flooring matches that of the adjacent landing*		✓		
1.51	*The [lift] lighting is bright, but glare-free and uniform*		✓		
1.52	*There are no mirrors or reflecting surfaces [inside the lift]*		✓		
1.53	*A sensor keeps the [lift] doors open until people are safely inside the lift*		✓		
1.54	*[Lift] Button controls are large and clear and contrast with the door frame*		✓		
1.55	*Lift is not in the bedrooms area*	✓			
1.56	*Lift is not on the adjoining wall of a bedroom*	✓			
	Unit 1: Query Count	13	38	5	

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
Unit 2	*Lounge*				
2.01	*The colour of the carpet/floor covering contrasts with the colour of the furniture*		✓		
2.02	*The colour of the carpet/floor covering contrasts with the colour of the walls*		✓		
2.03	*The skirting contrasts with both the floor and walls*		✓		
2.04	*The flooring is consistent in colour/tone throughout including threshold strips*		✓		
2.05	*Large-patterned carpets have been avoided*		✓		
2.06	*Strong wallpaper patterns have been avoided*		✓		
2.07	*The room has good levels of natural lighting*	✓			Difficult to evaluate precisely based on floor-plans alone. This is impacted by global location, orientation, area of glazing, roof overhangs, and the use of glazing types, shading devices, and blinds. It suggests a ‘rule of thumb’ approach to floor-plan based evaluation where a minimum threshold of one linear metre of wall glazing indicated in the drawings per 10 m^2 floor area.
2.08	*Glare from natural lighting can be managed*		✓		
2.09	*The room has good levels of artificial lighting*		✓		Specific lighting levels are not clarified making this item subjective in nature. The evaluation tool could be improved by noting expectations here.
2.10	*The lighting can be controlled according to the time of day*		✓		This item relates to artificial lighting, so is primarily related for detailed design and specification. Specialist electrical layouts may provide enough information on switch controls to different lighting circuits.

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
2.11	*The room is made recognisable through focal points which are age and culturally appropriate (e.g. a traditional fireplace) and includes comfortable seats, easy chairs, coffee table and display cabinets. Observe: The principal focal point should not be a television*		✓		Some of these features may be shown on floor-plans. However, detail and specification are key elements to ensure familiarity, so residents recognise the features.
2.12	*Ceilings, floors, floor coverings, window curtains and soft furnishings are sufficiently sound absorbent to support audible communication*		✓		
2.13	*There are sufficient 'domestic-style' light fittings to help promote a recognition of place*		✓		
2.14	*Decor is age-appropriate and culturally sensitive*		✓		
2.15	*The room is small and homely*	✓			What makes a place 'homely' is both subjective and culturally variable. Plan based evaluation would need to focus on sizes by defining the maximum floor of space permitted, to ensure its scale is like domestic settings.
2.16	*There is a range of furniture suitable for the needs of all, including chairs of different heights/depths*		✓		
2.17	*Furniture design/placement enables, rather than restrains, residents. Observe: Depth of seat; position of tables and seating*	✓			Furniture layout on plans (when indicated) may not be implemented in occupied environment. Specification of numbers, sizes, types and ergonomics are all detailed design specification matters.

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
2.18	*Window sills of the main windows are low enough to be able to see out to the garden or street from a sitting position. Assess by sitting down. Observe: Furniture or foliage in the garden does not obscure the view or the natural light*		✓		This may be possible to judge from elevation or section drawings, but not floor-plans.
2.19	*The layout incorporates fittings and furniture that will encourage staff/resident interaction*	✓			Furniture layout should be shown on plans. It is possible, however, that the arrangements shown in floor-plan drawings may not be implemented in the final occupied environment.
2.2	*There are enough seats for staff*	✓			Furniture layout should be shown on plans. It is possible however that the arrangements shown in floor-plan drawings may not be implemented in the final occupied environment.
2.21	*Toilet facilities are visible or are well signposted from the lounge*	✓			This may be evaluated using plans to establish whether the WC space or the door to the space is directly visible. Signage is useful but, used alone, is a less satisfactory design solution. Signage design and placement will be a detailed design and specification item. Plan based evaluation queries could appropriately omit the reference to signage.
2.22	*If there is an adjacent garden/balcony/roof terrace visible from the lounge, there is a door leading to it.*	✓			Observable from plan. Assumptions needed about level access, and unlocked access doors. Sliding doors may sometimes be difficult to determine if only plan drawing information is available.
2.23	*There are different areas of focus (e.g. an area for sitting and chatting)*	✓			Furniture layout should be shown on plans. It is possible, however, that the arrangements shown in floor-plan drawings may not be implemented in the final occupied environment.

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
2.24	*There are different focal points (e.g. fish tank, nice/engaging view).*	✓			Furniture layout should be shown on plans. It is possible, however, that the arrangements shown in floor-plan drawings may not be implemented in the final occupied environment. Specification of numbers, sizes, types, and materials is also partly dependent on detailed design specification stage.
2.25	*The TV is easily viewed by the residents. Observe: The seating arrangement allows all residents to see the TV, i.e. the TV is close enough to clearly see and hear; it is not on with nobody watching*	✓			Furniture layout should be shown on plans. It is possible however that the arrangements shown in floor-plan drawings may not be implemented in the final occupied environment.
2.26	*The remote-control design is suitable for the needs of the residents. Observe: There is a remote control*		✓		This may be a post-occupancy item in some settings, depending on procurement process.
2.27	*There is an optional quiet lounge for residents who do not wish to watch TV*	✓			
2.28	*The room has a quiet ambience. Observe: Soft furnishings and other sound-absorbing materials have been used. Listen: noise levels*		✓		Mainly related to detail design but supplemented by post-occupancy management
2.29	*There are alternative activities available for residents who wish this. Observe: There is a radio/CDs to listen to; newspapers/books to read*			✓	
	Unit 2: Query Count	12	16	1	
Unit 3	*Dining Area*				

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
3.01	*The colour of the carpet/floor covering contrasts with the colour of the furniture (especially chairs)*		✓		
3.02	*The colour of the carpet/floor covering contrasts with the colour of the walls*		✓		
3.03	*The skirting contrasts with both the floor and walls*		✓		
3.04	*The flooring is consistent in colour throughout including threshold strips*		✓		
3.05	*Large-patterned carpets have been avoided*		✓		
3.06	*Strong wallpaper patterns have been avoided*		✓		
3.07	*The dining room has good levels of natural lighting*	✓			Difficult to evaluate precisely based on floor-plans alone. This is impacted by global location, orientation, area of glazing, roof overhangs, and the use of glazing types, shading devices, and blinds. A suggested 'rule of thumb' approach to floor-plan based evaluation where a minimum threshold of one linear metre of wall glazing indicated in the drawings per 10 m^2 floor area.
3.08	*The dining room has good levels of artificial lighting*		✓		
3.09	*Daylight levels can be controlled to minimise glare*		✓		
3.10	*Ceilings, floors, floor coverings, window curtains and soft furnishings are sufficiently sound absorbent to support communication*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
3.11	*Window sills from the main windows are low enough to be able to see out to the outside space or street from a sitting position. Assess by sitting down. Observe: Furniture or foliage do not obscure the view*		✓		Requires elevations or sections to check during design evaluation.
3.12	*There are sufficient 'domestic-style' light fittings to help promote a recognition of place*		✓		
3.13	*The room is recognisable by dining room furniture*	✓			Furniture layout should be shown on plans. It is possible, however, that the arrangements shown in floor-plan drawings may not be implemented in the occupied environment.
3.14	*The dining room is small. No more than 10 people with dementia eating together*	✓			Assessment should be based on number of bed-spaces served by the room, not the number of tables and chairs provided. Over-supply per number of residents is necessary to allow choice of where to sit and encouraging staff to interact.
3.15	*The dining room is domestic in appearance*		✓		
3.16	*There are enough seats for all residents*	✓			
3.17	*There are extra/enough seats for staff interacting with residents at mealtimes*	✓			
3.18	*Furniture design/placement enables, rather than restrains, residents. Observe: Depth of seat; position of tables and seating*	✓			Furniture layout should be shown on plans. It is possible, however, that the arrangements shown in floor-plan drawings may not be implemented in the occupied environment.

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
3.19	*There are sideboards/dressers equipped with mealtime items - cutlery, napkins, place mats etc.*		✓		
3.20	*Table layout is designed to allow residents to eat alone if required*	✓			Assessment should be based on number of bed-spaces served by the room, not the number of tables and chairs provided. Over-supply per number of residents is necessary to allow choice of where to sit and encouraging to staff to interact.
3.21	*Crockery/cutlery are of traditional design*			✓	
3.22	*Crockery/cutlery contrast in colour to table and/or background surface. Observe: Crockery is not childish or unrecognisable*			✓	
3.23	*There is a glazed wall or clear signage on the door to aid understanding of the function of the room*	✓			Plans should show any glazed areas of walls. However, open plan configurations may require less glazing (or none) to obtain good visibility, so absence of glazing is not necessarily negative (Queries about vision between specific spaces, not currently provided in this instrument, would form a useful highlight). Glazing in doors may not be clear on plans, so may require some degrees of assumption during standardised design evaluation based on floor-plans.
3.24	*There is an open-plan kitchen or kitchenette/servery alongside the dining room*	✓			
3.25	*The noise from the main kitchen is not distracting to residents*		✓		Dependent on detailed design specification, types, and sizes of kitchen equipment.

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
3.26	*The room has a quiet ambience. Other noises are not distracting to the residents. Observe: Soft furnishings and other sound-absorbing materials have been used. Listen: noise levels, listen to food trolleys where possible*			✓	
3.27	*If there is an adjacent garden/balcony/roof terrace visible from the dining room, there is a door leading to it.*	✓			
	Unit 3: Query Count	10	14	3	
Unit 4	*Meaningful Occupation*				
4.01	*There are facilities for visiting services such as hairdressers, aromatherapists, manicurists*	✓			
4.02	*There are facilities for residents to participate in kitchen chores*		✓		
4.03	*The kitchenette/servery counter is visible to residents from various vantage points. Observe: Facilities and access*	✓			
4.04	*There are facilities for residents to do their own laundry if they wish. Observe: Drying racks, washing lines*	✓			
4.05	*There are spaces for arts, crafts, and recreational activity, both for individuals and groups. Observe: Areas within the unit where residents can*	✓			Ideally needs room labels on plans to identify these functions.

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
	engage in arts, craft, music				
4.06	*There are attractive shelving and display areas for residents' work if they wish to display it. Observe: Shelving, framed picture boards; use of Blu-tak and drawing pins avoided*		✓		
4.07	*There is easy access to safe outside space with facilities for residents to engage in light gardening or exploring, where desired. Observe: The exit is unlocked; the exit is not blocked by furniture*	✓			Needs some input from all stages, but most heavily dependent on the floor-plan.
4.08	*There is a large room that is used for social occasions*	✓			
4.09	*There is a room divider available in the main Communal room to reduce noise when activities are taking place in one area.*	✓			
	Unit 4: Query Count	7	2	0	
Unit 5	*Examination Room*				
5.01	*The colour of the carpet/floor covering contrasts with the colour of the furniture*		✓		
5.02	*The colour of the carpet/floor covering contrasts with the colour of the walls*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
5.03	*The skirting contrasts with both the floor and walls*		✓		
5.04	*The flooring is consistent in co lour throughout including threshold strips*		✓		
5.05	*Large-patterned carpets have been avoided*		✓		
5.06	*Strong wallpaper patterns have been avoided*		✓		
5.07	*The room has good levels of natural lighting*	✓			Difficult to evaluate precisely based on floor-plans alone. This is impacted by global location, orientation, area of glazing, roof overhangs, and the use of glazing types, shading devices, and blinds. A suggested 'rule of thumb' approach to floor-plan based evaluation where a minimum threshold of one linear metre of wall glazing indicated in the drawings per 10 m^2 floor area.
5.08	*Glare from natural lighting can be managed*		✓		
5.09	*The room has good levels of artificial lighting*		✓		
5.10	*Ceilings, floors, floor coverings, window curtains and soft furnishings are sufficiently sound absorbent to support communication*		✓		
5.11	*There is clear signage on the door to aid understanding of the function of the room*		✓		
5.12	*The room is made recognisable through features such as a treatment table, appropriate lighting, consultation area etc.*		✓		
5.13	*The waiting area can be supervised easily*	✓			

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
5.14	*The waiting area is in close proximity to communal areas*	✓			
5.15	*There is sufficient seating to accommodate resident, staff, and carer (if present). Observe: Seating promotes good communication*	✓			Requires that loose furniture is shown on drawings.
5.16	*There is a privacy screen/curtain to prevent viewing-in when the door is opened*		✓		
5.17	*The screen/curtains are not strongly patterned*		✓		
5.18	*The screen/curtains contrast with the colour of adjacent walls*		✓		
5.19	*There is adequate concealed storage for equipment*		✓		
	Unit 5: Query Count	4	15	0	
Unit 6	*Hairdressing Room*				
6.01	*The colour of the carpet/floor covering contrasts with the colour of the furniture*		✓		
6.02	*The colour of the carpet/floor covering contrasts with the colour of the walls*		✓		
6.03	*The skirting contrasts with both the floor and walls*		✓		
6.04	*The flooring is consistent in colour throughout including threshold strips*		✓		
6.05	*Large-patterned carpets have been avoided*		✓		
6.06	*Strong wallpaper patterns have been avoided*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
6.07	*The room has good levels of natural lighting*	✓			Difficult to evaluate precisely based on floor-plans alone. This is impacted by global location, orientation, area of glazing, roof overhangs, and the use of glazing types, shading devices, and blinds. A suggested 'rule of thumb' approach to floor-plan based evaluation where a minimum threshold of one linear metre of wall glazing indicated in the drawings per 10 m^2 floor area.
6.08	*Glare from natural lighting can be managed*		✓		
6.09	*The room has good levels of artificial lighting*		✓		
6.10	*Ceilings, floors, floor coverings, window curtains and soft furnishings are sufficiently sound absorbent to support audible communication*		✓		
6.11	*There are glazed walls or clear signage on the door to aid understanding of the function of the room*	✓			
6.12	*The room is made recognisable through features such as a hairdressing equipment, appropriate lighting, hair washing area etc.*		✓		
6.13	*The waiting area can be supervised easily*	✓			
6.14	*The waiting area is in close proximity to communal areas*	✓			
6.15	*There is sufficient seating to accommodate resident, staff and carer (if present). Observe: Seating promotes good communication*	✓			Requires that loose furniture is shown on drawings.

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
6.16	*There is adequate concealed storage for equipment*		✓		
	Unit 6: Query Count	5	11	0	
Unit 7	*Bedrooms*				
7.01	*The colour of the carpet/floor covering contrasts with the colour of the furniture*		✓		
7.02	*The colour of the carpet/floor covering contrasts with the colour of the walls*		✓		
7.03	*The skirting contrasts with both the floor and walls*		✓		
7.04	*The flooring is consistent in colour/tone throughout including threshold strips*		✓		
7.05	*Large-patterned carpets have been avoided*		✓		
7.06	*Strong wallpaper patterns have been avoided*		✓		
7.07	*Ceilings, floors, floor coverings, window curtains and soft furnishings are sufficiently sound absorbent to support communication*		✓		
7.08	*The room is made recognisable by easy visibility of the bed*	✓			Drawings should show furniture.
7.09	*The entrance to the resident's bedroom is individualised. Observe: Doors - consider use of number or nameplate, doorbell, letter box, artwork, display boards/ boxes, photographs. Observe: Individualisation*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
	is relevant for each resident				
7.10	*There are personal items in the resident's room*			✓	
7.11	*There are items of the resident's own furniture in the room*			✓	
7.12	*The door to the bedroom is easy to open, the handles comfortable and easy to use*		✓		
7.13	*The room can be made dark overnight but there is an optional facility for very low-level lighting*		✓		
7.14	*There is a soft light in the en suite which can be left on if necessary.*		✓		
7.15	*There is a mechanism to facilitate night-time checks by staff without disturbing sleep. Observe: A discreet dimmer switch by the door; a discreet switch by the door to an ultra-low output lamp; a curtain over a door window that can be partially opened; a torch made available in the corridor*		✓		
7.16	*The room has good levels of natural lighting*	✓			Difficult to evaluate precisely based on floor-plans alone. This is impacted by global location, orientation, area of glazing, roof overhangs, and the use of glazing types, shading devices, and

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
					blinds. A suggested 'rule of thumb' approach to floor-plan based evaluation where a minimum threshold of one linear metre of wall glazing indicated in the drawings per 10 m^2 floor area.
7.17	*Glare from natural lighting can be managed*		✓		
7.18	*The lighting can be controlled according to the time of day*		✓		
7.19	*There are sufficient domestic-style light fittings to help promote a recognition of place*		✓		
7.20	*Where there is a door from the garden/balcony/roof terrace/roof garden the lighting, inside is bright enough to compensate for impaired vision when returning from a bright outdoor space*		✓		
7.21	*Window sills are low enough to be able to see out to the garden/ balcony/roof terrace or street from a sitting position. Assess by sitting down. Observe: Furniture or foliage does not obscure the view*		✓		Requires elevation or section drawings to evaluate this query.
7.22	*There are no heavy pelmets and there is space to draw back curtains, so they do not obscure the view out of the window. Observe: The curtain rails/rods/battens extend well beyond the width of the*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
7.23	*There are light blinds or curtains to control glare*		✓		
7.24	*There are heavy curtains, or a combination of curtains and blinds, to allow dark conditions*		✓		
7.25	*The floors, floor coverings, ceilings and soft furnishings minimise noise*		✓		
7.26	*The size of the room allows for choice in positioning the bed*	✓			
7.27	*Mirrors are well situated*		✓		
7.28	*Mirrors are designed to be removable or easily covered*		✓		
7.29	*Doors open easily with minimal physical effort*		✓		
7.30	*There are sufficient socket outlets (plug points) for resident's electrical appliances. Observe: The number, visibility and accessibility of plug points*		✓		
7.31	*Technology has been adapted to accommodate resident's specific needs. Observe: Adapted phones; big-button remote control; large-face clock etc.*			✓	
7.32	*The resident has access to private en suite toilet facilities*	✓			
7.33	*En suite facilities are adapted to the resident's individual needs and taste. Observe: Presence of a safety mat, rails or equipment, personal items such as bowls of*			✓	

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
	soap, seashells and photographs				
7.34	*There is a sign on the door*			✓	
7.35	*The toilet can be made visible from the bed for those who need this cue*	✓			
7.36	*If there is no en suite toilet, there are toilet facilities nearby. Observe: Toilet facilities*	✓			This question with the proceeding one gives the same evaluation outcome for less satisfactory design. It may have been better to score this (7.37) an additional point should the room already have an en-suite.
7.37	*There is clear signage to aid wayfinding to the nearest toilet*		✓		
	Unit 7: Query Count	6	26	5	
Unit 8:	*En-Suite provision*				
8.01	*The colour of the door contrasts clearly with the colour of the adjacent walls*		✓		
8.02	*The colour of the floor covering contrasts with the colour of any fixtures and fittings*		✓		
8.03	*The colour of the floor covering contrasts. with the colour of the walls*		✓		
8.04	*The skirting contrasts with both the floor and walls*		✓		
8.05	*The flooring is consistent in colour/tone throughout including threshold strips*		✓		
8.06	*Strong patterns on the wall finishes have been avoided*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
8.07	*Ceilings, floors, floor coverings, are sufficiently sound absorbent to minimise noise and support*		✓		
8.08	*There is a sign on the door to aid wayfinding*		✓		
8.09	*The room is made recognisable through the visibility of bathroom fittings and other items such as shampoo and towels*	✓			
8.10	*There are a minimum of two artificial lights in the room*		✓		
8.11	*Wall colours are warm and light to maximise light levels*		✓		
8.12	*Ceramic wall tiling or waterproof lining materials are domestic in appearance*		✓		
8.13	*The colour of the tiling/wall contrasts clearly with the colour of sanitary fittings*		✓		
8.14	*The colour of the tiling/wall contrasts clearly with the colour of grab rails*		✓		
8.15	*Grab rails are comfortable to grip*		✓		
8.16	*The room is homely*		✓		What makes a place 'homely' is subjective and culturally variable. This is mostly related to interior design, with some additions and personalisation's added after occupation.
8.17	*The room does not smell unpleasant*			✓	

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
8.18	*The resident has his/her own personal items and toiletries in the room*			✓	
8.19	*There is creative use of technology to support a resident in their independence or in doing what they wish to do. Observe: Passive alarms; sensor pads; carer call system*			✓	
8.20	*Extractor fans are quiet*		✓		
8.21	*The colour of the toilet seat contrasts clearly with the colour of the toilet bowl*		✓		
8.22	*The colour of the toilet seat contrasts clearly with the colour and tone of the floor*		✓		
8.23	*Cisterns are traditional in appearance*		✓		
8.24	*Lever handles or flush buttons contrast in colour with the cistern or background wall*		✓		
8.25	*There are domestic-style toilet roll holders*		✓		
8.26	*Toilet roll holders contrast clearly with the background wall (or contain contrasting coloured toilet rolls).*		✓		
8.27	*The toilet roll is within easy reach of the toilet. Observe: Location/height. Assess by sitting on toilet*		✓		
8.28	*There is adequate space for transfer to toilet from wheelchair or hoist, especially when two carers are required*	✓			It would help if this requirement could be defined dimensionally, or to refer to an external published standard that clarifies this information. People who are not experts in the subject may not

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
					appreciate the amount of space needed for the activity, or how this might vary from one individual to another.
8.29	*Wash hand basin taps are traditional in appearance (e.g. cross-head)*		✓		
8.30	*Wash hand basin taps are simple to operate*		✓		
8.31	*Wash hand basin taps have clear indications to help people understand which is hot and which is cold*		✓		
8.32	*The mirrors are well positioned. Observe: Location/height (e.g. over wash hand basin)*		✓		
8.33	*The mirrors are designed to be removable or easily covered*		✓		
8.34	*Wash hand basin taps are simple to operate*		✓		
8.35	*Wash hand basin taps have clear indications to help people understand which is hot and which is cold*		✓		
8.36	*The mirrors are well positioned. Observe: Location/height (e.g. over wash hand basin)*		✓		
8.37	*The mirrors are designed to be removable or easily covered*		✓		
8.38	*There is adequate space for transfer to shower/bath from wheelchair or hoist, especially when two carers are required.*	✓			

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
	Unit 8: Query Count	3	32	3	
Unit 9	*Communal Toilets/Bathrooms*				
9.01	*The colour of the door contrasts clearly with the colour of adjacent walls*		✓		
9.02	*There is a sign on the door to aid wayfinding*		✓		
9.03	*The room is made recognisable through the visibility of bathroom fittings and other items such as shampoo and towels*		✓		
9.04	*The colour of the floor covering contrasts with the colour of the fixtures and fittings*		✓		
9.05	*The skirting contrasts with both the floor and walls*		✓		
9.06	*The flooring is consistent in colour throughout including threshold strips*		✓		
9.07	*Strong wall finish patterns have been avoided*		✓		
9.08	*Ceilings, floors, floor coverings, are sufficiently sound absorbent to support communication*		✓		
9.09	*The room has good artificial lighting*		✓		
9.10	*There are a minimum of two main artificial lights in the room*		✓		
9.11	*The main light fitting is not placed directly over the bath*		✓		
9.12	*Wall colours are warm and light to maximise light levels*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
9.13	*Ceramic wall tiling or waterproof lining materials are domestic in appearance*		✓		
9.14	*The colour of the tiling/walls contrasts clearly with the colour of sanitary fittings*		✓		
9.15	*Tiling and wall colours contrast clearly with the grab rails*		✓		
9.16	*The room is homely*		✓		
9.17	*The room does not smell unpleasant*			✓	
9.18	*Grab rails are comfortable to grip*		✓		
9.19	*The room is fitted with bath/toilet aids to suit the needs of the residents*		✓		
9.20	*There is adequate space for transfer to the toilet from a wheelchair or hoist, especially when two carers are required*	✓			
9.21	*Extractor fans are quiet*		✓		
9.22	*The colour of the toilet seat contrasts clearly with the colour of the toilet bowl*		✓		
9.23	*The colour of the toilet seat contrasts clearly with the colour and tone of the floor*		✓		
9.24	*Cisterns are traditional in appearance*		✓		
9.25	*Lever handles or flush buttons contrast in colour with the cistern or background wall*		✓		
9.26	*There are domestic-style toilet roll holders*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
9.27	*These contrast clearly with the background wall (or contain contrasting-colour toilet rolls)*		✓		
9.28	*The toilet roll is within easy reach of the toilet. Observe: Location/height. Assess by sitting on toilet*		✓		
9.29	*Wash hand basin taps are traditional in appearance (e.g. cross-head)*		✓		
9.3	*Wash hand basin taps are simple to operate*		✓		
9.31	*Wash hand basin taps have clear indications to help people understand which is hot and which is cold*		✓		
9.32	*Mirrors are well situated*		✓		
9.33	*Mirrors are designed to be removable or easily covered*		✓		
9.34	*There is convenient shelving close by for toiletries*		✓		
9.35	*Shower/bath controls are simple to operate. Try out*		✓		
9.36	*Shower/bath controls have clear indications to help people understand which is hot and which is cold. Observe: Are the controls easy to understand with clear colour contrast?*		✓		
9.37	*There is a shower/bath curtain to provide privacy*		✓		
9.38	*The floors, floor coverings and ceilings are designed to minimise noise*		✓		
9.39	*Extractor fans are quiet*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
	Unit 9: Query Count	1	37	1	
Unit 10	*External Areas*				
10.01	*The access to the outdoor area is visible and/or very well signed*	✓			Plan based evaluation would be based on direct visibility to outdoor spaces, preferably including the access point. Signage is not normally indicated on plans and is considered inferior to direct visibility and other architectural aids to wayfinding.
10.02	*The door threshold to the outdoor area is level*	✓			Level access would need to be assumed, unless drawings indicate otherwise, from all doors to/from common spaces, corridors, outdoor spaces etc. Formal evaluations should, include a note to clarify this assumption.
10.03	*The door to the outdoor area is wide enough for wheelchair users*	✓			
10.04	*Access to the roof garden is barrier free*	✓			This query needs a definition of 'barrier free' - physical barriers may not exist but materials/colours may create cognitive barrier for people with dementia (see 10.05). 'Green' roofs may not be physically accessible to occupants. Plan evaluation would therefore be subject to several assumptions and caveats.
10.05	*Colour contrast between the interior floor finish and exterior surfacing is minimal*		✓		
10.06	*Access to outdoor areas is available during the day. Observe: The doors to the outdoor areas are unlocked*			✓	

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
10.07	*Access is available from communal areas (with the exception of most roof gardens). Observe: The garden/balcony/roof terrace is visible from the communal areas and/or well signed*	✓			It is unclear how this query should this be scored if physical access provided but not visually accessible. The wording also suggests that access from circulation corridors (as a 'communal' space) would suffice when other literature makes it clear that the access should preferably be directly from a shared social space such as dining room or main lounge.
10.08	*Where there is a slope, there are handrails. Observe: Handrails are provided where the gradient of ramps and slopes are greater than 1:20*	✓			Plans may show approximate levels/slopes etc, but most drawings should graphically indicate any steps and ramps.
10.09	*The way back into the building is clearly visible from the outdoor area. Observe: There is visible and clear signage indicating the way back into the building*	✓			
10.10	*The door contrasts clearly with the surrounding walls*		✓		
10.11	*There are landmarks to help identify the door e.g. specimen plant, sculpture etc.*		✓		
10.12	*The door handle is comfortable to use*		✓		
10.13	*The door handle is recognisable*		✓		
10.14	*The door handle is easy to operate*		✓		
10.15	*The door handle is clearly visible and contrasts against the door*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
10.16	*The external space is enclosed*	✓			Plan evaluation should be possible assuming that enclosing elements such as fences, walls or other buildings are indicated on drawings. Note: The practice of physical restriction is the subject of ongoing ethical debate with some countries and many care organisations allowing greater freedom, making greater use of personal care, or tracking technology etc. to help maintain resident safety without resorting to obvious physical restriction.
10.17	*The enclosure is difficult or impossible to climb (i.e. there are no footholds or horizontal fencing bars on the internal side)*		✓		
10.18	*There is barrier planting to deter access to the enclosure*		✓		This will depend on the species of plants used for certainty of deterrent, so unlikely to be possible to evaluate using floor-plans alone.
10.19	*Where adjacent surfaces vary in level, e.g. from a single step height to much greater heights, a balustrade of suitable height is provided. Observe: Balustrade 1.1 metres high and where there is a significant drop, is higher and slopes inward or has a sloping top*	✓			Plans should show approximate level differences/slopes, and necessary ramps and stairs, together with associated rails. Other railings within gardens and landscaped areas may not always be indicated on architectural plans.
10.20	*The external lighting is evenly distributed. Observe: External lighting fixtures*		✓		
10.21	*The shadows cast from fencing and railings are not confusing. Observe: Orientation*		✓		
10.22	*The gates are disguised*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
10.23	*Handles and latches are hidden*		✓		
10.24	*Hard surfacing is level*		✓		
10.25	*Hard surfacing is non-slip*		✓		
10.26	*Hard surfacing is non-reflective. Observe: Sunlight does not create glare*		✓		
10.27	*Hard surfacing has defined edges*		✓		
10.28	*Raised edges do not create a trip hazard*		✓		
10.29	*Location of accessible areas does not extend within reach of opening windows*	✓			
10.33	*Hard surfacing is well drained. Observe: The water could drain off to soft landscape; there are gullies*		✓		
10.31	*Service covers (manhole covers) where people are likely to walk are concealed*		✓		
10.32	*There are opportunities for activities. Observe: Raised planters; areas for tables and chairs; washing lines; greenhouses; sheds; putting green etc.*	✓			
10.33	*The outside areas are sunny during at least one part of the day and preferably for most of the day*	✓			
10.34	*There are opportunities for activities for visiting children. Observe: Climbing frame; swings*	✓			
10.35	*There are pergolas, a summer house or a*	✓			

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
	gazebo to break up the space				
10.36	*There are trellises to break up the space*	✓			
10.37	*There are some features that will be of particular interest to residents. Observe: Items of local interest; artworks such as sculptures; wind chimes; water features etc.*		✓		
10.38	*There are trees to provide shade. Observe: The items in the garden/roof terrace/roof garden/balcony provide shelter and protection but do not prevent direct sunlight reaching the resident*	✓			
10.39	*There are awnings/parasols to provide shade. Observe: The items in the garden/roof terrace/roof garden/balcony provide shelter and protection but do not prevent direct sunlight reaching the resident*	✓			
10.40	*There are wind breaks*	✓			
10.41	*Seating and furniture are available*	✓			
10.42	*The arms of the seating furniture are comfortable to use when sitting down or getting up*		✓		
10.43	*Seating and furniture are robustly constructed. Observe: Chairs and benches do not move*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
	when sitting down or getting up				
10.44	*Seating and furniture are stable. Observe: The tables and seat do not easily move, get knocked over or shift when leaning on them*		✓		
10.45	*There is sufficient colour contrast between the furniture and the ground surface*		✓		
10.46	*Items/furniture in the garden/ balcony/roof terrace/roof garden are in good condition*			✓	
10.47	*There is a toilet near the building entrance (either inside or outside the building). Observe: The toilet door is clearly visible from the garden/balcony/roof terrace/roof garden or the toilet door is clearly signed*	✓			
10.48	*To avoid sound reflecting into the building, there should not be large areas of hard surfacing outside bedrooms, offices or treatment rooms*	✓			
10.49	*There is access to outdoor areas in all weathers. Observe: There is a lobby/veranda or similar space to allow access outside in all weathers*	✓			

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
10.50	*There is an area where clothing and footwear can be changed*	✓			
10.51	*The tap, watering-can or hose are easily available*		✓		
10.52	*If space allows, there is a path of minimum 1000mm width that returns either to the starting point or alternative safe access to the building*	✓			
10.53	*The path route can be generally seen from the communal areas and/or staff offices*	✓			
10.54	*There are resting areas along the path*	✓			
10.55	*Dead ends and locked gates [sic]*	✓			Dead ends are to be avoided in environments for people with dementia. It is also preferable that they do not encounter and recognise locked gates. It is assumed therefore that the wording of this query contains a typographical error, and that the current words should be preceded with the word 'Avoid or similar.
10.56	*The hard-surfaced patio is large enough for the number of people that might use it*	✓			
10.57	*There is a no colour contrast between the paths leading from the patio and the patio itself*		✓		
10.58	*Plants are not harmful. Observe: No poisonous or spiny plants within reach of users*		✓		
10.59	*Planting does not overhang access routes*			✓	

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
10.60	*There is a range of plants providing 'year-round' interest*		✓		
10.61	*There are raised planters that provide opportunities for gardening*		✓		
10.62	*Planting beds are well maintained*			✓	
10.63	*Grass areas are well maintained. Observe: Grass is level, well drained and usable*			✓	
10.64	*There are landmarks to aid wayfinding such as trees, plants and garden furniture*	✓			
	Unit 10: Query Count	29	30	5	
Unit 11:	*General Principles*				
11.01	*There are library facilities*	✓			
11.02	*There are hairdressing facilities*	✓			Room labelling on plans is likely to be needed to identify this spatial function using floor-plans.
11.03	*Facilities are equipped with easily visible furniture and fittings that clearly express their use*		✓		
11.04	*There are display spaces for items to help stimulate memory. Observe: These are readily accessible to residents; they contain items of interest*		✓		
11.05	*There is imaginative use of techniques to make fire doors less obvious or to conceal areas where residents are denied access for safety reasons. Observe: Doors blended into colour schemes, with*		✓		

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
	lengths of skirting and handrails applied to them				
11.06	*There is evidence of respect for residents' ethnic, cultural and religious backgrounds. Observe: Space for prayers. If multicultural, no dominance of one particular religion's image*	✓			
11.07	*The doors to the toilet areas should have a consistent signature colour throughout the building.*		✓		
11.08	*The colour and tone of the toilet doors should contrast clearly with adjacent walls*		✓		
11.09	*The building has an overall domestic ambience. Observe: Small intimate scale of spaces and avoidance of clinical white décor.*	✓			The scale of spaces can be evaluated from plans, but decor is dependent on detailing, specification, and post-occupancy management.
11.10	*There is adequate storage for large items so that residents can bring in their own furniture and other possessions Check with staff what arrangements are made to store spare items of furniture.*	✓			Note - Storage rooms may be in another building nearby, so not shown on the main floor-plan drawing.
11.11	*There are plenty of clocks which are large and easy to understand*			✓	

	Dementia Design Audit Tool (Cunningham et al., 2011)	Plan	Detail	Manage	Comments/Notes
	Unit 11: Query Count	5	5	1	
	Query Items Totals by Unit				
Unit 1	*Entrance, corridors, wayfinding and lift*	13	38	5	
Unit 2	*Lounge area*	11	17	1	
Unit 3	*Dining room*	10	14	3	
Unit 4	*Meaningful occupation*	7	2	0	
Unit 5	*Examination room*	4	15	0	
Unit 6	*Hairdressing room*	5	11	0	
Unit 7	*Bedrooms*	6	26	5	
Unit 8	*En-Suite Provision*	3	32	3	
Unit 9	*Communal Toilets/Bathrooms*	1	37	1	
Unit 10	*External Areas*	29	30	5	
Unit 11	*General Principles*	5	5	1	
	Overall Question Count	94	227	24	

Notes on the Dementia Design Audit Tool:

- Each section in the DDAT tool concludes with a non-scoring query, as follows: 'Are any of the positive design features compromised by the observed use of space e.g. inappropriate storage, signs or windows covered, access obstructed? Whilst these enquiries help to reinforce the impact of management on environment quality, they are discounted for the purposes of this study due both to lack of direct relevance, as well as their non-scoring evaluation status.

- Unit 12 from the original tool is also omitted here. This non-scoring section asks the auditor to record examples of positive design features in the scheme not already identified in responses to the preceding formal design audit queries.

APPENDIX D: PLAN-EAT EVALUATION PROTOCOLS

Query no.	Plan-EAT query item	Protocols / Comments
DDP#1	SAFETY	
1.05	*Is the garden easily supervised from the point(s) where staff spend most of their time?*	Determining the likely location of staff during a floor-plan based evaluation requires some assumptions by the person undertaking the evaluation. Staff location can differ somewhat depending on the care model and staff ratios etc. to be employed in the environment being evaluated. For example, in traditional 'general' care settings, where the care model is based on the traditional medical or institutional model, staff will tend to be based in and around a formal Nurse Station. Conversely, In the more contemporary 'household' based care models, staff may not have a clear or fixed base to work from and are more likely to be located amongst residents, near common dining and lounge spaces, or around a resident-accessible kitchen area. Assumptions for evaluation based on drawings therefore respond to the drawn representations of spaces in combination with the labels provided for each space. Where possible, prior to Plan-EAT evaluations being undertaken, it would help to first determine the model of care in the environment to be evaluated.
1.13	*Is the lounge room easily supervised from the point(s) where the staff spend most of their time?*	See notes for query 1.05
DDP#2	HUMAN SCALE	
2.01	How many people live in the unit? [≤10 = 3 points / 10-15 = 2 points / 16-3- =1 point / >30 = 0 points]	
DDP#3	3: VISUAL ACCESS	
3.01	*What proportion of confused residents can see their bedroom door from the lounge room?*	For this evaluation item the resident's viewing point must be located completely with the main (largest or most central) lounge room. From there they should be able to see the bedroom door itself, or at least the wall space immediately adjacent to it, where a memory box, artwork, or other unique identifying feature could be

Query no.	Plan-EAT query item	Protocols / Comments
		located. For open-plan lounge spaces the notional line of enclosure (in plan) of the space should encompass all associated furniture indicated on drawings. An assumption is made that lounge, dining, other open-plan communal social spaces should not encroach into an adjacent space that might ordinarily be used for circulation. This space allowance should be it least similar in width to typical corridor widths throughout the overall unit. Any notional boundary line between open-plan lounge, kitchen, dining, or other communal spaces should remain consistent for the full duration of a single evaluation. (For the present research, a notional line of enclosure was superimposed on the floor-plan drawings for each part of all main open-plan communal social spaces).
3.02	*What proportion of confused residents can see the lounge room as soon as they leave their bedroom?*	The phrase "as soon as they leave…" is evaluated based on a floor area visible by a resident standing outside their bedroom, but who still have contact with the door handle. For consistency, during the current research, the view point is required to be within 1m x 1m square space immediately in front of the relevant bedroom door. Visibility to the largest or most centrally located lounge from this location (the same lounge as for other evaluation queries) must be into to the lounge room itself, or as a minimum to the surface of the lounge room door. Although many residential aged care units are provided with more than one lounge or sitting space, which can be valuable to residents, these secondary spaces are not considered as part of this evaluation item.
3.03	*What proportion of confused residents can see the dining room as soon as they leave their bedroom?*	This item is evaluated on the same basis as 3.02 above. Although it is acknowledged that the visibility to a domestic kitchen may trigger a similar benefit to wayfinding at a dining space, visibility to a kitchen is not formally accepted for the purposes of this evaluation item.
3.04	*Can the exit to the garden be seen from the lounge room? (If there is more than 1 lounge room*	The door leading to the garden should be visible from within a major lounge room. The availability of visibility to the garden, without clear visibility to the door as the means of getting there, is not considered enough to satisfy this evaluation item. For the purposes on floor-plan based evaluation, any door in the plan shown

Query no.	Plan-EAT query item	Protocols / Comments
	answer with reference to the one most used by most confused residents).	leading to the garden will be assumed to be glazed, or amongst adjacent glazed panels if they are indicated in the drawings. The door does not need to lead from the lounge directly into the garden, but it must be visible from at least 50% of the lounge room floor area. The means of getting to the door must be obvious for the resident.
3.05	*Can the dining room be seen into from the lounge room? (If there is more than 1 dining room or lounge room answer with reference to those used by most confused residents).*	The term to "be seen into" is assumed to require, as a minimum, for the resident to be able to see the parts of a space likely to contain the familiar three-dimensional objects likely to help residents understand the intended functional or social purpose of a space. For the dining room this requirement is the ability to clearly see at least one part of the space likely to contain a dining table and chair. Like other queries, this level of visibility is required to be available across at least 50% of the floor areas of the space where the viewer is located; in this case the main lounge room.
3.06	*Can the kitchen be seen into from the lounge room? (If there is more than 1 lounge room answer with reference to the one used by most confused residents).*	This query item requires the visibility of familiar features of the kitchen space from at 50% of the floor area of the lounge room. Features such as the kitchen sink, cooker, and main appliances will help recognition. There are follow-on requirements for these elements to be recognisable, coming within the domain of detailed design and specification. 'Integrated' kitchens, for example, where kitchen appliances are hidden behind cupboard doors, would not normally be helpful towards the goal of supporting people with dementia to independently find and use the kitchen. Plan information will not tend to include information about the style or aesthetic qualities of these features, but they will, where indicated, be assumed to be somewhat traditional in visual appearance. (e.g. recent inventions for a touch panels and induction hobs require caution).
3.07	*Can the kitchen be seen into from the dining room? (If there is more than 1 dining room answer with reference to the one used by most*	This query is approached in a similar manner as queries 3.05 and 3.06 above. Recognisable features of the kitchen must be visibly from at least 50% of the dining floor area.

Query no.	Plan-EAT query item	Protocols / Comments
	confused residents).	
3.08	*Can a toilet be seen from the dining room? (If there is more than 1 dining room answer with reference to the one used by most confused residents).*	Evaluated based on whether the door to the toilet space can be seen from a position inside the dining room. Scenarios where the resident is expected to take a few steps outside the door of the dining room, to see the toilet door, are not accepted.
3.09	*Can a toilet be seen from the lounge room? (If there is more than 1 lounge room answer with reference to the one used by most confused residents).*	The query is approached on the same basis as query 3.8 above. The toilet door must be visible to a resident positioned within the lounge room.
3.10	*Can the lounge room be seen into from the point(s) where staff spend most of their time?*	This query ideally requires some knowledge of the care model used in the setting, as the care model affects the likely locations of staff. Where either an openly accessible Kitchen, or Nurse Station is indicated, this is assumed to be the primary location where staff will spend their time. There is some consideration of likely movement patterns of staff beyond these specific spaces, but primarily limited to short distances between this location and some of the primary communal social spaces. Where neither a household kitchen or nurse station is indicated in drawings then evaluation is on case by case basis. See also the notes for query item 1.05. Evaluation is based on the relationship between the likely staff location(s) and the largest or most central resident lounge space.
DDP#4	STIMULUS REDUCTION FEATURES	
4.05	*Are deliveries of food, linen etc. taken across*	This item is evaluated by tracing the likely path(s) of delivery trollies from the service entry (or main entry where no service entry is present) to locations such as

Query no.	Plan-EAT query item	Protocols / Comments
	public areas such as the lounge or dining room?	the kitchen, and linen room. Movement along corridor spaces that run adjacent to resident social spaces is accepted, but movement that requires them to physically cross these spaces is not considered acceptable. Some degree of case-based evaluation is needed in some instances where the unit layout is on an open-plan basis.
4.07	*Is the front entry to the unit easily visible to the residents?*	In normal use, within the EAT, this query item allows for the exit door to be visually disguised. However, floor-plan information alone does not allow evaluation to consider this. Even where the door is disguised it is possible where residents can see people coming and going that the door becomes a source of confusion or distress. Plan-based evaluation therefore takes the stance of requiring complete absence of the entry door position from the most prominent areas visible from the main lounge, dining, kitchen, and primary circulation spaces This evaluation item presents a possible conflict with some of the latest practice in residential aged care where residents are permitted freedom to leave the unit and move through the rest of the facility. This is informed in part by the ongoing development of a human rights approach to residential care, but also enabled by recent technological developments which permit the use of wearable chips and sensors to provide control, and to provide alerts to staff where residents attempt to leave the overall facility. Considering this potential approach to managed care, it now becomes possible for visibility to the door to be a helpful feature encouraging residents to be more physically and socially active by regularly moving out of the strict confines of their own home unit.
4.08	*Is the service entry (where food, linen etc. is delivered to) easily visible to the residents?*	Evaluated on the basis that neither the external nor internal delivery access doors should be visible from any of the main social spaces, such as lounge room, dining room, kitchen, nor from the most commonly used circulation spaces between these elements, or leading and main bedroom areas.
DDP#5	HIGHLIGHT USEFUL STIMULI	
5.01	*Is the dining room looked into from the lounge room*	Signage is not normally indicated in any way on floor-plan drawings, so plan based evaluation for the Plan-EAT is based on the provision of a line of sight between the

Query no.	Plan-EAT query item	Protocols / Comments
	or clearly marked with a sign or symbol?	lounge room and dining room. Although signage is known to be helpful in wayfinding tasks for people living with dementia, research evidence suggests that direct visibility is much more effective for this purpose. Signage may help where direct vision is not possible, such as in existing buildings, and help to provide clarity of location where direct visibility exists.
5.02	*Is the lounge room either looked into from the dining room or clearly marked with a sign or symbol?*	Plan based evaluation will exclude signage as an optional solution to the query. See further notes on this at query 5.01 above
5.05	*Is the kitchen either looked into from the lounge or dining room or clearly marked with a sign or symbol?*	The term "looked into" is to be based on the same interpretation as the terms "seen into" from other queries (e.g.3.05, 3.06, 3.07). Some of the key features of the space that are likely to be recognised by residents to help them understand the function of the space, should be visible from at least 50% of the dining room, or at least 50% of the lounge room.
5.06	*Are toilets visible as soon as the toilet/bathroom door is opened?*	Sanitary-ware is usually indicated on architectural floor-plans but may sometimes be absent from simpler drawings. Where the space does not show the location of the toilet, evaluation will take an assumption that the space fails against this query, unless it is clear from the drawings that it impossible for the toilet not to be visible without entering the space, without the door being opened by more than 90 degrees, and where the shape of the space is such that it would not be possible to 'hide' the WC around a corner. Where there is a mix of compliant and non-compliant toilets, it is a requirement that a majority have enough visibility. This must include the communal spaces located closest to the main communal lounge and dining spaces. Where en-suite bathrooms are provided a majority of these must also comply to this query item.
5.07	*Is there a lot of natural lighting in the lounge room?*	Floor-plans typically show window and door widths, but it will not normally be possible to understand the full extent of glazing, and the extent to which they can admit natural light to the space, without additional drawings, such as elevations or section drawings to indicate heights of these items. Plans will not tend to confirm whether doors are glazed or not. In some cases,

Query no.	Plan-EAT query item	Protocols / Comments
		roof-light or clerestory (high level) windows may also be missing from the drawing information. Evaluations under this query make use of a rule of thumb threshold to determine whether natural light levels are likely to be enough. The Building Code of Australia requires glazing to a habitable space to be a minimum of 10% of the floor area. Based on an assumption that the average external opening is 1.2m high (say a 900mm high sill and 2100) and the loss of about 100mm glazing to solid framing items in every linear metre, each 1 linear meter of opening should provide about $1m^2$ of light-admitting glazing. To achieve a 10% glazing to floor area ratio then, the threshold for this item is set at a requirement for a minimum of one linear metre of wall opening for every ten square metres of floor area in the room. Where roof-light windows are indicated these can be assumed to offset glazing in the vertical plane at an area ratio of approximately 200% (significantly higher levels of natural is light is typically available through roof-lights windows).
DDP#6	WANDERING AND OUTDOOR SPACE	
6.1a	*Is there a clearly defined and easily accessible (i.e. no locked exit) path in the garden that guides the resident back to their starting point without taking them into a blind alley? (If answer to 1a is YES answer 1b,1c,1d,1e,1g and 1g)*	This evaluation item can accept paths which starts and end at different entry points to the building so long as there is an easy to follow internal passageway or corridor which takes the resident back to their original starting point. Where no path is indicated in floor-plan drawings then this item cannot be passed. Where the external space is of a size and shape to accommodate a path, then feedback to designers and building owners can include the advice to consider adding such a feature.
6.1b	*Does the external path allow the resident to see into areas that might invite participation in an appropriate*	Satisfying both the requirement to avoid 'blind alleys' and having ‘areas that might invite participation' requires some care in design. Presence of seating is a start, but in some cases (such as path ends or 'eddy’s') these would need to be turned to face a direction which gives the people living with dementia a viable direction of travel back to the main garden and /or main building.

Query no.	Plan-EAT query item	Protocols / Comments
	activity other than wandering?	See also the comments against query 6.1a above. Floor-plan evaluation must be based on what is indicated on drawings. If outside furniture is not shown, then no provision can be assumed. Evaluation assumes it being acceptable for paths to end at a different entry door that the start, if the internal path leads clearly back to the original starting point.
6.1c	*Is the path within a secure perimeter?*	The restriction of people living with dementia to accommodation located behind closed doors and within fenced enclosures is the subject of increasing criticism from ethical and human rights perspectives. However, this discourse is typically overridden by care organisations who prioritise perceived 'safety' and liability issues. Where fences are deemed necessary, there is a preference for these to be at the absolute perimeter to the overall facility, or at least that only the fences in locations adjacent to public parking or roads are secured. Reflecting what appears to be the most common manifestation of fencing in Australian residential aged care facilities, where a fence or wall is indicated on plans, it will be assumed to be a full height secure fence. Where no enclosure is represented, it will be assumed, for evaluation purposes, that none exists.
6.1d	*Can this path be easily and unobtrusively surveyed by staff members?*	This evaluation item depends on knowledge of assumptions where staff are likely to be located. Assumptions on likely staff locations, based on clues within the drawings are identified in the notes against query item 1.05. The path must be drawn and meet these requirements to pass. Where a path is not drawn, but the scale and size of the contained outdoor space is clearly visible to staff from their main areas of working then this can be a suggested design improvement for the designer and building owner.
6.1e	*Are there chairs or benches along the path where people can sit and enjoy the fresh air?*	Loose furniture placement in indoor spaces tends to be under control of staff management, but external furniture is often fixed in place according to design information. For floor-plan evaluations, garden seating must be shown on drawings, and will for the purposes of design evaluations be assumed to be kept in these positions. The furniture located on decks, roofs terraces

Query no.	Plan-EAT query item	Protocols / Comments
		etc. (where no path exists) can be considered to satisfy this query item.
6.1f	*Are there both sunny and shady areas along the path?*	For this item to be evaluated based on drawing alone, design information needs to identify the cardinal orientation of building and garden spaces together with global project location (esp. latitude). It needs to be assumed that drawings will indicate the presence, positions and sizes of any (mature) trees or shade structures that might contribute to this query. The item is evaluated based on allowing residents to choose between occupying either a sunny or a shaded space at any time of day (say between 9am-3pm). This item can be accepted if provided in a sufficient manner on roof decks or other outdoor spaces, if there is clear hard paved access to facilitate moving around the space.
6.1g	*Does the path take residents past a toilet?*	For purposes of the evaluation process, this query can be read alternatively as whether a toilet is visible to residents occupying the main outdoor spaces. It is assumed that the toilet must be directly accessible from the garden space, or available within a few short steps inside an obvious access door, or via a very short lobby space.
6.2a	*Is there a clearly defined path inside that takes the resident around furniture and back to their starting point without taking them into a blind alley? (If answer to 2a is YES answer 2b)*	This path could be apparent in floor-plans but will depend upon furniture being indicated in drawings where there are open-plan spaces, and on an assumption that furniture will be laid out the same way whilst in use as suggested in floor-plan drawings. In open plan settings a walkway around the edge of a larger group of common spaces and their associated furniture can be considered to satisfy this item.
6.2b	*Does the internal path allow the resident to see into areas that might invite participation in an appropriate activity other than wandering?*	Room labelling, and the indication of furniture in floor-plans is important information to evaluate this and many other items. Where furniture and other loose items are not indicated, then either room label or space design should make clear that it is intended to support meaningful activities. As per many audit items, there is also some reliance on care provider. They must ensure that supporting artefacts are provided in order to trigger and support

Query no.	Plan-EAT query item	Protocols / Comments
		various activities (e.g. newspapers, bird feed, books, games etc.).
DDP#7	FAMILIARITY	(This dementia design principle is omitted from Plan-EAT).
DDP#8	PRIVACY AND SOCIAL INTERACTION	
8.01	*Are there small areas (nooks) that provide opportunities for casual interaction and quiet chats?*	The provision of places to sit is important for the intended social functions to be supported appropriately. This assessment item requires the space for smaller places to sit, with either the relevant furniture indicated on drawings, or enough space for this along with a 'room' label to indicate this intended use. E.g. A cluster of chairs in a locally widened areas of a hallway or foyer spaces.
8.02	*How many of these areas or nooks have views of pleasant or interesting scenes (outside, the living room, the nursing station)?*	The EAT handbook suggests that artwork may be a suitable focus for these spaces. However, as per signage, artwork will not be indicated in floor-plans. However, with the volume of research evidence supporting the value of views to sky, landscape, and greenery, as well as the views to other pleasant spaces, floor-plan based evaluations will be based on the these. Wall fixed artwork cannot be considered as part of plan-based design evaluation. However, views to other spaces and 3d objects can be considered.
8.03	*Do the shared living areas support small group activities (4-6 people) without re-arranging the furniture?*	Appropriate furniture must be indicated to satisfy this evaluation item. At least some seating and table arrangements should support 4-6 people. Both larger groups (only) or several smaller groups (only) do not satisfy the audit item. If spaces are generously proportioned, to support this preferred furniture arrangement that supports group activities, without impacting other uses, then this can be accepted as meeting the evaluation item.
8.04	*Does the dining room provide opportunities for residents to eat in small groups (2-4)?*	This assessment scores based on furniture indicated on drawings, not the potential to add or modify to achieve this. If insufficient furniture information is provided on floor-plans, then evaluation should assume the layout is a 'fail'.
8.05	*Does the dining area provide opportunities for*	As 8.4 above. A comfortable surplus of seating and tables is required for this to be satisfied. Some degree of physical and visual separation should be possible so that the person dining alone has excess sensory information

Query no.	Plan-EAT query item	Protocols / Comments
	people to eat alone?	managed, but without completely removing the person from the overall communal area of the building (i.e. they do not need to resort to dining in their own bedroom).
DDP#9	LINKS TO COMMUNITY	
9.1	*Is there an area or room somewhat removed from the main dining room where families can share meals with their relatives? (If answer to 1 is YES answer 1a)*	It assumed that this should this be visually removed from main common rooms, even if physically adjacent [Possible additional 'negative' item to space visibility graph.] Family space must be physically, and preferably visually, separate space (not within main household dining / lounge spaces). This may potentially be located outside the immediate household, but within the overall building.
DDP#10	ORDINARY LIFE + DOMESTIC ACTIVITIES	
10.01	*Have access to a kitchen*	Plan evaluations will assume that if a room labelled 'Kitchen' is provided within a unit that, unless drawing design graphics suggest otherwise, that residents can access this at most times. Rooms labelled 'Servery' are assumed to be staff access only. They are expected only to occur in older facilities using traditional care practices. Only Kitchens and 'tea-stations' depicted as being open-plan to a common space such as a lounge or dining space, are deemed to be accessible to residents. A 'tea-station' may potentially allow residents to engage sufficiently in kitchen-based activities but to satisfy the requirements of this audit item the drawings are expected to indicate the provision of sink and basic cooking facilities. For the purposes of evaluation, a threshold of at least three linear metres of kitchen bench (including base unit sink and appliances) should be provided to ensure there is enough working space.
10.07	*Have constant and easy access to a lounge?*	It is assumed that common rooms are always generally left unlocked. Unless drawings indicate clearly to the contrary, the route to and access to doors of main lounge and dining spaces within each household are always assumed to remain unlocked to resident access.
10.08	*Have constant and easy access to a dining room?*	(As query no 10.07 above)

APPENDIX E: PARTICIPANT QUESTIONNAIRE AND CONSENT FORM

Prof. Mark Taylor
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NSW 2308, Australia
Tel: (02) 4921 5783
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Consent Form for the Research Project:
"An Analysis of Care Home Layouts:
Spatial Arrangements for People with Dementia"
Prof. Mark Taylor Prof. Tony Williams Mr Martin Quirke
Document Version 3; dated 07/08/2014

On behalf of my organisation, I freely consent to participation in the above research project.
I confirm that:

- I understand that the project will be conducted as described in the Information Statement, a copy of which I have retained.
- I agree to provide access to floor-plan drawings for above the named research project. I have indicated preferred means of doing so on the following page.
- I understand that information identifying my organisation's participation in this research will remain confidential to the researchers.
- I understand that the research team will endeavour to minimise any risk of our facility, consultants, employees or residents from being identifiable in reports or publications resulting from this research.
- I understand that my organisation can withdraw from the project at any time and do not have to give any reason for withdrawing, and I understand that withdrawal from this research will not affect the organisation's relationship with the University of Newcastle.
- I understand that my organisation may not benefit by participation in the project.
- I am aware that I can obtain copies of design assessment results about my facility as well as a copy of the final research report. I have indicated my preference on the following page.
- I have had the opportunity to have questions answered to my satisfaction.
- I am authorised to give this consent on behalf of the Residential Aged Care Facility named on the following page.

Print Name: ______________________________

Signature ______________________________ Date: ____________

Consent Form for the Research Project:
"An Analysis of Care Home Layouts:
Spatial Arrangements for People with Dementia"

(cont'd)

Please indicate preferred means of providing drawings to the researchers (choose one):

I/We will email □ Please collect □ OK to obtain from Council □

Please indicate if you would like to be provided with reports:

Results for your individual facility(s) □ Copy of the final research report □

Please identify the RACF you have consented for participation in the above research:

Care Organisation: ___________________________ Facility Name: ___________________________

Address: ____

Year of construction or major alterations (if known) _______________________________________

Please identify which of your RACF wings or units fit into the following categories:

Purpose-Built Dementia-Specific:	**Designated Dementia Unit:** i.e. Not Purpose-Built	**General Residential Care:**

Print Name: ____

Signature ____ Date: ________________

Position: ____ (e.g. Manager)

Email: ____

Telephone: ____

APPENDIX F: PLAN-EAT SCORES - NSW

Plan-EAT query no.	1.05	1.13	2.01	3.01	3.02	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.10	4.05	4.07	4.80	5.01	5.02	5.05	5.06	5.07	6.1a	6.1b	6.1c	6.1d	6.1e	6.1f	6.1g	6.2a	6.2b	8.01	8.02	8.03	8.04	8.05	9.01	10.01	10.07	10.08
Max points	**2**	**2**	**3**	**4**	**4**	**4**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**2**
Unit type:																																							
NSW#01	0	2	2	0	2	2	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1	0	1	1	3	3	2	2	1	1	0	2	2
NSW#02	0	0	0	2	2	2	1	1	0	0	0	0	0	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1	3	3	2	2	2	1	0	2	2
NSW#03	1	2	1	2	4	3	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	3	3	2	2	1	1	2	2	2
NSW#04	0	1	2	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	2	2	2	0	0	2	1
NSW#05	0	1	2	2	3	0	1	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	2	2	2	0	0	2	1
NSW#06	0	1	2	2	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
NSW#07	0	1	1	2	2	2	1	1	0	1	0	0	1	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	2	2
NSW#08	0	2	1	2	4	4	1	1	0	1	0	0	1	1	0	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	2	2
NSW#09	0	0	1	0	4	0	1	0	0	1	1	0	1	1	0	1	0	0	1	1	1	1	1	1	0	1	1	0	1	1	3	1	1	2	1	1	0	2	2
NSW#10	1	1	1	1	4	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	1	0	1	1	1	0	1	0	1	1	3	3	1	2	1	1	0	2	1
NSW#11	1	1	2	1	4	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	1	0	1	1	1	0	1	0	1	1	3	3	1	2	1	1	0	2	1
NSW#12	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	2	2	1	1	0	1	0	2	2
NSW#13	0	1	1	1	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	1	1	1	1	1	0	2	1
NSW#14	0	0	1	0	0	0	0	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	0	1	0	0	0	0	0	0	2	1	0	1	0	1	0	2	2
NSW#15	2	2	1	1	1	1	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	0	0	1	0	0	0	0	1	1	2	2	1	1	1	1	0	2	2
NSW#16	2	2	1	1	1	1	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	0	0	1	0	0	0	0	1	1	2	2	1	1	1	1	0	2	2
NSW#17	2	2	1	1	1	1	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	0	1	1	0	0	0	0	1	1	2	2	1	1	1	1	0	2	2
NSW#18	2	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	1	1	3	3	1	1	1	1	0	2	2
NSW#19	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	3	3	1	1	1	1	0	2	2
NSW#20	0	0	0	0	1	1	1	1	0	0	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	2	2
NSW#21	0	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	1	0	1	0	0	1	0	0	1	0	1	1	3	3	1	1	1	1	0	2	2
NSW#22	1	1	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0	0	0	0	1	0	0	1	2	2	1	1	1	1	2	2	2
NSW#23	0	0	0	0	0	0	1	1	0	1	0	0	1	1	0	0	1	1	1	1	1	0	0	1	1	0	1	0	0	1	3	2	2	2	2	1	0	2	2

Plan-EAT query no.	1.05	1.13	2.01	3.01	3.02	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.10	4.05	4.07	4.80	5.01	5.02	5.05	5.06	5.07	6.1a	6.1b	6.1c	6.1d	6.1e	6.1f	6.1g	6.2a	6.2b	8.01	8.02	8.03	8.04	8.05	9.01	10.01	10.07	10.08
Max points	**2**	**2**	**3**	**4**	**4**	**4**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**2**
Unit type:																																							
NSW#24	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2	1	1	1	1	1	1	2	2
NSW#25	0	0	2	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	2	1	1	1	1	1	1	2	2
NSW#26	0	0	3	0	0	3	1	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	2	1	1	1	1	1	1	2	2
NSW#27	1	2	2	1	1	0	1	1	1	1	0	1	1	1	0	0	1	1	1	1	1	1	0	1	0	0	1	0	0	0	2	2	1	1	1	1	2	2	2
NSW#28	1	2	2	0	0	0	1	1	1	1	0	1	1	1	0	0	1	1	1	1	1	1	0	1	0	0	1	0	0	0	2	2	1	1	1	1	2	2	2
NSW#29	1	2	2	0	0	0	1	1	1	1	0	0	1	1	0	0	1	1	1	1	1	1	0	1	0	0	1	0	0	0	2	2	1	1	1	1	2	2	2
NSW#30	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	1	1	3	3	2	2	2	1	2	2	2
NSW#31	2	2	0	0	0	0	1	1	0	1	1	1	1	1	0	0	1	1	1	1	1	0	0	1	1	0	0	0	1	1	3	3	2	2	2	1	2	2	2
NSW#32	0	1	2	0	0	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	0	1	0	0	1	1	3	2	2	1	1	1	0	2	2
NSW#33	0	1	2	0	0	0	0	1	1	1	1	1	1	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	1	3	2	2	1	1	1	0	2	2
NSW#34	1	2	2	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	0	0	1	2	1	1	1	1	1	0	2	2
NSW#35	1	2	1	2	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0	1	0	1	1	2	2	2	2	1	1	0	2	2
NSW#36	1	2	1	2	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	1	1	2	2	2	2	1	1	0	2	2
NSW#37	1	2	1	2	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	1	1	2	2	2	2	1	1	0	2	2
NSW#38	0	2	1	0	0	2	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	1	0	1	1	2	2	1	1	1	1	2	2	2
NSW#39	0	2	1	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	1	0	1	1	2	2	1	1	1	1	2	2	2
NSW#40	2	2	1	0	0	2	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0	1	1	0	0	0	1	1	2	2	1	1	1	1	2	2	2
NSW#41	2	2	1	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0	1	1	0	0	0	1	1	2	2	1	1	1	1	2	2	2
NSW#42	2	2	1	0	0	3	1	0	0	1	1	1	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	0	1	1	2	2	1	1	1	1	2	2	2
NSW#43	2	2	1	1	2	3	1	1	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	2	2	1	1	1	1	2	2	2
NSW#44	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	1	1	1	0	0	0	0	2	0
NSW#45	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	0	1	1	0	1	0	0	1	2	2	2	0	0	1	0	2	2
NSW#46	0	1	2	2	4	0	1	0	0	0	0	0	1	1	1	0	0	0	0	1	1	0	0	1	0	0	0	0	1	1	1	1	0	0	0	1	0	2	0
NSW#47	1	0	1	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	1	1	1	0	0	1	0	0	1	0	1	1	2	1	1	1	1	1	2	2	2

Plan-EAT query no.	1.05	1.13	2.01	3.01	3.02	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.10	4.05	4.07	4.80	5.01	5.02	5.05	5.06	5.07	6.1a	6.1b	6.1c	6.1d	6.1e	6.1f	6.1g	6.2a	6.2b	8.01	8.02	8.03	8.04	8.05	9.01	10.01	10.07	10.08
Max points	**2**	**2**	**3**	**4**	**4**	**4**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**2**
Unit type:																																							
NSW#48	2	2	2	0	0	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0	1	1	0	0	0	1	1	2	2	1	1	1	1	2	2	2
NSW#49	2	1	1	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0	1	1	1	1	1	1	1	0	1	0	1	1	2	2	1	1	1	1	2	2	2
NSW#50	2	1	3	4	4	1	1	1	0	0	0	0	1	1	0	0	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	2	2	2	1	0	2	2
NSW#51	0	2	1	2	3	3	1	1	1	1	0	0	1	0	1	0	1	1	1	0	1	0	0	1	0	0	1	0	1	1	1	1	2	2	2	1	2	2	2
NSW#52	0	2	1	2	3	3	1	1	1	1	0	0	1	0	1	0	1	1	1	0	1	0	1	0	0	1	1	0	1	1	1	1	2	2	2	1	2	2	2
NSW#53	0	2	1	1	2	3	1	1	1	1	0	0	1	0	1	0	1	1	1	0	1	0	0	1	0	0	1	0	1	1	2	2	2	2	2	1	2	2	2
NSW#54	0	2	2	3	3	3	1	1	1	1	0	0	1	0	1	0	1	1	1	0	1	0	1	0	0	0	1	0	1	1	2	2	2	2	2	1	2	2	2
NSW#55	0	2	2	2	2	3	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	0	0	1	0	0	1	0	0	0	1	1	2	2	2	1	2	2	2
NSW#56	0	2	1	2	2	3	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	1	1	2	2	2	1	2	2	2
NSW#57	0	2	2	0	0	0	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	1	1	2	2	0	0	0	1	2	2	2
NSW#58	1	2	2	0	0	0	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	1	1	2	2	0	0	0	1	2	2	2
NSW#59	1	1	2	0	0	0	0	0	0	1	1	0	1	0	1	1	0	0	1	0	0	1	1	1	1	1	1	0	1	1	3	3	2	2	2	1	2	2	2
NSW#60	1	1	2	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	2	2	0	0	0	1	2	2	2
NSW#61	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	2	1	1	1	1	0	0	2	2
NSW#62	0	0	1	0	4	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	2	1	1	1	1	0	0	2	2
NSW#63	0	0	1	0	4	0	1	0	0	1	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	2	1	1	1	1	0	0	2	2
NSW#64	0	0	1	0	4	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	2	1	1	2	1	0	0	2	2
NSW#65	0	2	1	1	1	1	1	1	1	1	0	1	1	0	0	0	1	1	1	1	1	0	0	0	0	0	1	0	0	0	2	2	1	1	1	0	2	2	2
NSW#66	0	0	0	2	2	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	2	1	1	1	1	0	2	2	2
NSW#67	0	1	1	1	1	1	0	1	1	1	1	0	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	0	2	2	2
NSW#68	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0
NSW#69	1	2	3	4	4	3	1	1	1	1	0	0	1	0	0	0	1	1	1	1	1	0	0	0	1	0	0	0	0	0	1	1	1	1	1	1	0	2	2
NSW#70	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
NSW#71	2	2	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	0	0	1	1	1	0	0	1	1	2	2	2	2	1	1	2	2	2

Plan-EAT query no.	1.05	1.13	2.01	3.01	3.02	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.10	4.05	4.07	4.80	5.01	5.02	5.05	5.06	5.07	6.1a	6.1b	6.1c	6.1d	6.1e	6.1f	6.1g	6.2a	6.2b	8.01	8.02	8.03	8.04	8.05	9.01	10.01	10.07	10.08
Max points	**2**	**2**	**3**	**4**	**4**	**4**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**2**
Unit type:																																							
NSW#72	2	2	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	2	2	2	2	1	1	2	2	2

APPENDIX G: PLAN-EAT DETAILED SCORES – INTERNATIONAL

Plan-EAT query no.	1.05	1.13	2.01	3.01	3.02	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.10	4.05	4.07	4.80	5.01	5.02	5.05	5.06	5.07	6.1a	6.1b	6.1c	6.1d	6.1e	6.1f	6.1g	6.2a	6.2b	8.01	8.02	8.03	8.04	8.05	9.01	10.01	10.07	10.08
Max. points	**2**	**2**	**3**	**4**	**4**	**4**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**2**
Unit type:																																							
INT#01	0	2	2	0	2	2	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1	0	1	1	3	3	2	2	1	1	0	2	2
INT#02	0	0	0	2	2	2	1	1	0	0	0	0	0	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1	3	3	2	2	2	1	0	2	2
INT#03	1	2	1	2	4	3	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	3	3	2	2	1	1	2	2	2
INT#04	0	1	2	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	2	2	2	0	0	2	1
INT#05	0	1	2	2	3	0	1	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	2	2	2	0	0	2	1
INT#06	0	1	2	2	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
INT#07	0	1	1	2	2	2	1	1	0	1	0	0	1	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	2	2
INT#08	0	2	1	2	4	4	1	1	0	1	0	0	1	1	0	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	2	2
INT#09	0	0	1	0	4	0	1	0	0	1	1	0	1	1	0	1	0	0	1	1	1	1	1	1	0	1	1	0	1	1	3	1	1	2	1	1	0	2	2
INT#10	1	1	1	1	4	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	1	0	1	1	1	0	1	0	1	1	3	3	1	2	1	1	0	2	1
INT#11	1	1	2	1	4	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	1	0	1	1	1	0	1	0	1	1	3	3	1	2	1	1	0	2	1
INT#12	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	2	2	1	1	0	1	0	2	2
INT#13	0	1	1	1	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	1	1	1	1	1	0	2	1

Plan-EAT query no.	1.05	1.13	2.01	3.01	3.02	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.10	4.05	4.07	4.80	5.01	5.02	5.05	5.06	5.07	6.1a	6.1b	6.1c	6.1d	6.1e	6.1f	6.1g	6.2a	6.2b	8.01	8.02	8.03	8.04	8.05	9.01	10.01	10.07	10.08
Max. points	**2**	**2**	**3**	**4**	**4**	**4**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**2**
Unit type:																																							
INT#14	0	0	1	0	0	0	0	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	0	1	0	0	0	0	0	0	2	1	0	1	0	1	0	2	2
INT#15	2	2	1	1	1	1	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	0	0	1	0	0	0	0	1	1	2	2	1	1	1	1	0	2	2
INT#16	2	2	1	1	1	1	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	0	0	1	0	0	0	0	1	1	2	2	1	1	1	1	0	2	2
INT#17	2	2	1	1	1	1	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	0	1	1	0	0	0	0	1	1	2	2	1	1	1	1	0	2	2
INT#18	2	2	0	0	1	0	1	1	1	1	0	0	1	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	1	1	3	3	1	1	1	1	0	2	2
INT#19	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	3	3	1	1	1	1	0	2	2
INT#20	0	0	0	0	1	1	1	1	0	0	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	2	2
INT#21	0	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	1	0	1	0	0	1	0	0	1	0	1	1	3	3	1	1	1	1	0	2	2
INT#22	1	1	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0	0	0	0	1	0	0	1	2	2	1	1	1	1	2	2	2
INT#23	0	0	0	0	0	0	1	1	0	1	0	0	1	1	0	0	1	1	1	1	1	0	0	1	1	0	1	0	0	1	3	2	2	2	2	1	0	2	2
INT#24	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2	1	1	1	1	1	1	2	2
INT#25	0	0	2	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	2	1	1	1	1	1	1	2	2
INT#26	0	0	3	0	0	3	1	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	2	1	1	1	1	1	1	2	2
INT#27	0	2	2	4	4	4	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	2	1	2	1	1	1	2	2	2
INT#28	2	2	2	3	3	3	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	3	3	2	2	2	0	2	2	2
INT#29	2	2	3	4	4	4	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	0	0	0	1	0	1	1	0	1	1	1	1	1	1	0	1	2	2
INT#30	2	2	3	1	2	2	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	2	2	2	2	1	1	2	2	2
INT#31	2	2	2	1	2	2	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	2	2	1	1	1	1	2	2	2
INT#32	1	2	1	1	1	0	1	0	0	0	1	0	1	1	0	1	0	0	0	0	1	0	1	1	1	1	1	0	1	1	2	2	2	2	1	0	0	2	2
INT#33	0	2	3	1	4	0	1	1	1	1	0	1	1	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1	1	2	2	1	1	1	1	2	2	2
INT#34	0	2	0	3	3	3	0	1	0	0	1	1	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1	2	2	1	2	0	0	0	2	2
INT#35	1	1	2	0	0	1	1	1	0	0	1	1	1	1	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	3	3	2	1	1	1	2	2	2
INT#36	1	1	2	0	0	1	1	1	0	0	1	1	1	1	0	0	1	1	0	1	1	1	1	1	1	1	1	0	1	1	3	3	2	1	1	1	2	2	2

APPENDIX H: PLAN-EAT SUMMARY SCORES – NSW

	Dementia design principles point-score totals										**Plan-EAT scores (%) by dementia design principles**										
	DDP #1	**DDP #2**	**DDP #3**	**DDP #4**	**DDP #5**	**DDP #6**	**DDP #8**	**DDP #9**	**DDP #10**	**O/A**	**DDP #1**	**DDP #2**	**DDP #3**	**DDP #4**	**DDP #5**	**DDP #6**	**DDP #8**	**DDP #9**	**DDP #10**	**Plan-EAT**	**Type Rank**
Max. points	**4**	**3**	**19**	**3**	**5**	**9**	**12**	**1**	**6**	**62**											
NSW Avg.*[32]	1.9	1.2	7.6	1.3	3.7	3.3	7.3	0.8	4.8	31.9	46.7%	40.0%	40.2%	42.2%	74.0%	37.0%	61.2%	77.8%	79.3%	55.4%	
NSW Med*	2	1	8	1	4	3	7	1	4	34	50.0%	33.3%	42.1%	33.3%	80.0%	33.3%	58.3%	100%	66.7%	60.0%	
SD*	1.4	0.7	3.9	1.0	1.2	2.2	2.5	0.4	1.2	9.7	35.6%	23.5%	20.6%	32.3%	23.9%	24.2%	21.1%	41.8%	20.5%	16.9%	
NSW#01	2	2	8	3	4	6	11	1	4	41	50.0%	66.7%	42.1%	100%	80.0%	66.7%	91.7%	100%	66.7%	73.8%	16
NSW#02	0	0	8	2	3	2	12	1	4	32	0.0%	0.0%	42.1%	66.7%	60.0%	22.2%	100%	100%	66.7%	50.9%	76
NSW#03	3	1	14	3	5	7	11	1	6	51	75.0%	33.3%	73.7%	100%	100%	77.8%	91.7%	100%	100%	83.5%	2
NSW#04	1	2	4	0	2	0	8	0	3	20	25.0%	66.7%	21.1%	0.0%	40.0%	0.0%	66.7%	0.0%	50.0%	29.9%	101
NSW#05	1	2	8	1	2	0	8	0	3	25	25.0%	66.7%	42.1%	33.3%	40.0%	0.0%	66.7%	0.0%	50.0%	36.0%	95
NSW#06	1	2	5	1	1	0	1	0	2	13	25.0%	66.7%	26.3%	33.3%	20.0%	0.0%	8.3%	0.0%	33.3%	23.7%	106
NSW#07	1	1	10	0	5	1	3	0	4	25	25.0%	33.3%	52.6%	0.0%	100%	11.1%	25.0%	0.0%	66.7%	34.9%	96
NSW#08	2	1	14	1	5	1	3	0	4	31	50.0%	33.3%	73.7%	33.3%	100%	11.1%	25.0%	0.0%	66.7%	43.7%	85
NSW#09	0	1	8	2	3	7	8	1	4	34	0.0%	33.3%	42.1%	66.7%	60.0%	77.8%	66.7%	100%	66.7%	57.0%	66
NSW#10	2	1	8	2	3	6	10	1	3	36	50.0%	33.3%	42.1%	66.7%	60.0%	66.7%	83.3%	100%	50.0%	61.3%	56
NSW#11	2	2	8	2	3	6	10	1	3	37	50.0%	66.7%	42.1%	66.7%	60.0%	66.7%	83.3%	100%	50.0%	65.0%	43
NSW#12	1	0	3	1	2	1	6	1	4	19	25.0%	0.0%	15.8%	33.3%	40.0%	11.1%	50.0%	100%	66.7%	38.0%	92
NSW#13	1	1	4	1	2	0	6	1	3	19	25.0%	33.3%	21.1%	33.3%	40.0%	0.0%	50.0%	100%	50.0%	39.2%	90
NSW#14	0	1	4	0	4	1	4	1	4	19	0.0%	33.3%	21.1%	0.0%	80.0%	11.1%	33.3%	100%	66.7%	38.4%	91
NSW#15	4	1	8	1	5	3	7	1	4	34	100%	33.3%	42.1%	33.3%	100%	33.3%	58.3%	100%	66.7%	63.0%	53

[32] *Average, median, and standard deviation values are calculated across the full set of ninety (n=90) directly recruited NSW-based residential aged care units, and account for the repeat occurrences of several unit types.

	Dementia design principles point-score totals										Plan-EAT scores (%) by dementia design principles										
	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	O/A	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT	Type Rank
Max. points	**4**	**3**	**19**	**3**	**5**	**9**	**12**	**1**	**6**	**62**											
NSW#16	4	1	8	1	5	3	7	1	4	34	100%	33.3%	42.1%	33.3%	100%	33.3%	58.3%	100%	66.7%	63.0%	54
NSW#17	4	1	8	1	5	4	7	1	4	35	100%	33.3%	42.1%	33.3%	100%	44.4%	58.3%	100%	66.7%	64.2%	49
NSW#18	4	0	6	0	5	3	9	1	4	32	100%	0.0%	31.6%	0.0%	100%	33.3%	75.0%	100%	66.7%	56.3%	68
NSW#19	0	0	6	1	3	2	9	1	4	26	0.0%	0.0%	31.6%	33.3%	60.0%	22.2%	75.0%	100%	66.7%	43.2%	86
NSW#20	0	0	6	1	2	1	5	0	4	19	0.0%	0.0%	31.6%	33.3%	40.0%	11.1%	41.7%	0.0%	66.7%	24.9%	104
NSW#21	0	0	3	1	2	4	9	1	4	24	0.0%	0.0%	15.8%	33.3%	40.0%	44.4%	75.0%	100%	66.7%	41.7%	87
NSW#22	2	0	9	0	5	2	7	1	6	32	50.0%	0.0%	47.4%	0.0%	100%	22.2%	58.3%	100%	100%	53.1%	72
NSW#23	0	0	4	1	5	4	11	1	4	30	0.0%	0.0%	21.1%	33.3%	100%	44.4%	91.7%	100%	66.7%	50.8%	77
NSW#24	0	1	1	1	1	1	6	1	5	17	0.0%	33.3%	5.3%	33.3%	20.0%	11.1%	50.0%	100%	83.3%	37.4%	94
NSW#25	0	2	2	1	3	1	6	1	5	21	0.0%	66.7%	10.5%	33.3%	60.0%	11.1%	50.0%	100%	83.3%	46.1%	83
NSW#26	0	3	4	1	3	1	6	1	5	24	0.0%	100%	21.1%	33.3%	60.0%	11.1%	50.0%	100%	83.3%	51.0%	75
NSW#27	3	2	8	1	5	3	7	1	6	36	75.0%	66.7%	42.1%	33.3%	100%	33.3%	58.3%	100%	100%	67.6%	33
NSW#28	3	2	6	1	5	3	7	1	6	34	75.0%	66.7%	31.6%	33.3%	100%	33.3%	58.3%	100%	100%	66.5%	39
NSW#29	3	2	5	1	5	3	7	1	6	33	75.0%	66.7%	26.3%	33.3%	100%	33.3%	58.3%	100%	100%	65.9%	40
NSW#30	0	0	2	2	3	2	12	1	6	28	0.0%	0.0%	10.5%	66.7%	60.0%	22.2%	100%	100%	100%	51.0%	74
NSW#31	4	0	6	1	5	4	12	1	6	39	100%	0.0%	31.6%	33.3%	100%	44.4%	100%	100%	100%	67.7%	32
NSW#32	1	2	7	1	4	6	9	1	4	35	25.0%	66.7%	36.8%	33.3%	80.0%	66.7%	75.0%	100%	66.7%	61.1%	57
NSW#33	1	2	6	1	4	2	9	1	4	30	25.0%	66.7%	31.6%	33.3%	80.0%	22.2%	75.0%	100%	66.7%	55.6%	69
NSW#34	3	2	10	0	4	7	6	1	4	37	75.0%	66.7%	52.6%	0.0%	80.0%	77.8%	50.0%	100%	66.7%	63.2%	52
NSW#35	3	1	15	3	4	5	9	1	4	45	75.0%	33.3%	78.9%	100%	80.0%	55.6%	75.0%	100%	66.7%	73.8%	16
NSW#36	3	1	15	3	5	5	9	1	4	46	75.0%	33.3%	78.9%	100%	100%	55.6%	75.0%	100%	66.7%	76.1%	9
NSW#37	3	1	15	3	5	5	9	1	4	46	75.0%	33.3%	78.9%	100%	100%	55.6%	75.0%	100%	66.7%	76.1%	9
NSW#38	2	1	9	0	5	4	7	1	6	35	50.0%	33.3%	47.4%	0.0%	100%	44.4%	58.3%	100%	100%	59.3%	60
NSW#39	2	1	9	0	5	4	7	1	6	35	50.0%	33.3%	47.4%	0.0%	100%	44.4%	58.3%	100%	100%	59.3%	61
NSW#40	4	1	9	0	5	4	7	1	6	37	100%	33.3%	47.4%	0.0%	100%	44.4%	58.3%	100%	100%	64.8%	44

	Dementia design principles point-score totals										Plan-EAT scores (%) by dementia design principles										
	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	O/A	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT	Type Rank
Max. points	**4**	**3**	**19**	**3**	**5**	**9**	**12**	**1**	**6**	**62**											
NSW#41	4	1	9	0	5	4	7	1	6	37	100%	33.3%	47.4%	0.0%	100%	44.4%	58.3%	100%	100%	64.8%	44
NSW#42	4	1	7	0	3	4	7	1	6	33	100%	33.3%	36.8%	0.0%	60.0%	44.4%	58.3%	100%	100%	59.2%	62
NSW#43	4	1	12	0	2	4	7	1	6	37	100%	33.3%	63.2%	0.0%	40.0%	44.4%	58.3%	100%	100%	59.9%	59
NSW#44	0	2	0	1	2	2	3	0	2	12	0.0%	66.7%	0.0%	33.3%	40.0%	22.2%	25.0%	0.0%	33.3%	24.5%	105
NSW#45	1	1	2	1	3	4	6	1	4	23	25.0%	33.3%	10.5%	33.3%	60.0%	44.4%	50.0%	100%	66.7%	47.0%	82
NSW#46	1	2	8	2	2	3	2	1	2	23	25.0%	66.7%	42.1%	66.7%	40.0%	33.3%	16.7%	100%	33.3%	47.1%	81
NSW#47	1	1	3	1	3	4	6	1	6	26	25.0%	33.3%	15.8%	33.3%	60.0%	44.4%	50.0%	100%	100%	51.3%	73
NSW#48	4	2	7	0	5	4	7	1	6	36	100%	66.7%	36.8%	0.0%	100%	44.4%	58.3%	100%	100%	67.4%	35
NSW#49	3	1	4	0	3	7	7	1	6	32	75.0%	33.3%	21.1%	0.0%	60.0%	77.8%	58.3%	100%	100%	58.4%	63
NSW#50	3	3	12	1	3	2	6	1	4	35	75.0%	100%	63.2%	33.3%	60.0%	22.2%	50.0%	100%	66.7%	63.4%	51
NSW#51	2	1	13	1	4	4	8	1	6	40	50.0%	33.3%	68.4%	33.3%	80.0%	44.4%	66.7%	100%	100%	64.0%	50
NSW#52	2	1	13	1	4	5	8	1	6	41	50.0%	33.3%	68.4%	33.3%	80.0%	55.6%	66.7%	100%	100%	65.3%	42
NSW#53	2	1	11	1	4	4	10	1	6	40	50.0%	33.3%	57.9%	33.3%	80.0%	44.4%	83.3%	100%	100%	64.7%	46
NSW#54	2	2	14	1	4	4	10	1	6	44	50.0%	66.7%	73.7%	33.3%	80.0%	44.4%	83.3%	100%	100%	70.2%	26
NSW#55	2	2	12	3	4	2	8	1	6	40	50.0%	66.7%	63.2%	100%	80.0%	22.2%	66.7%	100%	100%	72.1%	21
NSW#56	2	1	12	3	4	1	8	1	6	38	50.0%	33.3%	63.2%	100%	80.0%	11.1%	66.7%	100%	100%	67.1%	37
NSW#57	2	2	6	2	3	3	4	1	6	29	50.0%	66.7%	31.6%	66.7%	60.0%	33.3%	33.3%	100%	100%	60.2%	58
NSW#58	3	2	6	2	3	3	4	1	6	30	75.0%	66.7%	31.6%	66.7%	60.0%	33.3%	33.3%	100%	100%	63.0%	55
NSW#59	2	2	3	2	1	8	12	1	6	37	50.0%	66.7%	15.8%	66.7%	20.0%	88.9%	100%	100%	100%	67.6%	34
NSW#60	2	2	1	1	1	3	4	1	6	21	50.0%	66.7%	5.3%	33.3%	20.0%	33.3%	33.3%	100%	100%	49.1%	78
NSW#61	0	1	3	1	3	2	6	0	4	20	0.0%	33.3%	15.8%	33.3%	60.0%	22.2%	50.0%	0.0%	66.7%	31.3%	100
NSW#62	0	1	6	1	3	2	6	0	4	23	0.0%	33.3%	31.6%	33.3%	60.0%	22.2%	50.0%	0.0%	66.7%	33.0%	99
NSW#63	0	1	7	1	3	2	6	0	4	24	0.0%	33.3%	36.8%	33.3%	60.0%	22.2%	50.0%	0.0%	66.7%	33.6%	98
NSW#64	0	1	6	1	3	2	7	0	4	24	0.0%	33.3%	31.6%	33.3%	60.0%	22.2%	58.3%	0.0%	66.7%	33.9%	97
NSW#65	2	1	9	0	5	1	7	0	6	31	50.0%	33.3%	47.4%	0.0%	100%	11.1%	58.3%	0.0%	100%	44.5%	84

	Dementia design principles point-score totals										Plan-EAT scores (%) by dementia design principles										
	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	O/A	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT	Type Rank
Max. points	**4**	**3**	**19**	**3**	**5**	**9**	**12**	**1**	**6**	**62**											
NSW#66	0	0	7	0	3	0	6	0	6	22	0.0%	0.0%	36.8%	0.0%	60.0%	0.0%	50.0%	0.0%	100%	27.4%	102
NSW#67	1	1	8	0	4	0	7	0	6	27	25.0%	33.3%	42.1%	0.0%	80.0%	0.0%	58.3%	0.0%	100%	37.6%	93
NSW#68	0	1	3	0	2	0	1	0	2	9	0.0%	33.3%	15.8%	0.0%	40.0%	0.0%	8.3%	0.0%	33.3%	14.5%	108
NSW#69	3	3	16	0	5	1	5	1	4	38	75.0%	100%	84.2%	0.0%	100%	11.1%	41.7%	100%	66.7%	64.3%	48
NSW#70	0	0	1	1	4	0	0	0	4	10	0.0%	0.0%	5.3%	33.3%	80.0%	0.0%	0.0%	0.0%	66.7%	20.6%	107
NSW#71	4	1	9	2	5	5	9	1	6	42	100%	33.3%	47.4%	66.7%	100%	55.6%	75.0%	100%	100%	75.3%	12
NSW#72	4	1	9	2	5	8	9	1	6	45	100%	33.3%	47.4%	66.7%	100%	88.9%	75.0%	100%	100%	79.0%	4

APPENDIX J: PLAN-EAT SUMMARY SCORES – INTERNATIONAL

	Dementia design principles point-score totals										Plan-EAT scores (%) by dementia design principles										
	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	O/A Points	DDP #1	DDP 2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT	Type rank
Max points	**4**	**3**	**19**	**3**	**5**	**9**	**12**	**1**	**6**	**62**											
INT Avg.*[33]	2.9	2.0	10.6	1.5	4.1	5.0	7.2	0.8	5.5	39.5	72.6%	66.7%	55.7%	48.9%	81.1%	55.8%	60.0%	84.0%	91.1%	68.4%	
INT Med*	3	2	10	2	4	6	7	1	6	39.5	75.0%	66.7%	52.6%	66.7%	80.0%	66.7%	58.3%	100%	100%	74.0%	
SD*	1.0	1.0	4.6	0.8	1.0	2.4	2.1	0.4	1.1	7.2	25.4%	32.8%	24.3%	27.1%	20.8%	26.8%	17.1%	36.8%	18.4%	13.6%	
INT#01	3	0	4	2	2	5	9	1	4	30	75.0%	0.0%	21.1%	66.7%	40.0%	55.6%	75.0%	100%	66.7%	73.8%	70
INT#02	1	0	2	1	3	6	8	1	4	26	25.0%	0.0%	10.5%	33.3%	60.0%	66.7%	66.7%	100%	66.7%	50.9%	80
INT#03	4	0	7	2	5	7	11	1	5	42	100%	0.0%	36.8%	66.7%	100%	77.8%	91.7%	100%	83.3%	83.5%	19
INT#04	4	1	9	2	5	4	11	1	6	43	100%	33.3%	47.4%	66.7%	100%	44.4%	91.7%	100%	100%	29.9%	11
INT#05	4	1	10	1	4	8	7	1	5	41	100%	33.3%	52.6%	33.3%	80.0%	88.9%	58.3%	100%	83.3%	36.0%	27
INT#06	4	2	10	1	4	8	7	1	5	42	100%	66.7%	52.6%	33.3%	80.0%	88.9%	58.3%	100%	83.3%	23.7%	18
INT#07	4	1	10	1	4	8	7	1	5	41	100%	33.3%	52.6%	33.3%	80.0%	88.9%	58.3%	100%	83.3%	34.9%	27
INT#08	4	1	15	1	4	3	6	0	6	40	100%	33.3%	78.9%	33.3%	80.0%	33.3%	50.0%	0.0%	100%	43.7%	67
INT#09	3	2	3	3	2	6	12	1	5	37	75.0%	66.7%	15.8%	100%	40.0%	66.7%	100%	100%	83.3%	57.0%	22
INT#10	2	1	10	3	3	8	10	1	6	44	50.0%	33.3%	52.6%	100%	60.0%	88.9%	83.3%	100%	100%	61.3%	15
INT#11	1	2	12	0	2	4	9	1	6	37	25.0%	66.7%	63.2%	0.0%	40.0%	44.4%	75.0%	100%	100%	65.0%	65
INT#12	3	3	6	2	5	6	7	1	6	39	75.0%	100%	31.6%	66.7%	100%	66.7%	58.3%	100%	100%	38.0%	6
INT#13	2	2	9	2	5	6	7	0	4	37	50.0%	66.7%	47.4%	66.7%	100%	66.7%	58.3%	0.0%	66.7%	39.2%	64
INT#14	3	1	16	1	5	2	4	1	6	39	75.0%	33.3%	84.2%	33.3%	100%	22.2%	33.3%	100%	100%	38.4%	47
INT#15	3	1	16	1	5	7	4	1	6	44	75.0%	33.3%	84.2%	33.3%	100%	77.8%	33.3%	100%	100%	63.0%	24

[33] Average, median, and standard deviation values are calculated across the full set of ninety-four (n=94) international residential aged care units, and account for the repeat occurrences of several unit types.

	Dementia design principles point-score totals										Plan-EAT scores (%) by dementia design principles										
	DDP #1	DDP #2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	O/A Points	DDP #1	DDP 2	DDP #3	DDP #4	DDP #5	DDP #6	DDP #8	DDP #9	DDP #10	Plan-EAT	Type rank
Max points	**4**	**3**	**19**	**3**	**5**	**9**	**12**	**1**	**6**	**62**											
INT#16	3	2	17	0	4	2	8	1	6	43	75.0%	66.7%	89.5%	0.0%	80.0%	22.2%	66.7%	100%	100%	55.5%	38
INT#17	4	2	15	1	5	3	5	1	6	42	100%	66.7%	78.9%	33.3%	100%	33.3%	41.7%	100%	100%	47.7%	20
INT#18	3	3	18	2	4	3	6	1	6	46	75.0%	100%	94.7%	66.7%	80.0%	33.3%	50.0%	100%	100%	72.9%	5
INT#19	1	1	8	1	2	0	4	0	2	19	25.0%	33.3%	42.1%	33.3%	40.0%	0.0%	33.3%	0.0%	33.3%	75.9%	103
INT#20	1	1	8	1	2	2	4	1	2	22	25.0%	33.3%	42.1%	33.3%	40.0%	22.2%	33.3%	100%	33.3%	70.0%	88
INT#21	4	3	16	0	4	5	7	1	6	46	100%	100%	84.2%	0.0%	80.0%	55.6%	58.3%	100%	100%	73.7%	12
INT#22	4	3	16	0	4	5	7	1	6	46	100%	100%	84.2%	0.0%	80.0%	55.6%	58.3%	100%	100%	70.0%	12
INT#23	4	2	7	2	3	7	10	1	6	42	100%	66.7%	36.8%	66.7%	60.0%	77.8%	83.3%	100%	100%	56.5%	8
INT#24	1	1	3	3	3	1	8	1	4	25	25.0%	33.3%	15.8%	100%	60.0%	11.1%	66.7%	100%	66.7%	71.9%	71
INT#25	1	1	15	2	3	3	11	1	6	43	25.0%	33.3%	78.9%	66.7%	60.0%	33.3%	91.7%	100%	100%	74.2%	41
INT#26	4	2	9	2	4	4	12	0	6	43	100%	66.7%	47.4%	66.7%	80.0%	44.4%	100%	0.0%	100%	57.1%	36
INT#27	2	2	17	2	4	0	7	1	6	41	50.0%	66.7%	89.5%	66.7%	80.0%	0.0%	58.3%	100%	100%	77.6%	31
INT#28	4	2	16	2	5	7	12	0	6	54	100%	66.7%	84.2%	66.7%	100%	77.8%	100%	0.0%	100%	58.0%	7
INT#29	4	3	19	2	4	4	5	0	5	46	100%	100%	100%	66.7%	80.0%	44.4%	41.7%	0.0%	83.3%	64.6%	30
INT#30	4	3	12	2	4	8	9	1	6	49	100%	100%	63.2%	66.7%	80.0%	88.9%	75.0%	100%	100%	70.8%	1
INT#31	4	2	12	2	4	8	7	1	6	46	100%	66.7%	63.2%	66.7%	80.0%	88.9%	58.3%	100%	100%	66.7%	3
INT#32	3	1	5	2	1	7	9	0	4	32	75.0%	33.3%	26.3%	66.7%	20.0%	77.8%	75.0%	0.0%	66.7%	72.7%	79
INT#33	2	3	11	1	5	2	7	1	6	38	50.0%	100%	57.9%	33.3%	100%	22.2%	58.3%	100%	100%	77.7%	29
INT#34	2	0	13	1	3	2	7	0	4	32	50.0%	0.0%	68.4%	33.3%	60.0%	22.2%	58.3%	0.0%	66.7%	26.7%	89
INT#35	2	2	6	1	4	9	10	1	6	41	50.0%	66.7%	31.6%	33.3%	80.0%	100%	83.3%	100%	100%	40.3%	23
INT#36	2	2	6	1	4	8	10	1	6	40	50.0%	66.7%	31.6%	33.3%	80.0%	88.9%	83.3%	100%	100%	75.3%	25

APPENDIX K: KEY ATTRIBUTES – NSW UNITS

Unit Type:	Unit name	No. of units/type	Year	Unit floor area (m^2)*	Bed-spaces/unit	Area/resident (m^2)	Ground/upper (G/U)	Purpose-built? (Y/N)	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT	O/A Plan-EAT rank (NSW & Intl.)
NSW#01	(Anon.)	2	2007	1017	15	67.8	G	Y	50%	67%	42%	100%	80%	67%	92%	100%	67%	73.8%	16
NSW#02	(Anon.)	1	1990	1766	30	58.9	G	N	0%	0%	42%	67%	60%	22%	100%	100%	67%	50.9%	76
NSW#03	(Anon.)	4	2016	985	21	46.9	G	Y	75%	33%	74%	100%	100%	78%	92%	100%	100%	83.5%	2
NSW#04	(Anon.)	1	2009	1163	19	61.2	U	N	25%	67%	21%	0%	40%	0%	67%	0%	50%	29.9%	101
NSW#05	(Anon.)	1	2009	1206	21	57.4	U	N	25%	67%	42%	33%	40%	0%	67%	0%	50%	36.0%	95
NSW#06	(Anon.)	1	2009	738	12	61.5	U	N	25%	67%	26%	33%	20%	0%	8%	0%	33%	23.7%	106
NSW#07	(Anon.)	1	2009	728	12	60.7	G	N	25%	33%	53%	0%	100%	11%	25%	0%	67%	34.9%	96
NSW#08	(Anon.)	1	2009	795	10	79.5	G	N	50%	33%	74%	33%	100%	11%	25%	0%	67%	43.7%	85
NSW#09	(Anon.)	1	2006	1221	17	71.8	G	Y	0%	33%	42%	67%	60%	78%	67%	100%	67%	57.0%	66
NSW#10	(Anon.)	3	2006	898	16	56.1	G	N	50%	33%	42%	67%	60%	67%	83%	100%	50%	61.3%	56
NSW#11	(Anon.)	1	2006	878	15	58.5	G	N	50%	67%	42%	67%	60%	67%	83%	100%	50%	65.0%	43
NSW#12	(Anon.)	1	1970	1257	31	40.5	U	N	25%	0%	16%	33%	40%	11%	50%	100%	67%	38.0%	92
NSW#13	(Anon.)	1	1970	1128	24	47.0	G	N	25%	33%	21%	33%	40%	0%	50%	100%	50%	39.2%	90
NSW#14	(Anon.)	1	1970	838	17	49.3	U	N	0%	33%	21%	0%	80%	11%	33%	100%	67%	38.4%	91
NSW#15	(Anon.)	2	2007	1035	16	64.7	G	Y	100%	33%	42%	33%	100%	33%	58%	100%	67%	63.0%	53
NSW#16	(Anon.)	1	2007	1072	18	59.6	G	Y	100%	33%	42%	33%	100%	33%	58%	100%	67%	63.0%	54
NSW#17	(Anon.)	1	2007	1067	18	59.3	G	Y	100%	33%	42%	33%	100%	44%	58%	100%	67%	64.2%	49
NSW#18	(Anon.)	1	2007	1410	32	44.1	G	N	100%	0%	32%	0%	100%	33%	75%	100%	67%	56.3%	68
NSW#19	(Anon.)	1	1975	1395	39	35.8	U	N	0%	0%	32%	33%	60%	22%	75%	100%	67%	43.2%	86
NSW#20	(Anon.)	1	1975	1032	40	25.8	G	N	0%	0%	32%	33%	40%	11%	42%	0%	67%	24.9%	104

Unit Type:	Unit name	No. of units/type	Year	Unit floor area (m^2)*	Bed-spaces/unit	Area/resident (m^2)	Ground/upper (G/U)	Purpose-built? (Y/N)	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT	O/A Plan-EAT rank (NSW & Intl.)
NSW#21	(Anon.)	1	1987	2018	47	42.9	G	N	0%	0%	16%	33%	40%	44%	75%	100%	67%	41.7%	87
NSW#22	(Anon.)	1	1987	2370	73	32.5	G	N	50%	0%	47%	0%	100%	22%	58%	100%	100%	53.1%	72
NSW#23	(Anon.)	1	2003	2489	46	54.1	G	N	0%	0%	21%	33%	100%	44%	92%	100%	67%	50.8%	77
NSW#24	(Anon.)	1	2003	909	16	56.8	U	N	0%	33%	5%	33%	20%	11%	50%	100%	83%	37.4%	94
NSW#25	(Anon.)	1	2003	817	14	58.4	U	N	0%	67%	11%	33%	60%	11%	50%	100%	83%	46.1%	83
NSW#26	(Anon.)	1	2003	834	10	83.4	G	N	0%	100%	21%	33%	60%	11%	50%	100%	83%	51.0%	75
NSW#27	(Anon.)	1	2002	991	14	70.8	G	N	75%	67%	42%	33%	100%	33%	58%	100%	100%	67.6%	33
NSW#28	(Anon.)	2	2002	994	14	71.0	G	N	75%	67%	32%	33%	100%	33%	58%	100%	100%	66.5%	39
NSW#29	(Anon.)	1	2002	958	13	73.7	G	N	75%	67%	26%	33%	100%	33%	58%	100%	100%	65.9%	40
NSW#30	(Anon.)	1	2002	3304	45	73.4	U	N	0%	0%	11%	67%	60%	22%	100%	100%	100%	51.0%	74
NSW#31	(Anon.)	1	2010	1827	30	60.9	U	N	100%	0%	32%	33%	100%	44%	100%	100%	100%	67.7%	32
NSW#32	(Anon.)	1	2010	824	15	54.9	G	Y	25%	67%	37%	33%	80%	67%	75%	100%	67%	61.1%	57
NSW#33	(Anon.)	1	2010	825	15	55.0	G	Y	25%	67%	32%	33%	80%	22%	75%	100%	67%	55.6%	69
NSW#34	(Anon.)	1	2000	770	12	64.2	G	Y	75%	67%	53%	0%	80%	78%	50%	100%	67%	63.2%	52
NSW#35	(Anon.)	1	2007	1477	26	56.8	U	Y	75%	33%	79%	100%	80%	56%	75%	100%	67%	73.8%	16
NSW#36	(Anon.)	1	2007	1427	24	59.5	G	Y	75%	33%	79%	100%	100%	56%	75%	100%	67%	76.1%	9
NSW#37	(Anon.)	2	2007	1477	24	61.5	U	Y	75%	33%	79%	100%	100%	56%	75%	100%	67%	76.1%	9
NSW#38	(Anon.)	1	2008	1035	20	51.8	G	Y	50%	33%	47%	0%	100%	44%	58%	100%	100%	59.3%	60
NSW#39	(Anon.)	1	2008	1047	16	65.4	G	Y	50%	33%	47%	0%	100%	44%	58%	100%	100%	59.3%	61
NSW#40	(Anon.)	1	2008	983	19	51.7	U	Y	100%	33%	47%	0%	100%	44%	58%	100%	100%	64.8%	44
NSW#41	(Anon.)	1	2008	936	16	58.5	U	Y	100%	33%	47%	0%	100%	44%	58%	100%	100%	64.8%	44
NSW#42	(Anon.)	1	2008	1045	20	52.3	G	Y	100%	33%	37%	0%	60%	44%	58%	100%	100%	59.2%	62

Unit Type:	Unit name	No. of units/type	Year	Unit floor area (m^2)*	Bed-spaces/unit	Area/resident (m^2)	Ground/upper (G/U)	Purpose-built? (Y/N)	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT	O/A Plan-EAT rank (NSW & Intl.)
NSW#43	(Anon.)	1	2008	991	19	52.2	G	Y	100%	33%	63%	0%	40%	44%	58%	100%	100%	59.9%	59
NSW#44	(Anon.)	1	1980	1064	15	70.9	U	N	0%	67%	0%	33%	40%	22%	25%	0%	33%	24.5%	105
NSW#45	(Anon.)	1	1980	1530	22	69.5	G	N	25%	33%	11%	33%	60%	44%	50%	100%	67%	47.0%	82
NSW#46	(Anon.)	1	2009	714	12	59.5	U	Y	25%	67%	42%	67%	40%	33%	17%	100%	33%	47.1%	81
NSW#47	(Anon.)	2	2009	1137	20	56.9	U	Y	25%	33%	16%	33%	60%	44%	50%	100%	100%	51.3%	73
NSW#48	(Anon.)	1	2009	865	14	61.8	U	Y	100%	67%	37%	0%	100%	44%	58%	100%	100%	67.4%	35
NSW#49	(Anon.)	1	2009	1107	20	55.4	U	Y	75%	33%	21%	0%	60%	78%	58%	100%	100%	58.4%	63
NSW#50	(Anon.)	1	2014	856	9	95.1	U	Y	75%	100%	63%	33%	60%	22%	50%	100%	67%	63.4%	51
NSW#51	(Anon.)	1	2014	1388	25	55.5	U	Y	50%	33%	68%	33%	80%	44%	67%	100%	100%	64.0%	50
NSW#52	(Anon.)	1	2014	1388	25	55.5	G	Y	50%	33%	68%	33%	80%	56%	67%	100%	100%	65.3%	42
NSW#53	(Anon.)	1	2014	1330	25	53.2	U	Y	50%	33%	58%	33%	80%	44%	83%	100%	100%	64.7%	46
NSW#54	(Anon.)	1	2014	804	12	67.0	G	Y	50%	67%	74%	33%	80%	44%	83%	100%	100%	70.2%	26
NSW#55	(Anon.)	2	2014	905	15	60.3	U	Y	50%	67%	63%	100%	80%	22%	67%	100%	100%	72.1%	21
NSW#56	(Anon.)	2	2014	955	16	59.7	G	Y	50%	33%	63%	100%	80%	11%	67%	100%	100%	67.1%	37
NSW#57	(Anon.)	1	1995	848	15	56.5	G	N	50%	67%	32%	67%	60%	33%	33%	100%	100%	60.2%	58
NSW#58	(Anon.)	1	1995	880	15	58.7	G	N	75%	67%	32%	67%	60%	33%	33%	100%	100%	63.0%	55
NSW#59	(Anon.)	1	1995	908	15	60.5	G	N	50%	67%	16%	67%	20%	89%	100%	100%	100%	67.6%	34
NSW#60	(Anon.)	1	1995	886	15	59.1	G	Y	50%	67%	5%	33%	20%	33%	33%	100%	100%	49.1%	78
NSW#61	(Anon.)	4	2009	627	16	39.2	U	Y	0%	33%	16%	33%	60%	22%	50%	0%	67%	31.3%	100
NSW#62	(Anon.)	1	2009	638	19	33.6	U	Y	0%	33%	32%	33%	60%	22%	50%	0%	67%	33.0%	99
NSW#63	(Anon.)	2	2009	682	20	34.1	U	Y	0%	33%	37%	33%	60%	22%	50%	0%	67%	33.6%	98
NSW#64	(Anon.)	1	2009	638	19	33.6	G	Y	0%	33%	32%	33%	60%	22%	58%	0%	67%	33.9%	97

Unit Type:	Unit name	No. of units/type	Year	Unit floor area (m^2)*	Bed-spaces/unit	Area/resident (m^2)	Ground/upper (G/U)	Purpose-built? (Y/N)	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT	O/A Plan-EAT rank (NSW & Intl.)
NSW#65	(Anon.)	1	2008	1513	23	65.8	G	N	50%	33%	47%	0%	100%	11%	58%	0%	100%	44.5%	84
NSW#66	(Anon.)	1	2008	1631	48	34.0	U	N	0%	0%	37%	0%	60%	0%	50%	0%	100%	27.4%	102
NSW#67	(Anon.)	1	2008	1145	20	57.3	U	N	25%	33%	42%	0%	80%	0%	58%	0%	100%	37.6%	93
NSW#68	(Anon.)	1	1977	731	25	29.2	U	N	0%	33%	16%	0%	40%	0%	8%	0%	33%	14.5%	108
NSW#69	(Anon.)	1	1977	408	7	58.3	G	N	75%	100%	84%	0%	100%	11%	42%	100%	67%	64.3%	48
NSW#70	(Anon.)	1	1977	758	36	21.1	U	N	0%	0%	5%	33%	80%	0%	0%	0%	67%	20.6%	107
NSW#71	(Anon.)	2	2014	1172	18	65.1	U	Y	100%	33%	47%	67%	100%	56%	75%	100%	100%	75.3%	12
NSW#72	(Anon.)	2	2014	1171	18	65.1	G	Y	100%	33%	47%	67%	100%	89%	75%	100%	100%	79.0%	4

*Floor areas are based on the sum of measured unit floor area, plus a proportional amount of any communal areas shared between units.

APPENDIX L: KEY ATTRIBUTES – INTERNATIONAL UNITS

Unit Type:	Unit name	No. of units/type	Year	Unit floor area (m^2)*	Bed-spaces/unit	Area/resident (m^2)	Ground/upper (G/U)	Purpose-built? (Y/N)	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT	O/A Plan-EAT rank (NSW & Intl.)
INT#01	Alexian Village	1	1980	2280	40	57.0	G	N	75%	0%	21%	67%	40%	56%	75%	100%	67%	55.5%	70
INT#02	Alois Alzheimer's Centre	1	1987	1764	76	23.2	G	N	25%	0%	11%	33%	60%	67%	67%	100%	67%	47.7%	80
INT#03	Alzheimer's Care Centre	1	1988	1459	30	48.6	G	Y	100%	0%	37%	67%	100%	78%	92%	100%	83%	72.9%	19
INT#04	Alzheimer's Disease Residential Center	1	1994	1419	20	71.0	G	Y	100%	33%	47%	67%	100%	44%	92%	100%	100%	75.9%	11
INT#05	Brightwater Onslow Gardens: 1/3 – NE	1	2001	859	16	53.7	G	Y	100%	33%	53%	33%	80%	89%	58%	100%	83%	70.0%	27
INT#06	Brightwater Onslow Gardens: 2/3 – NW	1	2000	826	15	55.1	G	Y	100%	67%	53%	33%	80%	89%	58%	100%	83%	73.7%	18
INT#07	Brightwater Onslow Gdns: 3/3 – SE/SW	2	2000	829	16	51.8	G	Y	100%	33%	53%	33%	80%	89%	58%	100%	83%	70.0%	27
INT#08	Butterfly Concept	1	1985	927	24	38.6	G	Y	100%	33%	79%	33%	80%	33%	50%	0%	100%	56.5%	67
INT#09	Orchard Centre	1	2009	1087	11	98.8	G	Y	75%	67%	16%	100%	40%	67%	100%	100%	83%	71.9%	22
INT#10	Childers Place	3	2007	1425	20	71.3	G	Y	50%	33%	53%	100%	60%	89%	83%	100%	100%	74.2%	15
INT#11	Corine Dolan Centre	2	1989	559	12	46.6	G	Y	25%	67%	63%	0%	40%	44%	75%	100%	100%	57.1%	65
INT#12	De Hogeweyk: Typical unit	23	2009	407	6	67.8	G	Y	75%	100%	32%	67%	100%	67%	58%	100%	100%	77.6%	6
INT#13	Elderkare	1	1991	509	12	42.4	G	Y	50%	67%	47%	67%	100%	67%	58%	0%	67%	58.0%	64

Unit Type:	Unit name	No. of units/type	Year	Unit floor area (m^2)*	Bed-spaces/unit	Area/resident (m^2)	Ground/upper (G/U)	Purpose-built? (Y/N)	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT	O/A Plan-EAT rank (NSW & Intl.)
INT#14	Friendship House: 1 of 2 - Terrace	4	1976	486.5	16	30.4	G	Y	75%	33%	84%	33%	100%	22%	33%	100%	100%	64.6%	47
INT#15	Friendship House: 2 of 2 - Courtyard	4	1976	486.5	16	30.4	G	Y	75%	33%	84%	33%	100%	78%	33%	100%	100%	70.8%	24
INT#16	Hale Kako'O	1	1992	521	12	43.4	G	Y	75%	67%	89%	0%	80%	22%	67%	100%	100%	66.7%	38
INT#17	Helen Bader Center	2	1993	709	12	59.1	G	Y	100%	67%	79%	33%	100%	33%	42%	100%	100%	72.7%	20
INT#18	Himawari Group Home	1	1996	279	8	34.9	G	Y	75%	100%	95%	67%	80%	33%	50%	100%	100%	77.7%	5
INT#19	John Douglas French Cntr: 1/2 - Upper	4	1987	1026	26	39.4	U	N	25%	33%	42%	33%	40%	0%	33%	0%	33%	26.7%	103
INT#20	John Douglas French Cntr: 2/2 - Ground	2	1987	1026	26	39.4	G	N	25%	33%	42%	33%	40%	22%	33%	100%	33%	40.3%	88
INT#21	Leonard Florence Cntr: 1/2 - South	5	2010	854	10	85.4	U	Y	100%	100%	84%	0%	80%	56%	58%	100%	100%	75.3%	12
INT#22	Leonard Florence Cntr: 2/2 - North	5	2010	778	10	77.8	U	Y	100%	100%	84%	0%	80%	56%	58%	100%	100%	75.3%	12
INT#23	Minna Murra	1	1986	519	15	34.6	G	Y	100%	67%	37%	67%	60%	78%	83%	100%	100%	76.8%	8
INT#24	Namaste Alzheimer Cntr: 1/2 - East	2	1990	643.8	16	40.2	G	Y	25%	33%	16%	100%	60%	11%	67%	100%	67%	53.2%	71
INT#25	Namaste Alzheimer Cntr: 2/2 - West	2	1990	816.8	16	51.1	G	Y	25%	33%	79%	67%	60%	33%	92%	100%	100%	65.4%	41
INT#26	New Perspective Group Home #4	1	1990	575	12	47.9	G	Y	100%	67%	47%	67%	80%	44%	100%	0%	100%	67.2%	36

Unit Type:	Unit name	No. of units/type	Year	Unit floor area (m^2)*	Bed-spaces/unit	Area/resident (m^2)	Ground/upper (G/U)	Purpose-built? (Y/N)	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT	O/A Plan-EAT rank (NSW & Intl.)
INT#27	NPO Group Fugi	2	2007	349	11	31.7	U	Y	50%	67%	89%	67%	80%	0%	58%	100%	100%	67.9%	31
INT#28	Park Homes at Parkside	2	2006	752	12	62.7	G	Y	100%	67%	84%	67%	100%	78%	100%	0%	100%	77.3%	7
INT#29	Riverview Lodge	2	1990	354	8	44.3	G	Y	100%	100%	100%	67%	80%	44%	42%	0%	83%	68.5%	30
INT#30	Southwood Home: 1 of 2 - SCU	1	2007	796.5	8	99.6	G	Y	100%	100%	63%	67%	80%	89%	75%	100%	100%	86.0%	1
INT#31	Southwood Home: 2 of 2 - Typical	5	2007	1065	15	71.0	G	Y	100%	67%	63%	67%	80%	89%	58%	100%	100%	80.4%	3
INT#32	Stonefield Home	1	1991	1179	24	49.1	G	Y	75%	33%	26%	67%	20%	78%	75%	0%	67%	49.0%	79
INT#33	Weikslag Krabbenlaan	2	2010	405	6	67.5	G	Y	50%	100%	58%	33%	100%	22%	58%	100%	100%	69.1%	29
INT#34	Weiss Institute,	3	1972	1253	40	31.3	U	Y	50%	0%	68%	33%	60%	22%	58%	0%	67%	39.9%	89
INT#35	Woodside Place: 1/2 - West and Mid.	2	1991	686.3	12	57.2	G	Y	50%	67%	32%	33%	80%	100%	83%	100%	100%	71.7%	23
INT#36	Woodside Place: 2/2 - East	1	1991	686.3	12	57.2	G	Y	50%	67%	32%	33%	80%	89%	83%	100%	100%	70.4%	25

*Floor areas are based on the sum of measured unit floor area, plus a proportional amount of any communal areas shared between units.

APPENDIX M: KEY ATTRIBUTES SUMMARY

INT=international units	No. of units	Unit types	Year	Unit floor area (m^2)	Service area (m^2/unit)	Bed-spaces/unit	Area/resident (m^2)	Ground Floor	Purpose built?	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT
Available DDP points										4	3	19	3	5	9	12	1	6	62
INT total/avg. * [34] (A)	94	36	1998	623	110	14.4	57.5	79.8%	91.5%	72.6%	66.7%	55.7%	48.9%	81.1%	55.8%	60.0%	84.0%	91.1%	68.4%
INT median*	n/a	n/a	2007	544	87	12	62.7	n/a	n/a	75.0%	66.7%	52.6%	66.7%	80.0%	66.7%	58.3%	100%	100%	74.0%
Standard deviation*	n/a	n/a	12.3	356	92.7	10.4	17.9	n/a	n/a	25.4%	32.8%	24.3%	27.1%	20.8%	26.8%	17.1%	36.8%	18.4%	13.6%
NSW total/avg. * (B)	90	72	2004	915	173	21	55.9	61.1%	55.6%	46.7%	40.0%	40.2%	42.2%	74.0%	37.0%	61.2%	77.8%	79.3%	55.4%
NSW median*	n/a	n/a	2008	807	145	18	58.3	n/a	n/a	50.0%	33.3%	42.1%	33.3%	80.0%	33.3%	58.3%	100%	66.7%	60.0%
Standard Dev*	n/a	n/a	11.8	420	111.9	10.0	13.0	n/a	n/a	35.6%	23.5%	20.6%	32.3%	23.9%	24.2%	21.1%	41.8%	20.5%	16.9%
INT versus NSW Ratio (=A/B)	(1.04)	(2.77)	n/a	(0.68)	(0.64)	(0.69)	(1.02)	(1.31)	(1.65)	(1.56)	(1.67)	(1.38)	(1.16)	(1.10)	(1.51)	(0.98)	(1.08)	(1.15)	(1.24)
INT ground floor avg.(C)	75	41	1998	598	97	13.4	57.0	100%	94.7%	73.0%	66.7%	51.2%	56.4%	84.3%	61.6%	61.8%	89.3%	93.8%	70.9%
INT upper floor avg. (D)	19	5	1999	719	161	18.2	59.7	0%	79.0%	71.1%	66.7%	73.4%	19.3%	68.4%	32.8%	53.1%	63.2%	80.7%	58.7%
Ratio (=C/D)	(3.95)	(8.2)	n/a	(0.83)	(0.60)	(0.74)	(0.95)	n/a	(1.20)	(1.03)	(1.00)	(0.70)	(2.92)	(1.23)	(1.88)	(1.16)	(1.41)	(1.16)	(1.21)

[34] Average, median, and standard deviation values are calculated across the full sets of ninety (n=90) NSW and ninety-four (n=94) international residential aged care units, including recurrences of unit types.

INT=international units	No. of units	Unit types	Year	Unit floor area (m^2)	Service area (m^2/unit)	Bed-spaces/unit	Area/resident (m^2)	Ground Floor	Purpose built?	DDP#1	DDP#2	DDP#3	DDP#4	DDP#5	DDP#6	DDP#8	DDP#9	DDP#10	Plan-EAT
NSW ground floor avg. (E)	55	41	2004	897	176	19.9	57.2	100%	54.6%	52.7%	41.2%	43.8%	46.1%	78.6%	43.2%	65.2%	85.5%	80.0%	59.6%
NSW upper floor avg. (F)	35	31	2003	944	167	21.6	53.9	0%	57.1%	37.1%	38.1%	34.6%	36.2%	66.9%	27.3%	55.0%	65.7%	78.1%	48.8%
Ratio (=E/F)	(1.57)	(1.32)	n/a	(0.95)	(1.05)	(0.92)	(1.06)	n/a	(0.96)	(1.42)	(1.08)	(1.27)	(1.27)	(1.17)	(1.58)	(1.18)	(1.30)	(1.02)	(1.22)
INT purpose-built avg. (G)	86	32	1999	578	104	12.6	59.2	82.6%	100%	76.5%	70.5%	57.5%	50.0%	84.7%	59.0%	61.6%	87.2%	95.7%	71.4%
INT non-purpose-built avg. (H)	8	4	1986	1103	172	34.0	39.6	50.0%	0%	31.3%	25.0%	35.5%	37.5%	42.5%	20.8%	42.7%	50.0%	41.7%	36.3%
Ratio (=G/H)	(10.75)	(8.0)	n/a	(0.52)	(0.60)	(0.37)	(1.49)	n/a	n/a	(2.45)	(2.82)	(1.62)	(1.33)	(1.99)	(2.83)	(1.44)	(1.74)	(2.30)	(1.97)
NSW purpose-built avg. (J)	50	36	2010	810	188	18.2	55.8	62.5%	100%	57.0%	41.3%	47.7%	48.7%	79.6%	45.6%	64.0%	84.0%	84.0%	61.3%
NSW non-purpose-built avg. (K)	40	36	1996	1046	153	23.6	56.2	60.0%	0%	33.8%	38.3%	30.9%	34.2%	67.0%	26.4%	57.7%	70.0%	73.3%	48.0%
Ratio (=J/K)	(1.25)	(1.0)	n/a	(0.77)	(1.23)	(0.77)	(0.99)	n/a	n/a	(1.69)	(1.08)	(1.54)	(1.42)	(1.19)	(1.73)	(1.11)	(1.20)	(1.15)	(1.28)

APPENDIX N: EAT QUERY SCORE AVERAGES

Plan-EAT query no.	1.05	1.13	2.01	3.01	3.02	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.10	4.05	4.07	4.80	5.01	5.02	5.05	5.06
NSW avg. as %*	33%	61%	40%	21%	38%	28%	84%	62%	54%	82%	36%	26%	74%	59%	28%	40%	61%	61%	88%	80%
INT avg. as a %*	56%	89%	67%	41%	53%	46%	79%	94%	51%	81%	56%	46%	93%	77%	07%	63%	90%	90%	80%	68%
NSW Ground floor Avg.	35%	70%	41%	21%	42%	32%	91%	71%	62%	89%	35%	25%	82%	62%	31%	45%	69%	69%	91%	80%
NSW Upper floor Avg.	29%	46%	38%	20%	31%	22%	74%	49%	43%	71%	40%	26%	63%	54%	23%	31%	49%	49%	83%	80%
INT Ground Avg.	57%	89%	67%	34%	48%	38%	85%	92%	48%	85%	53%	37%	91%	84%	9%	76%	88%	88%	84%	69%
INT Upper Avg.	53%	89%	67%	67%	72%	78%	53%	100%	63%	63%	68%	79%	100%	47%	0%	11%	100%	100%	63%	63%
NSW purpose-built	42%	72%	41%	24%	45%	38%	96%	70%	68%	94%	48%	26%	76%	64%	38%	44%	68%	68%	96%	80%
NSW non-purpose-built	21%	46%	38%	16%	28%	16%	70%	53%	38%	68%	23%	25%	73%	53%	15%	35%	53%	53%	78%	80%
INT purpose-built	60%	92%	71%	43%	54%	45%	85%	94%	56%	87%	60%	50%	93%	76%	7%	67%	91%	91%	86%	74%
INT non-purpose-built	13%	50%	25%	19%	41%	56%	13%	88%	0%	13%	13%	0%	88%	88%	13%	13%	88%	88%	13%	0%

Plan-EAT query no.	5.07	6.1a	6.1b	6.1c	6.1d	6.1e	6.1f	6.1g	6.2a	6.2b	8.01	8.02	8.03	8.04	8.05	9.01	10.01	10.07	10.08
NSW avg. as %*	80%	19%	22%	57%	32%	17%	49%	0%	64%	73%	66%	57%	64%	66%	53%	78%	46%	100%	92%
INT avg. as a %*	77%	51%	52%	72%	47%	52%	81%	31%	52%	64%	63%	62%	81%	51%	41%	84%	80%	97%	97%
NSW Ground floor Avg.	84%	29%	35%	55%	35%	24%	64%	0%	71%	78%	72%	64%	65%	67%	54%	85%	45%	100%	95%
NSW Upper floor Avg.	74%	3%	3%	60%	29%	6%	26%	0%	54%	66%	56%	46%	61%	63%	53%	66%	49%	100%	86%
INT Ground Avg.	92%	64%	65%	77%	45%	65%	88%	39%	48%	63%	64%	63%	81%	49%	50%	89%	84%	99%	99%
INT Upper Avg.	16%	0%	0%	53%	53%	0%	53%	0%	68%	68%	60%	56%	82%	58%	5%	63%	63%	89%	89%
NSW purpose-built	86%	24%	28%	60%	40%	26%	54%	0%	88%	90%	66%	56%	72%	72%	57%	84%	54%	100%	98%
NSW non-purpose-built	73%	13%	15%	53%	23%	5%	43%	0%	35%	53%	66%	58%	54%	58%	49%	70%	36%	100%	84%
INT purpose-built	81%	56%	55%	74%	50%	56%	84%	34%	56%	67%	65%	63%	83%	50%	45%	87%	87%	100%	100%
INT non-purpose-built	25%	0%	25%	50%	13%	13%	50%	0%	13%	25%	46%	46%	56%	63%	0%	50%	0%	63%	63%

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