



## 4 Definition of key terms

### Nature

Bratman et al (2014) state that “in general, by nature we mean areas containing elements of living systems that include plants and nonhuman animals across a range of scales and degrees of human management, from a small urban park through to relatively “pristine wilderness” (cited in Frumkin et al, 2017) . “Nature” is defined by the Victorian Department of Environment, Land, Water and Planning (DELWP) in Biodiversity 2037 as “any green open spaces and water bodies that support living things... [including] highly modified or constructed landscapes through to pristine wilderness areas” (DELWP, 2017 p. 63).

There is a significant body of literature that that calls into question the distinction between humans and nature implied in these definitions. Many scholars from Val Plumwood to Bruno Latour and Timothy Morton “remind us that viewing the natural world as separated from humans is not only ethically problematic but empirically false” (Alberro, 2020). Our recent experiences with both COVID-19 and climate change confirm this world view but to date the vast majority of the literature in the “nature for health and wellbeing” field uses the more traditional definitions of “nature” as defined above.

### Health

The World Health Organisation (WHO) provides a range of commonly used definitions in this field. The WHO definition of “health” is “A complete state of physical, mental and social wellbeing and not merely the absence of disease or infirmity” (WHO, 2014).

### Mental health

“Mental health” is defined by the WHO as; “A state of well-being in which an individual realises his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community”. Conceived in this way, mental health encompasses (i) the absence of mental illness and (ii) the presence of psychological wellbeing (WHO, 2014).

### Wellbeing

The OECD considers subjective “wellbeing” to be “good mental states, including all of the various evaluations, positive and negative, that people make of their lives and the affective reactions of people to their experiences” (OECD, 2013 p. 10). Wellbeing is usually conceptualised as some combination of positive affective states such as happiness (the hedonic perspective) and functioning with optimal effectiveness in individual and social life (the eudaimonic perspective) (Deci & Ryan, 2008).

### Urban green space

The WHO describes “urban green space” as “public green areas used predominantly for recreation such as gardens, zoos, parks, and suburban natural areas and forests, or green areas bordered by urban areas that are managed or used for recreational purposes” (WHO, 2016 p. 64). Accordingly, this report uses the term “urban green space” to describe the RBGV environments at Melbourne Gardens and Cranbourne Gardens. The term “gardens” tends to be used in the literature to describe domestic gardens and active gardening spaces such as community gardens. Veale & Kendall (2019) use the term “place-based nature experiences” to describe those that occur in more formalised and typically protected environments such as botanic gardens, national and marine parks” (Veale & Kendal, 2020, p. 1).

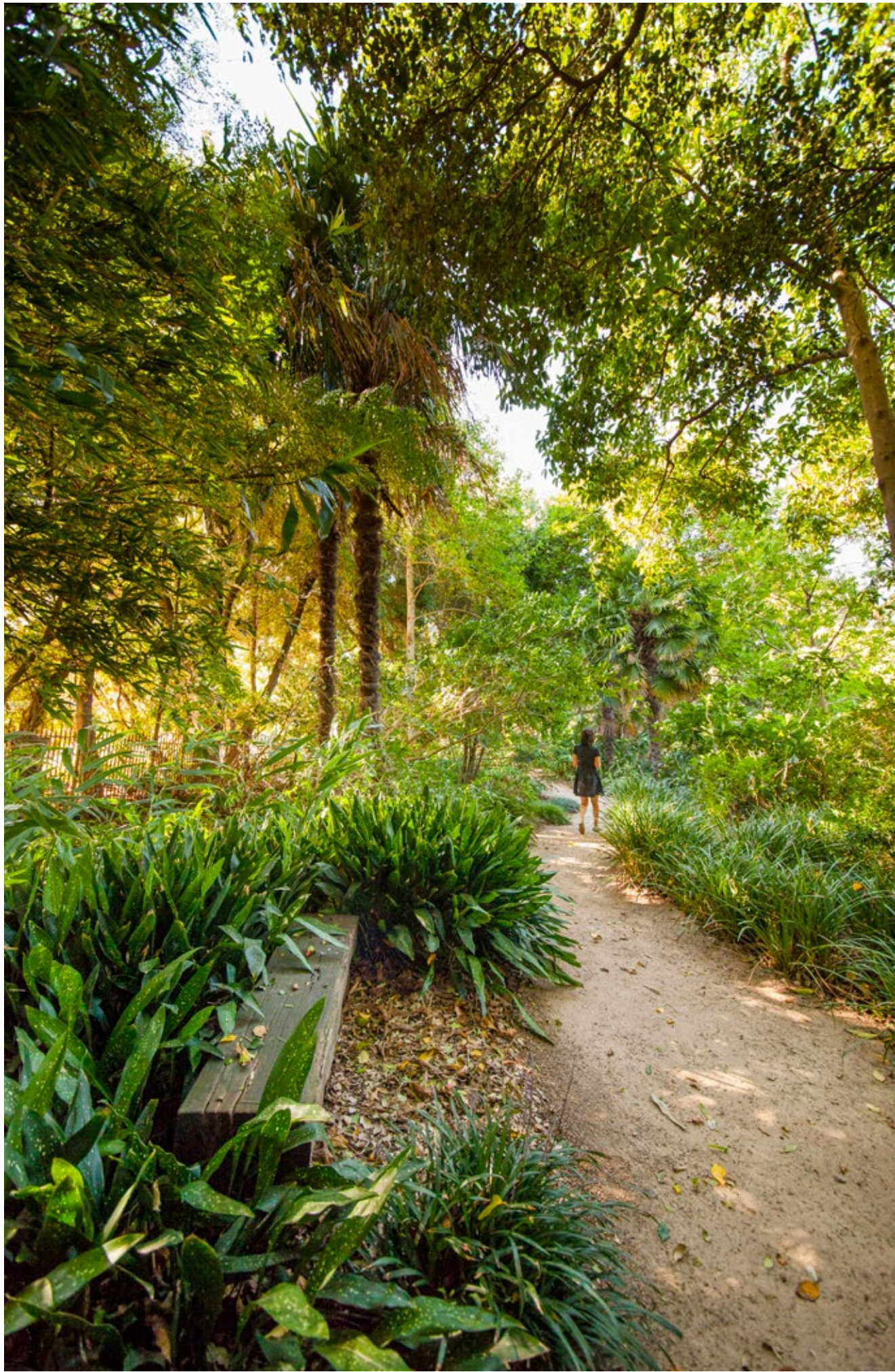
### Nature therapy

Miyazaki et al. (2015) define Nature therapy as “a set of practices aimed at achieving ‘preventive medical effects’ through exposure to natural stimuli that render a state of physiological relaxation and boost the weakened immune functions to prevent diseases”. The Japanese term Shinrin-yoku means “taking in the forest atmosphere through all of our senses” – sight, smell, sound, touch and taste. Shinrin-yoku is usually translated as “forest bathing”. Forest therapy is defined as a shinrin-yoku effect.

### Nature deficit disorder

Richard Louv coined the term “nature-deficit disorder” in 2005 as not being a medical diagnosis, but a way to “describe the human costs of alienation from nature: diminished use of the senses, attention difficulties, higher rates of physical and emotional illnesses, a rising rate of myopia, child and adult obesity, Vitamin D deficiency, and other maladies” (Louv, Oct 20, 2019).





## 5 Individual health impacts

### 5.1 Physical health

A growing body of literature indicates that there is, in general, a positive relationship between greener environments and physical health. The WHO (2016) indicates that the research suggests four principal and interacting pathways through which nature or green space may contribute to physical health:

- improved air quality,
- enhanced physical activity,
- stress reduction, and
- greater social cohesion.

Air quality benefits provided by green space are particularly relevant due to the relationship between air pollution and respiratory illnesses. Nowak and others (2014) calculated that in 2010, trees removed 17.4 million tons of air pollution across the United States, which prevented 850 human deaths and 670,000 cases of acute respiratory symptoms (U.S. Dept. of Ag., 2018). Yet as Kendal et al. (2016) indicate there has been less clear findings from research investigating the links between respiratory health and vegetation/canopy cover in urban areas. “Vegetation can also increase pollutants by emitting volatile organic compounds (VOCs) that can contribute to ozone and carbon monoxide formation. However, due to the high degree of uncertainty in atmospheric modelling, it is not clear whether ozone formation from VOC emissions for these species is greater than ozone removal or prevention” (U.S. Dept. of Ag., 2018 p. 4). In some circumstances, the allergenic role of trees may eclipse their ability to improve health by reducing air contaminants.

#### Links to increased activity levels

The evidence indicates that urban green space is associated with increased physical activity leading to improved fitness and reduced obesity as well as improved sleep and cardiovascular health. Kathryn Bowen in Kendal et al. (2016) highlights a number of studies showing that higher levels of green space have been associated with lower levels of obesity. Davern et al. (2017) also note evidence from a range of authors including Maas, Verheij et al. (2009) and Astell-Burt, Mitchell et al. (2014) that “access to and use of green public open space appears protective of several diseases including chronic heart disease, respiratory tract infection, asthma, migraine and severe headaches, vertigo, acute urinary tract infection and diabetes mellitus (type 2 diabetes)” (Davern et al., 2017 p. 12).

The WHO (2016, p. 4) cite several studies in various countries that have demonstrated that recreational walking, increased physical activity and reduced sedentary time were associated with access to, and use of, green spaces in working age adults, children and senior citizens (Astell-Burt et al., 2013; Schipperijn et al., 2013; Lachowycz and Jones, 2014; Sugiyama et al., 2014; James et al., 2015). Interestingly Terry Hartig Uppsala University, Sweden and colleagues indicates that recent evidence suggests that the health benefits of increased physical activity are largest among those who were initially doing the least (Hartig et al., 2014, p. 214).

#### Stress reduction

There are consistent findings, that as many of us instinctively feel, green space is associated with reduced stress. Stress is associated with sleep loss, suppressed immune system, stroke, diabetes, high blood pressure and cardiovascular disease (Wolf and Robbins, 2015 cited in Davern, et.al., 2017). Stress triggers a combination of signals from both hormones and nerves, causes our adrenal glands to release hormones, including adrenaline and cortisol.

Much of the research evidence regarding green space reducing stress in the past relied on self-reported change in emotional states. More recently cortisol measurement combined with blood pressure measurement and subjective wellbeing health measures have become key measurement tools in this field. Overexposure to cortisol and other stress hormones has been linked to increased heart disease, weight gain and anxiety and depression, as well as focus and concentration difficulties. As Roe et al (2013) indicate cortisol is about more than just stress. This steroid hormone is made in adrenal glands. Most of the cells in our bodies have cortisol receptors that use cortisol for a variety of functions, including: blood sugar regulation, inflammation reduction, metabolism regulation and memory formulation.

Cortisol measurement combined with blood pressure and subjective wellbeing health measures have become key measurement tools in this field.

<sup>1</sup> As your body perceives stress, your adrenal glands make and release the hormone cortisol into your bloodstream. Often called the “stress hormone,” cortisol causes an increase in your heart rate and blood pressure. It’s your natural “flight or fight” response that has kept humans alive for thousands of years. Cortisol narrows the arteries, while another hormone, epinephrine, increases your heart rate. Working together, they force your blood to pump harder and faster as you confront and resolve the immediate threat. –Roe et al. (2013). Adrenaline increases your heart rate, elevates your blood pressure and boosts energy supplies. Cortisol, the primary stress hormone, increases sugars (glucose) in the bloodstream, enhances your brain’s use of glucose and increases the availability of substances that repair tissues. <https://www.tciheart.com/HealthLibrary/>



“Evidence of psychoneuroendocrine responses to woodland environments are based on observed associations with lower concentrations of cortisol, lower pulse rate, lower blood pressure, greater parasympathetic nerve activity and lower sympathetic nerve activity when compared to city environments” (Lee et al., 2011; Park et al., 2007 cited in WHO, 2016, p. 4).

**Social cohesion**

The protective effects of social cohesion on health and wellbeing are well documented, so what role does green space play in social cohesion? In the Netherlands, de Vries et. al. (2013) found an association between the quantity and, even more strongly, the quality of streetscape greenery and perceived social cohesion at the neighbourhood scale. Conversely, a shortage of green space in the environment has been linked to feelings of loneliness and lack of social support (Maas et al. 2009a, Ward Thompson et al., 2016 cited in WHO, 2016).

**“Green exercise”**

“Green exercise” is defined as physical activity undertaken in green or natural environments (Barton & Pretty, 2010). This very broad term can refer to any form of exercise that takes place outside; walking, cycling, conservation work, horse riding, boating, fishing or playing football. Research shows that there are even greater health benefits when the positive impacts of nature are combined with physical exercise. It has been suggested as being more beneficial than other types of exercise (Marselle et al., 2013). For example, running in a park is associated with a more restorative experience when compared to the same exercise in an urban environment (Bodin and Hartig, 2003 cited in WHO, 2016, p. 6).

There are even greater health benefits when the positive impacts of nature are combined with physical exercise.

Richard Mitchell’s study of the Scottish population (Mitchell, 2013) concluded that physical activity in natural environments is associated with a reduction in the risk of poor mental health to a greater extent than physical activity in other environments. Mitchell also found that activity in different types of environments may promote different kinds of positive psychological response.

An important precondition for the use of natural environments for physical activity is individuals’ (perceived) safety (Jansson M, Fors H, Lindgren T, Wiströ m B. 2013 cited in (Hartig et al., 2014, p. 214). There is evidence that disused, poorly maintained urban green space is experienced very differently to well maintained areas. Although green space generally is positively associated with feelings of safety, in dense urban areas enclosed green spaces may reduce such feelings (Hartig et al., 2014, p. 214). A qualitative analysis (McCormack et al., 2010) revealed that attributes of green spaces, such as safety, aesthetics, amenities, maintenance and proximity to home, are important for supporting physical activity outdoors.

Gary Veale and Dave Kendal (2020, p.38) in their ‘Nature Connectedness Activity Level framework’ (NCAL) suggest that ‘being healthy and active’ is the main reason that many people give for wanting to spend time in nature. Their research found that “some individuals play an important role in influencing and/or leading the everyday nature experiences of others” and that “those who most influence nature connectivity in others are already physically active people” (Veale & Kendal, 2019, p. 38).

Richard Mitchell, from Public Health and Health Policy, University of Glasgow states that “access to natural environments for physical activity should be protected and promoted as a contribution to protecting and improving population mental health.” (Mitchell, 2013, p.1)

**5.2 Mental health and wellbeing**

There is now broad consensus about the role of nature on mental health and wellbeing from the leading health and environmental researchers in regard to nature, mental health and wellbeing. Gregory Bratman and 25 top researchers from across the globe have recently published a paper (July, 2019) containing two key ‘consensus statements’ that evidence supports an association between common types of nature experience and:

- 1. increased psychological wellbeing, and
- 2. a reduction of risk factors and burden of some types of mental illness (Bratman et al., 2019 p. 23)

Studies of green spaces and health have demonstrated stronger evidence for mental health benefits, and for stress reduction, compared with other potential pathways to health (de Vries, 2010; Gascon et al., 2015 cited in WHO 2016 p. 9). For people with mental illness living in urban areas, physical activity in green space may be particularly beneficial (Roe and Aspinall, 2011 cited in WHO, 2016 p. 7). Davern et al. note that “there is convincing evidence from several studies that access to natural environments can help individuals to recover from acute stress and mental fatigue better than other environments” (Bodin and Hartig, 2003; van den Berg, van Poppel et al., 2016 cited in Davern et al. 2017, p. 13).

Davern et al. citing White, Alcock et al. (2013) and Sugiyama, Leslie et al. (2008) also conclude that “studies have demonstrated being in green spaces reduces frustration and distress and urban dwellers who perceived their neighbourhood to be greener were found to have better mental health than those who perceived their neighbourhood as less green” (Davern et al (2017, p. 13).

Leading researchers agree that the evidence supports an association between nature experiences and:

- 1. increased psychological wellbeing, and
- 2. a reduction of risk factors and burden of some types of mental illness

Green space has long been associated with stress reduction, but much evidence until the early 2000’s relied on self-reported health measures<sup>2</sup>, or experiments in artificially controlled environmental conditions. A pivotal study by the University of Exeter Medical School (White et al. 2013) took this to a larger scale. They drew on 18 years of data from over 10,000 participants to explore the self-reported psychological health of individuals over time and the relationship between urban green space, wellbeing and mental distress. After controlling for other factors such as income, employment, marital status, health, and housing, they found that, on average, people reported higher levels of well-being and lower levels of mental distress when living in greener urban areas. They explained that “living in an area with higher levels of green space was associated with improvements in our wellbeing indicators roughly equal to a third of that gained from being married, or a tenth as large as being employed vs. unemployed” (ECEHH, 2013).

10,000 people over 18 years reported higher levels of wellbeing and lower levels of mental distress when living in greener urban areas.

More studies are exploring what cortisol markers tell us. Long-term activation of the stress-response system and overexposure to cortisol and other stress hormones disrupts many body processes. Ward Thompson et el (2012) studied chronic stress in urban neighbourhoods. They established that salivary cortisol can act as a biomarker for variation in stress levels and that unsupervised, salivary cortisol sampling within the domestic setting could be achieved. WHO (2016, p. 4) citing Roe et al., (2013) and Ward Thompson et al., (2012) describe that they used the diurnal cortisol pattern as a biomarker of chronic stress and demonstrated that exposure to green space reduces chronic stress in adults living in deprived urban neighbourhoods. “Results indicate significant relationships between self-reported stress (*P* < 0.01), diurnal patterns of cortisol secretion (*P* < 0.05), and quantity of green space in the living environment” (Ward Thompson et al., 2012, p. 221).

These and other studies have found that higher amounts of green space in a neighbourhood are associated with lower levels of cortisol and that these levels drop through the day. On the other hand, lower amounts of green space in a neighbourhood are associated with higher cortisol levels and that these levels drop less through the day (Roe et al., 2013). Similar relationships between green space and stress reduction have been also been shown using hair cortisol as a biomarker of chronic stress. The WHO (2016, p. 5) cite van den Berg & Custer (2011) when indicating that cortisol measures have also demonstrated the stress reducing effects of gardening suggesting that such activities in green space may be particularly restorative.

**What about visits to green spaces rather than residential proximity?**

Many studies have found that people living in environments with more green space report better mental health than those with less green space. However, the association between **visits** to green space and mental health has seldom been studied. Two studies, Grahn and Stigsdotter, 2003 ; Stigsdotter et al., 2010 cited in van den Berg et al., 2016, p. 83), showed that both a larger number of visits and more time spent per week in green space was significantly associated with lower levels of perceived stress.

Magdalena Van den Berg, Amsterdam University Medical Centre and colleagues explored the association between time spent in green spaces by ‘purposeful visits’ and perceived mental health and vitality in four different European cities, and to what extent gender, age, level of education, attitude towards nature and childhood nature experience moderate these associations. Data was gathered using a questionnaire in four European cities, Barcelona Spain, Stoke-on-Trent UK, Doetinchem, Netherlands and Kaunas, Lithuania. The data showed significant positive associations between time spent visiting green spaces and mental health and vitality across all four cities. “The findings confirmed their hypothesis that more time spent in green space is associated with higher scores on mental health and vitality scales, independent of cultural and climatic contexts” (van den Berg et al., 2016, Abstract).

Time spent in green space is associated with higher scores on mental health and vitality scales, independent of cultural and climatic contexts.

2 Self-reported measures might include: depression (self-disparaging; dispirited, gloomy, blue; convinced that life has no meaning or value; pessimistic about the future; unable to experience enjoyment or satisfaction; unable to become interested or involved), anxiety (apprehensive, panicky; trembly, shaky; aware of dryness of the mouth, breathing difficulties, pounding of the heart, sweatiness of the palms; worried about performance and possible loss of control) and stress (over-aroused, tense; unable to relax; touchy, easily upset; irritable; easily startled; nervy, jumpy, fidgety; intolerant of interruption or delay).

A range of studies are now using wearable electroencephalography (EEG) to measure brain activity to record the effects of walking in different environments. Researchers in environmental psychology, Peter Aspinall et al. monitored participants on 25 min walks through three different areas of Edinburgh. The areas included an urban shopping street, a path through green space and a street in a busy commercial district. The results showed evidence of lower frustration, engagement and arousal, and higher meditation when moving into the green space; and higher engagement when moving out of it. This lower engagement and arousal might be what allows for attention restoration, encouraging a more open, meditative mindset (Aspinall et al., 2015).

There is also evidence that ruminative processes and the functioning of the subgenual prefrontal cortex may also be a key factor in the link between green space and mental health and wellbeing. Bratman et al. (2010) investigated whether nature experience would influence rumination (repetitive thought focused on negative aspects of the self), a known risk factor for mental illness, particularly depression. In another study Bratman et al. found that “participants who went on a 90–min walk through a natural environment reported lower levels of rumination and showed reduced neural activity in an area of the brain linked to risk for mental illness compared with those who walked through an urban environment” (Bratman et al., 2015, p. 8567).

**The theoretical basis – how green space impacts on mental health**

By what mechanisms might nature experience buffer against the development of mental illness?

The biophilia hypothesis: humans have an innate need to affiliate with the natural environment within which they have evolved.

There are two main theories that attempt to explain the restorative psychological effects of interaction with green space:

- Attention Restoration Theory
- Psycho–physiological stress reduction theory.

Both are psycho–evolutionary theories, based on the biophilia hypothesis, which postulates that humans have an innate need to affiliate with the natural environment within which they have evolved (Wilson, 1984). Both theories suggest that interaction with the natural environment serve a restorative function but through different mechanisms.

The theories are explained below by Clatworthy et al. (2013, p. 215)

“Attention restoration theory is primarily concerned with cognitive functioning. Kaplan and Kaplan (1989) suggest that people have two types of attention: directed attention (requiring effort, e.g. when we problem solve) and fascination (non–goal oriented and effortless attention). They propose that directed attention is a limited resource that can be overloaded (causing stress) and that people need to use the alternative system – fascination – to restore it. Fascination is thought to be dominant in natural environments, such as gardens, where there are captivating stimuli to hold attention.... Gardens often have three further qualities suggested to contribute to a restorative environment: being away (allowing a person to mentally and physically move to a different space), extent (providing a sense of being connected to a larger world) and compatibility (the ability of an environment to meet the needs and interests of the person) (Kaplan and Kaplan, 1989).”

There is also evidence that the restorative quality of green space may be particularly relevant to people experiencing mental health difficulties, as cognitive problems such as poor attention, memory and problem–solving ability are commonly reported symptoms associated with mental distress (Adhemar, 2008 cited in Clatworthy et al., 2013, p. 215).

“While Kaplan’s model is concerned with the restorative effect of nature on cognitive functioning, Ulrich’s (1983) psycho–physiological stress reduction theory is primarily concerned with the effect of nature on emotional and physiological functioning. He suggests that we are predisposed to find (non–threatening) natural stimuli relaxing, and that exposure to these stimuli has an immediate impact on affect and triggers a parasympathetic nervous system response leading to feelings of enhanced wellbeing and relaxation. Again, there is considerable experimental evidence to support this theory. For example, using measures of affect and physiological functioning (e.g. heart rate, skin conductance), people recovered more quickly and completely from a stressful event (watching a distressing film) when viewing images of natural rather than urban environments (Ulrich et al., 1991)” (Clatworthy et al., 2013, p. 215).







## 6 Impact on community health and wellbeing

### 6.1 Social cohesion

The research indicates that in a neighbourhood setting “there is growing evidence that access to green space enhances social cohesion (Lee and Maheswaran, 2011) which is likely to result from enhanced local interactions” (Davern et al., 2017, p. 15). Hartig et al. (2014) considered that “Unlike physical activity, the environmental correlates of social cohesion have received little research attention” to date. But considered that “generally, the few studies available suggest a positive relationship between social cohesion and natural environments” (Hartig et al., 2014, p. 215).

Visits to urban green space is often a social activity. Public programming and education visits in green settings are undertaken in groups. Most casual visits are taken with others, in groups of families, friends and pets. Dog walking in green space plays an important social role for some. “Dogs, like children, are ‘social lubricants’ and as people walk their dogs, they get to know their neighbours and other dog owners, with evidence that dog owners tend to have higher levels of social capital than others (Wood, GilesCorti et al., 2005)” (Davern, et al., 2017, p. 16).

A “shortage of green space in the environment has been linked to feelings of loneliness and lack of social support (Maas et al., 2009a, Ward Thompson et al., 2016). Various types of urban green space have been shown to facilitate social networking and promote social inclusion in children and adolescents (Seeland et al., 2009)” (WHO, 2016, p.5). Yet social wellbeing may not be beneficially affected if the green space is perceived as unsafe or where people engage in antisocial behaviour.

### 6.2 Violence & crime reduction

Some research has shown that increased access to green space may well be linked to reductions in neighbourhood crime, violence, and aggression.

Ming Kuo, University of Illinois and colleague William Sullivan studied how access to nature influences crime and conflict resolution among residents of a Chicago public housing estate in one of the 10 poorest neighbourhoods in the US (Kuo & Sullivan, 2001). Kuo thought this provided an ideal laboratory for studying the “green effect,” because occupants are randomly assigned to flats, some of which have grass and trees nearby. They found that those who lived with no immediate view of or access to nature reported a greater number of aggressive, including violent, conflicts with partners or children than their peers who lived near trees and grass. The researchers then looked at two years of crime statistics related to this estate. After controlling for other factors, they found that crime rates were highest for flats with little or no proximity to nature. Identical flats with views of grass and trees were associated with significantly less crime. Kuo & Sullivan found that roughly 7% of the variation in crime that can’t be accounted for by other factors can be accounted for by the amount of trees. On the other hand, some research has demonstrated perceived fear increases when vegetation reduces sightlines in urban areas that could be used for concealment. Donovan & Prestemon, (2010) also found that smaller, view-obstructing trees are associated with increased crime, whereas larger trees are associated with reduced crime.

There is also some evidence that greening of vacant lots in disadvantaged neighbourhoods can reduce crime. Branas et al, (2018) conducted a citywide trial in Philadelphia to “restore blighted vacant land: and its effects on violence, crime, and fear.” After “cleaning and greening” of neighbourhoods below the poverty line they found a 29% decrease in gun violence and 22% decrease in burglaries” (Branas et al., 2018, p. 2946).

### 6.3 Eco-anxiety, disaster recovery

“Urban green space may play an important role in enhancing community resilience and helping communities cope with natural disasters and extreme weather events”. (WHO, 2016 p. 20, citing Tidball & Krasny (2014).

Eco-anxiety or climate anxiety was defined by the American Psychological Association in 2017 as “a chronic fear of environmental doom.”It is a sense of anxiety primarily based on the current and predicted future state of the environment because of human-induced climate change. Studies have found that anxiety over climate change is a growing phenomenon. Ironically, one of the best antidotes for that might be a dose of green space. (Robbins, Jan 9 2020).

Glenn Albrecht introduced the term “solastalgia”<sup>3</sup> to describe an element of eco-anxiety. Solastalgia is what happens when you remain in the same locality, but that sense of “home”, that sense of place, is lost through the destruction of the landscape; “It is the homesickness you have when you are still at home” (Albrecht 2008). “The intense desire to be organically connected to living landscapes is, in part, a desire to overcome solastalgia by finding an earthly home in connection with other living things on this Earth” (Albrecht, 2006 cited in Marche, 2017).

While climate change affects all Australians, the impact is likely to be most severe on those already disadvantaged and vulnerable. Ernest Hunter points out that many indigenous communities are particularly impacted by climate change because of their close relationship to land (Hunter, 2009). “For those with a close relationship to the land, their identity is linked to not only its physical features but uses and knowledge of it. The loss of local knowledge, or traditional ecological knowledge, may be a key trigger for ecological grief” (Yin, 2018).

<sup>3</sup> “Solasta” contains the sense both of “solace” and “desolation.” Where nostalgia describes a longing for another place and another time



The scope of this evidence review has not identified significant peer reviewed research indicating the impact of contact with nature as a way to address eco-anxiety, although the theme is clearly a subject of growing interest. On the other hand, there is respected advice in the psychiatric community suggesting that environmental action can be beneficial. Ruzek suggests that one step to dealing with eco-anxiety is to increase the availability of contact with nature. “More time spent interacting with nature can improve health and lower stress via several mechanisms including exposure to better air quality, increased exercise, the calming effects of natural environments, and increased social cohesion” (Ruzek, 2020). As Sara L. Warber, professor of family medicine at the University of Michigan says, “If I am feeling depressed and anxious and worried about the environment,” “then one of the best things I can do is go out in nature” (Robbins, 2020).

Much of the literature on eco-anxiety is linked to that on disaster recovery. The key literature on the role of connection to nature in recovery from disaster is linked to recovery in war zones, after hurricanes Sandy and Katrina with a growing body of literature on literature on bushfire recovery.

Keith Tidball & Marianne Krasny of Cornell University in ‘Greening in the Red Zone’ (Tidball & Krasny, 2014) assert that creation of and access to green spaces improves resilience and recovery in systems disrupted by violent conflict or disaster. They come to the view that “We’re compelled to affiliate with nature, which comes to the fore with urgency in times of crisis, because we associate nature with the healing aspects of hope and optimism” (cited in Randall, 2020). A research team led by Lisa Gibbs of the University of Melbourne and others report related findings in bushfire recovery. “Self-reported attachment to the natural environment appeared ... to have a protective effect in terms of life satisfaction, mental health outcomes, resilience, posttraumatic growth and community attachment” (Gibbs et al., 2016, P. 19).

Research undertaken following Hurricane Sandy found that “community gardens functioned as multi-purpose community refuges which hosted meaningful and restorative greening practices and developed supportive communities” (Chan et al., 2015, p. 625). There is also evidence that community gardens played an important role in Christchurch, New Zealand, following the 2010/11 Canterbury Earthquakes (Shimpo et al., 2019).

Covid-19 has also generated a lot of discussion about re-evaluation of what is important in the lives of people in many different societies. It has become anecdotally clear that time in nature is seen as especially crucial. “The novel coronavirus has forced us to re-evaluate the value of natural outdoor settings, a rare pause to a decades-old trend” (Smith, 2020). “In this time of crisis, we are seeing people across the country visit their parks to seek out exercise, community and healing” (S Muqueeth, cited in Randall, 2020). While there has been a significant increase in visits to local parks and gardens, the biggest impact has been the increase in active home gardening (Atkinson, 2020).

### 6.4 Community gardens – the act of gardening

Community gardens clearly incorporate and strengthen social ties. Gardening involves a broad range of physical exercise and also reduces stress. Cortisol measures demonstrate the stress reducing effects of active gardening (van den Berg & Custer, 2011). Community gardens also provide opportunities for people to interact with others. “They also enable people to engage in a meaningful activity, developing specific knowledge and skills. These social and occupational factors may play a key role in promoting a sense of belonging and enhancing social inclusion for people experiencing mental health difficulties” (Diamant and Waterhouse, 2010 cited in Clatworthy et al., 2013, p. 215).

Royal Botanic Garden Sydney’s Community Greening programme, running since 2000, by 2018 it had involved almost 100,000 participants and established 627 community gardens. Truong et al., (2018) analysed the impact that this program had on the health and wellbeing of communities in social housing. “Nearly 80% of participants reported that community gardens have benefited their community. Important behavioural changes were observed, particularly in relation to health; participants were now eating vegetables and cooking healthy food more regularly since becoming active in a community garden. Participants also noted that gardening reduced anxiety and stress” (Smith and Harvey-Brown, 2018, p. 11).

It appears that gardening is particularly important to older people’s wellbeing. In one study by van den Berg et al. (2010), “older allotment gardeners reported having more contacts with friends and felt less lonely than did nongardening neighbours in the same age category” (Hartig et al., 2014, p. 216).

### 6.5 Hospital and formal care settings

Melanie Davern, University of Melbourne and colleagues note that “Several studies have demonstrated that access to natural landscapes, through nature experiences or even views of nature, can assist physical healing (e.g. faster surgical recovery and patient healing) and are associated with higher pain thresholds in hospitals (Wolf and Robbins 2015)” (Davern et al., 2017, p. 13). As Wolf and Robbins explain “One hypothesis is that nature serves as a distraction that allows individuals to refocus cognitive effort, resulting in increased pain thresholds and tolerance as well as improved coping and healing (Ulrich, 1999). Another hypothesis posits that exposure to green attributes in hospitals helps to reduce cognitive stress levels (Kaplan and Kaplan 1982) which can be linked to negative health outcomes (Varni & Katz, 1998)” (Wolf and Robbins, 2015, p. 394).

This research has prompted some hospitals to establish healing gardens and provide horticulture therapy programs. “Well-designed hospital gardens not only provide restorative and pleasant nature views, but also can reduce stress and improve clinical outcomes through other mechanisms such as increasing access to social support and providing opportunities for positive escape from stressful clinical settings” (Ulrich, 2002 .p. 9). For example, Khoo Teck Puat Hospital in Singapore is well known for its “biophilic design” (Choo, Jan 2, 2019). In 2018 Mardie Townsend and colleagues at Deakin University conducted a systematic review of access to green spaces in healthcare facilities (Weerasuriya et al., 2018). It highlighted the importance of incorporating green spaces into urban healthcare settings and “contributes to the evidence base accessible to designers, planners, policy makers and hospital administrators who aim to create and support health promoting settings” (Weerasuriya et al., 2018, Abstract).

Studies report that, in both adult day settings and nursing homes for those with dementia, there are positive correlations of wellbeing and enhanced competence following passive and active interaction with nature. “For instance, a formal systematic review found that the use of dementia gardens was associated with decreased agitation (Whear et al. 2014)” (Beyer et al., 2013, p. 28).

The RBGV and Regis Aged Care developed Victoria’s first dedicated program for older Australians, *Branch Out– Experiences in the Gardens for the over 60s*. RBGV learning facilitators lead incursion workshops at Regis Aged Care facilities along with a public program for older people at both sites. In an initial program evaluation, it was found that residents of Regis aged care facilities were very positive about two incursions and one excursion to the RBGV Melbourne and Cranbourne gardens. Regis staff also were also positive about the experience for residents (Evaluating the Performance of the Regis Aged Care / RBGV Partnership, August 2019).

### 6.6 Nature based interventions, horticultural therapy

Horticultural therapy is defined by the American Horticultural Therapy Association as “the engagement of a person in gardening and plant-based activities, facilitated by a trained therapist, to achieve specific therapeutic treatment goals.” These nature-based interventions (also called green care and ecotherapy) can be stand-alone organisations or be incorporated into other care settings.

Assessing horticultural therapy interventions can be challenging given the range of organisations delivering nature-based projects and services, the variety of terms and language used to describe their activity and benefits and the variation in delivery models which use different impact measures. Nonetheless “a systematic review of over 240 scientific studies found reliable evidence to support horticultural therapy as an intervention for a variety of conditions, from cerebral palsy to schizophrenia” (Annerstedt and Währborg. 2011 cited in Wolf et al., 2014). Some studies investigating the effects of nature and gardening on psychiatric patients displayed a range of results, from general mood improvement to impacts on specific illnesses (Wolf et al., 2014).

Jane Clatworthy and colleagues in their 2013 review *Gardening as a mental health intervention* concluded that “studies evaluating the benefits of gardening-based interventions for adults experiencing mental health difficulties reported positive effects of gardening as a mental health intervention for service users, including reduced symptoms of depression and anxiety. Participants described a range of benefits across emotional, social, vocational, physical and spiritual domains” (Clatworthy et al. 2013, p. 214). They state that “for people experiencing psychological distress, who may not feel able to meet the demands of the human world, sensory contact with the natural environment enables connection and communication on a simpler, safer level (Grahm et al., 2010; Adevi, 2012)” (Clatworthy et al., 2013, p. 216).