DEVELOPING ROBUST INDICATORS FOR VALUING LANEWAY GREENING

FINAL REPORT

Clean Air and Urban Landscapes Hub
National Environmental Science Programme

CITY OF MELBOURNE

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

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Contents

Introduction

This document describes a set of proposed indicators for the project Developing Robust Indicators for Valuing Laneway Greening, a collaborative research project between City of Melbourne, Victoria University and the University of Melbourne. The purpose of these indicators is to provide a baseline for ongoing monitoring and evaluation of inner-city laneway greening projects.

The project analyses and presents initial baseline measures from which indicators that can be used to assess the effects of laneway greening, will be constructed. Initially, the laneways were to be developed on very tight timelines and efforts were taken to maximise the effectiveness of measures (e.g., by logging temperatures in summer), but this was not always possible. These indicators are also designed to be integrated with larger scale measures wherever feasible.

Indicators for laneway greening will also help link the outcomes of these projects to the City of Melbourne's broader strategic objectives, contributing to plans such as the Future Melbourne Plan, Beyond the Safe City Strategy 2014–2017 and Green Our City Strategic Action Plan 2017–2021.

Background

If cities are considered as ecosystems, laneways add structure, providing interesting niches that form pockets of urban diversity. Because of their size, laneways are never going to dominate the urban landscape, but collectively, they can enrich it considerably.

Laneways were originally designed to allow secluded access to buildings for delivery and removal of rubbish and waste, or were accidental, providing access to smaller buildings, constructed as shops and residences in the 19th and early 20th century. Large buildings presented their attractive public face onto the wide streets of the city and their unattractive private entrances into secluded laneways. At best, laneways were ignored and were usually considered to be unsavoury and unsafe.

In the past few decades, Melbourne's laneways have undergone a revival, changing from being ignored to being valued by residents, tourists, workers and businesses. This is partly due to technology – how buildings operate has changed, with fewer deliveries; sewered systems have done away with the night carts; garbage storage and collection is a lot cleaner. Many other cities have lost their laneways through development and, although Melbourne has lost a few, the city's preservationist ethic has meant that many have been retained. New laneways are also being created.

These days laneways are generally seen as an asset, providing artscapes, eateries, entertainment and access into a variety of small worlds off the main street. They are now destinations in themselves. The earliest laneway renewals are now well known, with Hardware Lane, Degraves Street and McKillop Street attracting thousands of people each day. Melbourne has an annual Laneway music festival, which quickly became too large to for the laneways, migrating to the Maribyrnong Riverbank in Footscray.

The City of Melbourne (CoM) is expanding its urban greening projects into laneways as part of laneway development, with the Green Your Laneways pilot program. This kicked off in late 2015 with a community nomination process, which received a large number of nominations.

Four laneways were selected: Coromandel Place, Guildford Lane, Katherine Place and Meyers Place. These were developed during 2017–2018. As part of this project, the City of Melbourne has engaged the Victoria Institute of Strategic Economic Studies (VISES), Victoria University and the Clean Air and Urban Landscapes Hub (CAUL), University of Melbourne to develop a robust set of indicators for measuring the progress and potential success of laneway development. This report describes the conditions for the laneways and proposes a number of indicators that can be used to measure laneway services and benefits as a baseline. Monitoring started in January 2017 and continued through to November 2017.

Laneway characteristics

At the start of the Green Your Laneways pilot, four laneway types were identified and a set of criteria developed to select laneways rated as having good potential (Table 1). Mapping of the CBD, indicating areas of good potential, was used as the basis for public nominations. The four laneways were selected on the basis of over 800 submissions from within the City of Melbourne Hoddle grid.

Draft project plans were developed and distributed for comment. Following engagement of in-lane stakeholders, there was a program of public engagement, as well as a pop-up event where laneway greening was trialled. Adjacent building owners and business have been engaged extensively through 2016. This project of monitoring and developing indicators therefore began with a population who are largely aware of the developments and the benefits included in the engagement program. They may have certain expectations as a result and questions for residents and business were drafted to capture these expectations.

Table 1: Selection criteria for prioritising laneways for greening (T. Croeser, CoM).

	Food lane	Park/Plaza lane	Vertical Garden	Forest lane
	Narrow or close lane and grow food, usually in raised beds.	Close some/all of a lane and create a comfortable, vegetated public space. Full closure of at least part of the lane.	Find large walls and grow a green façade, ideally training it overhead, while maintaining access or narrowing slightly.	Narrow lane and plant trees, while maintaining access.
Potential for partial closure	Important	Vital	Irrelevant	Irrelevant
Potential for narrowing	Desirable	Irrelevant	Irrelevant	Vital
Absence of driveways	Desirable	Important	Desirable	Important
Good Sun	Vital	Important	Important	Desirable
Shelter from the wind	Desirable	Important	Desirable	Desirable
Suitable Walls	Not important	Not Important	Vital	Irrelevant
Downpipes and drainage channels for WSUD	Desirable	Desirable	Desirable	Desirable
Absence/scarcity of bins	Desirable	Desirable	Desirable	Desirable
Wide	Important	Important	Irrelevant	Desirable

Physical description

Laneway catchments

In discussion with council staff a laneway catchment size of 400 m diameter was chosen, selected in order to include access by walking, so taking in specific blocks, rather than being a specific shape. The catchments of Meyers Place and Coromandel Place overlap. While this means some properties are sampled twice, the analysis for each laneway catchment is independent so does not affect the results. Location of the four laneways in and their catchments are shown in Figures 1–4.

Figure 1: Coromandel Place and catchment area.

Figure 2: Guildford Lane and catchment area.

Figure 3: Katherine Place and catchment area.

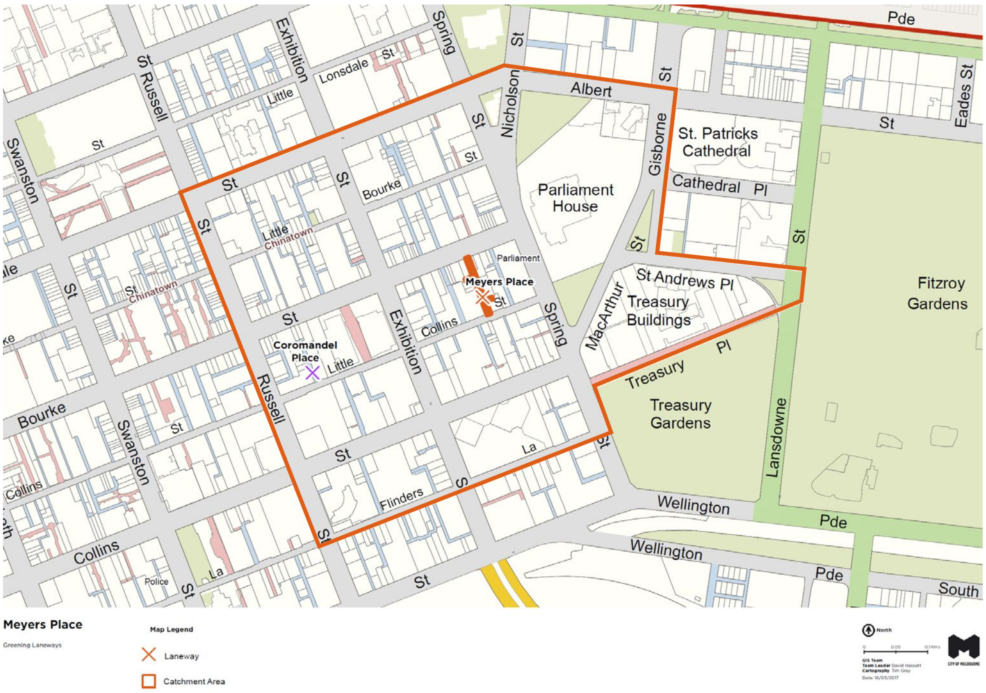


Figure 4: Meyers Place and catchment area.

Climate

The historic mean annual temperature before 1950 for central Melbourne was approximately 14.8 °C. Since 1950, this has steadily increased and the average in the last 20 years (1995–2014) was 16.3 °C. This increase has been more pronounced in minimum (overnight) temperatures, although daytime temperatures have also increased. The long-term mean annual rainfall around central Melbourne is 650 mm but rainfall over the last 20 years has averaged 564 mm/year, and during the drought of 2002–2009, averaged 488 mm/year. While some of these changes are due to human induced global warming (via CO_2 emissions), local changes have been exacerbated by other factors such as the Urban

Heat Island (UHI) effect. The UHI effect is at a maximum during 21:00 to 0:00 and at a minimum at 9:00 to 15:00 (Earl et al., 2016). There is also a weekend effect measured in winter for maximum temperature of 0.29 °C, and a 0.24 °C effect on minimum temperature and 0.20 mm/day effect on rainfall (Simmonds and Keay, 1997). When contrasted with the UHI effect a weekend effect of -0.20 °C at 9:00 on Sunday and slightly less in the afternoon shows the contribution of traffic and radiated heat from buildings on the UHI (Earl et al., 2016).

Models of Melbourne's UHI have recorded the maximum urban heat intensity (approximately 4 °C) in areas of the highest commercial and residential development in Melbourne's CBD (Figures 5 and 6).

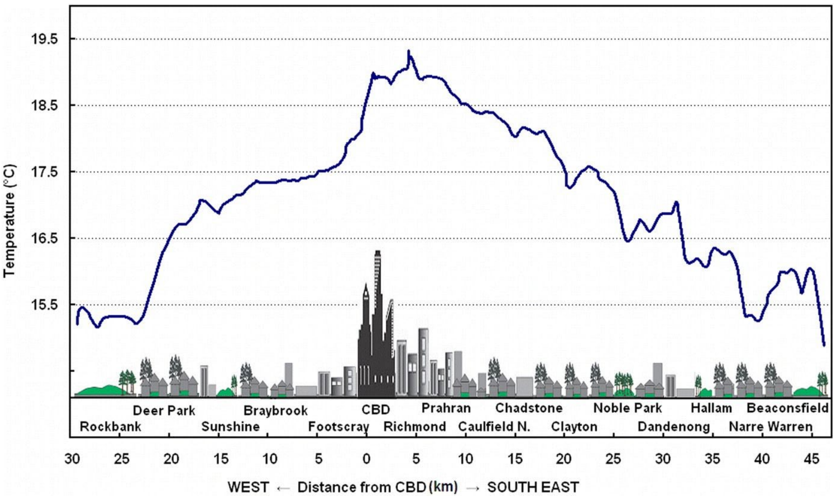


Figure 5: Spatial variability of Melbourne's night-time urban heat island effect with the maximum urban heat island intensity (approximately 4°C) recorded in areas of the highest commercial and residential development in Melbourne's CBD. Figure modelled by and reproduced from Coutts et al. (2010).

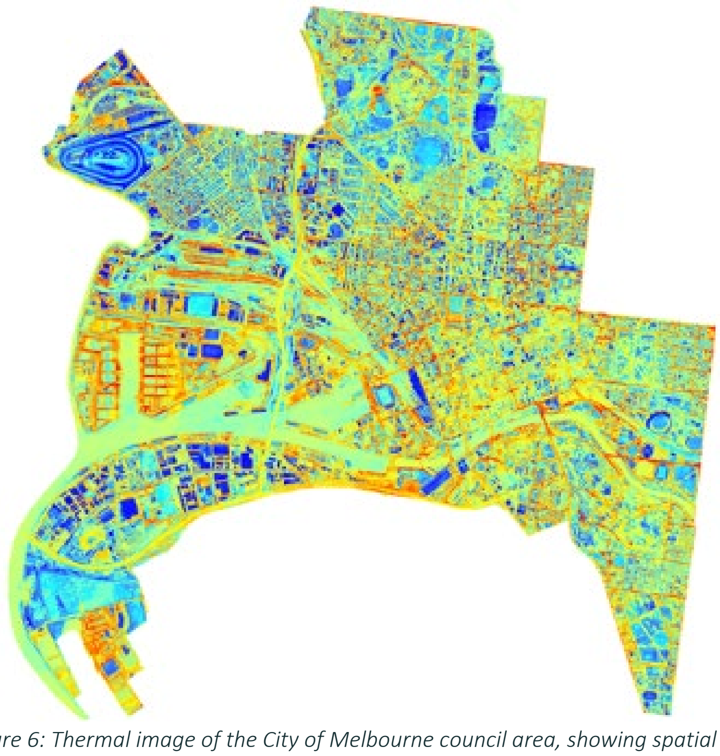


Figure 6: Thermal image of the City of Melbourne council area, showing spatial variability of heat intensity. Areas of red and yellow (e.g., Melbourne's CBD) radiate most heat and areas of blue and green (e.g., large parks) radiate less heat.

Temperature can also vary greatly at street level. For example, shade offered by street trees or from the tall surrounding buildings creates spatial variation in temperature of streets. At these local scales, planting trees and vegetation is expected to create a cooling effect within streetscapes, and was a key factor in selecting the laneways to be greened. Figure 7 is a picture of a typical streetscape within the city area (to show shade effects from trees) and Figures 8–11 show each of the laneways. The thermal imaging photographs of the four laneways were taken on a hot, +30 °C day. These photos were taken using a Seek Thermal Compact Pro imaging camera adapter for Android smartphones. They show the variation of temperature in each of the four laneways in warm conditions.

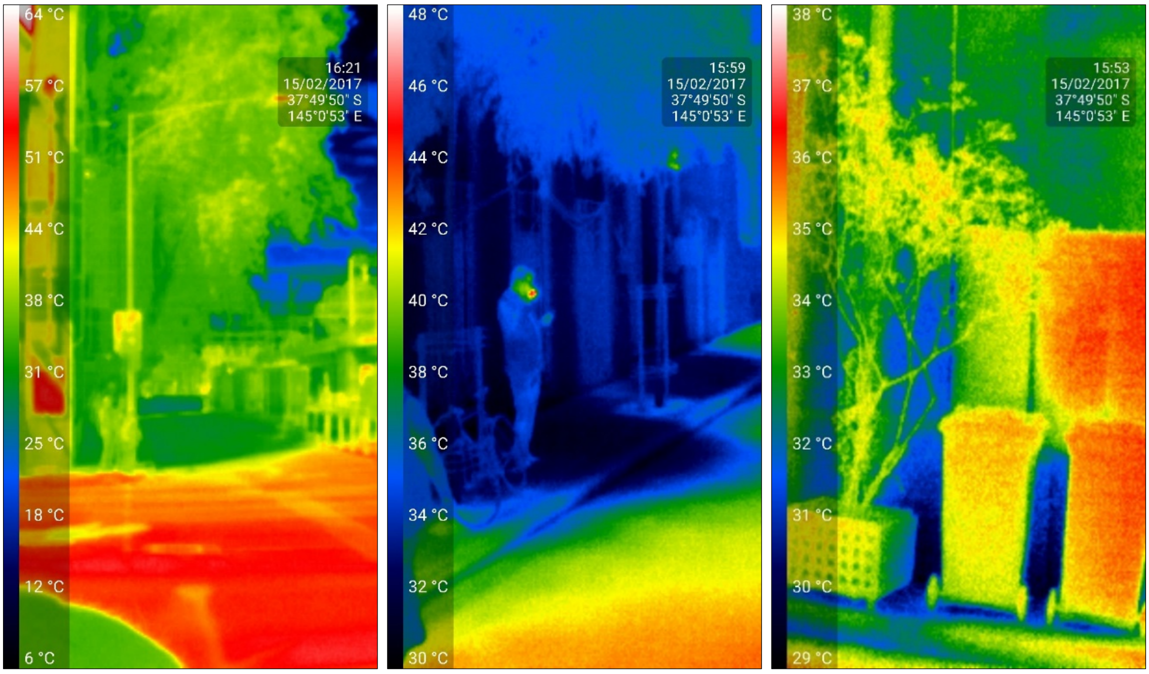


Figure 7: Thermal images of a streetscape in Melbourne's CBD. Colour scales in °C are on the far left of each picture. Blue and green colours indicate the coldest areas and yellow and red indicate the hottest areas. The coolest areas are under the tree canopies, highlighting their important cooling effect. The hottest areas are roads, dark surfaces and a cigarette.

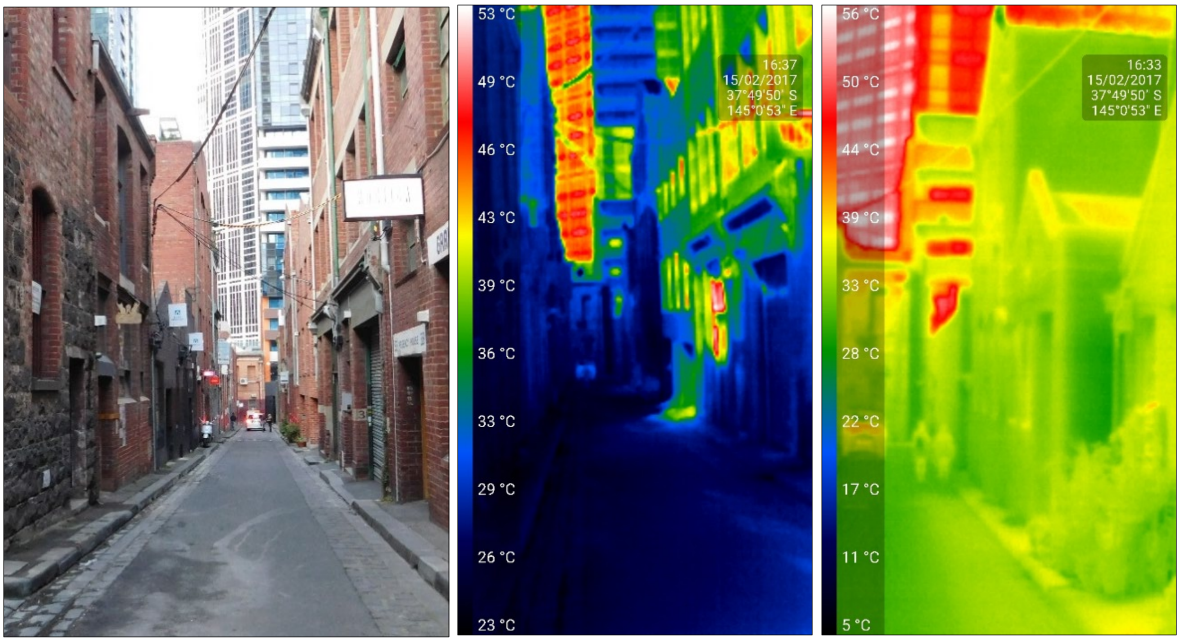


Figure 8: Conventional and thermal images (eastward facing) of Guildford Lane. Colour scales in °C are on the far left of the thermal images, highlighting the temperature variation within the lane.

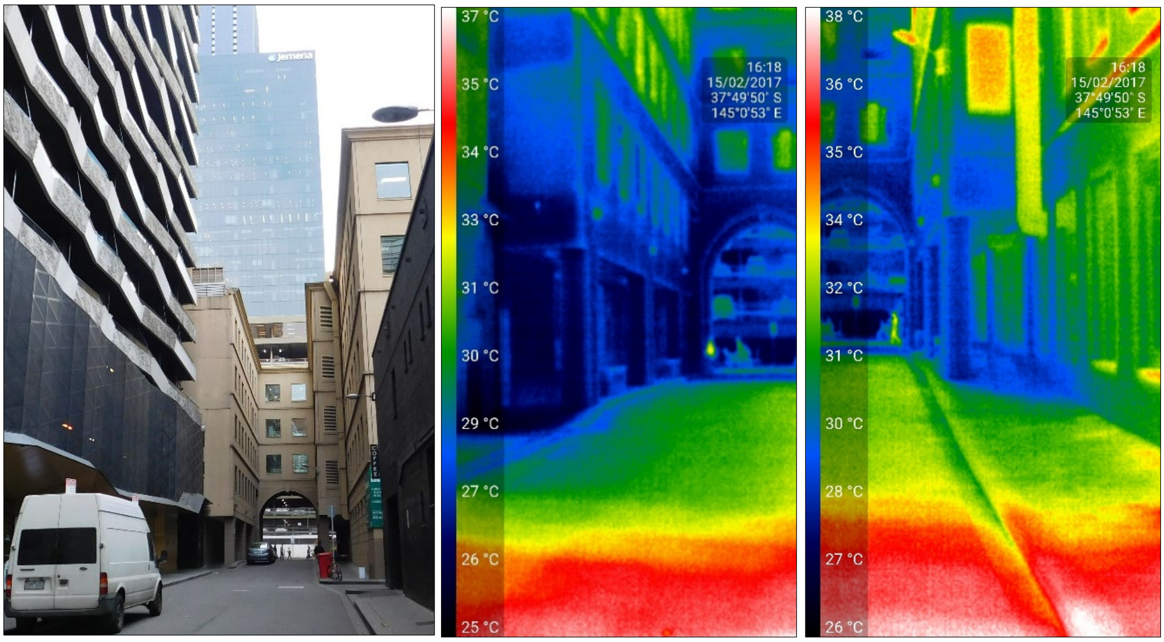


Figure 9: Conventional and thermal images (northward facing) of Katherine Place. Colour scales in °C are on the far left of the thermal images, highlighting the temperature variation within the lane.

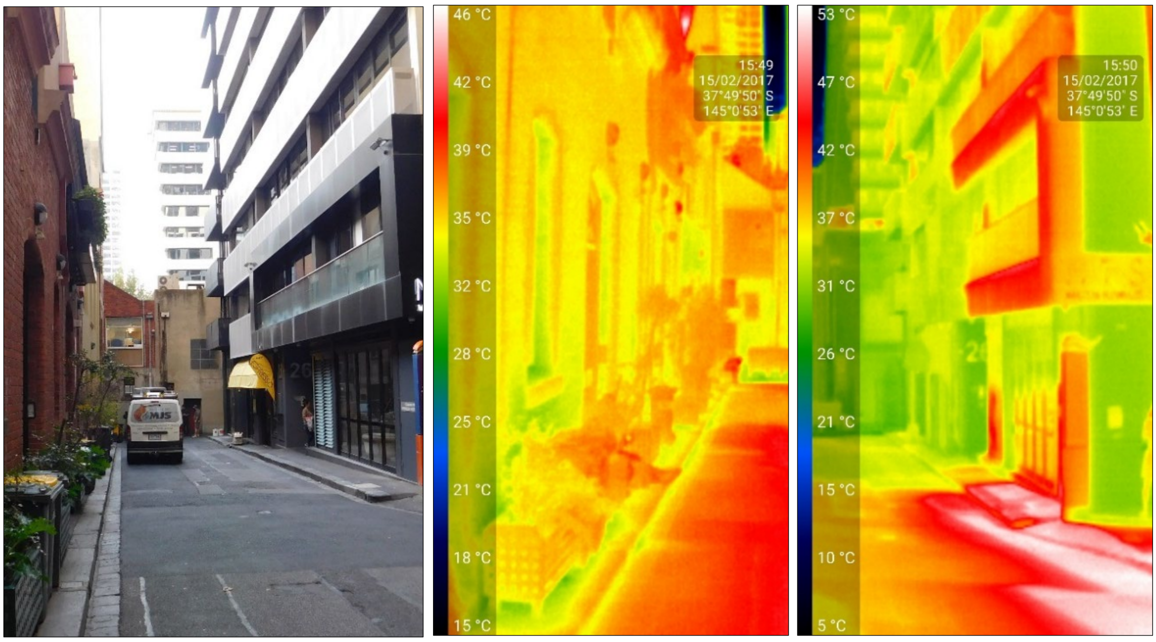


Figure 10: Conventional and thermal images (northward facing) of Coromandel Place. Colour scales in °C are on the far left of the thermal images, highlighting the temperature variation within the lane.

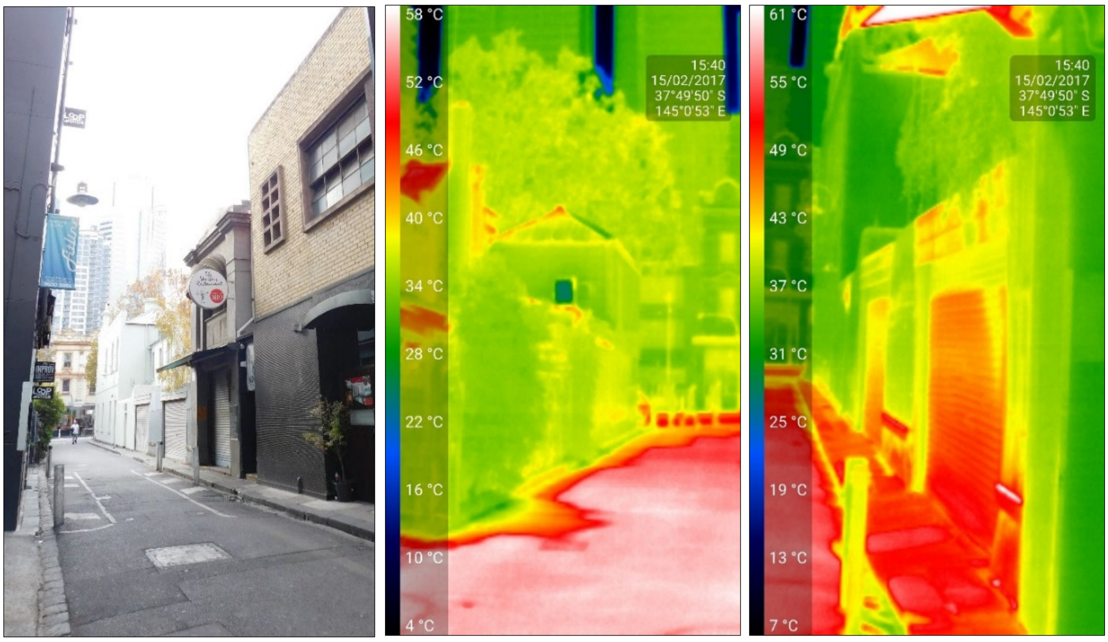


Figure 11: Conventional and thermal images (northward facing) of Meyers Place. Colour scales in °C are on the far left of the thermal images, highlighting the temperature variation within the lane.

Public perception of laneways

Street intercept interviews of twelve people (n = 12) were conducted to assess background public perceptions of laneways (see Appendix 7 for details). The purpose of the interviews was to gain insight into how people think about laneways, and the type of language they use when talking about them.

Word clouds were created from the data collected during the interviews. A word cloud represents word frequency, giving greater prominence to words that appear more frequently in the interviews. Word clouds were produced for each laneway (except for Katherine Place due to the low response rate) to visualise the patterns of words used in the interviews (Figure 12).

Figure 12: Word cloud representation of all comments from the interviews across all four laneways, Coromandel Place, Guildford Lane and Meyers Place.

Identifying robust indicators

The following indicators have been selected to measure how benefits increase as laneway greenery grows and develops. They are also designed to be integrated into the ongoing monitoring and evaluation program run by the City of Melbourne.

Indicators can identify types of outcome or benefits and measure specific levels of performance (Figure 13). The aim of developing any set of indicators is to select as small a set as possible that indicate the widest possible range of key benefits. Ideally, indicators should be measurable, where measurement is straightforward, and be part of an ongoing monitoring program. The indicators that can fulfil the above criteria and describe benefits with a high level of confidence we consider as being robust.

Table 2 outlines the main indicators selected and their key benefits. Appendix 1 provides a comprehensive list from the literature and a more detailed version of Table 2 with notes. A wide variety of indicators are possible, so where the laneways would have little effect, or collection methods were difficult or not routine, indicators were not selected. Some considered to be in this category are listed in Appendix 4. Note that the effort in collecting and analysing indicators should be as efficient as possible, or will detract from any benefits gained.

Table 2: Selected indicators and major benefits of laneway greening.

Indicator	Method	Baseline	Benefits
Greening			
Tree canopy	Proportion of street covered by tree canopy	0%	Cooling, shade, aesthetics, stormwater interception, pollution filtering
Green wall cover	Proportion of walls covered by vegetation	0%	Cooling, aesthetics, pollution filtering
Plant diversity	Shannon index (see p 11)	0	Biodiversity, aesthetics, resilience
Social			
Public safety	Questionnaire using CoM perceptions of safety items	see below	Increased economic activity, reduced crime
Quality of life	Questionnaire using CoM perceptions of safety items	see below	Increased economic activity, more positive attitudes and wellbeing
Occupancy/Activity	CoM Public Life survey methods	see below	Increased economic activity, community connectedness
Social values	Measured using adapted Valued Attributes of Landscapes Scale in questionnaire	see below	Identifies how different people receive benefits of urban greening
Environmental			
Temperature	Direct measurement using iButton temperature sensors	see below	Reduced temperatures will improve laneway occupancy rates* and reduce adverse heat effects
Biodiversity	Insect, bird diversity	see below	Ecosystem function, aesthetics, conservation
Economic			
Property values	Council rental returns	see below	Private benefits
Employment	Biennial survey, direct question	see below	Economic activity
Business benefits	Direct questions	see below	Economic activity

*occupancy rates – number of people and time spent

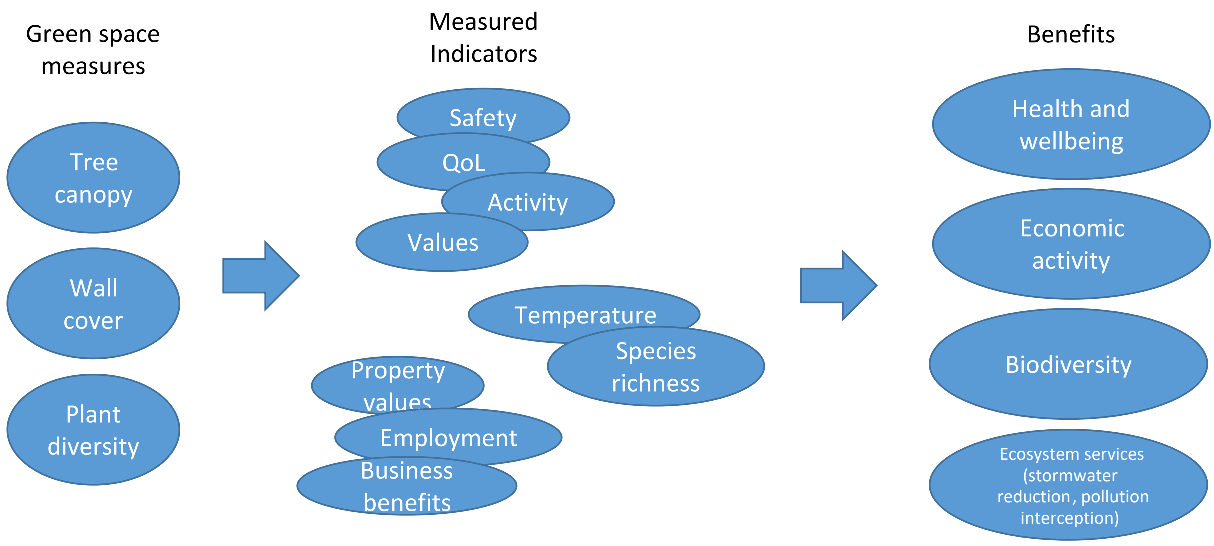


Figure 13: Relationship between green space measures, indicators and benefits

Methods to collect indicators

Greening indicators

Tree canopy

Tree canopy is measured as the proportion of the plan area of the laneway covered by tree canopy. As there were no trees in the laneways prior to the greening intervention, the baseline was calculated as 0%. Tree canopy can also be converted into a few other measures such as leaf area index when the species are known for measuring benefits such as stormwater reduction and pollution interception.

Green wall cover

Green wall cover is measured as the extent (in m^2) of vertical walls covered by live green vegetation in the laneway. As there was no green wall cover in the laneways prior to the greening intervention, the baseline was calculated as 0 m^2.

Plant diversity

The Shannon index is a measure of diversity that includes both species richness and the relative abundance of different species. It is higher when there are more species present, and these species are relatively evenly represented. It is lower when there are fewer species, and there a small number of species with relatively high abundance. The Shannon index (H) is calculated using the following formula, where the proportion of species (i) relative to the total number of species (pi) is calculated, and then multiplied by the natural logarithm of this proportion (lnpi); this product is summed across species, and multiplied by -1:

$$H = -\sum_{i=1}^{s} p_i \ln p_i$$

It is relatively easily calculated using many common statistical software packages.

As there were no plants in the laneways prior to the greening intervention, aside from a few privately-owned plants in pots in Guildford Lane, the baseline value is 0.

Social indicators

Social values were addressed by questionnaire and observation, using CoM data collection methods to allow comparison with citywide benchmarks where appropriate (e.g. quality of life and public life surveys). Some feedback on changing social activities has also been obtained from local businesses.

Where possible, the methods and tools used to collect the social data used existing methods used by the City of Melbourne; e.g., quality of life survey, survey of public life. A new scale, which measures public values for Melbourne's laneways was developed for this project. This scale can be easily inserted into existing surveys conducted by the council to measure changing community values overtime. Baseline data has been collected and is described below.

The Questionnaire

A psychometric questionnaire was developed to support the development of the public safety, quality of life and social values indicators. The questionnaire consisted of three sections:

- *Values of Melbourne's laneways:* Using a modified version of the Valued Attributes of Landscapes Scale (VALS; Kendal et al., 2015), this scale measured what people find important about Melbourne's laneways (n = 18 questions; participants were asked to rate how important they thought attributes of Melbourne's laneways were to them on a 7-point scale).
- *Awareness and attitudes towards the four specific laneways:* Awareness of the four specific laneways and purpose for visiting the laneway was measured using multiple choice and an open-ended question. Attitudes including satisfaction, perceptions of maintenance and feelings of safety was also measured (n = 4 questions; participants were asked to rate their level of agreement with statement on a 7-point scale with an option for an 'I don't know' response).
- *Subjective wellbeing as a resident of the City of Melbourne:* Using the Personal Subjective Wellbeing Index already in use by the City of Melbourne, this scale is a subjective indicator of personal wellbeing and is used by the City of Melbourne as a proxy for quality of life (n = 9 questions; participants were asked to rate their level of satisfaction with statements on a 7-point scale with an option for an 'I don't know' response).

Some basic demographic questions were also asked, such as gender, age, level of education and language other than English to identify the representativeness of the sample compared to the general population of the City of Melbourne. Questionnaires were modified slightly for each lane – the survey for Coromandel Place is in Appendix 8.

The population of interest in this survey was occupiers of residential buildings, but not workers or visitors, which was considered achievable within the given budget. The economic survey captured the opinions of business owners. Future research could explore the opinions of workers, although different (and more expensive) methods such as intercept surveys would likely be required. The survey and a follow-up reminder postcard was hand-delivered to residents living within the 200 m diameter laneway catchment (n = 763). The survey was intended to capture the perceptions residents living close to the laneways being greened to understand the local scale benefits of greening for nearby residents. Residents were invited to return the survey by post or complete it online. A total of 459 surveys were able to be delivered, and 53 completed questionnaires were returned (a response rate of 11.5%, which is consistent with similar studies).

Values for Melbourne's laneways: analysis and results

The published factor structure of the VALS was used to group scale items into six overall dimensions, and item scores were averaged within each factor. Natural values came lowest, perhaps due to the lack of greenery in the laneways at present (Figure 14). Laneways are largely thought of as social and cultural assets at present.

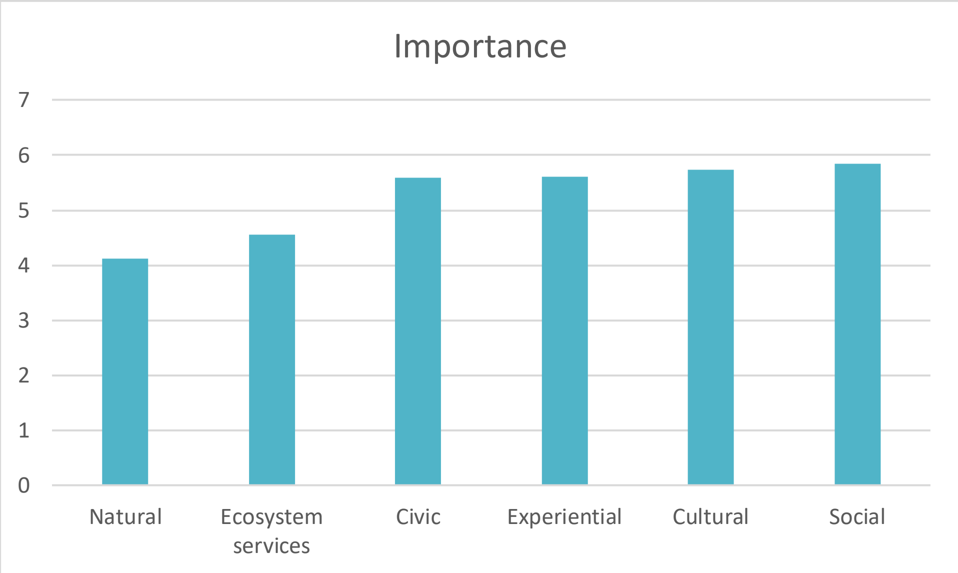


Figure 14: The importance of each value category on a Likert Scale (0–7) to all survey participants.

Quality of life: analysis and results

Consistent with the analysis used by the City of Melbourne, the valid responses (n = 49) to the Personal Subjective Wellbeing Index asked in the survey were aggregated for each respondent and then for all survey responses across the four laneways. The index ranges from a score between 0–100, with 0 being low and 100 being high self-reported wellbeing. The average Personal Wellbeing Index for the survey respondents was 73.5. This is similar to the data collected by the City of Melbourne in 2016 where the average Personal Wellbeing Index for residents living in Melbourne was 76.5. Table 3 shows changes overtime to the average Personal Wellbeing Index score measured in the City of Melbourne from 2011–2016.

Table 3: Average Personal Subjective Wellbeing Index scores from 2012–2016 as measured by the City of Melbourne, and the scores calculated from the project survey, 2017.

Year	2012	2013	2014	2015	2016	2017 project survey
Average subjective wellbeing (%)	75.6	76.7	76.8	76.9	76.5	73.5

Perceptions of safety: analysis and results

The valid responses (n = 32) to the personal safety survey questions were aggregated for all survey responses and across the four laneways. The results show that 90.3% of respondents feel safe in the four laneways during the day, compared to only 70.9% of respondents who said they feel safe at night. These figures are very consistent with the perceptions of safety data collected by the City of Melbourne in 2016 which showed that 90.3% of residents in Melbourne felt safe during the day and 69.9% felt safe at night. Figure 15 shows the change overtime in resident's feelings of safety collected by the City of Melbourne from 2014–2016.

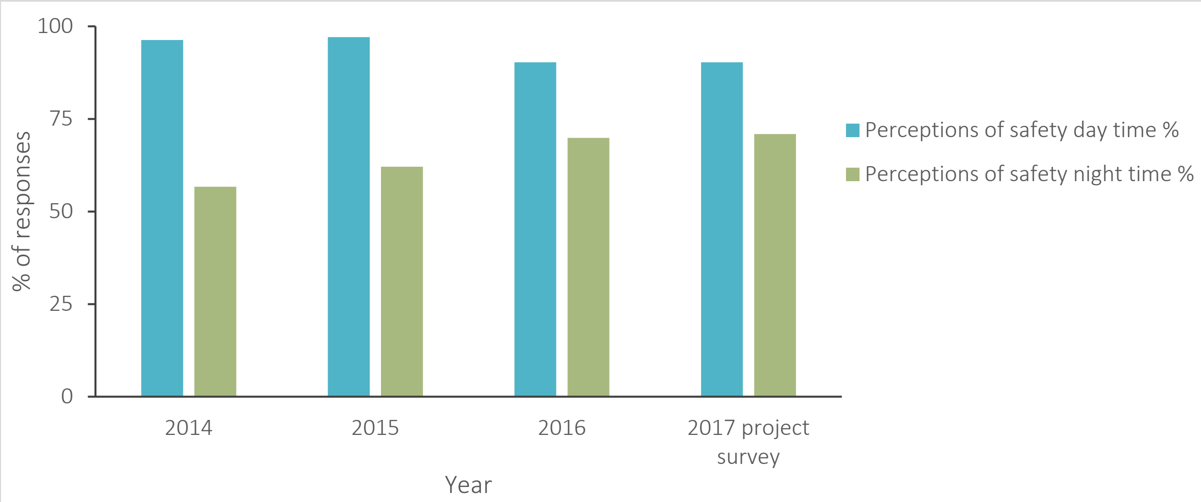


Figure 15: Residents perceptions of safety during the day time and night time as collected by the City of Melbourne from 2014–2016, and responses of residents collected in the project survey, 2017.

Public life surveys

The Places for People (City of Melbourne, 2016) survey methods currently used by the City of Melbourne was used to develop indicators for public life in laneways. The data collected to measure public life included:

- *Pedestrian counts:* pedestrians, children, people in wheelchairs/ buggies and people on roller-skates and skateboards were recorded over a 10-minute period at various times of the day, across several weekday days in the four laneways. This data was collected during April and May 2017 (refer to Appendix 6 for exact times and days).
- *Stationary activities:* people standing, sitting, lying down, playing and involved in cultural and commercial activities was recorded on a map of the laneways. This data was collected during weekday days in April and May.
- *Seats:* areas of public or secondary seating was mapped throughout the laneways.

Pedestrian counts: analysis and results

The pedestrian count data collected for this project was aggregated to estimate hourly pedestrian traffic, and then aggregated across all weekday data to produce an estimation of average weekday pedestrian traffic (between 10am – 5pm). These estimates were then compared to the hourly count of pedestrian traffic currently collected by the council which is available on the City of Melbourne's Open Data Platform. The data estimates show that the laneways measured for this study have significantly less pedestrian traffic compared to other lanes in similar areas on the city (Table 4). While the laneways sampled for this project, and the laneways CoM currently collects pedestrian data for are close in proximity, this is result is expected, being due to the differences between surrounding land uses of the lanes used in this study, compared to the retail and dining hot spots of Collins and Alfred Place.

Table 4: Estimated average number of pedestrian traffic per hour during weekdays (between 10am – 5pm).

Lane	Average number of weekday pedestrians per hour
Coromandel Place	105
Guildford Lane	159
Katherine Place	165
Meyers Place	312
Alfred Place	524
Collins Place	636
Corner of Spencer and Collins Street (south)	601

Stationary activities: analysis and results

The stationary activity data was spatially mapped using ESRI ArcGIS 10.4 to identify clusters of stationary activity within the laneways. The frequency for stationary activities were also analysed.

Coromandel Place

Similar to the other laneways, standing, sitting outdoors at a café and sitting on secondary seats were the reported stationary activities occurring in Coromandel Place at the time of the surveys. These activities occurred in clusters near the café and a public ashtray in the laneway (Figure 16).

Figure 16: Stationary activities reported in Coromandel Place.

Guildford Lane

Standing and sitting outdoors at a café were the two reported stationary activities occurring in Guildford Lane at the time of the surveys. The survey highlighted clusters of stationary activity occurring near a café with outdoor seats (Figure 17).

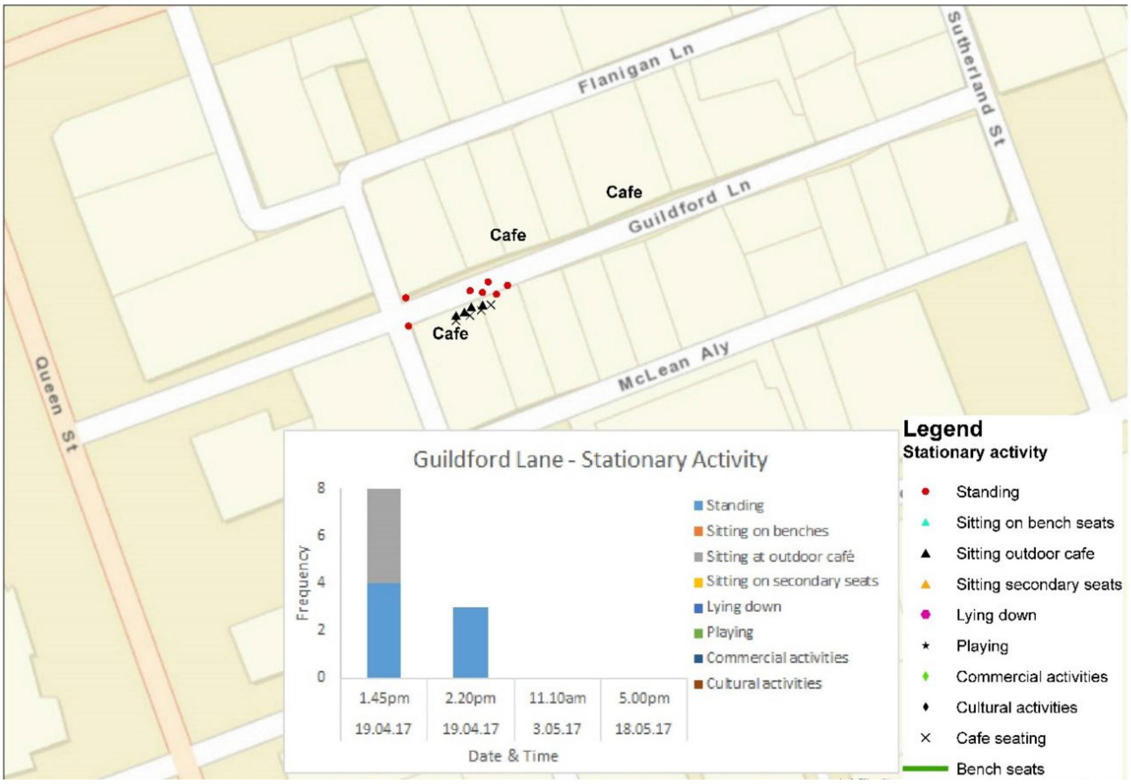


Figure 17: Stationary activities collected across several days in Guildford Lane.

Katherine Place

Standing, sitting on secondary seats and sitting outdoors at a café were the reported stationary activities at the time of the surveys in Katherine Place. These activities occurred in clusters throughout the laneway near cafes (Figure 18).

Figure 18: Stationary activities reported in Katherine Place.

Meyers Place

Standing was the only recorded stationary activity in Meyers Place at the time of the survey. Unlike the other three laneways, the cafes in Meyers Place do not have outdoor seating and there were no secondary seats in the laneways at the time of the surveys. There were less defined clusters of stationary activity in Meyers Place, however there still seemed to be a small relationship with people standing near areas of cafes (Figure 19).

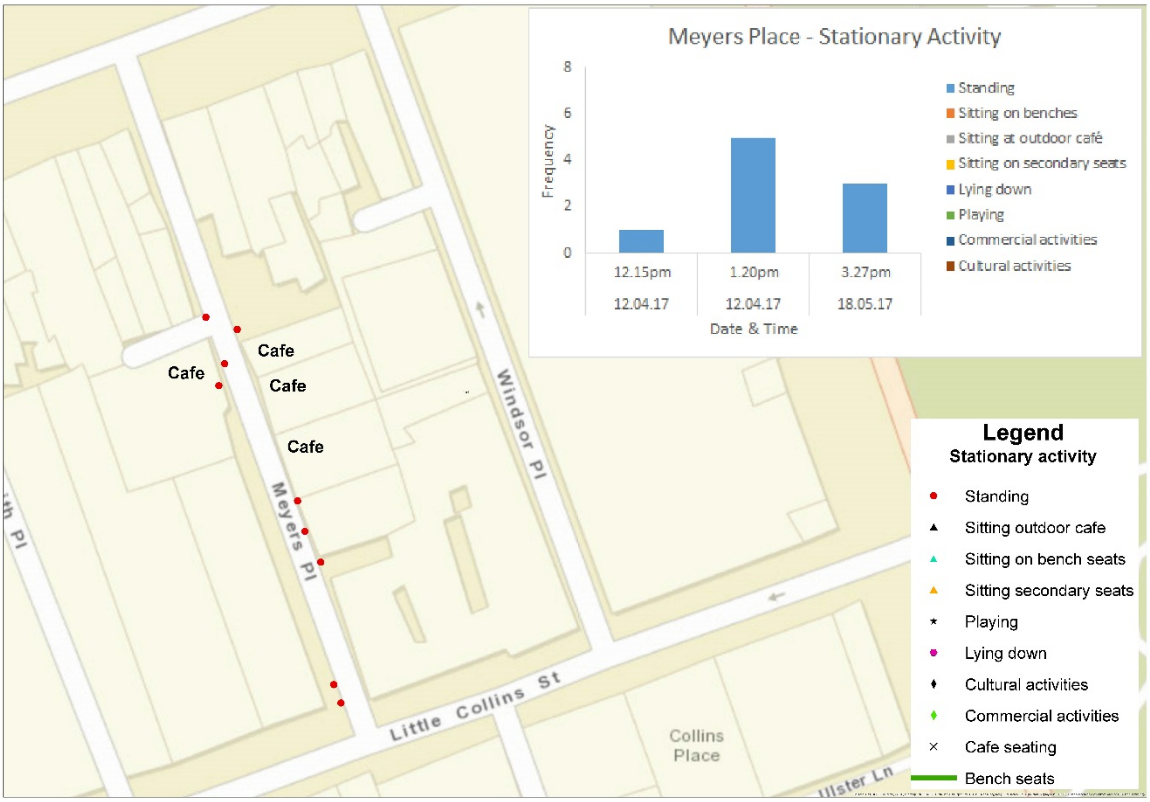


Figure 19: Stationary activities reported in Meyers Place.

Environmental indicators

Environmental indicators include the laneway greening itself as the source of potential benefits and the benefits from environmental services provided as a result. For this initial work, only direct benefits within or adjacent to the laneway itself are being assessed. While the cooling effects of tree canopy cover are well established, it is difficult to measure this benefit within the small-scale context of the four laneways.

Temperature

To gain a greater insight into the local climate of the four laneways, ambient temperature was measured to support the development of the cooling indicator. Hourly temperature readings were collected over a three-month period from January to April 2017 using iButton temperature sensors. Following methods by Roznik and Alford (2012), the sensors were waterproofed and installed in shaded areas of the laneways; e.g., behind street signs and drain pipes (Appendix 3). Six sensors were installed in three locations across Katherine Place, Meyers Place and Guildford Lane, and four sensors were installed across two locations in Coromandel Place (see Appendix 3 for exact locations of the sensors). Sensors were installed in pairs and the temperature records were averaged to increase the accuracy of the readings. Temperatures are registered in 0.5°C increments and have an accuracy rating of ±1°C.

Figure 20 shows the daily temperature profile of each lane compared with the Bureau of Meteorology site at Olympic Park. Meyers Place is slightly warmer than the others. Katherine Place, which runs north-south shows an early peak coincident with sunshine and rapid cooling back down to background levels. All four show the heat retained in the city at night compared to the more exposed Olympic Park location.

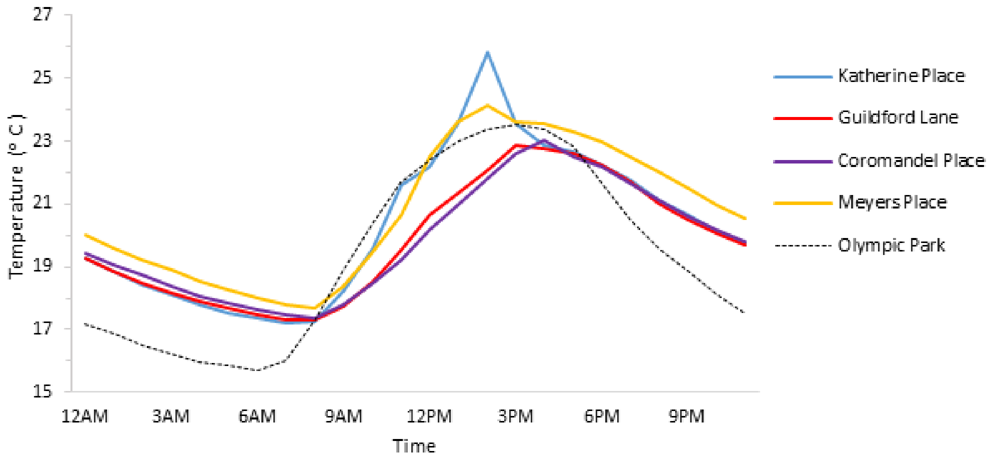


Figure 20: Daily temperature profile of the four laneways and Olympic Park Weather Station. Daily profile is based on average hourly temperature from January to March, 2017.

Biodiversity

There is relatively little information on the plants, animals and insects that inhabit the laneways throughout central Melbourne. Biodiversity experts were consulted and suggested that baseline surveys were not required due to the lack of vegetation in the laneways. The pool of species that could occur in the laneways in the future was compiled from the City of Melbourne's Open Data Platform which gives some insight into the tree (but not all plants) and insect species inhabiting the streets, parks and gardens in central Melbourne. For animals apart from insects, only birds were considered relevant at the laneway scale, due to the lack of habitat for other animals.

As Melbourne's laneways continue to be greened, it is likely that plant and subsequently insect diversity will, overtime, increase throughout central Melbourne. As no biodiversity data were collected as part of the baseline surveys, there is flexibility in choosing the final methods used to monitor biodiversity. The final methods will depend on the available monitoring budget, but the methods used should be consistent with approaches to biodiversity collection across the municipality (i.e., adopt council standards where they are available).

Trees

There are 2,567 publicly managed trees planted throughout Melbourne's CBD, comprising 80 known species (City of Melbourne open data portal). The most common tree species throughout the CBD include *Corymbia citriodora* (Lemon-scented gum); *Corymbia maculata* (Spotted Gum); *Platanus orientalis 'Digitalis'* (Oriental Plane); *Platanus x acerifolia* (London plane); and *Syzygium floribundum* (Weeping Lilli Pilli). Refer to Appendix 2 for a summary of the trees throughout the municipality. Figure 21 shows the location of the publicly managed street trees from the City of Melbourne's Urban

Forest Visual. These maps show that prior to greening installations there were no trees in the four laneways used in this study.

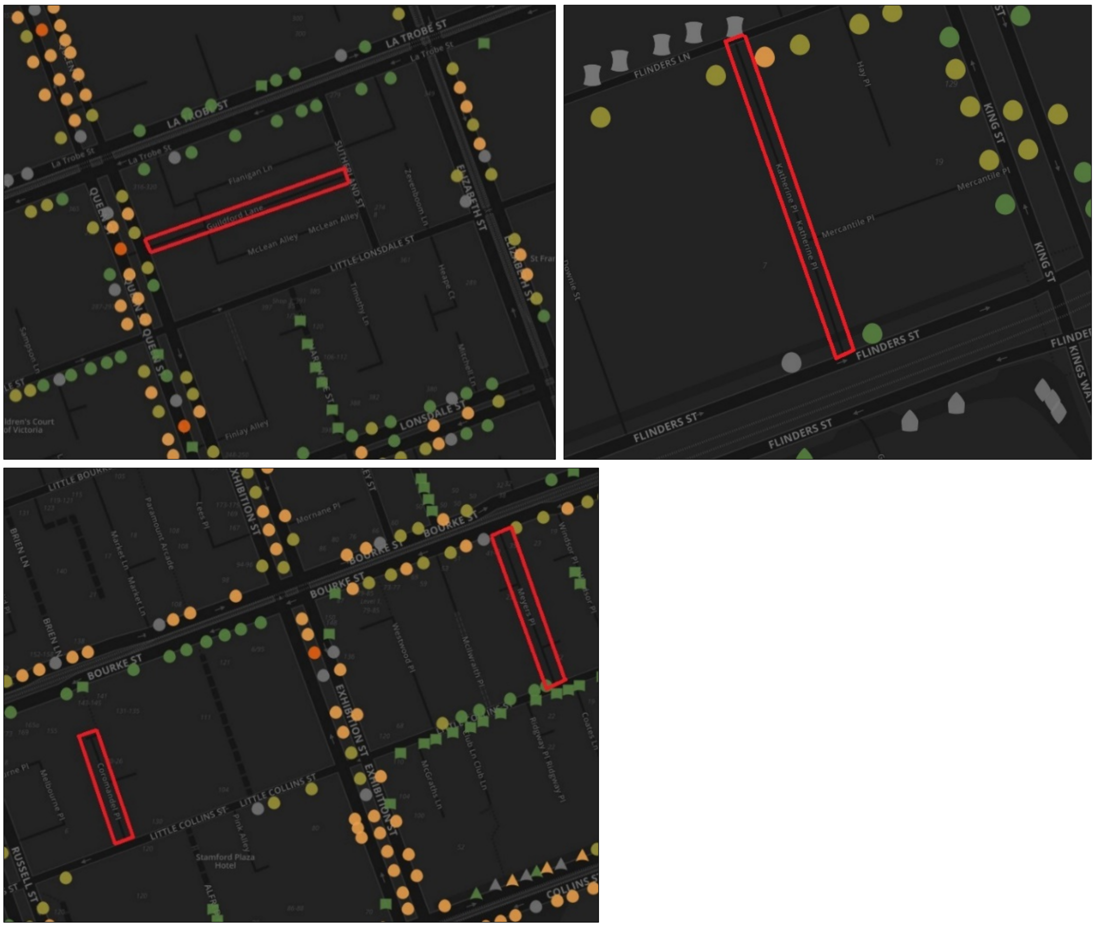


Figure 21: Location of publicly managed trees throughout Melbourne's CBD in mid 2017. The laneways (top left Guildford Lane; top right Katherine Place; and bottom left Coromandel Place and Meyers Place) are highlighted in red and each coloured dot represents a tree. Source: http://melbourneurbanforestvisual.com.au/bigmap.html

Birds

At present there is little information available at laneway scale and bird diversity is unlikely to increase until vegetation becomes established. Future monitoring could include bird surveys, using standardised protocols adopted for the City of Melbourne.

Insects

A total of 103 families of insects recorded during the City of Melbourne's The Little Things that run the City program (Mata et al., 2015;Mata et al., 2016). These records were collected in 2017 across 15 parks and gardens throughout the municipality (Figure 22). The five most common families of insects recorded throughout the city include Latridiidae (a family of small beetles commonly referred to as minute brown scavenger beetles); Formicidae (ants); Ephydridae (shore fly); Coccinellidae (a family of small beetles widely referred to as ladybird beetles); and Cicadellidae (leafhoppers). Refer to Appendix 2 for a summary of the data collected from the program.

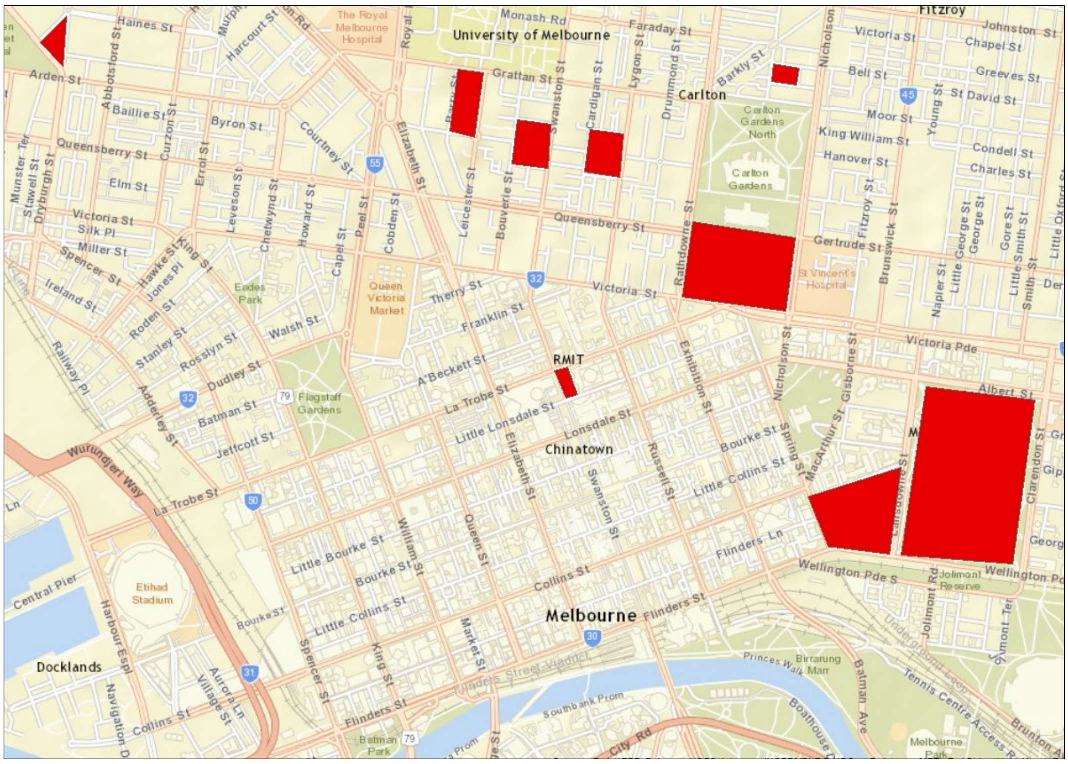


Figure 22: Locations of parks in the inner city and immediate surrounds (in red) where insect surveys were conducted in 2017 as part of The Little Things that Run the City program.

Economic indicators

Laneways and net asset value

The property valuation data provided by the City of Melbourne is the Net Asset Value (NAV) of each property which describes its annual rental value. Figure 23 shows that at the larger catchment scale, changes in NAV over time are similar and correlated, with the more easterly laneway catchments having higher values. The catchments are shown in Figure 1 to 4. At the laneway scale, asset value per property is much more varied and sensitive to property size and any redevelopment taking place.

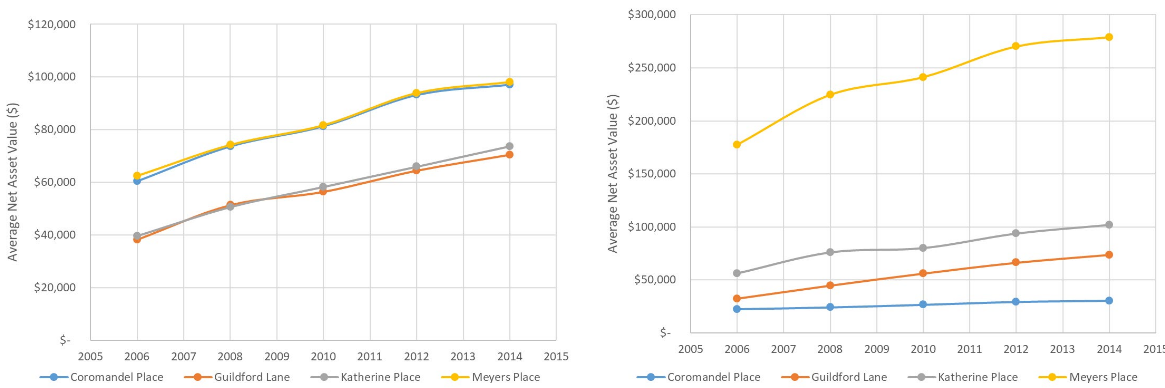


Figure 23: Average Net Asset Value per property for catchments (left) and laneways (right).

The most meaningful measure for NAV is per unit area, which allows property values in different sized areas to be readily compared. Laneway values are lower for Katherine and Meyers Place, similar in Guildford Land and varies strongly over time in Coromandel Place (Figure 24). This shows that NAV measured over floorspace is sensitive to redevelopment. If a large development that increases floorspace has ongoing rental vacancies, as is the case for Coromandel Place, property values will decline until rental returns recover and stabilise. For valuing the effect of the Laneways greening, NAV is a promising indicator that is routinely collected by CoM. This provides valuable longitudinal data to assess any the monetary benefit of Laneways Greening. Changes over time would need to be monitored and compared with catchments and control laneways.

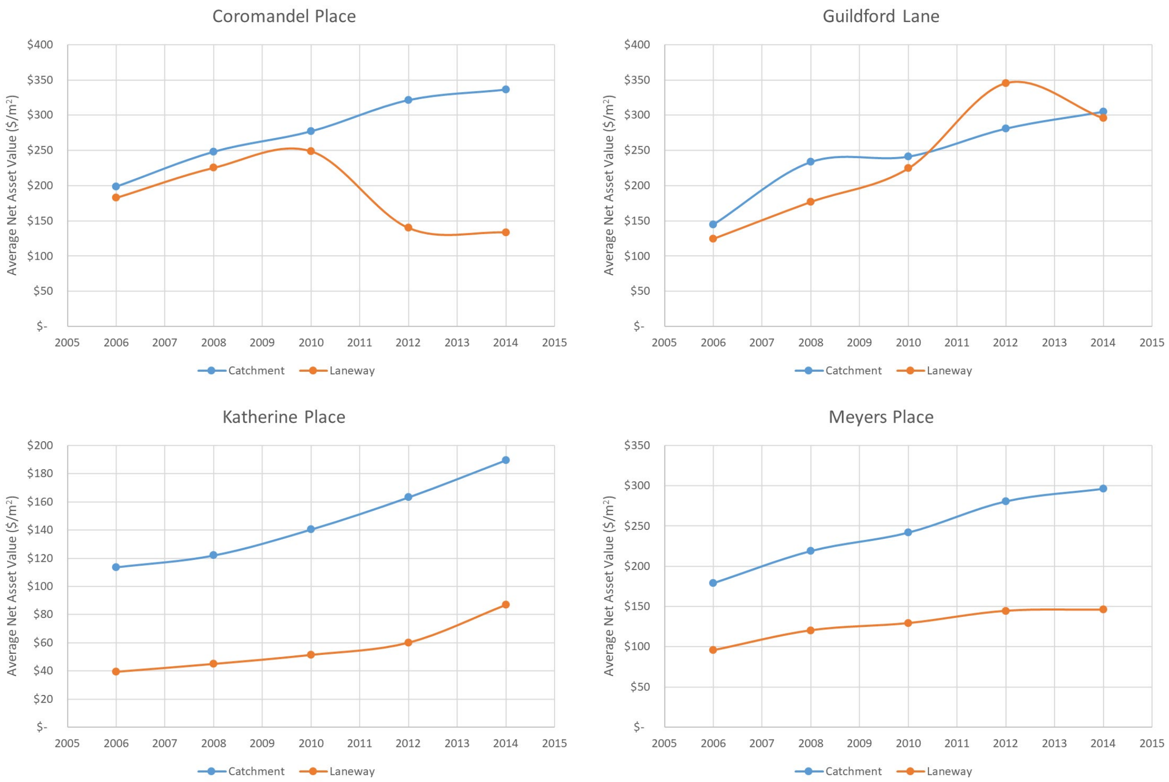


Figure 24: Average Net Asset Value per square metre for each laneway.

Laneways Employment

Employment data from the City of Melbourne was analysed for individual lanes and their respective catchments across a range of economic sectors. The latter are not shown here but are available for further analysis.

The total number of jobs in each catchment area is relatively constant (Figure 25), but numbers vary within laneways (Figure 26). If Laneway Greening leads to increased economic activity, this may lead to an increase in the number of jobs, but the lack of consistent correlation between laneway jobs and catchment jobs means any benefit from greening on employment may be lost in noisy data unless there is a clear and consistent signal. Turnover of businesses and building redevelopment can also lead to changes in employees. If a large business were to occupy new or renovated premises, laneway employment could change considerably. This data is probably best applied with specific knowledge of local businesses and involve analysis of industry-specific employment. Total employment across the laneways compared to total catchment employment could provide useful information, alternatively employment within laneways where no redevelopment has taken place may also provide a useful comparison. At this stage, it is difficult to anticipate which alternative may be the best.

There was a similar issue when employment within specific sectors (e.g., retail) was looked at – the data was even noisier.

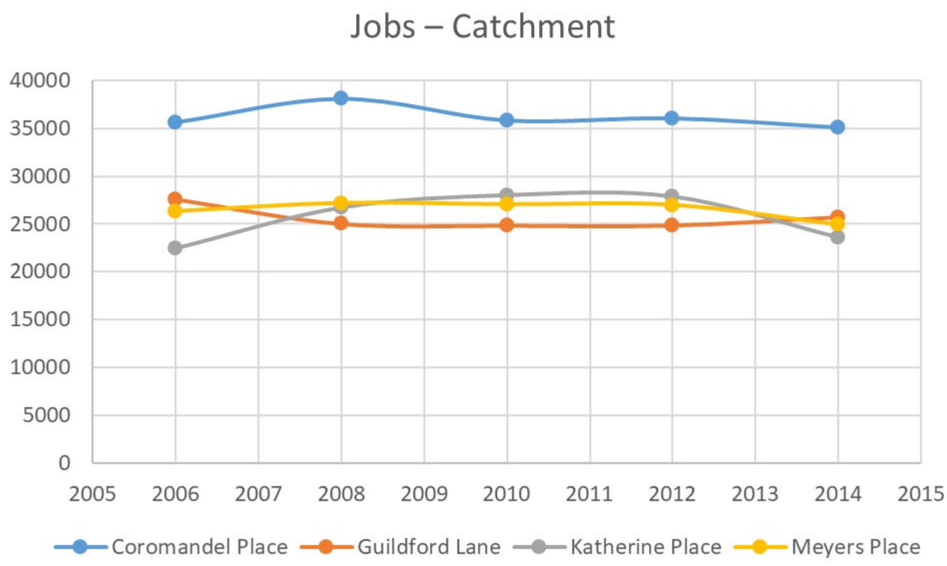


Figure 25: Jobs in catchment areas.

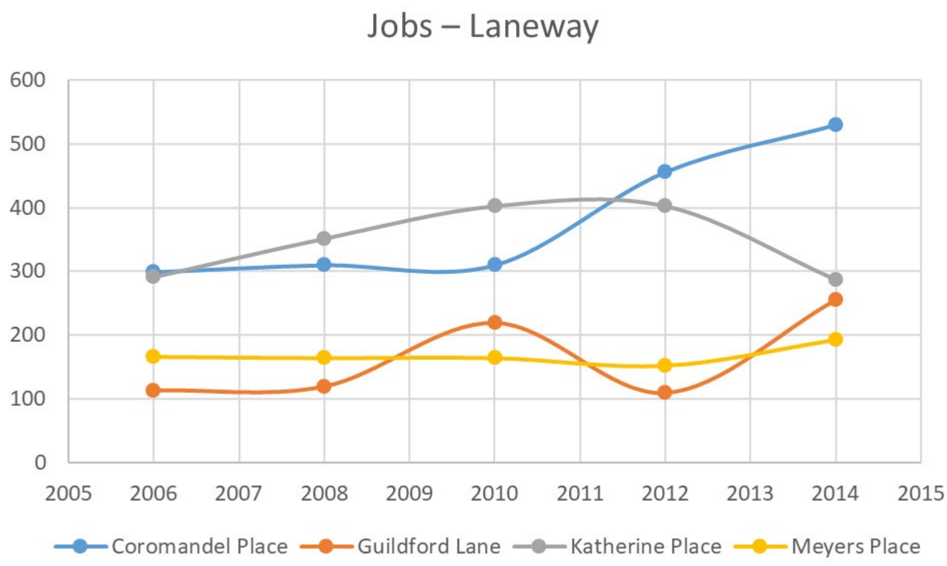


Figure 26: Jobs in laneways.

Business benefits

All of the businesses in the four laneways were approached to participate in a survey regarding the potential business benefits of the Laneways Greening project. Of the 27 businesses approached, 15 agreed to participate.

Most businesses considered the Laneways Greening project to be favourable (4) or very favourable (10) for their business with only one business being neutral (neither favourable or nor favourable). That business had concerns about who was to pay for the project, did not think it would contribute to their business and would not invest. Thirteen business thought they would have a business benefit and two did not. Seven businesses said they were going to invest in their businesses, usually in the form of street furniture. The businesses which were most favourable were restaurants or bars/cafes which had street frontages and considered the improved amenity would draw more foot traffic and make the laneway a 'destination', which in turn would increase their business turnover. The businesses that were less inclined to invest did not have street frontages and were not in the café/restaurant sector; for example, web design or watch repair. One business said they would invest in public benefit, another maybe and ten said not. The other responses were blanks. The results (edited to de-identify specific businesses) are summarised in Appendix 5.

Almost all respondents were positive. If we assume some of the unsurveyed businesses were as positive, consistent with their earlier engagement with the CoM, these responses suggest the project has strong support from the business community.

Economic evaluation

This section discusses how the proposed indicators may be used to estimate the stream of economic benefits over time. The section describes the conceptual basis of the valuation methods described and their potential uses by the CoM. Methods and barriers are outlined. In some cases, it is unclear which indicators may work best, and the final choice also depends on other valuations undertaken for urban greening initiatives in the CoM (e.g., the urban forest program, green roofs and walls). Some of these methods have quite demanding data requirements; applying them to laneways would not be justified, but as part of a larger program valuing the benefits of green infrastructure would be worth the investment.

Valuation methodology

The methodology used to obtain monetary values described here is based on the pathway in Figure 27 that goes from ecosystem structure and function, to the economic valuation of human wellbeing (de Groot et al. (2010); Haines-Young and Potschin (2010) and Maltby (2009). This common-sense framework starts with biophysical structure and processes that produce functions. These in turn provide services. These services can be linked to benefits (or dis-benefits) that can, in turn, be valued. Benefits are separated from services because one service such as visual amenity can have both public and private benefits.

Valuation can take on differing degrees of complexity depending on what is being measured and type of measure being aimed for. For example, a simple measure may be canopy cover, and a complex measure may be the benefits that its shade, water-intercepting capacity and pollution reduction capacity can provide. For a green infrastructure project, the effort to calculate the details of each function, service and benefit in dollar terms can be too great to be worthwhile, and the largest benefits are selected. If there are no existing valuation methods in place, an iterative process may be needed to assess measures for ecosystem function, the services provided, the benefits gained and their economic value to determine the best indicator. Indicators can be taken from any two or more of these items as long as they are straightforward to measure, are accurate, relatively cost effective and repeatable.

For example, the City of Melbourne uses the I-Tree model to value the rainfall interception for each tree, calculating avoided stormwater, which is then given a value of $2.12 per kL. The inputs are restricted to data collected about the tree such as species, trunk width and age/height. The output is given a value. The major shortcoming at present is that the value per kL has not been costed at the local level and is an old estimate (David Callow, pers. comm.). The I-Tree model is being used to value trees on the register, but many of these values may need updating. If used to value those trees, the smaller plants and green walls and facades would be excluded from that valuation.

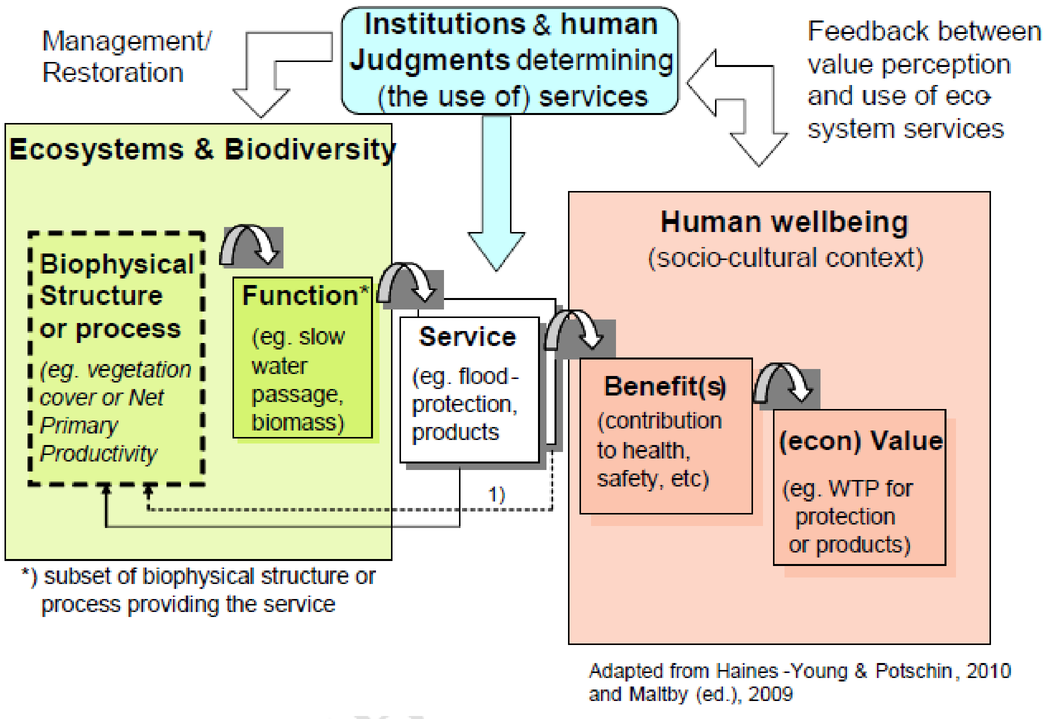


Figure 27: The pathway from ecosystem structure and processes to human well-being (de Groot et al., 2010).

The major challenge for the Laneways Greening project is to determine the pathways that extend from laneway settings and ecosystem structure through to who or what benefits. The challenge comes from their relatively small size with respect to the size of the city and the many other effects within the city that create value. However, qualitatively, there is little doubt that developed laneways create significant local value.

The indicators listed in Table 2 are relatively simple. Some are measures that provide a range of services, whereas others measure outcomes. For example, area of tree canopy is a simple measure that can be used to estimate stormwater reduction, pollution interception, and with some more modelling canopy-scale cooling. Property values are an outcome where value changes over time, and where influences on those values may be assessed, but can be statistically demanding to remove other influences in value.

We apply a loose structure of public and private values, and of monetary, social and environmental values. Public values are those held by communities and institutions, or constitute the commons, where values are shared by many. Sometimes private assets will contribute to public values, and sometimes public assets enhance private values. For example, if businesses invest in improving their outside settings to attract more business, which improves laneway public amenity and council develops the laneways therefore attracting more people to the laneway, which is good for some businesses.

The role of social values in determining services

The way people think about green space in cities is likely to be a determinant of the way value is generated. Researchers have identified several psychological constructs that shape the way people think about the surrounding world and influence behaviour. Social values (e.g., altruism, biospherism) are important factors in shaping the decisions people make about the world around them. A growing body of research describes the hierarchical cognitive relationships between valued attributes of the landscape (i.e., properties of landscapes that are important to people such as biodiversity or cultural features; Kendal et al., 2015) and how these influence attitudes and acceptability regarding public space and its management (Stern, 2000;Ford et al., 2009).

Kendal et al. (2015) have identified five valued dimensions of landscape attributes that are important to people:

i. experiential attributes (things that are important for human experience of nature; e.g., sights and smell, relaxing atmosphere);
ii. natural attributes (things that are important for the environment; e.g., providing habitat, ecosystem services);
iii. social attributes (things that are important to people; e.g., accessibility, safety);
iv. cultural attributes (things that are important for human culture and retaining heritage (e.g. learning about cultural traditions, seeing historic things); and
v. productive attributes (extracting timber or minerals e.g. timber production, agriculture).

Recognising how and why people value different aspects of the public space, can allow managers to identify the benefits different people receive from the management of public space (Ives and Kendal, 2014). Over several generations, post-industrial societies such as Australia have shifted from more utilitarian values for nature, towards more ecocentric values, including species conservation (e.g., Xu and Bengston, 1997;Dietsch et al., 2016). These value shifts are likely to change the way people expect public space to be designed and managed in cities in the future.

As social values were collected as an indicator of the benefits of laneway greening, future work may be able to use such values to better understand how benefits accrue to different people.

Social evaluation

The everyday use of public space in central Melbourne has been changing from necessary uses (e.g., building access) to optional, recreational uses (outdoor café seating, street vendors, buskers, public art, street trees). This changing role increases the need for well-designed places where people choose to spend time to socialise, relax and feel connected to Melbourne's urban life (Gehl and Matan, 2009). Public spaces also express the city's culture, values and history. The most successful public spaces are valued for various reasons by different people in the community, and feature attractions that are used for different reasons by residents, workers and visitors people (Gehl and Matan, 2009). Well-designed public spaces also support and encourage healthy behaviours such as walking and cycling, promotes interactions between people in the community and fosters feelings of safety (Giles-Corti et al., 2014). The consequences of increased activity and community wellbeing from well-designed public space is also considered to drive economic activity in the local area (City of Melbourne, 2014, 2016).

Use of an area such as a laneway depends on visitations rates and time spent within the laneway, and baseline numbers were shown as part of the social survey. These can be converted into an amenity value by a range of methods, such as willingness to pay or by other standard valuation methods for public space (see amenity values below).

Public life

In recent decades many of Melbourne's laneways have undergone pedestrian improvements (e.g., extending footpaths, limiting vehicular access and allowing outdoor dining). Places for People is a longitudinal research study conducted by the City of Melbourne. Findings from the study in 2015 (follow-up to the 1994 and 2004 survey) show that public space improvements have the potential to significantly impact public life in the city. Increases public life has the potential to benefit economic activity and well as the social connection between city dwellers (City of Melbourne, 2016). Encouraging active forms of transportation is not only beneficial for traffic management and the environment, but is also very beneficial for the health and wellbeing of residents (Giles-Corti et al., 2014). Increases in the number of people using public spaces is considered an indicator of successful public space design (City of Melbourne, 2016).

Pedestrian activity is an indication of a city's vibrant life and there is a direct link between a city's economic prosperity and the safety and convenience of the pedestrian experience (City of Melbourne, 2014). Pedestrians are more aware of shops and window displays and are more likely to notice the opportunities to spend (Tolley, 2011). Both walking and cycling are sufficiently slow and flexible to allow people to stop and spend money on route more easily than other motorised forms of transport.

The economic value of walkability is also related to travel efficiencies over short distances. Walking is generally the fastest means of travel for trips of up to 400 metres (DIT, 2013). It follows that creating the conditions to shift these short trips from cars to walking will improve the overall efficiency of the economy (Victoria Walks, 2017). In the City of Melbourne approximately 63% of trips made for a work purpose are on foot and walking is the primary mode for shopping and tourism. Close to 35% of residents of the Hoddle Grid and 34% of residents in Southbank walk to work (City of Melbourne, 2014). The City of Melbourne's Walking Plan 2014–2017 analysed the economic impact of walking and found that if the walking connectivity within the Hoddle Grid increased by 10%, the value of the economy of the Hoddle Grid would increase by up to $2.1 billion per annum. This represents a 6.6% increase in the value of the current economy (City of Melbourne, 2014).

The quality of the streetscape also determines visitation, dwell times, and higher levels of expenditure per head (Tolley, 2011). For example, seating provides opportunities for people to rest and pause, and are important for creating inviting public space and increasing dwell time. Between the 1994 and 2015 studies, the number of café seats grew from 1,938 to 9,332 (+382%), while the number of public seats fell from 3,493 to 3,368 (-4%). The growth of café seating has contributed much to the life of public space, but what has been apparent since the 2015 Places for People study is that café seating can come at a cost to public seating provision by displacing it and reducing the area of freely available public space (City of Melbourne, 2016).

Quality of life

Local governments play a key role in creating public spaces that promote and support good health and wellbeing; e.g., providing a walking and cycling friendly environment, creating places for people to connect and relax. Understanding the community's quality of life and perceived wellbeing can improve councils' effectiveness in manage their public space for residents, workers and visitors.

The built environment and the way neighbourhoods are designed and maintained, greatly impact perceptions of safety and sense of well-being. The City of Melbourne has partnered with Community Indicators Victoria to measure the perceived quality of life of its residents to understand the aspects of wellbeing that are most important to their citizens (City of Melbourne, 2016).

Quality of life encompasses life satisfaction, including physical health, family, education, employment, wealth, religious beliefs, finance and the environment (City of Melbourne, 2016). Sense of safety and security is another important aspect contributing to resident's quality of life. Neighbourhoods which are perceived as safe, foster community participation, encourage physical activity, community connectedness and add to the health and well-being of local residents and visitors. Passive surveillance gained through public life is considered critical to people's sense of safety and security (City of Melbourne, 2016). Improvement in the perceptions of safety and wellbeing of residents is considered an indicator of successful public space design (City of Melbourne, 2016). The laneways therefore will contribute to these general surveys.

Amenity

Few studies have directly quantified the visual amenity benefit of green infrastructure, most relying on benefit transfer. A research report for the City of Waterloo (2005) derived an amenity value by considering it to be the same as a park or passive recreation area, combining both viewing and visiting amenity, allocating a value of approximately \$4.40 per m^2. For example, the green roof on a library in Vancouver was designed to provide a visual amenity for occupants of surrounding office buildings (Peck et al., 1999). MacMullan et al. (2008) record that rooms at a local hotel beside a 200 m^2 green roof were \$80 more per night than comparable rooms without the view.

Nurmi et al. (2016) provide the most detailed treatment of visual amenity to date. They use apartment prices in Helsinki, evidence of preference for green space from the literature and for welfare benefits to construct a relationship between proximity, value and park size. Subtracting small parks from that relationship gave them a value of 0–1.25% per m^2. Average viewing radius was calculated from GIS as 30 m. They concluded that the value of a small park was €130 per m^2 for a radius of 30 m. The value attached to a small park 30–50 m was €20, which was interpreted as the visiting premium. Given that rooftops can be seen but not visited they assumed that the residual (€130 minus €20 or €110) within 30 m was the viewing radius. In percentage terms, this ranged up to 2.3% of property price, but allowing for roofs and likely available views this was reduced to 1.2%. This would suggest that in addition to people within the laneway receiving amenity, those also overlooking it will as well.

Although sound attenuation was not on the priority list, it is becoming an important part of the general amenity of green walls and facades, particularly in regions where sound regulations are in place, such as the EU. Sound attenuation occurs through absorption and diffusion in terms of reflected sound and absorption through transmitted sound, where the installation acts as a barrier.

Costing for sound has been on the basis of annoyance, where a nuisance value is allocated per dB. Amenity benefits can provide the upside of that, where noise is below nuisance level but provides amenity contributing to mental health and general welfare, where a courtyard provides an oasis from the broader noisy city environment (Veisten et al., 2012). Having a noise oasis or refuge on one side of a dwelling is seen as three to five times as beneficial as reducing noise on the noisy side as measured in dB. Applying a model to simulate green facades in a European example, Veisten et al.

(2012) estimated that a welfare benefit of €2.47 m^{-2} provided mostly positive returns in a range of situations.

Environmental evaluation

Although there are many potential environmental benefits of laneway greening, most are small. However, integrated into the broader green infrastructure strategies of the CoM, these benefits accumulate, through services that do not just benefit the local environment, but the city as a whole. However, due to the small size of the lanes, these broader benefits provided will be marginal, with the major benefits provided within the laneway. The main areas of benefit cover stormwater volume and quality, local climate and the urban heat island affect, pollution interception, and biodiversity and amenity.

Providing a dollar value for these benefits is data-intensive, requiring the pathway between ecosystem function and benefits to be quantified. Some of this can be done by using locally collected data in models; where there is potential to do this, we have selected those as indicators. Where this is not possible, we have selected indicators that contribute directly to council environmental and biodiversity policy targets.

Most of the benefits produced from environmental services, such as cooler temperatures, shelter and social amenity yield greater social benefits than environmental benefits.

Stormwater interception

The two main measures for reduced flood risk via stormwater interception are water volume and peak flow providing the following benefits:

- Water volume: reduced flood damages
- Peak flow: avoided infrastructure upgrades

Flood damages can be costed in many ways but having some kind of flood frequency/severity relationship with accompanying damages is the ideal baseline economic data for assessment. Most green infrastructure studies use a value per volume relationship. These are costed in two ways:

1. Through explicitly costed damage on infrastructure, activities and people, or
2. Through flood offset schemes where a charge per volume generated or area of development/hard surface is set. This is the case for new developments in mid to outer Melbourne, but not for established suburbs, despite ongoing catchment modification.

Flood average return intervals (ARI) have been calculated for all catchments in the City of Melbourne by Melbourne Water. These extend from return periods of less than a year to a rated probable maximum flood. From these relationships, Melbourne Water has calculated annual average damage (AAD) rates. Damage rates depend on the condition of the catchment, its hard surfaces and stormwater infrastructure, beginning to accrue costs when water affects services or damages people or property.

The Integrated Climate Adaptation model (ICAM) has been constructed to assess the benefits of a wide range of interventions within the City of Melbourne (Kunapo et al., 2016). The potential for the addition of green roofs as an adaptation has been included in the model. It measures flood depth velocity and hazard, on a 1%, 2%, 10% and 20% annual exceedance probability. For interventions where canopy is increased, ICAM uses flood volume as a measure, having determined volumetric reductions for key subcatchments within Melbourne. Model input is a 100-year record of climate from the BoM's Melbourne Office and, on an event basis, the Bureau of Meteorology's Intensity Frequency Duration (IFD) data for Melbourne.

Use of ICAM with costs from Melbourne Water's AAD estimates will provide an estimate of benefits. However, these will be quite minor. The rough area of the four laneways is 160, 200, 155 and 255 m^2 for Coromandel, Guildford, Katherine and Meyers respectively. This would yield 464 kL (kilolitres) of water at the rainfall average for the past twenty years. The 20% and 10% annual exceedance probability 20-hour rainfalls would yield 53 and 64 kL, respectively. Partial interception of these amounts converted into dollars, would not be large.

As mentioned earlier, stormwater interception can be estimated from area of canopy cover and species, which provides a specific Leaf Area Index. This can then be used to estimate interception rates using the I-Tree model, and valued per kL, using a set catchment-wide value. Area of canopy can also provide an estimate of interception using the ICAM model.

Peak flow

To value peak flow, it is important to ensure there is no double counting with value calculated for reduced flooding volume. The management principle for peak flow is to reduce the speed and height of the flood, and the conventional measure is to build larger stormwater drains. One way to value peak flow is to calculate the avoided costs of drainage upgrades. If peak flow is valued according to avoided upgrade costs and flood volume according to avoided flood damages then there will be no double counting. Peak flow can be measured through percentage change (simplest) to delay in peak volume (most accurate). There are no plans to cost that at present.

Water quality

Laneway developments may prevent water from entering streams and rivers via interception by plants and through pervious surfaces. Generally N and P are the only two pollutants to be costed. N interception is provided a value per kg by Melbourne Water ($6,645 per kg) based on the cost of extracting N as part of water purification, preventing its entry into streams and Port Phillip Bay. This can be calculated using typical concentrations of street runoff per kL.

Heat island and local heat effects

Heat modification through increased shade, changed albedo and increased evapotranspiration has both a local and areal effect for the latter. The physical benefit of heat modification on the UHI is that buildings and surfaces do not warm so much during the day and radiate heat at night. Green walls and facades can significantly reduce temperatures at street level and in courtyard settings. This can also lead to energy savings in adjacent buildings but savings will depend on the type of vegetation, building type and aspect and existing insulation.

The following methods can be applied to assess levels of exposure to heat or discomfort:

1. Microclimate – microclimate can be assessed at the fine scale – street and at elevation using a very fine scale climate model and building surface data base. Best for detailed results on modelling walls and facades. Energy savings are best modelled at this scale.
2. Urban climate – these models are not as high resolution and can use surface and roughness or building data bases with surface characteristics, but may omit microclimate in street canyons etc. Can also do air pollutant distribution.

3. Surface energy balance modelling uses simplified relationships to measure changes in albedo and transpiration rates.
4. Simple rules of thumb derived from any of the above.

Selected local benefits within each laneway could ultimately be bundled into a general value for direct amenity as a function of laneway area – this would also be influenced by the number of people and amount of time they spend in the laneway after redevelopment. Canopy cover can be added to the area of CoM's urban forest and used to calculate broader cooling effects on the UHI, but is not worth doing at the laneway scale.

Pollution interception

Pollution interception can include visible dust, microparticles (e.g., PM10 and PM2.5) and airborne chemicals that include SO_2, NO_x, CO and O_3. Pollution has both direct and indirect effects. Direct effects are linked to health and include heart and respiratory diseases leading to hospitalisation and death. Melbourne's air is comparatively clean, to the point where the EPA have removed their Carlton monitoring station, which unfortunately would help set benchmarks for CoM.

Most air pollution removed by vegetation is through dry deposition. Most estimates are made using models rather than direct measurement. Vegetation types have widely varying rates of deposition. Green walls, grasses and shrubs are considered to have around half the deposition rate as trees.

The methodology for valuing improvements in air quality are avoided medical and nonmedical costs and loss of wellbeing. Avoided health costs for PM10, PM2.5, nitrates, ozone and black carbon can be calculated using the WHO AirQ+ model with local demographic and air quality data. This model calculates mortality and shortened life span but does not calculate illness, such as air quality-related asthma attacks. These can be linked to Australian data for avoided health costs, and statistical valuations of premature death and shortened life spans.

Jones and Ooi (2014) calculated lost welfare for PM10 for people downwind of pollution from the Brooklyn Industrial Precinct (PM10 and PM2.5), west of Melbourne based on benefit transfer from US studies. For PM10, they calculated an annual range of \$0.16 to \$86 per m^2 based on deposition rates of 3 to 8 g per m^2 for health and welfare benefits for tree removal and for PM2.5, direct health benefits of \$0.35 to \$2.89 for deposition rates of 0.13 to 0.36 g per m^2. Given that PM10 levels for the City of Melbourne are much lower and rarely exceed health limits, the main benefits would be the removal of PM2.5 from mainly local sources, especially diesel fuel and wood fuelled fires in winter. Note that health effects are considered to occur even with pollution occurring within regulated safety limits, just at very low levels. Usually only residents are included in such estimates and not workers.

The main impact of vegetation will be minor effects on air quality, too small to be measured in individual laneways without great expense. The marginal benefits of removing pollutants by green roofs and walls will provide a benefit to people within the airshed affected by that small area. This can be considered as contributing to local amenity with a small dollar benefit per m^2 of leaf area. Such pollution removal benefits are probably best considered at the urban forest scale, with laneway vegetation making a small, but positive contribution.

Monetary evaluation

Conventional market returns from laneway improvements mainly go to the private sector, largely as increased property values and business income, but public returns in the form of rates and taxes will also be produced.

Property valuation

We used rental returns routinely calculated by CoM as the best available indicator for property value, given that it is regularly updated, and have listed some of potential limitations above.

Property market value (land and improved value) is the most direct value but is slow to emerge from statistical noise, because of the small amount of sales (and therefore turnover) and the number of other influences on property value. The main methods for calculating adjacent influences on property values are through direct survey and hedonic pricing. The direct valuation method would be too slow to yield results, although total laneway assets in Melbourne may show a signal over time as they are improved.

Hedonic pricing is a method that treats the value of an asset as the sum of its individual attributes, including any environmental attributes. Valuing a single attribute on a property, such as proximity to a laneway, would mean calculating all the other influences on property value using regression analysis and subtracting them – the residual is the value of the specific attribute being tested (Hidano, 2002).

If a park or other green infrastructure asset is close to a property, its presence can have a positive effect. However, that property's value will also be due to its internal attributes (e.g., size and features) and external attributes such as proximity to schools, shops or transport. The main drawback is the sheer amount of data required to establish a relationship with the service or benefit being investigated. For example, Mahmoudi et al. (2013) investigated open space in Adelaide using house prices, applying dozens of variables including those expected to have a negative effect, in order to separate out the influence of open space on house prices. This was the only Australian study we could identify that assessed small areas similar to laneways; i.e., pocket parks.

Mahmoudi et al. (2013) calculated per metre distance from a variety of different types of open space in Adelaide using house price data collected during the Millennium drought, showing that benefits were strongly nonlinear, depending on how close the house was to open space. The size of benefits depended on the type of open space. Values for sports areas, linear parks and manicured areas were positive and natural areas such as national parks were negative, possibly due to fire risk, aesthetics and snakes. A square metre of private open space on a house block added $17 to the value of a median-sized house whereas a square metre of building on the same block added $810, so building capital is much more highly valued than private open space. Mahmoudi et al. (2013) simulated the effect of expanding a pocket park of 0.4 ha to 1, 2 and 3 ha in size, estimated the increase in capital value to be about $160 per m^2.

The variation in property prices between parks and smaller features such as green walls and green roofs, which are comparable in size to the laneways, ranges between a few percent for green walls in Tokyo (Gao and Asami, 2007) up to 16% in rental premiums for property in New York (Ichihara and Cohen, 2011). Whether there will be a measurable effect from the greening of the four target laneways is unknown.

Employment

We selected employment in businesses within and adjacent to the laneway as a potential measure of business activity. CoM collects business scale employment data down to ANZSIC four-digit code every two years, which breaks economic sectors into specific activities. There will be another round in 2018, against which an effect may be noticeable. Data can be cross-checked with local business activity measured directly.

Business activity and experience

Each of the businesses around the four target laneways has been contacted as part of the project (around 20–25 businesses). Follow up interviews after the laneways have been developed will show whether their expectations as the possible benefits have been met and any benefits or disadvantages they may have experienced.

Conclusion

This report assesses and describes an initial set of indicators to assess the benefits of laneway greening and outlines work done to establish baselines for those indicators. Four groups of indicators are described:

- Laneway greening: tree canopy, green wall cover, plant diversity
- Social: public safety, quality of life, occupancy/activity, social values
- Environmental: Temperature, biodiversity
- Economic: property values, employment, business benefits

These indicators are designed to fit into the City of Melbourne's normal data gathering as much as possible. In some cases, some further work may be needed if benefits are to be monetized. In others, the benefits of laneway greening are small, but they fit into larger programs. For instance, any trees will be incorporated into the urban forest data base. The benefits of stormwater interception are limited because of the small area available for canopy development.

The direct environmental benefits of greening these four laneways is likely to be small, in the order of a few thousand dollars a year at most. However, the literature suggests that the economic and social benefits will be much larger, although without being able to directly measure pre- and post-improvement stages at present, assessing the scale of these benefits is difficult.

References

City of Melbourne, 2014: *Walking Plan 2014–2017*, 56 pp.

City of Melbourne, 2016: *Places for people: Establishing a platform of evidence to shape Melbourne's future, 2015 study*, City of Melbourne, Melbourne, 80 pp.

City of Waterloo, 2005: *Green Roof Feasibility Study and City Wide implementation Plan*, City of Waterloo, Waterloo, Canada.

Coutts, A., J. Beringer and N. Tapper, 2010: Changing urban climate and CO2 emissions: implications for the development of policies for sustainable cities. *Urban Policy and Research*, **28**, 27-47.

de Groot, R., B. Fisher, M. Christie, J. Aronson, L. Braat, J. Gowdy, R. Haines-Young, E. Maltby and A. Neuville, 2010: Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation. In: *The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations* [Kumar, P. (ed.) Earthscan, London and Washington, 9-40.

Dietsch, A.M., T.L. Teel and M.J. Manfredo, 2016: Social values and biodiversity conservation in a dynamic world. *Conservation Biology*, **30**, 1212-1221.

DIT, 2013: *Walking, Riding and Access to Public Transport*. Ministerial Statement, Department of Infrastructure and Transport, Canberra, 62 pp.

Earl, N., I. Simmonds and N. Tapper, 2016: Weekly cycles in peak time temperatures and urban heat island intensity. *Environmental Research Letters*, **11**, 074003.

Ford, R.M., K.J. Williams, I.D. Bishop and T. Webb, 2009: A value basis for the social acceptability of clearfelling in Tasmania, Australia. *Landscape and Urban Planning*, **90**, 196-206.

Gao, X. and Y. Asami, 2007: Effect of urban landscapes on land prices in two Japanese cities. *Landscape and Urban Planning*, **81**, 155-166.

Gehl, J. and A. Matan, 2009: *Two perspectives on public spaces*. Taylor & Francis.

Giles-Corti, B., G. Macaulay, N. Middleton, B. Boruff, F. Bull, I. Butterworth, H. Badland, S. Mavoa, R. Roberts and H. Christian, 2014: Developing a research and practice tool to measure walkability: a demonstration project. *Health promotion journal of Australia*, **25**, 160-166.

Haines-Young, R. and M. Potschin, 2010: The links between biodiversity, ecosystem services and human well-being In: *Ecosystem Ecology: a new synthesis* [Raffaelli, D. and C. Frid (eds.)] Cambridge University Press, Cambridge, UK, 110-139.

Hidano, N., 2002: *The Economic Valuation of the Environment and Public Policy*. Edward Elgar Publishing, Cheltenham, UK.

Ichihara, K. and J.P. Cohen, 2011: New York City property values: what is the impact of green roofs on rental pricing? *Letters in spatial and resource sciences*, **4**, 21-30.

Ives, C.D. and D. Kendal, 2014: The role of social values in the management of ecological systems. *Journal of Environmental Management*, **144**, 67-72.

Jones, R.N. and D. Ooi, 2014: *Living Brooklyn: Baseline Report on the Economics of the Urban Water Cycle in the Brooklyn Industrial Precinct*. Victoria Institute of Strategic Economic Studies, Melbourne, 42 pp.

Kendal, D., R.M. Ford, N.M. Anderson and A. Farrar, 2015: The VALS: A new tool to measure people's general valued attributes of landscapes. *Journal of Environmental Management*, **163**, 224-233.

Kunapo, J., T. Fletcher, M. Burns and T. Ladson, 2016: *Integrated Climate Adaptation Model*, Melbourne City Council, Melbourne, 107 pp.

MacMullan, E., S. Reich, T. Puttman and K. Rodgers, 2008: *Cost Benefit Evaluation of Ecoroofs*, ECONorthwest, David Evans and Associates, Inc.

Mahmoudi, P., D. Hatton MacDonald, N.D. Crossman, D.M. Summers and J. van der Hoek, 2013: Space matters: the importance of amenity in planning metropolitan growth. *Australian Journal of Agricultural and Resource Economics*, **57**, 38-59.

Maltby, E., 2009: *Functional Assessment of Wetlands: Towards evaluation of ecosystem services*. Woodhead Publishing Limited, Abington Hall Cambridge.

Mata, L., C. Ives, G. Garrard, A. Gordon, A. Backstrom, K. Cranney, T. Smith, L. Stark, D. Bickel, S. Cunningham, A. Hahs, D. Hochuli, M. Malipatil, M. Moir, M. Plein, N. Porch, L. Semeraro, R. Standish, K. Walker and S. Bekessy, 2015: *The Little Things that Run the City: How do Melbourne's green spaces support insect biodiversity and ecosystem health?*.

Mata, L., C. Ives, A. Morán-Ordóñez, G. Garrard, A. Gordon, K. Cranney, T. Smith, A. Backstrom, D. Bickel, A. Hahs, M. Malipatil, M. Moir, M. Plein, N. Porch, L. Semeraro, K. Walker, P. Vesk, K. Parris and S.

Bekessy, 2016: *The Little Things that Run the City: Insect ecology, biodiversity and conservation in the City of Melbourne*.
Nurmi, V., A. Votsis, A. Perrels and S. Lehvävirta, 2016: Green roof cost-benefit analysis: special emphasis on scenic benefits. *Journal of Benefit-Cost Analysis*, **7**, 488-522.
Peck, S., M. Callaghan, M. Kuhn and B. Bass, 1999: *Greenbacks from Green Roofs: Forging A New Industry In Canada. Status Report on Benefits, Barriers and Opportunities for Green Roof and Vertical Garden Technology Diffusion.* , Canada Mortgage and Housing Corporation, Ottowa.
Simmonds, I. and K. Keay, 1997: Weekly cycle of meteorological variations in Melbourne and the role of pollution and anthropogenic heat release. *Atmospheric Environment*, **31**, 1589-1603.
Stern, P.C., 2000: New environmental theories: toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, **56**, 407-424.
Tolley, R., 2011: *Good for Busine$$ The benefits of making streets more walking and cycling friendly. Discussion Paper*, National Heart Foundation of Australia, Adelaide, 28 pp.
Veisten, K., Y. Smyrnova, R. Klæboe, M. Hornikx, M. Mosslemi and J. Kang, 2012: Valuation of Green Walls and Green Roofs as Soundscape Measures: Including Monetised Amenity Values Together with Noise-attenuation Values in a Cost-benefit Analysis of a Green Wall Affecting Courtyards. *International Journal of Environmental Research and Public Health*, **9**, 3770.
Victoria Walks, 2017: *Economic Benefits*. Victoria Walks, Melbourne, http://www.victoriawalks.org.au/economic_benefits/, (Last accessed October 5 2017).
Xu, Z. and D.N. Bengston, 1997: Trends in national forest values among forestry professionals, environmentalists, and the news media, 1982–1993. *Society & Natural Resources*, **10**, 43-59.

Appendix 1 Areas of benefit from laneway greening

Area of Benefit	Type of Benefit	Supporting data and potential indicator	Potential size of effect	Degree of difficulty	Monitoring as part of the indicator program
Social					
i) Human health and well-being		• Identification of activity zones • Demographics within laneway and catchments • Residents, workers, visitors			• Yes
(a) Physical	• Increase opportunities and reduce barriers to physical activity • Influence travel behaviour - walking, cycling, public transport and car travel • Increase opportunities for recreational activity by providing useable open spaces	• Activity surveys • Pedestrian traffic monitoring	• Small, minor	• Part of broader monitoring	• Yes to activity (intercept survey), no to pedestrian traffic (too costly)
(b) Social and psychological	• Benefits for children • Residents have improved sense of mental wellbeing • Lowered crime, increased safety • Faster healing of the sick	• Potential benefits to adjacent residents • Slight benefit to worker productivity • Perception of space and safety	• Limited and local but may add up	• Perceptions can be elicited, data for effect is difficult	• Some included in intercept survey
(c) Community	• Increased sense of neighbourhood • Improved liveability in space • Liveability benefits of noise abatement • Improved community connectedness	• Increased sense of community • Perception of space (quality)	• Local catchment	• Core data • Dependent on level & intensity of survey	• Some included in intercept survey
ii) Cultural and spiritual	• Improved urban heritage	• Laneway culture – art, food and nature	• Visitors, passers-by and residents	• Hard not to double count ib, ii and iii	• Some included in intercept survey
iii) Visual and aesthetic	• Visual aesthetics improved	• Laneway culture – art, food and nature	• Line of sight	• Hard not to double count ib, ii and iii	• Some included in intercept survey
2) Economic					
i) Commercial vitality	• Increased business turnover • Increased productivity	• Survey • Use as a meeting place, worker perception	• Local but potentially significant	• Engage with businesses, some CoM data	• Included in business survey
ii) Increased property values	• Residential and commercial property value increased • Rates returns increased • Public land permits and rental?	• Existing property value data • Council data	• Local but potentially significant	• CoM data	• To be assessed in study of historical property prices
iii) Value of ecosystem services	• Urban food supply	• Harvest value (species and area planted)	• Very local	• Easy	• Will document if present

3) Environmental					
i) Climatic modification					
(a) Temperature reduction (Physical)	• Reduced heat in laneway • Reduced energy demand in adjacent buildings • Increased human comfort •	• Data monitoring • CoM sunlight incidence	• Within laneway	• Direct temp monitoring straightforward, needs good tech set-up • Thermal benefits difficult	• Yes to direct temperature measurement, no to energy savings (too resource intensive for small effect)
(b) Temperature reduction (Evapotranspiration)	• Cooling potential through addition to the urban canopy	• Data monitoring • Possibly simple energy balance model	• Small	• Simple canopy bulk transfer method	• Yes to direct temperature measurement
(c) Wind speed modification	• Local shelter – increased comfort	• Models(?) • Simple mapping	• Within laneway	• Guesstimate, qualitative (subjective comfort)	• No, but qualitative changes will be noted
ii) Climate change mitigation					
(a) Carbon sequestration and storage	• Carbon sequestration	• DBH, shrub and plant estimates	• Very small	• $/tonne	• No, too early in the growth cycle
(b) Avoided emissions (reduced energy use)	• Avoided CO_2 emissions due to reduced energy use, may be offset by increased on street heating	• Hard to estimate (end of pipe effect)	• Tiny	• $/tonne	• No, too resource intensive for small effect
iii) Air quality improvement					
(a) Pollutant removal	• Trees absorb gaseous pollutants through the leaf surface (SO_2, NO_2) as well as intercepting particulate matter on leaves (PM10, PM2.5, black carbon).	• Leaf area index, leaf type and estimated deposition/absorption rates	• Modest	• $/weight, might require demographics & health model	• Can be estimated (mg per m^2 of canopy from literature)
iv) Water cycle modification					
(a) Flow control and flood reduction	• Urban stormwater interception by canopy and raingardens	• kL per year intercepted, requires LAI, permeable surface & rainfall	• Small	• $ bulk water	• Can be estimated (L per m^2 of canopy from literature)
(b) Soil infiltration and storage	• Local infiltration offset water supply	• Substitution for potable water?	• Small	• Increased plant water use offset	• No, too resource intensive for small effect
(c) Water quality improvement	• Biofiltration improves water quality through the removal of pollutants.	• Gardens will alter nutrient cycle, hard to estimate	• Very small	• $N and P (nutrients may be added by gardens)	• No, too resource intensive for small effect
v) Biodiversity					
(a) Species diversity	• Increased and differing habitats lead to increased species diversity.	• Species lists of plants • Bird and insect monitoring	• Within laneways	• Plants easy • Insects require ID • Birds require twitching	• Yes
(b) Habitat and corridors	• Wider benefit to the local area through biodiversity and habitat provision.	• Mapping connectivity & links	• Broader environment, small overall effect		• No, too early in the growth cycle
vi) Food production	• Even small community plots and kitchen gardens can improve amenity and ambience.	• Visual mapping	• Very small	• Non-monetary benefits complement the above	• Will be noted if present

Appendix 2 Biological survey data

Table 2.1 List of insect families recorded in the City of Melbourne during a survey of the city's parks and gardens in 2017.

Family	Number	Family	Number	Family	Number	Row Labels	Number
ADERIDAE	9	CURCULIONIDAE	67	NABIDAE	19	TEPHRITIDAE	25
AGAONIDAE	4	DELPHACIDAE	6	NITIDULIDAE	24	THEREVIDAE	20
AGROMYZIDAE	38	DERMESTIDAE	4	PACHYGRONTHIDAE	15	TINGIDAE	8
ALYDIDAE	13	DIAPRIIDAE	42	PENTATOMIDAE	31	TIPHIIDAE	6
ANTHICIDAE	11	DOLICHOPODIDAE	41	PERGIDAE	2	TORYMIDAE	3
ANTHRIBIDAE	10	DROSOPHILIDAE	13	PHALACRIDAE	4	TRIOZIDAE	9
APIDAE	28	DRYINIDAE	1	PHALACRIDAE	9	VESPIDAE	3
ARCHAEOCRYPTICIDAE	1	ELATERIDAE	5	PHORIDAE	58		
ARTHENEIDAE	2	EMPIDIDAE	2	PIESMATIDAE	1		
ASILIDAE	8	ENCYRTIDAE	12	PIPUNCULIDAE	6		
ATTELABIDAE	2	EPHYDRIDAE	263	PLATYPEZIDAE	2		
BETHYLIDAE	41	EROTYLIDAE	6	PLATYSTOMATIDAE	37		
BLISSIDAE	8	FLATIDAE	47	POMPILIDAE	7		
BRACONIDAE	103	FORMICIDAE	414	PSYLLIDAE	75		
BRENTIDAE	2	GASTERUPTIIDAE	1	PTEROMALIDAE	71		
BUPRESTIDAE	1	GEOCORIDAE	6	PTINIDAE	12		
CALLIPHORIDAE	26	HALICTIDAE	8	PYRGOTIDAE	4		
CANTHARIDAE	8	HALTICIDAE	9	REDUVIIDAE	3		
CARABIDAE	3	HELEOMYZIDAE	2	RHYPAROCHROMIDAE	20		
CERAMBYCIDAE	2	HOMOTOMIDAE	4	RICANIIDAE	20		
CHALCIDIDAE	18	HYDROPHILIDAE	8	SCARABAEIDAE	1		
CHLOROPIDAE	97	ICHNEUMONIDAE	36	SCELIONIDAE	23		
CHRYSOMELIDAE	110	LATRIIDAE	437	SCENOPINIDAE	9		
CICADELLIDAE	284	LAUXANIIDAE	199	SCOLIDAE	1		
CICADIDAE	1	LONCHOPTERIDAE	13	SCOLIIDAE	1		
CIXIIDAE	4	LYGAEIDAE	84	SEPSIDAE	14		
CLERIDAE	4	MELYRIDAE	12	SILVNIDAE	2		
COCCINELLIDAE	208	MEMBRACIDAE	2	STAPHYLINIDAE	3		
COLLETIDAE	5	MIRIDAE	119	STRATIOMYIDAE	18		
CORYLOPHIDAE	1	MORDELLIDAE	11	SYRPHIDAE	8		
CRABRONIDAE	4	MUSCIDAE	154	TACHINIDAE	10		
CRYPTORHAMPHIDAE	4	MUTILLIDAE	13	TENEBRIONIDAE	5		
						Grand Total	**3690**

Table 2.2 List of publicly managed trees in Melbourne's CBD.

Species	Number of trees	Species	Number of trees	Species	Number of trees
CBD	2567				
Acca sellowiana	1	Ginkgo biloba	10	Taxodium distichum	5
Acer x freemanii 'Jeffersred' autumn blaze	15	Gleditsia triacanthos	1	Tilia cordata	2
Acmena smithii (Syzygium smithii)	1	Hakea salicifolia	1	Tilia cordata 'Green Spire'	8
Agathis robusta	6	Hymenosporum flavum	1	Toona ciliata	1
Allocasuarina littoralis	2	Jacaranda mimosifolia	2	Tristaniopsis laurina	1
Angophora costata	20	Liquidambar styraciflua	5	Ulmus glabra 'Lutescen'	1
Araucaria bidwillii	1	Liriodendron tulipifera	16	Ulmus procera	4
Araucaria columnaris	1	Lophostemon confertus	15	Ulmus sp.	29
Backhousia citriodora	1	Lophostemon confertus Variegatus	2	UNKNOWN	69
Banksia integrifolia	2	Magnolia grandiflora	8	Washingtonia filifera	2
Betula pendula	6	Melaleuca ericifolia	1	Zelkova serrata	10
Brachychiton acerifolius	10	Melaleuca styphelioides	1		
Brachychiton populneus	59	Melia azedarach	6		
Callitris columellaris	1	Paulownia tomentosa	2		
Casuarina cunninghamiana	21	Phoenix canariensis	8		
Celtis australis	7	Pinus pinea	1		
Corylus colurna	5	Pittosporum eugenioides 'Variegatum'	1		
Corymbia citriodora	61	Pittosporum undulatum	2		
Corymbia ficifolia	1	Platanus orientalis	3		
Corymbia maculata	83	Platanus orientalis 'Autumn Glory'	3		
Cupaniopsis anacardioides	1	Platanus orientalis Digitata	289		
Cupressus sempervirens 'Stricta'	3	Platanus x acerifolia	1424		
Elaeocarpus reticulatus	6	Populus simonii	14		
Eucalyptus blakelyi	1	Populus x canadensis	5		
Eucalyptus camaldulensis	9	Populus x canadensis Aurea	1		
Eucalyptus globulus	1	Populus yunnanensis	10		
Eucalyptus mannifera	2	Prunus cerasifera	1		
Eucalyptus melliodora	3	Pyrus calleryana	4		
Eucalyptus microcorys	2	Quercus cerris	3		
Eucalyptus saligna	12	Quercus palustris	16		
Ficus carica	1	Quercus robur	2		
Ficus macrophylla	12	Robinia pseudoacacia Frisia	17		
Ficus microcarpa var. hillii	9	Schinus molle	3		
Ficus rubiginosa	16	Stenocarpus sinuatus	43		
Flindersia australis	1	Syzygium floribundum	131		
				Grand Total	**2567**

Appendix 3 Location of temperature sensors

Figure A3.1: iButton temperature sensor (Thermocron iButton DS1921G, left) and examples of where the sensors where installed throughout the laneways (centre and right).

Figure A3.2: Location of temperature sensors (red dots) that collected ambient temperature data in Coromandel Place, Guildford Lane, Katherine Place and Meyers Place (left to right). Each dot represents two sensors.

Appendix 4 Additional indicators

Table A4.1 lists a broader set of prospective indicators that were flagged in the project proposal but are not principal indicators for the project—either because they are difficult to measure or their affect is likely to be small. However, if any information in these or similar indicators (e.g., in Appendix 1) is obtained during the project, it will be reported on.

Table A4.1: Broader list of indicators that are not going to be monitored but will be treated opportunistically.

Social
• Community connectedness • Perceptions of community involvement
Environmental
• Air quality • Stormwater interception & quality • Hours of sunlight, daily to seasonal • Human comfort indices • Acoustic benefits
Monetary and socio-economic
• Tourism • Business-related activity; e.g. people coming there for business meetings • Private sector investment

Appendix 5 Business perception survey

Table A7.1: Selected anonymous responses from the business perception survey. Responses have been edited for space and to remove identifying remarks.

Perception of Laneway Greening	**Reasons for perception**	**Business Benefit**	**Main benefits**	**Why not**	**Private investment?**	**Type of private investment**	**Public investment**
Favourable	Hope to brighten up landscape of street, minimise impact of graffiti	No		We don't believe the project will change perceptions of our business from clients. More impact from office environment instead?	No		No
Very favourable	The greening laneway will bring positive impact not only to the lane and to the city; i.e., more trees and plants around the area and more pedestrian friendly even though we are in the middle of the city	Yes	I think so. People will visit and more foot traffic will be brought to the laneway, business or not, it actually allows people to know our lane		Yes	We will do bits and pieces that needed to enhance and support the greening laneway if needed	Maybe
Favourable	Will brighten up the laneway and the views from our studio. Increase in general foot traffic to the laneway	Yes	Anticipate general staff happiness will increase and external perception of our studio will be more positive; e.g., more desirable place to work		No		No
Very favourable	Increase business	Yes	More exposure		No		No
Very favourable	To develop our street's environment and I think it will suit the atmosphere with my shop. Attract more customers	Yes	If the street gets popular, our shop will be available to become one of popular size		Yes	We will try to make our business environment greener to make it look balanced with the project	No
Very favourable	Great for local business. Somewhere to create a "zone" for office workers to relax	Yes	Increased sales		No		No
Very favourable	I think it will bring more people to our laneway, make their visit more enjoyable and give them places to sit outside on nice days	Yes	More foot traffic and seating		Yes	More seats, will need more refrigeration for more traffic	No
Favourable		Yes			No		No

Very favourable	Community development/spirit Cleaner and eco-friendly laneway. Good updates from council team	Yes	More foot traffic/less cars beautiful greenery to brighten up laneway look outdoor space for customers to enjoy our food/drinks media and marketing promotions about this project		Yes	Outdoor furniture Marketing about this project	No
Favourable	Environmental friendly Brings good atmosphere	Yes	pleasant fresh look clean				
Very favourable	Increased foot traffic, to make our laneway a destination in Melbourne	Yes	Increased foot traffic = increase in potential guests, more brand exposure		Yes	Outdoor seating areas	
Neither	I have concerns over the cost of this project and exactly who is going to pay for it. I believe we will not benefit much from this project and have no intention of investing money in it	No		The bars and restaurants will benefit more from this project	No		
Very favourable	I think that humanity's isolation from nature, particularly in cities, is one of the fundamental reasons we have lost our understanding with it, and our subsequent exploitation of it. Merging man made cities with nature, will not only serve to mitigate climate change, but it will affect the collective psyche of the inhabitants in a very real and in time palpable and positive way.	Yes	People are drawn to nature. Most vacations are away from cities and into nature. The fact that we spend our lunch breaks in parks to declutter our minds and return to relative inner peace is an indication that time in or close to nature is important for our mental health. People will be drawn to the lane and subsequently our business		No		No
Very favourable	Foot traffic, Aesthetics, Potential for outdoor laneway trading	Yes	Mainly from outdoor trading		Yes	Outdoor furniture	No
Very favourable	An expected positive outcome with little effort on our part	Yes	More foot traffic to market to		Yes	Modest budget towards green maintenance	Yes

Appendix 6 Pedestrian survey data

Pedestrian count data collected across the four laneways. Pedestrians were counted during a 10min period.

Laneway	Date	Time	Count over 10 mins
Myers	Wednesday 12.04.17	12.15pm	63
Myers	Wednesday 12.04.18	1.10pm	74
Coromandel	Wednesday 12.04.19	1.35pm	20
Coromandel	Wednesday 12.04.20	2.10pm	14
Guildford	Wednesday 19.04.17	1.55pm	39
Guildford	Wednesday 19.04.18	2.25pm	37
Katherine	Wednesday 19.04.19	3.00pm	22
Katherine	Wednesday 19.04.20	3.30pm	25
Coromandel	Wednesday 3.05.17	12.50pm	19
Guildford	Wednesday 3.05.18	11.15am	21
Katherine	Wednesday 3.05.19	11.50am	34
Guildford	Thursday 18.05.17	4.50pm	9
Katherine	Thursday 18.05.18	4.20pm	29
Coromandel	Thursday 18.05.19	3.54pm	17
Myers	Thursday 18.05.20	3.30pm	19

Average hourly pedestrian counts calculated over 52 weeks for three laneways/ streets near the locations of the laneways being greened.

Time	Alfred Place - Wednesday hourly average over 52 weeks	Collins Place North - Wednesday hourly average over 52 weeks	Spencer Street and Collins Street south - Wednesday hourly average over 52 weeks
Wednesday 12-1pm	893	670	800
Wednesday 1-2pm	895	669	791
Wednesday 1-2pm	895	669	791
Wednesday 2-3pm	426	519	490
Wednesday 1-2pm	895	669	791
Wednesday 2-3pm	426	519	490
Wednesday 3-4pm	304	561	456
Wednesday 3-4pm	304	561	456
Wednesday 12-1pm	893	670	800
Wednesday 11-12pm	348	472	447
Wednesday 11-12pm	348	472	447
Thursday 4-5pm	304	970	638
Thursday 4-5pm	304	970	638
Thursday 3-4pm	309	572	490
Thursday 3-4pm	309	572	490

Appendix 7 Street intercept interviews

Street intercept interviews were conducted to collect qualitative data to inform the development of the questionnaire and to augment the socially-based indicators. The interviews were semi-structured allowing for an open discussion and for the interviewer to explore particular themes or responses.

The guiding questions covered the themes of:

- The purpose for visiting the laneway
- Values for Melbourne's laneways
- How Melbourne's laneways contribute to quality of life
- Feelings of safety in laneways
- Attitudes towards greening laneways

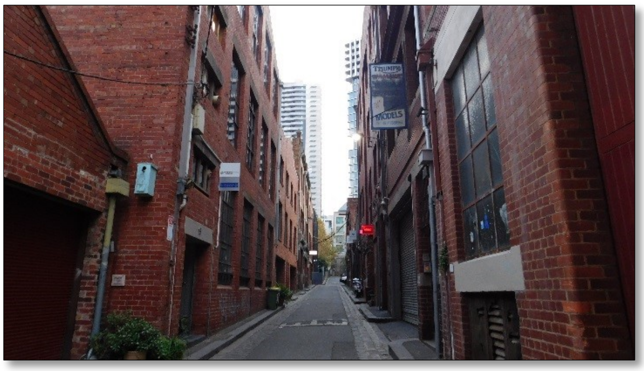
A total of 12 interviews were conducted (n = 4 interviews at Meyers Place; n = 4 interviews at Coromandel Place; n = 3 interviews at Guildford Lane; and n = 1 interview at Katherine Place). Participants were selected based on a convenience sample (i.e., whoever is present and willing to answer questions, rather than sample until a statistically-representative number is obtained), to obtain a wide range of views rather than a representative sample of the public. The purpose of the interviews was to gain insight into how people think about laneways, and the type of language they use when talking about them. The results of the interviews were used to inform the concepts in the questionnaire and to supplement the socially-based indicators.

Interviews: Analysis and results

The interviews were analysed using NVivo 11 to create word clouds. A word cloud is a representation of word frequency giving greater prominence to words that appear more frequently in the interviews. Words clouds were produced for each laneway (except for Katherine Place due to the low response rate) to visualise the patterns of words used in the interviews to supplement the socially-based indicators (Figure 12).

Appendix 8 Resident survey

What do you think about Melbourne's laneways?



Guildford Lane

Meyers Place

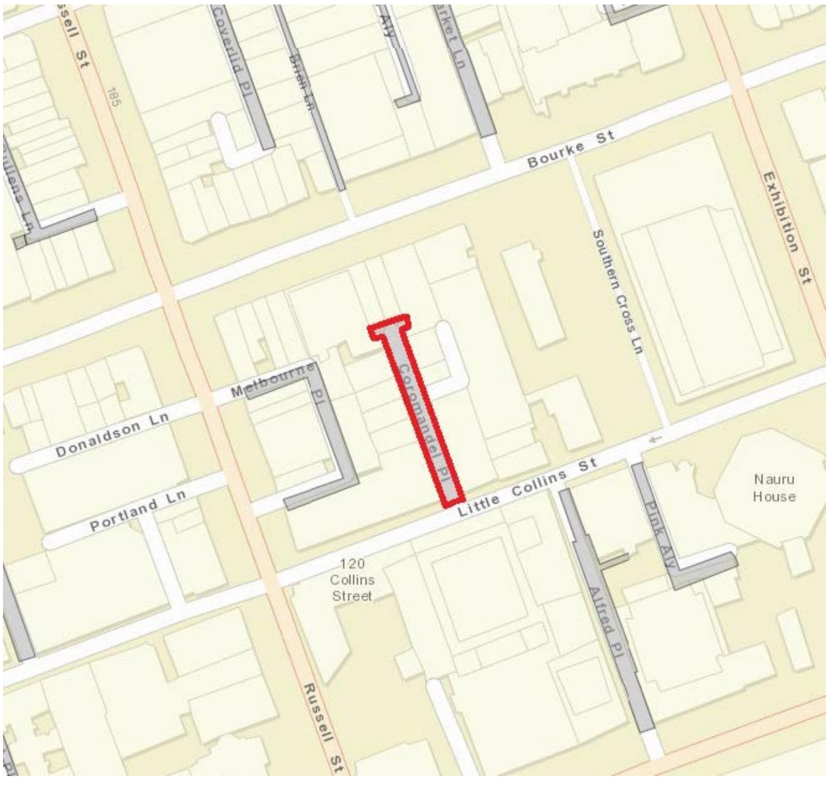
Section 1: What do you value about Melbourne's laneways?

Melbourne's laneways include small lanes and pedestrian lanes scattered throughout Melbourne Central Business District. Please take a minute or so to think about these laneways. Regardless of whether you visit or use laneways, we would like you to indicate how important each of the following things are about Melbourne's laneways:

How important are each of the following things about Melbourne's laneways?	**Not important at all** 1	2	3	**Neither important nor unimportant** 4	5	6	**Very important** 7
Attracting tourists to the city	☐	☐	☐	☐	☐	☐	☐
Reducing air pollution	☐	☐	☐	☐	☐	☐	☐
Beautiful sights, sounds and smells	☐	☐	☐	☐	☐	☐	☐
Spaces for people to interact and socialise	☐	☐	☐	☐	☐	☐	☐
Providing space for many kinds of animals, birds and plants to be	☐	☐	☐	☐	☐	☐	☐
Being part of the heritage of the city	☐	☐	☐	☐	☐	☐	☐
A place for a short walk	☐	☐	☐	☐	☐	☐	☐
Contributing to the city's identity	☐	☐	☐	☐	☐	☐	☐
A sense of peace and tranquillity	☐	☐	☐	☐	☐	☐	☐
A place to experience the city's history	☐	☐	☐	☐	☐	☐	☐
Habitat for rare or threatened plants, birds and animals	☐	☐	☐	☐	☐	☐	☐
Being safe for people to visit	☐	☐	☐	☐	☐	☐	☐
Getting away from stresses of everyday life	☐	☐	☐	☐	☐	☐	☐
Native plants and animals	☐	☐	☐	☐	☐	☐	☐
Producing oxygen	☐	☐	☐	☐	☐	☐	☐
Marketing the city	☐	☐	☐	☐	☐	☐	☐
Cooling the city	☐	☐	☐	☐	☐	☐	☐
Learning about cultural traditions	☐	☐	☐	☐	☐	☐	☐

Section 2: Coromandel Place, a laneway in your neighbourhood

Below is a map of the laneways in your neighbourhood: Coromandel Place is highlighted in red. Take a minute or so to think about this area.



We would now like you to answer a few questions about this laneway.

Were you aware of Coromandel Place before today?

Yes ☐ No ☐ (Skip to section 3) Not sure ☐ (Skip to Section 3)

Have you visited or walked through Coromandel Place?

Yes ☐ No ☐ Not sure ☐

If yes, what was the purpose of your visit(s)? (e.g. passing through, visiting shops, cafes or bars in the laneway)

Think for a moment about Coromandel Place.

When thinking about Coromandel Place, how much do you agree with the following statements?

	Don't agree at all 1	2	3	Neither agree nor disagree 4	5	6	Strongly agree 7	I don't know
Overall, I am satisfied with Coromandel Place	☐	☐	☐	☐	☐	☐	☐	☐
Coromandel Place is well maintained	☐	☐	☐	☐	☐	☐	☐	☐
I feel safe in Coromandel Place by myself during the day	☐	☐	☐	☐	☐	☐	☐	☐
I feel safe in Coromandel Place by myself at night	☐	☐	☐	☐	☐	☐	☐	☐

Section 3: Your feelings of wellbeing

We would like to know how happy you feel as a resident of the City of Melbourne. We would like you to indicate how satisfied you are with the following areas of your life.

How satisfied are you with the following things in your life?	**Not satisfied at all** 1	2	3	4	5	6	**Very satisfied** 7	**I don't know**
Your standard of living	☐	☐	☐	☐	☐	☐	☐	☐
Your health	☐	☐	☐	☐	☐	☐	☐	☐
What you are achieving in life	☐	☐	☐	☐	☐	☐	☐	☐
Your personal relationships	☐	☐	☐	☐	☐	☐	☐	☐
How safe you feel	☐	☐	☐	☐	☐	☐	☐	☐
Feeling part of your community	☐	☐	☐	☐	☐	☐	☐	☐
Your future security	☐	☐	☐	☐	☐	☐	☐	☐
Your spirituality or religion	☐	☐	☐	☐	☐	☐	☐	☐
Your life as a whole	☐	☐	☐	☐	☐	☐	☐	☐

Section 4: Some questions about you

(We ask this so that we can group your responses with other people like you)

Gender: ***please tick.***

☐ Female ☐ Male ☐ Other

What is your age? (in years)________

What is the *highest* level of education attained: *please tick the most correct.*

☐ Up to Year 10
☐ Year 11 or equivalent
☐ High School certificate/ Year 12
☐ Trade Certificate
☐ Diploma or Advanced diploma
☐ Bachelor Degree
☐ Postgraduate qualification (e.g. Masters, PhD)

Do you speak a language other than English at home?

☐ Yes ☐ No **If yes, which language(s):________________________**

This is the end of the survey.
Thank you for completing our questionnaire!