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Assessment of non-market benefits of implementing large-scale WSUD: Greening the Pipeline case study

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Contents

Executive summary

Many cities around the world are experiencing rapid population growth and land-use changes, which are putting substantial pressure on existing green infrastructure and public open spaces. In Australia, water utilities are undertaking many liveability improvement projects to tackle these challenges. However, making a decision about investing in these projects requires information on all benefits, including social benefits.

In this report, we assess people's preferences for different restoration options for a major water infrastructure in Melbourne, the Main Outfall Sewer (MOS) reserve, as part of the Greening the Pipeline initiative. There is growing interest to convert the area into parklands for community use. However, information on people's preferences for different restoration features is currently lacking.

We use two economic non-market valuation approaches to understand the benefits associated with improving the MOS reserve, a hedonic pricing analysis and a discrete choice experiment. These approaches measure the values associated with improvements as quantitative dollar values, so that we can integrate these values into decision support tools such as benefit–cost analyses.

Our results can inform investment decisions about upgrades to the MOS reserve, and complement the INFFEWS value database (Iftekhar, Gunawardena et al. 2019). This repository of non-market values relevant to water sensitive systems and practices currently lacks specific information on large-scale liveability projects.

Summary of the hedonic analysis

The hedonic pricing method is commonly used to analyse how much the different attributes of a property contribute to the property price. These attributes can include the size of the property, the number of bedrooms, and location-specific features such as access to nearby amenities.

We examined whether the completed upgrades to a section of the MOS reserve in Brooklyn Park had influenced the value of nearby properties, and found there is a 5.3% (90% Confidence Interval (CI): 1% to 9%) increase in value for properties within 50 m of the Brooklyn Park project. The 200 properties in this 50 m range of the park have a median value of $442,000 (2018AUD), and can be used to calculate the overall benefit:

- ***The Brooklyn Park project has generated $23,426 per property (90% CI: $5,249/property to $41,603/property) of additional value for the adjacent properties.***
- ***The aggregate additional property value generated by the Brooklyn Park project is $4.7 million (90% CI: $1.05 million to $8.32 million) for the 200 properties nearby.***

How to use this information in decision making

- This information can be used to establish the benefits of a restoration project in a benefit–cost analysis.

Summary of the discrete choice experiment

The choice experiment explored the tradeoffs people are willing to make between a set of attributes associated with reserve improvement, and how much they would be willing to pay for changes in the levels of these attributes.

The attributes and their levels included:

- General park facilities, with five levels:
    - No facilities – *this defines the current situation*

  - Minimum (seats)
  - Basic (seats + drink fountains)
  - Moderate (seats + drink fountains + BBQs)
  - High (seats + drinking fountains + BBQs + toilets)
- Exercise facilities, with five levels:
  - No facilities – *this defines the current situation*
  - Basic 1 (exercise equipment)
  - Basic 2 (playground)
  - Moderate (exercise equipment + playground)
  - High (exercise equipment + playground + skate park)
- Rainwater management, with three levels:
  - No pollutant removal – *this defines the current situation*
  - Pollutant removal
  - Pollutant removal and water reuse
- Vegetation, with four levels:
  - Bare soil and grass (non-maintained) – *this defines the current situation*
  - Grass only (well-maintained)
  - Grass and some trees
  - Grass and many trees (irrigated)
- Local crossings, with four levels:
  - No crossings – *this defines the current situation*
  - Footbridges, 1 km apart
  - Narrow crossings 100 m wide, 1 km apart
  - Wide crossings for sections up to 1 km long
- Paths, with three levels:
  - No path renovation – *this defines the current situation*
  - Renovated shared path
  - Renovated separate paths for pedestrians and cyclists
- Cost, a (hypothetical) one-off charge added to the annual Waterways and Drainage charge on the household water bill, applicable to all households in Melbourne:
  - $0 *for the current situation*
  - $50, $100, $200, $300 or $400 for other options.

The attributes were presented together as a set of options in a ‘choice scenario’, from which respondents had to choose their most preferred (Figure 1). Each respondent was presented with eight of these questions in an online survey, each time seeing a different combination of options.

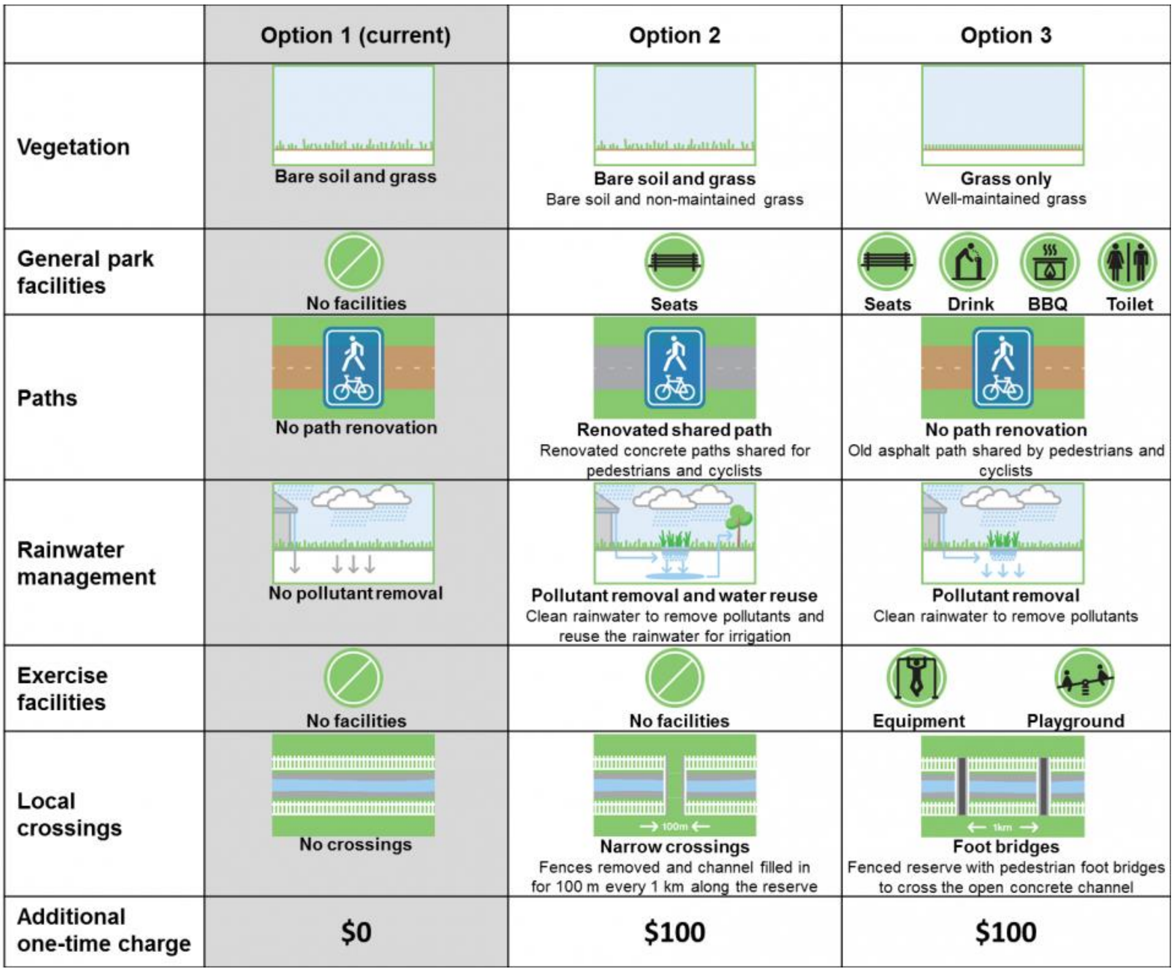


Figure 1: Example of how the choice scenarios were presented in the survey instrument

A sample of 624 respondents was collected from households within 5 km of the MOS; 518 respondents were used in the final analysis.

We estimated a model that could identify different 'segments' of the community; that is, distinct groups of respondents with like-minded preferences. Two different groups were identified.

One group, comprising about 14% of the sample, had only a positive preference for renovating the paths along the MOS reserve. They had no significant preferences for anything else and did not respond to the cost attribute, implying their willingness to pay is not different from zero.

- ***14% of the sampled population is not willing to pay for reserve improvement.***

The other group, comprising the majority of the sample, had positive preferences for reserve improvement attributes and responded to the cost attribute.

- ***86% of the sampled population were willing to pay for reserve improvements.***

The estimated willingness to pay from this group is reported below (Table 1). All of the willingness to pay figures estimated were significantly different from zero, meaning that for this group of people (86% of the sample), they had a positive willingness to pay for each different level of improvement.

- ***This group was willing to pay for all of the different MOS improvement attributes. Willingness to pay ranged from $35 to have well-maintained grass areas, to $221 for a high level of park facilities.***

Table 1: Willingness to pay for MOS reserve improvements, as a one-off payment per household, (2019AUD)

Features	Average willingness to pay
Park facilities	
Seats	$84
Seats + drink fountain	$89
Seats + drink fountain + BBQs	$136
Seats + drink fountain + BBQs + toilets	$221^^
Exercise facilities	
Exercise equipment	$64
Playground	$87
Exercise equipment + playground	$121
Exercise equipment + playground + skate park	$128
Rainwater management	
Pollutant removal	$114
Pollutant removal and water reuse	$135
Vegetation	
Grass only	$35^^
Grass and some trees	$146
Grass and many trees	$179
Crossing	
Footbridge	$90
Narrow crossing	$75
Wide crossing	$76
Path	
Renovated shared path	$78
Renovated separate path	$78
Status quo	–$588

^^The willingness to pay reported for this attribute level is significantly different from the willingness to pay for other improvement levels. All willingness to pay figures reported are significantly different from $0.

While it was clear respondents valued improvements of some degree for all attributes, relative to the status quo, we also tested if their willingness to pay values for incremental improvements were different from each other for each particular attribute. That is, we examined whether higher levels of improvement were significantly better than lower levels of improvement. In most cases, they were not statistically different. In two cases they were:

- ***Respondents were willing to pay significantly more for the highest level of park facilities ("Seats + drink fountain + BBQs + toilets") than for other levels of park facilities.***
- ***Respondents were willing to pay significantly more to have at least some trees ("Grass and some trees" or "Grass and many trees") than to just have grass only***.

Finally, we noted a large and negative willingness to pay associated with the status quo.

- ***Respondents had a negative value of –$588 associated with maintaining the status quo, which indicated their strong willingness to avoid the current derelict condition.***

How to use this information in decision making

- ❖ If decisions are being informed by a benefit–cost ratio or net benefit analysis, the willingness to pay values for the different levels of the relevant attributes should be used to estimate the benefit of undertaking a particular restoration project for the MOS reserve.

We examined which demographics were more likely to be part of the group that was willing to pay for improvements, indicating that these types of people have a more positive willingness to pay than others. This group included:

- Homeowners (including mortgage payers), who comprised 56% of the sample
- People who use the MOS reserve or other local parks, who comprised 80% of the sample
- People who believed households in the local area or in Melbourne should contribute to the costs of improving the reserve, comprising 74% of the sample.

People who were less likely to belong to this group, meaning they are less likely to be willing to pay for reserve improvements, included:

- Households with a gross weekly income of less than $2,000, who comprised 55% of the sample
- Respondents who thought the general public should be responsible for maintaining and restoring the MOS, who comprised 46% of the sample.

How to use this information in decision making

- ❖ This information shows which demographics are more likely to support and benefit from a restoration project, and has implications for how you would aggregate values across a population in a welfare analysis. In our survey, 86% of the respondents were willing to pay for reserve improvement. Therefore, in an aggregation of willingness to pay, 86% of the population can be included.

- ❖ You can use demographic information to tailor your community engagement (e.g., information campaign) activities according to their socio-demographic conditions. This information is also useful to adjust the numbers derived from this study for other places (i.e., for benefit transfer).

Restoration scenarios

The values for the different attributes, and from the two different valuation approaches, are most useful when considered in the context of a specific restoration scenario – as a means to identify the total economic benefit of that scenario.

For each scenario, we aggregated values across the relevant population. We assumed the relevant population comprised: (a) 700 properties within a 50 m ‘adjacent area’ to the MOS reserve; (b) 127,202 households within a 50 m to 5 km ‘buffer area’ along the MOS reserve.

We considered two hypothetical restoration scenarios: one that assumed the minimum levels of improvement for each attribute, and one that assumed the highest levels of improvement.

1. Low improvement option, a restoration project that would include the provision of:
    a. seats
    b. exercise equipment
    c. pollutant removal
    d. grass only
    e. footbridge
    f. a renovated shared path.

2. High improvement option, a restoration project that would include the provision of:
    a. seats + drink fountains + BBQs + toilets
    b. exercise equipment + playground + skate park
    c. pollutant removal and water reuse
    d. grass and many trees
    e. wide crossing
    f. renovated separate paths.

Based on the results of the choice experiment, for households in the 50 m to 5 km zone:

- ***The low improvement option had a mean willingness to pay value of $451 per household.***
- ***The high improvement option had a mean willingness to pay value of $817 per household.***

For households within the 50 m strip along the MOS reserve, benefits are partially explained through increased house prices, and partially through the willingness to pay values from the choice experiment. At Brooklyn Park, where the increase in house price was observed, the restoration project included improvements to vegetation and crossings, but not to the other attributes. The benefit to these properties was, therefore, the increase in house price, plus the willingness to pay values associated with (low or high) improvements to park facilities, exercise equipment facilities, rainwater management, and paths.

The values can be aggregated over the number of households in the adjacent and buffer areas of the MOS reserve, accounting for an adjustment to remove the proportion of households who are not willing to pay for improvements as identified in the choice experiment analysis (14% of households, but noting that all households in the adjacent area will attract the property price premium benefit).

- ***The low improvement option has a total benefit of $55 million.***
- ***The high improvement option has a total benefit of $109 million.***

How to use this information in decision making

- The aggregation of benefits for a particular restoration scenario can be used to identify the total benefit of the scenario, for comparison with the costs of the scenario in a benefit–cost analysis.
- Multiple scenarios can be compared.
- This information can be used directly to prioritise investment in restoration projects through benefit–cost analysis.

Concluding remarks

This study identified that there are significant non-market benefits associated with options to restore the MOS reserve, both in terms of the potential to reflect increases in house value and in terms of people's willingness to pay for improvements in amenity. The information is designed to contribute to quantitative prioritisation processes that might be undertaken to determine investment in MOS restoration projects. It also provides a broader contribution to the literature and evidence base for investing in water sensitive urban design projects. In particular, the application of the hedonic analysis and choice experiment jointly enables a thorough understanding of the non-market benefits that are attributed through real price increases and for genuinely intangible benefits, respectively.

1. Introduction

Urban communities and environments depend on urban greenspaces for different services, such as recreation, aesthetic, cultural and environmental functions. However, many cities around the world are experiencing rapid population growth and land-use changes. Urban sprawl and densification have resulted in the loss of trees and green vegetation in both public and private domains in many cities around the world. The combined pressure of population growth and the loss of vegetation is putting substantial pressure on existing parks and green spaces, and causes the loss of biodiversity, hydrological function, active and passive recreation opportunities, and amenity values. This has a material impact on the liveability and physical and mental wellbeing of the urban residents.

To reduce the adverse effects of less urban greenspace, government agencies and departments are implementing multi-functional green infrastructures in public and private space and converting single-use public lands. In Australia, water utilities play a substantial role in supporting these outcomes as major landholders. Even though the core duty of water utilities is to supply safe and reliable water and manage wastewater, there is a growing expectation that water utilities will also contribute to ensuring liveability and environmental sustainability (CRCWSC 2018). Many water utilities are evolving to implement water sensitive urban designs, nature-based solutions, and multi-functional green spaces (Furlong, Phelan et al. 2018).

In Australia, water utilities are investing in liveability improvement projects in many places. However, investing in these projects requires information on all benefits. While there is a good understanding of the physical (environmental) performance of these projects, information on the social preferences of the services provided by these projects is often lacking. Without this information, it is difficult to assess whether investing in these projects is likely to benefit society or not. We need to quantify (monetise) expected social benefits when developing business cases for such projects. However, there is no market for the intangible services of public open space and its attributes. In the absence of this market, we cannot use market prices to estimate the social benefit from implementing such projects (Baker and Ruting 2014).

These benefits could be assessed using non-market valuation methods (Champ, Boyle et al. 2003). The two main approaches are stated preferences and revealed preferences. The stated preference approach uses surveys that elucidate the values respondents place on assets or benefits being valued (Bateman and Transport 2002). Examples include contingent valuation and choice experiment. The revealed preference approach analyses peoples' behaviour to derive non-market values (Boyle 2003). Examples include the travel cost and hedonic pricing methods (Gunawardena, Zhang et al. 2017).

Both stated preference and revealed preference approaches were extensively used to value urban environmental assets such as public open space or green infrastructure (Luttik 2000, Sander, Ghosh et al. 2010, Lanz and Provins 2013, Pandit, Polyakov et al. 2014). The advantage of stated preferences is that they can be used to estimate values in hypothetical situations and estimate both use and non-use values. Their disadvantage is susceptibility to hypothetical bias. The advantage of revealed preference approaches is that they are based on observed behaviours, therefore are considered more trustworthy. The disadvantage is that they can estimate only use-values, depend on the existence of a market for other goods (such as the market for houses in the proximity to an asset being valued in the case of hedonic pricing method), and can only be used to value establishment or improvements of the assets ex-post (Earnhart 2001).

Many non-market valuations studies conducted in Australia and overseas use these techniques. For example, Iftekhar, Gunawardena et al. (2019) reported a database that contains more than 1,500 records of non-market values from more than 160 Australian studies on water sensitive systems and practices. However, despite the growing literature on non-market values, information is lacking about large-scale liveability improvement projects, especially in Australia. We contribute to this knowledge gap by focusing on a major infrastructure controlled by a large water utility in Australia, Victoria's Main Outfall Sewer (MOS).

The MOS was constructed in the 1890s to carry Melbourne's raw sewage to the Western Treatment Plant in Werribee. The MOS was decommissioned in the 1990s and has been entirely replaced by an underground pipeline. It was state-heritage listed in 2001 due to its role in Melbourne's history, and its infrastructure including open channels, buried pipes and aqueducts is still present in the landscape. It is currently in disrepair and is fenced off for public safety.

There is growing interest to convert the area into a park for community use as part of the Greening the Pipeline initiative. However, information on which types of restoration features people prefer is lacking. This study aims to assess people's preferences and values for different options and features of the MOS restoration, to facilitate a design that will generate maximum benefit to society and justify the cost. We use non-market valuation techniques because the features of the project are not traded on the market, and therefore their benefits do not have market values.

This report addresses five research questions:

1. Is the amenity benefit of improving local parks capitalised in the property prices?
2. What is local residents' general attitude towards MOS improvement?
3. How much are people willing to pay for different features of MOS improvement?
4. Do different socio-demographic groups have different preferences?
5. What is the aggregate value of a potential restoration project?

As well as generating primary non-market values, we contribute to the non-market valuation literature by employing both revealed and stated preference approaches. Only a few studies have employed both of these approaches in the same case studies (Earnhart 2001, Earnhart 2002, Scarpa, Ruto et al. 2003, Bowman, Tyndall et al. 2012, Phaneuf, Taylor et al. 2013). Finally, we combine the information from both hedonic and choice analysis to calculate the aggregate values of MOS improvement. This information could be useful for formal benefit–cost analyses of similar projects.

2. Relevant literature

Both revealed and stated preference approaches have been used to estimate non-market values of water sensitive systems and practices. Several studies use the revealed preference approach, mostly the hedonic pricing method, to estimate non-market values of public open space (POS) (Mahmoudi, Hatton MacDonald et al. 2013, Pandit, Polyakov et al. 2013), water sensitive urban infrastructure (Tapsuwan, Ingram et al. 2009, Netusil, Levin et al. 2014) and their elements. The majority use a cross-sectional approach, where researchers analyse house prices at a specific point in time, with some of the houses being “treated” (located close to POS), while other houses being “untreated” (located far from POS). This approach is susceptible to endogeneity or correlation with the existing assets and infrastructure. For example, proximity to POS may coincide with proximity to other assets or amenities, or proximity to POS induces the construction of better houses. To overcome these shortcomings, researchers often use pseudo-experimental approaches, such as the difference-in-differences (DiD) technique, which estimates the changes in the benefits due to establishing or upgrading the assets. In other contexts, DiD was used to estimate the impact of Walmarts (Pope and Pope 2015), water levels of an irrigation storage lake (No Kim, Boxall et al. 2015), and disamenity of wind turbines (Vyn 2018).

Several hedonic studies used pseudo-experimental approaches to assess the impact of improvements to POS or water sensitive urban design (WSUD). Irwin, Klaiber et al. (2017) examined the capitalisation of stormwater retention basins in suburban housing developments using a hedonic pricing method. They found adjacency to retention basins decreased housing prices between 13% and 14% and that their negative effect increased with the age of a basin.

Livy and Klaiber (2016) used hedonic models to explore the capitalised value of renovations to local parks in Baltimore County, Maryland, between 2000 and 2007. They controlled for potential unobservable factors that may be correlated with providing local park features in traditional cross-sectional analyses, by exploiting time-variability in renovations to estimate property fixed-effects models that control for unobserved location and time-constant attributes. They found that hedonic models using an aggregate indicator for renovations do not provide significant estimates. However, when analysing various renovation types separately, they found both positive and negative significant effects of particular renovation types on property values.

Polyakov, Fogarty et al. (2017) assessed the changes in the amenity benefits of converting an urban drain into a natural ecosystem, known as the living stream project, in Perth, Western Australia. Eight years after the project, the median home within 200 m of the restoration site had increased in value by an additional $17,000 to $26,000. Also, the total benefit across all houses within 200 m of the project was more than enough to cover the cost of the project.

Noh (2019) analysed the impact of converting abandoned railways in the City of Whittier, California into greenways on the housing market. The analysis used two spatial regressions, before and after the conversion, applying the Adjusted Interrupted Time Series-Difference in Differences (AITS-DID) model. Using 2005–2012 single-family home sale data, the author found the conversion increased property values.

Stated preference methods, and, in particular, the choice experiment (CE) method (Adamowicz, Boxall et al. 1998, Louviere, Swait et al. 2000) can be used to estimate non-market values. The CE method is more suitable to elicit values and preferences for interventions or asset improvements because of its hypothetical nature. Unlike in revealed preference methods, researchers do not need to look for natural experiments and wait until the effect of the intervention is reflected in house prices. It has been used to estimate willingness to pay for preserving biodiversity (Subroy, Gunawardena et al. 2019), saving the Great Barrier Reef (Rolfe and Windle 2012), protecting urban greenspace (Bullock 2006), and identifying preferable urban land-use options (Iftekhar, Burton et al. 2018). Some of these studies are described below.

Campbell, Hutchinson et al. (2009) estimated the general populations’ willingness to pay for measures to improve rural landscapes through the Rural Environment Protection (REP) Scheme in the Republic of Ireland. The Scheme contributes to various rural landscape attributes, such as mountain land, stonewalls, tidiness of farmyards, and cultural heritage. The survey design included two levels of improvement for each attribute. The cost attribute was the expected annual cost that the respondent would personally have to pay per year through their income and value-added taxes. A panel mixed logit specification to account for unobserved taste heterogeneity was used to analyse the data. The study found a positive but spatially heterogenous willingness to pay for all attributes.

Lanz and Provins (2013) used choice experiments to evaluate preferences to improve public open space, recreation facilities, street cleanliness; restore derelict properties; and provide cycling and walking paths in Seaham, England. The survey included the spatial scope of the policy as an attribute. The cost attribute was defined as an increase in the respondent's annual council tax bill. The willingness to pay was estimated using mixed logit models with a random cost coefficient. The analysis revealed significant benefits of improved local environmental amenities, with the highest benefit attributed to restoring derelict properties and improving street cleanliness, while providing cycling and walking paths received the least value.

Iftekhar, Burton et al. (2018) reported results from a choice experiment survey of different land-use options for the buffer zones around wastewater treatment plants in Western Australia. They found the land-use mix with 50% nature, 30% recreation, 10% agriculture and 10% industry would generate the highest community value. The willingness to pay (WTP) for this combination of land uses was estimated at $522 per annum per household higher than the baseline 100% industrial land-use option.

For a systematic review of non-market valuation studies on water sensitive systems and practices see Gunawardena, Zhang et al. (2017) and Iftekhar, Gunawardena et al. (2019). These reviews highlight that few non-market valuation studies have analysed people's preferences for large-scale public restoration projects.

3. Case study area

The MOS reserve runs between Millers Road in Brooklyn and the Western Treatment Plant in Werribee (Figure 2). It is approximately 6 km inland from Port Phillip Bay (Miller 2005). It is about 25 km long and 40 m wide (ARUP 2013). The adjacent local government areas (LGAs) are Wyndham, Brimbank, Hobsons Bay, and Maribyrnong. Greening the Pipeline is an initiative of Melbourne Water, Wyndham City Council, City West Water and VicRoads, supported by Greening the West. It aims to transform the MOS reserve into a parkland to service a growing population in Melbourne's west.

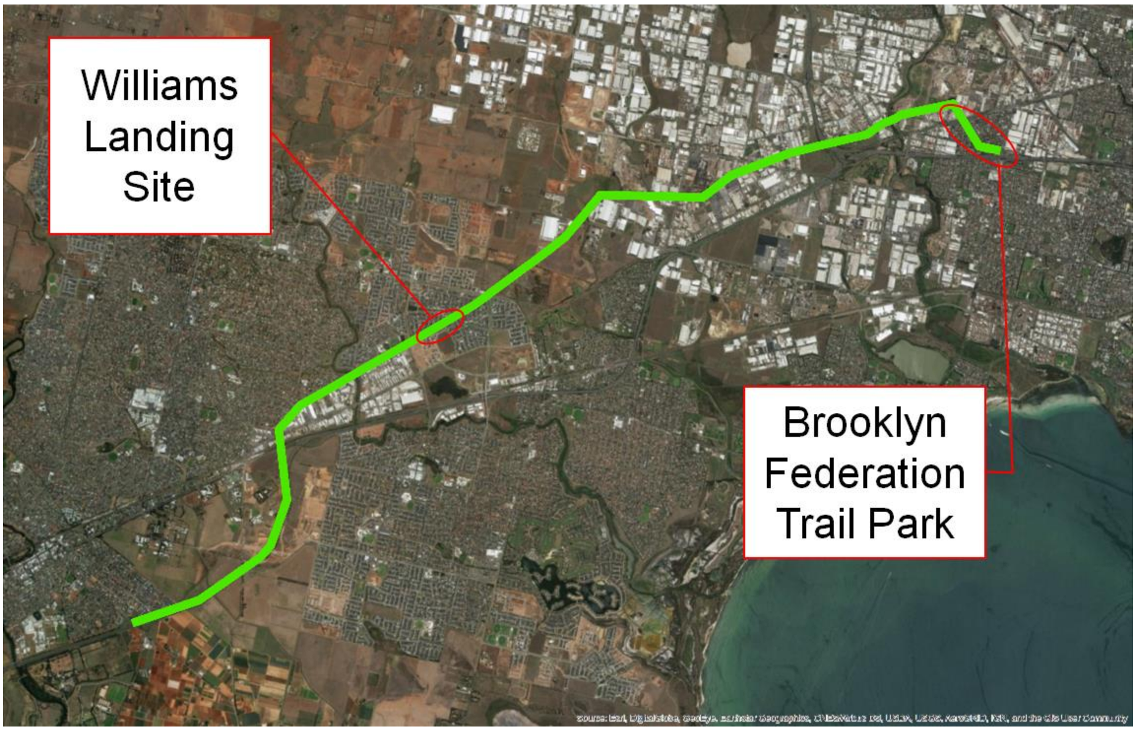


Figure 2: Location of the Main Outfall Sewer Reserve (Greening the Pipeline)

Table 2 presents the major land uses in the adjacent LGAs, as well as land uses within the 5 km buffer of the MOS reserve and greater Melbourne. The Brimbank, Hobsons Bay, and Maribyrnong LGAs have a higher proportion of industry compared with greater Melbourne. The industrial area is relatively low in the Wyndham LGA, and residential land use is relatively low compared with greater Melbourne.

Table 2: Major land uses in local government areas adjacent to the MOS

Land use	5 km buffer of the MOS reserve	Relevant local government areas				Melbourne
		Brimbank	Hobsons Bay	Maribyrnong	Wyndham	
Area (Ha)	27,638	12,476	6,500	3,158	54,859	273,791
Proportion (%)						
Commercial	3	3	1	8	1	5
Education	3	2	2	2	1	2
Hospital/medical	0	0	0	0	0	0
Industrial	24	22	31	18	5	9
Parkland	14	19	24	13	16	14
Primary production (agriculture)	10	0	0	0	52	7
Residential	38	47	38	51	19	56
Transport	1	2	2	3	0	1
Water	1	0	2	0	0	0
Other	6	5	0	4	6	6

Table 3 presents the socio-demographic profiles of these LGAs. Wyndham LGA has a lower population density than the other LGAs, but a relatively higher household income. Households in Brimbank LGA have a lower level of median household income. However, age, education, and income distributions between the two LGAs are similar.

Table 3: Socio-demographic profile of local government areas adjacent to the MOS

	Relevant local government areas				Greater Melbourne
	Wyndham	Brimbank	Hobsons Bay	Maribyrnong	
Area (sq km)	542	123	64	31	9,999
Total person	217,122	194,319	88,778	82,288	4,485,211
Population density (person / sq km)	401	1,580	1,387	2,654	449
Average household size	3.1	3	2.6	2.5	2.7
Distribution of persons (%) by age					
0–4 years	10	7	7	7	6
5–14 years	15	12	12	9	12
15–19 years	6	6	5	4	6
20–24 years	6	8	6	9	7
25–34 years	19	16	15	23	16
35–44 years	17	14	15	17	14
45–54 years	12	13	14	12	13
55–64 years	8	11	12	9	11
65–74 years	5	8	8	5	8
75–84 years	2	4	5	3	4
85 years and over	1	2	2	2	2
Distribution of persons (%) by the highest year of school completed					
Year 12 or equivalent	63	57	61	73	64
Year 11 or equivalent	11	10	12	7	11
Year 10 or equivalent	14	13	13	8	12
Year 9 or equivalent	6	6	5	4	5
Year 8 or below	5	11	7	6	6
Did not go to school	1	4	2	2	1
Median age of persons	32	35	38	33	36
Median total household income ($/weekly)	1,620	1,263	1,567	1,551	1,542
Distribution households (%) by total household income (weekly)					
Negative/Nil income	1	2	2	2	2
$1–$149	1	1	1	1	1
$150–$299	1	3	2	3	2
$300–$399	2	3	3	3	2
$400–$499	4	7	6	5	5
$500–$649	3	4	4	4	4
$650–$799	6	8	6	6	6
$800–$999	7	7	6	6	6
$1,000–$1,249	9	9	7	8	8
$1,250–$1,499	9	8	7	7	7
$1,500–$1,749	7	6	6	6	6
$1,750–$1,999	7	6	6	6	6
$2,000–$2,499	13	10	11	11	11
$2,500–$2,999	8	6	7	7	7
$3,000–$3,499	5	3	5	5	4
$3,500–$3,999	3	2	4	5	4
$4,000 or more	5	3	8	7	8
Partial income stated	7	8	7	7	8
All incomes not stated	2	3	3	2	2

Source: ABS (2016), https://www.abs.gov.au/websitedbs/censushome.nsf/home/communityprofiles?opendocument&navpos=230.

Originally, Melbourne Water managed the MOS. After the system was decommissioned, the reserve was transferred to VicRoads to use as a bike path known as the Federation Trail (ARUP 2013), although Melbourne Water still owns the sewer asset. The Greening the Pipeline initiative is converting the MOS into a linear park and bike track. A pilot park project of a 100 m section at Williams Landing was completed in April 2017 to showcase the potential for the broader project (Furlong, Phelan et al. 2018).

The key stakeholders in this project are Melbourne Water, Wyndham City Council, VicRoads, City West Water, Brimbank Council, and Hobsons Bay Council. The multiple beneficiaries of the newly created of parkland and active space include:

- residents of the surrounding suburbs, who benefit from access to a new amenity area
- all members of society, who benefit from environmental improvements (i.e. additional revegetation and stormwater capture and reuse)

- nearby residents, who benefit from higher house prices due to the proximity to an amenity asset
- local governments, that receive higher revenue due to higher property tax revenue
- the Victorian and Commonwealth governments, that benefit from lower public health care costs.

However, there are wide geographical variations in realising these benefits, due to differences in land uses and socio-economic conditions in various locations (Table 4).

Table 4: Major stakeholder in the Greening the Pipeline project and their interests

Stakeholder	Interests
Melbourne Water	• Reducing liability • Utilising land (crown) and asset • Integrated Water Management (IWM) • Waterway health • Flooding
Wyndham City Council	• Community connectedness • Offset • A higher level of services • Integrated Water Management (IWM)
City West Water	• Health • Green infrastructure • Recycled water • Potable water • Stormwater
Vic Road	• Maintenance liability • Maintenance of Federation bike trail
Brimbank Council	• Integrated Water Management (IWM) • Industry • Kororoit Creek connectivity • Bike trail
Hobsons Bay Council	• Residential

Source: Case study scoping meeting on 17 March 2017.

4. Methodology

We employed two separate non-market valuation methods in this case study: a hedonic analysis and a choice experiment, which are described below. For each method, we describe the analysis techniques and data collection approaches separately.

4.1 Hedonic analysis

We used hedonic analysis to estimate the amenity value of establishing Brooklyn Park, a four-hectare public open space created by landscaping and planting trees and shrubs in June 2012. Specifically, we used the prices of units and houses sold within Statistical Areas Level 1 (SA1) located within proximity to the park.

4.1.1 Analysis method

The hedonic pricing method (Rosen 1974). assumes a property's observed sale price is a function of the property attributes (such as lot size, number of bedrooms, bathrooms and parking spaces), and location-specific features. The hedonic method is well suited to estimating amenity benefits and has been used to estimate the extent to which environmental and recreational assets such as open space, parks, and WSUD elements (e.g., living streams) are capitalised into residential property prices (Acharya and Bennett 2001, Pandit, Polyakov et al. 2014, Polyakov, Fogarty et al. 2017). Because the amenity benefits of environmental assets usually depend on access to the site, a common approach to valuing these benefits is to use a measure of proximity to the asset to capture an implicit price for the asset (Bin 2005, Tapsuwan, Ingram et al. 2009, Sander, Ghosh et al. 2010, Polyakov, Fogarty et al. 2017). In quasi-experimental studies[1] (i.e., hedonic analysis) it is crucial to specify the spatial extent of the effect. This is commonly done by identifying properties adjacent to an asset (Garrod and Willis 1994, Earnhart 2001) or located within a certain distance (Crompton 2001, Pope and Pope 2015, Polyakov, Fogarty et al. 2017).

Creating Brooklyn Park improved the visual amenity of the MOS reserve. Residents can use the park for regular recreational activities such as jogging, dog walking, or birdwatching (Figure 3). The site does not have parking or picnic places and is therefore mainly used by the local residents. There are also several local public open spaces within proximity that provide amenities such as sports or exercise equipment, playgrounds, and picnic places. We assumed local residents would most likely benefit from the visual amenity of Brooklyn Park. Therefore, we assumed the benefits generated by the park are captured by the residents of properties immediately adjacent to the park, which we defined as properties within 50 m. To determine the impact of the project, we needed a set of reference sales of houses and units that were not affected by the project (located further than 50 m from the park), but similar in all other respects. We defined the reference area as the cluster of SA1's within 1 km of Brooklyn Park[2] (Figure 4).

[1] Such as the difference-in-differences (DiD) technique, which attempts to estimate the value of change in an asset, such as restoration of a wetland or construction of a park.

[2] We cross-checked the validity of this assumption with relevant stakeholders.

Figure 3: Aerial view of the changes at Brooklyn Park

We controlled the property price trend through the year temporal fixed effects: 2001 to 2018, with 2019 used as a reference year. The coefficients of the year binary variables represented a hedonic price index of property prices in the study area. The property values, as well as the factors determining these values, were characterised by spatial dependencies (Anselin 1988). Failure to model spatial effects can result in biased and inconsistent estimates of model parameters. We modelled the spatial relationships following the approach of Kuminoff, Parmeter et al. (2010) and controlled for unobserved variables and spatial dependency problems by using spatial fixed effects, where the fixed effects are set at the SA1 level. To account for the possibility of different trends in different SA1 areas, we interacted year and SA1 fixed effects.

The sales database contained observations of repeat sales of the same properties. Ignoring repeat sales could result in biased estimates of standard errors (Greene 2011). We addressed this issue by clustering errors for individual properties and then used heteroskedasticity-robust standard errors to determine the level of significance. We used the Box-Cox method to select the functional form of the hedonic model. Following common practice, we considered values for lambda in the Box-Cox transformation of between minus two and two. We found the log-likelihood was flat around zero with a minimum value slightly greater than zero. Therefore, we applied a log transformation to the dependent variable.

One of the quasi-experimental methods used with the hedonic pricing analysis is the difference-in-differences (DiD) technique (Ashenfelter 1978). Examples of hedonic-based DiD analyses include Galster, Tatian et al. (1999), and Pope and Pope (2015). The core of the DiD technique is estimating the difference between two potential outcomes, which is a function of treatment. Because researchers rarely observe the units (i.e., a property) in both treated and untreated state at the same time, the identification requires a comparison of treated and untreated units. In the standard DiD design, the units are observed before and after treatment and are grouped into treated and untreated. In our case, treatment means being located within a certain distance (50 m) of the park. Let the binary variable D_{ij} be equal to 1 if house *i* in SA1 *j* belongs to the treatment group (located within 50 m of the park), and equal to 0 otherwise. Let variable T_{ijt} indicate post-treatment and be equal to 1 if a house or a unit was sold after the project was completed and 0 otherwise. The model for the log resale price of a house or a unit can be written as:

$$\ln p_{ijt} = \alpha + \beta D_{ij} + \gamma T_{ijt} + \delta D_{ij} T_{ijt} + \mathbf{x}'_{ij}\boldsymbol{\theta} + \mathbf{s}'_{jt}\boldsymbol{\sigma} + \eta_{ij} + \varepsilon_{ijt}$$

where p_{ijt} is the observed sale price of property i, in area j, at time t; $\mathbf{x}_{ij}$ is a vector of time-invariant property attributes; $\mathbf{s}_{jt}$ is a vector of the interactions of spatial and temporal fixed effects taking the value 1 if the house is situated in SA1 j is sold in year t, and 0 otherwise; ε_{ijt} is a zero-mean observation-specific random error term; η_{ij} is a zero-mean property-specific error term, and $\alpha, \beta, \gamma, \delta, \boldsymbol{\theta}$, and $\boldsymbol{\sigma}$ are parameters to be estimated, where δ is a measure of the impact of constructing Brooklyn Park.

4.1.2 Data

We acquired the property sales data from a commercial company[3]. The data set contained information on home sale prices and dates, type of property (house or unit), area of the lot, and structural characteristics such as the number of bedrooms, bathrooms and car parking spaces. First, we selected the sales records for single-family homes and units sold between 1990 and 2019 in two suburbs overlapping the study area: Brooklyn and Altona North. We then georeferenced the sales data by matching sales records with the cadastral map obtained from the Australian Urban Research Infrastructure Network (AURIN). We selected sales in the SA1s located within 1 km of Brooklyn Park. Observations where the lot area in the sale record did not match the area of the cadastral lot were visually inspected using Nearmap aerial images, and the area was adjusted. We excluded the units in apartment complexes because they are substantially different from the townhouse or strata units and should be treated as a separate group (although there were not enough observations to treat them as a separate group). We also excluded observations with missing values and/or observations with a lot size greater than 1,000 m^2 (outlier)

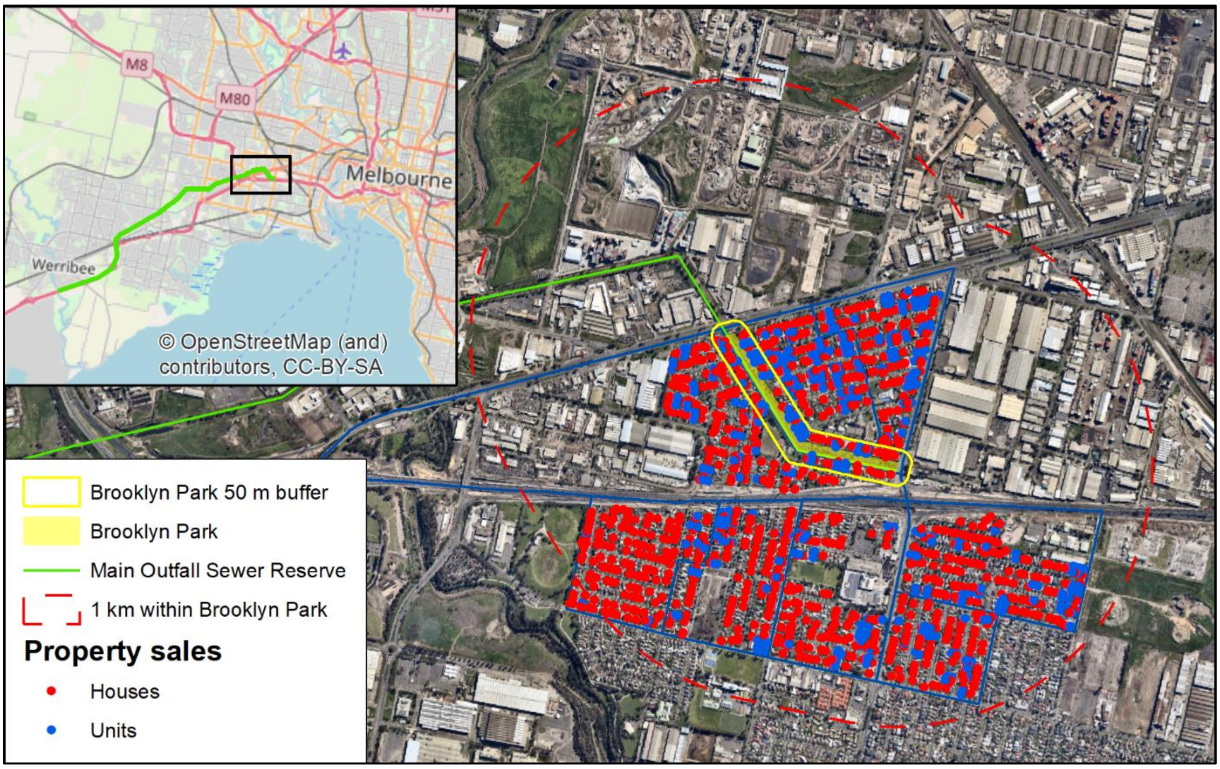


Figure 4: Location of Brooklyn Park and the sales data used for hedonic analysis

This selection provided 2,172 sales records for 1,346 unique properties (1990–2019). Of the properties in the sample, 564 properties were sold more than once. There were 1,744 observations of sales between 2000 and 2019, which we used for our main model. We used each property's spatial coordinate to assign them a relevant SA1 and to calculate their distance from the park. On the map (Figure 4), blue dots indicate units, and red dots indicate houses. Table 5 presents the descriptive statistics of the sample: 27% of total sales related to units; around 8% of sales related to properties within 50 m of the park; and around 34% of sales occurred after the park was constructed.

[3] "Pricefinder" (www.pricefinder.com.au).

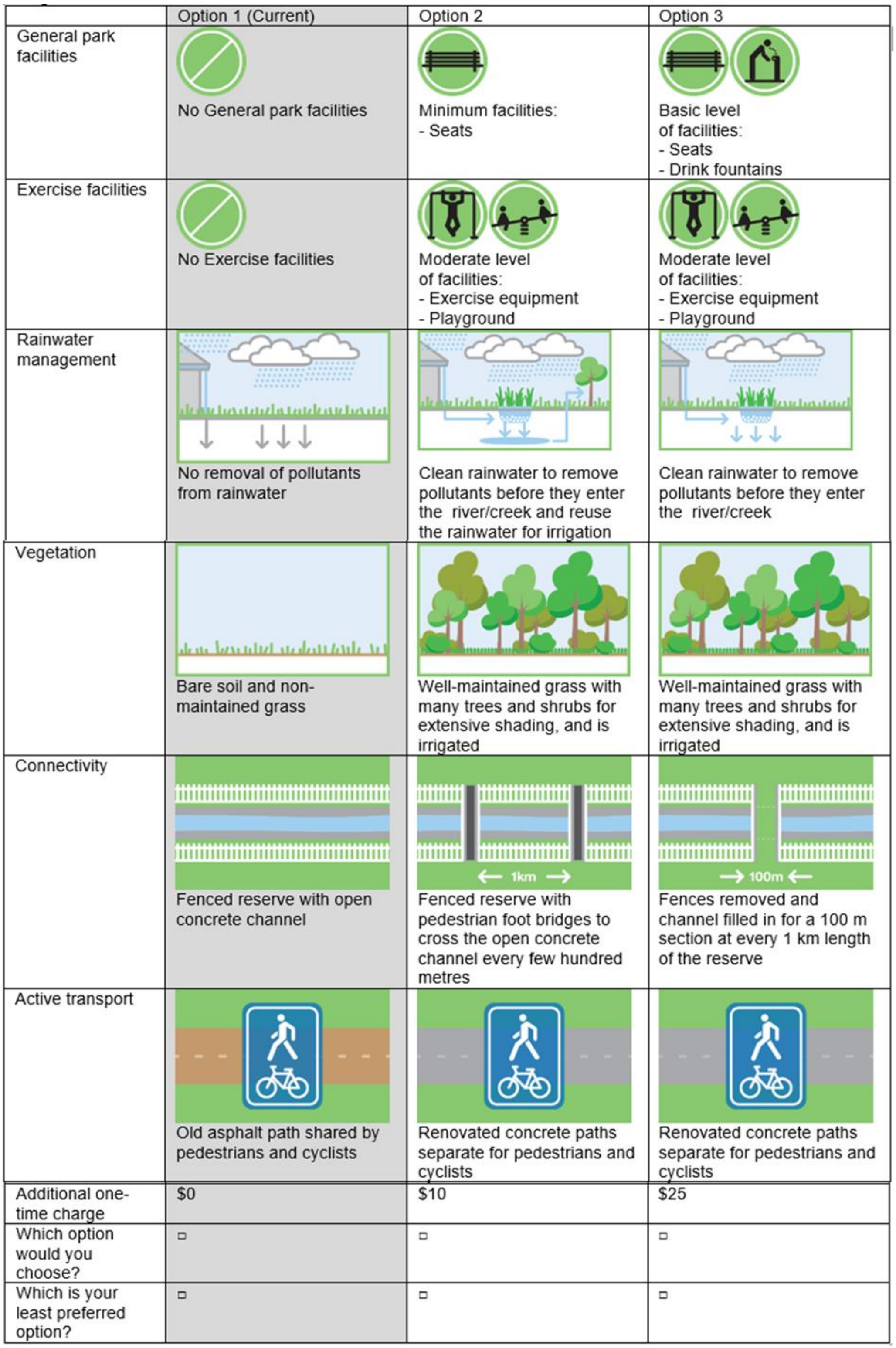
Table 5: Summary statistics of the sales data (N=2172)

Continuous variables	Mean	Std dev	Minimum	Median	Maximum
Sale price (2018AUD)	441,514	187,912	89,121	442,342	969,329
Lot area, m^2	490	227	64	585	932
Number of bedrooms	2.85	0.53	1	3	6
Number of bathrooms	1.32	0.51	1	1	4
Number of car parks	1.56	0.79	0	1	4
Binary variables	Proportion (%)				
Unit (0/1)	27				
Within 50 m of the major road	14				
Within 50 m of Brooklyn Park	8				
After Brooklyn Park construction	34				

4.2 Choice experiments

Discrete choice experiments (DCEs) are an economic approach widely used for quantifying people's preferences for intangible or non-market assets (Bateman, Carson et al. 2002, Pearce, Özdemiroğlu et al. 2002, Baker and Ruting 2014). Through a questionnaire, survey respondents are presented with a 'choice scenario', where they are asked to choose between two or more options. The options are defined by a set of common 'attributes', or characteristics, describing a policy or program. The attributes are defined by a range of levels, where the levels represent changes in the quantity or quality of the attribute. The levels of the attributes vary across each option. One of the attributes usually included is a cost associated with providing the option. One of the options included in the choice scenario is usually a representation of the 'status quo' or current situation. The respondent has to make tradeoffs between what is offered in each option, and the cost of the option, and choose their most preferred option.

Respondents are usually presented with a number of choice scenarios, each containing a different set of options to compare against the status quo (Figure 5). A large sample of respondents participates in answering the survey. The responses to the choice scenarios can then be statistically analysed to reveal respondents' preferences for each incremental change in an attribute, relative to changes in other attributes. This is known as a measure of 'marginal utility' for the attribute level. By comparing the marginal utilities for the cost attribute with those of the other attributes, it is possible to estimate how much people are willing to pay for the attributes of the policies or programs.



	Option 1 (Current)	Option 2	Option 3
General park facilities	No General park facilities	Minimum facilities: - Seats	Basic level of facilities: - Seats - Drink fountains
Exercise facilities	No Exercise facilities	Moderate level of facilities: - Exercise equipment - Playground	Moderate level of facilities: - Exercise equipment - Playground
Rainwater management	No removal of pollutants from rainwater	Clean rainwater to remove pollutants before they enter the river/creek and reuse the rainwater for irrigation	Clean rainwater to remove pollutants before they enter the river/creek
Vegetation	Bare soil and non-maintained grass	Well-maintained grass with many trees and shrubs for extensive shading, and is irrigated	Well-maintained grass with many trees and shrubs for extensive shading, and is irrigated
Connectivity	Fenced reserve with open concrete channel	Fenced reserve with pedestrian foot bridges to cross the open concrete channel every few hundred metres	Fences removed and channel filled in for a 100 m section at every 1 km length of the reserve
Active transport	Old asphalt path shared by pedestrians and cyclists	Renovated concrete paths separate for pedestrians and cyclists	Renovated concrete paths separate for pedestrians and cyclists
Additional one-time charge	$0	$10	$25
Which option would you choose?	☐	☐	☐
Which is your least preferred option?	☐	☐	☐

Figure 5: An example of a choice scenario

4.2.1 Survey design

Survey context

The choice experiment survey was aimed at identifying people's preferences for the changed amenity for sections of public open space along the MOS. We used the DCE methodology because it allowed us to simultaneously measure the values for different amenity attributes as well as the tradeoffs people were prepared to make between having more or less of these attributes in the design of public spaces. The DCE allowed us to test these preferences in a hypothetical setting, which was desirable because there were no set plans for redesigning the MOS reserve (i.e. no specific set of designs to test).

The survey context was developed in consultation with Melbourne Water and Wyndham City Council, which are the key management authorities responsible for upgrading the MOS reserve. The consultation occurred over several meetings throughout 2017–2019, with members from the Integrated Planning teams in Melbourne Water, to establish a set of amenity attributes to evaluate. These discussions were supported by a review of non-market values of water sensitive systems and practices (Gunawardena, Zhang et al. 2017).

Attributes

The DCE included six amenity attributes and a cost attribute. The amenity attributes related to recreational services, environmental benefits, connectivity, and accessibility. Each attribute was defined with a number of levels that ranged from having none of the amenity benefits associated with that attribute provided, to having a large amount of amenity provided. The amenity attributes are defined below, both with a text description and an accompanying icon image. Both the text and icons were used to describe the attribute levels in the choice scenarios.

- General park facilities: basic facilities that could be made available at a redeveloped public open space on the MOS reserve. There were five levels ranging from no facilities through to a high level of facilities being provided, with the gradual inclusion of additional facilities to differentiate each level (seats, drinking fountains, BBQ and toilet facilities) (Figure 6).

Level	Description
No facilities	
Minimum	Seats
Basic	Seats, Drink fountains
Moderate	Seats, Drink fountains, BBQs
High	Seats, Drink fountains, BBQs, Toilets

Figure 6: Levels of the general park facilities attribute

- Exercise facilities: dedicated exercise facilities, for adults and children. There were again five levels ranging from no facilities to a high level of facilities being provided. In this case, there were two basic levels of provision focused on either exercise equipment (for adults) or playground equipment (for children). A moderate level of facilities included providing both exercise and playground equipment, and a high level included specialised skate facilities (Figure 7)

Level	Description
No facilities	
Basic 1	Exercise equipment
Basic 2	Playground
Moderate	Exercise equipment Playground
High	Exercise equipment Playground Skate park

Figure 7: Levels of the exercise facilities attribute

- Rainwater management: water sensitive designs to improve environmental water flow. Three different levels defined the attribute. The lowest level involved no water management. The next level involved removing pollutants by filtering rainwater (e.g., through rain gardens). The highest level included removing pollutants, as well as capturing the reusing the rainwater to irrigate the lawn and garden areas of the reserve (Figure 8).

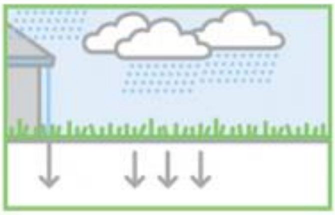
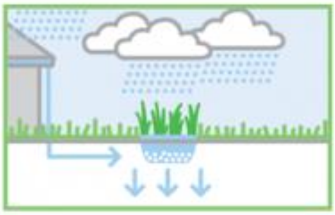
Level	Description
No pollutant removal	 **No removal of pollutants from rainwater**
Pollutant removal	 **Clean rainwater to remove pollutants before they enter the river/creek**
Pollutant removal and water reuse	 **Clean rainwater to remove pollutants before they enter the river/creek and reuse the rainwater for irrigation**

Figure 8: Levels of the rainwater management attribute

- Vegetation: four levels depicting different configurations of vegetation cover. The levels ranged from unkept grass/bare soil to well-maintained grass, to well-maintained grass with some trees and shrubs, to well-maintained grass with extensive and irrigated gardens with many trees and shrubs (Figure 9).

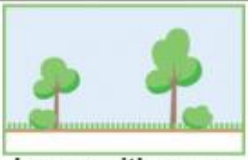
Level	Description
Bare soil and grass	 Bare soil and non-maintained grass
Grass only	 Well-maintained grass
Grass and some trees	 Well-maintained grass with sparse trees and shrubs to provide some shading
Grass and many trees	 Well-maintained grass with many trees and shrubs for extensive shading, and is irrigated

Figure 9: Levels of the vegetation attribute

- Local crossings: the connectivity of local communities was represented by the type of crossings provided, noting the reserve is fenced currently in nearly all areas limiting access and connectivity of communities on either side. This attribute had four levels ranging from: no crossings; crossings via small footbridges every few hundred metres along the reserve; narrow crossings that provided an open space about 100 m wide with the channel filled in, for every 1 km section of the reserve; and wide crossings, where fences are removed, the channel filled in, and a much larger open space created up to 1 km long (Figure 10).

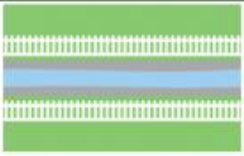
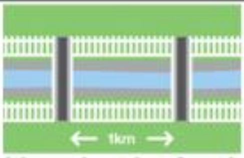
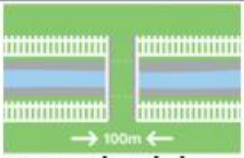
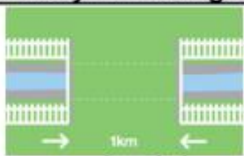
Level	Description
No crossings	 Fenced reserve with open concrete channel (MOS)
Foot bridges	 Fenced reserve with pedestrian foot bridges to cross the open concrete channel every 1 km along the reserve
Narrow crossings	 Fences removed and channel filled in for 100 m every 1 km along the reserve
Wide crossings	 Fences removed and channel filled in for sections up to 1 km long

Figure 10: Levels of the local crossings attribute

- Paths: finally, accessibility was represented by describing the provision of tracks and pathways for people to commute and recreate on. At its lowest level, there was no renovation of the existing asphalt path shared by cyclists and pedestrians. A medium level provided a renovated concrete path, still shared by cyclists and pedestrians, while the highest level provided renovated separate paths for cyclists and pedestrians (Figure 11).

Level	Description
No path renovation	 Old asphalt path shared by pedestrians and cyclists
Renovated shared path	 Renovated concrete path shared by pedestrians and cyclists
Renovated separate path	 Renovated concrete paths separate for pedestrians and cyclists

Figure 11: Levels of the paths attribute

- Finally, the cost attribute was defined as being a one-off charge added to the annual Waterways and Drainage charge that households receive with their water bill. The payment was to be applied to all households in Melbourne, and it was noted that the payment would be passed on to renters by their landlord. The cost attribute included levels of $0 for the current situation, which represented the lowest level of all of the amenity attributes, and for other options $50, $100, $200, $300 and $400.

Generation of choice scenarios

The choice scenarios were designed to each include three options: the first option represented the current situation or status quo (no upgrades in public open space on the MOS reserve), and the other two options represented improvements in the amenity attributes for an increased cost to the respondent.

We used a software program, Ngene (Choice Metrics Pty. Ltd.), to generate an experimental design for the choice scenarios. These types of programs aim to optimise the statistical efficiency of the design, to ensure we can estimate the tradeoffs people are prepared to make between each level of each attribute (Scarpa and Rose 2008). The design allocates attribute levels for the two options that include improvements in the amenity. The full design included 48 choice scenarios. The design was blocked into six sets of scenarios, so that each respondent was presented with eight scenarios. We used the D-error optimality criterion to find an efficient design, which is one of the most commonly used metrics in discrete choice design (Johnson, Lancsar et al. 2013, Yao, Scarpa et al. 2015). The priors required to produce an efficient design were generated from a pilot.

The icons and associated text for the attribute levels were then arranged in the choice scenario options according to the experiment design, as shown in Figure 12.

	Option 1 (current)	Option 2	Option 3
Vegetation	Bare soil and grass	Bare soil and grass Bare soil and non-maintained grass	Grass only Well-maintained grass
General park facilities	No facilities	Seats	Seats, Drink, BBQ, Toilet
Paths	No path renovation	Renovated shared path Renovated concrete paths shared for pedestrians and cyclists	No path renovation Old asphalt path shared by pedestrians and cyclists
Rainwater management	No pollutant removal	Pollutant removal and water reuse Clean rainwater to remove pollutants and reuse the rainwater for irrigation	Pollutant removal Clean rainwater to remove pollutants
Exercise facilities	No facilities	No facilities	Equipment, Playground
Local crossings	No crossings	Narrow crossings Fences removed and channel filled in for 100 m every 1 km along the reserve	Foot bridges Fenced reserve with pedestrian foot bridges to cross the open concrete channel
Additional one-time charge	$0	$100	$100

Figure 12: Example of how the choice scenarios were presented in the survey instrument

Other survey content

The survey contained several sections with information and questions to support the DCE exercise. It began with an introduction to the purpose of the survey – to understand community attitudes towards potential improvement projects along the MOS reserve – and information about what the MOS reserve refers to. This first section also included questions about people’s familiarity with and use of the MOS reserve.

The DCE section was then presented, with the attribute descriptions, instructions on how to answer, and the eight choice scenarios. A debriefing section followed the choice scenarios to provide insight about how receptive respondents were to the choice tasks. Questions included asking respondents to indicate their confidence in their choices, describe which attributes influenced their choices the most, and how influential they thought the survey results would be on future policy decisions about the MOS reserve. The answers to these questions can be important for understanding variability in responses in the choice model.

The final section collected socio-demographic information about the respondent. The survey concluded with a disclaimer to help manage any sensitivities associated with the hypothetical prospect of increased water service charges, stating:

> “*Although agencies have a long-term vision to improve the MOS, please note that currently there is no specific plan in place to improve the MOS. This survey contains hypothetical options and is designed to investigate the community’s interest in, and willingness to support liveability projects like the MOS.*
>
> *If a MOS improvement plan is developed and approved, it will not be financed by the drainage charge or any other direct charge to local residents.*

The scenarios presented here are hypothetical. They do not represent in any way that Melbourne Water or other agencies intend to increase the Waterways and Drainage charge."

The survey instrument is provided in Appendix C.

4.2.2 Survey testing

The draft survey was tested extensively, to ensure it was comprehensible, and meaningful both to public respondents and to the decision making agencies who might use the results. The first stage of testing was via focus groups.

We presented a paper draft of the survey to an expert focus group on 9 April 2018. The focus group consisted of nine participants from Melbourne Water, Citywest Water, and Wyndham City Council. The experts completed the survey as if participating as a respondent and then critiqued the content. A key concern related to the payment vehicle (the mechanism through which funds are proposed to be collected for the cost attribute). In the draft survey, the payment vehicle was defined as "a higher water service charge (the waterways and drainage charges included in the water bill) …[that] will apply for a period of five years". There was a perceived risk that respondents might not believe this approach was entirely hypothetical. Rather, respondents may think it suggests the water utilities were actually planning to increase this service charge, and that this would create potential concern in the local community. We discussed alternative payment mechanisms, including council rates, but the focus group raised similar concerns.

We conducted two public focus groups in Truganina, Victoria, with seven local residents from the MOS region participating in each group (10 and 11 April 2018). The 18–25 age demographic was under-represented, but otherwise, there was an even spread of gender and age demographics across the participants. These focus groups completed the same survey-draft and were provided with the opportunity to critique.

The public focus groups suggested a number of minor clarifications for the information and questions, and particularly they discussed alternative language to simplify the attribute descriptions and images. Preferences were mixed about whether to present the attributes using text or icon images or both. Given this diversity, the final survey was designed with both the text and icon descriptors for the attribute levels.

The public focus groups also raised the issue about the capability of non-native English speakers to complete the survey, acknowledging the diverse ethnic backgrounds in communities surrounding the MOS reserve. Many participants agreed that these households typically have access to family members and friends who could translate the survey if needed. Noting the survey sample was collected via an online panel, we assumed this issue was minimised because panel members would have sufficient English or access to translation.

The participants found the number of attributes (six) and options (three) in the choice scenarios manageable, so the final survey retained this configuration. Participants were presented with six scenarios in the focus groups, which was also received well. Based on this positive feedback, and given the number of attributes and levels in the survey design (meaning a large experimental design was required), the final survey contained eight scenarios.

The public focus groups discussed the payment vehicle and raised some different concerns to the expert group. Given the hypothetical nature of the task, the majority did not perceive that this implied water utilities were planning to raise the service charge. However, they preferred that the payment was scheduled as a one-off payment. They were concerned a stated '5-year' payment if implemented in reality, may turn into a perpetual annual payment. They also questioned the relevance of the service charge to all households, noting that renters do not pay this component of the bill. The service charge was retained as the payment vehicle in the final survey but was specified as a one-off payment, and a statement was included to explain that the payment would be passed on to renters via their landlord.

To minimise the risk of public sensitivity to the payment vehicle, we added a disclaimer to the end of the survey (shown in Section 3.2.1 above). This disclaimer was displayed to all respondents who completed the survey in full and also to any respondents who exited the survey at any point after they had reached the survey screen displaying the description of the payment vehicle.

We conducted a final test of the revised survey draft through internal testing at The University of Western Australia in January 2019. The group included 11 participants, consisting of postgraduate students at the School of

Agriculture and Environment. Most of them were not experts in non-market valuation. They completed surveys that included 18 choice scenarios.

4.2.3 Data collection

We defined the relevant population as the local communities living in the postcodes within 5 km of the MOS reserve (Figure 13). While the MOS is heritage listed by the State of Victoria and therefore may be valued by the wider Victorian population, this survey focused on valuing the amenity that could be provided to local communities by improving the MOS reserve, rather than the value of the heritage infrastructure. Given this, the valuation exercise was most relevant to Melbourne, and particularly local communities close enough to be likely to use the reserve.

A market research company (PureProfile) collected a sample of 600 participants. Online recruitment companies maintain panels of respondents and invite them via email to participate in surveys for minor remuneration (usually a few dollars or entries to a prize draw). Recruitment can be managed to provide a representative sample of the target population, with respect to gender and age demographics.

Sampling began in March 2019, with a pilot sample of 51 completed responses. We conducted a preliminary analysis of this pilot data, and discovered we could estimate statistically significant coefficients for only the first three amenity attributes presented in the choice scenarios, and cost. In the pilot survey, these first three attributes were: general park facilities, exercise facilities, and rainwater management. We collected an additional 55 complete responses, but preliminary analysis revealed similar results.

The lack of significance of the subsequent three attributes (vegetation, local crossings, and paths) could have been due to a number of factors: the respondents sampled may genuinely have been indifferent to changes in the levels of those attributes; the pilot sample size may have been too small to estimate statistically significant parameters; or, respondents may have been employing a decision heuristic to simplify the choice task, which was resulting in an attribute ordering effect. To counter the possibility of this last factor, for the subsequent sample collection, we changed the order of the attributes to reflect the order presented in Figure 12; that is, vegetation, general park facilities, paths, rainwater management, exercise facilities, and local crossings. The survey was otherwise unchanged.

The final sample of another 518 completed responses was collected in April 2019, providing a total sample of 624 completed responses. Partial responses were also collected from 244 respondents (n=868 overall).

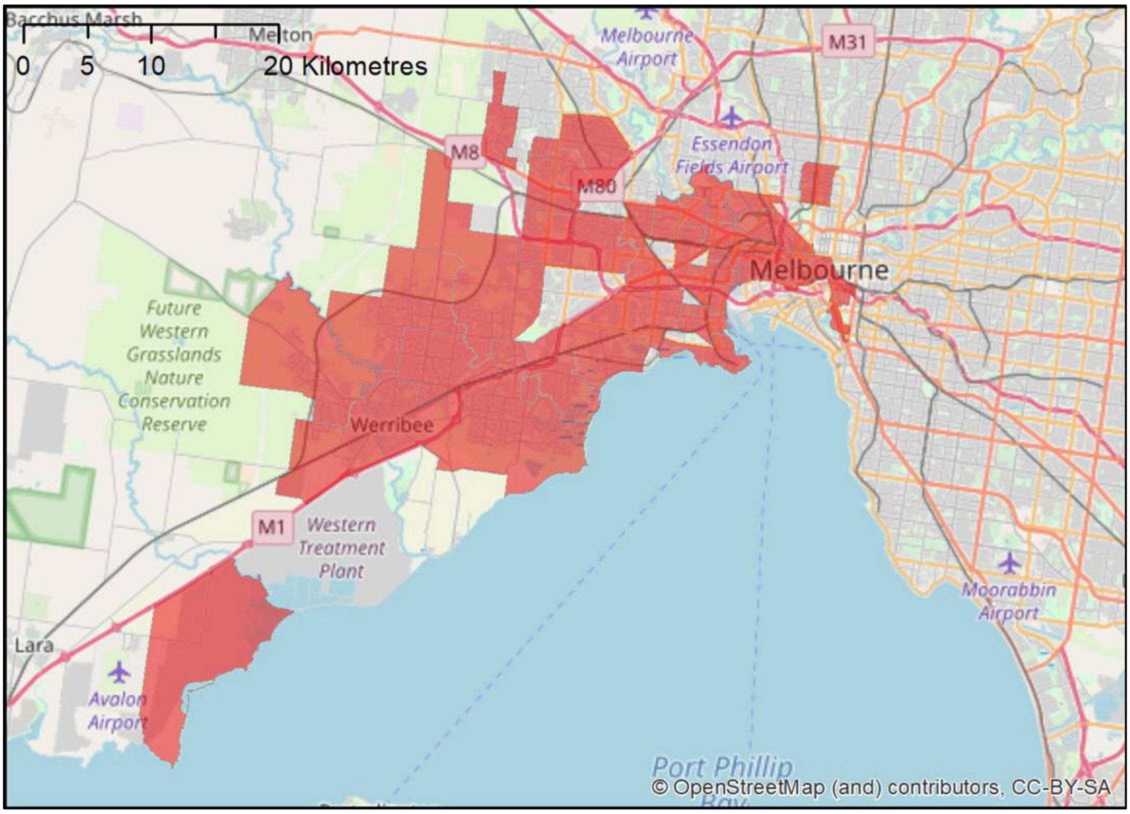


Figure 13: Location of the survey area

4.2.4 Sample characteristics

Summary statistics of the socio-demographic conditions of the respondents are presented in Table 6 and in Appendix B. There is a slightly higher representation of females (57%) in the final sample compared with the relative proportion of females (50%) in the surrounding LGAs. Around 55% of the households have weekly income less than $2,000. The distribution of household income is similar to the surrounding LGAs. This result was important to ensure that the income distribution in the sample matches that of the population, because it has been empirically observed that people's income status often significantly influences their preferences and willingness to pay (Bateman, Carson et al. 2002). Around 70% of respondents were below 46 years of age, which is also close to the age group distribution in the surrounding LGAs. In the final sample, more than 75% of the respondents have technical or University education, which is higher than the relevant estimate for the LGA. 70% of the respondents are employed. Half of the respondents are living in the current address for more than five years. More than half of the respondents own a house.

Around a quarter of the respondents live within 1 km and almost half of the respondents live more than 1 km away from the MOS. The rest do not know how far they live from the MOS. Around 10% of the respondents is a member of an environmental or community organisation. Around 31% of the respondents use MOS reserve (including the Federation Trail), whereas 76% of them use either the MOS or other parks. The main purpose for visiting the MOS and other local parks is walking (70% of respondents). This result suggests the MOS is already providing some services similar to other local parks. Cycling or commuting is the second main purpose (43%) for using the MOS, whereas spending time with kids and families is the second most cited reason for using other local parks. Such difference is expected given the Federation bike trail is a prominent feature of the MOS reserve, but the MOS reserve has not been developed to provide a high level of recreational and amenity services yet.

Table 6: Socio-demographic characteristics of the respondents

	Proportion (% of respondents)
Female	57
Male	40
Prefer to self-describe	1
Prefer not to say	1
Have technical or University education	76
Employed	70
Age <46 years)	71
Income (<2k/week)	55
Own the place	56
Renting	39
Staying with relatives and friends (not paying rent)	5
Living in the area <5 years	50
Living within 1 km	25
Living further than 1 km	48
Do not know the distance	28
Member of an environmental / community organisation	10
Use both MOS and local parks	27
Use MOS or local parks	80
Does not use MOS or local park	20

4.2.5 Method to analyse choice preference data

There are various methods to analyse choice experiment data (Olaru, Smith et al. 2011). Among these, the latent class analysis technique has the ability to identify groups of respondents (latent classes) with specific socio-demographic and preference characteristics (Boxall and Adamowicz 2002, Beharry-Borg, Smart et al. 2013, Quynh, Schilizzi et al. 2018, Rakatama, Pandit et al. 2018). Therefore, we used a latent class analysis technique to analyse the data. A general description of the latent class analysis is re-produced from Magidson and Vermunt (2007) in Appendix A.

To conduct the analysis, we used Latent GOLD® Choice 5.1 Syntax (Vermunt and Magidson 2013). In the latent class model, we included all attributes, including general park facilities, exercise facilities, rainwater management, vegetation, local crossings, paths, and the additional one-off charge. We also included a dummy variable reflecting the status quo situation, which captures the marginal utility that individuals may hold for maintaining the status quo, above and beyond the utility that is associated with the levels of the attributes that comprise that option. We treated all attribute variables as categorical variables, where the lowest level (i.e., 'no improvement') was used as the reference category. We included the cost parameter as a continuous variable. The status quo variable takes a value of '1' if the alternative is the current situation, otherwise '0'. We also included socio-demographic variables as covariates to explain class membership. However, we did not include any variables as predictors of class membership.

To find the most appropriate model, we estimated a series of models with a different number of preference and scale classes. Following common practice, we selected the model with the lowest Bayesian information criterion (BIC) and consistent Akaike information criterion (CAIC) as the most preferred model. Based on the results of BIC and CAIC simulation, we found that a scale adjusted model with 2 scale classes and 2 preference classes has the smallest BIC and CAIC (see Appendix A), which was deemed to be the most preferred model.

We found about 70% of the total sample belongs to scale class 1. The scale factor for scale class 2 is normalised to unity. The scale factor obtained for scale class 1 is 6.76 (Table 7). As the scale parameter is inversely related to the variance of the error term, respondents in scale class 1 have a much larger scale (lower error variance) than those in scale class 2. In other words, respondents of scale class 1 display a lower level of uncertainty in making their choices than respondents of scale class 2. We used people's certainty score (i.e., their response to the question 'how certain, on average, you were of the answers you gave when selecting your most favoured and least favoured scenarios') to explain the variation in scale. The coefficient for the 'Certainty' variable is positive for scale class 1 and negative for scale class 2. It is possible that the heterogeneity in scale variance might cause changes in the significance of preference parameters when preference parameters are rescaled for the alternative scale class. We checked the stability of the significance of the preference parameters by re-running the model where we normalised the scale factor for scale 2 to unity. We found the interpretation of results remained unchanged after rescaling, confirming the robustness of our reported preference estimates.

Table 7: Scale class membership

	Scale class 1		Scale class 2	
Scale factor (λ)	6.76	***	1.00	
Scale class membership				
Constant	–0.96		0.96	
Certainty	0.25	*	–0.25	*

***, **, * indicates significance at 1%, 5% and 10% levels, respectively.

The latent class models produce preference parameters for different levels of individual attributes for different preference classes. Based on the distribution of the estimated parameters it is possible to calculate the willingness to pay estimates which are the ratios of the coefficients for specific attributes (β_s^{att}) and cost parameter (β_s^{cost}) multiplied by negative one, i.e.,

$$MWT_s^{att} = -1 \times \beta_s^{att} / \beta_s^{cost}$$

The willingness to pay estimates were simulated based on the random parameter distribution of the coefficients from individual regression model estimates, where at first 1,000 random draws (s) of coefficients for the individual attributes were generated using the Krinsky–Robb procedure (Krinsky and Robb 1986). Next, the marginal willingness to pay for individual draws were calculated using the formula presented above. To formally compare the distribution of marginal willingness to pay for different attributes, we used the test proposed by Poe, Giraud et al. (2005). This is a one-sided approximate test of significance based on the complete combinatorial test. To implement this test, first we calculated the differences between all the possible combinations of simulated willingness to pay of any two levels of an attribute. This step resulted in $10^3 \times 10^3$ calculated differences. Then, we calculated the proportion of negative values in the distribution of differences as the level of significance. We used Bonferoni adjustment on the level of significance by dividing the critical P value by the number of comparisons to factor in multiple comparisons.

Using the willingness to pay estimates, we can calculate the total willingness to pay for a restoration scenario. Following Iftekhar, Buurman et al. (2019), the total willingness to pay is calculated as a linear combination of the 1,000 randomly drawn estimates simulated for individual attributes of a hypothetical restoration project. Given the total willingness to pay estimates generated are 'one-off' only, it is also useful to convert them into annualised values. Annualised values are useful to conduct a benefit–cost analysis of projects with a fixed lifespan. To calculate annualised values, we multiplied the 'one-off' total willingness to pay estimates by 0.05 (assuming a 5% discount rate).

4.3 Aggregating the benefits

Decision makers are often more interested in the total value of a project, because it could be applied in a benefit–cost analysis. Therefore, we aggregated results from the hedonic analysis and choice experiment to estimate the total value of several restoration options. To calculate the aggregate value, we followed these steps:

1. **Define the features of the restoration project**. The restoration project may include various levels of the attributes of restoration evaluated using the hedonic pricing method or the choice experiment. At this stage, we define the features and their level included in each restoration scenario.
2. **Establish the relevant catchment area.** The catchment area relates to the population (or the number of households) over which values should be aggregated. The relevant area depends on the scope of the non-

market valuation method being used. For the hedonic analysis, it was Brooklyn Park. For the choice experiment, it was the postcodes within 5 km of the MOS reserve.

3. **Identify the relevant willingness to pay estimates.** Determine which willingness to pay estimates to apply to which part of the community or the catchment. Values of some benefits estimated using the two methods overlap. To avoid double-counting we have to identify these overlapping benefits and include the most relevant estimates from only one of the methods.
4. **Aggregate values**: In this step, the appropriate willingness to pay estimates are applied to the properties/households within the relevant part of the catchment area. For example, the benefits capitalised in house values are applied to the households located within the influence distance from the MOS obtained using the hedonic method. The values obtained using a choice experiment are applied to the households located within the survey study area, excluding the households already assigned overlapping values based on the hedonic method. The values are aggregated over the households within the parts of the catchment area and added to get the total value of a restoration project.

5. Results

In this section, we present the results from the hedonic analysis, the choice experiment and finally, the aggregate values.

5.1 Hedonic analysis results

First, we estimated the DiD model with property-level random effects using 2000–2019 data (Table 8). The coefficients for the structural characteristics of the properties are significant and have expected signs, suggesting that property price increases with the number of bedrooms, bathrooms, garages, car parks, and is lower for units and properties located within 50 m of major roads. Location close to the MOS does not affect property prices. However, after construction/improvement of Brooklyn Park in June 2012, the prices of residential properties (houses and units) immediately adjacent to the park (within 50 m), increased by about 5.3% (90% CI: 1% to 9%).

To test that this is not a result of the trend in property prices near the park, we conducted a falsification test. We selected a sample of sales of the same length of time (20 years) before Brooklyn Park was constructed (1990–2009) and selected June 2002 as a falsified date of the construction of the park. This sample contained 1,253 observations. We estimated the same model, which is also presented in Table 8. The estimates of the coefficients for structural characteristics of the properties are consistent with the estimates in the DiD model. However, the coefficient for the interaction effect of the property being located within 50 m of Brooklyn Park and sold after the falsified construction date is small in magnitude and not statistically significant. This result confirmed the impact of constructing Brooklyn Park on the properties within 50 m estimated in the main model is valid.

Table 8: Regression results

Effect	DiD model (2000–2019)			Falsification test (1990–2009)		
	Estimate	P	SE	Estimate	P	SE
Intercept	12.825	***	0.098	12.526	***	0.161
Lot area, m^2	0.070	***	0.014	0.044	**	0.022
Number of bedrooms	0.053	***	0.011	0.076	***	0.015
Number of bathrooms	0.053	***	0.011	0.048	***	0.013
Number of car parks	0.029	***	0.006	0.017	**	0.008
Unit (0/1)	–0.064	***	0.015	–0.002		0.024
Within 50 m of main road	–0.073	***	0.014	–0.038	**	0.017
Within 50 m of Brooklyn Park	0.009		0.018	–0.001		0.033
After construction of Brooklyn Park	–0.023		0.032			
Within 50 m after construction of Brooklyn Park	0.053	**	0.025			
After June 2002				0.055		0.053
Within 50 m after June 2002				–0.014		0.040
Year * SA1 fixed effects	Yes			Yes		
Number of observations	1,744			1,253		
AIC	–446.01			–142.34		

***, **, * indicates significance at 1%, 5% and 10% levels, respectively.

5.2 Choice experiment results

This section presents summary statistics related to respondents' knowledge, attitude and response behaviour in the survey. Then, we present the results from the latent class models. Finally, we present the distribution of the simulated willingness to pay estimates.

5.2.1 Analysis of people's knowledge, attitude and response behaviour

Overall, there is a general consensus that it is important to protect the MOS reserve (Figure 14). Around 22% of the respondents agreed or strongly agreed the MOS reserve is personally important for them as a heritage site and recreational site. Further, around 42% agreed or strongly agreed the MOS reserve is an important part of the local landscape. There is also support to protect the MOS reserve: 28% agreed or strongly agreed the general public (individuals and community groups) should volunteer to maintain/restore the MOS reserve and Federation Trail in partnership with the relevant government agency. 47% agreed or strongly agreed government agencies should be responsible for maintaining/restoring the MOS reserve and Federation Trail on their own. Around 25% thought the general public (individuals and community groups) should volunteer to maintain/restore the MOS reserve and Federation Trail on their own, which indicated general support to preserve the MOS reserve.

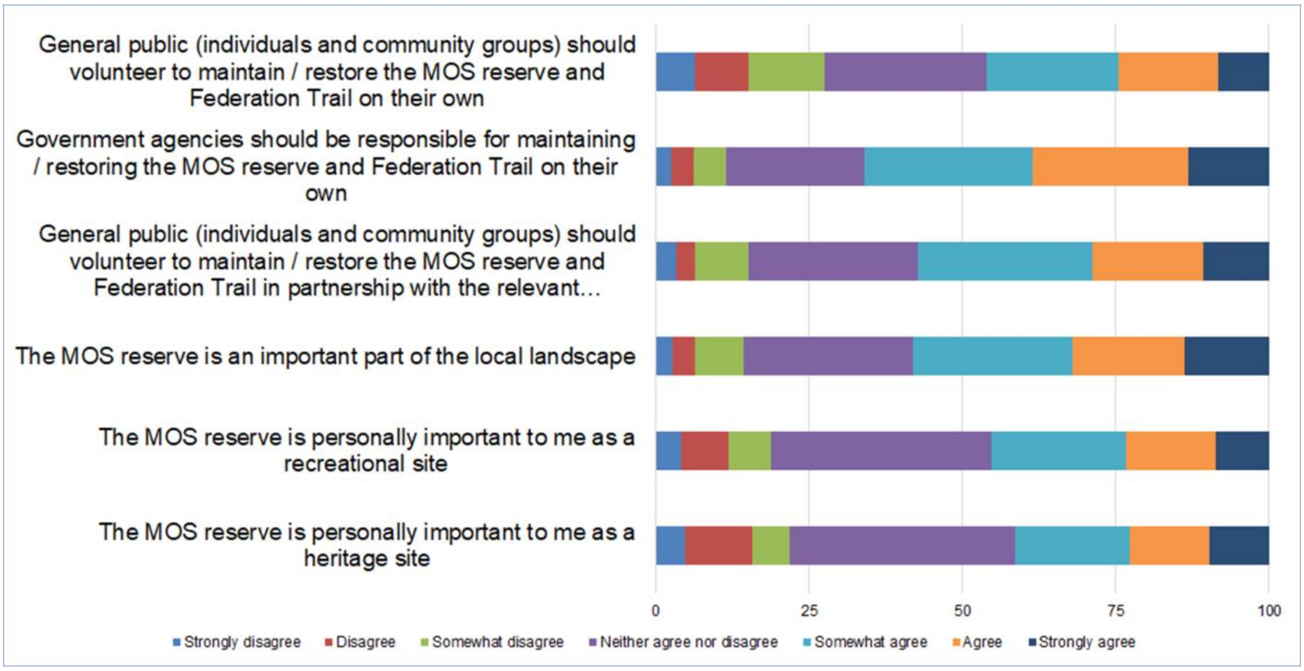


Figure 14: Proportion of responses to various attitudinal questions related to the MOS reserve

Further evidence of protecting the MOS could be gathered from their response to the question of who should pay to protect/manage the MOS. Around 47% of respondents thought all residents of Melbourne should pay for protecting the MOS reserve. Around 27% thought only those who will actually use the MOS reserve improvement projects should pay, whereas, the remainder (26%) thought that no one should pay to protect the reserve.

We also observed and collected information on how people responded to the survey. Overall, only 9% thought that the choice sets were confusing. More than 80% of the respondents were fairly certain of their responses (i.e., have a certainty score of 5 or more). Almost 75% of respondents considered their own financial circumstances while completing the choice scenarios. Finally, more than 60% of respondents thought (i.e., have a score of 5 or more) survey outcomes would influence future policies (Figure 15). Among the completed responses, 6% always selected the status quo option and around 2% were protest voters[4]. Protest voters were defined as those who always selected the status quo option and identified one of the following reasons for selecting the status quo option: 'I don't think I should have to pay for improving the MOS reserve', 'I think that Government agencies/local councils should have to pay for improving the MOS reserve from within their existing budgets', and 'I don't believe that I should have to make these choices'. Respondents who selected the status quo for other reasons, for example, because they could not afford to select the other options, are not considered protestors because this is a valid response to the question being asked.

[4] It is common to exclude the protest voters in a choice experiment analysis using different techniques. However, a latent class analysis could segregate them into a separate class and therefore it is not essential to exclude them.

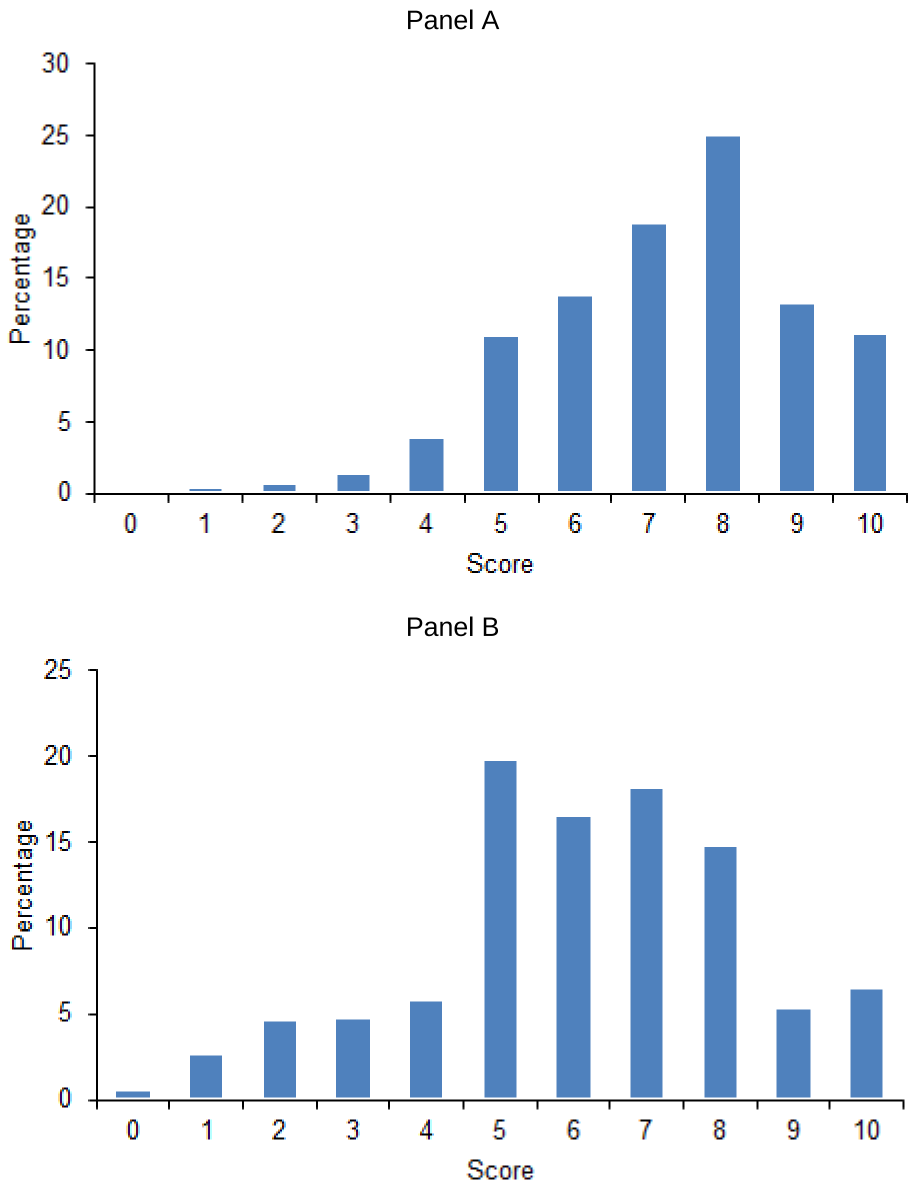


Figure 15: Distribution of respondents by their response to the ‘certainty’ and the ‘influence’ question. Panel A: Response to the question “How certain, on average, you were of the answers you gave when selecting your most favoured and least favoured scenarios”. Panel B: Response to the question “How likely you think the survey results will influence future policy decisions regarding the improvement of the MOS reserve”

5.2.2 Analysis of people’s response behaviour

The estimates from the latent class model are presented in Table 9. The majority of the respondents belong to class 1 (86% of the total sample) and the remainder is in class 2. Based on their preferences they could be named as Path class (class 2) and Upgrade class (class 1). The first thing to note is that almost all the variables in the Path class (class 2) are not statistically significant. This result indicates this group was not responding to many of the attributes (including the cost parameter and the status quo option). They do have a statistically significant preference for renovated paths relative to existing paths, with a slightly stronger preference for a shared path in particular. For some reason, they have a weak preference to have bare soil and non-maintained grass rather than some grass and trees. However, the non-significance of the cost parameter suggests that estimation of willingness to pay for this class would be meaningless, so we focused on the Upgrade class (class 1), which constituted a majority of the sample anyway.

Respondents in the Upgrade class have a positive preference for different features as indicated by the statistically significant and positive coefficients. Exercise facilities, park facilities, and vegetation attributes have expected directions, which means that the higher the levels, the higher the values of the coefficients. The cost parameter is statistically significant and negative, suggesting people's aversion to higher costs. The status quo parameter is strongly negatively significant, indicating people's strong preference to avoid the current situation.

Table 9: Model estimate

	Upgrade class			Path class		
	Estimate	p	se	Estimate	p	se
Cost	–0.001	***	0.000	0.000		0.001
Park facilities						
Seats	0.057	***	0.021	0.144		0.243
Seats + drink fountain	0.061	***	0.022	–0.020		0.236
Seats + drink fountain + BBQs	0.094	***	0.029	–0.168		0.310
Seats + drink fountain + BBQs + toilets	0.153	***	0.043	–0.227		0.414
Exercise facilities						
Exercise equipment	0.043	**	0.020	0.071		0.141
Playground	0.059	***	0.021	–0.267		0.269
Exercise equipment + playground	0.082	***	0.027	–0.289		0.221
Exercise equipment + playground + skate park	0.086	***	0.028	–0.208		0.235
Rainwater management						
Pollutant removal	0.080	***	0.024	–0.219		0.200
Pollutant removal and water reuse	0.094	***	0.028	–0.300		0.207
Vegetation						
Grass only	0.024	*	0.013	–0.029		0.149
Grass and some trees	0.102	***	0.030	–0.327	*	0.192
Grass and many trees	0.124	***	0.035	–0.142		0.159
Local Crossings						
Foot bridge	0.062	***	0.021	–0.164		0.197
Narrow crossing	0.051	***	0.018	–0.012		0.182
Wide crossing	0.052	***	0.019	0.095		0.142
Path						
Renovated shared path	0.054	***	0.018	0.362	**	0.162
Renovated separate path	0.054	***	0.017	0.355	**	0.170
Status quo	–0.413	***	0.132	0.480		0.461
Class size (%)	86%			14%		

***, **, * indicates significance at 1%, 5% and 10% levels, respectively.

Given we are interested to know what type of people have positive preferences for MOS restoration, we examined the role of covariates describing the class membership (Table 10). Those who are employed and those whose income is less than $2,000/week are less likely to be a member of the Upgrade class. Similarly, those who considered their financial circumstances while completing the survey were also less likely to be a member of the class. On the other hand, those who own a property or rent are more likely to be part of the Upgrade class, compared with those who live with someone else[5]. Distance to the MOS reserve and number of years living in the place do not explain class membership. However, those who use either the MOS or local parks are more likely to be a member of the Upgrade class. Those who thought residents of the whole of Melbourne or only those who use the MOS reserve should pay are more likely to be a member of the Upgrade class, compared with those who thought no-one should pay for the restoration. Interestingly, those who agreed with the statement that the general public on their own should be responsible for maintaining/restoring the MOS are less likely to be a member of the Upgrade class. This result is consistent, because people would be less likely to be willing to pay the government or an agency if they think that they are going to bear the cost anyway.

[5] This group could include people who are directly paying rent or mortgage to live in a house (e.g., live in extended families).

Table 10: Latent class membership: Influence of socio-demographic factors on the probability of being a member of the upgrade class

Socio-demographic variable (% of the total sample)	Coefficient	p	se
Constant	–0.577		0.628
Prefer not to say (1%)	base		
Female (57%)	1.278	**	0.563
Male (40%)	1.294	**	0.562
Prefer to self-describe (1%)	1.064		0.801
Do not know (28%)	base		
Living within 1 km (25%)	–0.186		0.245
Living further than 1 km (48%)	0.182		0.193
Living in the current address <5 years (50%)	0.262		0.185
Age <46 years (71%)	–0.135		0.196
Employed (69.7%)	–0.390	*	0.201
Have technical or University education (75.7%)	–0.279		0.211
Income (<2k/week) (55%)	–0.399	**	0.170
Staying with someone else (not paying for accommodation) (5%)	base		
Own the place (56%)	0.618	**	0.296
Renting (39%)	0.502	*	0.301
Member of an environmental / community organisation (10%)	–0.128		0.277
Do not use MOS or local parks (20%)	base		
Use both MOS and local parks (27%)	–0.012		0.217
Use MOS or local parks (80%)	0.390	**	0.196
Confused with the choice sets (9%)	0.018		0.281
Considered own financial circumstances (73%)	–0.392	*	0.202
No-one should pay (26%)	base		
All residents of Melbourne should pay (47%)	0.702	***	0.204
Only those who will actually use the MOS reserve improvement projects should pay (27%)	0.447	**	0.197
Agreed MOS is personally important as a heritage site (41%)^	0.383		0.317
Agreed MOS is personally important as a recreational site (45%) ^	–0.108		0.298
Agreed MOS is personally important as part of the local landscape (58%)^	0.033		0.246
Agreed the general public should volunteer to maintain/restore the MOS with government agencies (57%) ^	0.133		0.244
Agreed the government on their own should be responsible for maintaining/restoring the MOS (66%)^	0.108		0.188
Agreed the general public on their own should be responsible for maintaining/restoring the MOS (46%)^	–0.482	**	0.233

***, **, * indicates significance at 1%, 5% and 10% levels, respectively. ^ The respondent has been given a value of ‘1’ if they somewhat agreed or agreed or strongly agreed with the statement; otherwise they received a value of ‘0’.

5.2.3 Willingness to pay

While the information on people’s preference parameters is useful, investment decisions often require estimates of willingness to pay. The willingness to pay is the tradeoff between the cost and the non-monetary attributes and is computed as the negative of the ratio of the marginal utility of a change in the non-monetary attribute to the marginal utility of the cost. We estimated distribution of the willingness to pay estimates as described in the method section.

Here we estimate willingness to pay for the Upgrade class only, where there was a significant response to the cost attribute. People have a positive willingness to pay to have restoration features compared with the current situation which contains a minimum level of features (Table 11).

For example, people were willing to pay $84 per household, on average, for seats as park facilities compared with the current situation of no park facilities. The average willingness to pay estimates were higher for higher levels of park facilities. However, the results from the Poe test suggested the willingness to pay estimates for the lower levels of park facilities (such as between Seats, Seats + drink fountain, and Seats + drink fountain + BBQs) were not significantly different from each other. However, the willingness to pay estimates for the highest level of park facilities (i.e., Seats + drink fountain + BBQs + toilets) was statistically different from those for lower levels of park facilities.

People were also willing to pay for exercise facilities. For example, the average willingness to pay was $64 per household for exercise equipment compared with having no exercise facilities. Similarly, they were willing to pay $87 per household for a playground compared with having no exercise facilities. However, the respondents were not willing to pay substantially more for having both types of facilities together. In fact, a Poe test suggested no significant difference in willingness to pay estimates for different levels of exercise facilities.

People were also willing to pay for stormwater management compared with no stormwater management, but there was no difference between two levels of stormwater management. For example, on average, people were willing to pay $114 per household to have stormwater management facilities which would remove pollutants from stormwater. The average willingness to pay estimates for filtering and re-using stormwater was slightly higher ($135 per household) but it was not statistically different from the filtering-only option.

Compared with having bare soil people were willing to pay to have vegetation coverage. For example, the average willingness to pay to get grass only, grass and some trees and grass and many trees were $35, $146 and $179 per household respectively. The willingness to pay estimates for the lowest level of vegetation (i.e., grass only) was significantly lower than the willingness to pay estimates for the higher two levels of vegetation (i.e., between the grass and some trees and grass and many trees). However, there was no difference in willingness to pay estimates for the higher two levels of vegetation.

People liked the option to have crossing facilities and were willing to pay for the facility. For example, compared with having no crossing facility people were willing to pay $90 per household, on average, to have foot bridge. The similar figures for 'narrow crossing' and 'wide crossing' were $75 and $76 per household respectively. Again, the willingness to pay estimates for different levels of crossing facilities was similar. People were also willing to pay for renovated paths ($78 per household) compared with no improvement. The willingness to pay estimate distributions of different path development options were similar. Finally, we observed very strong dispreference for the 'status quo' option (–$588 per household), suggesting people's general willingness to accept MOS restoration projects.

Table 11: Distribution of willingness to pay estimates for the Upgrade class

Features	Mean	90% CI	
Park facilities			
Seats	84	45	127
Seats + drink fountain	89	53	128
Seats + drink fountain + BBQs	136	97	183
Seats + drink fountain + BBQs + toilets	221	174	277
Exercise facilities			
Exercise equipment	64	19	110
Playground	87	45	128
Exercise equipment + playground	121	78	167
Exercise equipment + playground + skate park	128	84	176
Rainwater management			
Pollutant removal	114	84	151
Pollutant removal and water reuse	135	104	170
Vegetation			
Grass only	35	3	65
Grass and some trees	146	107	190
Grass and many trees	179	140	224
Local crossing			
Foot bridge	90	57	124
Narrow crossing	75	44	109
Wide crossing	76	42	110
Path			
Renovated shared path	78	48	108
Renovated separate path	78	48	110
Status quo	–588	–825	–385

Using the willingness to pay, we calculated the total willingness to pay for two hypothetical restoration projects: low level of improvement and high level of improvement. The low level of improvement includes minimum levels of different features used in the survey: Seats; Exercise equipment; Pollutant removal; Grass only; Foot bridge; and Renovated shared path. The high level of improvement includes the maximum levels used in the survey: Seats + drink fountain + BBQs + toilets; Exercise equipment + playground + skate park; Pollutant removal and water reuse; Grass and many trees; Wide crossing; and Renovated separate path.

The distributions of the total willingness to pay estimates for the two options are presented in Figure 16. The high level of improvement could generate a higher level of total willingness to pay compared with the low-level improvement option. The mean value of the total willingness to pay for the high-level option was $817/household (90% CI: $687 to $984/household). The annualised total value was $41/household/year (90% CI: $34 to $49/household/year). On the other hand, the mean value of the total willingness to pay for the low-level option was $451/household (90% CI: $350 to $559/household). The annualised total value for this option was $23/household/year (90% CI: $18 to $28/household/year)[6]. However, this analysis does not include estimates from the hedonic analysis, which we do in the following section.

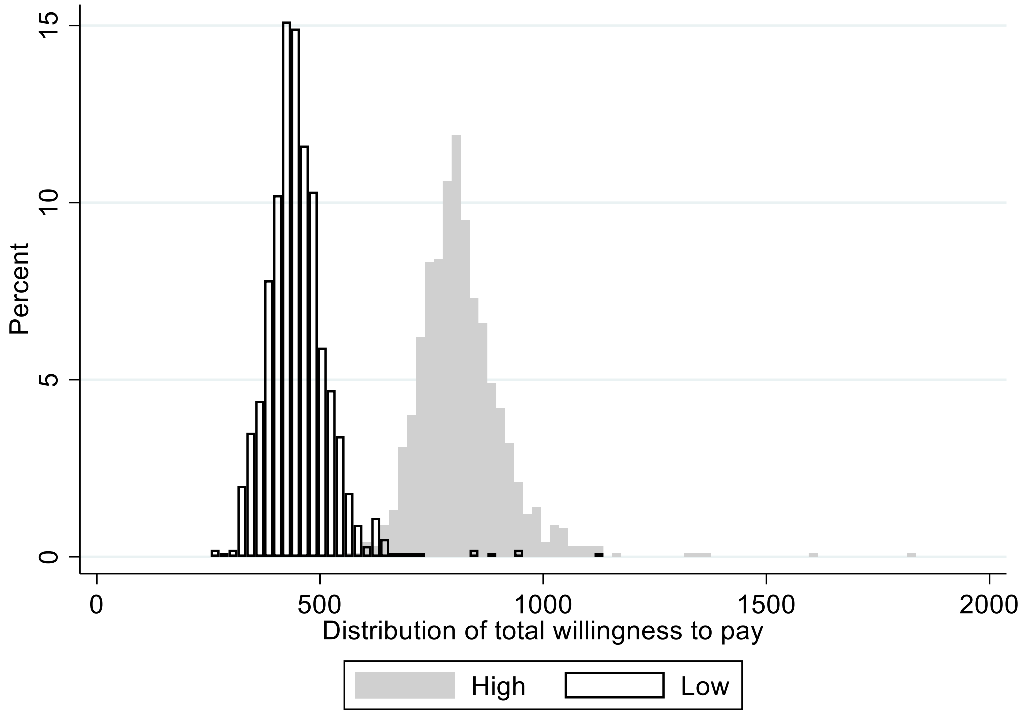


Figure 16: Distribution of total willingness to pay for low and high development options

5.3 Aggregate benefit

We estimated aggregate benefits following the steps outlined in section 4.3.

1. **Define the features of the restoration project**: We consider two different restoration options.
    a. In the first option, we assume the hypothetical restoration project would have minimum levels of different features used in the choice experiment survey: Seats; Exercise equipment; Pollutant removal; Grass only; Foot bridge; and Renovated shared path (See the second row in Figures 6–11).
    b. In the second option, we assume implementation of the maximum levels of facilities: Seats + drink fountain + BBQs + toilets; Exercise equipment + playground + skate park; Pollutant removal and water reuse; Grass and many trees; Wide crossing; and Renovated separate path (last rows in Figures 6–11).
2. **Establish relevant catchment area**:

    We base the assumptions about the catchment area on assumptions and results of our empirical models.

[6] After adjusting for the population segment with zero willingness to pay (i.e., multiplying by 0.86), the adjusted annualised values are $29/household/year to $42/household/year for a high-level and $15/household/year to $24/household/year for a low-level restoration project.

a. From the hedonic analysis, we established the impact of the Brooklyn Park project on house prices could extend up to 50 m and is unlikely to extend beyond this distance. We maintain the same assumption when we extrapolate the amenity benefit to the whole of the MOS reserve.

b. We conducted the choice experiment within the postcodes that intersect the 5 km buffer of the MOS. We consider the 5 km buffer to be the relevant catchment area to apply willingness to pay estimates from the choice experiment.

The catchment area consists of two parts: the 'adjacent area' (within 50 m) to the MOS and the 'buffer area' between 50 m and 5 km from the MOS. We used aerial photos to determine approximately 700 residential properties are within 50 m of the MOS. Using the 2016 census data, we determined 127,902 properties[7] are between 50 m to 5 km from the boundary of the MOS reserve. We use this distribution of properties to aggregate the non-market values of restoration projects.

3. **Identify the relevant willingness to pay estimates**. We apply different approaches to estimate willingness to pay within the two parts of the catchments identified in the previous step:

   a. For the residents of the properties adjacent to the MOS, we assume the improvement in amenity reflected in the uplift in house prices is the main relevant benefit[8]. Some of the benefits estimated using choice experiments are relevant for the 'adjacent area' properties, while others are already implicitly accounted for in the house prices: the Brooklyn Park project involved landscaping to establish the vegetation, and the residents can cross the site. Therefore, to avoid double-counting, we cannot add the willingness to pay estimates derived from the choice experiment on the vegetation and crossing attributes. However, the project did not involve the construction of any park or exercise facilities, rainwater management, or path restoration. Therefore, it is possible to add the estimates of willingness to pay for park facilities, exercise equipment facilities, rainwater management and restoration of the bike trail derived from the choice experiment.

   b. The uplift in property price does not extend to the residents living in the 'buffer area' between 50 m and 5 km from the MOS. Therefore for those residents, we can use the willingness to pay estimates derived wholly from the choice experiment. The types of values relevant to the people living in adjacent and surrounding areas are shown in columns 2 and 3 in Tables 12 and 13. To obtain the distribution of aggregate values, we use the mean, the low and the high values (the range of the 90% confidence interval) for each of the willingness to pay estimates.

   c. The choice experiment results reveal that only 86% of respondents were willing to pay for the MOS improvement. Therefore, we have adjusted the number of properties downwards (i.e., multiplied by 0.86) wherever we have applied the results from the choice experiment.

4. **Aggregate the values.** Tables 12 and 13 present aggregations of the willingness to pay under the low and high improvement options defined in Step 1 above.

   a. The first column in both tables lists the types of values derived from the choice experiment and hedonic analysis.

   b. The second and third columns indicate the number of households in the two parts of the catchment defined in Step 2 (adjacent and buffer areas), and whether the values in the first column apply to each respective area. For example, seats are applicable to both areas, because the value of seats is derived from the choice experiment, but not from the hedonic analysis. The value of grass, estimated using choice experiment, is applicable to the buffer area from 50 m to 5 km but not to the adjacent area (0–50 m) because the grass is part of the amenity value captured in the hedonic analysis.

   c. Columns 4, 5, and 6 present the lower bound, medium, and upper bound of the willingness to pay estimates per household for each of the values in the first column.

   d. Columns 7, 8, and 9 present aggregate estimates of the willingness to pay for the 'adjacent area' of the catchment (0–50 m). They are obtained by multiplying the number of households in this area

[7] This assumption includes both units and houses.

[8] The hedonic analysis on the Brooklyn Park Project reveals average uplift of property prices due to project as 0.053 (90%CI: 0.01 to 0.09). The current average property price in the adjacent areas of the MOS reserve is about $528,056. By multiplying the average property price with the percentage uplift it is possible to calculate the potential uplift in the prices of adjacent properties due to the construction of a restoration project. The average potential uplift in property price is $27,987/property (90%CI: $6,271/property to $49,703/property).

by the lower bound, medium, and upper bound values, respectively, of the benefits that are applicable to this area.

e. Similarly, columns 10, 11, and 12 show the lower bound, medium, and upper bound of the aggregate estimates of the willingness to pay applicable to the ‘buffer area’ (50 m – 5 km).

f. The aggregate estimates of willingness to pay are then added to get the total value for the two areas (see the ‘Total’ row for columns 7 to 12 in Tables 12 and 13). These columns also note an adjustment for the proportion of the population who are willing to pay for improvement programs (86%).

g. Finally, total values for the two areas are added to get the total value of a restoration project in the bottom rows of the tables (“Grand Total”).

The analysis revealed that for a low improvement option, the aggregate total non-market value of the project could range between $29 million to $82 million. Only a small portion of the benefit (<10%) is likely to be captured through the existing house prices. Implementing a high improvement restoration project would generate a benefit in the range of $69 million to $152 million. In this case, the benefit likely to be captured in the house prices could range between 7% to 30% of the total non-market values.

Table 12: Aggregate value of the low improvement option

Features	Population group: Adjacent (within 50 m)	Population group: Surrounding (50 m to 5 km)	Willingness to pay estimates: Low	Willingness to pay estimates: Medium	Willingness to pay estimates: High	Total value: Adjacent (within 50 m): Low	Total value: Adjacent (within 50 m): Medium	Total value: Adjacent (within 50 m): High	Total value: Surrounding (50 m to 5 km)^: Low	Total value: Surrounding (50 m to 5 km)^: Medium	Total value: Surrounding (50 m to 5 km)^: High
Number of dwellings	700	127,202									
Types of values applied											
Choice experiment											
Seats	Yes	Yes	45	84	127	27,090	50,568	76,454	4,922,717	9,189,072	13,893,002
Exercise equipment	Yes	Yes	19	64	110	11,438	38,528	66,220	2,078,481	7,001,198	12,033,309
Pollutant removal	Yes	Yes	84	114	151	50,568	68,628	90,902	9,189,072	12,470,884	16,518,452
Grass only	No	Yes	3	35	65	0	0	0	328,181	3,828,780	7,110,592
Footbridge	No	Yes	57	90	124	0	0	0	6,235,442	9,845,435	13,564,821
Renovated shared path	Yes	Yes	48	78	108	28,896	46,956	65,016	5,250,899	8,532,710	11,814,522
Hedonic analysis											
Amenity benefit*	Yes	No	1,254	5,597	9,941	877,893	3,918,176	6,958,458	0	0	0
Total						995,885	4,122,856	7,257,050	28,004,792	50,868,080	74,934,698
Grand Total									29,000,677	54,990,935	82,191,748

Notes: ^ Adjusted to remove the 14% of the population not willing to pay for the improvement. * The amenity benefit has been adjusted downwards (multiplied by 0.20) to reflect that this option does not include the planting of any trees. In the absence of more relevant information, the ratio of mean willingness to pay estimates for 'grass-only' and 'grass and lots of trees' obtained from the choice experiment was used as an adjustment factor.

Table 13: Aggregate value of the high improvement option

Features	Population group: Adjacent (within 50 m)	Population group: Surrounding (50 m to 5 km)	Willingness to pay estimates: Low	Willingness to pay estimates: Medium	Willingness to pay estimates: High	Total value: Adjacent (within 50 m): Low	Total value: Adjacent (within 50 m): Medium	Total value: Adjacent (within 50 m): High	Total value: Surrounding (50 m to 5 km)^: Low	Total value: Surrounding (50 m to 5 km)^: Medium	Total value: Surrounding (50 m to 5 km)^: High
Number of dwellings	700	127,202									
Choice experiment											
Seats + drink fountain + BBQs + toilets	Yes	Yes	174	221	277	104,748	133,042	166,754	19,034,507	24,176,012	30,302,060
Exercise equipment + playground + skate park	Yes	Yes	84	128	176	50,568	77,056	105,952	9,189,072	14,002,396	19,253,295
Pollutant removal and water reuse	Yes	Yes	104	135	170	62,608	81,270	102,340	11,376,947	14,768,152	18,596,932
Grass and many trees	No	Yes	140	179	224	0	0	0	15,315,121	19,581,476	24,504,193
Wide crossing	No	Yes	42	76	110	0	0	0	4,594,536	8,313,923	12,033,309
Renovated separate path	Yes	Yes	48	78	110	28,896	46,956	66,220	5,250,899	8,532,710	12,033,309
Hedonic analysis											
Amenity benefit	Yes	No	6,271	27,987	49,703	4,389,466	19,590,878	34,792,290	0	0	0
Total						4,636,286	19,929,202	35,233,556	64,761,082	89,374,669	116,723,099
Grand Total									69,397,368	109,303,871	151,956,655

Note: ^ Adjusted to remove the 14% of the population not willing to pay for the improvement.

6. Concluding remarks

This case study had five objectives: estimate the capitalised value of the Brooklyn Park improvement project, understand local residents' general attitude towards MOS improvement, estimate people's willingness to pay for different features of MOS improvement; understand the differences in the willingness to pay estimates among different socio-demographic groups; and calculate the aggregate value of a potential restoration project.

The hedonic analysis revealed there was an uplift in the prices of the properties adjacent to the Brooklyn Park project (within 50 m). The increment was about 5.3% (90% CI: 1% to 9%). This result is similar to the estimates found in some other hedonic analysis. For example, Polyakov, Fogarty et al. (2017) estimated the value of amenity benefits generated due to the restoration of an urban drain into a natural ecosystem (known as the living stream) in Perth, Western Australia. They found that eight years after completion of the project, the median home within 200 m of the restoration site had increased by 4.7%. The magnitude of the benefit of Brooklyn Park is similar, but, unlike the Bannister Creek project, the impact of Brooklyn Park extends only to immediately adjacent properties located within 50 m. This result is because the park does not contain any recreational infrastructure, there are several parks within close proximity, and the residents benefit most from the visual amenity of the upgraded park. There are 200 properties within 50 m of Brooklyn Park. The median property value in the study area was $442,000 in 2018. The benefit captured in the value of these properties was estimated at $4.7 million ($1.05 million – $8.32 million).

The choice experiment survey revealed that around one-third of the respondents were already using the reserve. The major purposes for using the MOS were walking (69%), followed by cycling / commuting (43%), running/jogging (31%) and spending time with kids/families (29%). These results were similar to the findings of a user survey conducted in the Williams Landing project site in 2017 (Schott and Keogh 2017). They found that 40% of the visitors were walking and 33% were cycling. Further, our survey revealed that local people have a positive attitude towards preserving or protecting the MOS reserve. The site was important to a large portion of the respondents for personal, recreational and heritage values.

The latent class analysis allowed us to differentiate the respondents into different segments. The majority of the local residents (86% of the respondents) have a positive willingness to pay to undertake a restoration project for the MOS. Income conditions and user experience with parks and attitudes clearly influenced class membership. Those who own or rent a house, use the MOS or a local park, and think that residents should pay for the restoration of the MOS have a positive willingness to pay. On the other hand, those who earn less than $2,000 per week were less likely to be willing to pay for the restoration.

For the segment of the respondents who have a positive willingness to pay, the annualised value of a high-level restoration project could range from $34 to $49 per household. For a low-level restoration project, the annualised value could range from $18 to $28/household/year. After adjusting for the population segment with zero willingness to pay (i.e., multiplying by 0.86), the adjusted annualised values were $29/household/year to $42/household/year for a high-level and $15/household/year to $24/household/year for a low-level restoration project. Such estimates are quite reasonable if we consider the drainage and stormwater charge is around $100 per household which is supposed to fund stormwater management projects (Melbourne Water 2019).

Finally, only a few studies around the world have combined analysis from two different non-market valuation methods: choice experiment and hedonic analysis. Previous studies relied on mostly benefit transfer methods and information from secondary sources for estimating aggregate non-market values of water sensitive systems or practices (ARUP 2013, Kandulu, Connor et al. 2014, Mekala, Jones et al. 2015, Iftekhar and Polyakov 2019). Applying both methods in the same case study allowed us to capture the different elements of non-market values. The aggregate non-market value of potential restoration projects could be substantial ($29 million to $152 million).

The information contained in this report could be used in several ways: 1) understand people's relative preferences for different MOS improvement options; 2) to understand which group or section of the community has a positive willingness to pay for MOS improvement (such information is useful to target specific groups for further engagement activities; 3) use the willingness to pay estimates for different design features in a welfare analysis to establish the benefits of a restoration project (e.g., in a benefit–cost analysis); 4) after appropriate adjustment (i.e., benefit transfer) apply the non-market value information to a new context (e.g., other parts of Melbourne and the country) to evaluate large-scale restoration projects; and 5) finally, use the aggregate value of different restoration options to identify the total benefit of the scenario, for comparison with the costs of the scenario, in a welfare analysis.

Finally, there is scope to extend the current non-market valuation exercise. The hedonic analysis could be carried out in the future for both the Brooklyn Park and Williams Landing projects when more data is available (i.e., more years have passed). This study will allow us to test the robustness of the current findings. The attributes in the choice experiment were designed with the focus on local level benefits. However, the MOS has potentially heritage values and the whole Melbourne community might be willing to pay to maintain/preserve the MOS as a state heritage asset even if they do not get a direct benefit. Future choice experiment analysis could include this aspect and conduct a survey with the general population of Melbourne. Finally, the information on people's willingness to pay estimates presented in this report could be used in a proper benefit–cost analysis before investing in any MOS improvement project.

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Appendixes

Appendix A: A general description of the latent class model

A latent class model assumes a respondent i selects alternative m at choice scenario t given values of the attribute z_{it}^{att} and values of the predictors z_{it}^{pre}. This probability is denoted by $P(y_{it} = m|z_{it}^{att}, z_{it}^{pre})$. Attributes are characteristics of the alternatives; that is, alternative m will have different attribute values than alternative m'. Predictors, on the other hand, are characteristics of the scenario and take on the same value across alternatives.

The conditional logit model for the response probabilities has the form

$$P(y_{it} = m|z_{it}^{att}, z_{it}^{pre}) = \frac{\exp(\eta_{m|z_{it}})}{\sum_{m'=1}^{M} exp(\eta_{m'|z_{it}})}$$

Where $\eta_{m|z_{it}}$ is the systematic component in the utility of alternative m at scenario t for respondent i. The term $\eta_{m|z_{it}}$ is a linear function of an alternative-specific constant β_m^{con}, attribute effects β_p^{att}, and the predictor effects β_{mq}^{pre}. That is,

$$\eta_{m|z_{it}} = \beta_m^{con} + \sum_{p=1}^{P} \beta_p^{att} z_{itmp}^{att} + \sum_{q=1}^{Q} \beta_{mq}^{pre} z_{itq}^{pre}$$

Without alternative-specific constants and without predictors, the linear model for $\eta_m|z_{it}$ simplifies to

$$\eta_{m|z_{it}} = \sum_{p=1}^{P} \beta_p^{att} z_{itmp}^{att}$$

A latent class model uses three types of explanatory variables: attributes or characteristics of alternatives (z_{itmp}^{att}), predictors or characteristics of scenarios (z_{itq}^{pre}) and covariates or characteristics of individuals (z_{ir}^{cov}). The model assumed individuals belong to different latent classes (x) that differ with respect to (some of) the β parameters appearing in the linear model for η. To indicate the choice probabilities depend on class membership x, the logistic model takes the following form

$$P(y_{it} = m|x, z_{it}^{att}, z_{it}^{pre}) = \frac{\exp(\eta_{m|x,z_{it}})}{\sum_{m'=1}^{M} exp(\eta_{m'|x,z_{it}})}$$

Here, $\eta_{m|x,z_{it}}$ is the systematic component in the utility of alternative m at scenario t given that respondent i belongs to latent class x. The linear model for $\eta_{m|x,z_{it}}$ is

$$\eta_{m|x,z_{it}} = \beta_{xm}^{con} + \sum_{p=1}^{P} \beta_{xp}^{att} z_{itmp}^{att} + \sum_{q=1}^{Q} \beta_{xmq}^{pre} z_{itq}^{pre}$$

As can be seen, the only difference with the aggregate model is that the logit regression coefficients are allowed to be class-specific. In the latent class choice model, the probability density associated with the responses of respondent i has the form

$$P(y_i|z_i) = \sum_{x=1}^{K} P(x) \prod_{t=1}^{T_i} P(y_{it}|x, z_{it}^{att}, z_{it}^{pre})$$

Here, $P(x)$ is the unconditional probability of belonging to class x. In addition to the explanatory variables that we called attributes and predictors, the model can also include covariates. While attributes and predictors enter the regression model for the choices, covariates are used to predict class membership. Including covariates changes the probability structure slightly

$$P(y_i|z_i) = \sum_{x=1}^{K} P(x|z_i^{cov}) \prod_{t=1}^{T_i} P\left(y_{it}|x, z_{it}^{att}, z_{it}^{pre}\right)$$

As can be seen, class membership of respondent i is now assumed to depend on a set of covariates denoted by z_i^{cov}. A multinomial logit is specified in which class membership is regressed on covariates; that is,

$$P(x|z_i^{cov}) = \frac{\exp\left(\eta_{x|z_i}\right)}{\sum_{x'=1}^{K} exp\left(\eta_{x'|z_i}\right)}$$

With linear term

$\eta_{x|z_i}$ =γ_{0x}+ $\sum_{r=1}^{R} \gamma_{rx}\, z_i^{cov}$

Here, γ_{0x} denotes the intercept or constant corresponding to latent class x and γ_{rx} is the effect of the rth covariate for class x. Similarly to the model for the choices, for identification, we either set $\sum_{r=1}^{R} \gamma_{rx}$=0, γ_{r1}=0, or γ_{rK}=0 for $0 \leq r \leq R$.

An extension of the latent class model is to use the 'scale adjusted' model, which distinguishes preference heterogeneity from heterogeneity in error variance. Heterogeneity in error variance arises from the fact that people might differ in how systematic or random they are in their choices. This difference is described by a scale factor ($\lambda_d, d = 1, \ldots, D$) that identifies the amount by which the parameter estimates of one group must be rescaled to arrive at the preference parameters appropriate to another group. For the purposes of identification, one scale parameter is normalised to 1 and the rest of the scale parameter estimates are ratios of the reference scale class (Quynh, Schilizzi et al. 2018). The probability is then,

$$P\left(y_{it} = m \middle| x, d, z_{it}^{att}, z_{it}^{pre}\right) = \frac{\exp\left(\eta_{m|x,d,z_{it}}\right)}{\sum_{m'=1}^{M} exp\left(\eta_{m'|x,d,z_{it}}\right)}$$

Appendix B: Information criteria stats

Model	BIC(LL)	CAIC(LL)
1-Class choice	8351.00	8371.00
2-Class choice	7366.36	7432.36
3-Class choice	7363.62	7475.62
4-Class choice	7447.69	7605.69
5-Class choice	7597.88	7801.88
6-Class choice	7769.04	8019.04
2-sClass 1-Class choice	7427.94	7449.94
2-sClass 2-Class choice	7188.48	7256.48
2-sClass 3-Class choice	7272.11	7386.11
2-sClass 4-Class choice	7401.29	7561.29
2-sClass 5-Class choice	7551.83	7757.83
2-sClass 6-Class choice	7683.95	7935.95
2-sClass 1-Class choice with	7420.70	7443.70
2-sClass 2-Class choice with	**7178.72**	**7247.72**
2-sClass 3-Class choice with	7260.62	7375.62
2-sClass 4-Class choice with	7399.20	7560.20
2-sClass 5-Class choice with	7567.31	7774.31
2-sClass 6-Class choice with	7691.53	7944.53

Appendix C: Data Tables

How far do you live from the MOS reserve?

	Frequency	Per cent	Cumulative per cent
0–100 m	16	3.1	3.1
100–200 m	22	4.2	7.3
0.2–0.5 km	39	7.5	14.9
0.5–1 km	51	9.8	24.7
> 1 km	247	47.7	72.4
I don't know	143	27.6	100.0
Total	518	100.0	

Do you use the MOS reserve (including the Federation Trail)?

	Frequency	Per cent	Cumulative per cent
Yes	163	31.5	31.5
No	355	68.5	100.0
Total	518	100.0	

How often do you use the MOS reserve? – Selected choice

	Frequency	Per cent	Cumulative per cent
Daily	19	11.7	11.7
Weekly	65	39.9	51.5
Monthly	34	20.9	72.4
Few times a year	42	25.8	98.2
Other:	3	1.8	100.0
Total	163	100.0	

Do you use other parks or reserves?

	Frequency	Per cent	Cumulative per cent
Yes	394	76.1	76.1
No	124	23.9	100.0
Total	518	100.0	

How often do you use other parks or reserves? – Selected choice

	Frequency	Per cent	Cumulative per cent
Daily	51	12.9	12.9
Weekly	181	45.9	58.9
Monthly	82	20.8	79.7
Few times a year	77	19.5	99.2
Other:	3	0.8	100.0
Total	394	100.0	

For what purposes do you use the park? Select all that apply

	Number		% of users	
	MOS	Other PoS	MOS	Other PoS
Cycling / commuting	70	79	43	20
Walking	113	266	69	68
Spending time with kids and families	47	182	29	46
Dog walking	39	95	24	24
Running/jogging	51	82	31	21
Sightseeing / observing nature	35	95	21	24
Picnicking / barbequing	15	78	9	20
Sport / exercise	24	72	15	18
Others	1	5	1	1
Number of respondents use the park or reserve (Users)	163	394		

Please tick the box that indicates how much you agree or disagree with the following statements: – The MOS reserve is personally important to me as a heritage site

	Frequency	Per cent	Cumulative per cent
Strongly disagree	25	4.8	4.8
Disagree	57	11.0	15.8
Somewhat disagree	31	6.0	21.8
Neither agree nor disagree	191	36.9	58.7
Somewhat agree	97	18.7	77.4
Agree	67	12.9	90.3
Strongly agree	50	9.7	100.0
Total	518	100.0	

Please tick the box that indicates how much you agree or disagree with the following statements: – The MOS reserve is personally important to me as a recreational site

	Frequency	Per cent	Cumulative per cent
Strongly disagree	22	4.2	4.2
Disagree	40	7.7	12.0
Somewhat disagree	36	6.9	18.9
Neither agree nor disagree	186	35.9	54.8
Somewhat agree	113	21.8	76.6
Agree	76	14.7	91.3
Strongly agree	45	8.7	100.0
Total	518	100.0	

Please tick the box that indicates how much you agree or disagree with the following statements: – The MOS reserve is an important part of the local landscape

	Frequency	Per cent	Cumulative per cent
Strongly disagree	15	2.9	2.9
Disagree	19	3.7	6.6
Somewhat disagree	40	7.7	14.3
Neither agree nor disagree	144	27.8	42.1
Somewhat agree	134	25.9	68.0
Agree	95	18.3	86.3
Strongly agree	71	13.7	100.0
Total	518	100.0	

Please tick the box that indicates how much you agree or disagree with the following statements: – General public (individuals and community groups) should volunteer to maintain / restore the MOS reserve and Federation Trail in partnership with the relevant government agency

	Frequency	Per cent	Cumulative per cent
Strongly disagree	18	3.5	3.5
Disagree	16	3.1	6.6
Somewhat disagree	45	8.7	15.3
Neither agree nor disagree	143	27.6	42.9
Somewhat agree	147	28.4	71.2
Agree	94	18.1	89.4
Strongly agree	55	10.6	100.0
Total	518	100.0	

Please tick the box that indicates how much you agree or disagree with the following statements: – Government agencies should be responsible for maintaining / restoring the MOS reserve and Federation Trail on their own

	Frequency	Per cent	Cumulative per cent
Strongly disagree	13	2.5	2.5
Disagree	19	3.7	6.2
Somewhat disagree	28	5.4	11.6
Neither agree nor disagree	117	22.6	34.2
Somewhat agree	141	27.2	61.4
Agree	132	25.5	86.9
Strongly agree	68	13.1	100.0
Total	518	100.0	

Please tick the box that indicates how much you agree or disagree with the following statements: – General public (individuals and community groups) should volunteer to maintain / restore the MOS reserve and Federation Trail on their own

	Frequency	Per cent	Cumulative per cent
Strongly disagree	34	6.6	6.6
Disagree	45	8.7	15.3
Somewhat disagree	64	12.4	27.6
Neither agree nor disagree	137	26.4	54.1
Somewhat agree	111	21.4	75.5
Agree	84	16.2	91.7
Strongly agree	43	8.3	100.0
Total	518	100.0	

Did you think that the design scenarios were confusing? – Selected choice

	Frequency	Per cent	Cumulative per cent
Yes (please specify why):	48	9.3	9.3
No	470	90.7	100.0
Total	518	100.0	

Who do you think should have to pay for improvement of the MOS?

	Frequency	Per cent	Cumulative per cent
All residents of Melbourne	243	46.9	46.9
Only those who will actually use the MOS reserve improvement projects	142	27.4	74.3
No one	133	25.7	100.0
Total	518	100.0	

Use the slider to show how certain, on average, you were of the answers you gave when selecting your most favoured and least favoured scenarios:

	Frequency	Per cent	Cumulative per cent
0.00	1	0.2	0.2
1.00	2	0.4	0.6
2.00	4	0.8	1.4
3.00	7	1.4	2.7
4.00	20	3.9	6.6
5.00	57	11.0	17.6
6.00	72	13.9	31.5
7.00	98	18.9	50.4
8.00	130	25.1	75.5
9.00	69	13.3	88.8
10.00	58	11.2	100.0
Total	518	100.0	

Did you consider your own financial circumstances while completing the design scenarios?

	Frequency	Per cent	Cumulative per cent
Yes	377	72.8	72.8
No	141	27.2	100.0
Total	518	100.0	

Please indicate on the following scale how likely you think the survey results will influence future policy decisions regarding the improvement of the MOS reserve:

	Frequency	Per cent	Cumulative per cent
0.00	3	0.6	0.6
1.00	14	2.7	3.3
2.00	24	4.6	7.9
3.00	25	4.8	12.7
4.00	30	5.8	18.5
5.00	103	19.9	38.4
6.00	86	16.6	55.0
7.00	94	18.1	73.2
8.00	77	14.9	88.0

9.00	28	5.4	93.4
10.00	34	6.6	100.0
Total	518	100.0	

What best describes your gender? – Selected choice

	Frequency	Per cent	Cumulative per cent
Female	297	57.3	57.3
Male	208	40.2	97.5
Prefer to self-describe	7	1.4	98.8
Prefer not to say	6	1.2	100.0
Total	518	100.0	

What is your highest level of education?

	Frequency	Per cent	Cumulative per cent
Completed year 11 or below	43	8.3	8.3
Completed year 12	83	16.0	24.3
TAFE qualification / Trade / Technical Certificate	137	26.4	50.8
University graduate	255	49.2	100.0
Total	518	100.0	

What is your current employment status? – Selected choice

	Frequency	Per cent	Cumulative per cent
Unemployed	26	5.0	5.0
Student	41	7.9	12.9
Full-time employed	259	50.0	62.9
Part-time employed	81	15.6	78.6
Self-employed	21	4.1	82.6
Homemaker	43	8.3	90.9
Retired	39	7.5	98.5
Other, please specify	8	1.5	100.0
Total	518	100.0	

Are you a member of any environmental or conservation group?

	Frequency	Per cent	Cumulative per cent
Yes	53	10.2	10.2
No	465	89.8	100.0
Total	518	100.0	

Which one of the following age groups do you belong to?

	Frequency	Per cent	Cumulative per cent
18–30 years	143	27.6	27.6
31–45	226	43.6	71.2
46–60	93	18.0	89.2
61–75	50	9.7	98.8
Over 75	6	1.2	100.0
Total	518	100.0	

How many people are currently living in your household? – Adults

	Frequency	Per cent	Cumulative per cent
1	68	13.3	13.3
2	316	61.7	75.0
3	67	13.1	88.1
4	46	9.0	97.1
5	13	2.5	99.6
7	1	0.2	99.8
8 or more	1	0.2	100.0
Total	512	100.0	

How many people are currently living in your household? – Children (15 years and under)

	Frequency	Per cent	Cumulative per cent
0	168	41.4	41.4
1	106	26.1	67.5
2	104	25.6	93.1
3	17	4.2	97.3
4	8	2.0	99.3
5	3	0.7	100.0
Total	406	100.0	

Do you or someone else in your household pay the water bill for your property?

	Frequency	Per cent	Cumulative per cent
Me	413	79.7	79.7
Someone else	105	20.3	100.0
Total	518	100.0	

Are you familiar with the amount that is paid for water bills?

	Frequency	Per cent	Cumulative per cent
Yes	57	54.3	54.3
No	48	45.7	100.0
Total	105	100.0	
System	413		

How many income earners are currently living in your household?

	Frequency	Per cent	Cumulative per cent
None	26	5.0	5.0
1	157	30.3	35.3
2	261	50.4	85.7
3	42	8.1	93.8
4	24	4.6	98.5
5	5	1.0	99.4
6	1	0.2	99.6
9	1	0.2	99.8
More than 10	1	0.2	100.0
Total	518	100.0	

Which of the following gross annual income groups currently applies to your household (before tax)?

	Frequency	Per cent	Cumulative per cent
Under $10,399	12	2.3	2.3
$10,400–$15,599	11	2.1	4.4
$15,600–$20,799	14	2.7	7.1
$20,800–$31,199	24	4.6	11.8
$31,200–$41,599	21	4.1	15.8
$41,600–$51,999	31	6.0	21.8
$52,000–$64,999	42	8.1	29.9
$65,000–$77,999	49	9.5	39.4
$78,000–$103,999	79	15.3	54.6
$104,000–$129,999	53	10.2	64.9
$130,000–$155,999	40	7.7	72.6
$156,000–$181,999	32	6.2	78.8
$182,000–$207,999	24	4.6	83.4
$208,000–$259,999	12	2.3	85.7
$260,000 and above	13	2.5	88.2
I would rather not say	61	11.8	100.0
Total	518	100.0	

Do you own the residence you are currently living in or you are renting?

	Frequency	Per cent	Cumulative per cent
Own the place (including properties with a mortgage)	289	55.8	55.8
Renting	204	39.4	95.2
Staying with relatives or friends (not paying for accommodation)	25	4.8	100.0
Total	518	100.0	

How many bedrooms do you have in the house you are currently living in?

	Frequency	Per cent	Cumulative per cent
1	28	5.4	5.4
2	102	19.7	25.1
3	213	41.1	66.2
4	141	27.2	93.4
5	25	4.8	98.3
6	3	0.6	98.8
More than 6	6	1.2	100.0
Total	518	100.0	

How long have you been living at your current address?

	Frequency	Per cent	Cumulative per cent
Less than 1 year	69	13.3	13.3
1 year	50	9.7	23.0
2 years	69	13.3	36.3
3 years	47	9.1	45.4
4 years	22	4.2	49.6
5 years	39	7.5	57.1
6 years	31	6.0	63.1
7 years	23	4.4	67.6
8 years	19	3.7	71.2
9 years	9	1.7	73.0
10 years	24	4.6	77.6
10–15 years	48	9.3	86.9
15–20 years	28	5.4	92.3
More than 20 years	40	7.7	100.0
Total	518	100.0	

Appendix D: Final questionnaire

CRC for
Water Sensitive Cities

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