Connecting blue-green infrastructure to communities in the Ōtākaro Avon River Corridor:

A pathway for community resilience.

(Kinghorn, 2014)
Abstract

Researchers have begun to explore the opportunity presented by blue-green infrastructure (a subset of nature-based solutions that provide blue and green space in urban infrastructure) as a response to the pressures of climate change. The 2010/2011 Canterbury earthquake sequence created a unique landscape within which there is opportunity to experiment with and invest in new solutions to climate change adaptation in urban centres. Constructed wetlands are an example of blue-green infrastructure that can potentially support resilience in urban communities. This research explores interactions between communities and constructed wetlands to understand how this may influence perceptions of community resilience. The regeneration of the Ōtākaro Avon River Corridor (OARC) provides a space to investigate these relationships.

Seven stakeholders from the community, industry, and academia, each with experience in blue-green infrastructure in the OARC, participated in a series of semi-structured interviews. Each participant was given the opportunity to reflect on their perspectives of community, community resilience, and constructed wetlands and their interconnections. Interview questions aligned with the overarching research objectives to (1) understand perceptions around the role of wetlands in urban communities, (2) develop a definition for community resilience in the context of the Ōtākaro Avon community, and (3) reflect on how wetlands can contribute to (or detract from) community resilience.

This study found that constructed wetlands can facilitate learning about the challenges and solutions needed to adapt to climate change. From the perspective of the community representatives, community resilience is linked to social capital. Strong social networks and a relationship with nature were emphasised as core components of a community’s ability to adapt to disruption. Constructed wetlands are therefore recognised as potentially contributing to community resilience by providing spaces for people to engage with each other and nature. Investment in constructed wetlands can support a wider response to climate change impacts.

This research was undertaken with the support of the Ōtākaro Living Laboratory Trust, who are invested in the future of the OARC. The outcomes of this study suggest that there is an opportunity to use wetland spaces to establish programmes that explore the perceptions of constructed wetlands from a broader community definition, at each stage of the wetland life cycle, and at wider scales (e.g., at a city scale or beyond).
Acknowledgements

First and foremost, I would like to thank my supervisor Dr Edward Challies for sharing his knowledge and providing ongoing support throughout this programme. Your insights, advice and ideas have been invaluable. I would also like to thank Dr Rita Dionisio for her role as a co-supervisor and providing a refreshing perspective on my approach.

I would like to thank Dr Eric Pawson and Rob Kerr from the Ōtākaro Living Laboratory Trust for the opportunity to work with them and for sharing their insights on community engagement in the Ōtākaro Avon River Corridor. I look forward to following the future of the Ōtākaro Living Laboratory Trust.

Thank you to Dr Lyndsey Conrow for her guidance through the Masters of Urban Resilience and Renewal (MURR) programme. To Evelyn Charlesworth, my internship buddy, and the rest of the MURR cohort, thank you for being part of this journey. I look forward to meeting up again.

Thank you to my family and friends for your unwavering support and patience, I would not have reached this point without you.
Contents

Abstract ........................................................................................................... i
Acknowledgements .......................................................................................... ii

Contents ........................................................................................................... iii
Figures ............................................................................................................... v
Tables ................................................................................................................ v

1. Introduction .................................................................................................. 1
   1.1. Key definitions ....................................................................................... 1
   1.2. Ōtākaro Avon River Corridor ................................................................. 3
   1.3. Ōtākaro Living Laboratory Trust ............................................................ 5
   1.4. Research objectives ............................................................................... 6
   1.5. Report structure ..................................................................................... 7

2. Literature Review .......................................................................................... 8
   2.1. Wetlands ................................................................................................. 9
   2.2. Wetlands in Ōtautahi Christchurch and a New Zealand context .............. 11
   2.3. Benefits .................................................................................................. 13
   2.4. Community ............................................................................................. 17
   2.5. Community Resilience .......................................................................... 19
   2.6. Summary ................................................................................................ 22

3. Methodology .................................................................................................. 24
   3.1. Ōtākaro Avon River Corridor – Case Study ............................................ 24
   3.2. Methods .................................................................................................. 25
   3.3. Semi-structured interviews ................................................................... 26
   3.4. Analysis .................................................................................................. 27
   3.5. Positionality ........................................................................................... 28

4. Results ............................................................................................................ 30
   4.1. Motivation ............................................................................................... 31
   4.2. Understanding of key concepts ............................................................ 35
4.2.1. Community ................................................................. 35
4.2.2. Community resilience .............................................. 37
4.2.3. Natural and constructed wetlands ......................... 40
4.3. Wetlands in urban spaces ............................................. 41
4.4. Contribution to community resilience ......................... 44
4.5. Knowledge gaps and barriers ...................................... 47
4.6. Summary .......................................................................... 50
5. Discussion ........................................................................... 52
  5.1. Perceptions on the role of wetlands in urban spaces .......... 52
  5.2. (Re)defining community resilience in the Ōtākaro Avon River Corridor .......... 55
  5.3. How can wetlands build community resilience? ................ 56
  5.4. Limitations ...................................................................... 59
6. Conclusion ............................................................................. 61
References .................................................................................. 63
Appendices .................................................................................. 67
  A. University of Canterbury Human Research Ethics Committee approval, reference
     HEC 2021/96/LR ................................................................. 67
  B. Interview prompts ............................................................... 69
Figures
Figure 1-1 Extent of the OARC (Regenerate Christchurch, 2019)..................................................3
Figure 1-2 Black Maps depicting the extent of wetland and swamps 1856 (Council, 2006)....4
Figure 2-1 Typologies of community engagement.................................................................19
Figure 3-1 OARC green spine as proposed by Regenerate Christchurch (Regenerate
Christchurch, 2019).............................................................................................................24
Figure 3-2 Interactions between community and constructed wetlands may influence
community resilience..............................................................................................................25
Figure 3-3 Breakdown of interview discussion themes............................................................28

Tables
Table 1-1 Definition of key terms as used in literature ..............................................................2
Table 4-1 Background of each research participant .................................................................30
1. Introduction

Climate change is recognised as one of the greatest challenges this generation will face, with impacts on the health of natural environments, communities, and cultural wellbeing. Kabisch, (2016, p. 3) defines climate change as “any change to climate over time, resulting from natural variability or human activity”. The Ōtautahi Christchurch Climate Resilience Strategy (2021) indicates that on a local level average temperatures are projected to rise 0.5°C to 1.5°C by 2040, sea level is projected to rise by 30cm by 2050, and there will be an increase in frequency of extreme weather events, including drought and storms. It is therefore increasingly imperative for us to understand these impacts of climate change and identify potential mitigation and adaptation strategies.

This research proposes to investigate the connection between constructed wetlands and communities, and how constructed wetlands can contribute to increased resilience to climate change, focusing on the Ōtākaro Avon River Corridor to provide a local context. The regeneration of the Ōtākaro Avon River Corridor (also referred to by as the Ōtākaro Avon Residential Red Zone or the ‘red zone’;) provides a unique opportunity to create a world-class living laboratory, to nurture experimentation and learning. The Canterbury earthquake sequence of 2010-2011 resulted in land subsidence of up to 1m in some areas of the OARC, creating a unique opportunity to explore the effects of sea level rise in an urban area. Several projects within the regeneration area propose to address risks associated with climate change through exploration of the role of blue-green infrastructure (BGI). International literature recognised that blue-green infrastructure can provide a range of benefits for communities, from water quality and quantity management to social-ecological connections. Constructed wetlands, an example of blue-green infrastructure, are proposed in the Ōtākaro Avon River Corridor and recognised to provide several of the benefits associated with blue-green infrastructure.

1.1. Key definitions

Several terms are used in this field of research: sustainable urban drainage systems (SUDS), green infrastructure (GI), blue-green infrastructure, nature-based solutions, low-impact development. These terms have variations in meaning and application, often varying between industries and countries. Therefore, for this research, the collective term ‘nature-based solutions’ (NBS) will be used, with a focus on the subset of blue-green infrastructure and
wetlands as an exemplar infrastructure type. Table 1-1 introduces a list of key terms and the definitions that will be used for this research.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blue-green infrastructure</strong></td>
<td>“…an interconnected network of landscape components, both natural and designed, that includes open, green spaces and water bodies (ephemeral, intermittent and perennial) which provide multiple functions” (O’Donnell, Netusil, Chan, Dolman, &amp; Gosling, 2021, p. 2)</td>
</tr>
<tr>
<td><strong>Community Resilience</strong></td>
<td>“represents the ability of communities to use their available resources to prepare for, respond to, endure, and recover from extreme events such as floods, economic shocks and disease outbreaks” (T. Robertson, Docherty, Millar, Ruck, &amp; Engstrom, 2021, p. 1).</td>
</tr>
<tr>
<td><strong>Constructed wetlands</strong></td>
<td>“… replicate the various naturally occurring processes under controlled conditions for a beneficial purpose, e.g., treatment of wastewater” (Stefanakis, 2019, p. 3).</td>
</tr>
<tr>
<td><strong>Ecosystem Services</strong></td>
<td>“… are broadly defined as the benefits society obtains from ecosystems. As categorized by the Millennium Ecosystem Assessment (2005), these services include regulating, provisioning, supporting, and cultural services” (Moore &amp; Hunt, 2012, p. 1).</td>
</tr>
<tr>
<td><strong>Natural wetlands</strong></td>
<td>“… are naturally occurring “ecosystems that are permanently or seasonally saturated in water and create habitats for aquatic plants” (Alikhani, Nummi, &amp; Ojala, 2021, p. 6).</td>
</tr>
<tr>
<td><strong>Nature-based solutions</strong></td>
<td>‘…solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions” (European Commission, 2021, p. 4).</td>
</tr>
</tbody>
</table>
Nature-based solutions is an umbrella term for a number of different solutions. The primary focus of this research will be on wetlands, as an example of nature-based solutions seen in Ōtautahi Christchurch. Literature refers to wetlands as including both natural and constructed wetlands. However, the distinction is not always noted. This is explored further in chapter 2.

1.2. Ōtākaro Avon River Corridor

The 2010/2011 Canterbury earthquake sequence left large tracts of land unsuitable and unsafe for habitation in Ōtautahi Christchurch. The New Zealand Government initiated a programme of ‘red zoning’, identifying this earthquake-affected land and moving to buy-out existing residents. One of the largest red zoned areas was along the Ōtākaro Avon River Corridor in east Christchurch, comprising 602-hectares of land which became known as the Ōtākaro Avon Residential Red Zone or the ‘red zone’ (Regenerate Christchurch, 2019). In this study the area will be referred to as the Ōtākaro Avon River Corridor or OARC. Although this land was deemed no longer suitable for residential use, there is now opportunity to regenerate a large space in the central city as a space for Christchurch residents.

The Ōtākaro Avon River Corridor Regeneration Plan (the Regeneration Plan) was developed by a government funded entity Regenerate Christchurch in collaboration with the community as the road map to restoring and developing the red zone (Regenerate Christchurch, 2019). Figure 1-1, drawn from the Regeneration Plan, shows the extent of the red zoned area and highlights key focal areas of the plan.

Figure 1-1 Extent of the OARC (Regenerate Christchurch, 2019)
Key objectives from the plan include regenerating nature, connecting and involving communities and living with water. These three objectives are consistent with the goals of a wider international movement seeking to integrate ‘blue-green infrastructure’ within urban spaces as a means to adapt to climate change. Blue-green infrastructure is a subset of nature-based solutions that are designed to turn ‘blue or bluer’ in events of high rainfall. They are becoming increasingly popular solutions to the urban water challenges communities face today (O’Donnell et al., 2021). Wetlands are an example of blue-green infrastructure that are proposed in the Regeneration Plan as an option for responding to increased water risk due to climate change. As such the OARC is a useful case study through which to examine the roles that urban wetlands can play in the strengthening of community resilience to climate change.

In the past the land in and around Ōtautahi Christchurch consisted predominantly of swamp and boggy land with numerous waterways and rivers flowing through the catchment. Urbanisation and development, and an attempt by settlers to control water, has resulted in significant modification and drainage of wetlands across the city. The ‘Black Map’s’, excerpt in figure 1-2, give an impression of the extent of the original waterways, swamp, and vegetation present in 1856 overlaid by a network of streets and railway that have since been constructed (Council, 2006). Modification and drainage of the wetland extent has degraded the environmental health and disconnected people from nature. The OARC presents an opportunity to reintroduce wetlands and native flora and fauna to the urban centre.

*Figure 1-2 Black Maps depicting the extent of wetland and swamps 1856 (Council, 2006)*
An important element of the narrative of the OARC is the relationship between mana whenua and Ōtautahi Christchurch. “Ōtautahi Christchurch is the ancestral home of Ngāi Tahu people who exercise mana whenua - Indigenous sovereignty with respect to land, derived from genealogy and occupation. (Hobbs et al, 2022, pg.1) Part of the expression of their relationship to the land is the Mahaanui Iwi Management Plan (2013) which reflects the plans and priorities of “six Papatipu Rūnanga¹ that represent the hapū [kinship group] who hold manawhenua rights [territorial rights] over lands and waters within the takiwā [area] from the Hurunui River to the Hakatere River and inland to Kā Tiritiri o Te Moana” (pg.17). The Mahaanui Iwi Management Plan (2013) recognises the importance of water and the care for water a life resource and that there is a need to rethink how water is used and valued. The Ōtākaro Avon River flows through the Ihutai catchment. Degradation of the natural ecology and environmental health of the catchment has degraded the cultural connection to the space. A cultural health assessment of the Ihutai Catchment undertaken in 2007, and repeated in 2012, finds that the catchment does not meet the basic standards for cultural use. Priorities of the Regeneration Plan include regenerating nature, connecting and involving communities, and practising mahinga kai (food-gathering place), returning Māori values and the Māori world view to the space.

The next step, from the Regeneration Plan, is to establish a co-governance structure for the OARC, that equitably represents the interests of all parties. This will form a foundation for future decisions and infrastructure investment. This research aims to investigate the value of blue-green infrastructure and whether it may provide additional benefits to the wider community.

### 1.3. Ōtākaro Living Laboratory Trust

This research is undertaken as part of the Master of Urban Resilience and Renewal at the University of Canterbury. A core component of this programme is working with a community partner to develop research that is relevant and connected to their core goals and values. I was fortunate to partner with the Ōtākaro Living Laboratory Trust (or Ōtākaro Living Lab).

One of the objectives within the Regeneration Plan identified the opportunity to build a living laboratory where the public and academics alike can come together to learn, experiment and

---

¹ The six Papatipu Rūnanga are Ngāi Tūāhuriri Rūnanga, Te Hapū o Ngāti Wheke (Rāpaki), Te Rūnanga o Koukourārata, Ōnuku Rūnanga, Wairewa Rūnanga, and Te Taumutu Rūnanga.
share ideas. The Ōtākaro Living Laboratory Trust was formed in 2021 to actualise the ideas within the plan. The OARC is uniquely situated in that the Canterbury earthquake sequence of 2010-2011 resulted in land subsidence of up to 1 m in some areas – mirroring the effects of rapid sea level rise due to climate change. The trust is developing a world-class living laboratory, to enable research, experimentation, and learning. A part of their mission is to grow a network of likeminded individuals (academics, professionals, schools, communities) to capitalise on the opportunity use the OARC as a “living example of land and people adapting to sea level rise”.

This research is designed to support the formation of the Ōtākaro Living Laboratory Trust by providing insights into the perspectives of key community and industry representatives on the role of blue-green infrastructure in the future of the OARC. This is intended to align with the objectives and provide guidance during the development of their next steps.

1.4. Research objectives

Blue-green infrastructure, and wetlands as a discrete element of blue-green infrastructure, are increasingly adopted in the planning and engineering world as practical solutions to interconnected environmental challenges facing urban centres. Research has documented some of the values that these spaces support in the neighbourhoods they are built in, through delivery of a multitude of co-benefits. However, to assess the added value these spaces provide (over traditional grey infrastructure), better understanding of how communities use and connect to them is necessary.

Climate change is one of the main challenges facing urban cities, with its associated impacts such as sea level rise, greater frequency of extreme weather events and flooding. This means that urban communities need to learn how to adapt and build resilience, to endure and recover from these challenges. Understanding and investing in the appropriate infrastructure solutions may not only provide physical buffers to flood and drought events, but it may also contribute to community resilience in a multitude of other ways.

The overarching question motivating this research is:

“How can wetlands build community resilience?”

This research is organised into three parts, which together are intended to explore the links between wetlands and community resilience. The three parts investigate:
- Understand perceptions around the role of wetlands in urban spaces and the value they can add to a community
- Develop a refined definition for community resilience to fit the Ōtākaro Avon community, considering the values, location, and perspective of the participants.
- Understand how wetlands can contribute to (or detract from) community resilience.

1.5. Report structure

This research explores the connection between constructed wetlands and community resilience by engaging with the community. The perspectives and reflections of expert community and industry stakeholders associated with the OARC are explored through semi-structured interviews.

This report is organised into six parts.

(1) Introduction
(2) Literature review
(3) Methodology
(4) Results
(5) Discussion
(6) Conclusion

The initial introduction sections have laid the foundation and context for this field of research. Chapter 2 explores existing literature, looking at the current understanding of the benefits of wetland infrastructure internationally and locally and exploring the concepts of community and resilience. In chapter 3, the approach to this study is detailed, with more contextual background on the case study site and semi-structured interview process. Chapters 4 and 5 outline and discuss the results of the semi-structured interviews, connecting to key themes pulled from the literature review in chapter 2. A brief conclusion with suggestions for further research is outlined in chapter 6.
2. Literature Review

Internationally and locally there has been increased interest and research into the application of nature-based solutions as an approach to mitigating and adapting to climate change. (Brillinger, Henze, Albert, & Schwarze, 2021; Calfapietra & Cherubini, 2019; Raymond et al., 2017; Seddon et al., 2020). Nature-based solutions is a term used to describe the movement away from traditional grey infrastructure (pipes, concrete, and paved structures) towards devices that work with, enhance, or mimic nature (European Commission, 2021). There are several interconnected terms and overlapping ideas in this space, including green infrastructure, blue-green infrastructure, water sensitive design and more. However, in the field of urban stormwater management there is a general consensus among researchers that nature-based solutions can incorporate natural and man-made systems, to harness natural processes and deliver a wide range of co-benefits for communities (Everett & Lamond, 2018; Raymond et al., 2017; Thorslund et al., 2017).

There are a number of articles that examine the applicability of nature-based solutions for climate change adaptation as a broad topic (Calfapietra & Cherubini, 2019; Chausson et al., 2020; Kabisch et al., 2016; Osaka, Bellamy, & Castree, 2021; Seddon et al., 2020; Wild, Henneberry, & Gill, 2017). The literature available on specific solutions, such as the social or community resilience benefits of natural or constructed wetlands, is limited. This research aims to explore this area further, starting with a review of existing literature in this space.

Blue-green infrastructure is a subset of nature-based solutions that is being widely adopted to address climate challenges in urban spaces (Drosou et al., 2019; Ghofrani, Sposito, & Faggian, 2017; Stefanakis, 2019). Blue-green infrastructure can also provide multifunctional spaces that offer benefits for the community beyond the primary stormwater quantity and/or quality management purpose. The benefits, as discussed by Britton et al. (2018) and Alves et al. (2018), can include ecological, social, cultural, recreational, health and amenity benefits. There is also potentially a connection to climate change resilience and community resilience more generally, with urban blue-green infrastructure providing avenues for education and social connection, as well as physical buffering from flood and drought events, and the urban heat island effect (Bush & Doyon, 2019; Sörensen et al., 2016).

Wetlands are an example of blue-green infrastructure that cities are increasingly investing in worldwide. This chapter provides a review of literature on the application of constructed wetlands and associated benefits, focusing in on Ōtautahi Christchurch, followed by a review
of literature on community well-being and community resilience. The aim of this literature review is to evaluate what is currently understood about the role of wetlands in building community resilience.

2.1. Wetlands

Stefanakis (2019), Masi (2018) and Thorslund et al. (2017) all investigated the role of wetlands, as large-scale nature-based solutions, in climate change adaptation. Internationally wetlands are commonly used as treatment devices for wastewater and stormwater overflows. However, there is growing research into their application in urban spaces and the co-benefits they may provide, as examples of blue-green infrastructure.

Constructed wetlands are man-made wetland devices that are designed to mimic and enhance the behaviour of natural wetlands. As identified by Stefanakis (2019), there are three common applications for constructed wetlands found in practice and in literature.

1. Wastewater treatment – For many years wetland systems have been utilized for their ability to remove pollutants and purify water, however natural wetlands are now rarely used for wastewater treatment as there is risk of irreversible damage to the ecosystems. As such, constructed wetlands are popular as they have the versatility to be designed for contaminant removal and water treatment.

2. Habitat creation – around the world there has been significant drainage of natural wetland and swamp areas, to provide land for agriculture and development. This loss of natural ecosystems has resulted in loss of habitat for native and migrant species. Constructed wetlands, particularly in urban spaces, can help reintroduce habitat and wildlife, reconnecting people and the environment.

3. Stormwater and flood management - wetlands provide both water quality and quantity management of urban stormwater runoff, with space for excess water to be stored in high rainfall events and removal of contaminants from run-off before discharge in freshwater or coastal environments.

Stefanakis (2019) argues that constructed wetlands are multi-purpose spaces that can mitigate degradation to blue-green space and can reconnect urban areas to nature. “They [constructed wetlands] are flexible, can be integrated almost everywhere, need little maintenance, have low operation cost” (Masi et al., 2018, p. 9). Masi (2018) highlights the view many have on the ability of constructed wetlands to be used in urban spaces. As devices they can be
designed to specifically provide a number of interrelated outcomes, as will be discussed in section 2.3.

A distinction is made in literature between the concepts of constructed (or man-made) and natural wetlands. Natural wetlands are naturally occurring ecological networks and “ecosystems that are permanently or seasonally saturated in water and create habitats for aquatic plants” (Alikhani et al., 2021, p. 6). The Canterbury region was historically predominantly made up of wetland areas, peat land, bogs, and swamps, as well as largely forested (Orchard, 2017). However, as colonisation and the transition to urban spaces has occurred, the number of nature wetlands has rapidly declined (Hobbs et al., 2022; Zhang et al., 2020). In contrast the number of constructed wetlands in growing in urban regions, (Alikhani et al., 2021), as developers, engineers, planners, and local council increasingly recognise the opportunities these spaces provide. These spaces traditionally provide water quality treatment, and may also be multifunctional spaces that provide biodiversity, habitat, and recreational space for the public. Alternatively, constructed wetlands are generally designed for a specific purpose (Masi et al., 2018; Zhang et al., 2020). This can limit the functionality and opportunities that come with these devices, as they are perceived as providing a very set function. However, as more is learnt about the opportunities there are for the multiple uses and benefits associated with wetlands, the better the ability to design spaces that capitalise on the co-benefits available.

Masi et al. (2018) focus on the role of constructed wetlands in wastewater treatment, but also consider the role they may play in creating circular economies. As Masi (2018) suggest, with increased risk from climate change there is a need for urban water management that works with the hydrological cycle to close the loop and minimise waste. They argue that constructed wetlands are a solution. However, there is not enough current research on their application, nor enough understanding and recognition of the values for them to be supported by decision makers and planners. Both Masi et al. (2018) and Stefanakis (2019) recognise that research into the application and benefits of constructed wetlands is currently focused on maximising the physical and ecological outcomes. Ecosystem services also feature in research, however again there is a focus on the physical and ecological benefits, whereas both articles suggest a gap in the social-cultural component of ecosystem services. It is this gap that this research aims to focus on.
Thorslund et al. (2017) suggest that the benefits of individual wetlands have been well covered in literature and argue that there is a need to look at networks of wetlands, or ‘wetlandscapes’ as they term them. They consider the scales of impact of climate change and how wetlandscapes can be used to address concerns on a larger scale than individual devices that are engineered to provide specific benefits and highlight a gap in current research around the linkages between devices and their ability to support climate change adaptation.

Considering this in relation to Ōtautahi Christchurch, there is opportunity in the OARC to invest in several wetland devices, which could form part of the wider network of blue-green spaces across the city. It is supportive of the idea that investing in a network of blue-green spaces and support a city’s wider climate adaptation strategy.

2.2. Wetlands in Ōtautahi Christchurch and a New Zealand context

Wetlands are of significance to all New Zealanders, and particularly to tangata whenua (local Māori people). A 1988 thesis by Kirkland on “preserving the Whangamarino Wetland” in the North Island, highlighted the conflict between land use pressures on natural wetlands and the need to be able to value the benefits provided by wetlands in comparison to alternative land uses. There is clear economic benefit for drainage of wetland areas to provide land for agriculture, farming, and urbanisation. This had led to ongoing drainage of wetlands across the country with 90% of natural wetlands drained/lost (Manaaki Whenua – Landcare Research & Waikato Raupatu River Trust, 2017; Manaaki Whenua Press, 2010). In 1985 the Planning Tribunal heard an appeal against plans to drain the Whangamarino Wetland and cancelled granted water rights for drainage on the grounds that the Whangamarino Wetland is of national importance and has significant ecological, social, and cultural value. Work has been ongoing, recognising the value of preserving natural wetlands. Clarkson, Ausseil, and Gerbeaux (2013) reflect on the research undertaken in New Zealand to evaluate the ecosystem services provided by natural wetlands, highlighting the provisioning, regulating, habitat, and cultural services that they provide. Of particular interest to this study if the reference to “the non-material benefits such as cultural, spiritual, aesthetic, and educational values” (Clarkson et al., 2013, p. 196) and the spiritual significance of wetlands to tangata whenua. They introduce several case studies undertaking to estimate the economic value of natural wetlands. However, as highlighted by assessments of the wetland extents within New Zealand undertaken in 2016, 2018 and 2021, (Dymond, Sabetizade, Newsome, Harmsworth, & Ausseil, 2021; H. Robertson, 2016; H. Robertson, Ausseil, Rance, Betts, & Pomeroy,
2018) many natural wetland areas have been lost, therefore could there be benefit or opportunity to regain these spaces through constructed wetlands.

Locally there are frameworks proposed in literature that may provide pathways too assess the potential benefits of constructed wetland implementation in the community. Christchurch City Council applied a 6-values framework in the Bells Creek Stage 1 programme of the Land Drainage Recovery Plan (LDRP), resulting in multipurpose blue-green infrastructure spaces (Christensen, 2019). The six core values used by Christchurch City Council as drivers to improve surface water management are ecology, drainage, culture, heritage, landscape, and recreation (Christchurch City Council, 2016). The programme was also seen as an opportunity to engage with the community and provide a wider set of outcomes, including improved water quality, better biodiversity, and greater recreational access. Murphy, Hyde, Shadbolt, and Christensen (2018) examine two Christchurch-based case studies, where investment in blue-green infrastructure for flood mitigation also enabled social, cultural, and economic benefits for the community. Edmonds Park and the Te Oranga Waikura Urban Forest are both part of the Bells Creek Stage 1 Scheme. The paper covers the drivers and challenges behind the design and construction of each device and how they can provide multiple benefits. Te Oranga Waikura doubles as an urban wetland, providing primarily flood management for the Bells Creek catchment and the Woolston neighbourhood, and an urban forest, providing a range of ecosystem services associated with an increase in tree canopy (A. Murphy, K. Hyde, A. Shadbolt, & P. Christensen, 2018). This is an example of constructed wetlands that are being retrofitted in urban suburbs. There are challenges in retrofitting wetlands into brownfield areas, due mainly to space constraints. Wetlands, as effective water management devices, are quite land ‘expensive’(Stefanakis, 2019). However, as Christensen (2019) covers in his case study, blue-green infrastructure provides an opportunity to undertake a multi-value approach that can provide wider benefits for the health of the catchment. It therefore may be worthwhile considering the investment of retrofitting urban areas with multifunctional wetland infrastructure. Raymond et al. (2017) propose a framework for holistically “assessing co-benefits (and costs) of nature-based solutions across elements of socio-cultural and socio-economic systems” (pg.1). This framework situates a 7-step cyclical and flexible process in the planning system and requires regular connection and engagement with stakeholders to be successful. The consistent message in these frameworks is the need for an adaptive process that connects to a wide network of stakeholders, to holistically assess the multiple co-benefits.
An aspect missing from the Christchurch studies was ongoing evaluation of the added benefit to community, from the community’s perspective. Although both designs are considered successes from a technical flood mitigation perspective, evaluating the response from the community could provide valuable insight and ideas for future projects of comparable scale. A New Zealand study on collaborative processes in regional council planning highlighted the importance of understanding how the public respond to and use blue-green infrastructure, by using a ‘monitoring’ stage to understand long term benefits and functionality (Sinner, Brown, & Newton, 2016). Raymond et al. (2017) also highlights this need for ongoing monitoring of nature-based solution implementation as necessary to long term success of any project. Sinner et al. (2016) argue that there is a risk in ‘empty engagement’, and collaboration should fit the wider context and consider the values held by the community. This is reliant on a communities’ capacity and commitment to providing input, as there is a risk of fatigue and over engagement. It also requires a commitment from authorities and practitioners to follow through (Carr, 2015). As Christchurch City Council is currently working on draft stormwater management plans for catchments in the city, understanding what works and what is valued in the community about existing devices would support and direct further investment in blue-green infrastructure.

2.3. Benefits

Most studies, in some capacity, apply an ecosystem services (ES) approach to understanding the benefits associated with blue-green infrastructure. “Ecosystem services can be defined as both part of the ecosystem that produces human well-being and the benefits that people derive from an ecosystem” (Venkataramanan et al., 2019, p. 3). The Millennium Ecosystem Assessment (MA) is one of the more famous frameworks that seeks to understand the ecosystem services provided by infrastructure and nature-based solutions. It is an approach used to conceptualise and understand the intrinsic value biodiversity and ecosystems provide (Millennium Ecosystem Assessment, 2003). The MA uses four categories to understand ecosystem services, provisioning, regulating, supporting, and cultural. The technical performance of blue-green infrastructure (i.e., wetlands) can be described using the direct or more physical ES, provisioning (food and water supply), regulating (urban heat, water quality and quantity management), and supporting (nutrient cycling or the underlying services that ensures the system can function, is fairly well researched (studies here). There is a growing focus on the applicability of these systems to provide pathways for climate adaptation and improve the ‘green health’ of urban environments. Meurk et al (2013) in their chapter
discussing Ecosystem Services in New Zealand Cities classifies the ecosystems services as direct value (with tangible and immediate benefits, including provisioning and regulating services), indirect value (the intangible benefits that are not easily measured, which covers most of the cultural services), or passive value (the supporting services that maintain the function of ecosystems). The chapter also recognises that the direct values are simpler to measure in that they are tangible and there are therefore more likely to be studies in this space, however the indirect value, those cultural services are more difficult to measure and although an essential component of the ES assessment, historically has not seen extensive research.

“Although its technical performance has been extensively studied, little is known about the effects of green stormwater infrastructure on human health and social well-being” (Venkataramanan et al., 2019, p. 1)

This is a gap that researchers are now starting to focus on. As Venkataramanan et al. (2019) indicate in the quote above, the link between blue-green space and the physical and social well-being of individuals, households, and communities needs better understanding. This section of the literature chapter will review the existing literature, and although it will briefly touch on direct values of ES the focus will be on the indirect values, the cultural ES and the link to human health and well-being.

Alikhani et al. (2021) and Venkataramanan et al. (2019) both provide a review of existing literature on social and cultural benefits provided for by green infrastructure. Alikhani et al. (2021) clearly outline the need for wetlands in urban spaces as a pathway to respond to climate change. The article investigates existing literature lenses, reviewing the ecological and cultural values linked to urban wetlands and breaks the benefits down into five values: Sustainability, biodiversity, urban heat islands, social perception, and recreation. It is the last two values that ties most closely to the concept of cultural ES. Here Alikhani et al. (2021) recognise that “ecosystem assessment has commonly been carried out in a purely ecological framework” (p.29) and has neglected the social measures such as sense of place, recreation, aesthetics, culture, and social connection. Venkataramanan et al. (2019) undertook a multidisciplinary review of both peer-reviewed and grey literature. However, they applied a narrow lens, selecting only articles that focus primarily on health and social well-being outcomes of green infrastructure relating to stormwater and flood management. From a list of almost 15,000 articles only 18 studies were found to report on at least one health or social
well-being outcome and met all the inclusion criteria. Of these 18, none “connected green infrastructure for stormwater and flood management to mental or physical health outcomes” (Venkataramanan et al., 2019, p. 1). Although the Venkataramanan et al. (2019) review could be built upon to consider a greater variety of literature (such as secondary data sources, green infrastructure designed for purposes other than stormwater and flood management), the article still highlights a large gap in that most research focuses on the technical performance of stormwater management devices and does not consider the additional benefits. As Alikhani and Venkataramanan agree, the awareness of the benefits to physical and social well-being, the cultural ecosystem services component, is necessary to motivate further investment in bringing blue-green infrastructure into urban spaces.

“The concept of co-benefits, which has been used widely in literature on environmental management and climate policy, can be defined as the positive effects that a policy or measure has on human or environmental welfare in addition to its original purpose or goal” (Osaka et al., 2021, p. 5)

An alternative approach to assessing the value of wetlands in urban spaces is the concept of co-benefits. Wetlands are recognised as multifunctional devices, with each function providing an associated benefit or benefits. These additional benefits are often linked to the ecological health of the systems, water quality, water quantity, carbon sinks, heat regulation as well as providing spaces for ecological habitat, improved biodiversity in urban areas (Stefanakis, 2019). A number of these functions can contribute to climate change resilience, for instance improved water quantity management can be in response to sea level rise (Alikhani et al., 2021). Urban wetlands and green canopy can also provide heat sinks mitigating the urban heat island effect that occurs in our cities. These are the direct values, the provisioning and regulating ecosystem services. Planners and engineers are increasingly designing recreation access as a function of wetland spaces. Spaces can be designed to have walking tracks and access for water-based activities. However local guidance literature on the design and functionality of wetland spaces is limited. The Christchurch City Council’s Waterways, Wetlands and Drainage Design Guide (2003) has limited direction on the designing multiuse spaces. Auckland Council’s equivalent design guide, GD01 (Auckland Council, 2017) is also primarily a technical design document, however, it does provide a very limited introduction to designing for mana whenua, amenity, and biodiversity. Therefore, there is opportunity in this space for further research on how to maximise the co-benefits of urban wetlands during the design process.
A commentary by Sutton-Grier and Sandifer (2019) reflects on the role coastal wetlands play in disaster response and promoting human health and well-being. “WHO define health as ‘a state of complete physical, mental, and social wellbeing, and not merely that absence of disease or infirmity’” (Britton et al., 2018, p. 2). Often in discourse health is considered in the context of disease and physical health, excluding mental and social well-being. Sutton-Grier and Sandifer posit that “most, if not all, ecosystem services are important to human well-being” (2019, p. 2) and characterise human health as the ultimate ecosystem service. They recognise that there is significant research on green space and its benefits for human health, particularly physical health and similarly there is research available on the role of blue space (Sutton-Grier & Sandifer, 2019). However, in their commentary they recognise that in many ecological analyses or studies the broad range of cultural ecosystem services, including “recreation and leisure; aesthetic; spiritual; cultural heritage and identity; educational; inspirational; sense of place; social; scientific; and existence” (Sutton-Grier & Sandifer, 2019, p. 2), are ignored or poorly accounted for. This is visible in the lack of literature directly evaluating the cultural ecosystem services of wetland and blue-green space. This commentary focuses on coastal wetlands rather than freshwater natural and constructed wetlands. A core component of their commentary is the connection between biodiversity loss and diminished ecosystem capacity. Urban constructed wetlands may lack the biodiversity of natural wetlands unless specifically designed to incorporate a wider range of ecosystem benefits. The challenge is to “help communities and cities incorporate more green and blue spaces into their design and growth because we do not know yet exactly which characteristics of green and blue spaces elicit human health benefits” (Sutton-Grier & Sandifer, 2019, p. 5). This is one of the gaps that this research aims to fulfil.

In response to the COVID-19 pandemic there has been a “growing policy need for a better understanding of the complex ways in which people engage and become disengaged with natural environments” (Reeves, John, Wood, & Maund, 2021, p. 3). Two studies undertaken internationally focus on the perceived benefits of visiting wetland parks. Zhai and Lange (2021) explore the perceived health benefits of visiting wetland parks and the potential impact the COVID-19 pandemic, and associated restrictions, may have had. They define wetland parks as public areas with rivers, lakes, and other blue spaces. The study confirmed that most participants recognise the health benefits of visiting these spaces, and that restrictions due to the pandemic saw a rise in that perception. Participants perceived habitat services (linked to biodiversity and range of flora and fauna present) to be the most valuable.
ecosystem service for promotion of health benefits. Reeves, John, Wood, & Maund (2021) undertook a similar study on the motivations and perceived benefits during and after visits to wetland centres in the United Kingdom. Wetland centres are defined as paid-for visitor attractions with a variety of amenities. They found evidence that visitors are motivated by biodiversity and the amenity value of the space and perceive benefits to their “psychological wellbeing by inducing feelings of happiness/pleasure, relaxation, mental restoration, vitality and satisfaction” (Reeves et al., 2021, p. 17). Both studies provide evidence supporting the idea that access to and engaging with wetland space can have positive health outcomes for people. They are adding to the narrative around mental and social wellbeing that are growing topics of concern within both the public and political spheres, suggesting further evidence in this area is necessary to capitalise on this interest. Elements of these studies can be applied in an Ōtautahi Christchurch and New Zealand context to further local interest.

Current research is increasingly recognising the social-cultural benefits of constructed wetlands to urban communities. Several authors (Alikhani et al., 2021; Stefanakis, 2019; Venkataramanan et al., 2019) recognise that further evidence, connecting blue-green infrastructure to community well-being, is necessary to motivate future investment. More recent literature explores the health benefits of blue-green space, both in general and in response to the COVID 19 pandemic. This section highlights the value of accessible wetland spaces for health, social and community well-being.

2.4. Community

While the term community is used widely in academic and grey literature, defining the community is not necessarily a straightforward process. This section considers difference approaches to defining community in available literature, approaches to community engagement, and considers different types of communities that may be present in Ōtautahi Christchurch. The communities present include the Indigenous Māori community who have ancestral ties to the region, communities of place, and of interest.

There are numerous definitions and types of communities. Understanding who the communities are, who are connected and impacted by change can be difficult. T. Robertson et al. (2021) suggest three main types of communities.

- Communities of interest – groups connected by a geographical area
- Communities of circumstance – groups with shared experiences, often connected to an adverse event
- Communities of supporters – groups engaged within organisations or volunteer networks.

In contrast, Everett, Adekola, and Lamond (2021) consider five community types, with only one definition overlapping with three types mentioned above. Communities of circumstance remains the same. However, a community of interest are defined as a group who share interests and communities of place relates to groups defined by geographical boundaries. The remaining two types are communities of action (similar to communities of supporters in that it’s a group of people active in trying to bring about change) and communities of practice (groups from the same profession or same activities). Missing from these definitions is a cultural component of community, groups brought together based on faith, spirituality, or a cultural connection. In the OARC there is also a consideration of the disestablished residents of the red zone who have a connection but are no longer physically connected (communities of memory) and the Indigenous communities who have historic and traditional ties to the area that must be respected. There is no right approach to defining the community present, instead it should be a process of engagement to identify all parties who may be impacted or connected.

In the aftermath of the Canterbury earthquake sequence community engagement was undertaken to develop plans for recovery and the future of Ōtautahi Christchurch. Orchard, Meurk, and Smith (2018) and Vallance and Tait (2013) undertook studies within the community to understand the priorities for the recovery of the OARC. Orchard et al. (2018) held focus groups to gather information on community perspectives. Participants were invited using a purposive sampling strategy and targeted four groups which are referred to “as researchers (current or retired), government/local government technical staff, local restoration practitioners including local government operational staff (e.g. park rangers), and local community or traditional knowledge holders”. Vallance and Tait (2013) engaged with the community through two phases. The first a series of in-depth interviews with 14 community representatives, which they used to develop a choice model survey that was distributed to 1500 residents, drawn from the electoral roll to be reflective of the wider Christchurch demographic, and has 291 responses. The two approaches described are just examples of a range of community engagement that occurred within planning process for recovery in Ōtautahi Christchurch. Everett et al. (2021) provide a framework for engaging with communities in the field of blue-green infrastructure and emphasises the need for two-way communication and questions the validity of engaging with representatives or groups.
Their concern is that purposive sample groups, as occurred in both examples above, may not sufficiently recognise the diversity of communities with. Everett et al. (2021) provide a typology of community engagement and suggest that most engagement sits within one of four areas. Figure 2-1 breaks down the four typologies of community engagement.

![Figure 2-1 Typologies of community engagement](image)

It is necessary therefore for practitioners and researchers to recognise the purpose of engagement and where they wish engagement to sit on the scale before embarking on any engagement. It is also argued that engagement is necessary for the life of a project, and therefore engagement needs to be considered from the outset to the implementation, through to maintenance and through the end-of-life process.

There are several approaches to define a community. However, literature recognises that no single approach that is right. Common typologies that may be applicable to help define community in this study include communities of circumstance, communities of geography or place, communities of culture, and communities of interest. As evidenced by Everett et al. (2021) defining the community is a process and required commitment to engaging with all interested parties to understand their unique experiences and perspectives.

2.5. Community Resilience

Community resilience is term that is used more commonly in disaster risk policy and planning and climate adaptation as an approach to assess and manage the preparation for and
response of a community to disruption. Although there is much literature that explores the definitions and indicators for community resilience, there is little consensus on what the term actually means. This section looks at common approaches to defining community resilience and indicators in literature, and how it may be applied to a New Zealand setting.

The term “community resilience” has two key components, both of which are individually complex to define and together create an additional layer of ambiguity. The understanding of the term ‘community’ as it is found in literature and applies to this research is previously discussed in section 2.4. Before jumping into a definition of “community resilience”, the ambiguity around ‘resilience’, stemming from the diverse meanings attributed to the term, should be understood. Each field has its own terminology and when applying it in an interdisciplinary setting, the background of participants can influence how resilience is applied. The Resilient Cities Network defines urban resilience as “the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience” (Resilient Cities Network, 2021). It should be recognised that a resilient environmental solution is not necessarily a resilient social solution and vice versa. "Resilience has fast become a popular catchphrase used by government, international finance organisations, NGOs, community groups and activists all over the globe” (Cretney, 2014, p. 1). Despite its widespread use, there remains confusion over what resilience is and the purpose it serves. As the focus of this research narrows to “community resilience” it is recognised that concepts of community resilience are locally specific and dependent on the community itself, the history, location, and networks. Wilding (2011) recommends giving space for communities to define resilience for themselves, considering how it applies to their unique circumstances. T. Robertson et al. (2021) put forward that community resilience reflects “the ability of communities to use their available resources to prepare for, respond to, endure and recover from shocks and stresses” (T. Robertson et al., 2021, p. 1). However, it also agreed that not having a predetermined definition of “community resilience” can be good, as it enables individual communities to define what resilience looks like to them, and how it applies in their context.

Le Dé, Wairama, Sath, and Petera (2021) undertook a study in the North Island, New Zealand to develop a tool kit of people-centred indicators of resilience. Indicators of resilience can be externally or internally measured. External indicators are reliant on outsider perceptions and measures outside of the community. Indicators are developed by experts and academics with a pre-defined framework then introduced for community feedback. While Le Dé et al. (2021)
suggest several benefits to this approach, they also highlight limitations. An alternative approach is to use internal indicators. Internal indicators are people-centred and recognise that local people have local knowledge about their environment and can self-evaluate their capabilities and vulnerabilities. Le Dé et al. (2021) and the Civil Defence and Emergency Management (CDEM) groups recognise the need for a people-centred approach and in response developed a 6-step tool to develop a set of internal indicators. This tool was then used with four community groups, one in Papamoa and three in the Hawke’s Bay. The three sessions in the Hawke’s Bay were run with migrant, Pacifica, and Māori communities. “Each community understood resilience differently, which reflects that resilience is highly contextual” (Le Dé et al., 2021, p. 11). The indicators developed by each group varied but the themes could be described as follows and linked to existing literature. It supports the idea that local people already have the knowledge and now need the support to express and measure their own resilience. Common indicators developed in Le Dé et al. (2021) study include:

- Communication
- Faith and spirituality
- Well-being and mental health
- Financial aspects
- Social connections and cooperation

Each group presented the themes differently, for instance Māori and Pacifica groups connected strongly to indicators of spirituality and faith, suggesting a cultural lens is necessary, and the people centred approach enabled a dialogue between participants and local government or decision makers. A limitation in this study may have been the division of the groups by culture – as it restricts the opportunity for learning across groups and does not recognise the inherent diversity of communities.

The T. Robertson et al. (2021) study focused on specialists already engaged in some manner in the Disaster Risk and Resilience field develop a set of indicators and understand the current state of knowledge in the UK. This can be considered an external approach. The stakeholders in T. Robertson et al. (2021) developed similar indicators and overarching themes. Particularly social connectedness, leadership, engagement and shared responsibility, and communication to name a couple. However, as found in the study by Le Dé et al. (2021), the cultural element and community context does shift how the indicators are understood and measured by the community. Both these articles support the idea from the Wilding (2011)
report to the UK Carnegie Trust, that community resilience requires the community to be engaged in the process to be able to properly measure their resilience.

The literature to date does not connect indicators of community resilience with blue-green infrastructure, or wetlands in our urban environments. However, there are links than can be extrapolated. Both studies, previously mentioned, highlighted social connectedness, social well-being, and mental well-being as indicators of a resilient community. A connection was previously made in this study between wetlands, and access to green space in general, and a potential improvement in social connections and mental well-being (Reeves et al., 2021; Sutton-Grier & Sandifer, 2019; Zhai & Lange, 2021). Therefore, it may be suggested that access to wetlands can contribute to community resilience. However, beyond this extrapolation there is limited evidence to support this. This research aims to fill this gap. Supporting this research aim is an article by Shimpo, Wesener, and McWilliam (2019) that discusses the role of community gardens in building community resilience. Community gardens in the aftermath of the 2010/2011 Canterbury earthquake sequence helped “strengthen social interactions, relieve stress and build the social capital that is needed when a disaster strikes” (Shimpo et al., 2019, p. 8). The structure of this study, with field surveys and in-depth interviews could also be applied to an urban wetland space, to explore whether the same benefits and indicators of community resilience can be attributed to wetlands.

2.6. Summary

Constructed wetlands, as an example of blue-green infrastructure, are recognised in existing literature to provide multiple benefits to the environments they are situated in. Research to date has focused primarily on the direct benefits, considering how wetland systems can support urban climate adaptation. However, the value of wetland systems to socio-cultural aspects of climate adaptation have not been explored to the same level of detail. It is in this space that this research proposes to focus.

This literature review reflects on the multi-values of constructed wetlands. The social-cultural value of constructed wetlands, to urban communities, is recognised by several authors (Alikhani et al., 2021; Stefanakis, 2019; Venkataramanan et al., 2019). However, additional evidence, highlighting the value of accessible wetland systems for health, social and community well-being, is necessary to encourage future investment.

Traditionally wetlands in New Zealand (natural wetlands) are valued by mana whenua for their spiritual significance, and contribution to the ecological and cultural well-being of the
environment. Despite this, over 90% of natural wetland systems have been drained or degraded. Constructed wetlands may prove to be an opportunity for recovering some of the lost value, through reintroduction of native biodiversity and reconnecting urban communities with nature.

Communities in Ōtautahi Christchurch, and in any urban centre, generally consist of diverse typologies and groups reflecting the spiritual, geographic, and social context. The literature explored in this review recognised the terms ‘community’ and ‘community resilience’ are contextual, and the background and experiences of the individual can influence how they are perceived. As such practitioners exploring the connections between blue-green infrastructure (such as constructed wetlands) and community resilience, must first endeavour to understand the community through a process of engagement.

Community resilience indicators, including social capital and mental well-being, have been linked in literature with the benefits of access to green space (Reeves et al., 2021; Sutton-Grier & Sandifer, 2019; Zhai & Lange, 2021). Constructed wetlands, as an example of green space or green infrastructure, could therefore potentially provide benefits to community wellbeing and to community resilience. This research proposes to explore this concept further, providing supporting evidence for the value of constructed wetlands in urban environments.
3. **Methodology**

3.1. Ōtākaro Avon River Corridor – Case Study

Several constructed wetlands are proposed along the OARC to manage urban stormwater runoff. These devices are already planned for this space, but could the design be such that additional benefits are gained from the space, beyond treatment and quantity management.

In the Regeneration Plan key land use and regeneration projects were identified, with help from the community. These included several opportunities for stormwater management. Figure 3-1 is an excerpt from the Regeneration Plan. The area is known as the “Green Spine”.

![Figure 3-1 OARC green spine as proposed by Regenerate Christchurch (Regenerate Christchurch, 2019)](image)

As a result of the Canterbury earthquakes areas of the red zone subsided by up to 1m in places, increasing flood vulnerability, and mimicking the effects of sea level rise due to climate change (Orchard et al., 2018). This space provides an opportunity to create ‘exemplar sites’ to demonstrate how wetlands can be implemented in areas where managed retreat may be necessary.

There is an active network of community groups with a vested interest in this space, including the Ōtākaro Living Laboratory, the Avon Ōtākaro Network (AvON) and Greening the Red Zone (Avon Ōtākaro Network, 2020). These organisations actively work towards the regeneration of the OARC.
3.2. Methods

This research aims to understand how the relationships and interactions between communities and blue-green infrastructure (such as constructed wetlands) influence perceptions of community resilience. Figure 3-2 visually represents potential interactions between constructed wetlands and communities and how these can influence perceptions of community resilience. Community resilience is a subjective term, and the background and context of a given community can influence how it is perceived or understood in-place. It therefore follows that engaging with the community of interest, in this case the community associated with the OARC, is a valuable approach to understanding the localised context of community and community resilience, and the role of constructed wetlands in it.

![Figure 3-2 Interactions between community and constructed wetlands may influence community resilience](image)

Gauging public perceptions is a challenge for research. Literature suggests several different methods for engaging with the public. Potentially suitable methods include surveys (in-person, online, telephone), interviews with specialists or members of the public, literature reviews and mixed-method approaches using more than one method to engage the public (Drosou et al., 2019). There is no ideal or perfect fit approach, however most literature explored (Chausson et al., 2020; Orchard et al., 2018). Vallance and Tait (2013) applied a mixed-methods approach, using multiple avenues of inquiry to best fit their research context.
A similar approach was therefore chosen as most appropriate for this research, however time constraints meant a scaled down approach was necessary. Therefore, to understand the context of the community in the OARC, a series of interviews with representatives and specialists with mixed backgrounds was deemed appropriate to understand their motivations.

3.3. Semi-structured interviews

Semi-structured interviews were used to engage with community representatives and specialist stakeholders that were particularly engaged with or passionate about an aspect of this study. Semi-structured interview questions enabled important points to be discussed in more depth than is possible in a focus group setting. The interviews focused primarily on the role of constructed wetlands in building community resilience, and how policy and planning can be used to foster support for blue-green infrastructure. The questions were adapted to fit each participant’s background and interests in the OARC, with the primary basis for each set of questions remaining consistent. O’Donnell et al. (2021) undertook a study with a similar approach surveying stakeholders with established experience in blue-green infrastructure implementation. They explored perceptions around governance of blue-green infrastructure and engaged with professional stakeholders from four cities. The semi-structured interviews adapted this approach to focus on Ōtautahi Christchurch and considered community stakeholders as well as professional stakeholders to understand a range of perceptions.

The interview questions focused on the following topics, with flexibility in the conversation to adapt to the participant’s needs and interests. The full list of interview prompts prepared for the interviews is attached in appendix B. Interviews explored:

- The value and benefits of investing in blue-green infrastructure in community spaces, directed toward social and cultural benefits
- Drivers to implementation of wetlands, particularly during the development of community plans, such as the Ōtākaro Avon Regeneration Plan and Christchurch City Council long term plans.
- Barriers to investment in wetland infrastructure
- The perceived role of wetlands in contributing to (or detracting from) community resilience

Seven participants were interviewed, three from industry and local government, three from the community (active members of community organisations within the OARC and one representative from mana whenua. Two of the interviewees also had an academic
background, with connections to the University of Canterbury. Participants were identified using a snowball approach, which began with two individuals recognised for their long involvement with the OARC. These individuals were invited to meet with the researcher and/or nominate other people in their circles who could be interested in this field of research. Although this limited the diversity of participants, potentially creating bias towards people highly engaged in community and environmental issues, this approach was deemed appropriate give the research objectives. It was also deemed a more practical approach given the time and resources constraints, and an inability to coordinate larger focus group sessions due to Covid restrictions.

The interviews were held either in-person, online, or over the phone, depending on what format was most practical for the participant. Data collection and analysis were conducted in line with the University of Canterbury Human Research Ethics Committee approval, reference HEC 2021/96/LR (see appendix A). Each interview was 30-45 minutes long and recorded with the permission of the participant. All audio recordings and notes on the interviews were securely stored, and transcripts anonymised using code names/pseudonyms in place of participant’s names. Other personal details, including age and ethnic and cultural background, were not recorded. Only the participants relevant experience, whether from an industry or local government perspective or from experience as a volunteer for a local community organisation, was recorded. Each participant received a detailed information sheet and consent from prior to the interview. The participants were engaged in their capacity as experts or key stakeholders and were not asked to discuss any sensitive topics or personal information.

3.4. Analysis

The seven interviews were transcribed by the researcher and significant quotes and comments manually highlighted. The quotes were then thematically grouped to align with both the research and the interview questions (the interview prompts are introduced in section 3.2 and presented in full in appendix B).

In this way evidence was assembled from the empirical data to address the overarching research objectives introduced in chapter 1. They are repeated here for reference.

- Understand perceptions around the role of wetlands in urban spaces and the value they can add to a community
Develop a refined definition for community resilience to fit the Ōtākaro Avon community, considering the values, location, and perspective of the participants.

Understand how wetlands can contribute to (or detract from) community resilience.

Through this process five key areas of discussion were identified (see Figure 3-3). These themes are used to organise the results section.

![Figure 3-3 Breakdown of interview discussion themes.](image)

Chapter 4 presents the results of the key informant interviews grouped according to these five themes. Results are presented through a mix of short and long form quotes, in order to let the voice of the participant come through. This reflects their experience and knowledge in its wider context.

### 3.5. Positionality

This study is a qualitative assessment of the perceptions of key stakeholders on the role of constructed wetlands in urban communities and community resilience. Due to constraints with time and resources, and the structure of the MURR programme, the interviews, transcription, and thematic analysis steps are all undertaken by this researcher. As such personal bias and the positionality of the researcher may influence the interpretation and discussion of the results presented in chapters 4 and 5.
Through literature (Derry, 2017; Holmes, 2020), positionality is understood to reflect an individual’s world view, values, beliefs, and moral standing that influence the approach taken in research. Elements that may contribute to the positionality of this researcher, include:

- A New Zealand citizen, originally from Auckland, but based in Canterbury for the duration of their studies
- A degree in Civil Engineering, and therefore a more analytical approach to resilience terms
- Place as a pakeha female in a male dominated engineering discipline
- Previous role working for the public sector (Auckland Council).

The researcher has an inherent bias, and although attempted to approach this study from an objective point of view, will likely be influenced by an existing recognition of the value of blue-green infrastructure. This stems from a personal interest and passion for building better communities through a stronger connection to water in urban spaces, believing that water has a valuable role to play in a community response to disruption and change.
4. Results

Seven stakeholders participated in this research through 30-40-minute semi-structured interviews. The participants came from a mix of backgrounds, including academia, community organisations, industry and local government, mana whenua and Regenerate Christchurch. Regenerate Christchurch, as explained in Chapter 1, was the primary organisation responsible for the development of the Regeneration Plan and a pathway for the restoration and redevelopment of the OARC after the Canterbury earthquake sequence. A breakdown of the background of each participant (anonymised) is presented in table 4-1.

<table>
<thead>
<tr>
<th>Interviewee Code</th>
<th>Interview Date</th>
<th>Academia</th>
<th>Community organisation</th>
<th>Industry/ local government</th>
<th>Mana Whenua</th>
<th>Regenerate Christchurch</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>Dec 2021</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>I2</td>
<td>Jan 2022</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I3</td>
<td>Jan 2022</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I4</td>
<td>Jan 2022</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I5</td>
<td>Jan 2022</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I6</td>
<td>Jan 2022</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I7</td>
<td>Jan 2022</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

This chapter outlines the common themes and discussions from across the seven interviews. To align with the objectives of this research, this is broken into five subsections: (1) the motivations for engaging in this field, (2) understanding and perspectives of key research terminology, (3) perceptions on the role of wetlands in urban environments, (4) perceptions on how wetlands contribute to (or detract from) community resilience and (5) perceived barriers to implementation of constructed wetlands or gaps in knowledge. This chapter identifies common perspectives and divergent views in the interview responses. The results are then discussed and interpreted in chapter 5.
4.1. Motivation

The interviews started with a background of the participant, as an approach to both understand the context of each participant’s responses and to understand their motivation to engage with this field. Each participant was in some manner connected to the restoration of the OARC, or more generally engaged in restoring blue-green spaces to the urban environment. A thematic review of the seven transcripts revealed four main motivations or drivers for their work: (1) changing approach towards a more nature-based philosophy, (2) cultural background, (3) the opportunity presented by the Canterbury earthquake sequence, and (4) setting a foundation for the future. Some of the participants also reflected on the motivations they see in the community groups and among the public that they engage with on a regular basis.

One participant referenced a change in society, towards a nature-based and environmental philosophy. “We have seen a change in the whole basis for the philosophy of our society to something quite different than the Christian. And it's a much more nature-based one” (I1). And that the zeitgeist of our time is the “ecological restoration, climate change response working with the land and nature” (II). It is recognising “that nature should come first” (I6). A common theme in each interview discussion was the importance of nature and how that is coming across in the way the public engages with urban environments. Drivers such as climate change and environmental management, which were once taboo topics, are now common.

“I took over the Facebook page fairly early. You just couldn’t mention things, like really obvious things that were drivers for us. Like climate change and sea level rise and all of those things. They weren’t actually things you could really talk about without kind of getting hammered […] And now we are finding that is becoming more of a driver for other people as well” (I6).

This shift was also observed in the local government space, as water quality measures and funding for projects that are seen to benefit the environment are more widely accepted and promoted.

2 Refer to table 4-1 for the date of interview and the interviewee’s background.
“Stormwater quality wetlands, they're kind of easy to talk about. That is, there is a natural funding source for them. As there is a responsibility by the council, or in the future a larger entity, to manage stormwater and to reduce the amount of contaminants discharging into the river” (I4).

The change in philosophy, towards nature-based approaches, is a sign of the current knowledge base and challenges facing urban communities, however what that may look like in the future is uncertain. As I1 stated, “if we did this 40 years [or] 50 years ago the answer would have been different” (II). Each participant recognises that it is our responsibility to care for the environment, and it is inherently important to us. This is one of the main drivers of participants engagement in restoration projects and in investing in blue-green infrastructure.

A second driver for engaging the ecological regeneration of the OARC is the cultural background of the participant. Indigenous and Māori world views are becoming more recognised in the traditionally western discourse on urban environment, development, and communities.

“In nearly every Indigenous population around the world, we come from the environment. We see different geographical features and landmarks as being repositories of our epistemologies and knowledge bases and quite often we see that as being inherently connected to us through ancestry or genealogy and things. So, we have that relationship which is mutually beneficial. So, if we care for the environment, it has the ability to care for us. And I think in some cases particularly in western societies and in colonial societies they still have this kind of notion or belief that they have the ability, not to terraform, but that they feel they can adapt their environment to suit their need. Which like I said you know the earthquakes and even you know climate change has demonstrated that we can’t, and we have got to be able to adapt and be agile in our adaption to our environments and changes.” (I7).

The participants recognise, even if not as explicitly stated as above, an inherent relationship between the environment and human well-being. The differences between a traditionally western approach to environmental management and Indigenous approaches are identified. As the community of experts, decision makers, and stakeholders increasingly value the natural environment, the shift towards more nature-based philosophies can also be interpreted as a recognition of Indigenous cultural world views.
“Because land in the Pākehā sense, land is worth more than water, water was where you disposed of waste. If you think about it from a mana whenua perspective, water was mahinga kai, you know, it was one of the attributes of Papatūānuku [Earth mother] that life depended on. A very very different perspective. That’s one of the exciting things of the river corridor and co-governance is that the interest of mana whenua and very different values will have to be centre stage” (I4).

A driver for I7 is “in restoring our cultural values, our cultural knowledge base, and our cultural world view back into the landscape” (I7). Bringing a cultural narrative back to the landscape and engaging with the Māori worldview can therefore be seen as a motivator for engaging with environmental restoration and wetland restoration.

The Canterbury earthquake sequence of 2010/2011, although a tragedy, opened large areas of land within Christchurch City for regeneration. As I3 said, “where in the world does a city get an opportunity to have that much land given back to them in an urban environment. So, it’s an opportunity to actually do something amazing not just mediocre” (I3). Four of the participants recognised the post-earthquakes setting as an opportunity to change the approach to green space within Ōtautahi Christchurch. Two of the participants who are involved in community organisations within the OARC first became more involved in the field of urban greening and regeneration in the aftermath of the earthquakes. “After the quakes it was clear to me that the river corridor was a great opportunity. I was just looking around for a place to volunteer [.....] happened upon Greening the Red Zone and so I just joined up with them, that was my in” (I6). I7 recognised the earthquakes as a turning point for the public of Canterbury.

“Ultimately the earthquakes demonstrated to the public of Canterbury that you can’t withstand the force of mother nature and so we had to be able to adapt to our environment and be agile with that adaptation. And so, maybe we should let the red zone become the boggy marshlands that it once was, bring back a massive mahinga kai site for the city” (I7).

Although, for one participant who was involved in the field of wetland design and urban green space prior to the earthquake sequence, the earthquakes were less of a trigger for change and more an opportunity to expand on existing practises.
“Christchurch has led the way in this [...] so since the sort of mid 80s or maybe early 90s, Christchurch has had a six values\(^3\) approach to stormwater management. So, what we're doing now is really just a continuation of that, except because of the earthquakes, because of the flooding, we're probably able to do that on a wider scale” (I5).

It was also important for the residents of the area, who were displaced by the red zoning after the earthquakes to have a say in what the future of the space could look like. “Several people for example on our committee, who were kicked out of the red zone and part of their motivation was to keep it so it wasn’t built back on” (I6). Keeping the space and the memory of the space alive is as important as protecting future generations. The earthquakes provided a space where the community could experiment and reintroduce nature to the urban environment, however, it is important to also recognise the history and the pain that the people experienced when moving forward.

For some of the interviewees building a foundation for future generations that is safe and healthy is a fundamental motivation. Whether that be through protecting water quality or preparing for climate change and rising sea levels, the temporal scale on which participants consider the OARC is a driver for their involvement.

“It stems from me being able to frame the red zone on a lot, a much larger temporal scale than someone who has lived next door for 10 years and wants to get engaged. My primary focus is on making sure that the foundations are set for the future rather than what’s happening here and now” (I2).

The future of the OARC consists of projects and initiatives driven by the community of today. I4 reflects on how the previous approaches to water management.

“[we have a habit of] relying mostly on the entirely false claim that we can do whatever we like [and] get away with it because we can and now, we're seeing the consequences again. That incidentally is again why the sorts of initiatives that take place in the river corridor now are not initiatives for the next 10 years they are for the next 50 years and much much longer “(I4).

\(^3\) Ecology, drainage, culture, heritage, landscape and recreation are the six core values driving Christchurch City Councils surface water management approach. (Christchurch City Council, 2016)
They recognise that the timeframes for the planned projects are longer than current lifetimes, and a priority or motivator should be about protecting what is left of native ecosystems for generations to come.

“Make sure we don’t make anything worse or that in 200- or 300-years’ time, if there is another big natural disaster or sea levels have risen completely or whatever, that we are not creating another series of issues for another generation to rectify” (I7).

Motivations for engaging in restoration projects, advocating for better environmental protections, or investing time and energy into the OARC vary between the seven participants. Underlying drivers can be tied for the most part to recognition of the value and importance of the natural world to human well-being, cultural knowledge, and a desire to create a safe foundation for future generations. The Canterbury earthquake sequence of 2010/2011 was a trigger for many of the participants to become more actively engaged and for the others it created an opportunity to change direction and bring blue-green space back into the urban landscape.

4.2. Understanding of key concepts

To situate this research, participants were asked for their understanding and perspective for three key concepts underpinning the research; community, community resilience, and natural and constructed wetlands. The following sections give an overview of these perspectives.

4.2.1. Community

Reflecting on the meaning of ‘community’ in relation to the OARC was thought-provoking for all interviewees. As the participants agreed, there is no single community present in the OARC, rather “multiple communities. Community of interest, community of geographical area, communities of impact, communities of faith, all those other [...] you know, all those sorts of particular types of community” (I2). I2 recognises community both from an academic perspective “community as interacting organisms” and from a people perspective:

“There are a lot of different communities in the red zone and it would be really interesting to bring everyone who interacts together into one space and actually look at the demographic and then sort of get them to split into sub communities because there would be the dog walkers, there’d be the rowers, the walkers, cyclists, community gardeners, and there’d be the people that are still living amongst it. It would be interesting” (I2).
Many of the participants are actively engaged in the volunteer networks of OARC and as such frame the community in relation to the members of their network.

“There are three different categories of people on the Ōtākaro and on our network. There is a localized community who live and work around their space and they are just really keen to be involved in their community. There is a large water sports contingent that come in to the Ōtākaro from all over the city and then there's specific projects that bring people in, so like the climate change campus, the Waitākiri Ecosanctuary and the living lab stuff and those sorts of things.” (I3).

I4 recognised that there is “a certain degree of overlap between the people or the sorts of people involved” (I4). Although the participants found it hard to define “an overarching community” (I2), it is plausible to summarise the communities into three general categories, from the perspectives of interviewees.

(1) Geographic community – individuals who live and work in the area, or were displaced by the red zoning process but still have a connection to the land;
(2) Recreational community – a community consisting of individuals invested in the OARC for recreational opportunities, including walkers, cyclists, and rowers; and
(3) Community of interest - individuals who are interested and engaged in the projects within the OARC and may have specialist skills or knowledge.

I4 suggests that there is not “a strong sense of community in the river corridor [...] what was community in that area has inevitably emptied out” and that they “haven't seen much evidence that there's a lot of community there to engage with. It's difficult in those spaces where people [...] it’s not a community of place anymore, more of a community of interests” (I4). They suggest that the community is more closely linked to interest in the land, rather than a group of residents physically located in the space.

“And I think where the sense of community is important, but you wouldn't use the word because it's a very academic word, is in the different interests in the land. In particular the interests of mana whenua which of course have been entirely ignored for the last 150 years and it's very interesting how that’s been brought entirely to the fore but is a very different expression of community” (I4).

This introduces a fourth conception of community to be considered, and that is the cultural community. The “mana whenua interest, of course in both sort of cultural memory from the
tribal point of view, but also that customary right” (I4). The discussion on community highlighted that there are many overlapping types of community in the OARC, including (1) cultural communities, (2) geographic communities, (3) recreational communities, and (4) communities of interest.

A secondary component to the definition of community that arose during discussion with the participants is the ‘how’. How to engage with the community? As I1 suggests, “community engagement [...] it's a negative impulsive to engage, [and so] it's really important in an engagement process, particularly one as big and as important as a regeneration plan like this, that it's a long conversation not a short conversation” (I1). It is a recognition that community engagement, although valuable, is a complex and time-consuming process, and in an environment like the OARC, it includes many stakeholders or community groups and can become complex. “The stakeholders in this are quite vast because you've got the homeowners that have left, people left behind, communities of interest and that balanced with the needs of the whole city, so it's quite a complicated stakeholder environment” (I3).

The definition of community is complex, and as the interviews have highlighted, since the process to develop the Regeneration Plan just after the earthquakes, there hasn’t been “really a sort of joined up conversation about exactly what it might be” (I4). It is therefore important to recognise that the process in which community is engaged is long and complex, and time needs to be taken to holistically recognise the different types of community present, particularly as there is a shift from a geographic community (though that is still present as indicated by I1 and I3) to a community of interest in the land (I4).

4.2.2. Community resilience

When asked for their thoughts on the concept of community resilience, participants responded in one of two ways. The first was to provide a technical definition that they then applied to a social context. The second kind of response was more emotive. Some participants connected the concept of community resilience to the current COVID19 pandemic response and applied personal frameworks for responding to change, in place of the term ‘resilience’.

Community resilience, as defined by I1 and I2, is the response of a group or community in the aftermath of an event or disruption.
“Resilience, you know the technical definition, it's how well you can respond after an adverse effect. But in truth this secondary to how people respond, and obviously there's less to respond to the higher the level of protection or mitigation that there is” (I1).

However, when discussed in a social context both participants relate community resilience to the social connections and response of the individual.

“Community resilience, I guess like from an ecological perspective, community resilience, by definition that is, is a group that’s environmental context and interactions context enable it to recover from perturbations or disruptions […] community resilience in an anthropogenic context is something that builds social connections and enables people to step outside or move away from disturbances” (I2).

The definitions provided by I1 and I2 are more technical than the responses from the other participants. Both I1 and I2 have backgrounds in industry and local government.

In contrast, three of the participants had a negative impression of the term. They related the terms to academic or political buzzwords without a lot of substance. I3 defined community resilience as “a bureaucrat’s way of justifying their existence” (I3). Whereas I4 had a “fundamental issue with the term resilience”. I7 recognised the term as a buzzword that when peeled back can be linked to basic concepts familiar to every human being.

“About urban or social resilience or financial resilience, then all of those terms are, all the buzzwords’ terms at least, they can go back to key values of not only Māori but of many Indigenous cultures and actually many societies or religions. Be a good human. Look after you neighbour. Care for one another. Look after those that have less than you. They are common themes across humanity, and I think sometimes we get caught up in a linguistic exercise of wordsmithing things that, by doing that we obtain some sort of power or control or dominion over something. Whereas I think quite often we’ve gotta peel things back to basics” (I7).

I3 highlighted the point that a community can be resilient without interference from external parties. They demonstrated this with an anecdote from the COVID19 pandemic and the response they saw in Ōtautahi Christchurch.

“When Covid first, when we hit our first lockdown, the civil emergency teams in Wellington thought there was something wrong with the Christchurch 0800 number
because they weren't getting as many calls from people in Christchurch as they were from the rest of the country. And the reason behind that was that we had established really good networks after the earthquake. And what happened with COVID lockdown, all those networks instantly engaged […] and everyone just quickly converted, there was no messing around, everyone got their systems in place to be working from home. All our little community groups had lists of people to call. So, there are some of the groups where elders meet, for example the elder exercise groups, who rely on going to those exercise sessions as a way to mitigate social isolation. It's their social thing for the week. So, those group leaders instead of running exercise programs they ran phone trees and things like that. So, it was right across the city across all the organisations, because we had had the earthquake to establish, and so the end result of that was that there were less calls going into the civil defence 0800 number because the community had taken care of those inquiries and making those people feel good. So that to me really shows resilience. This community is resilient.” (I3)

Again, the importance of social connections to resilience is demonstrated. “If I just sum it up being resilient is being connected” (I3). Although interviewees did not like the term ‘community resilience’ breaking the buzzword down into fundamental concepts shows that, in the interviewee’s understandings, there is a common theme of social connections and basic human values.

Participants used personal frameworks to understand and explain resilience (or these underlying themes) as they understood it. I1 linked resilience to recovery, and “recovery was the time in which we stopped looking backwards at the disaster and everything that has unfolded since the disaster and started looking forwards to the future” (I1, December 2021). Whereas I4 recognises resilience in “the much more overt recognition of the relationship between the human and more than human” (I4, January 2022). I7 linked resilience to his cultural world view.

“The ability adapt and be agile in our adaption to our environment […] that when you peel them all back, they are on the most part, they are a lot of what I call the tanga values within Māoridom, whanaungatanga [Whānau and community togetherness], rangatiratanga [chieftainship, self-determination, leadership], manaakitanga [extension of charity and hospitality to others], all those words that end in tanga” (I7).
The differences in these expressions of resilience tie back to the individuals experience and world view.

4.2.3. Natural and constructed wetlands

Perspectives on natural and constructed wetlands varied among interviewees. For some there is overlap, where the line between constructed and natural wetlands blurs.

I2 describes wetlands as “an incredibly complex network of things” (I2) and states that “over time what will be considered wetland is set to increase” (I2). The definition and understanding of the function of a wetland in an urban context is set to change, as the design and purpose of these constructed wetlands evolves. I5, who has an industry background, provides context for the idea that there is overlap between constructed and natural wetlands.

“So, while it's constructing new wetlands, in a lot of instances it's restoring, kind of restoring, historical wetlands. But also, it is a mix of both constructed wetlands and recreating wetlands in, I guess […] for instance, in Cashmere Valley, we've got two large detention structures. And so, within those detention structures we have done quite a lot of excavation and then, you know planted them out, […] not as treatment wetlands but more as flood detention wetlands so they're more akin to a natural wetland, kind of, and if you look at the Black Maps, that area was historically wetland” (I5).

I5’s approach is that yes, we are building wetlands, man-made devices, but they are primarily designed to function like natural wetlands in areas were historically there were once natural wetlands. So, although they are new devices, it is also akin to restoring the natural wetland space that once was there.

“The concept for the lower reaches of the Avon would be that you allow nature to do a lot of that itself, of course it is going to need a bit of a helping hand. But they are constructing as you say a lot of these basins around the cities, the stormwater basin, and things like that, those are fantastic. And even those that are manmade, eventually nature will take those as well” (I3).

Participants highlighted that even though we are constructing the devices, there is overlap with natural wetlands and that, over time nature will adapt these devices for its own purposes.
The purpose of constructed wetlands is traditionally for water quality management, as such, they have issues associated with water quality that are not necessarily present in natural wetlands.

“The stormwater quality wetland is a treatment plant [...] so, there was some misunderstanding about, well great you're creating a wetland, it'll be fantastic but it's actually it's a constructed stormwater treatment wetland. It's an urban constructed wetland with the water quality problems that come with it” (I1).

Wetlands can be seen as “*the liver of the river*” (I3). Natural or constructed they are seen by participants to serve a purpose in our environment. For I3, who comes from a non-technical background, they are “*first and foremost, and an amazing biodiversity structure*” (I3).

There is a perceived overlap between the functions of natural and constructed wetlands in providing primarily water quality treatment and spaces for native flora and fauna. However, constructed wetlands are seen by several participants to be managed spaces with a primary purpose and design whereas natural wetlands are less controlled. I2 considers constructed wetlands with “*this undertone of well it's only there because it's infrastructure and then the way that we manage infrastructure and the way that we manage ecosystems is very very different*” (I2).

4.3. Wetlands in urban spaces

Participants were asked to consider the role of wetlands in urban spaces. Responses predominantly focused on the benefits that wetland devices, and access to green space in general, provide. The devices can be multifunctional, providing multiple layers of benefits including diversifying habitats and improving social connection. The role of wetlands in a wider system was considered by five of the participants and two considered how management of wetland systems can influence their functionality.

Participants I1, I4, and I5, all referenced the multifunctionality of wetland spaces in their responses. I4 highlighted the point that “*if you construct a whole series of wetlands for some sort of natural hydrological purpose that doesn't mean that is all that they are for, they can be for amenity purposes, they can be for recreational purposes, they can be for ecological purposes*” (I4). I1 in contrast, raised the concern that although spaces have layers of functionality there is potential for conflict which may not be easily resolved.
“Is this a recreation site, is this a wetland with recreation qualities and ecological qualities and at what point do they conflict? There are multiple layers so the best way to look at, anything actually in the urban environment, any environment, is to look at it in layers and how they link together. The wetland is a classic example of how it actually can serve multiple purposes, or you can serve one purpose at the expense of another one” (I1).

The conflict between functions is also recognised by 15, who gave examples of existing basins. “Wigram basin was possibly one of the first sort of multi-functional facilities intentionally put in and it's good it's a site of ecological significance, but that does make it difficult for managing it as a stormwater facility” (I5). I5 works in the industry, in the design and implementation of wetlands and further emphasised the conflict with this anecdote.

“We try and make sure that our facilities have as many values as possible [...] The one that creates most conflict is recreation, and you know recreation versus ecology. A good example of that is a basin on Sparks Road which, well you know is a wetland and it's extremely popular in that area, a lot of people walk their dogs and so on. But it's not a park and it's not managed as a park, it’s a stormwater facility. But everyone treats it like a park which is what should happen, but the conflict between dogs and birds’ and other wildlife is quite high there. So, you know, that balance between providing recreation and green space for people to use versus more wild ecological areas is something that we do have to think through and manage. From a strictly ecological point of view, we probably wouldn’t want people there” (I5).

Five participants referred to the habitat space for native wildlife that wetlands provide and how that can benefit ecology and biodiversity within the city. I6 described wetlands as “incredible habitats for so many of our species” (I6). I7 connected to presence of healthy green space and wetlands to greater presence of native wildlife. “If you have green places and spaces and wetlands, waterways that are pristine, well maintained and things then naturally you are going to attract native flora and fauna” (I7). I1, I2, and I3 also referenced benefits to the ecology when considering the role of urban wetlands. I2 went a step further and suggested an indigenous forest ecosystem is necessary in the OARC, for ecological benefits but also to meet cultural obligations.

“I think the primary level of importance is for us to demonstrate that a forest ecosystem can be integrated in an urban setting in New Zealand and that it can be a
healthy indigenous system. I think it's particularly important in Christchurch because Christchurch really lacks a non-colonial identity and so I see it as a process of decolonization and meeting our obligations as treaty partners. Then there's obviously just the net benefits of biodiversity and healthy ecosystem functioning, provisioning of services and all those fundamental things” (I2).

Most of the participants recognised the role wetlands play in providing habitat for native flora and fauna in urban centres. However, some of the participants recognised that wetlands also provide a range of other services for the city. I1 referenced the multifunctionality of wetlands devices by repeating his reference to layers of understanding of a wetland device. These include “recreation, passive or reactive, ecology and those design elements, and mahinga kai, and cultural, and art, and all those all those other layers” (I1). I6 mentioned the water quality treatment outcomes. “Also, that stormwater treatment, holding onto heavy metals and [...] there’s kind of no downside to increasing wetland everywhere” (I6). Whereas I3 recognises the flood management benefits from the provision of green space in their area, “whenever we have a major rain event, we're not having flooding issues that we had in areas like St. Albans” (I3). I7 recognises the fundamental human connection to the environment and how “it is important to have green spaces and wetlands because it provides opportunities for people to reconnect to the environment and reconnect locally” (I7). The participants described a wide range of benefits, from water quality and quantity management to social connection and cultural layers. Each shows a different perspective on how wetlands fit into urban environments.

When considering the role of wetlands in the urban environment participants reflected on how the individual device fits into a wider network. “The wetland is just a small part of the puzzle” (I3). As I1 states, “if we talk about wetlands, about only wetlands you miss the fact that it's actually part of a larger system” (I1). I2, when considering the role of wetlands in the OARC, sees “an opportunity to design a functioning system that is an integral part of the landscape in every sense” (I2). I4 builds on this idea that a wetland device is only one piece of the puzzle and suggests that the benefits can be better understood when considering it in a system.

“Why is wetland green infrastructure important in a wider sense? I guess it depends how you think about the river corridor, the Ōtākaro Avon Red Zone, if you just look at it as an area that is 11 kilometres long and how many hectares, 600 I think, with a
line round it then obviously it's a really good opportunity to get all sorts of ecosystem benefits, which can be amenity based, they can be hydrologically based, they can be sort of buffer based for climate change purposes, all of those sorts of things. I think it would probably be more constructive to look at the river corridor as part of a much wider metropolitan area and think about the hydrological role that it can play in that sense, in the amenity role it could play citywide, and obviously in that sense it's extremely important as a way of managing water flows and flood hazard both from onshore and offshore” (I4).

I5 recognises the value that wetland and green space provide to the public by the lack of pushback they receive for developing these spaces.

“I think probably if we weren't doing it, it'd be questions as to you know why we're not doing it. But having said that I think people, it's more general in people wanting green space and realizing the importance of the facilities, the habitats, than maybe a specific push for them. But maybe if we weren't doing it, we might hear more about that” (I5)

Wetlands are perceived to have multiple roles within urban communities. Predominantly valued for their ability to connect people and nature, they are also recognised by the interviewees to support biodiversity, benefit water management strategies, and improve social connections. Interviewees also recognised the contribution of wetlands to the health of the wider Ōtautahi Christchurch blue-green space network.

4.4. Contribution to community resilience

The final question asked participants what role they perceived wetlands to play in contributing to or detracting from community resilience. The responses predominantly provided reasons for how wetlands in urban spaces can contribute to resilience. Most responses considered the role wetlands play in connecting people to nature, and the positive effect that may have on well-being and therefore resilience. Some participants commented on the infrastructure or physical component of resilience. However, there were a couple of comments that suggested that wetlands did not contribute to community resilience.

The social and mental wellbeing benefits from interaction with nature was a common theme in responses considering the role of wetlands in community resilience. I6 states, “part of resilience, I think for the community, is that nature is hugely supportive of humans. When
they go into it you know you feel better. That’s one of the huge pluses” (I6). I7 recognised wetlands as opportunities for provision of green space.

“Create a pathway for other native flora and fauna to make their way back into the city [...] like kereru, tui, and our local native butterflies, other insects, they are gonna come back into the city. And again, having those things present in and around us, it is just a good vibe, a good impact on people and society” (I7).

I3 considered the social benefits of the space that wetlands provide for people to come together. Restoration of blue-green spaces and planting days are an avenue for people to work together and build those connections that support resilience.

“Probably one of the biggest networks in Christchurch is the riparian groups and the environmental groups, different planting places and the community lead plantings and things like that [...] it’s a place and a mechanism for people to come together over something” (I3).

I2 builds on the concept that wetlands can contribute to social resilience by providing a space for people to unwind or engage in recreational activities.

“Community resilience in an anthropogenic context is something that builds social connections or enables people to step outside or move away from disturbances, whether that be a stressful day and you’ve gotta get some green soaking time in. That’s how wetlands support social resilience. Almost like they facilitate hobbies or interests which enable people to step out of the rat race. In reality that doesn’t really provide financial resilience or anything like that it's more of well-being, mental well-being [...] On a highly localised sort of scale, it provides a recreational space which promotes well-being, - that recreation might be sports, activities, or it might be hobbies, such as birding, insects, or nature play, or whatever. Then there's the sort of provisioning of services so it provides resilience from the infrastructure side of things, its carbon cycling, its seed and habitat and protection storm water and things and I think that all those things are really rolled into resilience” (I2).

Resilience from the infrastructure side of things, as stated by I2 in the quote above, was also mentioned by two other participants. I6 suggests that the OARC “has that built in resilience. Because you immediately have taken people out of that dangerous riverside zone. So that’s a great win” (I6). Although this is a less direct example of how wetlands can contribute to
resilience, it speaks to the idea that making space for wetlands can contribute to resilience by taking people out of dangerous spaces. I5 has a technical background and approached the concept of resilience from that perspective.

“Wetlands are sort of low height earth structures that are flexible […] they’re reasonably resilient to cope with shocks as opposed to more engineered structures which are more vulnerable to particularly like earthquake would be probably the main example. They're not very resilient possibly to rapidly changing water levels or […] so I think that's something to consider for sea level rise or the like and even though it's not rapid but in the last like century it's probably relatively rapid […] they handle floods and so on of course because that's what happens in nature is they will get flooded for a period and, as long as it's not for an extremely long period, they can generally survive” (I5).

As physical devices, they are resilient to many, but not all, shocks. However, as contributors to community resilience I5 was less convinced. “Constructed wetlands may be reasonably neutral in terms of benefit and because while they may be able to be a sink, they are also a source for some non-carbon dioxide gases (I5). This is framing resilience in terms of resilience to climate change. I4 in contrast sees making space for the more-than-human, for example providing wetlands and blue-green space, as a pathway for improving resilience. “I like to think of you know the prospects of 21st century city which is going to be more resilient in the face of multi hazards and more resilient in the face of climate change has to be one which makes much much more space for the more-than-human” (I4).

When considering how devices can contribute to resilience I1 suggests that “it's the way that you do it that counts because the wetland in itself is just a thing right?” (I1). Their focus is on the process and how wetlands are a tool in the process of building resilience.

“Wetlands, the red zone, the engagement processes that were used around the projects, they are the fundamental tools that we use to help support and build resilience or recovery or whatever is the context of what you're talking about, and they are … you know the rebuild itself that was is a tool to support recovery but it's not the recovery itself […] but it is the process by which you do it that supports or doesn't support recovery. And that's social, that's environmental, that's economic as well as cultural” (I1).
The participants each had a perceptive on the role wetlands play in community resilience. There is consensus that a connection to blue-green space is good for individual and collective wellbeing, and as a result will support our resilience. I7 sums up the relationship between people and the environment by reiterating “if we care for the environment it’s going to care for us” (I7).

4.5. Knowledge gaps and barriers

In each interview participants were given the opportunity to mention any barriers for implementation of constructed wetlands or gaps in existing knowledge. This section reviews the key barriers, including bureaucracy, funding, physical barriers, and a lack of awareness from the public. This discussion highlighted several knowledge gaps, where there is a lack of cultural awareness, reference data and practical guidance.

Three barriers raised by interviewees are bureaucracy, funding, and technical infrastructure related barriers. Bureaucracy was raised by I2, who observed that the “people that get to make the choices have typically been the people that have been in positions of power and hands off for the longest” (I2), which suggests that processes and approaches to design and implementation do not necessarily change, despite support from industry and the community. As I3 suggested, with local government, the aim is to foster resilience and “it’s not that they don’t know how, it’s that they don’t have the mechanism too because they’re a different beast.” (I3). Part of the bureaucracy challenge that was raised by a few of the participants was the Three Waters reform currently going through central government and what that may mean for the future of constructed wetland infrastructure. A second barrier is funding. “It's not so much money, as just the phasing of money” (I5). I2 supported this claiming, “it’s a lot of the times resourcing” (I2). I5 related the challenge with funding to bureaucracy, arguing that the structures within council mean that funds for ongoing operation and maintenance are difficult to obtain, and multifunctional devices, such as wetlands, are more expensive to maintain over time.

“Operational costs, so building multi-value facilities can have higher operational costs [...] it's relatively easier to get the funding to build something, it’s that much harder to get funding to maintain something. That's a sort of structural issue within councils, as to where that funding comes from. If you are building something you can borrow for that, if you are operating maintaining something it has to come from rates” (I5).
I5 also raises several physical barriers to investment in and construction of wetlands. These include “public concerns around mosquitoes and security and shading from trees”, climate change and “issues around sea level rise and correspondent groundwater rise”, and a lack of space in brownfield areas as wetlands “are space intensive” (I5). The volume of work to complete these projects may also be a barrier. I4 emphasises “the immense amount of work that has to be done behind things that trip very easily off the tongue, it's not a simple process” (I4).

A fourth barrier raised by I3 and I6, who are both involved in local community groups, is the lack of connection or awareness from the public. “For some people green spaces are really really important they know it and they connect with, and they understand it. For a whole heap of people. They don't understand the importance of the green spaces to their wellbeing because they are not connected to it and stuff like that” (I3). I6 works with a local community organisation and is involved with communicating projects to the public. They shared the following thoughts.

“A real sort of communication deficit down there, where a lot of people simply cannot understand why they can’t have a wall that stops the ocean. Which I think they think will stop the ocean. Not understanding that the water would just come underneath. You can’t build a wall that goes down to bed rock. You know we are talking about miles down. So that’s been very interesting because they are thinking resilience is to have a big hard wall there but in fact it’s the opposite of what they need, and trying to communicate that has been kind of tricky” (I6).

I4 supports this idea by reflecting on past approaches to water management (from a colonial perspective). “People in the past, particularly in this country which has drained more of its wetlands that any other bar Holland, have been very threatened by water. So, you know there was good reason why what we now know as blue-green corridors used to be regarded with horror.” (I4). Working with public perceptions and public opinion requires education. As knowledge about the importance of wetland spaces, to the environment and to our well-being, grows there will be a change in how wetlands are perceived and used. Supporting this idea, I5 suggests “most people kind of recognize social benefit but there is a little bit of if it is directly affecting them then they can be less supportive” (I5).
Knowledge gaps were identified by participants in two areas. (1) A lack of cultural awareness and inclusivity and (2) a lack of data and reference information to support decision making. I7 considers the lack of Māori presence in Ōtautahi Christchurch in this anecdote.

“I remember coming back to Christchurch during the holidays and not seeing my world view in the design and layout of Christchurch. Whether that is you know walking down the main street or you know even going out to some of the wetland areas or even along the banks of the Avon, there was no sense of my cultural world view, well no expression of mana whenua really across the landscape and so in terms of what that looks like in a post-quake environment, I have been quite keen to look at ways in which we can put our cultural footprint on the city and try and bring a sense of, well basically instil our values within the landscape” (I7).

There is a need and an opportunity with wetland infrastructure and restoration to consider what I7 refers to as “the tanga values within Māoridom, whanaungatanga, rangatiratanga, manaakitanga, all those words that end in tanga, that quite often are not valued by mainstream New Zealand” (I7). This also extends to generational knowledge. As stated by I2, “the red zone lacks intelligent young people, I don’t mean that in discriminatory terms or anything like that, really the sector lacks youth engagement outside of anything other than community gardens” (I2). Knowledge in this space lacks inclusivity. It also lacks sufficient data to support current practises. I5 suggested a barrier can be a “lack of clear data to be able to make a strong case for why” (I5). I2’s challenge when it comes to knowledge is the reference system to use when designing wetland spaces.

“Really in terms of actual restoration there’s not a lot of reference systems and a part of that is, I believe, that systems that would be our reference systems were lost a long time ago. If you consider that New Zealand was 90% forest cover when Māori arrived, and Christchurch had a massive dunes system. What are we referencing against, the West Coast, the Catlin's? You know what are we aiming for? There is ambiguity about what these systems are actually going to look like” (I2).

Highlighting that ambiguity provides opportunity for further research. As I1 asks, “in terms of citizen science, ’cause I've been talking about building that resilience using blue-green infrastructure, then how do we how do that?” (I1).

Interviewees reflect that support and investment in wetland infrastructure is limited by bureaucracy, funding, and a lack of individual recognition of the value of blue-green space to
social and mental well-being. This is linked to knowledge gaps, where cultural values are missing from the current narrative and there is ambiguity in existing guidance on what a ‘good’ wetland may look like.

4.6. Summary

Interviewees were asked to reflect on the role they perceive constructed wetlands to play in urban communities. Motivations for investing time and energy into the restoration of urban blue-green space in the OARC and wider Ōtautahi Christchurch vary between across the interviewees. For the most part participants are motivated by a recognition of the value and importance of the natural world to human well-being, a desire to increase the presence of a cultural narrative, and a desire to create a safe future for the coming generations.

To understand the localised context of community and community resilience, and the role of wetland systems, participants were asked to consider their perception of three key concepts: community, community resilience, and natural and constructed wetlands.

- Community in the OARC was perceived as (1) cultural communities, (2) geographic communities, (3) recreational communities, and (4) communities of interest.
- Reflection on the underlying concepts of community resilience led to common themes of social connections and fundamental human values. Differences in expressions of resilience can relate back to an individual’s experience and world view.
- The functions of natural and constructed wetlands were perceived to overlap in providing primarily water quality treatment and spaces for native flora and fauna. However, several participants recognised constructed wetlands as managed spaces with a primary purpose and design, whereas natural wetlands are less controlled

Interviewees perceived wetlands to have multiple roles within urban neighbourhoods. Although primarily valued for their ability to connect people and nature, they are also recognised to support biodiversity, improve water management, and benefit social connectedness. These benefits are considered beneficial for individual and collective wellbeing. As such, there is consensus that community resilience is supported by a strong connection to nature. Essentially recognising a mutually beneficial relationship with the environment, “if we care for the environment it’s going to care for us” (I7).

Support for the investment in wetland infrastructure is perceived to be limited by bureaucracy, a lack of funding, and individual disconnect from blue-green space, and
associated benefits to social and mental well-being. Gaps in cultural knowledge and reference systems are also perceived as challenges to be overcome, to create wetland spaces that are widely beneficial and supported.
5. Discussion

5.1. Perceptions on the role of wetlands in urban spaces.

The role wetlands, and more specifically constructed wetlands, may play in urban spaces is closely linked to how they are valued by the community. This research connected with seven representatives of the community and industry to understand how they perceive wetlands to benefit community and underpin resilience. Wetland spaces were found to provide:

(1) Access to more diverse environments and ecosystems, including a greater number of native plants and birds
(2) Access to space for social connection and engagement

The participants interviewed are all actively engaged in the OARC or the development of urban blue-green spaces in Ōtautahi Christchurch. Another avenue to understanding how wetlands are valued by the community is to understand the motivations of those already engaged in the development of blue-green infrastructure in the OARC. The four main drivers for engaging in this field were found to be (1) a desire, and understanding of the need, to manage the environment sustainably, (2) returning a cultural narrative to community, (3) planning a strong foundation for future generations and (4) using the aftermath of the earthquakes as an opportunity to do things better. This section explores how these motivations are linked to how wetlands are valued, and what that means for the role wetlands may play in urban environments.

To understand the role wetlands may play in urban environments it is first necessary to understand how wetlands are perceived and defined. This includes understanding distinctions between the roles of constructed wetlands and natural wetlands. From the perspective of interviewees, a key distinction is that constructed wetlands are perceived as infrastructure, with a specific design or purpose, and are managed as such. Therefore, there may be conflict between the design purpose, i.e., water quality treatment or ecological system support, and how the public engage with the space, i.e., recreation. This is supported in literature by Alikhani et al. (2021, p. 7), who recognise that natural and constructed wetlands can “have significant differences in their intended use and functions”. Although natural wetlands can be used for treatment purposes, it may cause irreversible damage to the ecosystem of those wetlands. Constructed wetlands on the other hand can be designed for a treatment purpose, creating a sink for contaminants (Masi et al., 2018; Stefanakis, 2019; Zhang et al., 2020). It is interesting to note that two of the participants representing community organisations, I3 and
I6, did not draw a clear distinction between wetland types, and simply valued the spaces for the benefits they provide. Though this research focuses on constructed wetlands, it is important to recognise that these spaces are often perceived as natural wetland spaces by the public, as they are considered to provide the same outcomes. This may create conflict, as constructed wetlands that are managed as infrastructure may not meet standards for wildlife habitat and recreation desired by the community, while still meeting their primary design purpose (Zhang et al., 2020). It is therefore necessary that the community are engaged throughout the design and construction phases to ensure outcomes are achieved or at least understood. There will likely be a compromise in the outcomes and benefits achieved.

One of the main benefits that wetlands are perceived to provide is access to native flora and fauna in urban centres, introducing greater biodiversity and green space. In addition to the numerous benefits to ecosystem biodiversity, water quality, air quality and environmental health (Alikhani et al., 2021; European Commission, 2021; Haase, 2017), this is valued by participants as an opportunity for people to connect to nature. Participants are motivated by a desire to improve and protect natural environments in the urban space. This may be in response to challenges such as climate change, or simply a recognition of the detrimental impact that urbanisation is having on natural ecosystems. Wetlands are perceived as an avenue to do this, as they can create dedicated spaces for native birdlife, improve the quality of water entering waterways, and improve the biodiversity of present ecosystems (Clarkson et al., 2013; Stefanakis, 2019). Constructing new wetlands is also seen as a way to enable the environment to return, in a fashion, to its original state. As I5 recognised, Ōtautahi Christchurch was once predominantly covered in wetlands. This is reflected in the Black Maps (see figure 1-2, page 4), and “in a lot of instances it's restoring, kind of restoring, historical wetlands” (I5). Creating wetlands in the OARC is seen as an opportunity to reintroduce native species and create space for people to reconnect to nature and the history of the land.

The opportunity to reconnect people to nature, while also connecting socially, is also perceived as a primary benefit of wetland spaces. The Canterbury earthquake sequence triggered a change in the urban communities of Ōtautahi Christchurch. As I7 (2022) recognised, “the earthquakes demonstrated to the public of Canterbury that you can’t withstand the force of mother nature and so we had to be able to adapt to our environment”. In the aftermath of the earthquakes volunteer groups came together to regenerate and restore the OARC to a public space for all to use. This included advocating for nature-based
solutions and wetlands. As time has progressed the OARC has become a hub for volunteers to take ownership of space along the river corridor and for people to reconnect with nature. Sutton-Grier and Sandifer (2019), Reeves et al. (2021) and Zhai and Lange (2021) recognise a broad range of cultural ecosystem services provided by blue-green infrastructure. There include “recreation and leisure; aesthetic; spiritual; cultural heritage and identity; educational; inspirational; sense of place; social; scientific; and existence” (Sutton-Grier & Sandifer, 2019, p. 2). Interviewees recognised how access to good wetland spaces supports the inherent relationship between people and nature. The support for wetlands in the OARC is due to a recognition that they will provide spaces for people to interact with nature, recreationally, to learn from nature, through citizen science or nature play, and to connect with other people through volunteer work or shared appreciation of the space they are in.

Participants also appreciated the value of wetlands as part of a wider network of urban green spaces. Urbanisation and modification of natural wetlands and of green spaces in general has resulted in fragmentation or disconnection of green spaces. Participants recognised that, to quote participant I3, “the wetland is just a small part of the puzzle” (I3). A network of wetlands and blue-green spaces would create in effect a green highway for native species to be reintroduced into the urban fabric. Current approaches only consider the benefits an individual device may achieve for the neighbouring space, whereas considering the wider picture of Ōtautahi Christchurch when investing in constructed wetlands could multiply the benefits. Thorslund et al. (2017) call for a greater recognition of larger scales of wetlandscapes and the aggregated benefits of considering wetlands as interconnected with the landscape and wider catchment. This study shows that people actively engaged in blue-green infrastructure already acknowledge the value of a network of wetlands, or blue-green spaces, that provide pathways for native flora and fauna to re-enter urban centres. Approaching an area, such as the OARC, holistically provides a pathway to reconnect green spaces to the wider network and provide better access for residents. This is necessary to be able to capitalise on the benefits wetlands provide.

This research found that constructed wetlands are perceived to play a necessary role in the OARC. They provide avenues for people to reconnect with nature and each other, as well as teaching people about the history of the land by bringing back what was once present. It also plays a part in the wider city as it provides stepping-stones to increasing the accessibility of blue-green space for people and native species. This is beneficial to the health and wellbeing of communities and improves appreciation and care for our environment. Evidence collected
via this study reinforces the idea that access to wetland infrastructure in urban areas can contribute in important ways to community wellbeing.

5.2. (Re)defining community resilience in the Ōtākaro Avon River Corridor

A component of this research is understanding how community and community resilience are understood in the particular context of the OARC. As suggested in the literature (Le Dé et al., 2021; T. Robertson et al., 2021; Shimpo et al., 2019; Wilding, 2011), community resilience is a subjective term and contextually contingent, and it is appropriate to consider it in relation to the community, the history, knowledge, and cultural context in place. All these aspects influence how resilience is perceived, imagined, and understood. This section reflects on the diverse makeup of the OARC community, and how that contributes to community resilience. The term community resilience is perceived by many to be overly technical and academic, a buzzword used by bureaucrats, and as such not necessarily supported by community representatives. For this reason, this section also considers alternative ways in which a community’s response to disruption can be defined.

Community in the OARC is complex due in part to the history of the land. Discussion with key stakeholders revealed four dimensions of community: (1) cultural communities, (2) geographic communities, (3) recreational communities, and (4) communities of interest. This aligns with literature that recognises that several types of community are often present (Everett & Lamond, 2018; T. Robertson et al., 2021). It is therefore necessary for practitioners and decision makers to undertake a process of engagement to identify all parties affected, as argued by recent studies by articles by Everett et al. (2021) and Raymond et al. (2017). A process like this, as highlighted by the participants I1, I3 and I4, is not a simple or short process. It is relevant to reflect that the community in the OARC has shifted, “it’s not a community of place anymore, more of a community of interests” (I4). The community now predominantly consists of groups with a vested interest in the future of the river corridor focused on the role it plays in Ōtautahi Christchurch. This change in community will influence decision making in the OARC. As recognised by some of the participants, in the direct aftermath of the earthquakes there was significant engagement with residents and the people of Christchurch to understand priorities and desires for the river corridor (Orchard et al., 2018; Vallance & Tait, 2013). However, as time has progressed, and the community has changed there is loss of understanding of what community is actually present along the OARC. As the co-governance structure is put in place, it will be valuable for decision
makers to undertake ongoing engagement to reflect the current state of community in the river corridor.

Community resilience is highly contextual. As Le Dé et al. (2021) suggest, indicators for community resilience, as defined by communities, align with common indicators in the literature, (such as communication, spirituality, well-being, financial health, and social interactions) but vary in priority and expression. For the community representatives interviewed in this research, community resilience was linked very closely to the concept of social connectedness, with one participant defining ‘resilience as being connected’ (I3). Shimpo et al. (2019) support this concept, recognising that social connections and interactions in community garden suggesting that the community has a level of resilience, tied closely to strong social networks. networks in Ōtautahi Christchurch contribute to feelings of resilience. One of the participants (I3) gave an example of how the social networks established in the aftermath of the earthquakes enabled the community to respond quickly during the Covid-19 pandemic, suggesting that the community has a level of resilience, tied closely to strong social networks.

However, several of the participants disclosed a disconnect to the term “community resilience”. The phrase, stemming from academia, reflected (from the perspective of the participants) a bureaucratic and disengaged approach to community response to disruption. Cretney (2014) echoes this criticism of the use of ‘resilience’ as a way of justifying projects that are not necessarily supported by the wider community. Instead, participants approached resilience with their own frameworks, considering resilience as in the context of recovery, linking to a more overt relationship with the more-than-human, or peeling back the layers of terminology to consider basic human values. I7 reflected on the Indigenous values, “the tanga values within Māoridom, whanaungatanga, rangatiratanga, manaakitanga, all those words that end in tanga”, that relate to the ability of a community to adapt to the changes in the environment. The values link to values of community connection, self-determination, leadership, and the extension of charity and hospitality towards others. This is a reiteration of the indicators introduced by Le Dé et al. (2021), however expressed with a cultural lens, reinforcing the idea that resilience is linked to an individual’s experience and world view. A common theme in the expression of community resilience, from participants in this research, is the recognition of the role social connectedness.

5.3. How can wetlands build community resilience?
Wetlands provide a way for people to connect with nature. Access to blue-green space is recognised in literature to provide a range of social-cultural benefits, including recreation, physical and mental well-being, and cultural provisioning services (Alikhani et al., 2021; Reeves et al., 2021; Stefanakis, 2019; Sutton-Grier & Sandifer, 2019). Participants in this study recognised that wetlands can contribute to community resilience in these ways. Most of the participants reflected on the connection between wetlands and social and mental wellbeing, with a few raising cultural wellbeing and infrastructure as components of community resilience.

A common thread in this research suggests that access to wetlands spaces provides co-benefits for mental and social well-being, which in turn has a positive influence on the resilience of the community. Constructed wetlands may contribute to resilience through facilitating access to nature. It suggests that “nature is hugely supportive of humans” and that it has direct impacts on wellbeing that improve community resilience. Access to green space is well documented to have positive influences on the well-being of people and communities (Alves et al., 2018; Bertram & Rehdanz, 2015; Sutton-Grier & Sandifer, 2019). It provides a space for people to step away from routine, facilitating hobbies and enabling individuals to destress and reconnect with themselves and social networks (I2). Although the focus is generally on the benefits of access, there is also a recognition that inequity, in access to wetland space and blue-green infrastructure, may detract from resilience (Calderón-Argelich et al., 2021; Gerlak & Zuniga-Teran, 2020). It reflects that limited access to green infrastructure “impacts the people that lived here in the way they feel in the way that they sense of pride in their place and that kind of thing”. This links to previous discussion on the role of wetlands in the wider city network. Practitioners and decision makers should reflect on the equity of access, and actively engage with communities to connect the wider city network to the benefits of wetland infrastructure.

Social interactions encourage a sense of connection to people and place. Participants defined community resilience as being connected. In resilience literature, social connection is a core component of overall feelings of resilience (Aldrich, 2015; Le Dé et al., 2021; Wilding, 2011). Social connection is also referred to as social capital, or social networks that enhance resilience by enabling social interactions such as “local knowledge sharing, clear communication, social learning and people–place connections” (Carmen et al. 2022, pg 2.). Wetlands in the OARC are perceived to be a tool or mechanism potentially facilitating social connection, whether that be through working bees, community plantings, or meeting a friend.
for walk. It frames resilience as recovery, and the process by which people move forward hopefully rather than ruminate on past disruptions. Cretney (2018) reflects on the community-led recovery that occurred in the aftermath of the Canterbury earthquakes that recognised that although there was a general dissatisfaction with government-led recovery, community-facilitated movements fostered alternative pathways. This research indicates that wetland devices in the OARC are a “mechanism for people to come together over something” (I3) It follows then, that if wetlands are a mechanism or tool for engaging people and creating social connections, that they are also a tool for developing resilience in a community. Fundamentally this research shows that constructed wetlands are a blue-green infrastructure measure that can be used to facilitate recovery through creating connections between people and with nature. However, to maximise the benefits of constructed wetlands understanding of the community and ongoing commitment to community engagement is needed.

The participants in this research are actively engaged in conversations around recovery and resilience, and the importance of blue-green infrastructure to Ōtautahi Christchurch’s response to social and environmental challenges such as climate change. However, participants also acknowledge that there are people in the community who do not recognise the value of wetland infrastructure and access to blue-green spaces. People do not necessarily recognise the benefits, not only to wellbeing and social connection as previously discussed, but to cultural connections, infrastructure, and ecological networks. I2, I5, and I6 reflect that constructed wetlands have, to a certain degree, a built-in resilience. For instance, removing people from areas of risk (I6), and providing the provisioning, regulating, and habitat services that are recognised in literature as fundamental components of nature-based solutions applied to respond to disruption (Alves et al., 2018; Brillinger et al., 2021; Seddon et al., 2020). I7 sums it up efficiently: “If we care for the environment, it will care for us.” This requires a pathway for education and knowledge sharing. Constructed wetlands, by facilitating space for communities, promote learning about nature and the challenges and solutions needed to adapt to climate change. There is an opportunity in this space for citizen science to engage the public in exploring the value of wetlands in community adaptation to climate change.

The cultural connection to green space, is a narrative that does not appear as strongly in the urban environments of Ōtautahi Christchurch. Tangata whenua have a strong appreciation of the inherent relationship between the environment and people (Manaaki Whenua – Landcare Research & Waikato Raupatu River Trust, 2017; Walker, Wehi, Nelson, Beggs, & Whaanga, 2019). When considering the narrative of constructed wetlands in urban places and their
contribution to resilience. I7 returns to a cultural world view, recognising a “mutually
beneficial” relationship between the environment and people. Repo (wetlands) are “reservoirs
for mātauranga (knowledge), wellbeing, and utilisation” (Manaaki Whenua – Landcare
Research & Waikato Raupatu River Trust, 2017, p. 1). The value of wetlands and regard for
their importance is a narrative that should be incorporated into the wider conversation around
blue-green infrastructure. An inherently New Zealand approach, incorporation of mātauranga
Māori concepts into decision making and planning for wetland spaces will consider the
history of knowledge and improve the quality of outcomes. In the interviews I2 recognised a
lack of well-documented reference systems as a barrier to implementation of new devices.
However, incorporating the generations of knowledge and history, from a Māori people’s
perspective is an opportunity to create reference systems that fill the gap.

This research highlights the role of constructed wetlands as tools to support community
resilience through processes of recovery, creating social connections and relationships with
nature. There are gaps in knowledge in the community, which limit recognition of the value
of wetlands in this space. However, these gaps provide an opportunity to incorporate
mātauranga Māori and engage with citizen science to build further connections between
people and nature. It is these connections that this study has highlighted as fundamental
to resilient communities in the OARC.

5.4. Limitations

Reflection on the design and outcomes of this study has highlighted potential constraints and
opportunities for further research.

Due to time constraints participants were identified using a snowball approach, initiated with
two key community representatives. The participants were purposefully selected for their
experience and active engagement in the OARC and the development of urban blue-green
spaces in Ōtautahi Christchurch. As such the number and diversity of participants was
limited, predominantly NZ European, with one exception. Participants could not define a
single community for the OARC, as such it would be valuable to interview a broader
definition of community, including those less actively engaged with urban wetlands, to
understand different perspectives.

Semi-structured interviews were deemed to be the most appropriate approach considering the
time frame and current COVID 19 restrictions. Interviews could be flexible, held in a location
or format that best suited the participant. However, as recognised in the literature, a mixed-
methods approach, using multiple avenues of inquiry, can provide the most rounded qualitative data set. This was not possible given the restrictions already mentioned, however future research could build on these initial interviews and engage with the wider community, to explore connections across temporal and spatial scales (at each stage of wetland development or across Ōtautahi Christchurch). Focus groups and surveys may be appropriate approaches to engaging with the community, recognising that community in the OARC is complex and multi-faceted.
6. Conclusion

Constructed wetlands are an example of blue-green infrastructure that can be used in urban community spaces to facilitate recovery and resilience. In the context of the OARC they may provide an opportunity to reconnect the public to nature and reintroduce native biodiversity into Ōtautahi Christchurch. It is important to recognise that constructed wetlands are often perceived as providing the same outcomes as natural wetland spaces by the public, and therefore a distinction between the types of wetlands present may not be made. Constructed wetlands, by creating space for communities, can facilitate learning about the challenges and solutions needed to adapt to climate change. This study endeavoured to understand the role of constructed wetlands in the context of community wellbeing and community resilience. Seven stakeholders from the community, industry, and academia, each with experience in blue-green infrastructure in the OARC, were interviewed to understand their unique perspective on community, community resilience, and constructed wetlands.

From the perspective of the community representatives, community resilience is linked to social capital. One participant defined ‘resilience as being connected’ (I3). There was a disconnect between interviewees and the term ‘community resilience’, as interviewees criticised the term as overly political and academic, used to justify projects that are not necessarily desirable to the public. Instead, interviewees reflected on the basic human values that support community responses to disruption linked to their individual cultural lenses and experiences. Strong social networks and a relationship with nature were emphasised as core components of a community’s ability to respond well and adapt to disruption.

Constructed wetlands are therefore recognised as potentially contributing to community resilience by providing spaces for people to engage with each other and nature. This study reinforces the idea that access to wetland infrastructure in urban areas can contribute to community wellbeing, with participants and published research recognising the value of interacting with blue-green space for mental and social wellbeing. Support for investment into constructed wetlands in the OARC is therefore needed for the wider community to benefit. The OARC could provide an opportunity for citizen science and for the public to explore the value of wetlands in community adaptation to climate change.

This research has highlighted several avenues for further research. Research that seeks to build on this study should:
- Actively engage with community throughout the design, construction, and operation phases of a constructed wetland to explore perceptions and values at each stage, to provide a reference for future projects;
- Explore the broader inequities in access to blue-green space and how planning and policy decisions can influence perceptions of wellbeing and connectedness to nature;
- Consider a network of blue-green infrastructure. Explore what benefits for community resilience may be achieved through considering the wider network of blue-green infrastructure holistically (e.g., at a city scale or beyond); and
- Consider a wider concept of community, looking for approaches to engaging with people who are not currently actively engaged with urban wetlands, for a broader perspective

The Ōtākaro Living Laboratory Trust is invested in the future of the OARC, and therefore has an opportunity to use existing and planned constructed wetlands to establish citizen science and monitoring programmes that explore these avenues for further research. Interviewees established that reference systems and guidance for well designed and managed constructed wetlands are lacking. There is also an opportunity to incorporate mātauranga Māori, sharing the appreciation of the inherent and mutually beneficial relationship between the environment and people.

This study provided evidence that constructed wetlands are a valuable mechanism in connecting people to nature and each other, thereby supporting their ability to respond to and adapt to changes. With the challenge of climate change facing urban regions, investing in projects that can contribute to wider community resilience is a necessary consideration for practitioners and decision makers.
References


64


Appendices

A. University of Canterbury Human Research Ethics Committee approval, reference HEC 2021/96/LR
HUMAN ETHICS COMMITTEE
Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2021/96/LR

11 November 2021

Alison Bodmer
School of Earth and Environment
UNIVERSITY OF CANTERBURY

Dear Alison

Thank you for submitting your low risk application to the Human Ethics Committee for the research proposal titled “Connecting Blue-Green Infrastructure to Communities in the Ōtākaro Avon Red Zone: a Pathway for Community Resilience?”.

I am pleased to advise that this application has been reviewed and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 10th November 2021.

With best wishes for your project.

Yours sincerely

[Signature]

Dr Dean Sutherland
Chair, Human Ethics Committee
B. Interview prompts

Administration

- Request signed consent form
- Confirm verbal agreement to recording of interview

Interview prompts

1. Background and involvement with the Ōtākaro Avon River Corridor

2. Drivers for community engagement?
   a. What community did they engage with and how?

3. The future of the OARC. In the plans and proposed projects for the OARC there is a strong restoration focus/ nature-based solutions – why is that important going forward?

4. Understanding of what wetlands are, and what benefits you perceive there to be. Consider drivers to implementation of wetlands, particularly during the development of community plans, such as the Ōtākaro Avon Regeneration Plan and Christchurch City Council long term plans.

5. Barriers to investment in wetland infrastructure – what are the challenges with getting planners, government and councils and how have they responded to it?

6. Thoughts on the term community resilience and what that term may mean for the OARC.

7. The perceived role of wetlands in contributing to (or detracting from) community resilience