# HOW CAN DIFFERENT LAND USES INCREASE RESILIENCE WITHIN THE ŌTĀKARO-AVON RIVER CORRIDOR WHILST LIVING WITH WATER?

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# Table of Contents

# List of Figures



# List of Tables

## Abstract

Numerous effective flood mitigation land uses have been qualitatively evaluated on their success both internationally and in New Zealand. These land uses have been proven to provide co-benefits socially, economically and environmentally which brings ample socio-ecological wealth to areas which otherwise would be too vulnerable to urbanise. In the Residential Red Zone following the Canterbury Earthquake Sequence, a plan designed by Regenerate Christchurch including multiple land uses has also been evaluated via interviews and secondary data analysis of community engagement. COVID-19 has provided an unprecedented opportunity to fast track these plans thus rapid prioritisation of implementation is required. This research concludes that based on flood mitigation and increasing urban resilience post COVID- 19 the prioritisation of land uses should be ranked in the following order: community gardens, natural playgrounds, ecosanctuaries, recreational parks, wetlands and adaptable housing.


# 1 Introduction

Christchurch is situated on the east coast of the South Island in New Zealand. It's a low-lying coastal city built on the Waimakariri flood plain (Johnston et al., 2014). In 2010-2011 the Canterbury Earthquake Sequence (CES) devastated the natural and urban environments throughout Canterbury resulting in the loss of 185 lives (Christophersen et al., 2013). The CES caused significant urban damages within Christchurch CBD and what is now the Residential Red Zone (RRZ) (Figure 1). 15,000 families lost their homes, half of the city's roads needed repairs, 30% of the sewerage system was damaged and 8,000 families were permanently displaced, all contributing to over $40 billion NZD of repair and rebuild costs (Tonkin & Taylor, 2020).

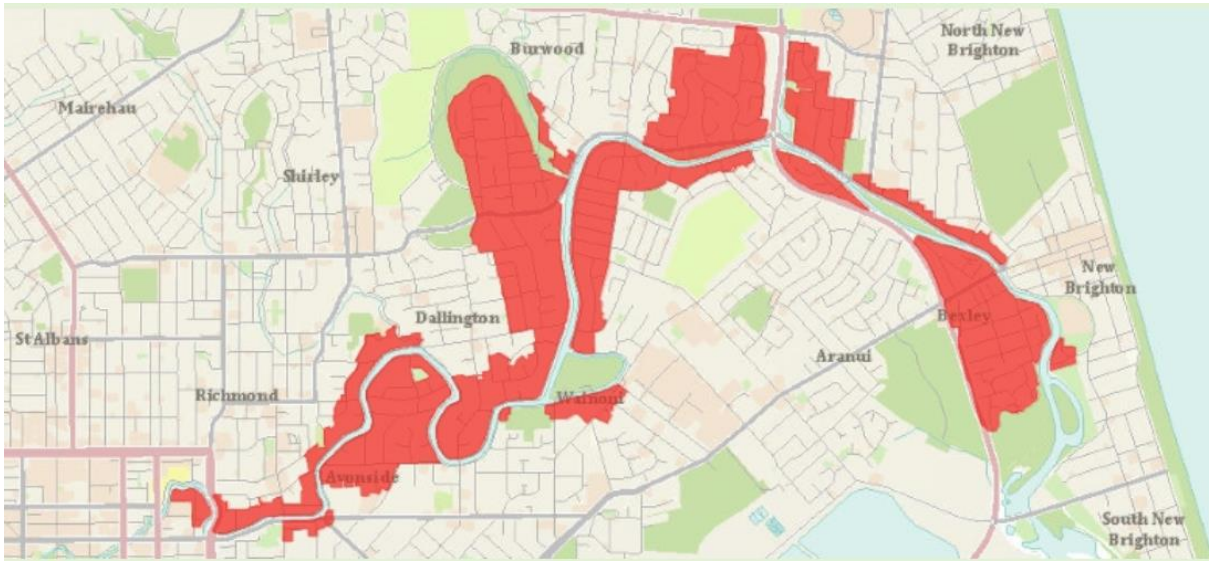


**Figure 1**- RRZ seen highlighted in red (Campbell et al., n.d)

There were also major changes to the landscape caused by subsidence, liquefaction and lateral spreading. It was found that areas within the RRZ, mostly near the Avon River had subsided over 1m (Tonkin & Taylor, 2014). Liquefaction was the principal cause for ground deformation on flat land (Van Ballegooy et al., 2014, as cited in Tonkin & Taylor, 2014), while lateral spreading resulted in the narrowing of waterways throughout the city and increased riverbed levels. These physical alterations caused decreased water capacity of the city's waterways, creating significant flood hazard implications, with an emphasis on fluvial flooding resulting in CERA forcing the demolition of thousands of homes within the RRZ (Department of the Prime Minister and Cabinet, 2019; Tonkin & Taylor, 2014). The RRZ faces significant flooding risks, however, climate change also poses the threat of increasing this risk through SLR. It has been predicted by Tonkin and Taylor (2013) that sea levels will have increased by 1m by 2115 producing further flood hazards for the area if no methods of mitigation are introduced.

Regenerate Christchurch was set up to introduce the Otakaro-Avon River Corridor (OARC) plan to the bare land of the RRZ (Figure 2), alongside other stakeholders as seen in Figure 3.

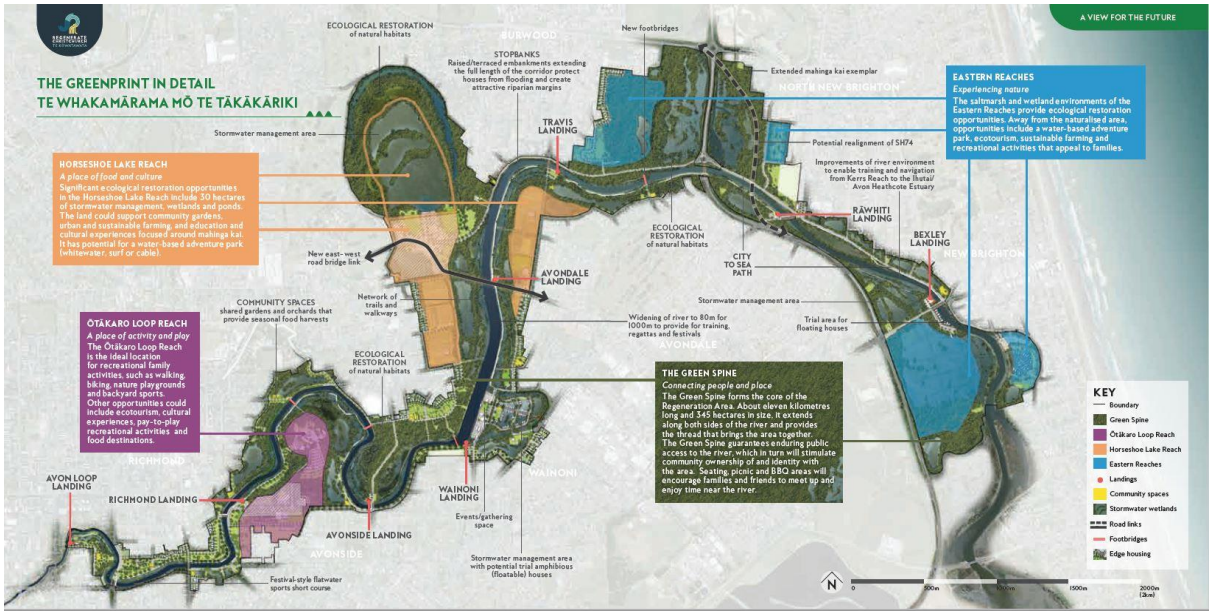


**Figure 2-** OARC plan (Regenerate Christchurch, 2019)

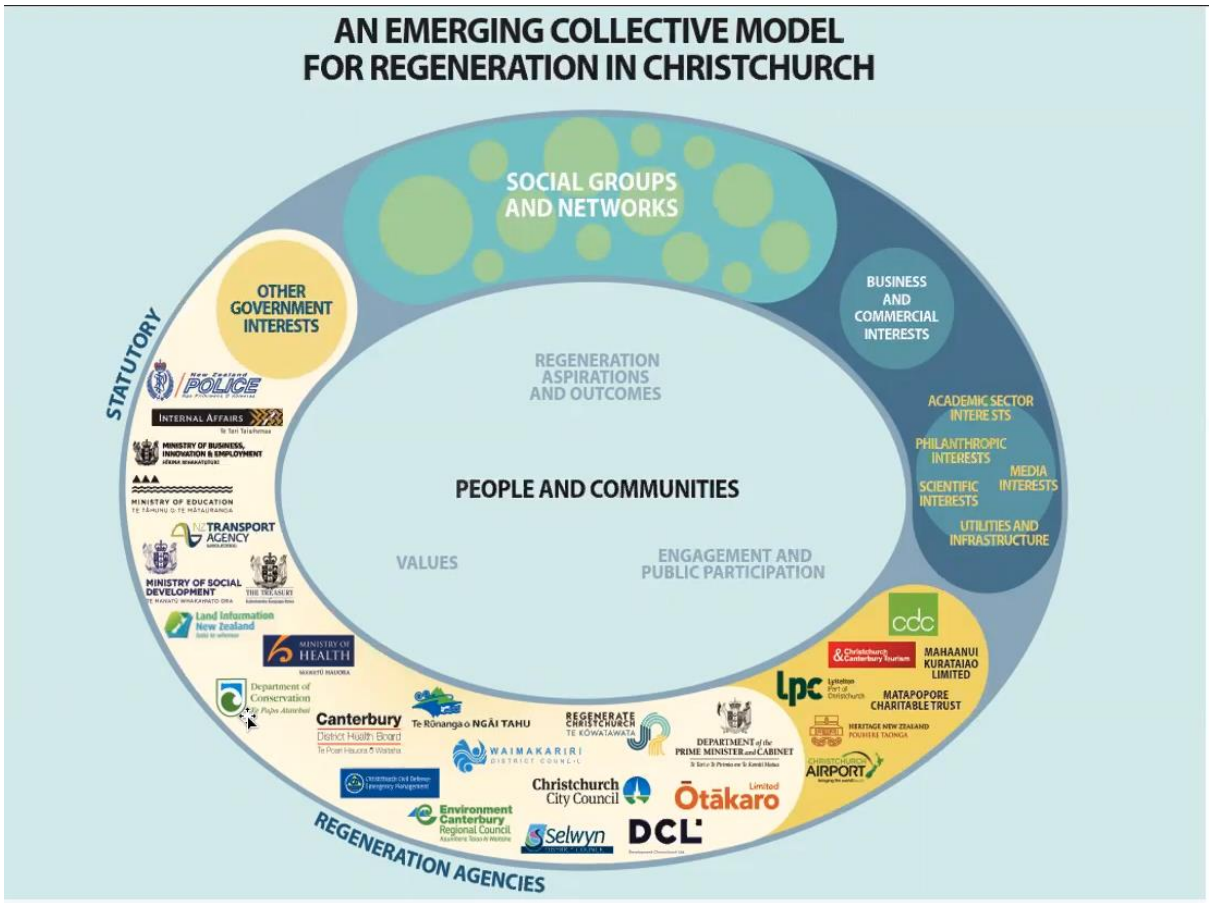


**Figure 3-** Agencies that were involved in the production of the OARC plan (C. Mene, personal communication, May 9th, 2020)

Wilson (2012) stated that to live with a hazard within an urban environment, the area and its people must achieve a strong state of resilience and enhanced adaptive capacity. Urban resilience has been defined as 'the capacity of any given system within a city to survive, adapt, and grow regardless of the stresses and shocks experienced' (Rockefeller Foundation, 2020). Wilson (2012) discusses the idea of the three capitals within society: economic, social and environmental. Masys (2015) states that these capitals can be managed to create a safe and resilient environment, while Wilson (2012) describes them as the glue that holds society together. Adaptive capacity is defined by Cutter et al (2008) as the ability of a system to adjust to change, moderate the effects and cope with disturbance. These terms can be employed to overcome the urban challenges associated with the RRZ, including but not limited to hazard management, environmental protection, societal and cultural needs, and economic gains.

There are many possibilities for how the OARC plan may be implemented and how these urban challenges can be faced, thus the question: "how can different land uses increase resilience within the OARC whilst living with water?" arose. The land use ideas this research will investigate include wetlands, ecosanctuaries, recreational spaces, community gardens and alternative housing. Questions that will be evaluated include:

- How do different land uses act to mitigate hazards and how do they increase resilience?
- How successful has the implementation of these land uses been globally?
- Are these viable options for the RRZ?
- How can these land uses be prioritised?

# 2 Literature Review

## 2.1 Blue/Green Infrastructure

Historically, flood mitigation methods have been centred around grey infrastructure such as stop-banks and underground drainage systems. However, these methods have been based on historical rainfall and flood events, meaning that these systems have been exceeded, and with the ever-changing climate they are likely to be exceeded again (Kim et al, 2016). Because of this, there have been multiple studies looking at the possibilities of nature and green infrastructure regarding the mitigation of flooding hazards. Nature can be utilised to provide amenities for communities by mitigating excessive heat and flooding or helping improve soil, water, and air quality (Karanikola et al., 2016). Green infrastructure is when nature is harnessed by people to provide an ecological framework for economic, social, and environmental health of the surroundings (Berte, 2014).

Urban green infrastructure encompasses parks, gardens, productive landscapes, green corridors and numerous other natural environments. These have been found to mitigate flooding hazards by increasing the infiltration rate which decreases both the speed and volume of peak flows produced by storms which commonly cause floods (Kim et al, 2016). Kim and Kim (2017) found that if implemented correctly, urban greenspaces in Beijing, China could successfully control 17% to 23% of the annual rainfall runoff. This displays the effectiveness of greenspaces in mitigating flooding risks. It was stated by Beatley and Newman (2013) that cities with extensive networks of parks and greenspaces are likely to cope with the impacts of climate change better than those with large amounts of impervious surfaces.

**Figure 4-** Sponge City China (Young, 2019)

## 2.2 River corridors

River corridors are defined as the area of land surrounding a river that allows for the necessary functions to maintain the stable or least erosive form of a river (University of Massachusetts, n.d.). There are multiple examples of the redevelopment of river corridors around the world, with one of the most compelling coming from Rome which holds multiple similarities to the OARC, due to the city being built on reclaimed wetlands. The River Tiber runs directly through Rome (Figure 5), however, the city is entirely disconnected from the river except for one instance, when it floods. This has left an estimated 250,000 people at a high flood risk from the river, one of the highest rates in Europe (Rockefeller Foundation, 2018). The similarities between the geologic histories of Rome and the OARC means that successful land uses in Rome could be effectively used within the OARC.

Rome is looking to increase the link between the community and the river through the implementation of parks and other greenspaces along the river (Rockefeller Foundation, 2018). This increases resilience to flooding hazards, with greenspaces being found to successfully mitigate flooding while also increasing community resilience through multiple health benefits and social ties which greatly decreases the recovery time following a disaster (Aldrich, 2012; Liu et al, 2014; Miller, 2020; Twohig-Bennet & Jones, 2018). This approach has also been taken in multiple other river corridors, particularly Bangkok and Vermont, however, Vermont has a significant focus on ecological restoration as well as the mitigation of hazards (Rockefeller Foundation, 2017; Agency of Natural Resources; 2010).

**Figure 5-** Green Corridor at River Tiber in Rome (Source: Footage Framepool)

This shows the opportunities for Christchurch, specifically the RRZ, to increase resilience to flooding hazards whilst still being able to live with water. This is through the implementation of the OARC plan; however, the question comes down to the priority of methods. This is now an important issue as funding for shovel-ready projects is being fast-tracked, meaning these projects can now bypass the Resource Management Act (RMA) to stimulate the economy following COVID-19 (Radio New Zealand, 2020; Spin Off, 2020). This report will attempt to fill the gap of what segments of the plan should be prioritised and why in relation to enabling Christchurch to better live with water and increasing resilience post COVID-19.

# 3 Methodology

A mixed methodology approach was utilised to gather both primary and secondary data on how communities can increase their resilience to hazards whilst living with water, in relevance to the OARC.

## 3.1 Literature Review

A literature review regarding global use of blue green infrastructure was undertaken. This method of secondary data analysis provided a suitable approach to analyse significant amounts of qualitative data gathered from peer reviewed literature (Creswell, 2014). The purpose of this was to gain an understanding of how different blue green infrastructures implemented in similar environments globally act to mitigate hazards and increase resilience (Creswell, 2014). The strengths and weaknesses were also sought out, providing evidence for the prioritisation of land uses.

## 3.2 Interviews

Unstructured interviews were undertaken with a mixed approach of both open and closed questions. The interviews were carried out with specialists Chris Mene (GM Partnerships and Engagement of Regenerate Christchurch) and Chrissie Williams (Independent Chair of Red Zone Transformational Land Use Consultative Group) along with frequent discussions with Eric Pawson (who has also worked within the OARC). These interviews will help address the research questions of the viability of blue green infrastructure in the RRZ and in particular the prioritisation of land uses, as it gives expert opinions on what determines the acceptance of events which will help to put into context what should be a priority. Interviews were chosen over surveys as it was more beneficial to get expert information to gain a deeper understanding of land uses in the OARC opposed to surveys which are used to obtain information regarding public opinion (Hay, 2016).

## 3.3 Analysis of prior community engagement efforts

Community engagement was undertaken by Regenerate Christchurch. They undertook two 1-month community feedback periods from March–May 2017 which gathered the opinions on the community's values of those living in the RRZ, resulting in 5569 responses (Regenerate Christchurch, 2017a). The other period of community feedback was held from October- November 2017 where members of the public were invited to give their opinion on 10 possible land uses for the OARC which gathered 1882 responses (Regenerate Christchurch, 2017b). The use of this data will help understand both the viability of land uses in the RRZ and what aspects of resilience need to be enhanced within the community. In turn helping to answer what land uses should be prioritised in the area.

The results from this have been analysed and collated into a table and a graph which calculated the number of community members supporting each land use using Excel for a reader friendly summary of results. This was deemed an appropriate approach given the restrictions associated with COVID-19, meaning no primary community engagement could be undertaken.

## 3.4 Prioritisation of land uses

This prioritisation of land uses will be based on a collective analysis of the global success of the land uses in mitigating flooding and increasing resilience obtained from the literature review, expert opinion on the viability of each land use in the RRZ gained via surveys and community engagement obtained by Regenerate Christchurch to provide an understanding of what the community wants in the OARC. This will provide an aggregate of the benefits that each land use can have in increasing community resilience and mitigating flood hazards within the OARC, the timeframe that the land uses will need to implement, and the community feedback obtained from

Regenerate Christchurch. This data will then be prioritised in relation to what would increase community resilience following COVID-19 and how Christchurch can better live with water.

### 3.5 Ethical obligations

The research undertaken factored in ethics in a social sense as it was for the residents, meaning that our research was morally driven (Boyd et al, 2008). Discussions were undertaken with people who had direct association to the area, or the area held value to them. Interviewees were asked prior to the interview if they consented with the interview being recorded. Ethical processes were also implemented when treating the community engagement data. Confidentiality of past participants was maintained meaning that nothing in the results can be linked back to an individual.

## 4 Discussion

It is important to note the difference between transitional and permanent land uses. Transitional land uses include community gardens, natural playgrounds and recreational parks. These create a sense of community whilst maintaining the land's original state. Permanent land uses would include the implementation of wetlands, ecosantuaries and sustainable housing, these will provide long term resilience. All of these land uses play varying roles in mitigating hazards while providing unique types of economic and social resilience to communities. These are highlighted in international case studies below, followed by an evaluation of their suitability for the OARC. They are presented in the order of prioritisation that is argued to be appropriate in relevance to enhancing community resilience and recovery following COVID-19 and allowing Christchurch to live with water.

### 4.1 Community Gardens

One use of greenspaces that has been found to significantly increase community resilience is the implementation of community gardens (Figure 6). It has been proven that community gardens provide multiple benefits for a community, including better health and nutrition, education on food production and the sustainability of the environment (Nursey-Bray et al, 2015). Community gardens have also proven to create social ties amongst the gardeners, with many stating that they would have struggled to create these ties without the garden (Brown, 2015). These social ties increase a community's resilience as it aids the recovery process following a disaster. Another benefit of a community garden is the role they play in providing food security, especially for those in deprived areas (Shimpo et al, 2019). This was evident in New York City following Hurricane Sandy in 2012, where community gardens played a significant role in the recovery process through the food produced along with the sense of community provided by these spaces (Chan et al, 2015).

**Figure 6-** Richmond Community gardens (Source: Canterbury Community Gardens Association)

The community engagement undertaken by Regenerate Christchurch as seen in Table 1 indicated that of the feedback given on productive land uses, 86.9% of it was positive while 3000 of the participants valued areas in which communities could connect (Regenerate Christchurch, 2017a; 2017b). Therefore, the implementation of community gardens is something that is part of the OARC plan, however, it has only been planned for the Horseshoe Lake Reaches (Regenerate Christchurch, 2019). While it's positive that community gardens have been planned, they are something that should be in each Reach due to their multiple benefits.

**Table 1-** Community opinion on the possible land uses for the OARC (Regenerate Christchurch, 2017a).

| Themes | Total | Breakdown: positive/negative |
|---|---|---|
| Ecological restoration | 48.6%<br>(906 comments) | All positive |
| Residential development | 36.7%<br>(685 comments) | Positive: 49.9% (342 comments)<br>Negative: 50.1% (343 comments) |
| Recreation | 33.1%<br>(617 comments) | All positive<br>*Note: feedback on recreation subthemes (ideas) was positive and negative* |
| Visitor attractions | 31.5%<br>(587 comments) | Positive: 96.3% (565 comments)<br>Negative: 3.7% (22 comments) |
| Productive land uses | 23.7%<br>(442 comments) | Positive: 86.9% (384 comments)<br>Negative: 13.1% (58 comments) |
| Process | 15.3%<br>(285 comments) | Positive: 50.5% (144 comments)<br>Negative: 49.5% (141 comments) |

The Ōtākaro Loop Reach is benefiting from community gardens as this is the busiest urban area of the three reaches which has been seen to be the most difficult area to create social ties, however, community gardens facilitate this (Figure 6) (Brown 2015). While the Eastern Reach would benefit from the increased food production and security, as the lack of produce shops in these areas when compared to the Ōtākaro Loop provides difficulties in obtaining fresh produce. It was also mentioned in the interview with Chrissie that two of the important factors determining the approval projects is how the project will support recovery and

regeneration objectives, and how the project links with and strengthens neighbouring communities (C. Williams, personal communication, May 12, 2020). Community gardens would support the recovery of Christchurch following COVID-19 by providing an area of social interaction and helping with food security while enabling Christchurch to better live with water due to the green transitional space they provide. Therefore, it was decided they should be the first priority within the OARC plan.

## 4.2 Nature-based playgrounds

Nature-based playgrounds have similar elements to traditional playgrounds, however, there is a focus on the use of natural materials including rocks, trees, sand and water (Figure 7) (Applin & Gentry, 2020). This encourages creativity, courage and engagement with nature in children, as well as providing the same benefits as 'traditional' playgrounds (Fjørtoft, 2001). These playgrounds are an example of where an urban green space can be multifunctional, therefore, not only benefiting the natural environment but also the social and economic capital of a place (Berte & Panagopoulos, 2014). Playgrounds increase social interaction and integration among neighbours increases resilience (Coley et al., 1997). Economic capital is also enhanced as the inclusion of parks and green spaces increases the monetary value of a community (Zuniga-Teran et al., 2020).

**Figure 7-** Example of a piece of equipment that could be used for nature-based playgrounds (Woods, 2016)

Nature-based playgrounds have been used in Collingwood, Canada, Norway and numerous other places globally (Bienenstock, 2013; Fjørtoft, 2001; Torkar, 2017). The issue of implementation these playgrounds have faced was health and safety consent. However, upon introduction there are numerous benefits measured which range from higher balance, IQ, and agility scores, while also helping psychological development (Bienenstock, 2013; Fjørtoft, 2001; Torkar, 2017). On top of these social benefits nature-based playgrounds are suitable for flood prone areas as there is no hard infrastructure to be damaged. Nature based playgrounds can adapt with the chronic stressors that climate change will bring and autonomously recover between flooding events (Sutton-Grier et al., 2015).

Nature based playgrounds would be suitable for the OARC as they are a greenspace where native plantings and natural infrastructure could be used to promote the wellbeing of children and communities. Ōtākaro translates to 'the place of game' (Woods, 2016) meaning natural playgrounds will help define the OARC. The engagement

of children with nature will promote their appreciation of the area and lead to Katiakatangita of the wetlands and river in the future, therefore, safeguarding one of Christchurch's biggest assets for years to come (Woods, 2016). Additionally, 3000 members of the community stated they wanted areas implemented in the OARC where communities could engage, as seen in Figure 8 (Regenerate Christchurch, 2017b). It was also mentioned in the interview with Chrissie that it's important for the approval of projects to not limit long term uses of the land while retaining the ability to return the land to its pre-use state, which are both key benefits of a natural playground (C. Williams, personal communication, May 12, 2020). As nature-based playgrounds can promote children's wellbeing post COVID-19 while enabling Christchurch to better live with water due to their flexibility in future adaptation of the land they occupy it was decided that their implementation should be the second priority within the OARC plan.

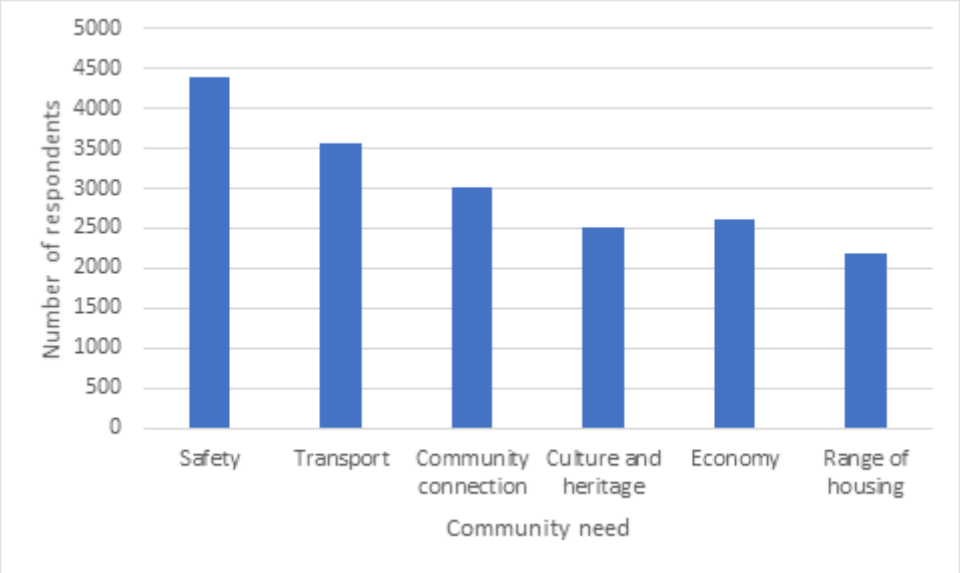


**Figure 8-** Number of respondents supporting each community need (Regenerate Christchurch, 2017b)

## 4.3 Ecosanctuaries

The definition of an ecosanctuary is a project larger than 25 ha that implements and protects native species with substantial community involvement (Innes et al., 2019). Ecosanctuaries are typically in controlled, sometimes fenced off areas that are actively managed and have minimal pests (Predator Free NZ, 2020). The best example of this is Wellington's Zealandia (Figure 9). Zealandia is the world's first fully fenced urban ecosanctuary, covering 225 ha with over twenty species of native wildlife reintroduced into the area (Zealandia, 2020). The empty fields of the RRZ present a perfect area for the installation of an ecosanctuary like that of Zealandia, creating the South Islands own urban ecological hub, which would greatly complement Christchurch's 'Garden City' brand, enhancing tourism while also providing a multi-use hazard buffer zone.

**Figure 9-** New Zealand example of an Eco sanctuary: Zealandia (Source: Wellington NZ)

There are many significant cultural relations, specifically in the Māori culture, where natural landscape are considered a medium, through a philosophy that acknowledges a system of environmental and resource management, celebrating guardianship and the relationship of environmental heritage, something that has been lost through urbanization (Innes et al., 2019; Marques et al, 2019). This is a critically important consideration in policy and planning throughout New Zealand.

In terms of introducing an ecosanctuary to the RRZ, a sanctuary with the foundation of native wetland would be relatively easy to implement as the RRZ land was originally wetlands (New Zealand Geographic, 2020). Regenerate Christchurch community engagement results indicated the support of the community with 100% of the 906 comments made regarding ecological restoration being positive while 96.3% of the 587 comments regarding visitor attractions also being positive (Regenerate Christchurch, 2017a: 2017b). The introduction of this idea is very practical for the OARC, and if implemented, it would increase the social, economic, and natural resilience of not just the OARC, but of wider Christchurch, which are all factors which determine the approval of projects (C. Williams, personal communication, May 12, 2020). It's for these reasons that it was decided that the implementation of a dedicated ecosanctuary should be the third priority within the OARC plan. It is the long timeframe estimated to implement an ecosanctuary which prohibits it from being a higher priority.

## 4.4 Recreational Parks

While greenspaces are extremely effective at increasing resilience through mitigating flooding hazards, they also contribute to social resilience within a community. This is through the multiple health benefits that have been linked to exposure to greenspaces, such as: reduced blood pressure, heart rate and reduced number of type II diabetes and a reported increase in mental wellbeing (Twohig-Bennet & Jones, 2018). This occurs as people are enticed to exercise more often resulting in an increased amount of people in the area interacting. This creates social ties within a neighbourhood which have been seen to significantly increase resilience as high levels of

social capital significantly help the recovery process following a disaster due to the benefits of strong social ties within the neighbourhood (Aldrich, 2012; Miller, 2020).

The idea of introducing parks and other recreational ideas is something that has been surveyed by Regenerate Christchurch (2017a) with all 617 comments provided being positive (Table 1). The implementation of this has already begun within the Ōtākaro Loop Reaches, with the introduction of football goals and rugby posts along the riverside, however further introduction of parks would be beneficial. While the RRZ is now vastly unpopulated, hosting events in these new parks could be extremely beneficial for those 8000 families who were displaced, as they would be able to maintain the community ties that were already in place (Regenerate Christchurch, 2019). This would also benefit wider Christchurch by providing low cost activities and social spaces for those in lower socio-economic areas. It was decided that the implementation of recreational parks should be the fourth priority within the OARC plan. It is not a higher priority as both community gardens and natural playgrounds increase resilience within the community whilst ecosanctuaries are better for hazard mitigation and ecological restoration.

## 4.5 Wetlands

Wetlands are defined as areas with water coverage at or near the soil surface for at least part of the year (EPA, 2018). Neri-Flores et al., (2019) stated that wetlands cost far less for a city to recover after natural hazard events than densely built-up urban areas. As well as the benefit of low-cost recovery, wetlands have many physical attributes that make them highly beneficial to both the environment and society. The benefits include increased well-being, air and water quality improvements, enhancement of natural habitats for native species and their flood mitigation ability (EPA, 2018; Zorrilla-Mirasa et al., 2014; Van Coppenolle & Temmerman., 2019), all of which are key factors in determining the approval of projects (C. Williams, personal communication, May 12, 2020). Wetlands act to lessen the impacts of flooding as they slow flood wave speed and store large quantities of water, thus increasing resilience to the hazard. (Acreman and Holden, as cited by Neri-Flores et al, 2019). However, wetlands must be well conserved or restored to their natural state, enabling them to successfully function as a natural flood defense (Barbier et al, 2011; Smolders et al, 2015; Spalding et al, 2014).

**Figure 10-** Travis Wetland (Source: Newsline)

Neri-Flores et al (2019) suggests that wetlands must be preserved around existing and growing cities, as they help prevent the loss of biodiversity under climate change. The implementation of wetlands and conservation of Travis Wetland could be extremely effective for flood mitigation and biodiversity protection for Christchurch City. The idea of implementing wetlands has proved popular within the community, with 906 positive comments regarding ecological restoration, as seen in Table 1 (Regenerate Christchurch, 2017a). Wetlands have been

decided to be fifth priority within the OARC plan. They are not ranked higher as ecosanctuaries provide the same benefits and the time and cost to implement wetlands would not result in any immediate benefits to Christchurch living with water or increasing resilience post COVID-19.

## 4.6 Housing

After the CES, there was an opportunity to rebuild more sustainable housing while accommodating the risk of future climate change to help those displaced from their homes (Bennett et al., 2014, p. 196). The CES removed a large portion of low-income housing which was previously available, particularly within the OARC which has seen a housing shortage for those of a lower socio-economic demographic (Bennett et al., 2014). The OARC plan assessed the possibility of implementing adaptable housing within the RRZ, which would hold multiple benefits, as the price of housing would likely be lower than average following COVID-19 (Corlet, 2020), allowing those who previously lived in the area the opportunity to return, while also creating multiple jobs. Due to the predicted sea level rise of up to 1m by 2115 (Tonkin & Taylor, 2013), the use of floating infrastructure is something that is being assessed and introduced globally. Successful examples of floating houses have been demonstrated in other cities in the world with a high risk of flooding. An example of this has been seen in the Netherlands, where the Ijburg district will accommodate 18,000 residential dwellings by building on the water. Several areas adopt the same idea of floating houses, such as Urban Rigger in Copenhagen and Hamburg (Urban Rigger, 2020).

**Figure 11-** Floating house in Copenhagen (Source: Detail Magazine)

A study conducted by the University of Washington suggests that an area within the Eastern Reaches, categorised as Bexley Landings may be suitable for developing floating houses (University of Washington, 2020). According to Chris, there was a definite appetite for experimentation with floating and adaptable housing within the OARC (C. Mene, personal communication, May 9th, 2020), however, only 39% of the public has been found to aspire to have a range and choice of housing infrastructures (Regenerate Christchurch, 2017b) . Additionally,

floating houses do not provide the wider ecological benefits that the other land uses provide thus they have been ranked sixth priority.

# 5 Limitations and Further research

Throughout this report, the group faced some limitations, with the obvious one being adapting to the ever-changing situation surrounding COVID-19. This provided challenges such as not being able to have group meetings in person, whilst also prohibiting the collection of any field data meaning that reliance on prior surveys was necessary. However, COVID-19 also provided challenges within the topic that was being researched as the governmental dynamic of the study area changed during this time. Further research could now be done on the assessment of other flood mitigation and adaptation methods and their respective costs that have not been analysed in this report and how these could be successfully implemented. Further research could also be done on these solutions from a different viewpoint, as they were assessed within this report from a geographical perspective meaning that those from different fields could find very different priorities than experienced here.

# 6 Conclusion

Throughout this research project an in-depth understanding and evaluation of land uses has been completed. The focus was to investigate what land use best helps Christchurch live with water whilst increasing resilience post COVID-19. This was answered by understanding what discussed land use most effectively increased resilience within the RRZ, while mitigating hazards and servicing both the natural and built environments. This information was gathered through a literature review which provided a background on how these methods have been implemented overseas, while interviews with specialists within the area provided ideas on how this could transfer over to the OARC. Based on the benefits provided by each land use, the time frame of each methods implementation and the community feedback gathered, it was decided that the implementation of the ideas should be prioritised as follows:

1. Community gardens
2. Natural playgrounds
3. Ecosanctuaries
4. Recreational parks
5. Wetlands
6. Adaptable housing

Despite this prioritisation the research completed indicates that all these land uses provide resilience and would enable the community to better live with water.

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