

SEISMIC-RESILIENT PUBLIC OPEN SPACE WITH MULTI-FUNCTIONS (AN EXAMINATION ON CENTRE CHRISTCHURCH) REGIONAL MAP 1:10000

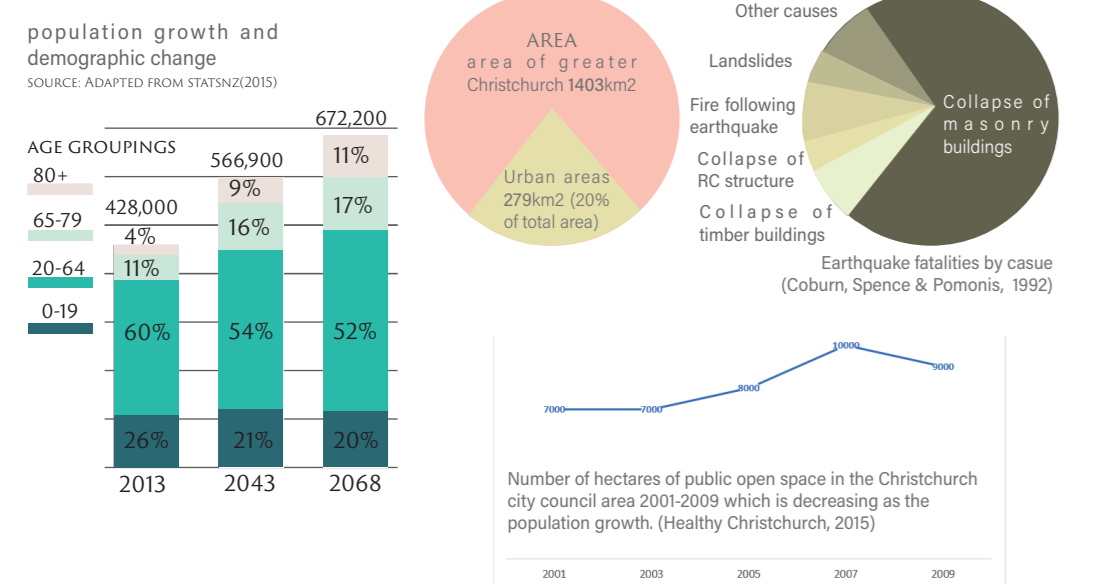


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Issue and opportunities

According to the Great Christchurch 2020 Plan, more residences are expected to live in the city center area with an increasing demand on public open space that is supposed to cater the various needs of people round the clock. Meanwhile, the experts predicted that a devastating earthquake that larger than magnitude 8 could happen on Alpine fault within 50 years. Therefore, to make Christchurch city resilient, I will investigate how to transform the existing urban context of Christchurch into an adaptive form to the potential earthquake, and seek to find the answer of how to make the people be mentally prepared for the earthquake.

As evidenced by the Great Hanshin-Awaji Earthquake (GHA), seismic-resilient parks suffered less damage than other infrastructures. Besides, the seismic-resilient parks provide space for temporary accommodation and even became the center of community resuscitation. Therefore, the park could become a media to preserve the inherent local culture, the nature of the ecosystem and social order, and at the same time act as a catalyst to catalyze the city's new post-disaster norms.

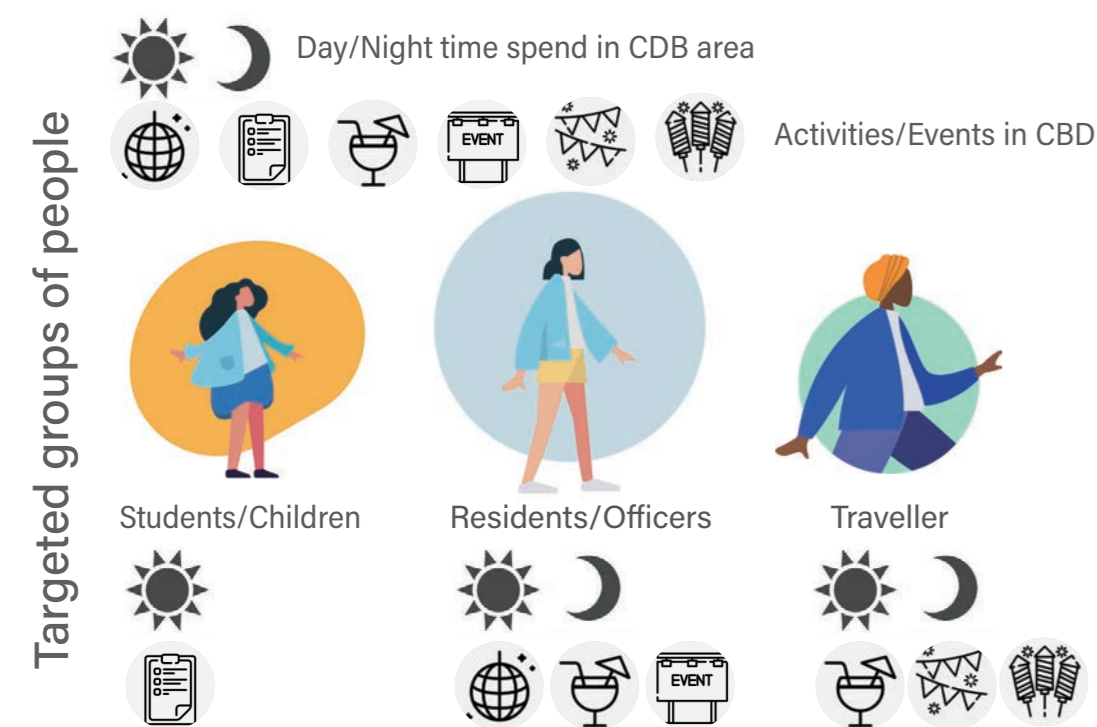


Design Vision

By integrating the existing public open space and fragmented void zones in the Christchurch city center, a park system is created to cater the various daily need of different people and also serves to earthquake prevention and evacuation purposes.

Goals

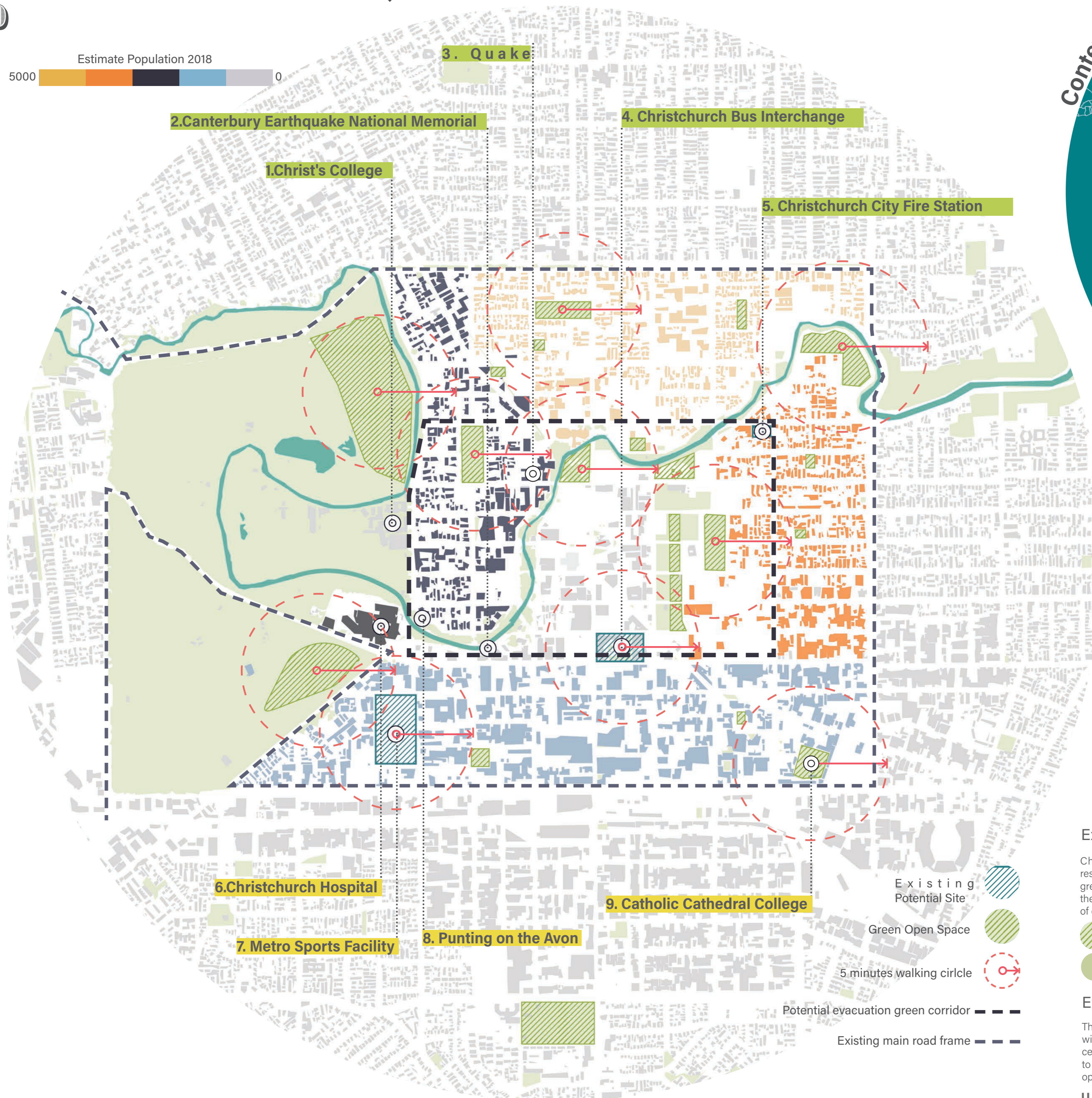
1. Improve the performance of existing public open space to cater the various needs of the local community.
2. Make the existing public open space seismic-resilient that serves not only to provide a safe space but also enhance the connectivity between urban fabric for better evacuation in an earthquake.
3. Increase the awareness of people towards an earthquake and make them mentally prepared.



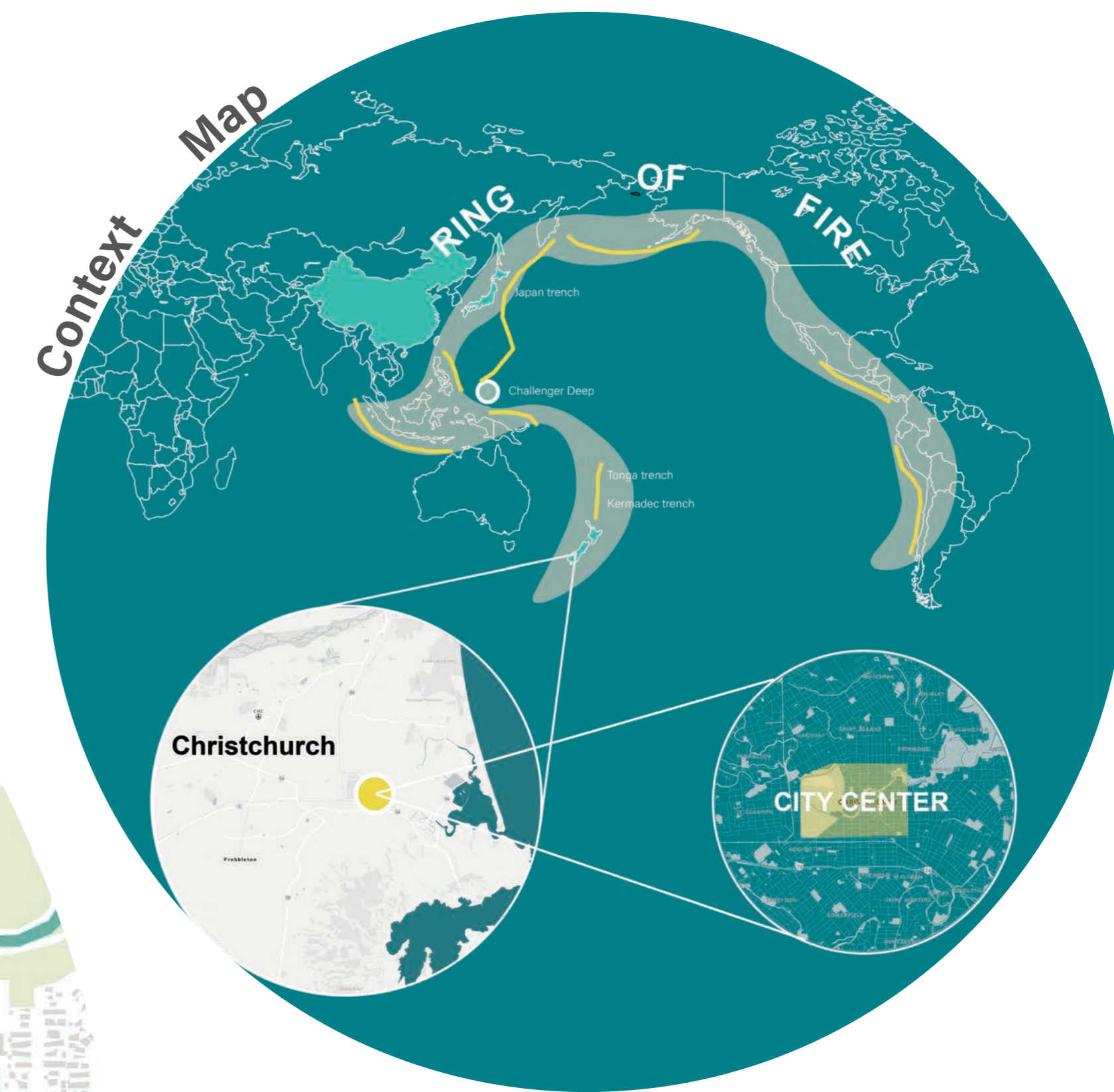
OBJECTIVES

1. Identifying and categorizing the existing public open spaces into four types that include Major urban park, Neighborhood park, Pocket park and greenway. The above four parks have different functioning scopes and catering to the different needs of the local community.
2. Design and install seismic-resilient facilities in the parks to provide temporary accommodation and supplies for the people.
3. Through planting different tree species and incorporate with signage to strengthen the connectivity between place to place and guide the people to seismic-resilient parks in an earthquake.
4. Creating a multifunctional use earthquake educational center for free visiting and dispersing relative knowledge, visitors can experience simulated earthquake movement by themselves to better understand the real condition.

Seismic resilient patterns of open space

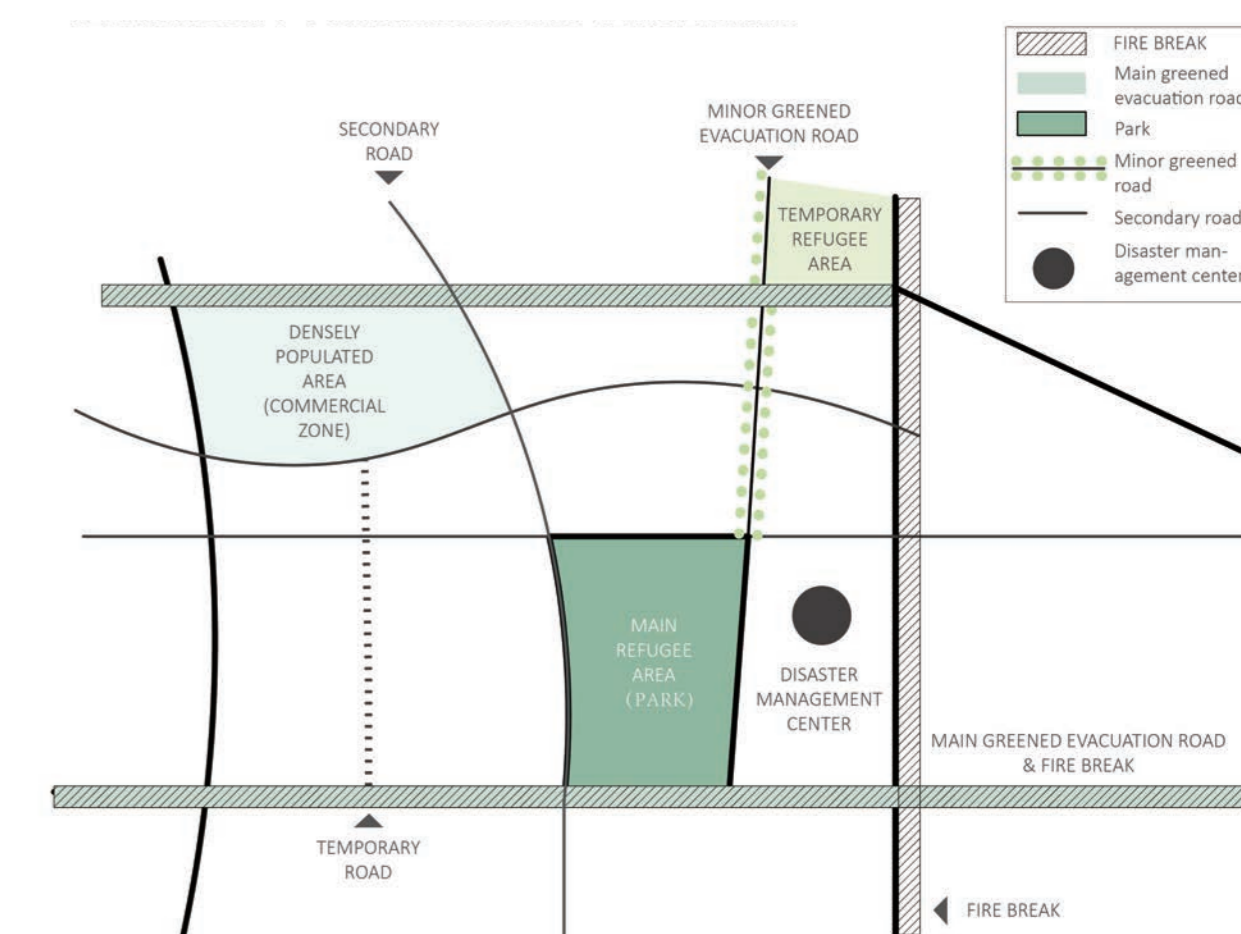


1. Christ's college
As one of secondary school in the city center, students have more opportunities to learn about disaster prevention knowledge through collaborative education both inside and outside the class.
2. Canterbury earthquake national memorial
The memorial is a place heroism, hope and loss from the 2010/2011 the Canterbury earthquakes. It explains the science Greater Christchurch forever and the phenomenon of which can be included liquefaction as one of visiting site in greenway frame.
3. Quake city
Quake City tells stories of earthquakes that changed the city. It explains the science of earthquakes and the phenomenon of which can be included liquefaction.
4. Bus Interchange
The Bus Interchange is the new, indoor bus exchange working mechanism, with the largest tertiary hospital in central Christchurch City, multiple crews working on in the South Island of located on the corner of a shift roster which can New Zealand. It treated Lichfield St and Colombo St which is close to the greenway frame.
5. City fire station
The station is a 24/7 crewed emergency in local area. last earthquake, and its To ensure the life safety of center location benefits high dense population in emergency transporting. city center.
6. Christchurch hospital
Christchurch Hospital is the largest tertiary hospital in central Christchurch City, multiple crews working on in the South Island of located on the corner of a shift roster which can New Zealand. It treated Lichfield St and Colombo St which is close to the greenway frame.
7. Metro sports facility
It will be the largest aquatic and indoor recreation small, flat-bottomed boat As a college and leisure venue in NZ, poled by a guide dressed in quite a large size of green accessible to people of all Edwardian clothing which is field is very suitable to be ages and abilities in regular close to the greenway frame used as temporary gathering condition. It also can be as well. Through adding spot serves for surrounding turned up into temporary jetties along the river to residents during emergency shelter during emergency expand sightseeing range phase. and also being used as water transportation
8. Punting in the Avon
Sightseeing rides in a College and leisure venue in NZ, poled by a guide dressed in quite a large size of green accessible to people of all Edwardian clothing which is field is very suitable to be ages and abilities in regular close to the greenway frame used as temporary gathering condition. It also can be as well. Through adding spot serves for surrounding turned up into temporary jetties along the river to residents during emergency shelter during emergency expand sightseeing range phase. and also being used as water transportation
9. Catholic Cathedral College
A college which has a large size of green accessible to people of all Edwardian clothing which is field is very suitable to be ages and abilities in regular close to the greenway frame used as temporary gathering condition. It also can be as well. Through adding spot serves for surrounding turned up into temporary jetties along the river to residents during emergency shelter during emergency expand sightseeing range phase. and also being used as water transportation



Planning for seismic resilient patterns of open space

(Ministry of Land, Infrastructure, Transport, and Tourism 2014b)



Existing green open space

Christchurch has plenty of green open space resources which included the different size of parks, green corridor and reserves. Also, some of them in the city centre is suitable to accommodate a variety of events or festivals

- Green open space holds event
- Existing green open space

Existing car & bus circulation

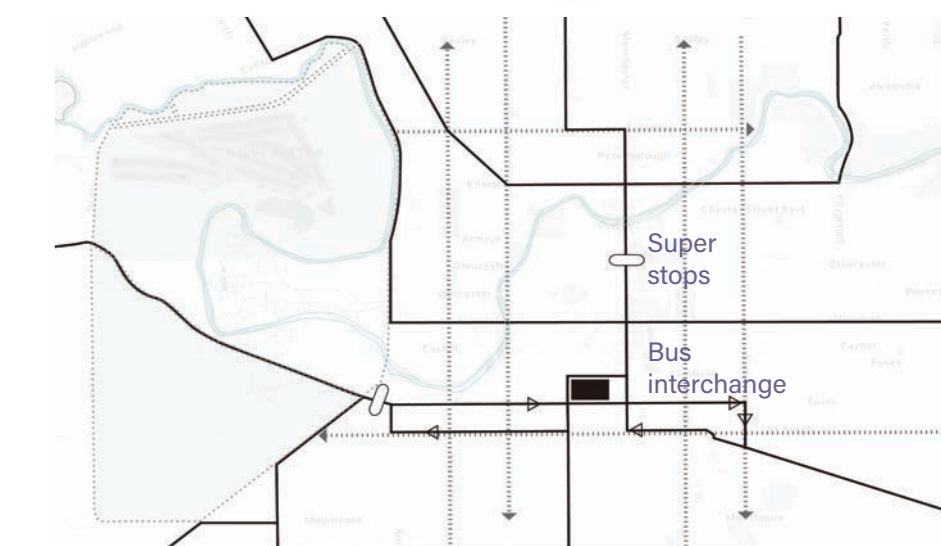
The public transport system is designed for dealing with future growth in population usage in the city centre. It will bring more people from other districts to centre area which increase the vitality of green open space day and night.

- One way road
- Public transport route

Existing walking & cycling circulation

Many existing walkway and cycling route are convenient for people such as tourists travelling around easily in the city centre from place to place.

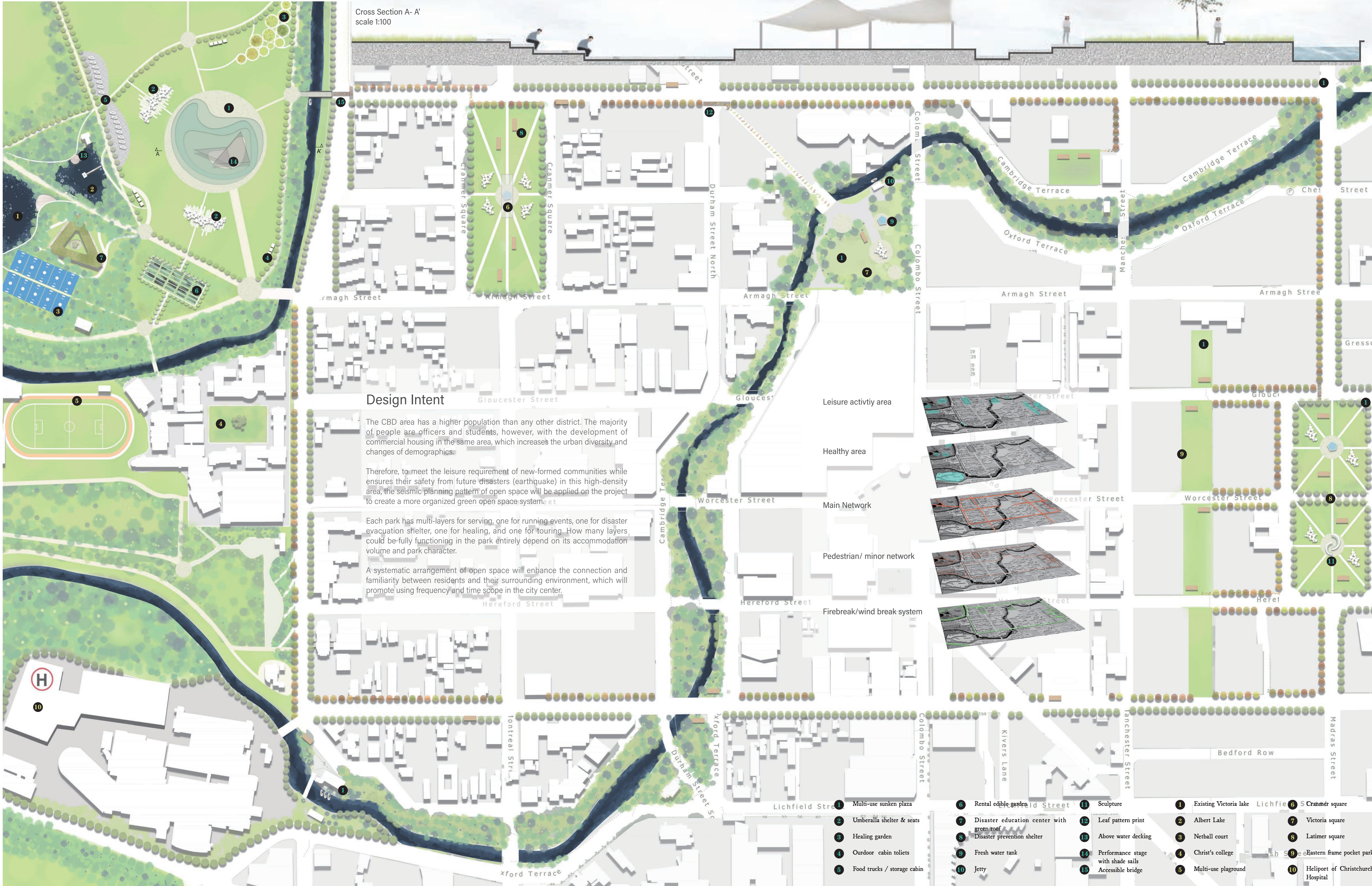
- Cycling routes
- Key walking links



SEISMIC-RESILIENT PUBLIC OPEN SPACE WITH MULTI-FUNCTIONS

(AN EXAMINATION ON CENTRE CHRISTCHURCH)

MASTER PLAN 1:2000



Cross Section A-A'
scale 1:100

Design Intent

The CBD area has a higher population than any other district. The majority of people are officers and students, however, with the development of commercial housing in the same area, which increases the urban diversity and changes of demographics.

Therefore, to meet the leisure requirement of new-formed communities while ensures their safety from future disasters (earthquake) in this high-density area, the seismic planning pattern of open space will be applied on the project to create a more organized green open space system.

Each park has multi-layers for serving, one for running events, one for disaster evacuation shelter, one for healing, and one for touring. How many layers could be fully functioning in the park entirely depend on its accommodation volume and park character.

A systematic arrangement of open space will enhance the connection and familiarity between residents and their surrounding environment, which will promote using frequency and time scope in the city center.

Leisure activity area

Healthy area

Main Network

Pedestrian/ minor network

Firebreak/wind break system

- 1 Multi-use sunken plaza
- 2 Umbrella shelter & seats
- 3 Healing garden
- 4 Outdoor cabin toilets
- 5 Food trucks / storage cabin
- 6 Rental edible garden
- 7 Disaster education center with green roof
- 8 Disaster prevention shelter
- 9 Fresh water tank
- 10 Jetty
- 11 Sculpture
- 12 Leaf pattern print
- 13 Above water decking
- 14 Performance stage with shade sails
- 15 Accessible bridge
- 1 Existing Victoria lake
- 2 Albert Lake
- 3 Netball court
- 4 Christ's college
- 5 Eastern frame pocket park
- 6 Multi-use playground
- 7 Victoria square
- 8 Latimer square
- 9 Eastern frame pocket park
- 10 Heliport of Christchurch Hospital

SEISMIC-RESILIENT PUBLIC OPEN SPACE WITH MULTI-FUNCTIONS

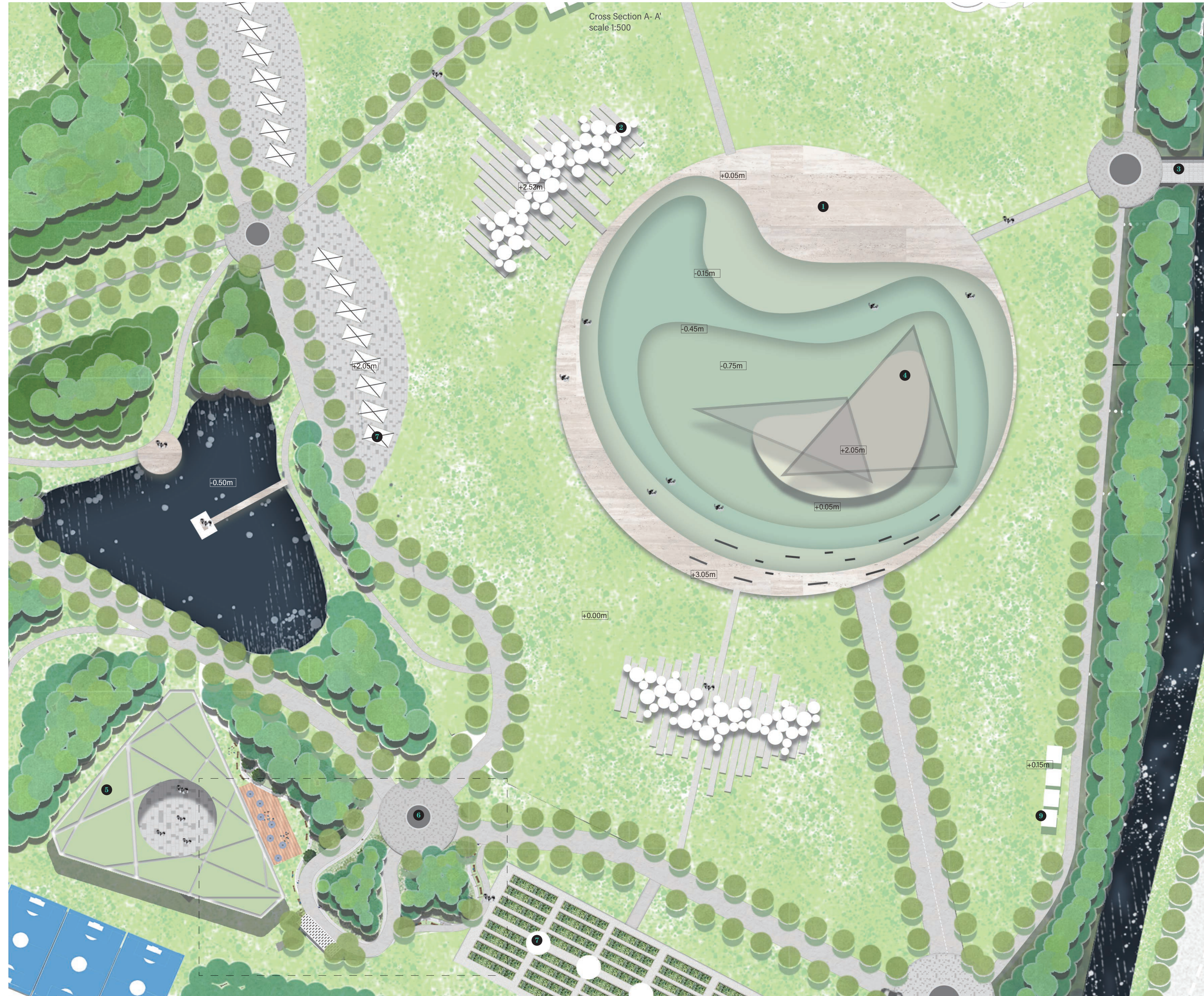
(AN EXAMINATION ON CENTRE CHRISTCHURCH)

INTERMEDIATE PLAN 1:500

- 1 Multi-use sunken plaza
- 2 Umbrella shelter & seats
- 3 Accessible bridge
- 4 Performance stage with shade sails
- 5 Disaster education center with green roof
- 6 Round about
- 7 Rental edible garden
- 8 Food trucks / storage cabin
- 9 Outdoor cabin toilets



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Design Intent

Hagley Park has most events and performances in all year round than the other parks in the city center, and it can accommodate a most significant amount of visitors at the same place for celebrating the festival.

Therefore, Hagley Park has been chosen as a significant designed area for further developing. The main thing in the park, firstly are the multi-functional used sunken plaza. Secondly, it is a disaster educational school and food truck corner.

The sunken designed plaza providing plenty of step seating at different levels and also placed the stage at the center of the plaza offers 360 angles broader views for better watching experience. Also, the layered circle shape reflects the history step that happened in the Christchurch in 2011.

These activities are all committed to attracting residents accessing into the park more frequently any time they like, which breaks the schedule of the city center. During the interaction processing, residents learn the disaster knowledge and preparation naturally.



Food trucks functioning at noodle festival
It can also be used as backup resources storage cabin if there is no event use.



Accessing bridge as the minor entrance from city to Hagley park.



Rental edible garden
Either residents or officers who working or living in the city center are able to rent one pod as their private garden. They can easily walk from home to garden maximum in 15 minutes and harvest the most fresh vegetables as daily cooking ingredients.

SEISMIC-RESILIENT PUBLIC OPEN SPACE WITH MULTI-FUNCTIONS

(AN EXAMINATION ON CENTRE CHRISTCHURCH)

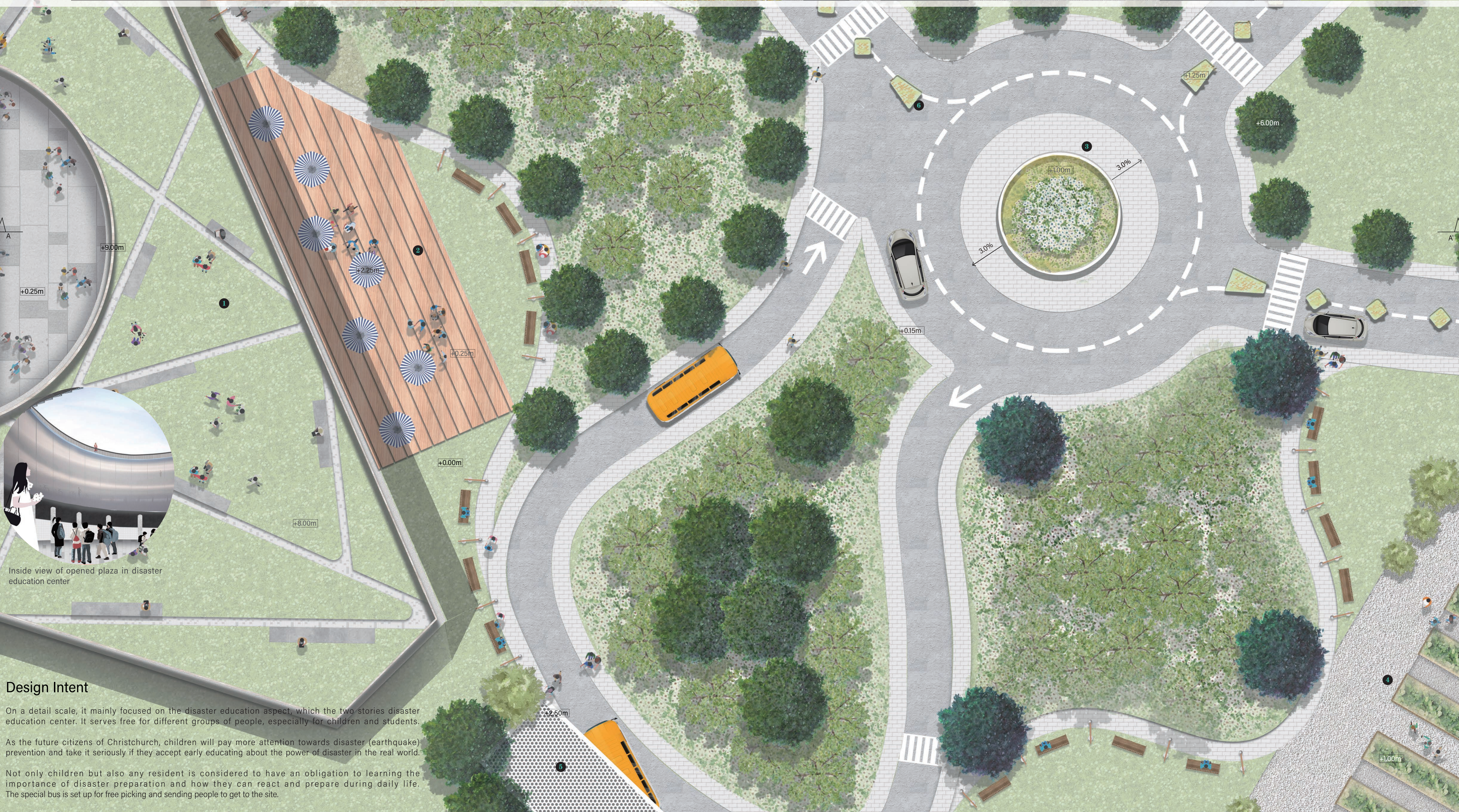
DETAIL PLAN 1:100

- 1 Disaster education center
- 2 Timber decking
- 3 Round about with flower bed
- 4 Rental edible garden
- 5 Touring bus stop
- 6 Isolation green belt



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Cross Section A-A'
scale 1:100



Design Intent

On a detail scale, it mainly focused on the disaster education aspect, which the two stories disaster education center. It serves free for different groups of people, especially for children and students.

As the future citizens of Christchurch, children will pay more attention towards disaster (earthquake) prevention and take it seriously if they accept early educating about the power of disaster in the real world.

Not only children but also any resident is considered to have an obligation to learning the importance of disaster preparation and how they can react and prepare during daily life. The special bus is set up for free picking and sending people to get to the site.

SEISMIC-RESILIENT PUBLIC OPEN SPACE WITH MULTI-FUNCTIONS

(AN EXAMINATION ON CENTRE CHRISTCHURCH)

MATERIAL STRATEGY



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Design Intent

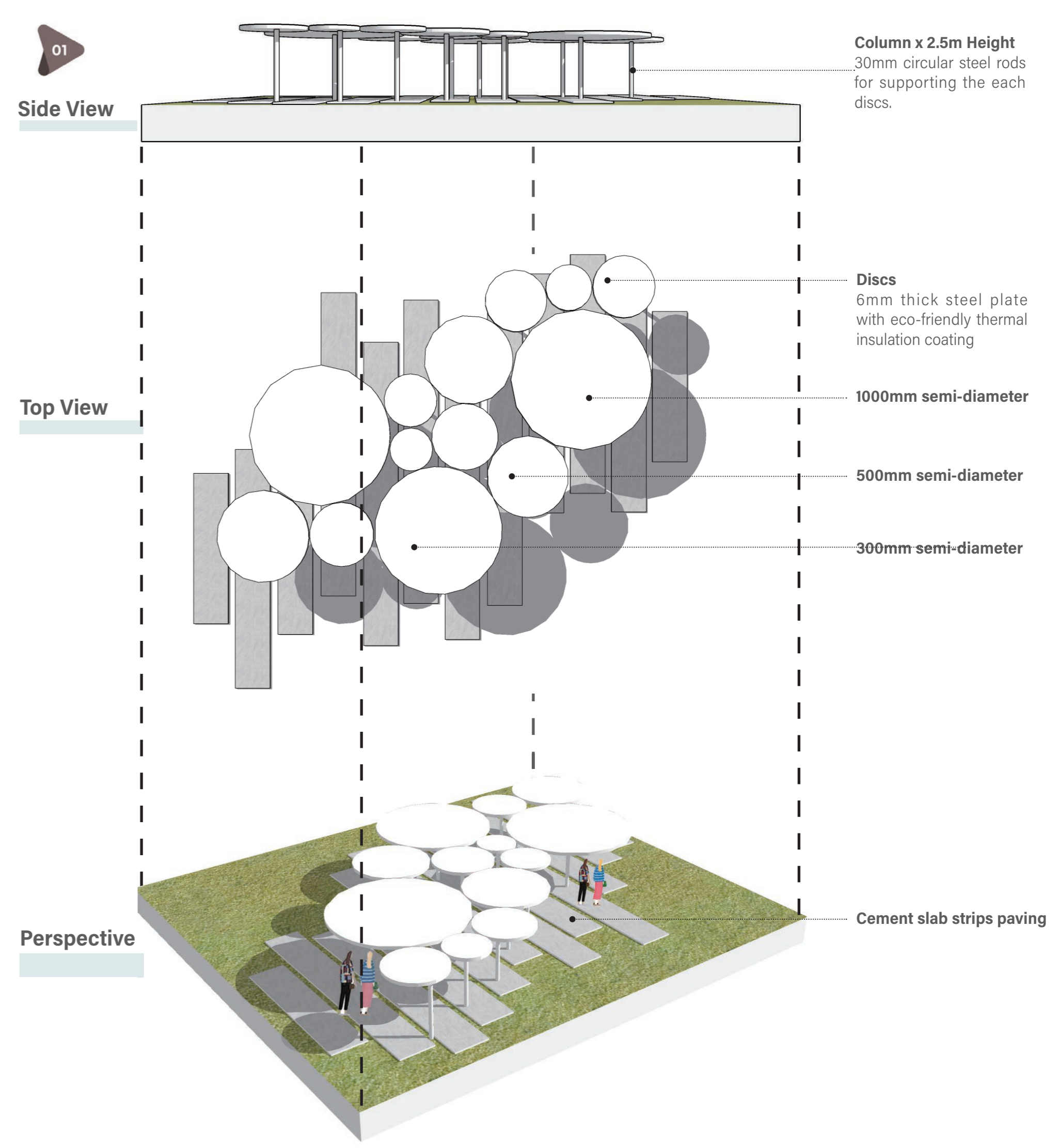
The city center of Christchurch has a rapid population growth that makes disaster preparation even more significant and urgent. To protect residences from a potential earthquake, material and structure are purposely designed to enhance the connectivity between the public open space and different people.

The material selection follows four principles. First, adapt to the existing environment. Second, catering the various need from both the residences and visitors. Third, balance the performance between the aspect of comfort and aesthetics. Fourth, memorial and abstract meaning are evoked through representative material.

Material Palette

	USE: Education center decking & Emergency shelter Light color and soft texture selection can provide a relatively warm and comfortable environment for visitors before enter the Earthquake education center.
	USE: Connective Bridge Attracting people's attention through dark red paving on accessing bridge from city to Hagley park.
	USE: Umbrella white shelter Applying white steel on whole structure of Umbrella shelter to create a simple and unified style. The white color makes the shelter stand out on the lawn but will not destroy the visual harmony.
	USE: Pathways and paving surface High tolerant but low-maintenance material for driving and walking requirements in public area (Hagley Park).
	USE: Paving of Umbrella Shelter Similar color with Umbrella shelter, but also offering comfortable walking and standing experience underneath the shelter.
	USE: Paving of emergency shelter which brings nature character into urban environment but also low maintenance and durable for public use.
	USE: Step Paving of Sunken Plaza Grey granite as the base layer, then randomly add some light blue blocks with various size to reflect the water feature in the city center.
	USE: Step Paving of Sunken Plaza Grey granite as the base layer, then randomly add some light green blocks with various size to reflect the parks feature in the city center.
	USE: Step Paving of Sunken Plaza Grey granite as the base layer, then randomly add some dark grey blocks with various size to reflect the human structure (buildings...) in the city center.
	USE: The reverse side of Umbrella shelter To encourage residents have more interaction in Hagley park (also the other parks in CBD area) through playing.
	USE: Reflection Mirror wall of sunken plaza Incompact arrangement of mirror strips along the sunken plaza edge which reflects the movement of sun, nature and people all the time.

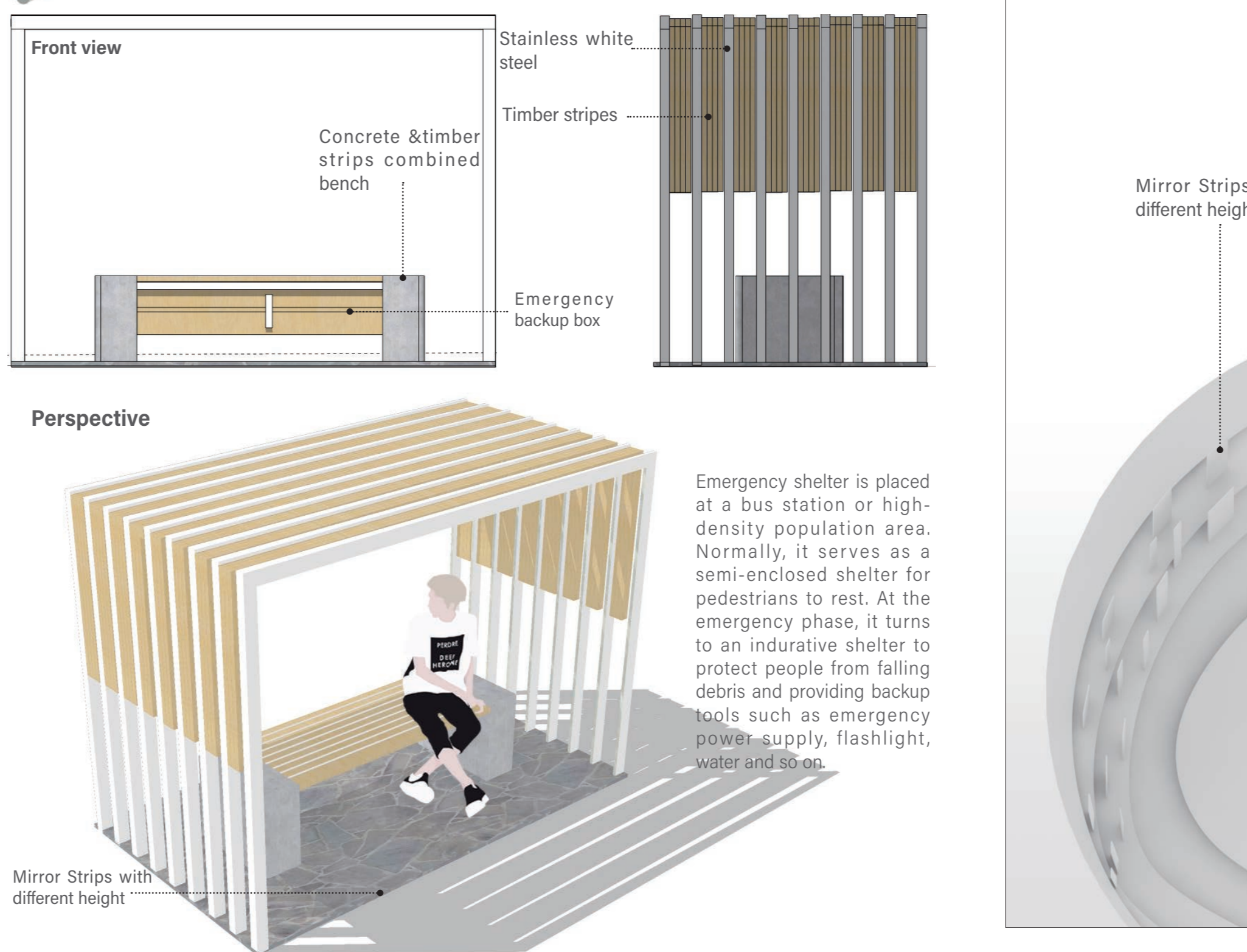
01 Umbrella White Shelter with Distorting Mirror
Semi-open shelter on the grass not only serves as a temporary shelter but also functions as an entertainment facility for children and tourists who are playing around in the park. Each reverse side of the disc has installed various type of distorting mirror that serves to increase interactivity between the site and visitors.



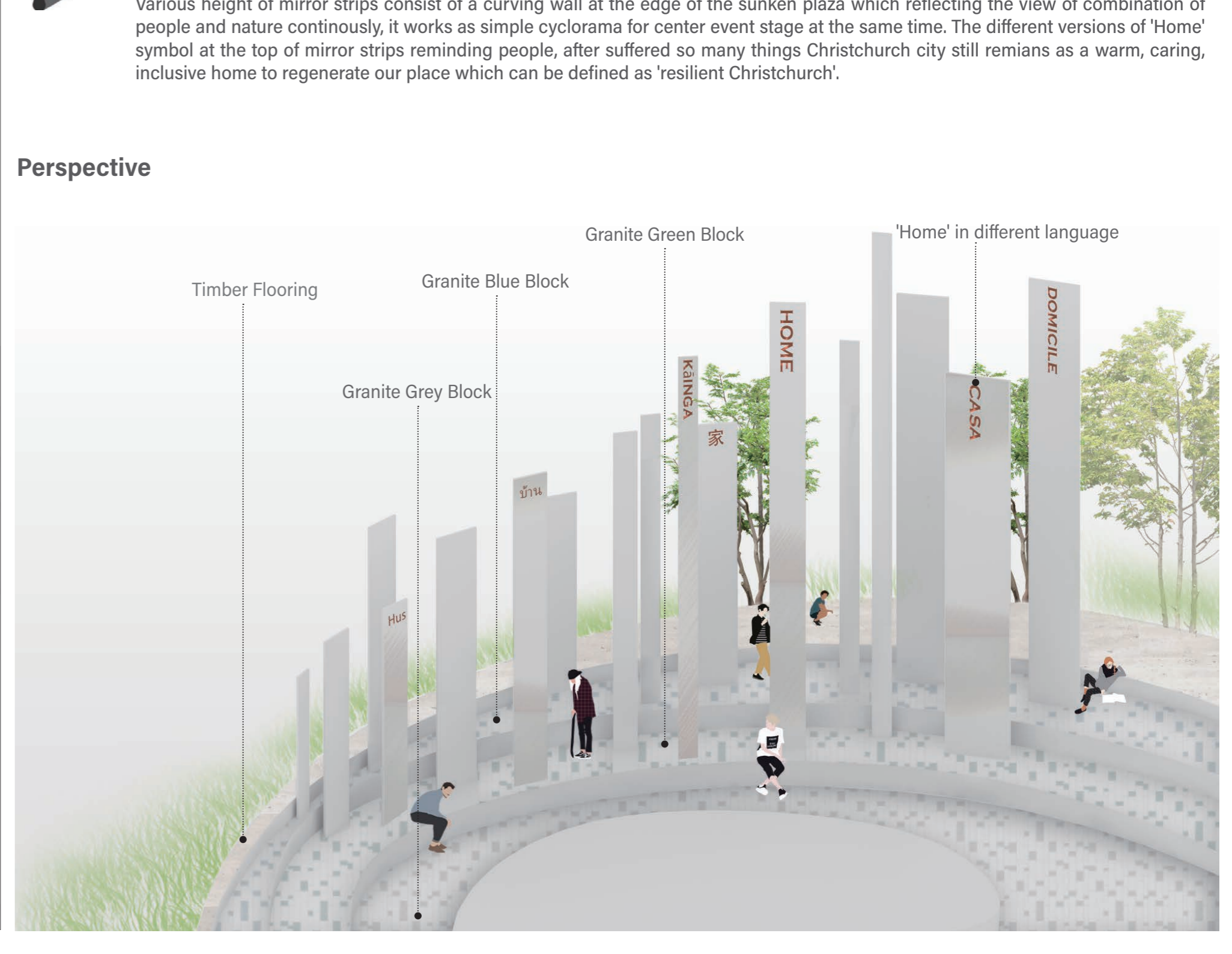
02 Leaf Pattern Connection (Top view)



03 Emergency Shelter



04 Reflection Mirror Wall of Sunken
Various height of mirror strips consist of a curving wall at the edge of the sunken plaza which reflecting the view of combination of people and nature continuously, it works as simple cyclorama for center event stage at the same time. The different versions of 'Home' symbol at the top of mirror strips reminding people, after suffered so many things Christchurch city still remains as a warm, caring, inclusive home to regenerate our place which can be defined as 'resilient Christchurch'.



SEISMIC-RESILIENT PUBLIC OPEN SPACE WITH MULTI-FUNCTIONS

(AN EXAMINATION ON CENTRE CHRISTCHURCH)

PLANTING STRATEGY



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01 Therapeutic Garden



Design Intent

The vegetation strategy for this project is to enhance the familiarity, stability and the sense of belonging to the CBD area after the Christchurch earthquake. To achieve these, different types of functional spots are applied in design including therapeutic garden, green evacuation route and rental pre-planted edible garden.

Roger Ulrich, a professor and director of the Center for Health Systems and Design at Texas A & M University, found that viewing natural scenes or elements fosters stress recovery by evoking positive feelings, reducing negative emotions, effectively holding attention/interest, and blocking or reducing stressful thoughts.

From plant selection to colours, textures, fragrance, and sounds even taste. The garden could be used for residents or specific groups of individuals (e.g PTSD from an earthquake), as well as for new member from other. Classes could be provided to teach gardening techniques, such as plant propagation, container gardening, and herb gardening.

Fragrant Plants



Chinese Wisteria *Wisteria sinensis*
French Lavender *Lavandula stoechas*
Star Jasmine *Trachelospermum jasminoides*
Sweet Almond *Aloysia virgata*

Plants with scented flowers and foliage provide opportunities to engage clients in exploring their sense of smell. In fact, our olfactory sense is directly connected with the parts of our brain associated with memory and emotion.

Seasonal Annuals



Bloody crane's-bill *Geranium sanguineum* Flower: June-Sept
Snapdragons *Antirrhinum majus* Flower: July-Oct
Signet Marigolds *Tagetes tenuifolia* Flower: summer-fall
Angelonia *Angelonia angustifolia* Flower: summer-early fall

Incorporating annuals provides continuity of seasonal activities with visitors in the garden. They provide various pop of colours when other plants are dormant which benefits pressure reduction through visual experience.

Ornamental Grasses



Mexican Feather Grass *Nassella tenuissima* Flower: late spring
Blue Oat Grass *Helictotrichon sempervirens* Flower: July-Oct
Purple Fountain Grass *Pennisetum setaceum* Flower: summer-fall purplish flower
NZ Hair Sedge *Carex testacea* Flower: spring-summer

Ornamental grasses respond to the breeze and often add a soft texture and sound to gardens. Fully grown at the shoulder and eye level, they offer a place to 'hide', to immerse oneself in the textures, to dim external noise with the grasses' rustle.

Wildlife Friendly



Dill *Anethum graveolens* Flower: late spring
Butterfly Bush *Buddleja davidii* Flower: summer-frost
Salvia *Salvia divinorum* Flower: summer-fall purplish flower
Chaste Tree *Vitex agnus-castus* Flower: summer

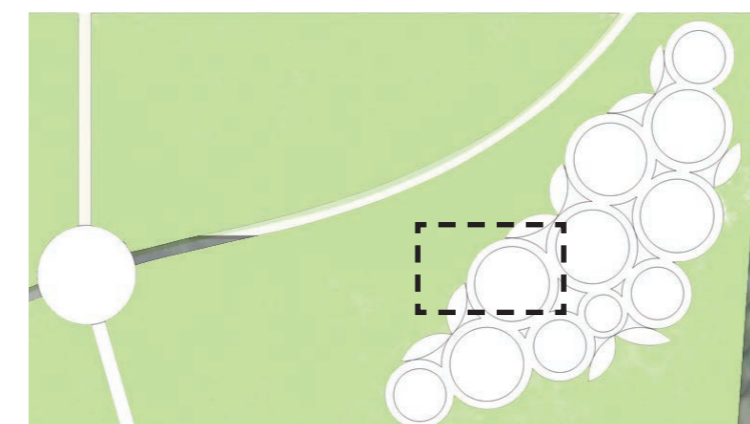
Incorporate especially native plants, that are known to attract pollinators and other forms of wildlife. A garden that serves other "community residents" is required to be considered as it serves for the visitors.

Planting Plan- Therapeutic Garden

Scale 1:50

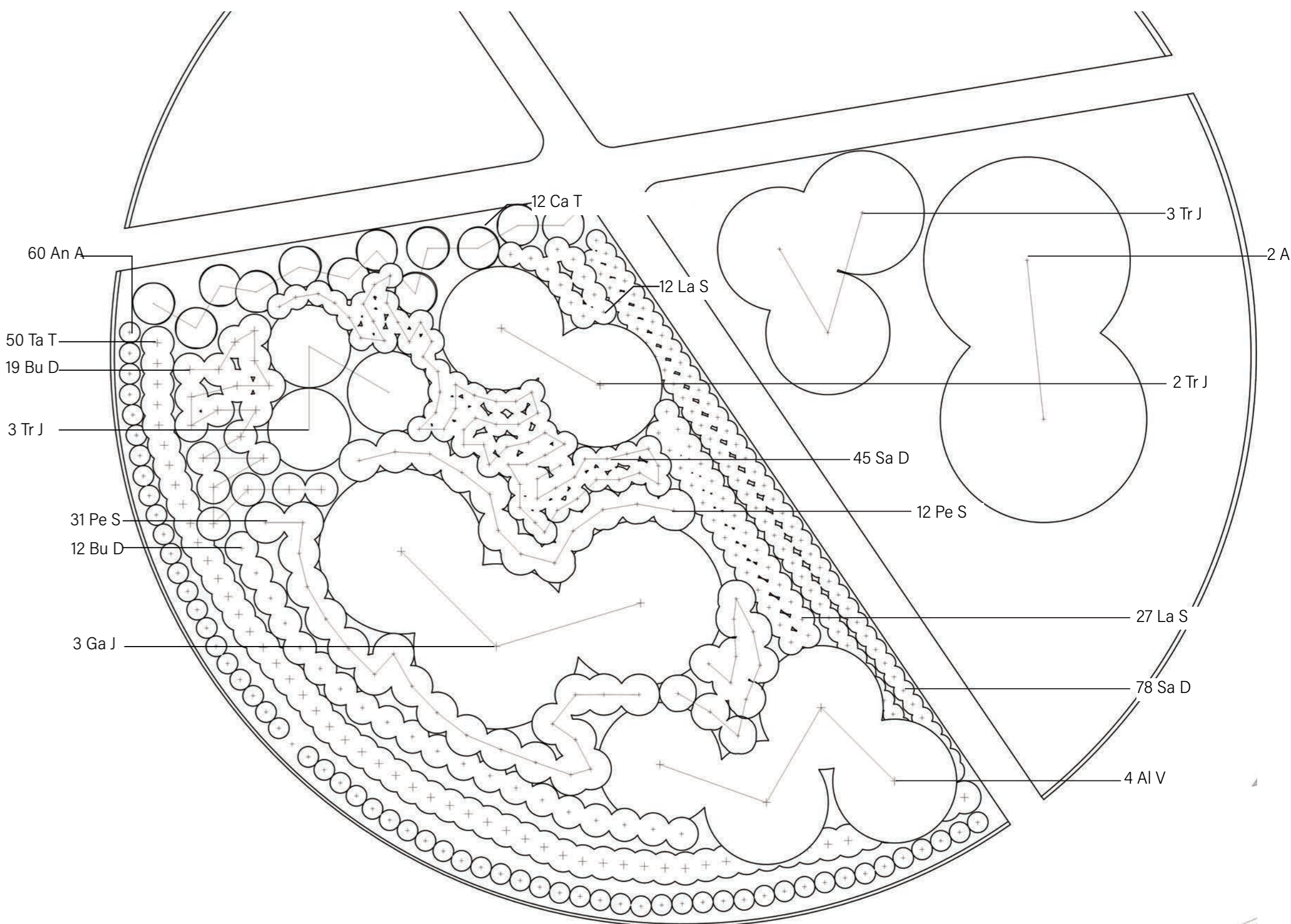
Context Map

selected area in Garden



Plant Schedule

ID	Qty	Botanical Name	Common Name	Schedule Size
Tr J	8	<i>Trachelospermum jasminoides</i>	Star Jasmine	PB3
Ga J	9	<i>Aloysia virgata</i>	Sweet Almond	PB3.5
La S	39	<i>Lavandula stoechas</i>	French Lavender	2.5L
An A	60	<i>Angelonia angustifolia</i>	Angelonia	PB4.5
Ta T	50	<i>Tagetes tenuifolia</i>	Signet Marigolds	PB2
Ca T	12	<i>Carex testacea</i>	New Zealand Hair Sedge	PB5
Pe S	43	<i>Pennisetum setaceum</i>	Purple Fountain Grass	PB5
Vi A	31	<i>Buddleja davidii</i>	Butterfly Bush	2.5L
Sa D	45	<i>Salvia divinorum</i>	Salvia	PB6.5



Pedestrian Tree



Japanese Zelkova
A tough urban tree for residential shade and street plantings.

Mature size high: 1.3-2.0m spread: 1.3-1.8m
Attributes: 1. provides dense shade 2. offers fall colour in red brown and yellow 3. tolerant wind, drought and air-pollution

Growth rate: medium rate, 0.3-0.2m per year
Soil preference: tolerant drought, adapt to wide range of soil



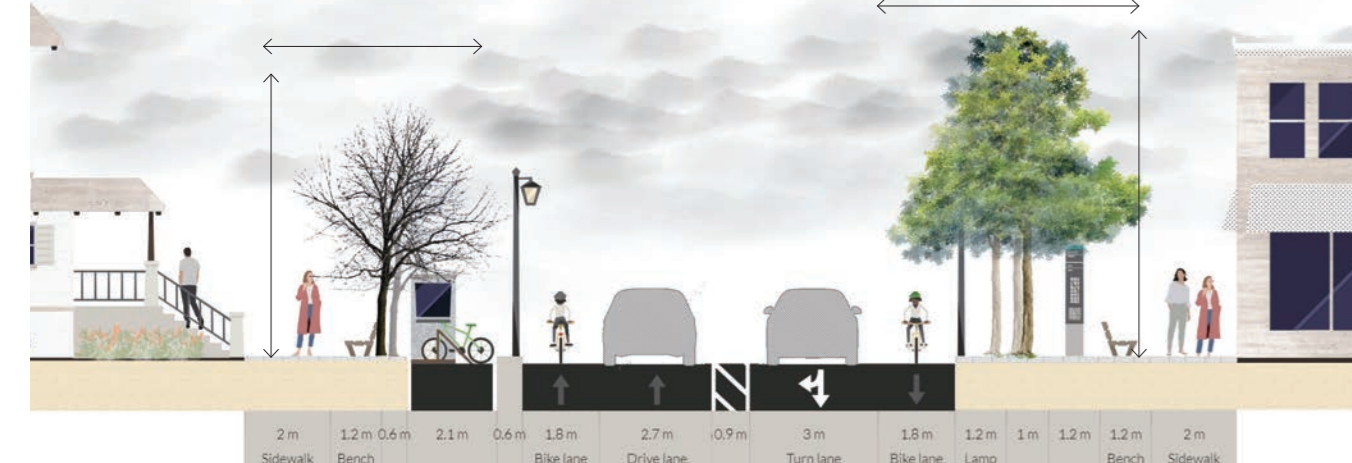
Chinese Lacbark Elm
A fast-growing and nearly evergreen tree

Mature size high: 4.0-15.0m spread: 3.0-10.0m
Attributes: 1. provide dense shade 2. tolerant urban stress

Growth rate: medium rate, 0.5-0.8m per year
Soil preference: tolerant drought, adapt to alkaline soil

Besides functioning as sunshade tree, but also leading signage towards other green open space through distinguished species and leaf colour from other pedestrian trees.

Winter scene of Kilmore St



02 Green Evacuation Route



Fall scene of Kilmore St

03 Rental Edible Garden



1 Leaf shaped leading pattern in order to connect the separated pedestrian trees of evacuation route.



2 Leading trees function in fall through its orange bright colour along the sidewalk which easily attract people get to the correct place.



3 Leading trees function in winter which is distinguished from evergreen trees on the opposite side of road.



Hemp *Cannabis sativa*
Turmeric *Curcuma longa*
Black Elderberry *Sambucus nigra*
Holy Basil *Ocimum sanctum*

Medicine Herbs

Residents can choose to plant medicine herbs which are benefits to their both physical and mental health according to specific requirement. To get further feeling of being healed through tasting plants.



Bitter Melon *Momordica charantia*
Alpine strawberry *Fragaria vesca*
Carrot *Daucus carota subsp. sativus*
Pumpkin *Curcubita pepo*

Vegetables

Planting vegetables which have a long harvest season, to provide food most of time in a year even as a backup during emergency phase of earthquake. Residents build up relationship with the land more tightly.



Basil *Ocimum basilicum*
Parsley *Petroselinum crispus*
Cilantro *Cannabis sativa*
Pineapple sage *Salvia elegans*

Tea Herbs

More common use as tea bag or seasoning in cooking, can be easily pick by anytime you like. Also have a long harvest season but low maintenance by renter.

Background

Earthquakes and other major disasters pose enormous challenges for communities and their authorities. While there are many things that can be done to prepare a city for a response in the event of a disaster, but not many cities are truly prepared for the initial impact, de-struction, sadness, and seemingly arduous recovery challenges. Base on the experiences, Canterbury has an incredible opportunity to lay the groundwork for good practice in earthquake recovery (Ayres, 2011). To take full advantage of this chance, it is critical that landscape architects participate more effectively in recovery efforts in broader recovery activities.

In fact, to approach the issues that our city should be turned into a pre-emptive landscape to prevent for the future uncertain factors (Oga-wa, 2014). Thinking of the existing rich park resources in Christchurch and its flexibility character to respond to different conditions, how to take full use of it as dynamic functional site for both regular and emergency conditions. Obviously, building up a systematic park network is vital and necessary towards any stage of disaster recovery.

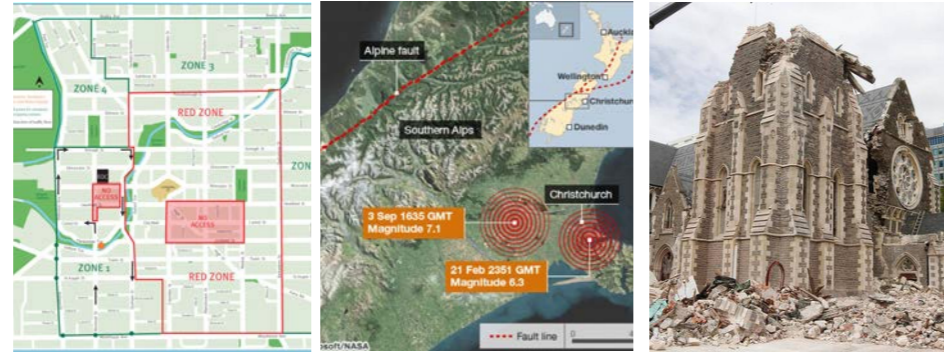


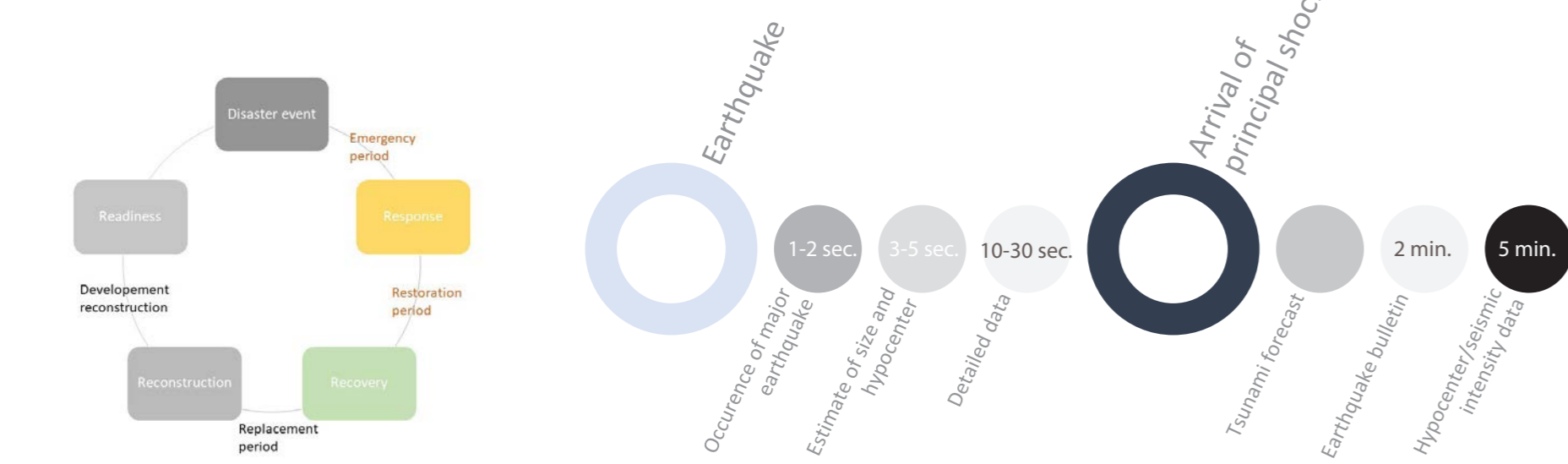
Figure 1: Affected area in city center after the earthquake

Figure 2: Schematic diagram of 2011 earthquake

Figure 3: Destroyed Christchurch cathedral

Goal

To design a complete disaster refuge and recovery process in Christchurch city through Urban park system.



Four R's of Disaster Management in NZ (Ayres, 2011) Figure 4: Earthquake Warning Bulletins (Katsutoshi, 2006)

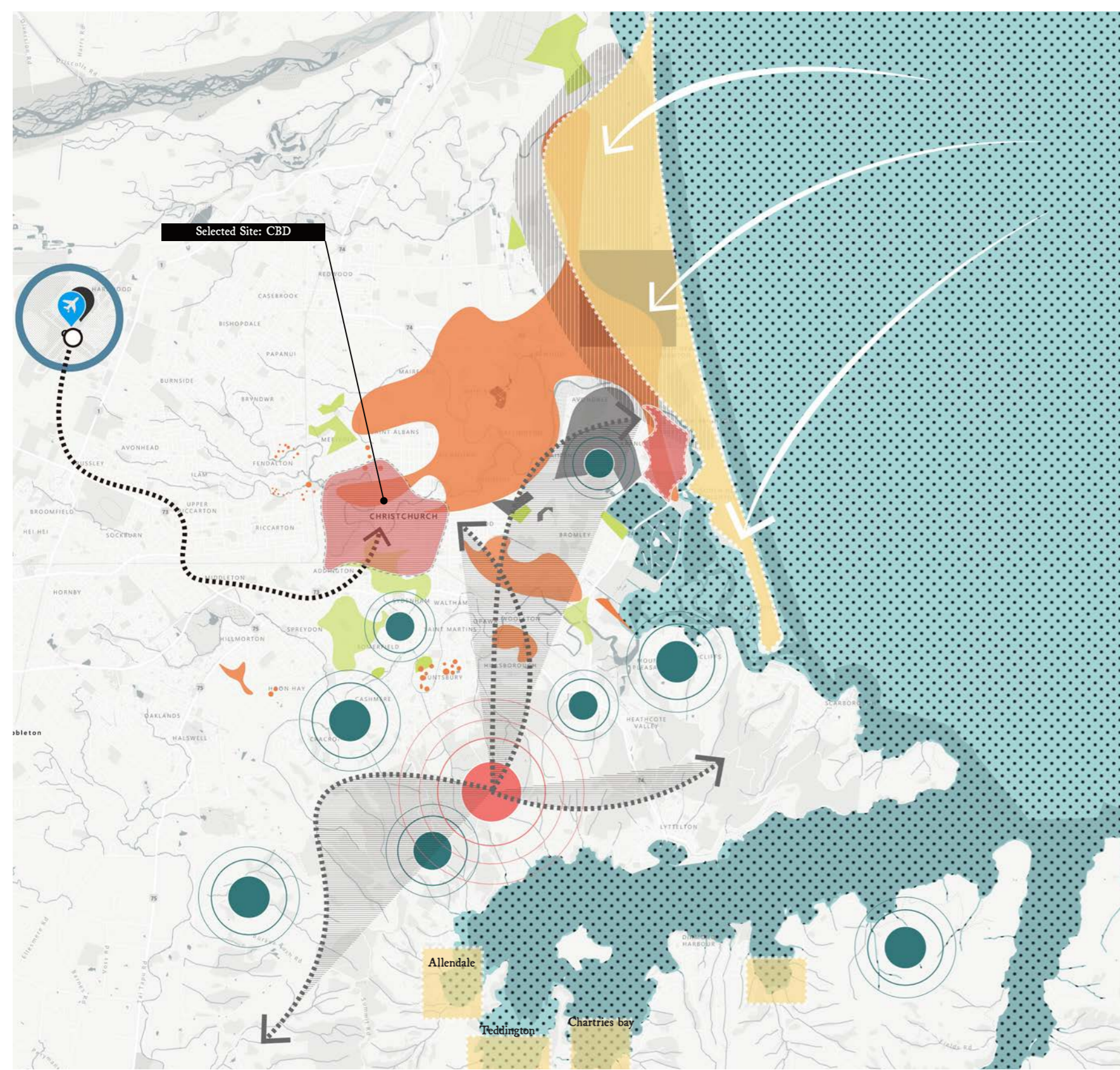
Objectives

Objectives	Inventory	Map Scale
1. Establish an education program through schools, companies, communities about how to prepare for the natural disaster or where to evacuate when it happens	Location of schools, companies, community center...	Regional Map
2. Re-purpose an 'abandoned' building/space in city center and turn it into vegetable garden or resources storage spots	Abandoned/vacant places/buildings liquefaction condition	Intermediate Map/ City Map
3. Establish a museum that also provides simulated disaster experience for citizens how-to response to a disaster	Site of museum Surrounding public transportation	Community Map
4. Accurate advanced disaster prediction forecast of time, location and size (Katsutoshi, 2006). see figure 4	Broadcast stations Mobile phone companies	Regional Map

Emergency Phase

Objectives	Inventory	Map Scale
1. Take full use of nearby green space or park by categorise them as proper emergency refuge after disaster immediately. At the same time, confirm the casualties in this area.	different types of green space, parks, corridors... walking distance coverage from surrounding area to green space.	Intermediate Map/ Detail Map
2. Providing shelters and medical aid in order to appease victims.	medical center/ hospital safe vacant space no obstacles circulation for ambulances	Regional Map/ Intermediate Map
3. Through provided supplies storage in parks to sustain life of survivors.	water resources supplyment food supplyment	Regional Map
4. Timely arrival of rescue team depending on the level of earthquake	location of fire station/NZ army/International rescue team/volunteer traveling route and assembly spots.	Regional Map/ Intermediate Map

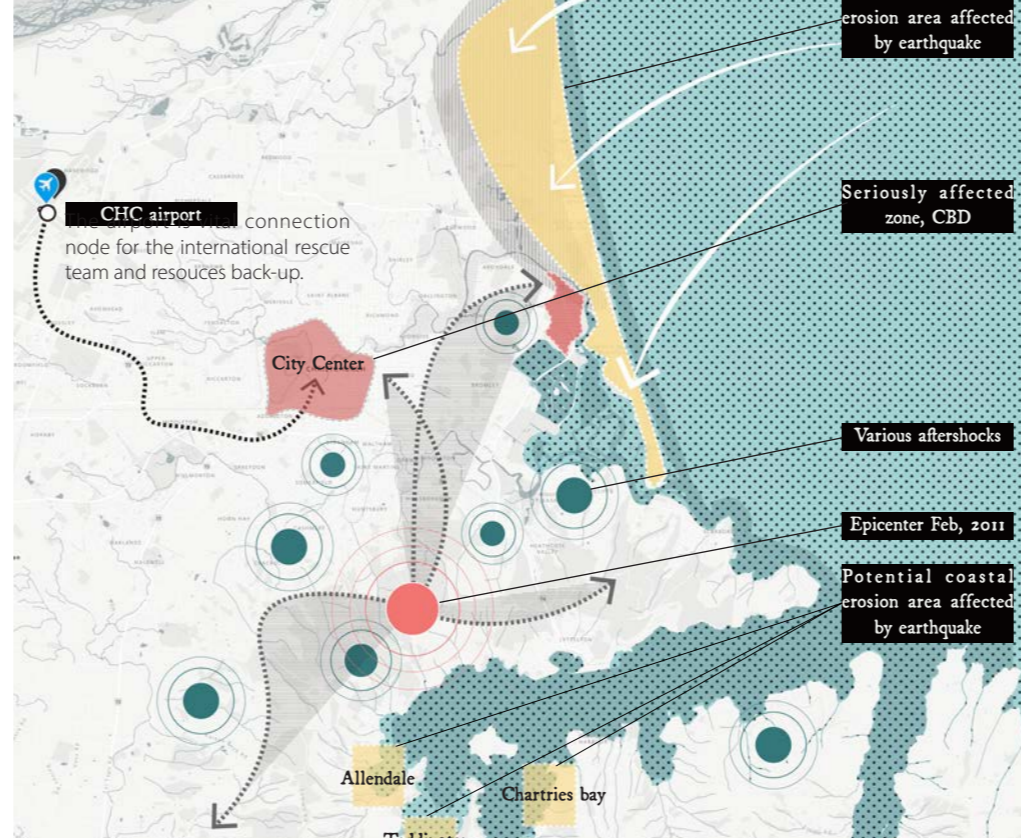
City Scale Map: Site Selection & Post-earthquake effect assessment



The city scale map is basically used as analysing the earthquake event and result it occurred. Through comparing the damaged level and condition of each district, pick out a proper place as next step analysing site. Apparently, we can tell the earthquake is not just a simple one-off disaster, after the first shake, there are many following aftershocks inevitably, even the earthquake-triggered tsunami, mudflow and so on.

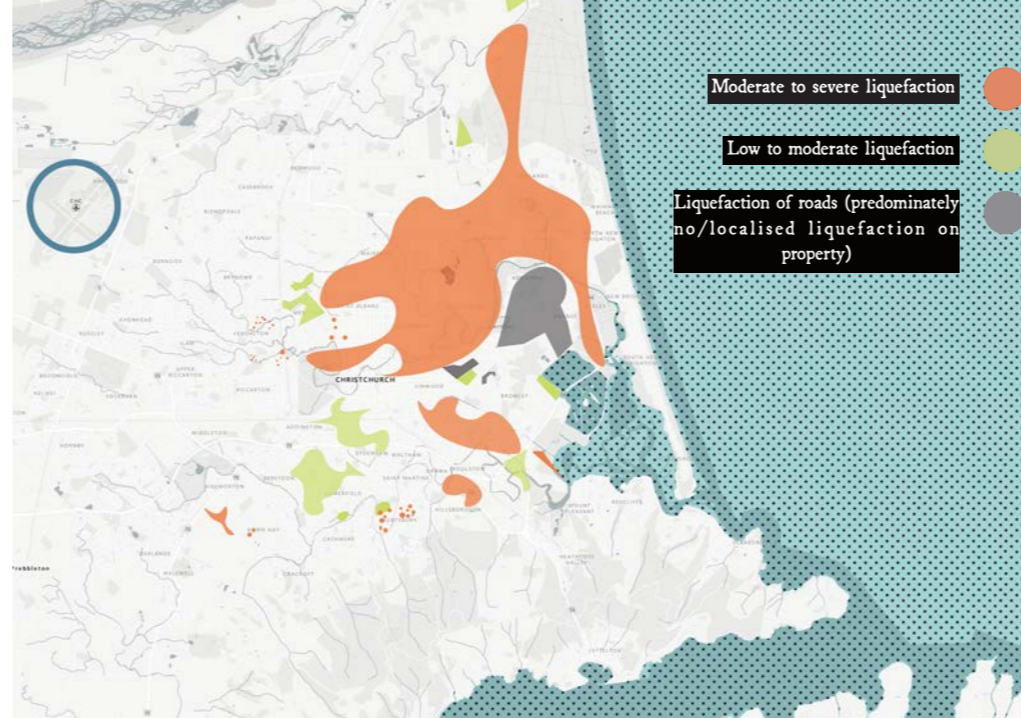
Though there is no all-purpose landscape design to treating all these disaster at one time, to ensure less death and safety of residents as much as possible can be achieved through early prevention, complete preparation and appropriate arrangement.

Earthquake & Tsunami Potentially Affected Analysis Map



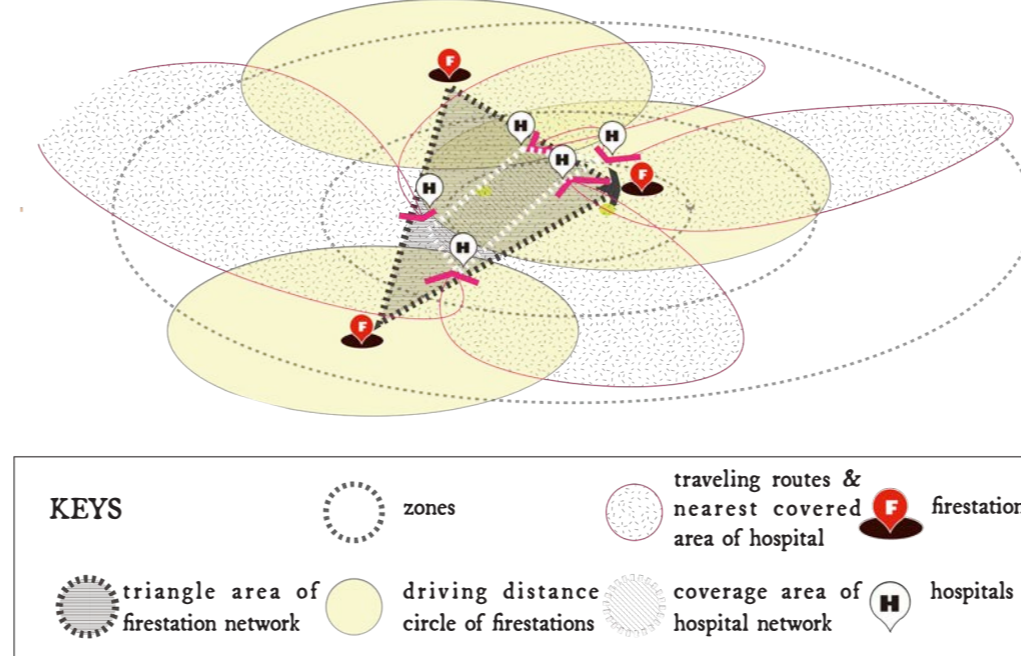
According to the analysis of 2011 earthquake locations and sizes, the map shows clearly about the actual destroyed and affected area. The city center that in red was the most seriously damaged zone for its high density buildings though there was no direct shock in it. Meanwhile, the yellow patches points out the high potential area which may be affected by tsunami when there is a strong earthquake. Even for a tsunami that won't flood land, waves can still cause strong and unpredictable currents and surges that can be dangerous for people in or near the water. These areas that mentioned above must be evacuated and avoided during and after earthquake until next officially warning or indications.

Christchurch Liquefaction Analysis Map after Earthquake



This liquefaction caused by earthquake in February and because of ground shaking during the earthquake the soil particles were rearranged and the soil mass compacts and decreased in volume. This decrease in volume caused water to be ejected to the ground surface. So that, according to the analysis map, some area is no longer suitable for any reconstruction or planting as post-disaster recovery and prevention. In order to mitigate the risk taking during next disaster (earthquake), these areas should be avoided or very carefully considered as refuge functioning zone.

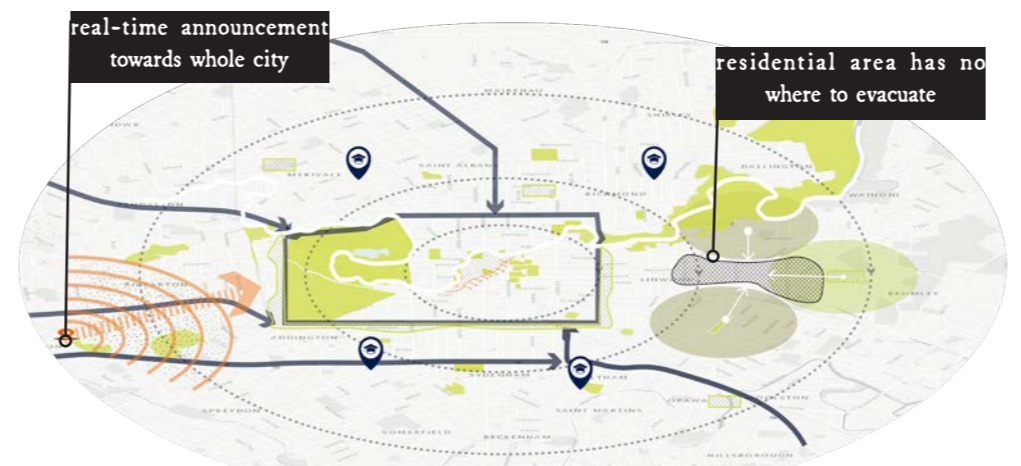
Existing Resources that Required for Emergency Phase



In the city center, there are sufficient medical treatment resources for first-aid of the earthquake casualties. They all located in the right center of Christchurch city and forms up an irregular closed-loop shape, each hospital is responsible for a particular area within 10 minutes driving distance, so that almost every corner space in the zone are nicely covered by fast-reaching range.

At the same time, the rescue team from fire station or police office at this area is going to be the first temporary helper as soon as there is an earthquake. Therefore, a reasonable arrangement and adequate numbers of brigade for dealing with the emergency burst in a short amount of time is crucial before having more off-site supports.

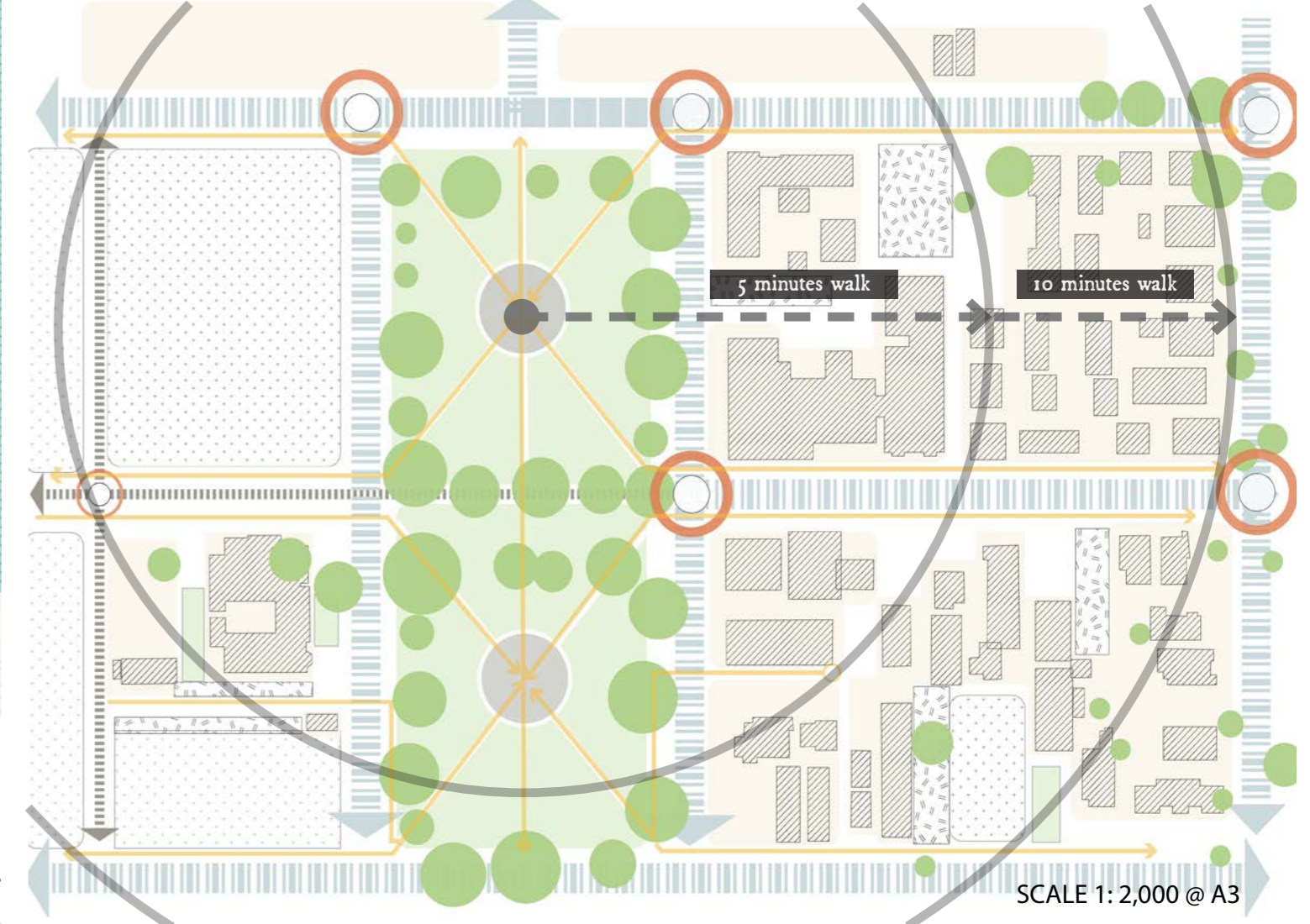
Potential Use of Green Open Space & Circulation



Residents who lived in city center have to evacuate to open space that cannot generate second injuries or accidents. A wide, open green park or school playground that without too many trees (tree might fall down during ground shaking) and able to arrived in maximum 10 minutes walking by adjacent residents which is appropriate choice as evacuation place.

The rescue routes here are wide enough for accommodating larger traffic flows and will always keep smooth under any circumstance because that majority of resources delivery or places traveling are rely on unblocked circulation.

Intermediate Scale Map: Cranmer Square Site Analysis

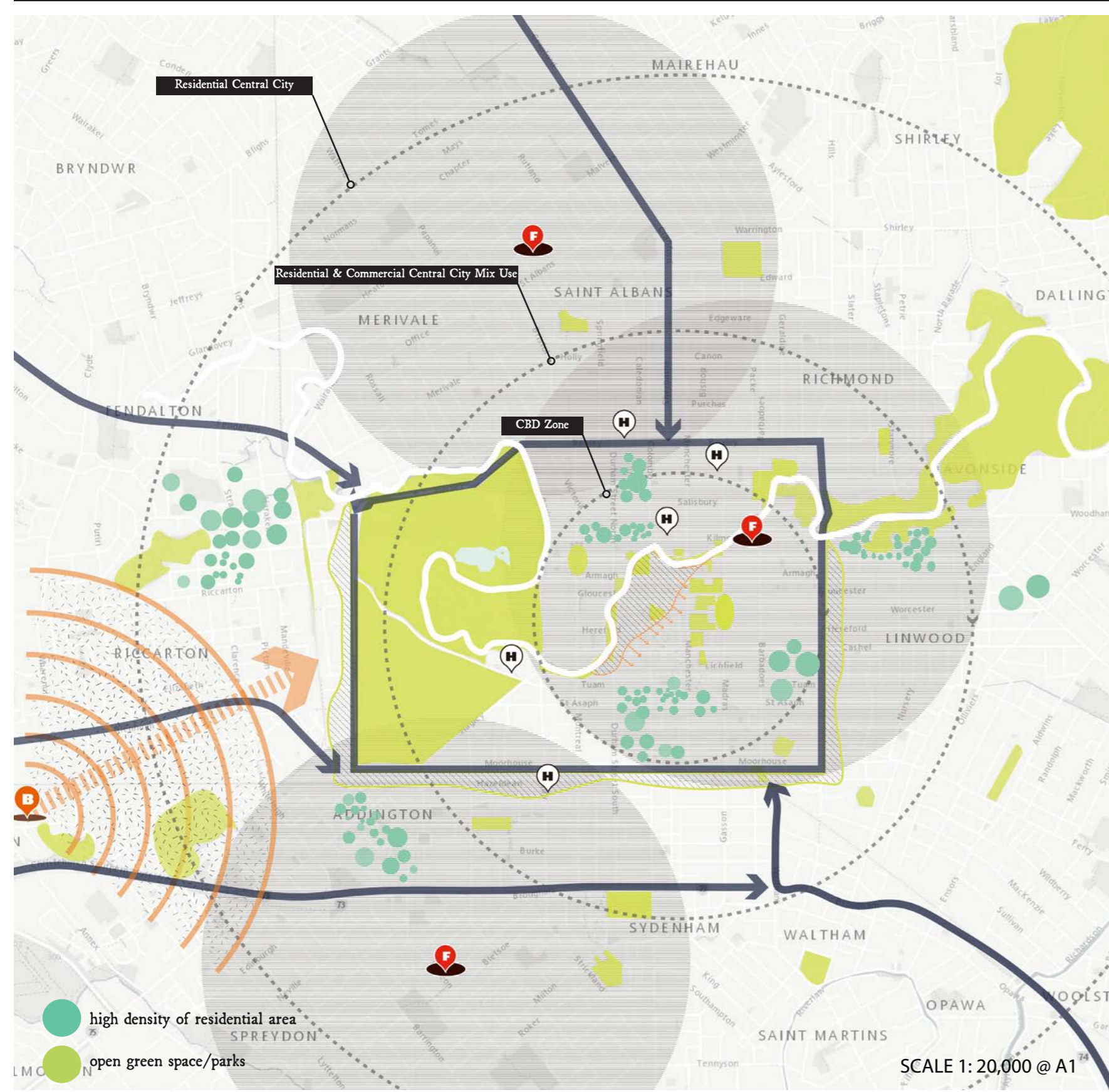


As there are many green open space, so that I picked one neighborhood size park- Cranmer Square. It located between inner and outer central city zones, and it has both commercial and residential buildings surround it. The square is big enough as a temporary outdoor refuge which can contain at least around 300 people at same time. Therefore, the square should always prepare to provide quite amount of critical gear, including lights, food, water and other necessary equipments. The square is comfortable for people who live in 10 minutes walk away from it, otherwise it might be too far and time-consuming to get there at emergency.

Existing 4 Type of Green Open Space

Assembly spot in Park people should gather around at the spot, to ensure the safety of each others and better not stroll around individually.	Park type: Urban Park (larger than 50hm ²) Similar site: Hagley Park Potential function: Urban Command Post
Circulation Nodes could be a mess after the disaster, might not have traffic light or signals temporarily.	Park type: Major urban park/ green space (larger than 10hm ²) Similar site: Girl's high school Potential function: Neighborhood command post
Small Trees quiet unstable, should be avoided in case there is any inevitable accidents.	Park type: Neighborhood park (larger than 2hm ²) Similar site: Cranmer Square Potential function: Emergency Shelter
Significant Park Trees ancient trees that have deep enough trees which will not easily affected by shakes, perfect as shelter after earthquake.	Park type: Greenway (greater than 10 m wide) Similar site: Glosaster Street Potential function: Evacuation Route

Regional Scale Map: Existing elements assessment in City Center



In the regional scale map, through analysing the existing arrangement of green space and other resources such as hospital, fire station and so on, then estimating the rationality of them if functioning as disaster prevention system in the future. Aim at the emergency phase of earthquake in 3 days, the most demanded measure for evacuation or rescue should be fully considered that each resident who lives in city center has handy open space to go, also people who are injured or require salvation is available be reached by salvor in maximum 10 minutes drive. If the above condition cannot be met base on the present urban planning, then increasing more proposed green space, green net work and urban facilities at uncovered place in order to achieve a high penetration rate can efficiently avoid dangerous situation during earthquake or other natural-disaster. Except that, when people know where day can go and what to do might weaken their mood of panic, they can relatively make right behaviour or decision.

Detail Scale Map: Street & Residential Movement Analysis



Down to the detail scale, the map shows more about different existing circulation and how does the Cranmer square relevant to surrounding residents or people. The yellow dash line shows how residents walk to the square when there is an earthquake, then the bold yellow line demonstrates that how cars moving through the square to place. However, the connection between residential area and the square is relatively weak, by increasing green network to enhance the connectivity and orientation is helpful towards evacuation.

Readings
Sato, M. (2011). Recent Trends in Earthquake Disaster Management in Japan. Retrieved from https://www.researchgate.net/publication/231770000/119131-Full-Report.pdf
Ayres, H. (2011). Disaster by design: the role of Landscape Architects in the Canterbury earthquake recovery (Doctoral dissertation, Lincoln University).
Oga-wa, N. (2014). Disaster to Preemptive Landscape: Resident Parks for Earthquake Disaster Management (Doctoral dissertation, University of Georgia).
Mitsuta, N. (2014). Disaster refuge and relief urban park system in Japan. Landscape Architecture Futures, 2(4), 12-41.
Canterbury Map (2018). Retrieved from https://canterburymap.govt.nz/

Figure
Ayres, H. (2011, February 25). Christchurch earthquake: Levels of liquefaction 300 - 500 pc wone. Retrieved June 6, 2019, from NZ Herald website: https://www.nzherald.co.nz/nz/news/article.cfm?id=10788723
Ayres, H. (2011, February 23). New Zealand earthquake: Depth and location key. BBC News. Retrieved from https://www.bbc.com/news/world-asia-pacific-1234181
Christchurch earthquake: CBD: visitors released (2011, March 6). Retrieved June 6, 2019, from The National Business Review website: https://www.nzbc.com/nz/articles/biz-earthquake-hits-south-island-mn-8648

LANDSCAPE PREVENTION SYSTEM OF EARTHQUAKE

World's largest earthquake and their damage statistics from 2000-2011

Popular name	Date of event	Type of hazard	Total number of deaths	Total number of affected	Total damages US\$
Christchurch earthquake	22 February 2011	Earthquake	185	100,000	40 billion
Japan earthquake	11 March 2011	Earthquake and tsunami	5178 (as of 17.03.2011)	Not yet known	Not yet known
Haiti earthquake	12 January 2010	Earthquake	222,570	3,400,000	n/a
Sichuan earthquake	12 May 2008	Earthquake	87,476	45,976,596	85 billion
Java earthquake	27 May 2006	Earthquake	5,778	3,177,923	3.1 billion
Kashmir earthquake	8 October 2005	Earthquake	73,338	5,128,000	5.2 billion
Bam earthquake	26 December 2003	Earthquake	26,796	267,628	500 million

Post-disaster reconstruction and recover slogan - "Build Back Better" (BBB)

1. risk reduction
2. community recovery
3. implementation
4. monitoring and evaluation

Principle 1: improvement of structural designs
Principle 2: land-use planning

Principle 1: disaster warning
Principle 2: **evacuation system**

Alexander (1999) stated that "the degree to which a society remains unaffected by natural extremes reflect its ability to adapt to hazards".

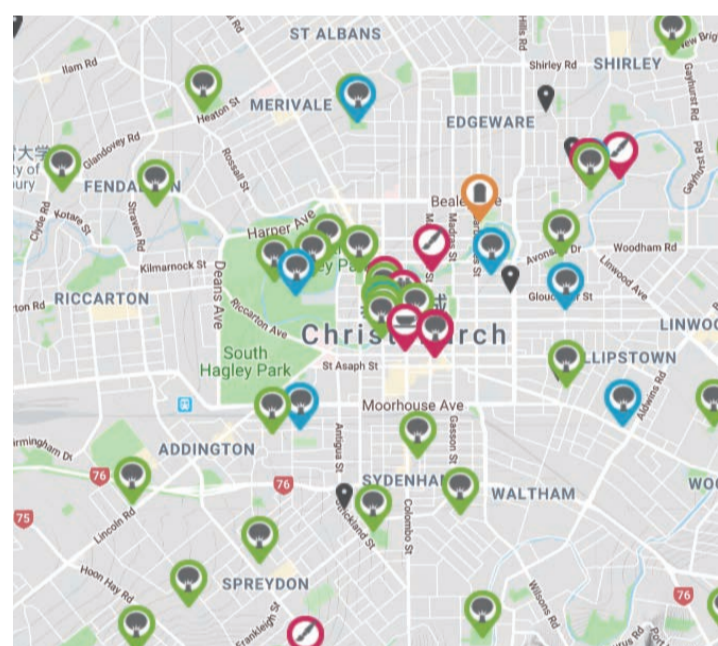
Structural and non-structural methods of hazard mitigation are often used as a means of coping with and adapting to the risks posed by hazards (Alexander, 1999).

Park resources

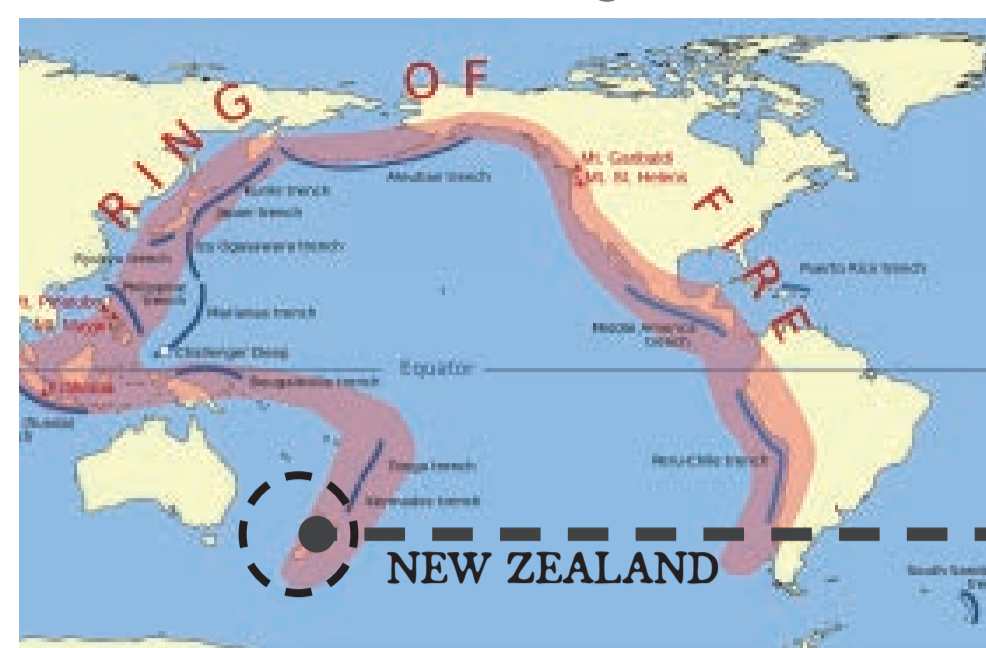
Christchurch is recognised as New Zealand's garden city with over 740 parks and gardens. Around 150 suitable size parks or greenfields are capable be used as emergency evacuation site.

Why choose park ?

1. As the Great Hanshin - Awaji Earthquake (GHAE) proved , parks recieved less damage compared to other infrastructure and became centers for residents to rebuild their lives.
2. Parks have a potential to become the media to preserve the essence of inherent local culture, ecosystem, and social order while functioning as a catalyst for a city to achieve a new norm in the post- disaster state.
3. Familiarity with local ecosystems and residential communities can help a neighbourhood to work together over time and rebuild after a disaster.

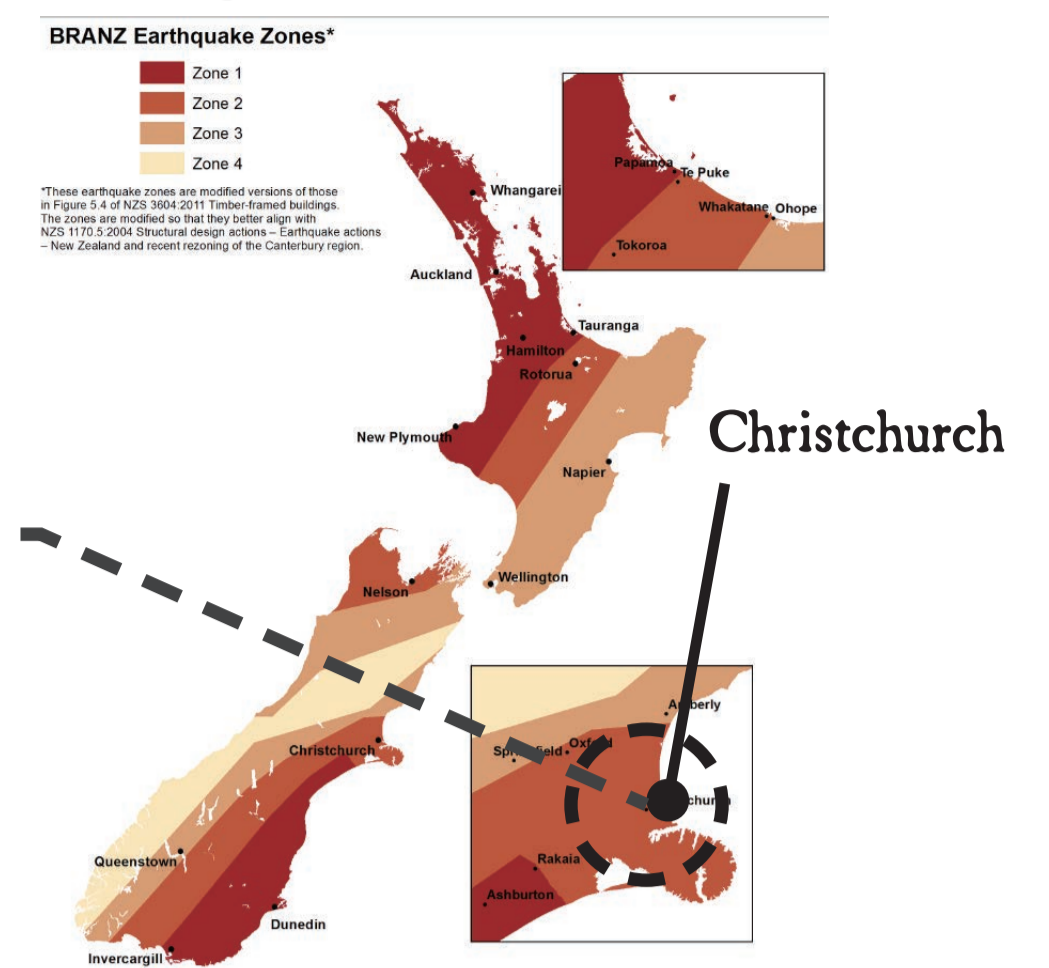


Why NZ has Earthquake?



The ring of active volcanoes, volcanic arcs and tectonic plate boundaries that frame the Pacific Ocean. (Public Domain)
New Zealand is located on the edge of a zone of intense seismic activity known as the Ring of Fire.

Earthquake risk zone map



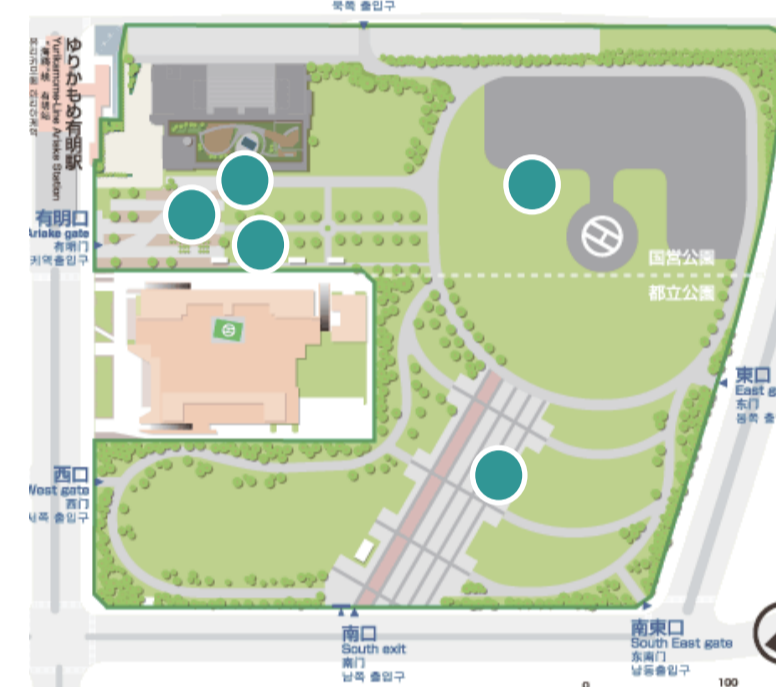
Christchurch located in the zone 2 which carries higher risk of earthquake. In this area, the building construction require stringent requirement than the other lower-risk zone.

EVALUATION OF DESIGN PRECEDENTS

The Tokyo Rinkai Disaster Prevention Park



The Tokyo Rinkai Disaster Prevention Park acts as a central base of operations for disaster prevention in the Tokyo Metropolitan Area that houses emergency response facilities including local disaster management headquarters, as well as institutions that compile disaster-related information and coordinate emergency disaster measures.



Multifunctional Use of the Park	
function during normal time	function during disaster
Disaster prevention center	Establishment of headquarters for times of disaster
Amenity functions in the coastal city area	Base camp for supporting troops
	Support base of the disaster medical

- PARK FACILITIES
- Headquarters building
 - Entrance space
 - Heliport
 - Multipurpose plaza/Outdoor plaza
 - Prevention base

PROS

The Tokyo Rinkai Disaster Prevention Park has more reasonable planning for disaster prevention use. It not just a command post for the earthquake, it also contains educational and amenity functions for public use. Also, the park can only served for its surrounding residents at emergency phase as its calculated resources and planning size.

CONS

It seems lack of greenway to connect the other parks, compare to urban park system, the Rinkai is more like an individual disaster prevention park which only serves for local community. The park is design for practical use therefore, it is deficient in aesthetic aspect.

REGIONAL SCALE OF SITE ANALYSIS

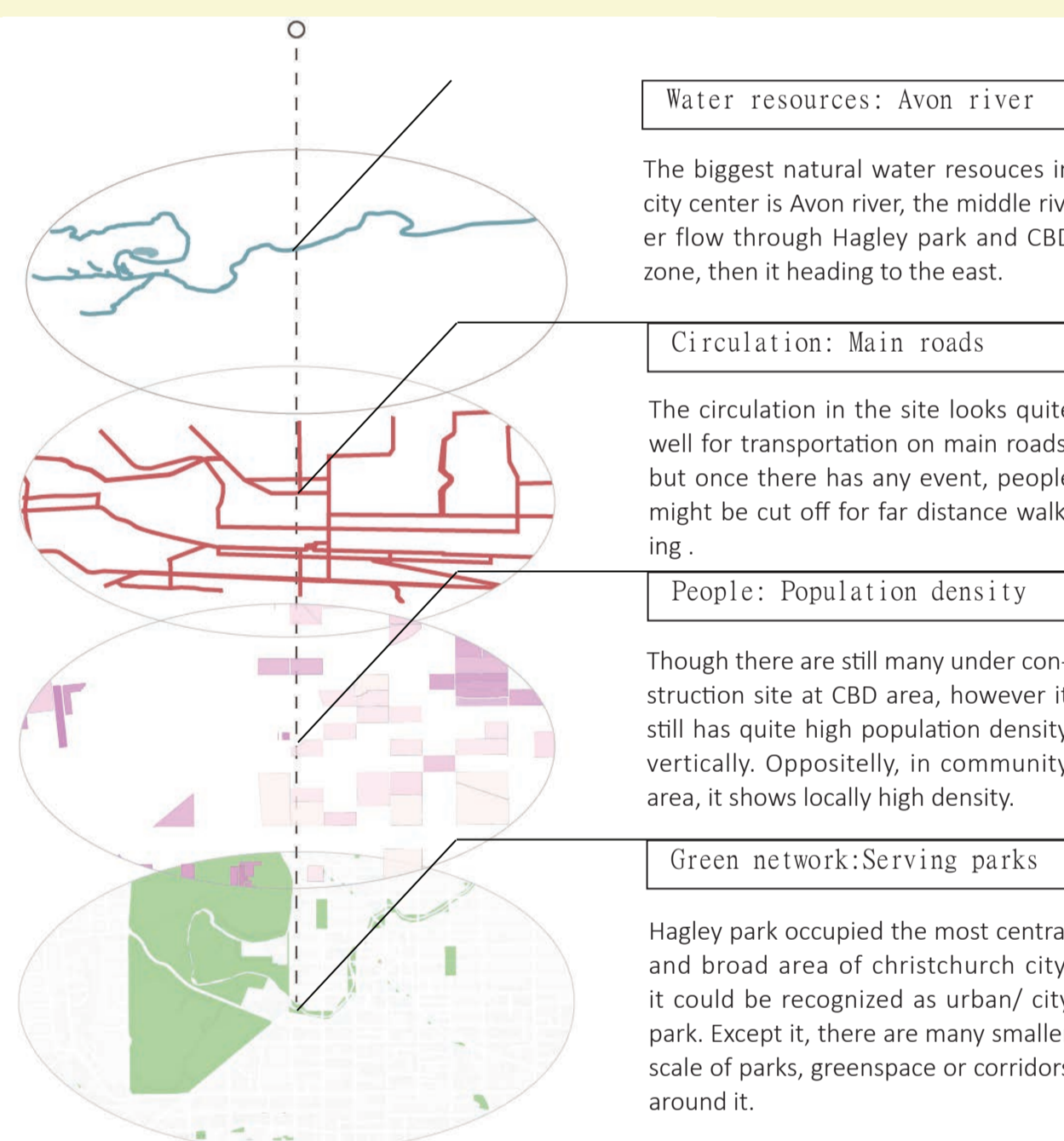
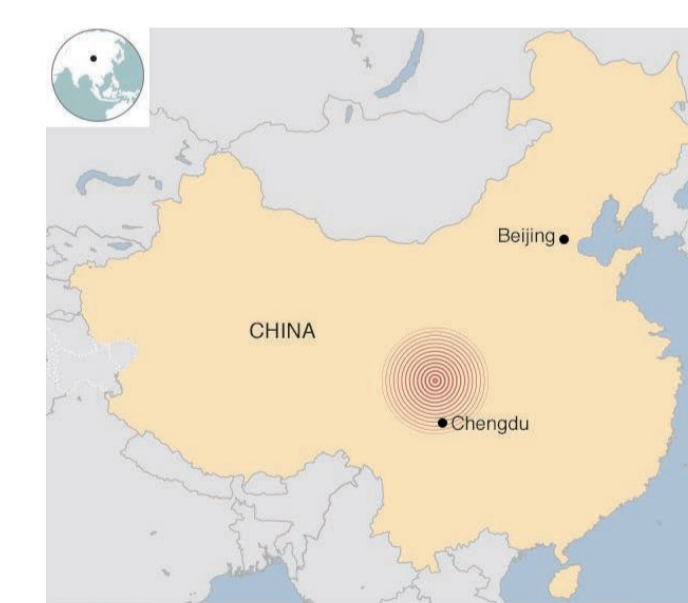


Figure 1: Stratification Analysis Diagram (not to scaled)

The People's Park (Chengdu)



People's Park (Chinese: 人民公园; pinyin: Rénmín Gōngyuán) is an urban public park in central Chengdu, capital of Sichuan province, China. Built in 1911 as Shaocheng Park (少城公园), it is the first public park in the city. The Railway Protection Movement Monument in the park is designated a Major Historical and Cultural Site of China.[1]

Map of Chengdu People's Park

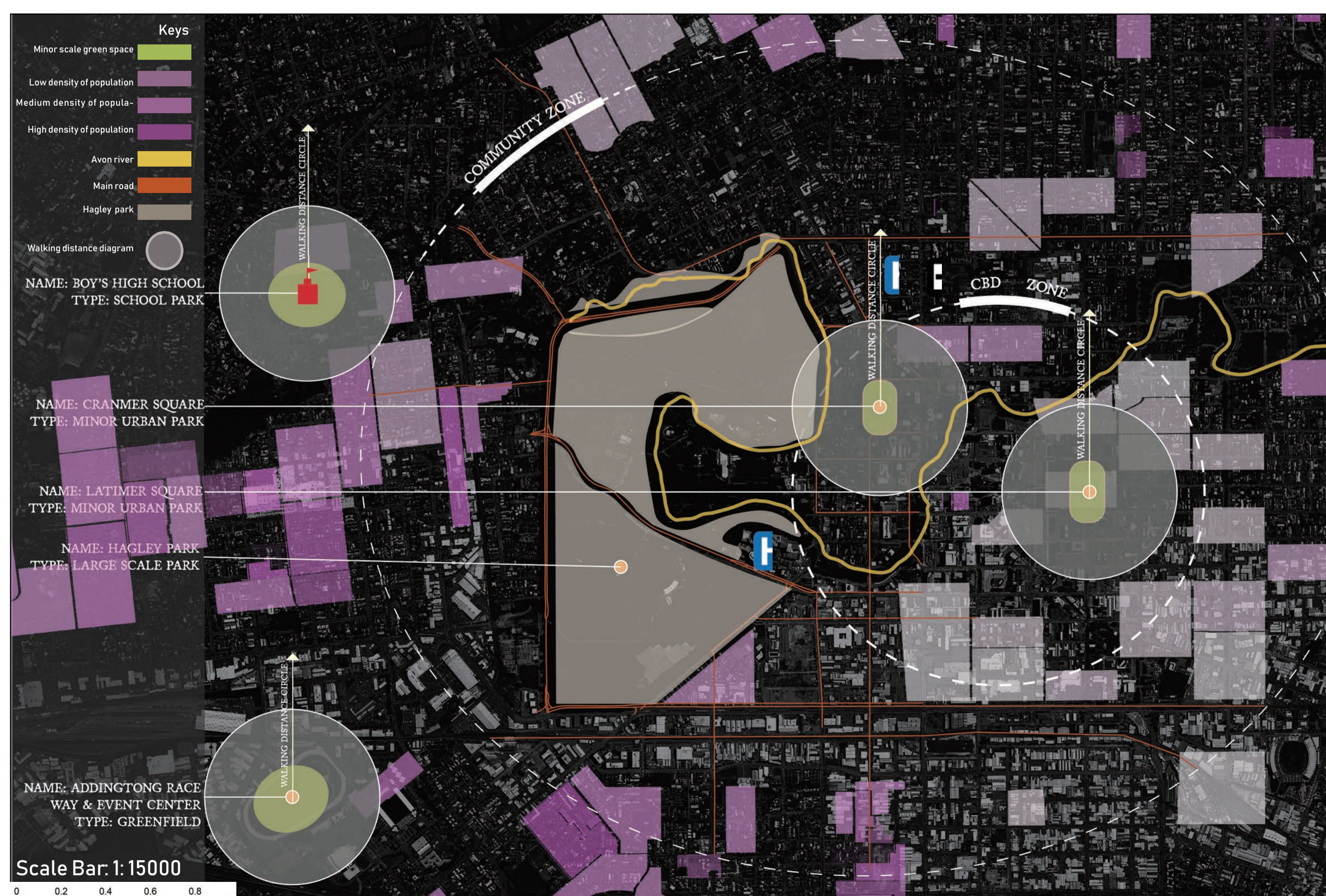


PROS

The park is steeped in history and stories compare the Rinkai in Tokyo. So that, the landscape and recreations are well designed before the disaster prevention system being applied. The park achieved multifunctional use in one place and it is fully satisfying residents demand of leisure

CONS

As i mention in pros that all of disaster prevention system is build up upon the previous park system. Therefore, the former is not that mature and need further improvement.



Reading References

Coburn, A. W., Spence, R. J., & Pomonis, A. (1992, July). Factors determining human casualty levels in earthquakes: mortality prediction in building collapse. In *Proceedings of the First International Forum on Earthquake related Casualties. Madrid, Spain, July 1992.*

Open and green space - Healthy Christchurch. (2015). Retrieved October 13, 2019, from Healthychristchurch.org.nz website: <https://www.healthychristchurch.org.nz/city-health-profile/factors-that-affect-our-health-and-wellbeing/waiora/open-and-green-space>

Saito, Kohei. "Greening Towns: Approach to Plan Parks". 2006. Accessed March 03, 2014. http://web.pref.hyogo.jp/wd33/wd33_000000126.html (In Japanese)

Ministry of Land, Infrastructure, Transport and Tourism (Japan). "The Image of Disaster Prevention City [Bousaitoshi Kouzou no Image]." 2014b. Accessed July 7, 2014. www.mlit.go.jp

Resilient Greater Christchurch: Greater Christchurch. (2018). Retrieved October 15, 2019, from Greaterchristchurch.org.nz website: <http://greaterchristchurch.org.nz/projects/resilient-greater-christchurch/>

Planting References

Chinese wisteria

Old Farmer's Almanac. (2019, August 16). Wisteria. Retrieved September 17, 2019, from Old Farmer's Almanac website: <https://www.almanac.com/plant/wisteria>

Star jasmine

Confederate Jasmine for Sale | Buy Jasmine Plant Online | Perfect Plants. (2016, April 13).

Retrieved September 17, 2019, from Perfect Plants website:

<https://myperfectplants.com/product/confederate-jasmine/>

Lavender

Wikipedia Contributors. (2019, August 26). Lavandula. Retrieved September 17, 2019, from

Wikipedia website:

https://en.wikipedia.org/wiki/Lavandula#/media/File:Single_lavendar_flower02.jpg

Gardenia

Bloody crane's-bill (*Geranium sanguineum*): growing, planting, caring. (2019). Retrieved

September 18, 2019, from Groww.fr website: <https://www.groww.fr/en/plants/bloody-crane-s-bill>

Marigolds

Tagetes tenuifolia (Signet Marigold). (2019). Retrieved September 18, 2019, from Gardenia.net

website: <https://www.gardenia.net/plant/tagetes-tenuifolia-signet-marigold>

Angelonia

Care Of Angelonia: How To Grow An Angelonia Plant. (2018, April 5). Retrieved September 18,

2019, from Gardening Know How website:

<https://www.gardeningknowhow.com/ornamental/flowers/angelonia/growing-angelonia-plants.htm>

Mexican Feather Grass

Nassella tenuissima Mexican Feather Grass information. (2016). Retrieved September 18, 2019,

from Hoffmannursery.com website: <http://hoffmannursery.com/plants/details/nassella-tenuissima>

Purple Grass

Pennisetum - purple fountain grass. (2013). Retrieved September 18, 2019, from

Australianplantsonline.com.au website:

<https://www.australianplantsonline.com.au/pennisetum-purple-fountain.html>

NZ Grass

Carex testacea. (2013). Retrieved September 18, 2019, from Craftsman Gardener Services website:

<https://www.craftsmangardener.co.nz/product/carex-testacea/>

Salvia

Salvia divinorum - Herba de Maria.jpg - Wikimedia Commons. (2019). Retrieved September 18,

2019, from Wikimedia.org website:

https://commons.wikimedia.org/wiki/File:Salvia_divinorum_-_Herba_de_Maria.jpg

Dill

Dill - Domino - 2500 Seeds - Anethum graveolens. (2018). Retrieved September 18, 2019, from

Google.com website:

https://www.google.com/url?sa=i&source=images&cd=&ved=2ahUKEwji_b37o9nkAhURA3IKHUEdDOAQjRx6BAgBEAQ&url=http%3A%2F%2Fwww.worldwondersgardens.co.uk%2Fdill-domino-2500-seeds-anethum-graveolens&psig=A0vVaw21bBnjUrHtwnI2NNy_ETGD&ust=1568858622788030

Buddleja

Wikipedia Contributors. (2019, March 24). Buddleja davidii. Retrieved September 18, 2019, from

Wikipedia website:

https://en.wikipedia.org/wiki/Buddleja_davidii#/media/File:Buddleia2.jpg

ZELKOVA SERRATA 'GREEN VASE'

Zelkova serrata 'Green Vase.' (2009). Retrieved October 9, 2019, from Ruppert Nurseries website:
<https://www.ruppertnurseries.com/inventories/zelkova-serrata-green-vase/>

Henry. (2017, November 5). Zelkovas on Norbeck. Retrieved October 9, 2019, from Henry Hartley website: <http://www.henryhartley.com/?p=13217>

Photo of the entire plant of Japanese Zelkova (Zelkova serrata 'Village Green') posted by ILPARW - Garden.org. (2011). Retrieved October 9, 2019, from Garden.org website:
<https://garden.org/plants/photo/536647/>

Websites

<https://htinstitute.org/community/favorite-plants-programmed-therapeutic-gardens/>

<https://www.gaiaherbs.com/pages/herb-reference-guide>

<https://www.shootgardening.co.uk/article/the-seeability-garden>

<https://bankkita.com/explore/vector-people-png/>

