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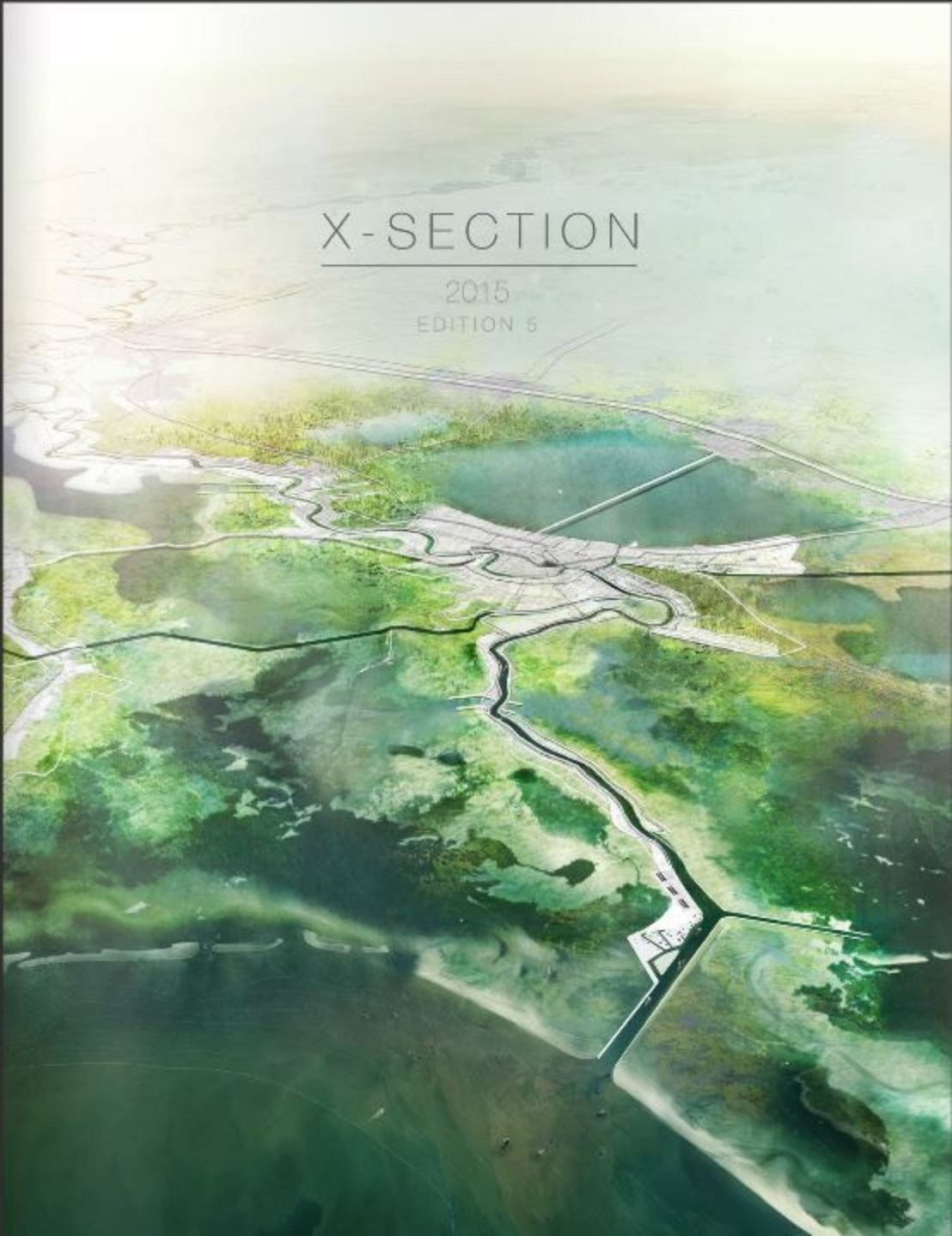

AUCKLAND VOLCANIC FIELD DISASTER RELIEF FRAMEWORK ON PUBLI

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INTRODUCTION

Auckland is a city built on volcanoes. Although the special volcanic landscape has brought benefits such as attracting foreign tourists and providing leisure for residents, it also brings potential risks. Volcanic eruption is ranked as the most dangerous hazard among all types of disaster and is considered a likely event with very high risks (Auckland Civil Defence, 2011). The challenge is to manage the aftermath of the disaster in a growing city as Auckland' population is expected to grow by one million by 2040 (Auckland Council, 2012). In addition, evidence from the historical record shows that natural disasters such as volcanic eruptions do not always happen in isolation. For instance, the active volcano Mount Tambora, situated on a peninsula in Indonesia, had its strongest recorded eruption in 1815. The volcanic eruption was followed by a tsunami that caused over 4,500 deaths (Monk, Fretes, & Reksodiharjo-Lilley, 1996). As mentioned in the Auckland Civil Defence and the Emergency Management (CDEM) Plan, "Volcanic eruption can also cause other natural disasters, including earthquakes, wildfires, and (given certain conditions) tsunamis" (Auckland Civil Defence, 2010, p. 4).

Response strategies in the case of natural disasters have been investigated in several ways. For example, CDEM Plan provides a comprehensive list of disasters that could happen in Auckland, as well as a variety of measures and suggestions relative to each type of disaster (Auckland Civil Defence, 2011). As outlined in the Auckland Evacuation Plan, the five phases of evacuation are decision, warning, physical evacuation, shelter and return (Auckland Civil Defence, 2014). The idea that open spaces can be part of a disaster relief system has been applied in other countries. For example, in many cities in China, use of parks as evacuation spaces has been built into policies (Ye & Fu, 2013).

At present, public open spaces in Auckland are not adequately designed as disaster relief spaces. As such, this research attempts to explore how an open space can be used in disaster relief.

Specifically, three aims will be addressed:

1. Assess public open spaces for availability of possible evacuation sites. Sites wherein secondary hazards (earthquakes and tsunami) may occur are considered as exclusion zones.
2. Explore the potential for increased usage of public open spaces and identify the emergency functions of open space approaches in disaster relief.
3. Design a sample site with emergency functions and test the design work though simulation in both a disaster situation and daily use.

PUBLIC OPEN SPACES IN AUCKLAND

"Parks and open space are core infrastructure required to support the growth of Auckland" (Auckland Council, 2013a, p.16). The Action Plan aims to develop more parks before 2040 to meet the growing population. Meanwhile, Council is conserving and upgrading the existing open spaces to achieve maximum benefits from the different roles of the parks. It also suggests using roads to form a green infrastructure in order to connect the parks (Auckland Council, 2013a). In the Auckland plan, one of the expected outcomes is a fair, safe and healthy Auckland in 2040. However, the strategy does not sufficiently mention how to respond to the changing environment and natural hazards such as coastal erosion, although it questions how to manage parks and create a resilient open space network in order to cut down environmental risks.

From the plan, it is clear that in Auckland, people need more open spaces, and more resources could be considered to play a role in disaster relief, while all parks or open spaces could be planned or managed with a disaster risk minimisation response in mind. Existing parks and open spaces are valuable resources because they may be redesigned to serve multiple roles in the future plan.

In this research, public open space (POS) mainly refers to the five types of green forms in the Auckland unitary plan; these are civic, communication, conservation, informal recreation, and sports and active recreation zones (Auckland Council, 2013b). Given the current urban growth rate, the research will focus on the urban public open spaces to meet the needs of the increasing population (Auckland Council, 2013a).

AUCKLAND VOLCANIC FIELD (AVF)

Approximately fifty volcanoes are found within a 360 square kilometers area of urban Auckland, also referred to as the Auckland volcanic field (AVF). In contrast to the central north volcanic sources, the volume of magma in AVF is much smaller but is enough to form today's central Auckland. Based on the past experience, erupted volcanic cones in AVF is unlikely to erupt again, except for Rangitoto, which have erupted more than once. Geologically, AVF is one of the youngest volcanoes as such still potentially active and its volcanic activity is hard to predict (Auckland Civil Defence, 2014).

Researchers have examined hazard zones by mapping. As Tomsen, Lindsay, Gahegan, Wilson and Blake (2014) reported, these are somewhat consistent with the primary (3 km radius) and secondary (5 km radius) evacuation zones in the AVF contingency plan, but crucially suggest an additional larger radius of 8 km should be considered in an evacuation demand analysis (2014). In addition, Auckland Council (2015) also mentions that within 3 km diameter of a volcanic vent, the lava flow will destroy any buildings and infrastructure. These factors were taken into consideration when selecting for possible relief sites in this research.

GIS APPLICATION

Geographic Information Systems (GIS), one of the essential applications for location mapping, dynamic condition visualisation, and decision-making, plays an important role in providing technical support in the aftermath of disasters. In January 2010, in the Haiti earthquake, damage assessment maps based on online data and geographic tools were generated using GIS as a timely response to the crisis. This technique will be applied here to identify the appropriate locations for evacuation.

M E T H O D S

The methodology comprises two parts as detailed below:

(1) S I T E S E L E C T I O

To select potential urban green spaces for use as evacuation sites, two sets of criteria were created. The first set of criteria aimed to identify safety zones in order to select a site (as outlined as Test A). The second set of criteria (Test B) was developed in order to address the limitations of Test A. Although Test A failed to identify suitable sites, it contributed to the development of Test B. Test B enabled the identification of several sites, of which the five most suitable were shortlisted for further analysis.

TEST A

Hazard zone were determined using 3, 5 and 8 km zonal radius (from volcanic vents). GIS mapping was performed for all known historical vents, and assumed that left areas outside the mapped hazard zones were potential safe sites.

FINDINGS IN TEST A

Small areas outside the 8 km radius zones were mostly located on the edge of the city's urban space. Due to the location of the next volcanic eruption is unpredictable; Test A cannot prove the "non-affected" areas safe. However, Test A shows that the effects are huge no matter where the next volcanic eruption occur. Instead of finding the safe areas, identifying a number of potential safe sites is rather important to provide more choices in an unpredicted volcanic event.

TEST B

Another set of criteria was the requirements that derived from historical effects and suggestions of volcanic eruptions, tsunami and earthquakes. Public open spaces were considered as suitable for use as evacuation sites when they fulfilled these criteria:

RANGE

1. Located in Auckland
2. Located in the urban space
   Potential sites
3. Out of secondary hazards
4. Big enough for massive evacuation
5. Flat

6. Proximity to roads
7. Proximity to river
8. Proximity to structural transport
9. Proximity to hospital

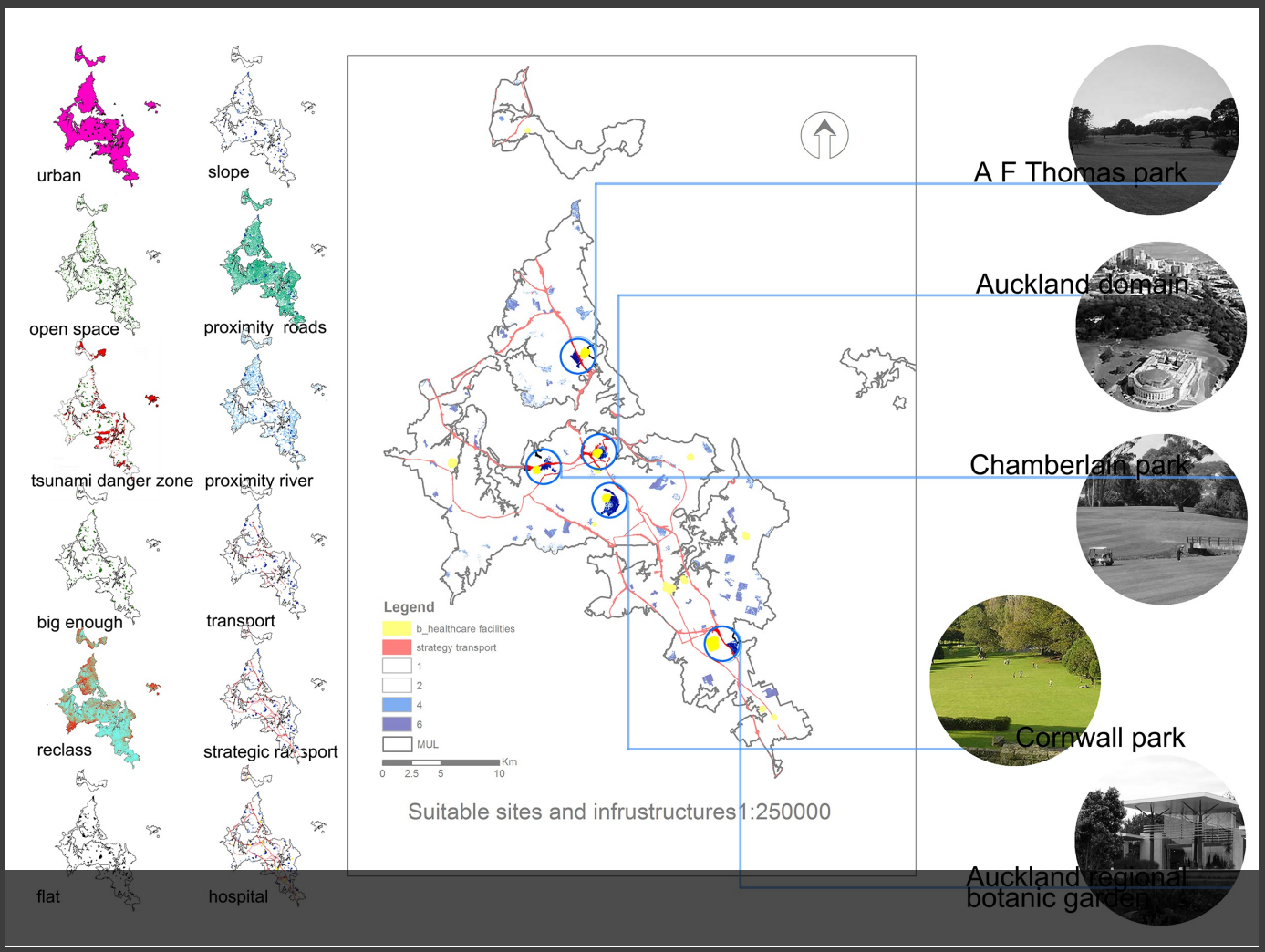
   Sample sites

10. Within 3km of criteria (3 – 8)

Having applied these criteria, many historical volcanic cones mapped to present day parks. These sites were finally chosen as possible evacuation sites because volcanoes in the AVF are unlikely to erupt more than once (except Rangitoto). Furthermore, many of these sites area flat. As sites of future eruptions are unknown, it is essential to have multiple evacuation sites in various locations.

FINDINGS IN TEST B

101 sites were identified as having the potential to function as disaster relief parks; 8 of them were volcanic cones. Apart from several sites which were bush lands and possible unsuitable for large vehicle to access, all remaining sites were considered suitable.



The five sites, namely A.F Thomas Park, Auckland Domain, Chamberlain Park, Cornwall Park, and Auckland Botanic Gardens were found meet all the criteria (Figure 1). Compared with the other potential sites, these five sites have more advantages that able to reach the sources (such as hospital) in a walking distance.

(2) M E T H O D : D E S I G N

The design component involves applying the different methods in a similar manner to site selection. It includes four parts: collect needs from interview; case studies and site analysis; and test the design.

COLLECT INFORMATION FROM INTERVIEW

In acquiring updated information to find a solution for response to a volcanic disaster, an extension research was developed during this ongoing study. The research incorporates new, related information from the newly published Auckland Volcanic Field Contingency Plan that appeared in March 2015 and outlined the planning arrangements for managing an eruption within the AVF. The focus of this publication is closely aligned with this research, such as site selection; both the plan and this research use criteria and mapping systems. To answer a question that arose from the plan regarding any pre-identified sites for volcanic eruption in Auckland, which was also due to the inconclusive findings of other government sources, an interview was arranged with the manager of Civil Defence.

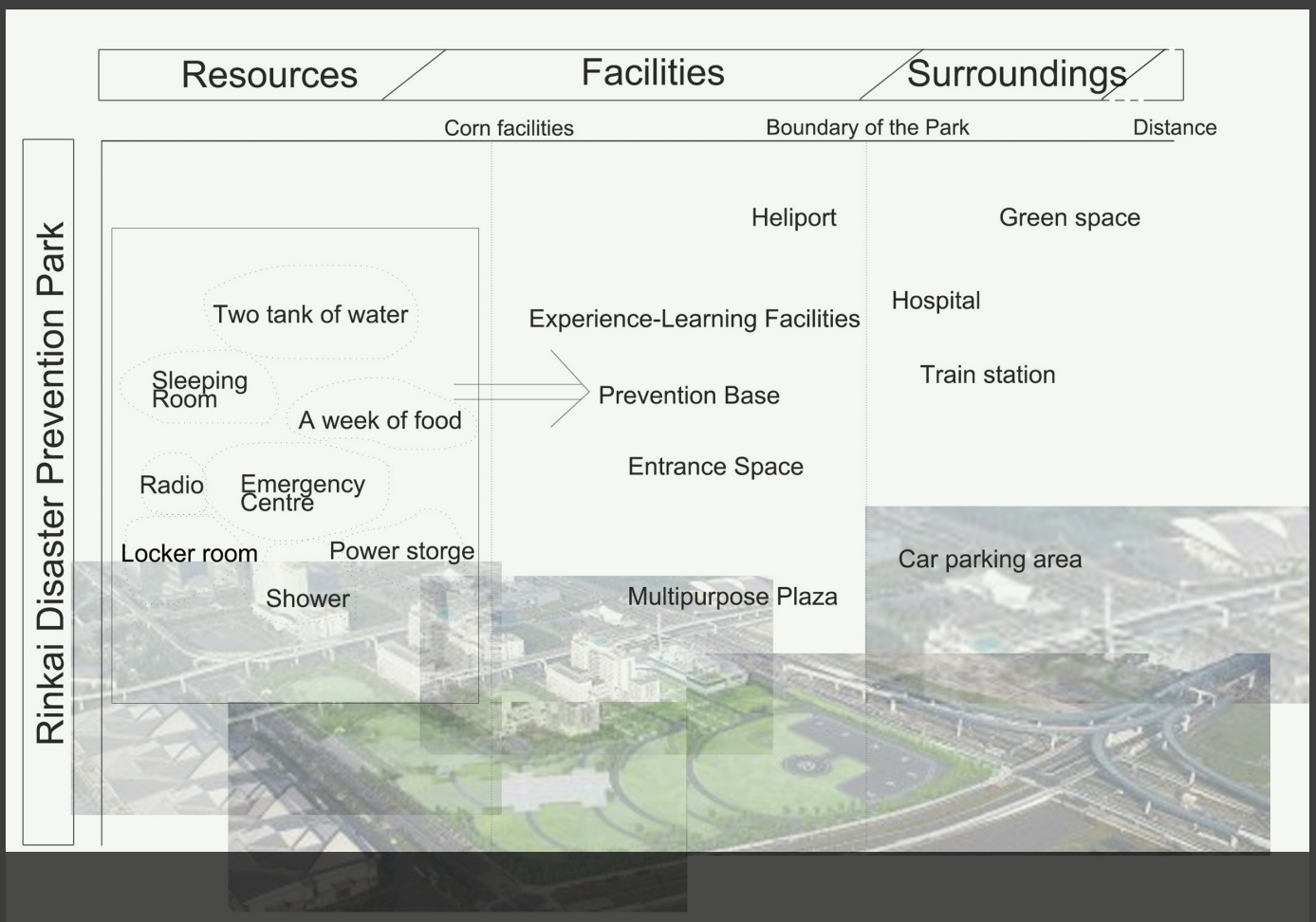
The interview reveled that possible shelter areas are not public information. In the New Zealand context, while storage of goods for natural disasters are not essential, other factors that need to be considered include proximity to the train station, victims need privacy and no signage in this research are flood plains, train routes, patients need a little bit privacy and signage for the possible sites are not needed.

CASE STUDIES

Case studies provide sufficient support for planning an evacuation system and specific emergency response programmes. The 13.2 ha area of Rinkai Disaster Prevention Park was examined. This park comprising the national government park and the adjacent municipal park, is located in the Tokyo Metropolitan Area. It acts as a central base for disaster prevention as well as for tourism and education programmes in everyday life ("About the Park", n.d.).

FINDINGS

Five facilities and eight response resources comprise the prevention park as summarised in Figure 2. These functional relationships will be applied to the analysis of a sample site.



SAMPLE SITE ANALYSIS

Cornwall Park, which covers over 129 ha, is located in the greater central area of urban Auckland. The nearest business centre is Manukau City Centre. The site was researched from three angles: 1. general and legal aspects of the site's history, current usage, and future plans; 2. hard data relating to the

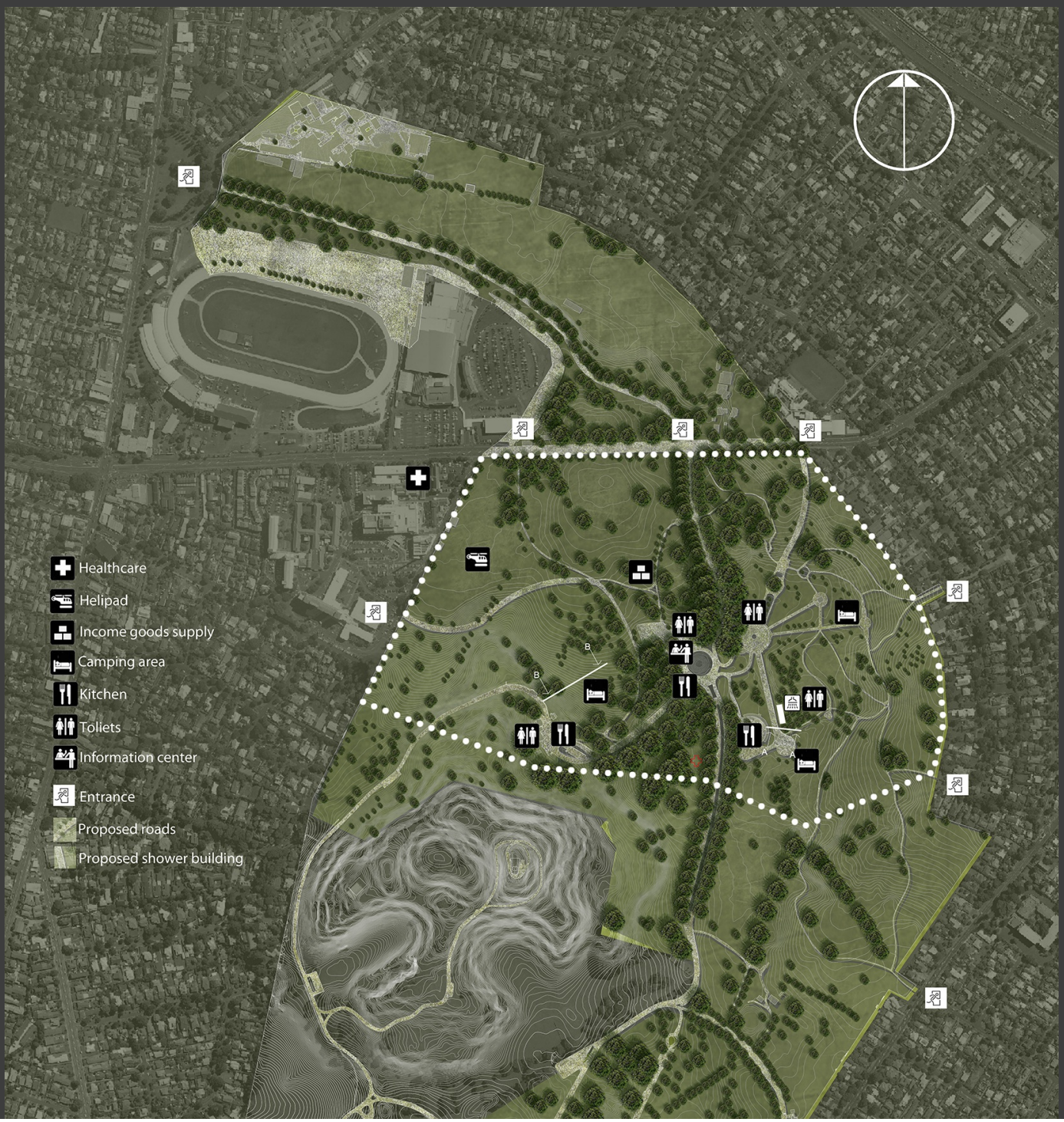
site features and relationships among its surroundings e.g., contours, slope, circulations, on-site features, and climate; and 3. soft data which involves on-site inspection of visual features and feelings from observation.

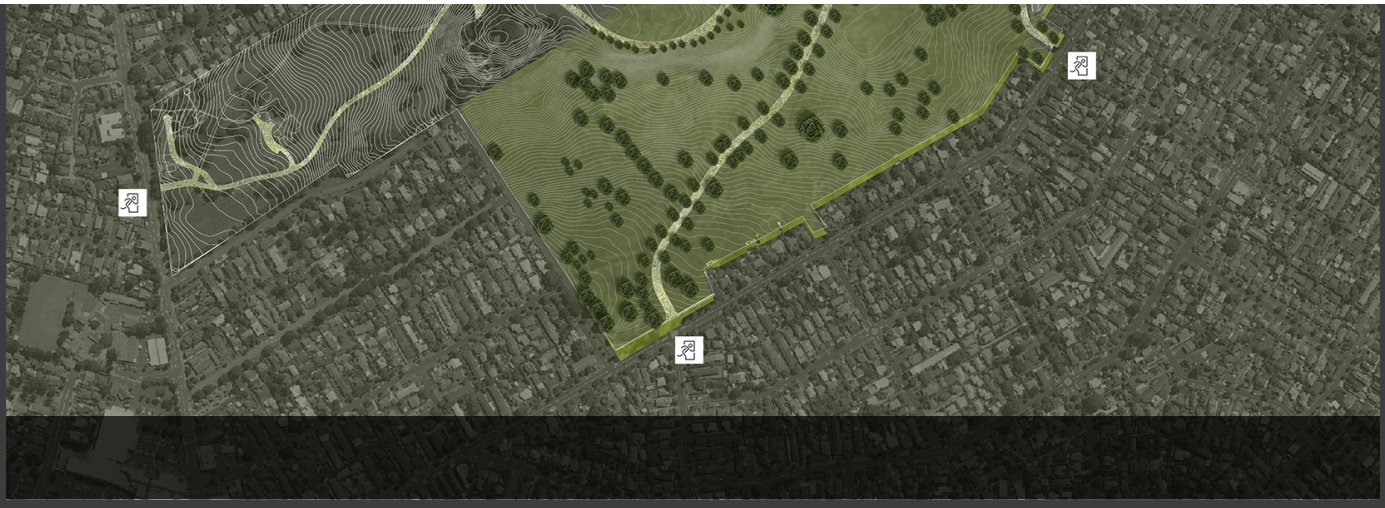
FINDINGS

In summary, this site study has researched both opportunities and constraints, and an emergency response programme was then applied to the most suitable zone identified.

TEST DESIGN

Combining information on real conditions within the local context determined from site analyses and the interview, the programmes summarised from the case study were finally laid out on site as an emergency situation. As Fu, Liang, Du, Wang and Chen mentioned (2008), the five principles of the planning disaster relief parks are as follows: integrated approach to disaster prevention and overall planning, accessibility, walking distance, balance distribution, and the consideration for both daily and emergency needs. In addition, in non-emergency use, it is expected that the design should respect the environment. Two roads are proposed to add to the layout to make sure the multiple choice in an emergency event, a shower (functional) building is proposed on a planned build up area. Those small designs would provide the value in an emergency event see Figure 3.





***EVALUATION**

Sphere Hand Book 2011 gives the minimum demands of sleeping, toilets, showering and rubbish bins. These features were used to evaluate the usage efficiency of the sample site. The analysis found that 22,528 people could be sheltered in the designed camping site in Cornwall Park. More facilities such as toilets and bins would be needed but could be provided in the case of an emergency event.

CONCLUSION

This research was set out to explore how Auckland's open spaces can be used in disaster relief to make the city more resilient. To address the concerns relating to the aftermath of volcanic eruptions, an issue relevant to Auckland, this research applied the idea of building an evacuation network system in existing open spaces as a part of a disaster relief system, a strategy which has been applied in other countries successfully, to a sample site in Auckland. Consequently, possible solutions to reduce loss of lives from a volcanic eruption in AVF were identified.

Open spaces in Auckland are found to be valuable in disaster relief. It is encouraging that there are 101 open spaces covering over 10ha that could function as evacuation sites to shelter people who are affected after a volcanic eruption, and from the secondary hazards of tsunami and earthquakes. Cornwall Park, a recreation site during non-emergency times, was used as a sample site to show how a small design of response facilities can bring significant value to the affected people in the aftermath of a disaster.

This research suggests that sustaining the green space of the existing open spaces creates potential value for their use in disaster relief. An estimated 20,000 people can be sheltered in Cornwall Park. Based on the current population of 1.5 million, this implies that there may be sufficient open spaces for disaster relief provided that all the 101 proposed sites are used, and that each site shelters 20,000 people. However, this capacity will not satisfy the city's need by 2040 given the projected population growth rate.

Another suggestion was to adopt an evacuation network system by including existing open space when building evacuation network systems. This idea has been approved in other countries, though the systems are quite different due to differences in open space classification. However, in the New Zealand, there are other kinds of evacuation sites available as public information. In any future study, it would be good to consider how open spaces could be engaged in forming an evacuation network system. It should include the open spaces smaller than 10 ha that were not studied in this research, and more types of disasters should be considered.

As Auckland population is growing, efficient management of open spaces and setting up evacuation net works can make Auckland city more resilient to future volcanic eruptions. More evacuation sites will improve population's survival. In a volcanic event, emergency alerts will be released by Auckland Civil Defence to warn people to remain at home or evacuate. Due to the amount of magma being small in AVF and volcanic eruptions non-repetitive, the chance of evacuation is increased. Open spaces can potentially be part of the evacuation route when traffic is down. Then, the government can inform the people the safe relief sites. Distant open spaces may be accessed as camping sites to assist recovery.

All the findings in response to the research question can be reduced to the following points:

- The location remains a park or an open space, but simple design moves can provide the residents with shelters and emergency services during disaster relief.
- Cornwall Park is one sample design site among several possible sites identified by a set of pre-defined criteria.
- All the possible sites identified could make up an evacuation network system, and be part of evacuation routes.
- The standard of the evacuation sites could also respond to earthquakes and tsunami as well as volcanic eruption.
- Emergency response features on site could be provided as corn facilities and their use extended to provide service in an emergency event
- Findings relating to the areas that would be affected by historical volcanic cones might be useful in other research.

REFERENCES

About the Park. (n.d.) Retrieved from http://www.ktr.mlit.go.jp/showa/tokyorinkai/english/

Auckland Civil Defence. (2010). Volcanoes, Part B: Hazard specific information (messages), Consistent messages for CDEM. Retrieved from http://www.civildefence.govt.nz/cdem-sector/consistent-messages-for-cdem/

Auckland Civil Defence. (2011). Auckalnd civil defence and emergency management group plan 2011-2016. Retrieved from http://www.aucklandcivildefence.org.nz/media/45880/AC-0162-CDEM-Group-Plan_WEB.PDF

Auckland Civil Defence. (2014). Auckland evacuation plan. Retrieved from http://www.aucklandcivildefence.org.nz/media/48200/BC3598-Auckland-Evacuation-Plan_WEB-spreads-.pdf

Auckland Council. (2012). The Auckland Plan. Retrieved from http://theplan.theaucklandplan.govt.nz/pdfs-and-maps/#downloads

Auckland Council. (2013a). Parks and open space acquisition policy. Retrieved from http://www.aucklandcouncil.govt.nz/EN/planspoliciesprojects/councilpolicies/Documents/parksopenspaceacquisitionpolicy.pdf

Auckland Council. (2013b). Public Open Space, Proposed Auckland unitary plan: Fact sheet. Retrieved from http://www.aucklandcouncil.govt.nz/EN/planspoliciesprojects/plansstrategies/unitaryplan/Documents/Key%20topics%20in%20detail/upkeytopicspublicopenspa

Auckland Council. (2015). The Auckland Volcanic Field (AVF). Retrieved from http://www.aucklandcouncil.govt.nz/EN/environmentwaste/naturalhazardsemergencies/hazards/Pages/volcanichazards.aspx

Fu, J.G., Liang,C.C., Wang, D.W.,& Chen, Z.Q. (2008). Research on the construction of Beijing urban disaster prevention parks. China Academic Journal Electronic Publishing House.

Li, S. H. (2014). The development of disaster prevention green space in China. Landscape Architecture Frontiers, 2(4), 44-51.

Masó, J., Pons, X., Schäffer, B., Foerster, T., & Lucchi, R. (2011). Haiti Earthquake: Harmonizing post-event distributed data processing. Retrieved fromhttp://earthzine.org/2011/03/18/haiti-earthquake-harmonizing-post-event-distributed-data-processing/

Monk, K.A., Fretes, Y., & Reksodiharjo-Lilley, G. (1996). The Ecology of Nusa Tenggara and Maluku. Hong Kong: Periplus Editions Ltd.

Smith, I.E.M.,& Allen, S. R. (1993) Volcanic hazards at the Auckland volcanic field. Wellington: Ministry of Civil Defence. Volcanic hazards information series 5(34) Retrieved from http://www.gns.cri.nz/Home/Learning/Science-Topics/Volcanoes/New-Zealand-Volcanoes/Volcano-Geology-and-Hazards/Auckland-Volcanic-Field-Geology

Tomsen, E., Lindsay, J.M., Gahegan, M., Wilson, T.M., & Blake, D.M. (2014). Evacuation planning in the Auckland Volcanic Field, New Zealand: a spatio-temporal approach for emergency management and transportation network decisions. Journal of Applied Volcanology 2014, 3(6). doi: 10.1186/2191-5040-3-6

Ye, D. Y., & Fu, L. Y. (2013). Planning of Urban Public Disaster-prevention Green Spaces: A Case Study of Living Water Park in Chengdu City. Journal of Landscape Research, 5(05). 20-23. Retrieved from http://jldr.cbpt.cnki.net/EditorEN/WebPublication/paperDigest.aspx?paperID=JLDR201305007&isCnki=ck01

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