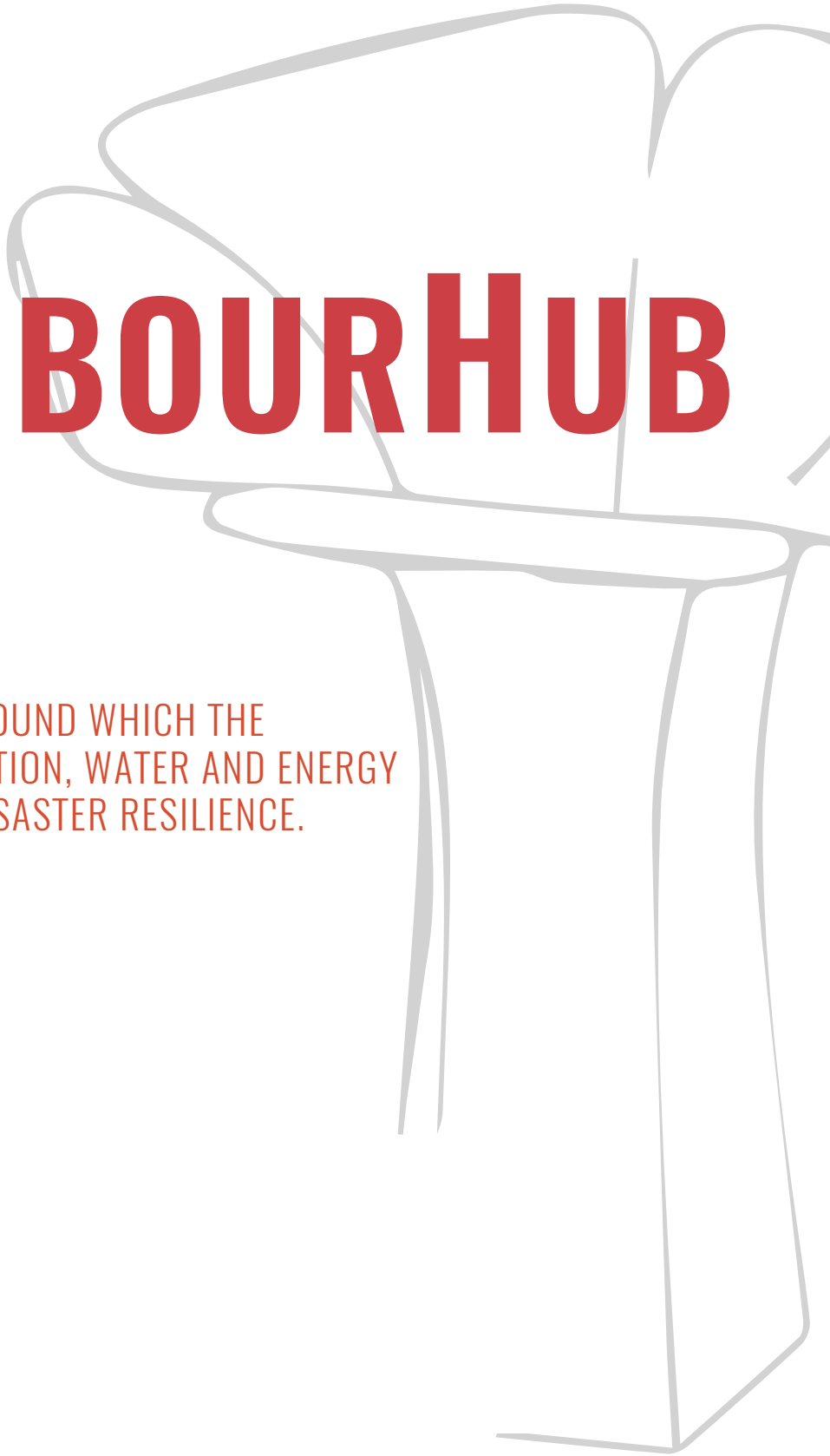
NeighbourHub

A CENTRAL ORGANIZING POINT AROUND WHICH THE COMMUNITY CAN SHARE INFORMATION, WATER AND ENERGY FOR IMPROVED PRE- AND POST-DISASTER RESILIENCE.



RESILIENT COMMUNITY DESIGN CHALLENGE

2018 ENGINEERS FOR A SUSTAINABLE WORLD

Phase 2 Deliverables

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BUILDING RESILIENCE

INTRODUCING VANCOUVER

Vancouver is a beautiful city located between the ocean and the mountains on Canada's west coast. It is renowned for its proximity to nature and leading sustainability initiatives. However, its geography is also the source of a variety of risks. Being located near the meeting point of the Juan de Fuca and North American tectonic plates, Vancouver faces a one in five chance of experiencing a serious crustal or megathrust earthquake in the next 50 years (Wagstaffe, 2016). The City of Vancouver, our primary partner in this project, is currently facilitating important conversations about the area's social and physical resilience. In 2017, the city appointed its first ever Chief Resilience Officer and officially launched a partnership with the Rockefeller Foundation as part of the 100 Resilient Cities Network, with a Resilient City Strategy expected to be released in 2018 (Resilient City, n.d.).

BEAUTIFUL VANCOUVER

Vancouver has been rated globally as a top livable city, with a growing metro population of over two million people.

SHAKEN REALITY

Seismology experts predict that the impacts of an earthquake in Vancouver are likely to resemble the aftermath of the 2011 earthquake in Christchurch, New Zealand. Following a magnitude 6.3 magnitude earthquake, Christchurch lost 185 people and nearly half of the downtown buildings. We were nervous to learn that the infrastructure, building codes, and soil structure of our own city are very similar to that of Christchurch (Linzey, 2016). We can only imagine how the experiences of 300,000 Christchurch residents would scale up to the two million residents in Metro Vancouver. Despite trying times, the population of Christchurch has shown resilience through creative initiatives (Marek, Campbell, & Bui, 2017). Through conversations and research, we learned that the most crucial resources are those which enable a community to come together and collaboratively rebuild.

BETWEEN FAULTLINES

The inactive tectonic plates along the west coast of Canada and the USA make the area long overdue for an earthquake.

NEIGHBOURHUB BUILDING BLOCKS

OUR SOLUTION

To respond to concerns over Vancouver's resilience to earthquakes, we have designed the NeighbourHub: An engaging structure to be located in public parks across the city. The structure responds to the implications of a crisis by offering energy, water, and communications – all independent of the city's existing power and water supply. The NeighbourHub's features, accessible for daily use, familiarize residents with the resources available to them and spark conversations in the neighbourhood around disaster preparedness.

Our NeighbourHub design has five sides, or panels. Each side addresses a particular post-disaster need that we identified in our research. In the following section, we explore how each component of our design addresses some of Vancouver's strengths and weaknesses.

THE NEIGHBOURHUB

A rendering shows how the NeighbourHub integrates into a local park.

ENERGY

CYCLE CITY

Energy is a valuable resource that is consumed on a daily basis. Local energy infrastructure, such as gas and power lines, are vulnerable to being harmed in the case of a natural disaster. In light of this vulnerability, the NeighbourHub produces energy from one of Vancouver's defining attributes: A strong cycling culture. Two sides of the NeighbourHub engage the public through stationary bike generators where passersby can dock their bicycles. These docking stations use human kinetic energy to produce electricity that is stored within 12 volt batteries inside the structure. Individuals will be invited to back their bike into the structure and pedal to generate power. A small LED display will indicate in real-time how much energy they are generating, turning the activity into an entertaining game. The LED indicator will foster a sense of responsibility as individuals are reminded that energy is a finite resource connected to their actions.

Vancouver is considered a top cycling city despite its notoriously rainy weather, with 175,000 cyclists out over the average month of August with 3,200 tips made in a single summer day. There is even a Bicycle Emergency Response Team of emergency-trained city volunteers

CYCLING CULTURE

The City of Vancouver promotes active transportation with designated cycling infrastructure.

PEOPLE POWER

Steph Koenig generates power at Dude Chilling Park in a rendering of the NeighbourHub.

POWERING THE PARK

Acknowledging that not everyone can own or ride a bike, our NeighbourHub is designed to bring together the community so that family members or neighbours can generate electricity to share. Each NeighbourHub also incorporates a hand crank that allows individuals of all capabilities to produce energy. One minute of rotating the hand crank creates enough energy required to make a one-minute long phone call. Situated at the top of the structure are three south-facing solar panels, each generating roughly 82 watts per day. Combined, the structure's energy-generating components could generate over 200 watts in one hour, enough to charge more than 30 cell phones.

WATER

REILIANT ON RESERVOIRS

Residents across Metro Vancouver receive tap water from one of three reservoirs on the mountains north of the city. Millions of litres per day travel through thousands of kilometers of underground water mains that weave below the city's surface ("Planning for growth...", n.d.). A serious earthquake has the potential to cause flooding, liquefaction, landslides, and even tsunamis. These effects could cause intense disruption to infrastructure like pipes, which would lead to the contamination of city water supplies. When underground tunnels and transmission pipes become susceptible to breakage, the chances of microbial contamination are heightened, magnifying the impact of the event and prolonging the recovery period.

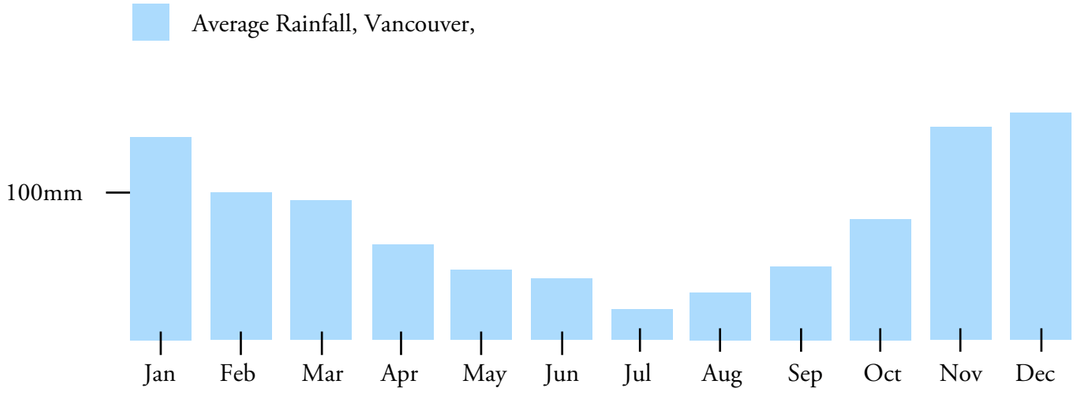
Vancouver is a narrow peninsula surrounded by mountains, rivers, lakes, and the Pacific Ocean. The only way in or out of the city core is via bridges or tunnels, which could be in a critical state following an earthquake and will require seismic evaluations before being opened for the transport of emergency supplies. In the case that fresh water cannot be immediately delivered to the city by external emergency responders, residents will be left without water. The government of British Columbia recommends emergency stores of at least one gallon of water per person per day, for three days following a disaster. However, only 42% of Metro Vancouver residents currently store such a supply (Ipsos Public Affairs, 2018, p. 25).

LAND LOCKED

Movement of supplies in and out of the city is dependent on a series of bridges and tunnels.

RAINY VANCOUVER

Another local strength of "Raincouver's" is an abundance of fresh, drinkable water in the form of rain. Our design incorporates the collection and storage of rainwater, making it Vancouver's first ever public rainwater catchment system. This feature supports Vancouver's 2018 Rain City Strategy, which focuses on developing more resource-efficient approaches to collecting the area's abundant rainfall. NeighbourHubs will help residents collect rainwater on a daily basis, increase the number of available drinking fountains in parks, and educate the public about the benefits of harvesting rainwater.



WATER

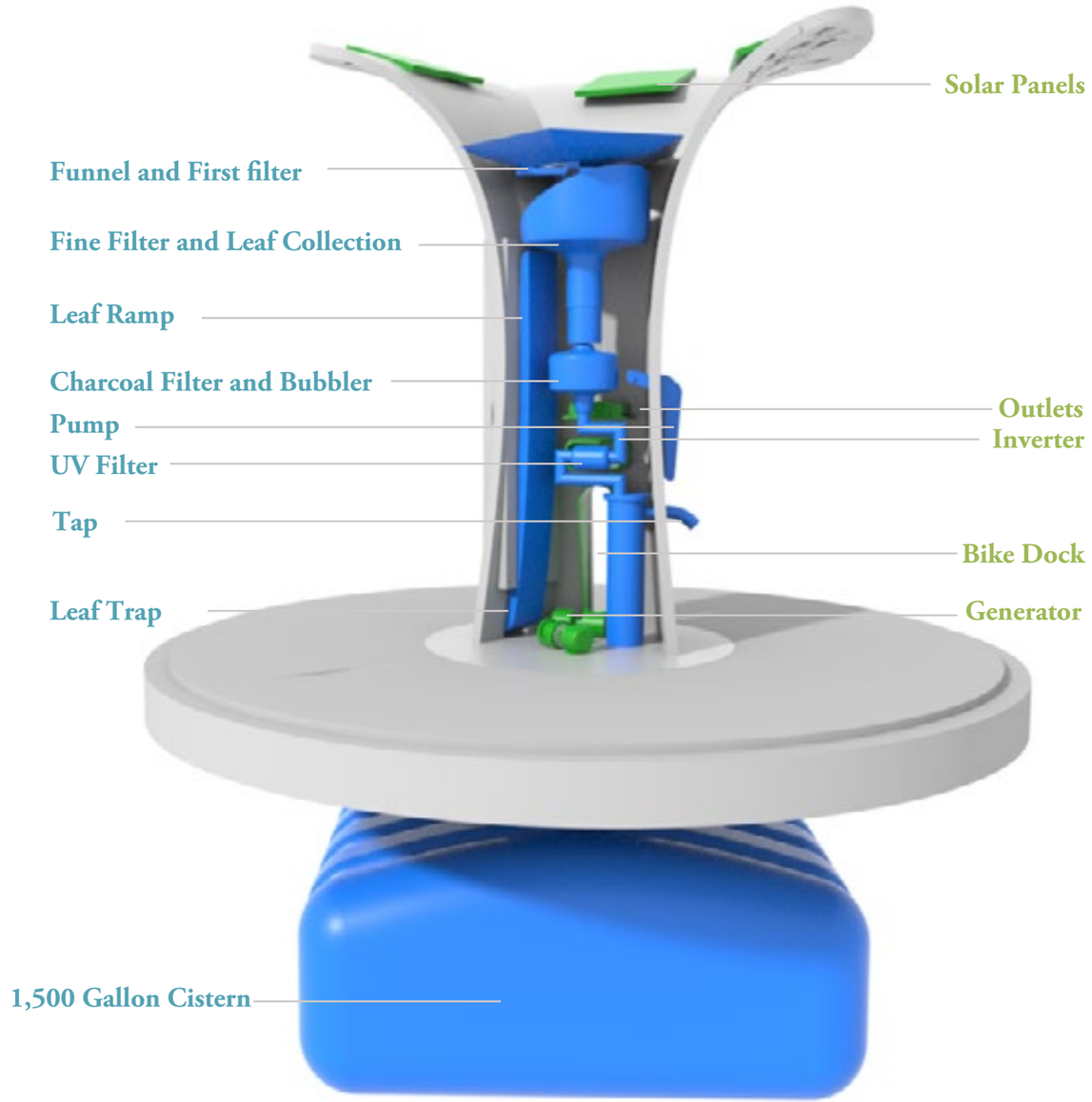
RAIN AS A RESOURCE

While it could take days to receive shipments of potable water and months to dig underground and repair the damaged water infrastructure, rainwater collected by each NeighbourHub will act as a localized backup supply for the first 72 hours following a disaster. Each NeighbourHub's underground cistern holds up to 1,500 gallons and is completely independent of Vancouver's water system. The 50,712 cm2 surface area of each NeighbourHub rain catchment area has the ability to collect 1,607 gallons of water (Ozcelik, 2018) in one year based on Vancouver's average yearly rainfall of 1,200 mm3 (Rain City Strategy, n.d.). For the 72 hours following a disaster, a full NeighbourHub cistern has the capacity to provide one gallon of water per day for 473 people, or a quarter gallon per day to 1,892 people. By encouraging neighbours to store sufficient water in their own homes and engage in rainwater-collection in their yards, the NeighbourHub aims to reduce the residents' dependence on external sources while supplementing existing water reserves in times of crisis.

To ensure the tank is full in the driest months of the year, summer fillings would be organized with the help of the City of Vancouver and community members. Potable water to top up the tank is easily accessed by nearby fire hydrants (Fire Hydrants, n.d.). The structure's storage tank contains a side valve opening to allow city staff and community stewards to easily replenish the tank and address any maintenance needs. The filtration system is designed to be self-cleaning (via a bubbler) to minimize the need for upkeep.

INSIDE THE NEIGHBOURHUB

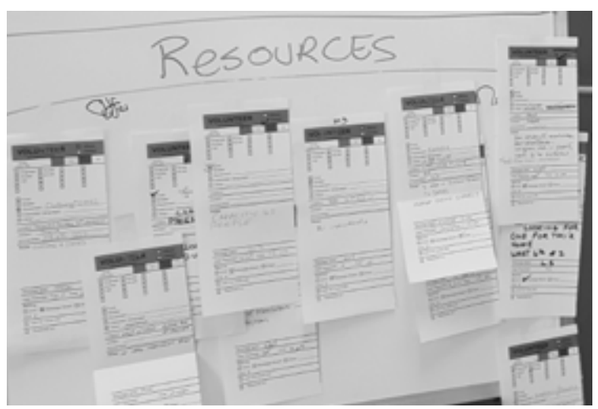
The shaded blue indicates parts related to water collection, filtration, and storage. The green parts represent the energy component of the structure.



COMMUNICATION

SHARING RESOURCES

Communication connects members of the community with each other, important resources, and emergency responders.



CONNECTING A COMMUNITY

An often overlooked post-disaster challenge is the need for communication. Considering that earthquakes impact physical communication infrastructure, residents are likely to be without cell phone or internet communication for hours to days (Wagstaffe, 2016). One-way radios will become a major source of information for government updates. However, according to a recent survey, only 32% of Metro Vancouver residents have a battery powered or hand crank radio (Ipsos Public Affairs, 2018, p. 25). For this reason, the NeighbourHub includes a one-way radio that is powered by the structure's solar and kinetic energy. To enable neighbours to share information with each other, one side of the NeighbourHub has a community bulletin board, which could also be used by the City of Vancouver to disseminate important information (Tobin Postma, Personal Communication).

EXISTING EFFORTS

Based on previous community exercises in Vancouver, bulletin boards have proven to be convenient tool to use in emergency situations and during the recovery period. The NeighbourHub could adopt the message-sharing framework developed by the Dunbar Earthquake and Emergency Preparedness group, that helps residents organize messages into "needs", "wants" and "missing people" to maximize efficiency (Ann Pacey, Personal Communication).

COMMUNICATING QUICKLY

Communication during and after a disaster is an important component of response and recovery.

COMMUNITY

SOCIAL FABRIC

Vancouver's many diverse communities present a range of socioeconomic and cultural conditions - from being home to one of Canada's largest urban indigenous populations (Ball, 2018), to the transient and visiting population (William-Ross, 2018), and to the extreme poverty concentrated in the Downtown Eastside ("Downtown Eastside Local Area Profile", 2013). These diverse conditions require that solutions to foster resilience be adaptable and context specific. In this light, we have designed the NeighbourHub with modular components, or "building-blocks", which can be adapted to meet specific community needs. To support equitable access to resources, our vision is to implement a NeighbourHub in a public park within a ten minute walk of every household. This is possible because the City of Vancouver has a mandate to implement parks within a five minute walk of all households by 2020 (City of Vancouver).

LONELY CITY

One of Vancouver's present challenges is a high rate of loneliness and social isolation. In a 2017 survey, social isolation was found to affect one in four people and Vancouver was characterized as "a hard place to make friends" with "a declining level of participation in community life" (Vancouver Foundation, 2017). These experiences have negative repercussions on a population's resilience to shocks and stresses, as illustrated in disaster scenarios comparing social cohesion in Japan, New Zealand, and Canada (Nirupama, 2015). In a disaster, the lack of social networks and community preperation plans will leave many residents vulnerable.Despite local outreach efforts, only 12% of Metro Vancouver residents have a complete emergency plan with loved ones (Ipsos Public Affairs, 2018, p. 18).

SOCIAL SUPPORT

Social cohesion has proven to be a crucial factor determining the response of communities to natural disasters.

THE NEIGHBOURHUB'S ROLE

NeighbourHubs will address the vulnerabilities of Vancouver communities in three fundamental ways. First, through educational signage, each NeighbourHub raises awareness of the risk of an earthquake and encourages residents to start conversations around disaster preparedness, prepare their personal safety kits, and make plans with loved ones. Second, the NeighbourHub fosters connection within a community, leading to new relationships and the sharing of knowledge and resources. Third, by engaging community members with functional components that produce water and energy, the NeighbourHub educates the public about the City of Vancouver's goals regarding large-scale sustainable resource management (such as the Rain City Strategy and Renewable City Strategy). By introducing NeighbourHubs into parks, the City of Vancouver also promotes the value of public space and encourages the everyday use of a valuable community asset.

After an earthquake shakes the Pacific Northwest, the NeighbourHub's resilient design will remain functional and will continue to support the community. People will have developed neighborhood-scale plans and will have a familiar and safe place to gather, free from debris, to share resources and information.

MAP OF VANCOUVER

NeighbourHub map with a focus on our original case study of Dude Chilling Park. Data Retrieved from Census Canada 2016.

Inspired by Center for Neighborhoods developed in Kansas City Missouri, the NeighbourHub team is considering holding yearly city-wide neighbourhood gatherings at which representatives from each NeighbourHub could share insights, discuss successes and challenges, and learn from each other. Yearly community gatherings around the NeighbourHub will help foster and maintain relationships.

IMPLEMENTATION PROCESS

CITY APPROVAL

Following approval of the overall concept from the City of Vancouver and the Vancouver Board of Parks and Recreation, and in consultation with local First Nations (including Musqueam, Squamish, and Tsleil-Waututh Nations), the NeighbourHub concept will be presented in various neighbourhoods to identify communities interested in participating. Where interest is indicated, community members will be invited to a co-creation workshop (a NeighbourHuddle) to discuss local needs, specific components of their NeighbourHub, and possible locations. A formal proposal will be formulated, a site analysis requested from the city's Engineering department, and permission requested from the city or Parks Board (depending on the site).

COMMUNITY ENGAGEMENT

A trial asset mapping workshop hosted by the NeighbourHub team at the Little Mountain Neighbourhood House.

CO-CREATING RESILIENCE

As city approval processes happen, community members will be provided with support as they plan how to incorporate the NeighbourHub into an existing organizational structure (such as a Neighbourhood Block Watch) or how to form an organizational structure and identify key stewards. Communities will be given a toolkit of resources, suggestions, and best practices to guide them through the process of taking ownership of the structure. The NeighbourHub team will also assist with a call-out for community art that integrates specific design features identified in the NeighbourHuddle. Submissions will be posted online and residents around the area will be invited to vote, using a voting method proven effective across Vancouver ("Decorative wraps in", 2017). After construction, the NeighbourHub stewards (called NeighbourHelpers) can organize a ribbon-cutting and asset-mapping event during which they will co-create the structure's community asset map. This event can provide an initial opportunity for neighbours to meet and exchange contact information.

LOCAL REALITIES

NeighbourHuddle workshops will help residents look critically at the needs and resources of their communities.

By hosting information sessions and workshops, the NeighbourHub team creates safe and comfortable spaces for diverse residents of Vancouver to discuss themes of resilience, share knowledge, and ask questions. Neighbours participate in activities that help them imagine and interact with the team's ideas in a tangible way (for instance, asset-mapping). Workshop participants provide ideas or feedback to be integrated into the design process. The success of community engagement could be evaluated based on the depth of conversation that takes place and the number of new connections made between neighbours in the process.

MEASURING SUCCESS

ASSESSING OUR ACHIEVEMENTS

In addition to the feedback and interactions generated during design, the team has identified several metrics by which to measure the success of different facets of the NeighbourHubs after implementation. A pilot NeighbourHub could have a designated steward responsible for keeping track of it for the set trial period of a year.

By using these measurements, the team will have a way to objectively measure the success of our prototype. However, we understand that each neighbourhood will have specific resilience needs that will require different measurable outcomes to determine each NeighbourHub's success.

CONTINUED INVOLVEMENT

The community can play as large a role during the design and implementation of the NeighbourHub, as seen in a mock NeighbourHub workshop.

USE OF SMALL-SCALE TECHNOLOGY:

- Meters that measure monthly rainwater collection, water use, energy production, and energy use will help us understand the distribution of resource usage over the year.

INFORMATION SHARING:

- Number of postings on bulletin board per month.
- Number of passersby who stop to look at bulletin board per day.

COMMUNITY ENGAGEMENT:

- Number of neighbours attending the initial NeighbourHub launch and follow-up workshops and events.

STEWARDSHIP:

- Number of neighbours on leadership team, and their representation of neighbourhood demographics.

PROJECT BUDGET

BUDGET BREAKDOWN

We have broken down the cost for a single NeighbourHub to be implemented in one park in Vancouver. The estimates in the table below are based on the average cost of materials and labour in Metro Vancouver. Although actual bids have yet to be offered, there are possibilities for potential partnerships and sponsorship.

Estimates cost of one structure including implementation and year-long maintenance: $6,422 CAD

CONSTRUCTION

Part	Details	Cost
Steel	Stainless steel sheets	$200
Engraving and CNC	Charged per hour of cut time	$500
Construction	Screwed and welded together	$300
Artist payment	Accepted contributions	$300
	Total Cost	$1,300

WATER

Part	Details	Cost
Tank	1,500 gallon underground water cistern tank	$2,000
Piping	An array of PVC pipes with flexible joints	$100
Siphon System	Lever-action hand pump with faucet	$50
Charcoal filtration system	Four Berkey charcoal filters	$250
UV filter	UVF11A UV Disinfection Sterilizer Water Filter	$200
First flush screen	Sized to fit	$50
Collection funnel	Part design and manufacture	$50
	Total Cost	$2,700

ENERGY

Part	Details	Cost
Batteries	Four 12 volt lithium ion batteries	$85
Docking Stand	Custom part manufacturing for two parts	$100
Motor	Two 120 volt motor	$200
Ball Bearing rollers	Four heavy duty rollers	$30
Inverter	Two 450 watt inverters	$42
Outlets	Stock outlets with grounding	$20
Radio	Stock radio	$20
	Total Cost	$497

IMPLEMENTATION

Part	Details	Cost
Hole digging	Backhoe and labourer	$500
Securing the tank	Cistern crane drop off and buffering sand	$500
Pouring foundation	Cement truck and labourer	$500
Securing the structure	Drill into the cement	$200
Replanting grass	Labourer	$50
	Total Cost	$1,750

ONGOING MAINTENANCE BASED ON YEARLY AVERAGE

Part	Details	Cost
Filing in drought months	Cost of labour based on two site visits per year	$100
Standard check-ups	Cost of labour based on four site visits per year	$75
	Total Cost	$175

NEXT STEPS

PRESENTATIONS & EXPOSURE

- March 29 CityStudio presentation
- April 6 presentation at the 2018 ESW Annual Conference
- April 24 Smart Cities Challenge proposal due
- May 4-20 Emily Carr Grad Show Exhibition

March-May

COLLABORATION WITH INDIGENOUS COMMUNITIES

- Schedule meetings with Musqueam, Squamish, and Tsleil-Waututh representatives to have conversations around resilience, Indigenous representation, and possible design implementation

May-June

CONTINUE CONVERSATIONS WITH PROJECT PARTNERS

- Meet with Neighbourhood Resilience Coordinator, Chief Resilience Officer, and Director of Strategic Initiatives for next steps
- Contact potential sponsors, including Shaw Communications
- Receive bids on manufacturing and construction

June-July

DEVELOP COMMUNITY IMPLEMENTATION STRATEGY

- Develop NeighbourHub implementation toolkit
- Approach communities to assess interest in launching a pilot NeighbourHub

August Onwards

CONCLUSION

DESIGNING FOR RESILIENCE

With the threat of an earthquake looming, Vancouver should be racing to develop a robust disaster response and recovery system. Although programs are in place to offer residents support making disaster preparedness plans and emergency kits, a gap seems to seperate resources from implementation and action. By bringing attention to the importance of community preparedness, social cohesion, and local resources, a network of NeighbourHubs would supplement Vancouver's existing efforts and support current city goals of disaster preparedness and sustainability. The ultimate goal is for local residents to be prepared and to care for one another in the critical 72 hours after a disaster and into the process of long-term recovery. This will move critical responsibility away from falling solely on the City of Vancouver and towards the empowerment of each and every community. With this achieved, residents of Vancouver will be more resilient before, during, and after an earthquake.

NEIGHBOURHUB

Rendering of team member Steph Koenig by the NeighbourHub in Dude Chilling Park.

REFERENCES

REFERENCES

Ball, D. (2018). Top 5 Cities in Canada With the Most Indigenous People. Indian Country Media Network. Available from: https://indiancountrymedianetwork.com/news/first-nations/top-5-cities-in-canada-with-the-most-indigenous-people/

Decorative wraps in, graffiti out, for B.C. utility boxes. (2017). Bchydro.com. Available from: https://www.bchydro.com/news/conservation/2017/wraps-resist-graffiti.html

Downtown Eastside Local Area Profile. (2013). Vancouver.ca. Available from: http://vancouver.ca/files/cov/profile-dtes-local-area-2013.pdf

Fire Hydrants, n.d. City of Vancouver. Available from: http://vancouver.ca/home-property-development/fire-hydrants.aspx [Accessed 22 March 2018]

Marek, L., Campbell, M., & Bui, L. (2017). Shaking for innovation: The (re)building of a (smart) city in a post disaster environment. Cities, 63, 41-50.

Nirupama, N., Popper, T., & Quirke, A. (2015). Role of social resilience in mitigating disasters. International Journal of Disaster Resilience in the Built Environment, 6(3), 363-377.

Ozcelik, M. (2018). Alternative model for electricity and water supply after disaster. ScienceDirect. Available from: https://www.sciencedirect.com/science/article/pii/S1658365517300031

Rain City Strategy. City of Vancouver. Available from: http://vancouver.ca/home-property-development/green-infrastructure-documents-and-policies.aspx

Resilient City (n.d.). City of Vancouver. Available from: http://vancouver.ca/people-programs/resilient-city.aspx [Accessed 20 March 2018]

Sinoski, K. (2015). Planning for growth in Metro Vancouver's demand for water .... Available from: http://www.vancouversun.com/technology/planning growth metro vancouver demand water with video/11366229/story.html

Survey about emergency preparedness in BC. Available from: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/preparedbc/preparedness_survey_report_feb_9.pdf

Wagstaffe, J. (2016). Faultlines [Audio podcast]. Available from: http://www.cbc.ca/radio/podcasts/fault-lines/ (Accessed 8 March 2018).

William-Ross, L. (2018). A record-setting 10.3 million people visited Vancouver in 2017. Vancouver Is Awesome. Available from: https://www.vancouverisawesome.com/2018/03/20/vancouver-tourism-record-2017/

PHOTO URL'S

See page 5 - Available from: www.cbc.ca/news/canada/british-columbia/fault-lines-big-one-1.3795416

See page 8 - Available from: https://news.ubc.ca/2014/01/06/cycling-safety-tips-for-the-new-year/

See page 16 - Available from: http://www.cbc.ca/news/canada/british-columbia/aftershocks-new-zealand-1.3798509