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Land Stewardship in the Climate Wrung Epoch

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Abstract: This paper discusses a student research by design project, undertaken as the culmination of a Bachelor of Landscape Architecture degree. The project used theories and principles from resilience thinking as a lens of inquiry, and guidelines for redefining vulnerable coastal land in Onehunga industrial zones undergoing urban development. Asking the question How can vulnerable land be turned into adaptive land that is 'safe' for communities? The project explores ways to prototype and test resilience ideas that re-examine and redefine everyday lives, challenge the status quo, and integrate living, working, playing and land stewarding. Key design moves were based on the understanding of complex adaptive social-ecological systems, from individual community members to society as a whole, are embedded in the biosphere and dependent on its life-supporting capacity. By hypothetically testing an alternative way of living, and through a shared process of learning, a new land-use agenda that incubates everyday forms of resilience would emerge, and a downshift mindset promoted by acquired skills would transcend the economic growth driven paradigm that is no longer adaptive and appropriate for the climate change wrung epoch: the Anthropocene.

Keywords: Resilience thinking; climate change; land stewardship; community building.

1. Introduction

Human inhabitation has been focused around bodies of water throughout history. In New Zealand particularly, access to our coast is considered a birthright (Peart, 2009). The coast is at the very core of New Zealand identity. Rapidly growing populations, particularly in urban environments, is putting increasing pressure on coastal settlements and has seen economic incentives take precedence over the ecological and environmental values, and increasingly coastlines are being overtaken by large-scale developments. The hardening of the coastal edge through intensive development has drastically limited the adaptive capacity of the coast, and coastal communities. Climate change and its related impacts continue to increase the tension between the built edge and the sea. The line that separates land from sea does not really exist beyond the conventions of map drawing (Mathur and Da Cunha, 2010). Continuing climate related change in the coastal environment only further blurs the edges. The natural environment does not work with finite lines and boundaries and we must begin to accept and integrate

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this into our coastal settlements. The need to develop a resilient and mutually beneficial relationship between these climate change vulnerable coastal zones and the human inhabitation is becoming increasingly apparent. Managed retreat, leaving the edge to its own devices, or intensive protection and development, neither addresses the history of human inhabitation of the coastal edge nor deals with the vulnerable nature of the coastal system appropriately (Bloomfield, 2018). With landscape architecture as the interface between the conflicting needs of ecological and socio-economic systems, a more adaptive and viably interdependent relationship can be created.

Auckland is known for its harbours and tributaries that form large areas prone to flooding hazards (Fernandez et al, 2019). Climate change will increase the severity and frequency of flooding across Auckland: 23% of Auckland buildings are prone to flooding, and 16,000 buildings are estimated to be at risk of floor flooding in 100year flood events (Fernandez et al, 2019).

The research by design case study project, sited in Onehunga, Auckland, New Zealand, proposes designed solutions for integrated coastal development that favours both inhabitation and the revitalisation of ecological coastal systems equally. The intention is to create a model that retrofits existing coastal developments, enhancing both the socio-cultural values of the community, and the ecological and environmental systems that characterize the coast.

Figure 1: Siting the project.

2. Methodology

This paper focuses on a landscape architecture student project as a case study. The case study project addressed climate change and community resilience using the methodology of research by design. This allowed for a reflexive process of multiple feedback that encourages complex system thinking as opposed to mechanistic and linear thinking (Roggenma, 2016). Design testing was conducted in three overlapping phases: pre-design, design and post-design. Design theories were developed into strategies and measures. They were then converted into site-specific design interventions and tested through the process, interwoven with continuous research and active exchange of critique and feedback. This was an iterative process. It is also understood that the purpose of research by design is not solution oriented, but rather a learning curve and a cognitive development. For this paper a desktop review of literature, and further case study analysis was undertaken to support and expand on the primary case. This allowed for discussion of alternative land 'ownership' strategies and approaches. This paper is intended as a starting point for further research.

3. Literature Review

Prehistorically the use of temporary settlements in changing environments allowed for resource

exploitation without a great extent of investment and risk (Nicholson and Cane, 1994). Migration has been a human adaptive strategy in the face of changes in the environment, due to climate or catastrophic events, that changed the availability of resources or the ability to access them (McLeman and Smit, 2006). As the climate settled and the knowledge and technological ability to protect against the advance of the sea developed, investment in the coastal environment has become more prevalent. With this increased confidence in protective structures, human responses to changes and instability in the coastal environment began to stabilise, often using hard engineering structures. By limiting the natural responses, the hard engineering protective structures are increasing the tensions between natural processes and the man-made environment (Charlier and Chaineux, 2005; Hansom, 2001; Helvarg, 2003; Klein et al, 2001; Nicholls and Klein, 2005; Tol and Klein, 2008).

3.1. Climate Change

Sea-level rise (SLR), increased storm intensity and a warming climate, due to increased C02 levels in the atmosphere, are among some of the accepted indicators of climate change. There are immediate impacts such as coastal inundation and flooding that cause disruption of low-lying bloodline infrastructure and transportation. Properties are exposed to damage and the community's safety and well-being is endangered (Fernandez et al, 2019). It is also necessary to consider less direct impacts such as social dislocation and displacement and related psychological stress (Lindley et al, 2011). Positioning those tensions and challenges in a reality of wicked problems: unstable global economy, volatile international politics and the current global pandemic exposed the complexity of climate change. Policy and decisions are defined by what society wants and expects from its environment, acknowledging human needs in the short term (Crance and Draper, 1996; Tol and Klein, 2008). This highlights the importance of education and knowledge sharing (Scott et al, 2006). Adjusting to living with the natural processes in the coastal environs will require a change of attitude, priorities, and of community understanding and awareness if there is to be integrated coastal management, sensitive development and coastal inhabitation in our future (Barnett, 2001; Helvarg, 2003; MacDonald and Thom, 2009; Nicholls and Klein, 2005; Scott et al, 2006).

Resilience thinking is based on system science that understands our planet and all its organic and inorganic elements as a changing whole. It positions the human dimension (individuals, households, communities, societies, economies and cultures) as part of the interlinked, complex and adaptive social ecological system. It was identified that a main driver of unsustainable development is the application of inappropriate approaches to natural resource management which are often based on static and linear understanding of the social-ecological system while ignoring abrupt changes such as climate change events (Folke, 2016; Walker and Salt, 2006). Exacerbating these circumstances is the illusion of command and control of natural processes and the belief in perpetual growth based on maximising efficiency and optimizing performance of the parts of the social-ecological system (Walker and Salt, 2006).

Thresholds and adaptive cycles are two key models in resilience thinking that provide practical analysing tools that allows insightful understanding of the structure and dynamics of socio-ecological systems at and across a range of temporal-spatial scales (Folke, 2016; Walker and Salt, 2006). Examining vulnerable coastal land through this lens exposed the risk of late conservation (K) and quick release (Ω), often meaning degraded and unhealthy ecological conditions with a backdrop of intensifying urban development. The danger is that the system might be pushed over an unclear threshold and enter an unfavourable yet resilient regime, for example an eutrophicated pond, devastated coral reefs or

collapsing ice shelves. Those two models also highlighted the importance of taking radical actions that increase biosphere capacity or the volume of the 'basin', and instigate fundamental paradigm shifts in system operations and individual behaviours, so that the overall system operates within the carrying capacity and keeping a safer distance from the late conservation and release phases (Folke, 2016; Walker and Salt, 2006).

Adaptive capacity is about latency and flexibility creating space for responsive adaptation within the socio-ecological system. Building adaptive capacity within coastal settlements increases their resilience and creates space within the community for the absorption of gradual changes, while also providing a platform for faster recovery in the event of any larger scale disturbances. The scientific prerogatives of reports dealing with the natural environment often tend to sideline issues of socio-environmental relationships, particularly on the coast. While the ecological research is critically important, the relationships between the natural environment and human settlement need to be better articulated and the high value of ecological resilience needs to be incorporated in the socio-economic values of the community. Our relationship with our environment needs to be symbiotic, and future development needs to value and highlight these interrelationships and interdependencies.

3.2. Land Ownership

Early colonial settlers to New Zealand had experienced the enclosure of the commons, eviction of tenant farmers and as a result were very aware of the independence and power that came with land ownership. The desire to freehold land was a powerful driver of land policy and settlement (McAloon, 2008). In economic terms land is considered a scarce resource and essential element of production to produce outputs (Bahmanteymouri, 2017). This has inevitably led to a people and land relationship that focuses on the capital value of land while overlooking its environmental values and its social-cultural significance.

The concept of land stewardship comes from the medieval word 'steward' meaning 'keeper of the hall', more recently it has come to mean someone who cares for something on someone else's behalf. Land stewardship is then the responsibility for, and care for, the natural environment. In a New Zealand context this is related to the Māori environmental management concept of *kaitiakitanga*, which translates as similar to guardianship or stewardship.

Stewardship has become associated with the environmental movement as a land management approach that allows concerned groups to invest in landscapes and environments for positive environmental outcomes. To date land stewardship is predominantly associated with voluntary engagement in privately owned land for the benefit of natural ecosystem health. Stewardship of public spaces on smaller scales in urban environments is becoming more common. Public space is considered the responsibility of territorial authorities in regard to management and maintenance, and conflicting views of how it might be managed within a community can lead to it being not managed or maintained at all. Like the enclosure of the commons this has led to a less inclusive approach to land management in urban environments in particular.

> ...public ownership too often means non-ownership, leading to the "Tragedy of the Commons". Land ownership patterns are critical to stewardship, but no one type of ownership guarantees good stewardship. It implies knowledge, and caring for, the entire system of which that land is a part, a knowledge of a land's context as well as its content… This means that stewardship depends on interconnected systems of ecology and economics, of politics and science, of sociology and planning (Young, 2020).

The definition of the city as a common as described by Foster and Iaione (2016) could be transferred into the context of coastal Onehunga's vulnerable land. Reimagined as a 'common' in this context the Onehunga site could be disentangled from the complexities of traditional western ownership paradigms in the face of climate related threats, and re-positioned as a community asset:

> ... to recognize the community's right to access and to use a resource which might otherwise be under exclusive private or public control - on account of the social value or utility that such access would generate or produce for the community (Foster and Iaione, 2016).

The inherent issues with, and the potential of the commons is often debated and is summarised well by Foster and Iaione (2016):

> Hardin famously postulated that threats of degradation and destruction of the commons give rise to either a system of centralized public regulation or the imposition of private property rights in order to avoid the "tragedy". Ostrom's ground-breaking work, on the other hand, demonstrated that there are options for commons management that are neither exclusively public nor exclusively private. Ostrom identified groups of users who were able to cooperate to create and enforce rules for using and managing natural resources.

In Te āo Māori (the Māori world view) we are the kaitiaki (guardians/stewards) of the land for future generations, as our ancestors were before us. Land ownership, and the conflict of ideals between Māori and European definitions of the concept, is at the heart of the ongoing negotiation of New Zealand's bi cultural identity. Māori did not have a concept of absolute ownership of land, multiple hapū (tribe or sub-tribe) and whanau (family) might have different rights to the same piece of land, rights were constantly renegotiated and exclusive boundaries were rare (McAloon, 2008). Māori world views regard all humans and living and non-living elements of the environment as interconnected in an interwoven relationship known as 'whakapapa' (lineage) (Thompson-Fawcett et al, 2017). This illustrated an understanding of the symbiotic relationship that people have with land and laid the foundation of Māori customary resource management practices. Traditional western land management is led by decisions typically driven by the site owner whereas land stewardship entails dialogue, collaboration and proactive stakeholder engagement, to be defined and facilitated by specific planning considering site complexity, and expected community end goals (Common Forum and NICOLE). Foster and Iaione (2016) also suggest a commons framework with a set of 'democratic' design principles that flatten the governance structures:

> These principles - horizontal subsidiarity, collaboration, and polycentrism - reorient public authorities away from a monopoly position over the use and management of common assets and toward a shared, collaborative governance approach. (Foster and Iaione, 2016).

There is clear potential, even need, for the development of a stewardship-focused land governance structure that derives from both Te āo Māori principles of *kaitiakitanga* and *whanaungatanga* and these 'democratic' design principles for our current and future climate-vulnerable urban environments.

4. Onehunga Foreshore Case Study

Onehunga is located on the northern shoreline of Auckland's Mangere Inlet, which is the north eastern arm of the Manukau Harbour. Onehunga's convenient access to the east coast made it a strategic hub for transport and infrastructure throughout consecutive settlement and development periods (Murdoch,

2013; Panuku, 2017). Major land use decisions including industry activities, port operations, coastal reclamations and roading have left blunt imprints on the coastal morphology that have effectively formed a hardened line as we see today (Murdoch, 2013; Panuku, 2017). This arbitrary edge not only interrupted community access to the waterfront but also fragmented local hydrological filtrations and ecological functions. The otherwise fertile and nurturing inlet has been facing increasingly deteriorating water and sediment contamination issues as indicated by very low biodiversity counting and an ecological healthy rating of 'unhealthy' (Kelly, 2008; Kelly 2009).

Compounding those predicaments are another two influxes of challenges: climate change induced flooding and population growth. Based on 50year Annual Recurrence Intervals with 1m sea level rise, sea level is encroaching Onehunga coastal land up to 4m above Mean Sea Level (MSL), meaning a significant proportion of land being inundated including state highway 20 and most of Neilson Street. Being one of Auckland's most popular areas for urban development, Onehunga has attracted millions of dollars of council upgrade budget and concomitant interests of private investments. By the year 2043, Onehunga is predicted to accommodate 4,773 more dwellings, 10,000 more residents and a significant increase in the aging population who are among the most climate change vulnerable groups (Panuku, 2017). Urban development brings about opportunities for change. However, if land use decisions are based on the status quo paradigm, there is a tendency toward trade-offs that neglect environmental warnings and drop down more plot lines and hard surfaces on vulnerable land. This gave rise to risks of moving further down along a late conservation curve and tapping on the dangerous brink of release phase.

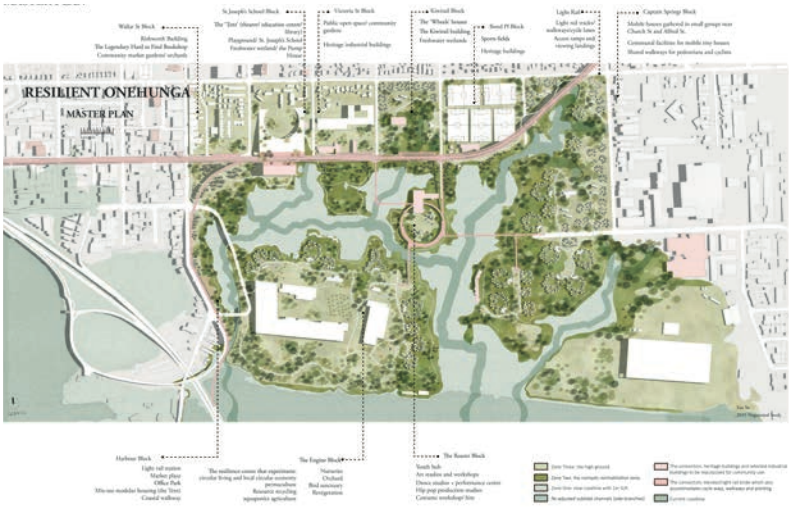

Figure 2: Project master plan.

Framed through resilience thinking, three core values emerged as the visions for this design project: restoring biosphere capacity, re-establishing biosphere connectivity and transforming towards stewardship. Complementing those values are seven fundamental principles: diversity; connectivity; feedback loops and slow variables; system thinking; experimentation; broad participation; and polycentric governance. The design project focused on the coastal industrial land between Onehunga Mall and Captain Spring Road. Key design moves started with reclassifying vulnerable land into three flexible zones based on their respective phases in adaptive cycles:

Zone one is 32 ha of 'quick release' land under immediate threat of 1m sea level rise (SLR) based on 50-year Annual Return Intervals (ARI). Those lands sit below the threshold delineated at 4m MSL while accommodating bloodline infrastructures including sections of state highway 20, Onehunga Harbour Road off ramp and Neilson Street. This design project seeks this conflicting tension as an opportunity to elevate or relocate threatened infrastructure to allow de-paving and ecological regeneration to filter and treat stormwater runoff within the south Maungakiekie catchment. Streams are to be restored, improved and connected where possible to enhance biochemical processes and provide habitats of functional sub-tidal channels. This design intervention is part of the overall effort to reposition the coastal suburb's social-ecological system so that it operates within a healthy and safe biophysical 'regime'.

Zone two is the "slow release" land and also a transitional belt sitting above zone one and under the identified threshold delineated at and above 6m MSL. Repurposed for ecological regeneration, this 34 ha of land is also envisaged to bring communities into the vulnerable land and test a 'lite' settlement plan that incubates behavioural transformation towards resilience and stewardship. The rationale is derived from the realisation that increasing biosphere capacity needs to engage people, so that it has the chance to become a place that incubates behavioural change as opposed to misanthropic re-naturalisation. The informal settlements are based on a premise of acknowledging uncertainties and impermanence while adapting to inundation, flooding and any climate change induced challenges. Settlement typologies such as off grid tiny houses on stilts, mobile houses on wheels or modular apartments with transferable units using cranes and rails, are allowed to pop-up, forming neighbourhoods, communities, and whanau. Those emergent and affordable households will be developing essential living skills with decentralised services of power, water and waste. They will accommodate residents who are willing to take an experimental tenure-ship that deviate from property values and re-align lifestyles with environmental responsibility and climate change equity. It aims to cultivate an ethos that cherishes a downshifted, frugalist lifestyle detached from current market norms. The proposed spatial arrangement allows and encourages observation of ecological impacts, instigates response and recalibration of everyday activities, so that an agile social-ecological feedback loop can be formed. Last but not least, it tests a new inhabiting paradigm that allows a wider community to own a home, not on land titled as property, but rather *Tūrangawaewae* - a place to stand, to be connected and empowered.

Zone three, or the 'high ground' is the area where the social-cultural sphere intersects with the biosphere. It is the richest ecotone where social-ecological interactions and ecosystem services interface. It is where economic and social infrastructures are to be invested, and community resources and supplies to be cached. Higher ground in this zone is used as a nexus that connects nodes of catalyst projects such as a resilience centre (the engine room), a youth centre (the router), and a new library/ community centre (the gateway). The long-discussed light rail project was incorporated in this zone. An elevated and vegetated hybrid bridge is envisioned to accommodate light rail transit, cycle ways and walkways. It provides resilient and storm-proof services and also gives way to non-obstructed hydrological and ecological right of way. It is intended to be used as a leverage project that allows this multi-generational

investment to better connect and serve local communities. Most existing buildings sitting at the threshold between 5m and 6m contour levels are proposed to be removed, to create redundancy and space for flexible land use. It will provide vital space for relocations of zone two housing in emergent events such as severe flooding or inundation, effectively function as the new zone two. It also allows for large areas of public open space available for community needs and experimentation such as food production and energy generation. Buildings of heritage value, including some industrial buildings, are to be repurposed as culture and identity anchors. With the above design moves, zone three is envisioned to be a functional biocultural refugia, providing pockets of social-ecological memory in time of change. It is a manifestation of a cultural landscape where community members, existing and new, develop a sense of place and a rooted Onehunga identity.

Projects like RISE (Revitalising Informal Settlements and their Environments) show us that the provision of critical infrastructure to informal settlement doesn't have to 'lock down' the settlement itself but provides for the residents and allows quality of life, and environmental health to be prioritised. This project identified climate change and rapid population growth as exacerbating health risks local communities have been facing (RISE, 2020; Wright, 2009). Flexible and integrated infrastructure including 'smart' sewage tanks, bio-filtration gardens, constructed wetlands and recycled wastewater are tested and adopted to ensure agile and site-specific solutions responding to local context (RISE, 2020; Wright, 2009). This is relevant to Onehunga coastal areas that are exposed to climate change risk of displacement and associated challenges. While this project was initiated in response to an informal settlement's obvious need for some kind of sanitation infrastructure there is no reason why such infrastructure couldn't be provided to a 'planned lite-settlement'.

5. Discussion

The Onehunga case study project explored the three core values around biosphere capacity, biosphere re-connectivity and transformation towards stewardship to propose a model for engaging with vulnerable land and developing adaptive capacity. This project has created a resilient Onehunga in the face of Climate change by enhancing:

Biosphere capacity: through retiring vulnerable land for ecological regeneration, allowing re-establishment of important ecosystems and habitats and promoting functional and response diversity.

Biosphere connectivity: reconnecting social-ecological processes and patterns via tangible and intangible infrastructure, identifying and preserving palimpsest of ecological and social heritage, spatial and temporal considerations. Biosphere connectivity is also achieved by allowing off-grid nomadic inhabitations on land for ecological regeneration. It holds two seemingly conflicting spheres together and attempts to build a structure of a modular nature, that is self-sufficient, ecologically diligent, and flexible and responsive.

Social transformation towards stewardship: providing space that allows for adaptive living to happen and evolve; providing opportunities for on-the-ground experimentation, co-learning, co-production of knowledge, and shared experience. It is about initiating an "adaptive wave" that cultivates adaptive behavioural and social patterns to emerge and feedback to the system, which then disperse the changes from the top and down to wider social spheres and individuals. Key design moves and elements employed key resilience principles of enhancing polycentric governance; broadening participation; encouraging learning and experimentation; fostering complex systems understanding; maintaining functional and responsive diversity; managing connectivity; and managing slow variables and feedback loops.

Resilience thinking has many intellectual overlaps with *Mātauranga Māori* or Māori knowledge. Due to the scope of this project, although several design concepts echoed and reflected Māori values, it must be acknowledged that they were not comprehensively integrated or sufficiently synthesised. However, it is noteworthy to mention their value and relevance. Core Māori values of *kaitiakitanga* (stewardship), whanaungatanga (relationships and connections through kinship as well as shared experiences), *kotahitanga* (solidarity, collaboration and collective action), and *manaakitanga* (wellbeing, kindness, respect and care for others) shared insights about the important factors in resilience in the human dimension in relation to the biosphere (Auckland Design Manual, 2019; Ministry of Civil Defence, 2019).

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6. Conclusion

Perhaps the opportunity that our changing climate is offering us can help to shift the rigid, socio-economic and power orientated definition of ownership toward a more inclusive, and viably interdependent one.

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