THE URBAN EDGE

AN INTEGRATIVE APPROACH TOWARDS A SUSTAINABLE AND RESILIENT WATERFRONT

RIYASP BHANDARI

This thesis is submitted in partial fulfilment of the requirements for the degree of Masters of Landscape Architecture at Unitec Institute of Technology, New Zealand, 2016.
by
Riyasp Bhandari. BLA (Hons)
ID: 179782

Masters of Landscape Architecture
Department of Landscape Architecture
Unitec, New Zealand

No material within this thesis may be used without the permission of the copyright owner
The human manipulation of landscape and environment has remained a prominent area of urban and environmental discourse over the past century. Contemporary urban waterfronts reflect and constitute changes in urban ecology, economic regulation, and societal issues under the influence of coastal cities (Bunce & Desfor, 2007). The urban sustainability framework articulates the relationship between humans and the environment and needs to remain at the heart of urban discourse. This project explores the positive and negative impacts on Auckland’s waterfront, further understanding the values of cultural shifts, trade, productivity, transportation, social cohesion and ecology in the urban realm. This project will comparatively critique, analyse and assess urban waterfronts, through a set of criteria drawn from literature relating to sustainable cities. The scope of Auckland’s waterfront can be re-imagined through design ingenuity to support a sustainability framework that aims to further enrich natural systems in relation to enhancing human well-being (Wu, 2014).
This thesis would not have been possible without the support of many individuals in so many ways. The fortuitous encounters with people have provided valuable assistance in my academic career.

Firstly, I would like to express my sincere gratitude and acknowledgement to my supervisor Daniel Irving for his support, motivation and immense knowledge. His guidance and encouragement inspired me towards completing my thesis.

I would also like to extend my acknowledgements to Matthew Bradbury for his insightful comments that guided me to widen the scope of my thesis and conduct this research.

Finally, I would like to thank my partner Janeen Spencer and my family for their immense and unconditional support throughout the entirety of my thesis. Last but not least to my friends, that have encouraged me throughout this journey.
## TABLE OF CONTENTS

Abstract iii  
Acknowledgements v  
List of Abbreviations and Acronyms ix  

### 1.0 Introduction

1.1 Rationale & Scope of Study 12  
1.2 Aims & Objectives 14  
1.3 Introduction to Research 15  
   - Port-city interface theory  
   - Review of port-cities in history: Antwerp, Rotterdam, Hamburg, and Auckland  
   - Role of ports in contemporary cities  
   - Sustainability models  
   - Auckland as the most "liveable" city  
   - City goals vs. "liveability" ratings  
1.4 Methodology 31  
   - Establishing critical relationships  
   - Project scope & evaluation  
   - Summary  

### 2.0 Literature review

2.1 Theoretical Argument 36  
   - Revising the sustainability framework  
   - Ecological economics  
   - Significance of maritime clusters  
2.2 Urban Ecology & Sustainability 44  
   - Urban ecology & sustainability of port-cities  
   - Postmodernism  
   - Case studies  
   - Urban identities at the waterfront  
2.3 Design Precedents 50  
   - Port Vell, Barcelona  
   - Port Botany, Sydney  
   - HafenCity, Hamburg  
   - Wynyard Quarter, Auckland  
   - The Dryline, New York  
   - Cheonggyecheon Stream, Seoul  
2.4 Summary Discussion of Literature 64  

### 3.0 Auckland Port-City Interface: Site Assessment

3.1 Regional Context 68  
   - History of Auckland’s waterfront  
   - Local communities & demographics  
   - Grid system  
   - Transportation network  
   - Hydrological networks  
   - Material analysis
3.2 Logistical Operations
   Background
   Technical requirements & logistics
   Review of NZIER - Port Study 2
3.3 Comparative Analysis of Auckland Council Planning Agenda
   Review of Waterfront Auckland Masterplan 2012
   Review of Auckland City Centre Masterplan 2014
3.4 Comparative Urban Character Profile
   Economic value & character assessment
   Opportunities of the site & context
3.5 In situ Analysis
3.6 Summary of Site Assessment
4.0 Design
   4.1 Design Scope & Objectives
   4.2 Initial tests
       Conceptual scheme 1
       Conceptual scheme 2
       Conceptual scheme 2 - variation
   4.3 Design Impetus
   4.4 Design Speculation
       Analysis
       Design development
       Design refinement
   4.5 Summary of Design
5.0 Design Proposal
   5.1 Overview
   5.2 Gateway to Auckland
       Cruise terminal, waterfront park & cultural centre
   5.3 Economic Hub
       Retail, commercial & entertainment
   5.4 Quay Park Community
       Residential living & leisure facilities
   5.5 Wetland Park
       Passive water recreation & leisure
   5.6 Stormwater Treatment System
       Stream daylighting, wetland Park & detention basin
   5.7 Design Summary
Conclusion
Bibliography
List of Figures
LIST OF ABBREVIATIONS AND ACRONYMS

AMETI - Auckland Manukau Eastern Transport Initiative
AADT - Annual daily traffic volume Auckland Transport (AT)
AUP - Auckland Unitary Plan
ARI - Average Recurrence Interval
AT - Auckland Transport
CBD - Central Business District
CPTED - Crime Prevention Through Environment Design
GDP - Gross Domestic Product
LRT - Light Rail Transit
LIUDD - Low impact urban design and development
MAF - Ministry of Agriculture and Forestry
NIWA - National Institute of Water and Atmospheric Research
POAL - The Ports of Auckland Limited
1.0 | INTRODUCTION

RATIONALE & SCOPE OF STUDY

AIMS & OBJECTIVES

INTRODUCTION TO RESEARCH

METHODOLOGY
1.1 | RATIONALE & SCOPE OF STUDY

Landscape urbanists posit that human influences have shaped the landscape through the process of urbanization, given more than 50 percent of the global population is now living in urban areas (Wu, 2008). However, the economic, environmental and social values of this change are understood poorly in the context of the sustainability paradigm (Wu, 2014). The current literature indicates that human civilization has had negative and sometimes disastrous impacts on the environment and coastal marine environments (Crain et al., 2009). However, it should be recognized that urban development, including buildings and road infrastructure, occupies less than one percent of the earth’s terrestrial surface (Schneider et al., 2010). So, while cities represent the pinnacle of such domestication, they also serve to mark the innovation, efficiency, and success of human ingenuity in building a life-support system to achieve our species survival (Wu, 2008). Understanding the relationship between the human species and the environment, as a “human dominated ecosystem” is valuable to the future development of ‘green’ and ‘smart’ cities (Steiner, 2011, p. 336).

For coastal cities, urban waterfronts pose similar social, environmental and economic challenges in the urban realm. A wave of transformation is occurring in current urban practice, driven by human interventions causing urban ecological issues and economic restructuring of port cities. The additional research marks the conventional notion of urban waterfront development as terrestrial zones, with individual environmental, economic and social identity values (Bunce & Desfor, 2007).

Waterfront revitalization in port-cities, reflect patterns of social and cultural change in the modern era that have caused a downward transition in port activities (Hoyle, 2000). This transition was caused by the separation of the port and city over time. While contemporary waterfronts in port-cities support business, commercial, public and residential development, they also reside in a zone of contention. The port-city interface zone divides land uses from maritime functions, increasing competition for new spaces (Boulos, 2016). Therefore, considerable strain has been placed on port-city links that relate to social, ecological and economic issues.
This thesis identifies the need for a strategic integration of the port and city functions that address contemporary issues through sustainable principles and planning.

The site of interest is Auckland’s waterfront, in particular, the port-city interface zone. Over time, Auckland’s waterfront has sustained major transformations and accommodated business, commercial and social infrastructure. However, over the last 40 years, the prime waterfront land has gradually been taken over by port-related operations. The Ports of Auckland Limited (POAL) are the country’s largest port and a valuable asset to the city, generating 22 percent of the Auckland economy, which is equivalent to more than 187,000 jobs (Ports of Auckland, 2016). Despite POAL economic success, the port and city lack synergy due to existing site conditions and competition for potential economic development.

This thesis questions the limitations and parameters of Auckland’s waterfront and identifies the need for a hybrid commercial port area. The theories will be rationalized through an empirical research process and aimed at transdisciplinary practices to resolve contentions towards sustainable designs on water fronts. The speculative design of Auckland’s port-city interface will aim to enhance port-city links and liveability on the waterfront. In conclusion, this thesis will focus on achieving a strategic integration of urban development and port-related activities.

**Research Question**

*How can port-cities achieve a strategic integration of urban development and port-related activities to enhance future liveability at water fronts?*
This project aims to address issues at the coastal edge of cities, with specific focus on the port-city interface. In the case of Auckland, New Zealand, significant cultural shifts from the 19th-20th century have played a major role in shaping the city. In particular, settlement patterns throughout the past century have defined trade and transportation routes. For the purpose of this study, attention is given to the critical relationships of port-cities in relation to the success and liveability of cities.

To achieve this, objectives are set as a course of critical study to understand the following:

1. Auckland waterfront’s edge conditions that relate to understanding the historical-geographical patterns of the coastal city, to enhance future port-city connectivity and liveability on the coastal edge (Hoyle et al., 1988).
2. Ecological systems as political ecologies that convey representations of nature to develop new social spaces with economic and ecological benefits, while preserving Auckland’s maritime identity.
3. Patterns of human behaviour to design quality public spaces that induce culture and knowledge, by increasing public access to the waterfront and permeating the port-city edge barrier.
4. Ecological resilience and biodiversity at the waterfront edge to strengthen and revive ecosystems, whilst enhancing amenity values and liveability conditions.
5. Socio-economic processes of port-cities using Porter’s framework of ‘economic clusters’, to understand and analyze global competition at the port-city edge (Porter, 2000).
1.3 | INTRODUCTION TO RESEARCH

Port-city interface theory

The port-city concept emerged at the end of 20th century aiming to capture the interdependent spatial and economic structures that functioned at water fronts, especially in relation to global trade (Ducruet, 2011).

Ports in port-cities were major transportation nodes that enhanced logistics, tourism, planning, and local economy (Bienfait & Delsalle, 1989; Amato, 1999 as cited in Ducruet, 2011). In 1982, Yehuda Hayuth used the term ‘port-city interface’ to study the spatial and functional aspects of cities in relation to unique geographical, political and economic characteristics (see also Merckx et al., 2003). Traditionally, the economic vitality of cities were linked with the success of ports, which were the principal source of employment, commercial revenue and provided access to the global market. The port-city interface model also helps describe how political, technological, economic and legislative forces began to reshape port-cities (see Figure 1.1)

Over time, due to the success of ports as transportation nodes for shipping goods and services, port and city interaction began to be impacted. The introduction of highways and roads were shortly established connecting the port to inland city areas. Trucks and trains were used to transport goods and cargo to inland hubs, which strengthened the port-city links. However, the progressive growth of port industries created a disconnection between the port and its host city. According to Hoyle (1989) the key factors that lead to the disconnection of port-cites were migration, containerization, safety and security, and accessibility.

Many ports were forced to migrate in deeper waters to accommodate larger vessels, berth space and potential for expanding their footprint. The relocation of ports was caused by technological advancements and urbanization of port-cities. Introduction of containerization resulted in intermodal freight transport and employment redundancy, which created a conflict between the locals and port logistics. Extensive use of heavy machinery and handling large volumes of cargo
raised safety and security concerns for the public. This phase of industrialization created a division between ports and cities, which restricted public access to the waterfront. However, heavy road infrastructure was retained for accessibility to inland city areas to deliver freight.

Brian Hoyle conceptualized the port-city interface model in 5 successive stages to articulate phases of waterfront redevelopment. This model reflects patterns of urban waterfront transformation (see Figure 1.2) that can be applied to numerous contemporary port-cities. According to Hoyle’s model, changes in patterns of economic activities and new technological developments were the primary forces that gave rise to new spatial and functional relations between the port and its city. Nowadays, ports are surrounded by different economic commodities and reside in a zone of contention facing global competition.
Figure 1.1. Characteristics and trends in the port-city interface (Hoyle, 2000, p. 404).

Figure 1.2. Stages in the evolution of port-city interrelationships (Hoyle, 2000, p. 405).
Review of port-cities in history: Antwerp, Rotterdam, Hamburg & Auckland

Port of Antwerp

The port of Antwerp is Europe’s second largest seaport and located on the historic river Scheldt. Commercial activity boomed from 19th Century in response to economic growth that was directly related to the port’s success. Following the industrial revolution, trade expanded Africa and Asia. Following World War II Antwerp’s port area moved from the existing harbour docks by the delta and separated from the city centre (see Figure 1.3). Lacking adequate capacity for berths and storage, the port was forced to expand further along the river Scheldt. The area was later reclaimed for residential development.

The port authorities in Antwerp implemented a ten-year plan for port expansion, shortly after World War II. Following this plan, Port of Antwerp’s footprint increased by over 9,000 hectares. Besides the port’s scheme, several port-related applications were established in the centre of the harbour, and the port expanded into a multifunctional logistics hub for containerised and non-containerised cargo (Merckx et al., 2003). Antwerp’s port-city interface has transformed over several decades, affecting maritime activities, logistics and transport systems. The model of Hoyle (2000) can be applied to this precedent to understand how the ports evolved since the 19th century. An increase in vessel sizes, transhipment, and containerization occurred due to technological advances and economic trends in the global market. The expansion of Antwerp city resulted in abandoning some port facilities and developing further inland. The urban planning of Antwerp city aimed at dealing with complexity of hybrid spatial zones within proximity of the burgeoning seaport (Merckx et al., 2003).
Figure 1.3. Urban development of city of Antwerp (Mercke et al., 2003, p. 11).

Figure 1.4. Canadian vessel at the harbour of Antwerp (IWM, 2016).
**Port of Rotterdam**

Rotterdam is considered Europe’s largest and busiest port. In early centuries, estuaries and streams were used to access the harbour from the seaport. A new canal gave the Port of Rotterdam greater access to cities and increased shipment of goods (World Port Source, 2016).

The completion of Nieuwe Waterweg (“New Waterway”) was designed to accommodate large steam ships and carry out international trade. Expanding the Port of Rotterdam drove the city’s commercial success and trading power. In the early 20th century Wall Harbour in Port of Rotterdam became the world’s largest dredged harbour. During World War II the city and port facilities were demolished. Post World War two the city began re-development that replaced old styles with modern trends.

In 2004, newly founded Rotterdam CityPorts Development Corporation (RCDC) investigated opportunities for expanding the port. RCDC worked towards transforming obsolete port areas into urban multifunctional zones and port-related industries (Daamen, 2007). Port of Rotterdam’s expansion took place along the North Sea, where terminal docks appeared. The Port reached its pinnacle of storage volume and could not berth larger vessels in confined space. The RCDC introduced plans for the Maasvlakte 2 (secondary port), which was a waterfront reclamation project up to 2,500 acres of port activities (Daamen, 2007). The design of Maasvlakte 2 emerged at the confluence of the North Sea and the harbour (see Figure 1.5). RCDC were motivated for Maasvlakte 2 to achieve similar success of Rotterdam’s major port.

Pressure on increased land use for industrial purposes and a lack of programmatic urbanisation, resulted in relocating the new port at the confluence of river Maas and the North Sea.

![Figure 1.5. Port-City of Rotterdam Region (Daamen, 2007, p. 11).](image-url)
Port of Hamburg

The Port of Hamburg was a central European port since early 14th century, when Hamburg engaged in an alliance with cities of similar trading power as part of the Hanseatic League (Port of Hamburg, 2016).

Hamburg’s commercial influence attracted an increase in population. The growth of Hamburg’s industrial sector shaped economic relations with foreign ports due to insufficient berthing space and increasing cargo shipment (Port of Hamburg, 2016). To cope with these changes Hamburg rebuilt the traditional docks as open tidal port zones. The integration of Speicherstadt (Warehouse City) in late 1800’s enabled storage of goods in the port to support expansion of trade.

Hamburg City’s close association to its industrial ports, contrast to traditional port cities (see Figure 1.6). As stated by Hayuth (1982), traditional port-cities are separated from a geographical ‘line of demarcation’ and can be perceived as ‘areas of transition’ between the port and urban infrastructure. However, the city of Hamburg launched the ‘Growing City’ initiative to strengthen the city’s position in the economic market as a national and international centre (Daamen, 2007). The framework of ‘Growing City’ was developed as a strategy to ‘make the city jump’ across the river Elbe. The aim of this project was to improve spatial connectivity and link HafenCity to ‘Channel Harburg’ project in southern Hamburg (Daamen, 2007).

With the commissioned launch of the ‘Growing City’ in 2003, business, port and industrial operations increased within a short time frame. However, new development on prime waterfront land created pressure on urban territorial uses adjacent urban areas. So while port-cities serve the ingenuity of economic clusters, they are exposed to global competition for future development.
Port of Auckland

Ports of Auckland were major economic contributors to its city in the early 1900’s, shortly after the British colonisation.

With Auckland’s low population count, most of the locals depended on the ports to make a living (Ports of Auckland, 2016). The Provincial Council of the time constructed the first wharf, which elongated from Queen Street known as ‘Queens Wharf’ (see Figure 1.8). The pier’s primary function was to provide berthage for large vessels. Auckland’s port served international commercial trade, which contributed to Auckland’s population rise to over 12,000 (Ports of Auckland, 2016). There were great demands for integrating new port facilities on Mechanics Bay, Point Britomart, Customs and Hobson Street. In line with technological growth, the ports introduced heavy machinery and containerization in the 19th Century. The port expanded to the east, and into the harbour as production gained momentum, acquiring greater berthage and storage space.

Like many traditional ports, Ports of Auckland constructed a barrier, which divided the industrial working ports and the urban city centre through a ‘red fence’, added for security. This very literal application of Hayuth (1982) on creating a geographical ‘line of demarcation’ between industrial and urban spatial uses, makes an important point in the new history of port-city disconnection for contemporary cities. Major arterial roads are prominent at Auckland’s waterfront, which are heavily utilized for daily commute and transporting freight to inland hubs.

Recent discussions on POAL are based on the future expansion of the existing footprint vs. relocating the port. A planned extension of POAL wharves was granted consent in early 2015, which was stopped by public protests to retain harbour space for maritime recreation. Auckland’s waterfront has progressively developed into a vibrant economic, social, and cultural commodity that lacks a strong port-city connection. Recent studies on POAL have indicated the ports are reaching capacity constraints. Discussion on the future of POAL analysed the economic vitality to its city in relation to additional urban development that would provide a greater economic return. A major economic study was carried out that estimated costs of up to $4 to $5.5 billion to relocate the ports to the Manukau Harbour or Firth of Thames.
Figure 1.7. Plan of Auckland waterfront showing the original coastline in 1841 (Auckland Council Libraries, 1900).

Figure 1.8. Perspective of Auckland City in 1840. (Heart of Auckland City Inc, 2016).
Role of ports in contemporary cities

Over time, port-city relations have incurred substantial spatial modifications and become functionally disconnected. In current literature, the re-conceptualization of spatial distribution on ports aim to serve sustainable strategies for a port-urban interface in contemporary port-cities (Wiegmans & Louw, 2011). According to Hoyle (2000), most port-cities are working towards the final phase (waterfront revitalization).

While ports are critical sources of economic vitality, they cause significant problems in their host cities, especially where new urban development is shaping port-cities. Tension between port-city borders is based on the available space for development, driven by land values and prospects for economic development. The three models represent the pressure created between the port and city due to limited and available spaces for port extension and urban development. In (Figure 1.9) the first model represents a gradual increase in land values at the port-city interface zone that co-exists with housing and commercial functions. However, this will put port functions under significant pressure over time. The second model articulates the fluctuating land values at different phases throughout the institutionalization of industrial ports. This model identifies a decline in the port functions and a rise in housing and commercial functions, in relation to available space for development. The third model illustrates a high port function along with housing and commercial functions throughout all the phases, due to limited expansion possibilities. These three scenarios help understand the economic patterns and urban functions of a port-cities.

Contemporary waterfronts consist of non-port related functions that include commercial, business, residential, entertainment, parks and leisure activities to relieve pressure on the city (Merckx et al., 2003). Wiegmans and Louw (2011) contemplate whether the existing port-city interface models can be used to resolve a new era of port development and port-urban interface concept. Wiegmans and Louw (2011) conclude that a new paradigm is required to rethink spatial developments of contemporary port-cities.

As ports have shifted further away from their host cities, the abandoned spaces have been used for residential, cultural and social spaces. A proposed model by
Norcliffe, Bassett and Hoare (1996), describes phases of port-city development of similar attributes to Hoyle’s generalised port-city interface model (see Figure 1.10).

The model indicates the city is growing rapidly towards the ports, forcing the ports to migrate further into the harbour or part to the east or west. In the diagram, t4 represents the city as a driving force, expanding rapidly towards the ports and increasing tension at the port-city interface. The illustrations t1-t3, demonstrate the

Figure 1.9. Tension on Port-City borders. (Merckx et al., 2005).
separation of that port and city through local forces (transport and port logistics) (Wiegmans & Louw, 2011). This has caused a reversal in the direction of influence between the port and its city.

The downward transition of port operations and regulations, have enhanced social and cultural ties at waterfronts following the revitalization phase in the 21st century. Modern industrial ports are working towards reconnecting urban precincts, through the integration of multi-programmatic systems on urban water fronts to attract and diversify spatial uses. However, the current literature on port-urban interface development has scant evidence of spatial components and sustainable policies on urban water fronts (Wiegmans & Louw, 2011).

**Sustainability models**

Urban planners and designers lack a theoretical framework to inform sustainable practices, however, they do aspire to improve connectivity between ports and cities.

The conceptualization of a few port-city interface models, by the likes of Bird (1973), Hoyle (1998) and Ducruet (2011) are pertinent towards our understanding of spatial and temporal functions of waterfront development. In particular, Bird focused on spatial developments of ports whereas Hoyle dealt with functional developments of port regulations and activities. Ducruet concentrated on the projected socio-economic trends as well as investigating sustainable solutions (Boulos, 2016).
The model conceptualized by Giovinazzi and Moretti explores the sustainable chain of links between cities and ports, which rely significantly on transportation systems. These conceptual models demonstrate the fundamentals of port-city relations in the modern era. For instance, new ways of transporting goods from coastal zones to the hinterland reflect signs of connectivity and sustainable development. The increase in technology has paved the way for incorporating new transportation modes to dispatch and receive cargo frequently. The transportation systems are utilitarian in parallel to human activities, which are dependent on the functionality of port operations and identifying locations of trade.

The economic restructuring of port-cities is pertinent for sustainable development and liveability. According to the European Sea Ports Organization, amendments have been made to ‘the waterfront development paradigm’ to enhance and fortify sustainable policies of port-city development enabling a strategic integration of port and non-port uses (Daamen & Vries, 2012).

Auckland as the most “liveable” city

Over the next 30 years, Auckland’s population is estimated to reach 1 million. Auckland has emerged in the list of top ten most liveable cities, ranking third according to Mercer’s survey of ‘quality living’ (Mercer, 2015). Mercer evaluates cities on its culture/environment, political stability, residential development, education, agglomeration benefits and safety (Gaffaney, 2016).

Despite Auckland’s consistent success in quality living, this does not mean for sustainable solutions in the future due to the ambiguous nature of an expanding...
city. While modern cities are the epicentres of innovative and urban niches, they aim to shape the foundation of our community/environment, social, cultural and economic entities. Hence, creating resilient and sustainable urban spaces that ensure the quality of living in dense neighbourhoods.

**City goals vs. “liveability” ratings**

Auckland’s Economic Development Strategy (EDS) identifies six objectives to achieve their vision over a ten-year plan:

- Dramatically accelerate the prospects of Auckland’s children and young people.
- Strongly commit to environmental action and green growth.
- Move to outstanding public transport within one network.
- Radically improve the quality of urban living.
- Substantially raise living standards for all Aucklanders and focus on those most in need.
- Significantly lift Māori social and economic well-being.

**Auckland’s goals vs liveability**

The Auckland Plan comprises of two big initiatives that include, The City Centre Masterplan and The Southern Initiative to achieve the previous objectives set out by Auckland Council. The Auckland Plan’s six transformational shifts are based over a 30-year plan to deliver the vision of the world’s ‘most liveable’ city. Auckland’s rapid population growth has put the city’s urban footprint under threat. The Auckland plan supports the idea of a compact city and aims to build between 60-70 percent of new dwellings within the urban city limits (Auckland Council, 2012). While housing intensification is the desired option for many citizens, comparative solutions should be explored that optimize social, cultural, economic, and ecological values. To reduce congestion and traffic flow, the Auckland Plan is investing in improving existing public transportation networks. The Auckland Plan consists of three major initiatives, which include the City Rail Link, the Auckland Manukau Eastern Transport Initiative (AMETI) East-West link, and the Waitemata Harbour Crossing projects. These projects are aimed at providing quality public transport and doubling the number of trips to 140 million by 2022 (Auckland Council, 2012).

The Southern Initiative is an integral part of the Auckland Plan that associates with the four local board areas to achieve high social and economic opportunities.
The Southern Initiative discusses the social and economic impetus towards Auckland’s growing city that contributes to liveability and sustainable development. A planning agenda is in place to support and improve education systems, increase employment opportunities, implement housing, enhance quality of living and improve public transport. These objectives are respectively planned over a five, ten, twenty and thirty years that coincides with the Auckland Unitary Plan (AUP).

To monitor these initiatives, the Economic Development Strategy (EDS) has set out a criteria to measure liveability as compared against other international cities (Auckland Council, 2016). The EDS report identifies the key elements derived from the initiatives that explain the aspirations towards achieving economic prosperity as well as social, cultural, and environmental values (see Table 1.1). The large investments being made towards attractive projects are judged on their economic opportunities, physical appeal, sustainability, community well-being and more. These indicators will be used to evaluate the success, in particular, liveability and sustainable outcomes.

This thesis will follow a similar process that uses liveability indicators as a criterion to evaluate proposed design strategies and interventions on Auckland’s waterfront.
<table>
<thead>
<tr>
<th>Element</th>
<th>What do we aspire to?</th>
<th>Key indicators</th>
</tr>
</thead>
</table>
| Lifestyle opportunities | People from all over the world love Auckland for the fantastic and affordable lifestyle it offers. It's easy to get to a range of recreation and leisure activities, whether in the urban or rural area. Auckland's relatively mild climate is a major element to its liveability and allows Aucklanders to get out and enjoy life. | Residents' perception that there is a wide range of recreational outdoor environments
Mean temperature
Mean rainfall
Cost of living |
| Connectivity            | Aucklanders are efficiently connected to each other, to the rest of New Zealand, and the world. Our transport system offers a pleasant journey, and our communications and social infrastructure enable quality relationships and innovation. | Residents' rating of transport system
Congestion indicators
Broadband availability and take-up
Civic participation |
| Physical appeal         | Auckland has well-designed places and spaces that people can easily access and utilise to enrich their lives. Natural environments such as the Hauraki Gulf, the surf beaches of the west coast, and the Waitakere Ranges are appealing and enjoyable. | Residents' rating of best things about living in Auckland
Residents' rating of the look and feel of their neighbourhood and of wider Auckland
Visitor ratings of Auckland |
| Environmental sustainability | The natural environment is able to sustain the effects of population growth, now and into the future. Aucklanders actively look after their wider environment. | Air quality
Water quality
Ecosystem health |
| Community well-being    | Auckland's communities — referring to neighbourhoods as well as communities of interest (e.g., ethnic, religious and special interest) — are cohesive, safe and vibrant. People feel safe in Auckland to express their culture and to have their say. | Residents' perceptions of safety
Residents' perceptions of community
Acceptance of diversity
Reported crime rates |
| Quality housing         | Auckland offers a range of quality affordable housing options suitable for a growing and diverse population. Housing supply meets demand.                                                                                               | Housing supply
Housing types
Housing affordability |
| Economic prosperity     | Auckland is a vibrant centre of employment and enterprise, offering a range of opportunities. Innovative ideas are brought to reality.                                                                                                   | GDP per capita, compared to other cities
Employment levels
Business confidence |

Table 1.1. Liveability Indicators of Auckland (Auckland Council, 2016).
1.4 | METHODOLOGY

This research methodology outlines the project analysis to establish critical findings of this thesis. A literature review outlines the scope of research that will provide a criteria for assessment. The following areas of research are included as following:

1. **Relationships between urban edge conditions.**
2. **Ecological systems & social values on urban waterfronts.**
3. **Understanding the socio-economic processes of Port-cities**

**Establishing critical relationships**

**Relationships between urban edge conditions.**

A study of urban political ecology enhances the understanding of historical geographical patterns and transformations (Bunce & Desfor 2007). This is in relation to the interrelations of social, political, and economic factors that impact environmental issues. This thesis will aim to understand relationships at macro and micro scales of urban waterfront development. Furthermore, this thesis will analyse waterfronts as subjective forms of transformation.

**Ecological systems & social values on urban waterfronts.**

The literature towards understanding the relationship between society and nature can be understood through the notion of ‘socio-nature’ (Swyngedouw, 1996). This theory captures the interrelationships between society and nature to establish human involvement within landscapes (Bunce & Desfor 2007). This concept revolves around discovering ‘hybrid’ entities, which are productions of socio-nature in tangent to human behavioural patterns on urban waterfronts. This theory also emphasizes the fluid and complex notions, which enhances nature-society relationships.

**Understanding the socio-economic processes of Port-cities**

Cities are described as ”*engines of socio-economic development and centres of cultural transformation and technological innovation*” according to (Wu, 2014, p. 210). Porter defines clusters as ”*geographic concentrations of interconnected companies and institutions in particular fields*” (Porter, 2000, p.15). The theory
emphasises the core relationships within related organizations of port industries, to enhance social connections within the competitive market and attract greater businesses. The sustainability component is key towards achieving equilibrium between ecosystem services, socio-economic development, and society. Analysis and critique of the sustainability model will rationalise relationships and processes of urban development. Establishing socio-economic processes on waterfronts will help understand relationships between ecosystem services and human well-being. The study of maritime clusters will help identify areas of existing and potential economic viability and social networks. The thesis will analyse the sustainability framework to understand the complex social-ecological systems that can be applied on urban waterfronts.

The following ideas are intended to frame a pragmatic research approach that will analyse and rationalize key themes. The literature will be applied to Auckland’s Waterfront to understand relationships between edge conditions at various scales. Following an empirical process of research by design, the thesis will generate a speculative model that is a response to Auckland waterfront’s urban issues.

**Project scope & evaluation**

This project will explore the following themes underpinned within the criteria and carry out a methodical process that will rationalize critical findings and develop a conceptual framework:

1. Define the relationships from current literature to a selected site at the Auckland’s waterfront.
2. Exercise findings and establish common threads from the literature in pursuit of unresolved research within the existing urban discourse.
3. Prioritizing themes reviewed from the literature to assess the opportunities and constraints of social spaces on urban waterfronts. This technique will aid in developing a set criteria for case studies.
4. An analytical critique of the site followed by design speculation and development of a model and a strategy that reflect critical findings and address the specific issues at Auckland’s waterfront.
5. Development of a final proposal based on a strategic and integrative approach that is a response to Auckland’s contemporary issues.
Summary

The process will then guide exploratory design work. The aim of this design work is to establish a sound strategy that integrates with the existing Auckland’s waterfront. The design will develop both a conceptual framework to encapsulate key elements of findings from the literature, to further define this proposed outcome as a point of reference to support discourse about urban waterfronts and their ‘zones of conflict’.

Tackling the issue of developing social spaces on urban waterfronts is an enduring discourse in the urban practice, due to the constant transformations occurring in the coastal cities (Bunce & Desfor, 2007). Cities are imagined as epicentres of cultural, environmental and economic innovation. The thesis will focus on understanding the interrelations of the three components that give rise to ‘green’ and ‘smart’ city revolution in the 21st century. The thesis will also explore the notion of physical and psychological human well-being in an urban waterfront. According to Steiner (2011) concepts such as sustainability, regeneration, resilience and ecosystem services hold the potential for advancing human ecology.
2.0 | LITERATURE REVIEW

THEORETICAL ARGUMENT

URBAN ECOLOGY & SUSTAINABILITY

DESIGN PRECEDENTS

SUMMARY
2.1 | THEORETICAL ARGUMENT

Revising the sustainability framework

Defining ‘Sustainability’ in the urban discourse

According to the United Nations World Commission on Environment and Development (WCED), the Brundtland Report states sustainable development is intended “to meet the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 16).

The notion of sustainability is buttressed in the concept of sustainable development imposed by modern-day technology and urbanization patterns have caused harmful impacts on our natural resources. Human interventions on land has affected the ability to sustain natural resources within the last century. The world’s population cannot be sustained and is now under threat in the new era of mass economic productions resulting in growing rates of poverty and hunger. Advancements in the sustainable development discourse can give towards sustaining and managing Social-Ecological Systems (SES) to enhance urban ecology and sustainable development for future generations.

In the urban discourse, the study of relationships between people and ecological systems rationalizes the scope of interdisciplinary fields within urban ecology, regarding sustainable outcomes. The current sustainability framework illustrates the overlapping of social, environmental, and economic values to understand the complex interrelationships to form the idea of sustainable development (see Figure 2.1).

Critiquing the framework

While the framework demonstrates an overarching idea of how ‘sustainable development’ is prioritized and achieved in the urban discourse, however, it fails to articulate the complex relations between internal variables within the subsystems of each component. Research towards understanding the sustainability paradigm has established empirical and pragmatic models to support sustainable development in transdisciplinary fields. However, scholars, urban planners, and theorists have
composed simple and generic theoretical models that identify the problems which propose comprehensive solutions (Ostrom, 2009). Research indicates there has been a lack of integration between transdisciplinary fields to resolve issues surrounding sustainability in the urban discourse. While very few models have simulated sustainable development in urban systems, some have lacked integration within individual entities. According to Ostrom (2009) efforts need to be made to enhance sustainable outcomes within environmental, economic and social dimensions. He further suggests that a myriad of inter-disciplines have worked independently and lacked cohesion.

Understanding complex interrelationships of each variable within sub-systems requires a comprehensive approach towards establishing the sub-systems of urban ecological systems (Ostrom, 2009). Thus, it is essential to grasp the complexity of urban ecological systems at multiple levels. The field of urban ecology encompasses some inter-disciplines, which rationalize the concept of human interaction within an urban environment to attain sustainability. The emergence of SES is a sub-system of human ecology that emphasizes on the relationship between ecosystem services and human well-being (Wu, 2014). An integrative framework is needed to understand social-ecological systems as networks rather than segregated economic, ecological and social sub-systems.

The nature of human involvement within ecosystems and natural and economic systems has been a topical issue towards ecological concerns on a global scale. A new framework of complex social-ecological systems has been developed to give a new dimension towards managing environmental and socioeconomic processes.
The new framework comprises of a four-dimensional conceptual model of structures that define interrelations and interactions within social-ecological systems (see Figure 2.2). Each dimension relates to natural sub-systems, social sub-system, economic sub-system and integrative decision sub-system. The relations between the four sub-systems hold the key towards sustainable development (Zhao & Wen, 2012). The networks within the construct form complex interactions and interdependencies at varying scales. According to Zhao and Wen (2012), the social-ecological systems networks formed by individual components of social, ecological and economic entities can interact and connect with each other to formulate critical networks.

**Ecological economics**

Economists have also contributed towards sustainable development within the field of economics, known as a sub-system of ecological economics (Howarth 2008, Spash and Ryan, 2012, as cited in Remig, 2015). Ecological economics is a comprehensive interdisciplinary field that focuses on the social-ecological interactions within human ecosystems. In the urban discourse, ecological economics

> "addresses the relationships between ecosystems and economic systems in the broadest sense. These relationships are the locus of many of our most pressing current problems (i.e. sustainability, acid rain, global warming, species extinction and wealth distribution)" (Costanza, 1989, p. 1).

The study of ecological economics helps understand human well-being (human capital), social ties and societal relationships (social capital), sustaining natural systems and resources (natural capital). Discussions on the interrelationships of economics, sociology, political sciences and related disciplines have generated debate towards the future of ecological economics and its next step in urban planning (Remig, 2015). Ecological economics within urban ecology attains sustainable and resilient outcomes that benefit socioeconomic systems. Examining the nature of economic efficiency can be characterized through political decisions that benefit governance processes as well as social and human capital.

**Political ecology**

Political ecology has many interpretations in the ecological discourse and draws relationships between social, economic and political factors with environmental
concerns (Environment and Ecology, 2016). Firstly, political ecology can be used to understand the changes in the environment that are distributed unequally such as political, social and economic entities. Secondly, the study is used to understand the relations between human society and political forces. Thirdly, the inequalities of environmental changes can alter relationships between human and nature (Environment and Ecology, 2016). Contemporary research can now conceptualize complex relationships between ecological and political spheres (Bunce & Desfor, 2007).

This theory can be used to resolve complexities and make informed decisions relating environmental issues and urban development. Furthermore, this framework is also used to understand decisions made within communities regarding environment, social and political concerns for future development. Political ecology can be used in a wide context to analyse the unequal forces that affect nature and society. Furthermore, this theory discusses the representations of nature being socially developed. The conceptual framework of political ecology has a wide scope and can be applied at various scales to understand the complex social and natural components concerning political-economic structures, such as urban waterfronts (Zimmer, 2010).

**Political ecology of urban waterfronts**

Contemporary urban waterfronts have endured major economic restructuring and transformation for decades. Bunce and Desfor (2007) believe waterfronts reflect social values within the non-human environment. Waterfronts have now become areas of political, ecological and social concerns that are now examined as a growing obsolesce (Hoyle, 1990). Hoyle further acknowledges the advancement in technology and economic activities were the primary drivers for separating port from its city.
The political ecology theory (Bunce & Desfor, 2007) can be applied on urban waterfronts in several ways. Firstly, it can be used to analyse the complex relations between society and nature. Secondly, it provides a better understanding of the communities’ role in a non-human environment concerning political synergies in urban planning and development. Finally, it is used to theorise waterfronts as subjective and open structures, rather than motionless objects.

The history of waterfront development exemplifies the “material forms of nature have been transformed by a range of socio-political decisions” (Bunce & Desfor, 2007, p. 254). The growth of innovative technology and trade consolidated port areas and reconfigured abandoned areas with various commercial and residential commodities. This shift towards de-industrialization created a compatible relationship with residential, entertainment and leisure based functions. This phase altered the approaches within communities and encouraged environmental friendly initiatives that included remediation processes of contaminated soil from industrial sites and restoring ecology and amenity values (Zimmer, 2010). While port operation continued, the society had adopted new methods by which they re-produced nature.

Interrelationships between society and nature are embedded components in the political ecology discourse that are studied to understand the production of human well-being on waterfronts. Swyngedouw (1996) terms the concept of ‘socio-nature’, which defines the relationships between society and nature that produce ‘hybrids’. In (Figure 2.3) hybrids are mediated through social relations between discourses, practices and the physical processes within cultural, political, economic and ecological conditions of a society (Zimmer, 2010). This process can be applied in different situations to understand how society re-produces nature. For instance,

“a filtration plant that is located on a waterfront might be seen as a hybrid product of material nature (water) and socially produced nature (labour, waste, products, policies, and political decisions that enter into the operation of the plant)” (Zimmer, 2010, p. 254).

Therefore, hybridization is the process of nature-society relationships that transform over time, and the interrelations are never stagnant (Bunce & Desfor, 2007). This can be considered as a critical point for understanding complex processes that produce nature through social relations on urban waterfronts. In summary, analyses of political ecology manifest urban waterfronts as living ecosystems at varied scales.
Significance of maritime clusters

Cluster theory

In this era of global economic competition, significant technological enhancements have evolved in the global markets. The competitive nature of technological growth, urban development, and corporate networks has created what Michael Porter defines as ‘clusters’ within local and regional contexts. Porter defines clusters as

“geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in particular fields that compete but also cooperate” (Porter, 2000, p.15).

The theoretical concept of clusters offers a new perspective towards identifying and organizing local economies as well as enhancing competition in areas of potential economic development. A cluster represents a group of interconnected companies that form various sectors of economic talent that drive profitability, social networks and competitiveness. Porter’s diamond model (see Figure 2.4) articulates dynamic interrelationships between four dimensions of a cluster. Factor conditions derived from clusters, motivate specialized labour, innovative technology, data and educational services. A larger concentration of clusters will generate more competition; offer investment opportunities and innovation that will stimulate the firm’s strategy, structure, and competition. The clustering benefits such agglomeration of enterprises by related and supporting industries, will thrive on demand conditions from customers and competitiveness at various geographical scales (Hansen & Clasen, 2010). Overall, the cluster model acts as a measure for analysing firms as independent entities that function on social and economic networks.
Diverse networks of clusters are formed through dynamic linkages of trust, power and social ties over a long time. These ties facilitate greater concentration and innovation, which develops a ‘core’ in a few sectors that generates demand and competition. The dominant sectors are shipping (or Maritime transport) and offshore operations (Hansen & Clasen, 2010).

**Maritime clusters**

According to Niko Wijnolst (2006) discrete maritime functions such as inland shipping, offshore facilities, dredging, and fisheries contribute towards economic capital and strengthening the clusters. Therefore, the clusters are highly dependable on these key drivers of economic prosperity. European economies have higher levels of clustering due to greater economic capital investments and employment levels (Wijnolst, 2006). According to Hansen and Clasen (2010) the stronger the core, the greater chance of cluster growth. Clusters play a vital role in maritime functions, social partners and sub-contractors. The involvement of sub-contractors assist in the development of sectors by improving seaborne trade and other related activities, which allow social partners to form collaborative strategies between sectors (Wijnolst, 2006).

Political studies examine the relationship between clusters and government processes of maritime activities. The significance of maritime clusters to a region are dependent on the social and economic ties with various sectors and not just internal clusters (Hansen & Clasen, 2010). The economic impacts of maritime activities can be categorized into direct and indirect effects. Direct effects relate to jobs generated by internal cluster dynamics. Indirect effects include jobs created through the external

---

**Figure 2.4. Framework of competitive advantage in an economic cluster (Porter, 2000, p. 20)**
economic activities linked to clusters (Hansen & Clasen, 2010). Hansen and Clasen (2010) conclude the economic significance of maritime clusters is driven by economic activities onshore rather than offshore due to greater demands of clusters. So, while predominant sectors of economic cluster relate to maritime functions such as ports, shipping and fisheries, the integration of onshore businesses, commercial and residential developments are equally prosperous.
2.2 | URBAN ECOLOGY & SUSTAINABILITY

Urban ecology & sustainability of port-cities

Urban Ecology looks at the way human-social systems relate to ecological systems. Landscape urbanists focus on the concept of humans and nature using a hybrid territory to examine social, cultural and environmental networks (Steiner, 2011). In particular, the traditional development of contemporary waterfronts from working ports have overlooked the ecology and fostered a contaminated environment. The economic viability has played a critical role towards waterfront development, in comparison to environmental and social values. This event became a conventional phase towards major urban expansion. Separating the port from its city provides an opportunity for valuable development on abandoned industrial port sites, to stimulate the city’s economy.

Many port-cities are majorly affected by environmental challenges and global competition despite being the drivers of socio-economic development. Wu (2014) discusses the future of cities leading to chaos if they fail to adopt sustainable development and strategic planning. A growing consciousness of sustainable development at port-cities has put immense pressure on the waterfront edge. As such, urban waterfront redevelopment projects hold an appreciating value, while addressing environmental, social and economic challenges.

Abandoned land near city borders is considered of significant value for non-port related economic development. This has lead to urban waterfronts transforming into a hybrid entity that integrates mixed-use development, recreational, cultural and leisure activities that now co-exist with maritime functions. Based on the discourse of urban waterfronts, a strategic integration of on shore urban functions are identified as sustainable development for coastal cities. According to Merckx et al. (2003), limited development opportunity between the port and its city will increase competition between port industries and public demand for urban development. In Hoyle’s model (Hoyle, 2000), the last stage of ‘revitalizing the waterfront’ is ambiguous and sees contemporary waterfronts’ as means of constructing public spaces, commercial and mixed-use scenarios.
Behavioural approach

Research indicates the behavioural approach towards waterfront development began with maritime port development, where ports operated as intermodal transport networks (Daamen, 2007). The growth of these intermodal networks constituted changes in port operations, which saw political decisions and behavioural approaches of port functions as immaterial. A rise in intermodal networks have made ports more passive, as they have been subsumed by the logistics within a global system (Oliver & Slack, 2006, as cited in Daamen, 2007). In the 21st century, waterfronts now reflect governance regulation and patterns of human manipulations over time.

Postmodernism

The emergence of postmodernism can be related to the shift of ports out of cities (Daamen, 2007). Postmodernism transition of port-city interfaces helped understand the societal imaginaries and economic capital of waterfronts. Due to a physical shift in port operations outside the city, increased competition and land values of vacant industrial sites to be commoditized and spaces of production. Daamen (2007) also discusses the impact of postmodern trends, which generated demands for mixed-use spaces and stimulated clusters of port and non-port activities. He also states the depletion in blue-collar employment was linked directly with the social effects, caused by post-Fordist shift on port-cities. The transition from modern to postmodern has established the renewal of port-city links. In summary, waterfronts “now mirror the socio-cultural trends of the city and its wider society, rather than the city reflecting the economic vitality of the port” (Norcliffe et al., 1996).

Commercial, residential, and recreational values of port-cities

Urban waterfronts nowadays rely on the core societal, economic and ecological principles that are buttressed in the concept of a liveable landscape. While waterfronts were once integral to our coastal cities for trade and businesses, they are now being restructured to benefit commercial, residential and recreational values within a hybrid territory.

In the 21st century, residential, commercial and recreational development have strict environmental restrictions towards nearby port-related operations. However, the re-linking of the port and city involves the integrating social, economic and environmental components to achieve sustainability. While waterfront development
within the local context, questions have risen towards amending the waterfront paradigm to reinforce a mix of sustainable urban development. In the discourse of urban planning, port-city integration is rationalized through strategic planning moulded around post-modern consumerism (Daamen & Vries, 2012). Waterfront districts are valued now for not only economic production, but for creating liveable and workable spaces that enhance human well-being. The demand for recreational and mixed-use spaces along the waterfront carries significant values, hence, adding pressure on the port-city edge.

Some examples of successful European port-cities that portray sustainable mixed-used functions and port-city integration are a catalyst for traditional port-city interfaces. The European seaport cities focus on rationalizing spatial interrelations between societies, nature, economic capital and complex governance processes (Daamen & Vries, 2012).

**Case studies**

**Cité de la Méditerranée in Marseille**

Marseille’s waterfront has not had any major transformation in the era of port-city redevelopment. The port segregates the industrial operations from its city’s central core. According to The European Sea Ports Organisation (ESPO) in Marseille, the improvement of port-city interface is vital. However, retaining existing port operations and development is essential for Marseille’s economy (Daamen & Vries, 2012). The port authorities will allow for new public space within existing urban infrastructure and terminals that reside adjacent to port activities. Marseille’s port currently consists of a cruise terminal to enhance tourism, commercial and leisure and recreational facilities in conjunction with office space, a concert hall, and a new national museum (see Figure 2.6).

**Port Vell and Nova Bocana in Barcelona**

This waterfront development project focuses mainly on tourism, retail, and leisure. The redevelopment of Port Vell stimulated economic growth, however, it came under public scrutiny as it lacked social integration with the surrounding architecture (Daamen & Vries, 2012). The shift in industrial port activities from the city offered potential land for developing hybrid entities that would co-exist and operate along
Barcelona’s port-city interface. The new urban project articulates spatial connection and integrates businesses, retail, prime waterfront living, and a marina (see Figure 2.7).

**Kleiner Grasbrook in Hamburg**

The Elbe Island resides adjacent to the recently developed Hafen City (‘Water City’), which was originally an area for industrial use and port activity (see Figure 2.9). Reiherstieg and Kleiner Grassbrook were former port areas that are now under construction to accommodate a mixed business district, a commercial centre along with residential living and recreational zones (see Figure 2.10). A proposed mixed-use development offers a mix of housing typologies for diverse waterfront living. Sustainable and resilient strategies towards coastal inundation were examined and implemented such as, dike systems, built on existing fill from the Elbe Island (Xiao, 2014).
Figure 2.5. Marseille’s port-city functions (Daamen & Vries, 2012, p. 5).

Figure 2.6. Marseille’s revitalized central wharf of the old port (Paysagiste, 2015).

Figure 2.7. Barcelona’s Rambla de Mar (Groundspeak, Inc., 2000-2016).

Figure 2.8. Barcelona’s Nova Bocana (Daamen & Vries, 2012, p. 5).

Figure 2.9. Hamburg’s Rehersieg and Kleiner Grasbrook on the Elbe Island (Daamen & Vries, 2012, p. 5).

Figure 2.10. Development of Kleiner Grasbrook on the Elbe Island (DragonByte Technologies Ltd, 2015).
Urban identities at port-cities

Definition of urban identity:
The author states "Urban identity is a reflection of all the local people’s traditions, culture, aspirations grouped together. It reflects their needs, their successes, their failures and their future" (Aly, 2011, p. 505).

In this era of urbanization, local communities and neighbourhoods reflect and express modern trends that foster gentrification in urban areas which have lost their identity. A shift in governance processes and a need for innovative economic development has forced planners, policy makers and designers to work collaboratively to produce a ‘liveable’ city and induce a sense of identity.

Building dense urban neighbourhoods is inevitable, however, they require an identity, sense of place and belonging in the modern era. Aly (2011) suggests development and identity can work in parallel to imported trends while respecting their original morals.

Urban identities of spaces expose the user’s physical and psychological association with the surrounding environment. Furthermore, identities are ‘socially constructed’ and how they as individuals define the environment is critical (Wendt, 1994, as cited in Cheshmehzangi & Heat, 2012). In light of this, reminiscent of several waterfront gentrification plans was the key to recognizing historical trends and links towards restoring identity back to the harbour edge. Cheshmehzangi and Heat (2012) discuss that spatial interrelations of an area that exercises the relationship between human behavioural patterns and the essence of the space. Furthermore, the spatial organizations of the place link to an individual’s memory or the past of that particular geographical location. It is safe to conclude that human behaviour has a direct correlation and integration with the identified space that manifests an identity. Furthermore, the symbiotic relationship between people and the physical environments provide for social and cultural innovation to form a ‘socially’ sustainable community (Woodcraft, 2012). The framework of urban identities can be applied and tested at urban waterfronts to examine human behaviour to generate quality public spaces and enhance the maritime identity.
2.3 | DESIGN PRECEDENTS

PORT VELL

HAFENCITY

THE DRYLINE

PORT BOTANY

WYNYARD QUARTER

CHEONGGYECHEON STREAM
While urban waterfronts are spaces of constant change, there is a growing demand for integrating public spaces and mixed-use development for future generations (Bunce & Desfor, 2007). In particular, the development of port-cities and specifically the port-city edge has been restricted due to security and safety measures of port operations. It is a challenging task for designers and planners to re-connect the public to its littoral edge, as there is little evidence on a global scale.

Nevertheless, there are few successful examples of contemporary waterfronts globally that integrate public and private spaces, commercial and mixed-use functions to attain sustainable development. The six case studies investigated in the thesis, exemplify revitalization of industrial sites, increasing biodiversity, instilling mixed-use development, enhancing port-city links and increasing resiliency at the waterfront edge. The following case studies are:

- **Port Vell, Barcelona**
- **Port Botany, Sydney**
- **Hafencity, Hamburg**
- **Wynyard Quarter, Auckland**
- **The Dryline, New York**
- **Cheonggyecheon Stream, Seoul**

The thesis will discuss each case study and establish the common threads to identifying the strengths and weaknesses. Each case study will unveil design themes and strategies following an analytical process, which will then be rationalized. The design principles and strategies extracted from the examination will form a set criteria, to be applied at Auckland’s Waterfront.
Port Vell, Barcelona

Port of Barcelona had decided to transform the 55.6 hectares of land between the south wall of Moll de Barcelona and the Moll Catalunya service road (Port Vell, 2000). Introduction of containerization and the need for deeper berths forced port activities to shift on the western coast (see Figure 2.12). This event influenced public demands for desiring better access to the waterfront edge, causing significant discontent. Port Vell’s introduction shortly followed after the redevelopment of Moll Bosch in 1981.

Port Vell’s redevelopment consists of recreation and leisure activities, which have reconfigured the old port area. The dramatic transformation of an industrial port has seen it develop into a yacht basin and an entertainment district with direct links to the onshore functions. By appropriating a coastal service road to a pedestrian promenade (Rambla de Mar) can be seen as ambitious and credible for reconnecting the public back to the original waterfront edge (see Figure 2.15). The urban renewal project further accommodates mixed-use functions such as retail, conference centre, aquarium and other port and non-port related activities. Port Vell has been revitalized and integrated with the city physically and economically due to mixed-use functions and a growing tourism industry (Wang, 2002).

Strengths: The design planning and development of Port Vell were based on explicit design principles that renew city-port links, increase the city’s economic capital, and integrate public and private partnership. These design principles encourage liveability and enhance human well-being. In the case of Auckland’s waterfront, these design strategies could potentially be applied to relieve pressure on the city.

Weaknesses: Even though the design encompasses some attributes towards achieving social and economic benefits, minimal significance has been given towards ecological challenges and preserving biodiversity at the port-city interface. The project lacks equilibrium of social, economic and environmental components.
Figure 2.11. Port of Barcelona in 1981 (Port de Barcelona, n.d.).

Figure 2.12. Port of Barcelona in 2011 (Port de Barcelona, n.d.).

Figure 2.13. PortVell marina (Ocean Port Vell, n.d.).

Figure 2.14. PortVell event space (Ocean Port Vell, n.d.).

Figure 2.15. An aerial panoramic of Port Vell (Iliff, 2007).
**Port Botany, Sydney**

Port Botany is a seaport in Botany Bay, Sydney, Australia. It is Australia’s second largest container port that carries out the trade of bulk liquid imports through intermodal freight transport. Port Botany reclaimed an additional 63 hectares of land, extending the footprint of an existing container terminal (see Figure 2.17). The recent extension marginally encloses the Penrhyn Estuary, which is the home of long-term roosting and feeding habitat for shorebirds (Cardno, 2015).

The Penrhyn Estuary was established between 1975 and 1978 after the reclamation of the Botany foreshore. The estuarine environment creates an intertidal habitat where shorebirds and a diverse fauna reside. Saltmarsh habitat accompanied by seagrass distribution has enhanced habitat values for the shorebirds. The Penrhyn Estuary Habitat Enhancement Plan (PEHEP) discusses on expanding the foreshore and estuarine habitat by replanting saltmarsh species to reduce beach erosion and sustain the migratory shorebirds (see Figure 2.20). Results have been monitored over the past few years indicating the succession of salt marsh habitats and reduced erosion of the foreshore (Cardno, 2015). Furthermore, the estuary offers public access to the water through walkways, complemented by a boat ramp for passive water recreation (see Figure 2.21). The low-lying foreshore beach also provides spectacular views to the harbour and the working ports.

**Strengths:** The concept of developing an estuary within proximity to a working port is unorthodox due to many environmental concerns. However, sustaining populations of migratory shorebirds and enhancing biodiversity can be looked at as a design strategy for many ports. Added human interaction with the ecosystem enhances human well-being, which is the key outcome of sustainable development. The concept of preserving and enhancing biodiversity on the edge conditions can be applied on Auckland’s waterfront to increase resiliency.

**Weaknesses:** Despite integrating ecology and public space, there is no direct connection with port activities. While the estuary sustains the shorebird habitat values and ecological production, the cost would be significant towards the management and conservation of the estuary. Regular maintenance would be required to keep the estuary functioning to its optimum level.
Figure 2.16. Port Botany expansion simulation (AECOM, 2016).

Figure 2.17. Port Botany reclamation of a container terminal. (AECOM, 2016).

Figure 2.18. Port Botany lookout point (Fighera, 2011).

Figure 2.19. Port Botany cycle way (Horticulture Innovation Australia Ltd, 2016).

Figure 2.20. Port Botany foreshore beach (Horticulture Innovation Australia Ltd, 2016).

Figure 2.21. Public boatramp near Port Botany (Jan De Nul Group, 2008 - 2011).
**HafenCity, Hamburg**

The former relationship between the Port of Hamburg and its host city thrived on an integrated system, interconnecting residential zones and port operations within a hybridized territory. The port industry boomed in the 19th century, physically separating residential living and port operations. The ports economy boomed and so did its structural development. Separating the port from its city meant constructing a bridge over the River Elbe and a railroad link to the central city (HafenCity Hamburg, n.d.).

The ambitious transformation of a historic port, initially utilized for storing warehouses and cargo is now a catalyst for urban renewal projects. The urban planners have proposed to create a metropolis with its identity that distinguishes itself from the surrounding urban development. HafenCity accommodates a rich mixed-use neighbourhood that resides in a flood-prone coastal city (see Figure 2.26). However, the ground level of the developed area has been raised above eight feet to endure the inevitable flooding due to climate change. Former port zones have now also been transformed into areas of residential living, recreational and leisure areas and business districts (see Figure 2.25). HafenCity’s high-quality living offers a mix of housing typologies accompanied by a diverse range of cultural institutions, retail, and a commercial centre. These are some of the design attributes that will attract people of all ages and ethnicities. The city further supports a strong public transportation system that functions on 92 percent of renewable energy, for the daily commute in urban communities (HafenCity Hamburg, n.d.).

**Strengths:** Regeneration of the old port into a contemporary mix of innovative urban functions and activities stimulates ecological, social and economic capital. The master plan addresses the environmental challenges of climate change; hence, implementing artificial mounds to absorb high wave energy and enclose the city with a dike system. Incorporating renewable energy and reducing carbon footprint is another step towards achieving sustainable outcomes. Thus, further reducing individual car ownership and encouraging public transport. These are some of the key design strategies extrapolated from HafenCity that can be applied on many contemporary waterfronts that seek sustainability, resilience and innovation.
Weaknesses: Studies have shown even though soft and hard engineering strategies have proven efficient as an immediate solution for flooding. However, there can be adverse effects of such techniques if not structured correctly. While soft engineering strategies would be effective towards ecological ecosystems, on the other hand, hard engineering strategies would be the culprit of ecological disruption.
Wynyard Quarter, Auckland

The predated footprint of the Ports of Auckland extended to the western fringes of the coastline. Further reclamation was carried out until 1930’s in need for berth capacity and storing bulk cargo (Wynyard Quarter, 2016). Port operations vacated the western reclamation due to demands for commercial development. Wynyard Quarter was the planned commercial project to revitalize the industrial port site over the next 25 years.

In 2005, the urban project’s vision was to create a waterfront community that emphasizes the core societal, environmental and economic values. In 2011, Wynyard Quarter opened to the public, and offered high quality social spaces that had a potential to evolve into a sustainable and innovative mixed-use precinct (see Figure 2.31). Wynyard Quarter’s enhanced proposal encompasses a mix of housing typologies, commercial, retail, entertainment, businesses and a hotel in addition to the existing urban functions (see Figure 2.28). The masterplan addresses the use of renewable energy through sustainable living solutions as well as communal park spaces. The design principles have explicitly emphasized creating a diverse and a working neighbourhood that enhances social connections throughout the site (see Figure 2.30). Despite the extensive urban restructuring, the site still preserves its maritime identity. The retention of many silos, marine facilities, and retrofitting cargo containers enables users to associate the site with a historic tank farm.

Strengths: Wynyard Quarter’s early development follows the gridded patterns of Auckland City. Wynyard Quarter can relate with many similar design attributes as HafenCity such as the establishment of city-port links, creating a mixed-use neighbourhood, and preserving its character and cultural identity. Innovative design principles are embedded in Wynyard Quarter that can be applied throughout Auckland’s waterfront.

Weaknesses: While significant consideration is given to the economic and social components in urban waterfront projects, the ecological component gets neglected far too often. Auckland waterfront is situated on a brownfield site that risks contamination and biodegradable fill leaching into the harbour. Auckland’s planning agendas must evaluate the critical threats to the environment and adopt a long-term solution to ensure sustainable and liveable conditions.
The Dryline, New York

Manhattan suffered a severe storm surge, known as the Hurricane Sandy, destroying the entire low-lying district and damaging 305,000 homes and $19 billion in total losses. A rebuilding job was soon underway post-Sandy, to remediate Manhattan’s vulnerable coastline. Climate resiliency and protecting residents from future storm events were the core objective towards the redevelopment of the region.

The Dryline (Big U) is now a flood protective ribbon that runs 12 kilometres of Manhattan’s coastline that comprises of dense and vibrant areas. The urban regeneration project integrates design functions and activities at various scales to provide social, ecological and economic benefits (see Figure 2.34). The mixed-use urban development regime integrates well with the flood-protection zoning programme, which offers a use of diverse social spaces throughout the waterfront (BIG, n.d.). Furthermore, the spatial interrelation of communities enhances the flexibility to stitch the social and urban fabric. Comprehensive and innovative techniques have been applied in various regions of the coastline to prepare for high storm events that act as detractions but also attractions (see Figure 2.37).

**Strengths:** This urban project is a solution towards sustaining a dense and vibrant waterfront community in a flood-prone environment through resilient flood-protection techniques. Synthesis of urban functions is supported through dynamic and physical social, ecological and economic entities. The vibrant waterfront community will also attract people to reside at the prime waterfront, increasing the economic production. Sea level rise at Auckland’s waterfront is projected to increase up to 3 meters by the close of the 21st century, potentially inundating the low-lying plains of the coastal city. These design strategies can be tested and implemented onto the edge conditions to sustain liveability in Auckland CBD.

**Weaknesses:** Despite the increased resiliency of the coastline where many social, cultural, learning community spaces are organized, coastal inundation is a constant threat if the main defensive mechanism fails to function.
Figure 2.32. Expansion of Manhattan into the harbour (Bjarke Ingels Group, 2014).

Figure 2.33. Mapping of social amenities at Lower Manhattan (Bjarke Ingels Group, 2014).

Figure 2.34. Panoramic aerial of Lower Manhattan (Bjarke Ingels Group, 2014).

Figure 2.35. Panoramic aerial of a revitalized waterfront (Bjarke Ingels Group, 2014).

Figure 2.36. Simulation of a passive recreation zone (Bjarke Ingels Group, 2014).

Figure 2.37. Simulation of a seasonal park acting as a flood barrier (Bjarke Ingels Group, 2014).
Cheonggyecheon Stream, Seoul

Following the Korean War in 1953, settlement took place near a stream that originally functioned as a drainage system. The city began to grow and faced environmental challenges. A concrete road and an elevated highway running through the heart of an industrial area buried the stream for several years. In 2003, the project for restoring the excavated river was initiated following the removal of the elevated highway. (Landscape Performance Series, n.d.).

The resurrection of the original stream has now been transformed into an innovative recreational space in downtown Seoul, now known as Cheonggyecheon River (see Figure 2.38). The daylighted stream is restored at the heart of the city, which cuts through the existing transport system and runs 13.7 kilometres and spreads 20-85 metres wide. It is a green recreational corridor that also filters contaminants through natural plant uptake and highlights the nodal points where runoff is daylighted. The core initiative was to remediate the pollution and grey water contamination following the demolition of the concrete structure while creating a social and cultural zone (see Figure 2.43). The design takes into account the flood risks that occur throughout the year, hence, designing for a 100-year storm level (see Figure 2.40). In addition to sustainable design efforts, the restoration project is a significant tourist attraction on a local and global scale.

Strengths: This project exemplifies the functional habitat in hybrid territory. The functional dynamics of these attributes enhance biodiversity in human ecosystems. Even though major urban restructuring functions have promoted contemporary styles, the cultural presence and identity are preserved in the open space. These design strategies can be explored at Auckland’s waterfront, to restore natural waterways that promote social, cultural, ecological and economic values.

Weaknesses: This project is not sustainable due to pumping 120,000 tonnes of water daily from Han River into the stream restoration system. Therefore, the stream’s functional system is stagnant and heavily dependent on Han River to provide social, cultural, ecological and economic opportunities.
Figure 2.38. Conceptual site plan (Seoul Metropolitan Government, 2002).

Figure 2.39. Detail site plan (Kim, 2015).

Figure 2.40. Site cross section for 100-yr storm level (Kim, 2015).

Figure 2.41. Cheonggyecheon stream waterfall (Kim, 2002).

Figure 2.42. Seoul's Cheonggye stream was once covered by an elevated highway (City Clock Magazine, 2014).

Figure 2.43. Cheonggye stream public space at night (Kim, 2008).
2.4 | SUMMARY DISCUSSION OF LITERATURE

Port-cities have endured major transformations over the decades and diversified their economic, social and ecological functions in parallel to their growth. The transformations have seen ports separate from their hinterland to where trade and port activities can be more efficient and productive. Thus, paving the way for cities to become more commercialized through consumerism, tourism, residential, and business development. In the fourth stage of Hoyle’s model, the spatial relationship between the port and its city can be described as almost ‘invisible’ and irresponsible (Hoyle, 2000). The connectivity of port-city functions was later improved by transportation systems, as conceptualized in Giovinazzi and Moretti’s model (Giovinazzi & Moretti, 2010). Giovinazzi and Moretti’s model illustrates the sustainable chain and interdependencies of human activities between the port and non-port functions (Giovinazzi & Moretti, 2010, as cited in Boulos, 2016).

Social interactions and sustainable design ingenuity drive the socio-economic trends of port-city redevelopment. Even though the terms ‘sustainability’ or ‘sustainable development’ are conventional in urban practice and theory, it is the complexity that lacks a comprehensive understanding. Ostrom (2009) believes that ‘social-ecological systems’ are the key to analysing the complex interrelationships between humans and ecosystem services. In (Figure 2.2) this theory is conceptualized by Zhao and Wen. The theory on political ecology introduces the concept of ‘socio-nature’ on urban waterfronts, which discusses the intricate relationships between society and nature to form hybrids (Bunce & Desfor, 2007). The processes of urban identities are functions that are ‘socially constructed’ by human behavioural patterns in an environment (Wendt, 1994, as cited in Cheshmehzangi & Heat, 2011). In terms of understanding political economics of port-cities, Porter (1998) proposes a framework, rationalizing economic cluster dynamics that help understand global competitiveness and social networks at various scales.

Transition from modern to postmodern development has reversed the chronological waterfront re-development process and increased the city’s social-cultural trends.
With an increase in land values and development of clusters throughout port-cities, sustainable living conditions have been encouraged not only in the CBD but also the urban edge. Many international case studies such as HafenCity, Barcelona, Rotterdam and Marseille exemplify multi-programmatic systems and a hybridized nature of waterfront living (Daamen & Vries, 2012). A series of design strategies and design principles can be extracted and applied to Auckland’s waterfront at different scales.

The thesis will utilize critical theoretical findings, design strategies, and principles explored from the literature review to develop a model that will focus on fostering multi-programmatic systems at the urban waterfront. A fundamental objective of this design thesis is to re-connect the public to its Auckland’s prime waterfront edge, while preserving existing urban functions at the port-city edge. An analytical and a strategic approach to the test site (Auckland’s Waterfront - ‘port-city interface’ zone) will be carried out. This thesis will enable an understanding of complex spatial and functional dynamics of port-city edge conditions influenced by surrounding urban functions and human interaction.
3.0 | SITE ASSESSMENT

REGIONAL CONTEXT

LOGISTICAL OPERATIONS

COMPARATIVE ANALYSIS OF AUCKLAND COUNCIL PLANNING AGENDA

COMPARATIVE URBAN CHARACTER PROFILE

SUMMARY DISCUSSION OF SITE ASSESSMENT
3.1 | REGIONAL CONTEXT

History of Auckland’s waterfront

According to Auckland City Heritage Walks report (Auckland Council, n.d.) the topographical sequence of Tāmaki Makaurau is the result of many existing coastal headlands used as Pa sites by the natives (see Figure 3.1). Former bays (such as Freeman’s and Commercial Bay) were inlets that were utilized for food and natural resources. The Auckland isthmus (also known as Tāmaki Makaurau) was the home of several iwi tribes and the land where many battles were fought (Auckland Council, n.d.). The narrow land was a popular destination for Polynesian navigators who migrated a thousand years ago (Auckland Council, n.d.). Urban sprawl to numerous pa sites within Tāmaki Makaurau shaped the landscape to provide for the population growth. The report also acknowledges Auckland’s significant waterways and portage systems. The Waitemata Harbour and myriad historic streams provided the Māori with an abundance of shellfish and birds. The Waihorotiu Stream was a prominent open stream that flowed under Queen Street and was a destination for fishing as well as trapping birds and eels. The historic waterway streamed through a swampy area before discharging at the confluence of Commercial Bay (Auckland Regional Council, 2008).

Furthermore, the Auckland City Heritage Walks report suggests European settlement took place in Auckland CBD, which saw the British flag erected in 1841 at Point Britomart (see Figure 3.2). Many Pa sites were established at Auckland’s foreshore, which were later colonised and vacated by the Europeans. The report also indicates that Commercial Bay was the epicentre of Auckland where trading was
carried out. This was followed by the introduction of railway links at wharfs and dockyards. By 1870, the reclamation of Commercial Bay extended up to Customs and Queen Street. The report also states in 1871, the foundation of Auckland Harbour Board was established, which authorized dramatic transformations to construct new wharf structures at Freemans, Official, and Mechanics Bay (see Figure 3.3). Following the progressive growth of port activities, a plan to build a fence bordering port functions was on the agenda. The proposed installation was erected to increase security and safety of the people, as well as signifying the colonisation of European settlement (Ports of Auckland, n.d.).

Reclamation of Auckland’s waterfront spread up till the western fringe nearby the current harbour bridge (see Figure 3.3). The western edge of the reclaimed land was a hotspot for marine activity and storage space for chemical bulk and petrol, known as the ‘Tank Farm’. The shift in technological advancements reconfigured port functions and operations resulting in vacated land and potential for valuable economic development. The boom in the shipping industry and the revolution of containerization improved productivity and efficiency gains releasing 70 hectares of land for non-port activities. Today, Auckland’s revitalized waterfront highlights a mix of commercial and mixed-use development on the western portion of reclaimed land that co-exists with maritime operations on the eastern edge.
Figure 3.3. Overlapping Plan of Auckland’s waterfront in 1841 over present day land reclamation (Auckland Council Libraries, n.d.).
Local communities & demographics

Between the years 1950-1970, the inner city population of Auckland declined due to urbanization in surrounding suburbs (Friesen, 2009). Immense transformations of commercial, residential and government policies have shaped the landscape and the demographics of Auckland City and its waterfront.

The inner city population rapidly declined following the post-World War II, in the same period of the baby boom. Infrastructural development was underway to build life-support systems for the growing population, eradicating bay areas where primary residential housing was established. The shift in postmodern trends led to gentrification, resulting in a diverse ethnic population that forced residents with lower incomes away from the central Auckland. Innovative planning regimes and local strategies stimulated urban intensification throughout Auckland, especially the CBD. An increased population growth of diverse ethnicities fostered the enhancements of educational systems and training institutions, attracting foreigners especially the Asian ethnic group (Friesen, 2009).

Auckland City’s identity can be defined as a vibrant and culturally diverse, that inhabits a range of ethnic communities. Over 50 percent of Auckland City’s residential demographic is European, compared to less than 8 percent Māori (Statistics New Zealand, n.d.). The Māori rank fourth out of all the ethnic groups in Auckland City. The Asian demographic is growing and is the second largest ethnic group in the city. A total population recorded in 2006 was well over 26,000 and gradually increasing annually. Population growth rates (see Figure 3.5) were recorded at over 1000 percent between 1986-2006 and are projected to rise 254 percent (100,000 residents) between 2006-2026 in the CBD (Friesen, 2009).

In light of the population growth and density occurring in central Auckland (see Figure 3.4), the city will face negative impacts that involve, future housing development and environmental challenges. Therefore, Auckland’s waterfront will continue to be under significant pressure due to growing demands of quality public spaces and urban intensification planning.
Figure 3.4. Population Density (Statistics New Zealand, n.d.).

Figure 3.5. Population Growth Rates (Statistics New Zealand, n.d.).
Grid system

The gridded layout of coastal cities is a common phenomenon, influenced by an American development trend. Many planners and urban designers utilize the grid system in this modern age. This orthogonal layout induces linearity and provides some social and economic benefits to the city.

Auckland City’s build configuration was based on a gridded layout post-European development. The linearity of streets increases walkability and supports a robust connection between the waterfront and its urban fabric. The city is highly navigable and adaptable to any land use change (Knight, 2013). Economic efficiency is enhanced through interchange and reconfiguration of existing and future development. In particular, the finger wharves were based on the gridded layout to increase transport efficiency of goods (see Figure 3.6). The shift in contemporary port operations lacks the direct axial links to the hinterland due to cut-off points by arterial routes and present day urban development. This thesis will test the characteristics of Auckland’s grid orientation to reconnect the port-city edge.
Transportation networks

The introduction of a tram network was the first innovative transport system which serviced the old port areas. The rise of commercial and industrial development in central Auckland influenced the demands for implementing public transport systems. Following the ingenuity of bus networks, motorways and large road infrastructure were the next steps towards enhancing transportation networks. With increasing, urbanizing patterns in urban and suburban locations, public transport was encouraged. However, people residing in low-density areas preferred to use privately owned vehicles rather than public transport for commute.

In the modern age of Auckland City, public transportation systems have emerged again, following their decline post-World War II. However, public transit has become marginalised in comparison to the daily usage of private vehicles. Commuters travelling into Auckland City are highly dependable on cars, thus, creating traffic congestion throughout the city. Public transport in recent years has released congestion from arterial roads, contributing to the city’s social and environmental gains. Queen Street and Quay Street are arterial roads, accompanied by a secondary arterial road and narrow lanes, that are serviced by commuters (see Figure 3.7). However, the spatial relations and dynamics of existing public transport at the waterfront can be enhanced to achieve a stronger port-city connectivity.
Figure 3.7. Existing transportation network and modes (Authors own, 2015)
**Hydrological networks**

Tāmaki Makaurau celebrated their natural waterways and portage systems to carry out trade, travel, food production and recreation (Auckland Council, 2013). The waterways were utilized as transport corridors that connected the surrounding districts. Reclamation of land saw many natural streams being submerged underground, cutting of natural resources for sustaining human life. The trading industry grew following the extension of port infrastructure, increasing exports of goods. Efficient modes of transportations were acquired for north, south, east, and west connections to increase productivity and economic gains in the postmodern era. The introduction of water transport and bridges evidently enhanced transportation networks between districts and surrounding islands.

Despite the restructuring of Auckland’s coastal geography, the Māori continued using their wakas and canoes channelling their streams and rivers. Tāmaki Makaurau had three distinctive streams, which flowed through deforested landscapes (see Figure 3.8). The Waihorotiu Stream was formerly established along the course of Myers Park, channelling under Queen Street and spilling at the confluence of Horotiu Bay (Commercial Bay). The stream was bordered with native species and was used as a source for capturing food. The Waipapa Stream flowed through the undulating pa site adjacent to the eastern edge of Auckland Museum. The stream channelled through a wetland before being released into Mechanics Bay (Auckland Regional Council, 2008). Freemans Bay was the collection point of many freshwater streams, one of them being, Tunamau Stream (to catch eels). The stream originally flowed through the present-day Western Park before meeting at the foot of Franklin Road and discharging into Freemans Bay (Auckland Council, n.d.). Progressive development has led to the contamination of these natural streams, which are now contained in stormwater pipes concealed underground.

Auckland City currently faces various environmental challenges in this century due to urbanization and globalization. Climate change is a contemporary issue for Auckland City’s vulnerable hydrological systems (see Figure 3.9). Increasing urban runoff and rain intensity will put significant pressure on stormwater pipes, resulting in drainage overflow and mixing with grey water before being discharged into the Waitemata Harbour. Opportunities exist for sustainable ingenuity and development of multi-programmatic systems in the urban fabric.
Figure 3.8. The pre-European shorefront superimposed on a 1950's map of the inner city (K Road Business Association, 2016).

Figure 3.9. GIS mapping of Auckland’s hydrology (Authors own, 2015)
Littoral zones at Waitemata Harbour

Ports of Auckland are situated where diverse marine species are established at the littoral zones. The Waitemata Harbour consists of three fundamental edge conditions, which exemplifies the functional tidal dynamics in a marine ecosystem (see Figure 3.10, 3.11, 3.12).

Ministry of Agriculture and Forestry (MAF) Biosecurity New Zealand is responsible for improving the marine ecosystem and controlling the nature of unwanted exotic species in the harbour. A high count of exotic marine species has been recorded of which many have been transported through cargo ships holding ballast and bilge water (Auckland Council, n.d.). These exotic species have spread and increased marine habitat and biodiversity at Auckland’s littoral and intertidal zones.

Material analysis

A large portion of Auckland’s waterfront comprises of old industrial development and material use since post-World War II. The exposure of the old infrastructure to harsh environmental conditions has shown signs of corrosion, rust, degradation, erosion, moss and algae. Degraded timber posts, concrete, steel, stone and iron are
the prime ingredients that have led to optimum contamination of the Waitemata Harbour (see Figure 3.17). Studies indicate the quality of salt water at the peripheries of the harbour edge is the lowest in comparison to the rest of the harbour (Auckland Council, n.d.). Discovering high concentration levels of copper, lead and zinc are the key agents that have destabilized the coastal marine habitat (see Figure 3.19). Consistent use of heavy machinery, shipping and port operations are the clear functions of a contaminated harbour. Modification of existing contaminated prone materials needs addressing at Auckland’s waterfront, followed by implementing durable materials.
Figure 3.20. Auckland's waterfront view from Google Earth (Authors own, 2015).
Figure 3.21. Locating Auckland’s waterfront at various scales (Authors own, 2015)
Background

POAL are New Zealand’s largest commercial seaport and voted the most efficient in Australasia. The Port is situated in the heart of Waitemata Harbour since 175 years and is now owned by Auckland Council Investments. The industrial site operates on 76 hectares of land and spreads 1.5 kilometres across the central and eastern fringe of Auckland’s waterfront. They contribute to 22 percent of Auckland’s economy annually. POAL consist of a container and multi-cargo wharves that contain significant bulk and break-bulk cargo, with a handling capacity of 968,741 units of twenty-foot equivalent units (TEU) of containers (NZIER, 2015). The footprint of Fergusson container terminal is being expanded to accommodate greater handling capacity, while the remaining wharves are reaching capacity constraints. Captain Cook Wharf acts as a secondary cruise ship terminal during peak seasons, contributing to Auckland’s economy. POAL have a marine rescue centre with a helipad located at the eastern edge, which was originally Mechanics Bay (see Figure 3.22). So, while POAL are considered an economic asset to their host city, they do reside in a zone of contention surrounded by commercial, business, entertainment, residential, and recreational maritime functions.
Physical & operational boundaries

The Ports are very complex territories that possess many constraints and security regulations in the 21st century. Ports of Auckland in particular, have been bordered by a historic red fence built during the European colonisation, separating any non-port related activities from the working port. The reason being, ports operate with extensive heavy machinery which includes gantry cranes, rubber tyre gantry (RTG) cranes and straddle carriers throughout the day (see Figure 3.28). Multi-cargo and break-bulk cargo are contained in warehouses to keep the goods cool and prevent contamination before being dispatched.

Quay Street promenade is the ideal lookout point to observe ongoing port operations through the red fence (see Figure 3.25). The peak height for viewing the port operations is at the junction of Quay Street and The Strand. The western edge of the port is part of the red fence heritage walk that runs adjacent to a riprap wall, and enables public to connect with the water’s edge while capturing spectacular views of the harbour (see Figure 3.24).
POAL organizes an annual SeePort event aimed at the public of all ages to celebrate the port’s growth. The event takes place at Captain Cook Wharf, hosting boat tours, a carnival, live music and food stalls, attracting up to 65,000 people over three days. In addition to the SeePort event, POAL allow public boat tours of the site, while educating the public on port’s functions (Ports of Auckland, 2015). The dominance of car imports over bulk cargo are stored on Captain Cook and Marsden Wharfs due to capacity constraints on Bledisloe Wharf. The heavy use of freight transport is accessed and constantly dispatched through the main entrances of Tinley, Plumer and Solent Street located at the foot of Bledisloe wharf and Fergusson terminal. Growing concerns of freight and cargo storage has put pressure on the throughput of containers dispatched by rail and trucks. However, strategic approaches are being made by POAL to increase efficiency and productivity gains through reducing the amount of freight transported on roads and increasing it on freight rail.
**Technical requirements & logistics**

**Port layout**

The port’s current configuration consists of sub-optimal ‘finger wharf’ structures to berth main-cargo ships, however, they have limited backup storage capacity as indicated in the New Zealand Institute of Economic Research (NZIER) *Port-Study 2 report* (NZIER, 2015). The orientation and angles of many berths at POAL are not flexible and could potentially restrict larger cargo ships to dock. In this case, it would make POAL less efficient and increase dwell time of vessels. Bledisloe wharf is primarily a multi-cargo wharf which also operates as a secondary container terminal to release capacity constraints of Fergusson terminal. Hence, this has ideally reconfigured the former layout and operations of each wharf, increasing critical awareness of the backup land. The gridded system applied on the ports reinforce the horizontal and vertical linearity of stored containers and cargo, effectively maximizing port machinery mobility (see Figure 3.30).

**Berthing**

POAL’s total berth length is estimated at 2,000 metres square which occupies ten main berths throughout (NZIER, 2015). The berth layout is dependable on many
factors of the Waitemata Basin and the individual functions equipped in the ships. The characteristics of the finger piers provide maximum berth length, despite having minimal storage capacity. Early development of narrow piers can no longer sustain the berth capacity and berth occupancy of larger container ships at Marsden, Jellicoe and Freyburg Wharf. Thus, adding critical pressure on Bledisloe Wharf and Fergusson terminal according to the NZIER – Port Study 2 report.

**Channel depth**

Each wharf has distinctive channel depths and manoeuvring lanes to accommodate container and cargo ships of various lengths. In (Figure 3.32) the manoeuvring lane is ideally 1.6-2.0 times the width of the largest ship occupying the channel based on the Port Designer’s Handbook (Thoresen, 2010). Other factors that influence the channel’s functions are the wind and current (Thoresen, 2010). With a growing trend of container throughput of TEU and larger vessels, POAL might need to consider deepening their current channel depths.
Dredging

According to Thoresen (2010), the dredged length of the channel should not be below 1.25 times the length of the largest ship berthing and must require tugboat assistance. Bledisloe Wharf and Fergusson terminal are dredged up to 12.2 metres in-depth, whereas Captain Cook, Marsden, Jellicoe and Freyburg wharves are dredged below eleven metres to dock smaller vessels (see Figure 3.31). POAL are close to completing the extension of Fergusson terminal following 13,700 cubic metres of dredged material used for reclamation (Ports of Auckland, 2015). The ongoing trend of dredging at the Waitemata harbour has had disastrous impacts on the biodiversity near the littoral zones.

Review of NZIER - Port Study 2

Existing concerns

The ports growing industry has contributed towards Auckland City’s economy for the past decade; however, it is not anymore a significant asset that contributes to the city’s GDP.

The POAL’s current footprint is investigated and analysed as a key issue for flexible storing capacity on all the wharves, due to the growing demands of exports and imports. Furthermore, the uncertainty of dredging at the Waitemata harbour and extending the port’s current footprint has raised public awareness. The port’s dredging projects have generated adverse effects, which exemplify the harbour’s contaminated salinity, disrupted marine habitat and affected maritime recreation in the previous years. In relation to freight transport, an increase in cargo has enforced pressure on transport links. High volumes of heavy commercial vehicles are identified on the roads, generating a high carbon footprint and noise pollution.

Port’s capacity & constraints

According to NZIER (2015), the estimated container capacity could reach up to two million TEUs annually, compared to the container throughput of 972,434 TEUs in 2015. Despite the capacity estimate, the container terminal seeks greater improvements in the labour efficiency and productivity gains that would lead to increasing storage capacity. The three-hectare extension of Fergusson terminal provides storage for backup land and occupying two additional berths for larger vessels, to increase ship’s maneuverability. At this stage, the container terminal
has adequate storage space for handling containers. However, during peak periods Bledisloe wharf is utilized as a secondary container terminal.

The multi-cargo wharves accommodated over 5.9 million freight tonnes of bulk and break-bulk cargo in 2015 (see Figure 3.37), including 243,801 car imports in (Figure 3.38) according to the Ports of Auckland 2015 annual review (Ports of Auckland, 2015). POAL have handled high volumes of imports than exports, while struggling for storage capacity. According to the Port-Study 2 report, multi-cargo wharves are incapable of berthing larger container ships up to 200 metres in length (2,000 TEU) (NZIER, 2015). The growth in vessel size has reconfigured the berthing system of the ports and influenced multi-cargo ships to berth at Bledisloe Wharf and be assisted by tugboats to prevent destabilization. Despite the inefficiency of shifting cargo quickly, the port industry has improved their handling capacity for non-containerized goods.

**Freight transport links & capacity**

The POAL handled 972,434 TEU of imports and exports through trucks, rail and transhipment (see Figure 3.36) in 2015 according to the statistics from POAL annual review 2015 (Ports of Auckland, 2015). A staggering increase of 44.2 percent of freight transport (100,332 TEUs) was moved by rail in 2015, compared to 69,585
TEUs in 2014 (see Figure 3.39). Thus, indicating trucks transported 55.8 percent of TEU to the inland ports of Onehunga and Wiri. The ideal route for freight transportation is along The Strand and Stanley Street, which connects to state highway 16 (SH16). Heavy volumes of traffic recorded by annual daily traffic volume (AADT), identify 44,500 vehicles service the motorway of which 7.9 percent are freight trucks (NZIER, 2015). The implementation of an efficient intermodal network between POAL and inland port hubs, could potentially release pressure at Grafton Gully.

**Projected output of container terminal & multi-cargo wharves**

According to the calculations and examination done in the Port-Study 2 report, the port’s container terminal will reach its peak capacity of 2 million TEUs annually by 2035 (NZIER, 2015). The increasing global trends of trade growth in New Zealand runs parallel to the ingenuity of technological advancements in the port industry. The integration of automated RTG cranes and straddle carriers are the next steps towards increasing productivity gains and rapidly discharging cargo. Furthermore, containers can be stacked up to six high (rather than three high) (NZIER, 2015). Capacity can be maximised on Fergusson terminal and would increase the estimated peak capacity up to four million TEUs annually, without having to extend the port’s operational boundaries. However, this efficient mode of machinery would increase redundancy of several operators.

POAL’s peak capacity requirements have reduced the flexibility of the multi-cargo wharves. Bulk and breakbulk cargo cannot be stacked due to the physical attributes of the load, limiting backup land capacity. Growing trends of car imports are close to exceeding the port’s peak capacity. In (Figure 3.41) an increase of 36,210 units of cars from 2014, is projected to reach 280,000 units of cars by 2041 (NZIER, 2015). Growing demand for car ownership would intensify traffic congestion. Thus, adding pressure on Captain Cook Wharf, which also functions as a temporary cruise terminal in peak periods despite having a shorter wharf length. Strategic planning is underway for the central wharves that involve the extension of Captain Cook Wharf to facilitate large cruise terminals. Followed by the deconstruction of Marsden Wharf and finally substituting the 5.3 hectares of land to the north of Bledisloe wharf (NZIER, 2015). Utilizing the wharf as a secondary cruise terminal would significantly improve the economic viability and generate employment opportunities. However, this will reduce the number of berths the port currently occupies unless the Bledisloe wharf extension is successful.
Despite the fundamental concerns that revolve around capacity constraints on multi-cargo wharves and the inability to dock larger vessels on most berths, POAL’s is generating significant economic gains. Projections of multi-cargo and container throughput are displaying progressive signs in line with the handling efficiency and productivity gains. The modification of the central wharves is a long-term strategy to stimulate economic growth and employment opportunities; however, this would not support the port’s cargo capacity constraints. On a positive note, efficiency has been growing following the rapid distribution of freight through rail and reducing the number of trips made by trucks. Furthermore, automated machinery is the future of handling freight and improving productivity measures. However, the port’s current growth will acquire additional backup land to sustain and stimulate the economic capital or alternatively relocate to a subordinate location.
Viability & Economic Growth

POAL managed to achieve significant volumes of cargo and container freight, increasing 0.4 percent from the year 2014. The car import industry (including bulk and breakbulk cargo), grew by 4.4 percent from 2014, recording 5.9 million tonnes of freight (Ports of Auckland, 2015). The port’s cruise ship visits accumulated over $135 million, contributing heavily to Auckland’s economic vitality (see Figure 3.43).
Comparative Analysis of Auckland Council Planning Agenda

Review of Waterfront Auckland Masterplan 2012

Waterfront Auckland projects a population of 2.5 million people by 2041, significantly increasing the region’s cultural diversity. The Waterfront Auckland plan aims to redevelop the industrial waterfront to enhance liveability, recreation and commercial involvement in Auckland City (Waterfront Auckland, 2012). Strategic planning between urban disciplines involves the vision for an integrated system to re-connect the public and private sectors.

The goals set out by Waterfront Auckland are based on achieving sustainability, resiliency and productivity (The Waterfront Plan, 2012).

- Increase resiliency and enhance marine and natural ecosystems
- Enhance social values on the public waterfront
- Create a smart working waterfront and that involves business opportunities
- Connect public vs private sectors through innovative waterfront design
- Improve sustainable and liveable outcomes at the waterfront and the city

Waterfront Auckland Plan has set out a few initiatives to reunite the harbour’s edge and its city, termed as the ‘harbour edge stitch’ (Waterfront Auckland, 2012). This sector involves many urban functions that interrelate every day, which includes Quay Street, Auckland CBD, Lower Hobson Street and the Britomart precinct. The proposal for Quay Street redevelopment is an impetus towards integrating the revitalized waterfront with the city’s urban fabric. Furthermore, the implementation of an extended promenade would improve walkway and cycleway networks that connect with various urban functions situated at the waterfront. According to the plan, an efficient transit layout is in place to improve transportation for commuters and residents from Britomart to Wynyard Quarter. The plan’s initiative is to refine many existing laneways and fine-tune its functional and aesthetic attributes to enhance the north-south flow between the city and its waterfront (Waterfront Auckland, 2012). The benefits involve a safe passage of vibrant social spaces that offer connections to entertainment, commercial, and business districts. Following the initiative of transforming Quay Street into a pedestrian focused system, raises awareness for accommodating existing and future commute. Waterfront Auckland’s proposal aims
to re-route the existing transport flow in the central district by reducing the volume of cars on Quay Street and diverting traffic flow on to Customs Street. The proposal of an urban boulevard will comprise of public transportation, vehicular traffic and pedestrian flow (Waterfront Auckland, 2012).

Opportunities

The reconfiguration of Quay Street transforms the traffic-choked system into a shared space that permeates the barrier to allow enhanced public access to the waterfront (see Figure 3.44). The strong linear axis will attract and reconnect the urban systems in the central district to the waterfront via socially constructed laneways. Hosting events and festivals throughout the year on Quay Street will attract a diverse demographic at the waters’ edge. The proposed waterfront promenade could potentially connect with the inner city precincts and encourage public transport modes. Laneways on the other hand, would not only increase accessibility to the waterfront but improve wider connections through socially imposed structures that seamlessly integrate with service facilities and residential living. By evading the traffic flow from Quay Street and on to Customs Street releases congestion and opens up the edge for the public. The planned urban boulevard on Customs Street offers efficient commute during peak hours to SH16 and central Auckland.

Constraints

Controversial outcomes, however, may struggle to co-exist with some ambitious design moves in the Waterfront Auckland Plan. The complex functions of Quay Street include fundamental dependencies for an efficient commute, access to service facilities, and major road connections. Therefore, a strategic modelling of the transport network is acquired that rectifies Quay Street’s functional interdependencies before reprogramming a new transport route. The proposed extension of the promenade across the borders of port operations may conflict pedestrian activity with freight traffic. In particular, limited development around the port precinct has identified scant opportunities for growth in the Waterfront Plan (see Figure 3.45). No initiatives have been made to reconnect the port to its city despite having a pre-existing functional system encircling the port infrastructure.
Figure 3.44. Planned development of Auckland’s waterfront (Waterfront Auckland, 2012).

Figure 3.45. Quay Park Quarter – plan showing the consented northern extent of Fergusson Wharf (Waterfront Auckland, 2012).
Review of Auckland City Centre Masterplan 2014

According to the Downtown Framework (Auckland Council, 2014), the core vision is to become the world’s ‘most liveable city’. The initiatives proposed in the document are relatively ambitious with an estimated completion time over the next twenty years. Some of the objectives involve enhancing public transport systems in the central district, increase quality urban living and invigorate the city’s economic, cultural, social and environmental values. Various challenges outlined in the document are critical towards achieving sustainable solutions. In particular, a substantial emphasis is given to redevelop the central wharves to address critical challenges (Auckland Council, 2014).

- Growing demands of ferry users has increased significantly over the last decade.
- Cruise ship industry is booming, despite sufficient berths to accommodate larger vessels.
- Managing public vs private sectors, in relation to public demands for quality open space.
- Planning for adverse impacts of port operations on to Queens Wharf.

The framework generates four concept ideas that aim to solve the growing concerns of existing central wharf structures and to maximise economic and social viability. Concept one focuses on the extension of Princes and Queens Wharf to make them primary cruise facilities. Concept two favours the demolition of Marsden Wharf and extending Bledisloe Wharf to operate as a primary cruise facility. Princes Wharf would function as a secondary cruise terminal, vacating Queens Wharf for public space. Concept three illustrates the extension of Captain Cook and Bledisloe wharves, followed by the deconstruction of Marsden Wharf. This move would dedicate Captain Cook Wharf as the primary cruise terminal and Princes Wharf being the secondary. This concept would transform Queens Wharf into a public space including the breastworks area at the foot of the central wharves. Finally, concept four demonstrates a dramatic change that relocates the ferry terminal in place of Captain Cook Wharf. This move increases the capacity to berth larger vessels at Queens and Princes Wharf and operate as cruise terminal facilities (see Figure 3.46).
Opportunities & constraints

The redevelopment of central wharves is an integral part of revitalizing Auckland’s waterfront and achieving sustainable solutions. Throughout the four concepts proposed in the plan, they all have a common theme directed towards addressing the social and economic challenges. The demand for cruise facilities and quality public spaces are considered valuable opportunities towards reconfiguring the wharves existing functions and footprint. Queens Wharf is currently a public open space that acts as a primary cruise terminal; however, it is dominated by vehicles invariably. It would be ideal to modify either, Queens or Captain Cook Wharf as cruise ship terminals as they align predominantly with Queen Street to create a strong axis. Integrating public space on the central wharves has been public’s opinion for almost a decade. The City Centre Masterplan envisions integrated planning of commercial and social development on the waterfront.

Figure 3.46. Investigating opportunities for Central wharves development (Transport blog, 2014).
Early 2016, Auckland was voted the third most liveable city in the world based on specific criteria. In particular to the growing consciousness of immigrants to Auckland has put substantial development and economic pressures in urban areas. An estimation of 2.5 million people has been projected by 2040, creating over 8,000 jobs at the waterfront and contributing $987 million to Auckland’s GDP (Price Waterhouse Coopers, 2010). The economic value of Auckland’s waterfront is compartmentalized and directly distributed to surrounding businesses, marine facilities, hospitality and commercial hubs. By 2040, employment at the waterfront is expected to accrue $2.02 billion, of which $218 million will directly be supported by business agglomeration at the waterfront (Price Waterhouse Coopers, 2010). Existing maritime clusters and business agglomerations have increased the labour productivity over the years and are fundamental drivers of the GDP’s growth.

The agglomeration benefit has stimulated the region’s economy by injecting $6 billion annually (Auckland, 2016). Auckland’s cruise industry is represented as a significant source of income towards the GDP and is estimated to rise above the current annual return of $135 million. Several events take place at the waterfront throughout the year, many of which are major economic and social contributors, which include The America’s Cup, Rugby World Cup, New Zealand Fashion Week, Buskers Festival and more. These maritime events endorse Auckland’s maritime identity and create a sense of belonging at the waters’ edge. Furthermore, the events attract high volumes of tourists and refine the waterfront’s profile. The Wynyard Quarter project was destined for dramatic transformations that consisted of an innovative precinct comprising of a mixed-use development and quality living (see Figure 3.49). Wynyard Quarter’s revitalization is subject to span over 25 years, aiming to support 20,000 jobs (Price Waterhouse Coopers, 2010). The innovative precinct is estimated to deliver $4.29 billion to Auckland’s economy, by 2040 (Waterfront Auckland, 2012).
Recent studies have indicated Auckland’s waterfront redevelopment framework will not reach the city’s economic goals (Oram, 2013). In addition, the economic targets outlined by Auckland Council need revision to double efficiently, offer high productivity and higher paying jobs according to Oram. Oram discusses Price Water Coopers (PwC) blunt analysis on Auckland’s waterfront redevelopment strategy to point out the critical issues that need addressing. Oram believes Auckland’s economic principles are correct; however, the framework is lacking assurance. The PwC analysis reveals the quality build of mixed-use, commercial and residential development at Wynyard Central only highlights the aesthetics of contemporary infrastructure (Oram, 2013). The overarching argument by Oram discusses the Council’s sub-organizations’ inability to work collaboratively, has led to critical concerns, potentially having failed to reach the economic goals.

However, greater contribution needs to be made towards valuable economic development opportunities at the waterfront, specifically in the port-city interface zone. In recent years the POAL have flourished on an international level, despite the growing contention of capacity constraints within their current footprint. POAL’s future has been a topical debate since early 2015, leading to public protests preventing the organization from reclaiming additional land for expansion. A trio of mayors in New Zealand including, Phil Goff, John Palino and Victoria Crone are advocates for moving the POAL from its current location. Phil Goff stated,

“at a certain point Auckland will not be able to take any further traffic and I am not in the favour of the port expanding into the harbour...the prime central business district land would produce a better return than a port”

(Schoultz, 2016, p. 2).

Furthermore, Phil Goff suggests the 75-hectare prime waterfront land needs to be accessed by the public, followed by valuable economic development that comprises of commercial and residential development similar to Wynyard Quarter. Palino and Crone further commented that the ports potential relocation, would immensely reduce traffic congestion in Central Auckland (Schoultz, 2016).

This thesis will evaluate the opportunities and constraints that address social, economic and environmental concerns at the port-city interface. This process will lead to an in situ analysis of the site followed by design speculation to form a model that integrates public and private sectors.
Opportunities of the site & context

While POAL are an integral cog of Auckland’s economic growth, mayoral candidate Victoria Crone believes the port is no longer the main driver (Schoultz, 2016). It is understood that the port should no longer expand into the harbour and should work within its current footprint. If the port were to relocate the estimated cost is between $4 and $5.5 billion. Even though the cost for port’s expansion is marginal, demands for further expansion into the harbour will persist. In light of this, no contribution is being made to re-connect the public back to its prime waterfront despite the safety and security measure of port operations. This thesis seeks to enhance the public’s interaction at the port-city interface and re-connect them to the waterfront, while retaining the port’s current functions.

This thesis will rationalise possible outcomes to increase social, economic and environmental functions at the interface zone. Successful port-cities on a global scale have adapted to their cities’ growing demands and requirements which oversee port-city connections intensifying through business, commercial, residential and entertainment clusters. While Auckland’s waterfront comprises of such urban functions at the interface, it lacks spatial interaction with the urban fabric. Existing laneways struggle to link the inner city to the waterfront causing spatial dysfunctions and making the port-city interface zone obsolete.

Current areas dedicated to large parks are organized in the city district and suburban areas. There are confined open green spaces at the waterfront despite the cost-effective infrastructure that supplements daily edge recreation of walking, biking and fishing. Retaining and enhancing passive water recreation at the Waitemata Harbour is critical to Auckland’s maritime identity. The waterfront holds a substantial potential to integrate social activities and amenities for a large demographic.

The waterfront hosts a large number of festivals throughout the year that occur from Wynyard Quarter to Queens Wharf. Furthermore, events and entertainment facilities which appear between the central wharves and the port include, bars, cafes, restaurants, and Vector Arena (see Figure 3.48). With a growing demographic there is definite potential to expand the entertainment precinct through innovative design strategies that transform the entire waterfront as a vibrant mixed-use hub.
The growing population of Auckland is addressed in the AUP, which has catered for 80,000 dwellings in the central region when projections suggest we need 400,000 (Cumming, 2015). Auckland’s density has changed dramatically by 33 percent from 2001-13 and the council is solely relying on intensification methods within the city’s urban limits. Increased competition for urban development has increased land values, leading to unaffordable housing in dense residential quarters. The public supports the demand for cost-effective housing in central areas of the city as well as the waterfront. Wynyard Quarter is a prime example of waterfront living that encapsulates a mix of housing typologies for a diverse demographic and quality performance build infrastructure (see Figure 3.50).

Economic clusters have long been established at the waterfront and have increased employment opportunities. Existing business and commercial infrastructure incorporated with residential apartments are constructed in a gridded system along the port-city edge. This design strategy bears similar qualities to Wynyard’s innovative precinct that can be applied to the port-city edge while integrating residential, entertainment and recreational functions. The business and commercial sectors would increase employment opportunities and could potentially link up directly with existing maritime activities. The revival of Auckland’s economic goals can be accomplished through investments in business and commercial sectors that host multi-programmatic systems.

This thesis will now rationalize the design strategies extrapolated from the literature to develop an integrated model, which addresses social, economic and environmental concerns of Auckland City and its waterfront. The refined model will be obtained from staging design experiments and tests that embed key design principles and themes of sustainability, resiliency, liveability and identity.
Figure 3.47. Silo Cinema is a magical spot to visit over the Christmas season (Auckland’s Heart of the City, 2015).

Figure 3.48. Public gathering outside Vector Arena (Crawford, n.d.).

Figure 3.49. Artist impression of Wynyard Quarter apartments (Transport blog, 2015).

Figure 3.50. Artist impression of Wynyard Quarter pavilions (Transport blog, 2015).

Figure 3.51. Artist impression of Lower Queen Street – public space and facade (Transport blog, 2016).

Figure 3.52. Artist impression of Lower Queen Street – east/west laneway (Transport blog, 2016).
The initial site visit encompassed a visual assessment from Queens Wharf to the end of POAL. The data gathered illustrates the nature of existing site conditions and how they are affected and programmed through environmental effects, surrounding urban functions and human activities.

Queens Wharf is the current primary cruise terminal, which acts as a public wharf throughout the day. The wharf entertains major events for large crowds during all seasons in The Cloud and Shed 10. Limited use of the wharf occurs throughout the day, used mainly by public for fishing at the tip of the wharf as well as taking in harbour views (see Figure 3.53). Major flood plains were identified on the concrete structure with no apparent filtration devices integrated on site. Construction at the public wharf resisted user activation of the space, as well as constant vehicular flow.

While Quay Street’s promenade is an active social space for pedestrians, cyclists and runners, it constrains the publics’ flexibility due to a fence on one side and a congested arterial road on the other. This finding confines the user’s behaviour within the site and raises safety awareness. Comprehensive observations were made from the promenade, overseeing Captain Cook, Marsden and Bledisloe Wharf covered in light vehicles while heavy machinery operated the remainder of the port’s footprint (see Figure 3.55).
Figure 3.54. Site analysis – investigating limitations and restrictions (Authors own, 2015)

Figure 3.55. Identifying degraded materials onsite (Authors own, 2015)
Mapping pedestrian movement on Quay Street, Customs Street and the narrow laneways adjoining the arterial roads demonstrated the public’s behavioural patterns (see Figure 3.56). Pedestrian activity was distinct throughout multiple areas of the site, especially the promenades on Quay Street. Runners and cyclists were spotted on the promenade adjacent to the waterfront edge, compared to pedestrians who favoured the commercial and entertainment interface. A strong network of social amenities was identified throughout the waterfront precinct, of which many lack a physical connection.

**Opportunities & constraints**

- Insufficient public access to the waters’ edge – restricted by the red fence and port operations.
- High levels of contaminated runoff from the urban catchment and old industrial infrastructure on central wharves and ports.
- Negative impacts on the marine ecosystem due to harbour contamination and dredging initiatives.
- Quay Street is a congested road in the Central Auckland and acts as a critical barrier between the waterfront and its city.
- Reconfiguring the central wharves purpose to maximize economic, social and environmental benefits.
- Permeating Quay Street to transform into a pedestrian oriented function to reconnect existing social functions and rerouting traffic flow.
- Enabling public access to the waterfront by reconfiguring existing port functions to find an integrated solution.
- Expand on existing business, commercial, residential and entertainment functions along the waterfront to establish a cohesive viable product.
The evolution of Auckland’s coastline has undergone major transformations since 1840, soon followed by the founding of a port industry. The shift from modern to postmodern era involved new infrastructure trends and saw the population increase rapidly in the central and outlying suburbs of Auckland. Urban intensification saw the rise of diverse ethnic groups and communities spread across the region. Auckland’s demographic ranks European the highest followed by Asian and Maori.

Auckland’s geography has been configured to adapt a gridded layout, forming an orthogonal pattern on the reclaimed waterfront land. This linear structural format was adopted to strengthen direct axial links from the port to its hinterland, enhance walkability and support navigability. The transport systems adapted to the linear alignment until the need for an integrative approach. Public transport systems were introduced including trams, buses, trains and ferries to increase efficient commute throughout the region and across islands. Despite the invention of multiple transport modes and road infrastructure, the early indigenous Maori preferred to portage via their natural waterways. The historic streams are now contaminated following urban development. Stormwater overflow and heavy rainfalls have established major flood prone zones in urban areas that require immediate treatment. Contaminant injection into the Waitemata Harbour has degraded the marine ecosystems and ecology, due to the high concentration levels of zinc, copper and lead from the wider catchment.

The site of interest is POAL, in particular, the port-city edge interface. POAL are the largest commercial seaport in New Zealand and handle over 900,000 TEU of containers annually (Ports of Auckland, 2015). The industrial port operates on a 75-hectare land and has strict safety and security policies, prohibiting any public interaction within the confined territory. The port operations can be viewed from the peripheries of the site, in addition the eastern and western edges of the port allow public access to the water. A review of the NZIER – Port Study 2 report outlines the existing concerns of the port’s capacity constraints, as well as cargo handling.
capacity, economic viability and future projections. The comparative analysis of Auckland Council’s planning agenda analyzes The Waterfront Plan and the City Centre Masterplan for Auckland’s future development. The comparative study carried out by the organizations for potential development along the waterfront provided no scope or consideration towards redeveloping the port-city interface, excluding the central wharves development plans.

Auckland’s character profile gives an insight of the pre-existing and current programmes that have shaped the city’s growth and its economic capital. The business and commercial agglomeration have been an impetus to Auckland waterfront’s thriving economic success. An increase in the global economic markets for tourism, events and festivals and development of quality living at Wynyard Quarter has contributed significantly to Auckland’s annual GDP. However, opportunities exist for additional valuable development along the port-city interface to sustain the economic capital and work towards Auckland’s contemporary challenges. Opportunities for mixed-use, commercial, residential and recreational development are solutions towards addressing some of the critical challenges Auckland has faced for the past decade.
4.0 | DESIGN

DESIGN SCOPE & OBJECTIVES

INITIAL TESTS

DESIGN IMPETUS

DESIGN SPECULATION
4.1 | DESIGN SCOPE & OBJECTIVES
Expansion of ports within port-cities has ceased development opportunities and increased competitiveness, while security measures persist at the edge interface. Auckland’s inability to absorb rapidly expanding population growth has placed immense pressure with its urban peripheries, including the waterfront edge. Thus, restricting economic and social capital growth. Strategic planning is required to resolve the critical challenges Auckland faces and provide an integrated model for the future.

This chapter will focus on the experimental design of the site (Auckland’s port-city interface) through comparative design principles and strategies extracted from the literature review to investigate the opportunities of an integrated product that addresses Auckland’s urban challenges. The design investigation will explore viable options for integrating public, residential and commercial functions within the limitations of the urban edge. The successful integration will be based on the functionality of separate urban programmes operating cohesively, efficiently and productively within a hybrid territory.

Objectives:

- Increase liveability on the coastal edge that offer sustainable outcomes and enhance human well-being.
- Develop social spaces with economic and ecological benefits while preserving existing port and non-port activities.
- Expand business, commercial and entertainment cluster networks along the waterfront edge and strengthen the economic viability.
- ‘Harbour edge stitch’ - a desire for better public access to the waterfront by permeating the port-city edge and connecting with the city’s urban fabric.
- Increase physical resiliency and biodiversity at the waterfront edge as well as treat urban runoff from the catchment feeding into POAL.

The aim of this investigation is to develop a multi-programmatic system that is a self-sustained network at the waterfront edge and responsive to Auckland’s contemporary challenges. The speculative design model could potentially act as a catalyst at various precincts of Auckland’s waterfront or wider suburban regions.
4.2 | INITIAL TESTS

**Conceptual scheme 1**

**PART 1**

The staged design exploration is categorized into three parts, investigating existing opportunities and constraints of the port-city interface. The concept identifies Vector Arena as a critical social node that is conventionally utilized to the potential for becoming a dominant social hub expanding further into the existing port territory. Implementing an elevated promenade above port operations would ideally give public access over the port territory and observe scenic views.

**PART 2**

Integration of a Light Rail Transit (LRT) proposed by Auckland Transport (AT) would service Queen Street to Customs Street and Anzac Avenue. This proposal incorporates a LRT route on Quay Street that connects with the proposed layout by AT and to the eastern region. Furthermore, integrating a new station at the existing commercial and residential quarter will encourage public transport. These moves were aimed at connecting port-city links as well as integrating public and private sectors.

**PART 3**

Following the interventions from part two, part three demonstrates the spatial functions between the promenade, cruise facility, and the proposed light rail station. The interchange of transport modes is made more efficient through a public promenade. Integrating open green spaces on the elevated promenade would act as noise buffers but also as recreational spaces, similar to the concept of the Highline project (see Figure 4.1).

**STRENGTHS**

- Public transit connection to the city and potentially wider eastern districts.
- Integrating public infrastructure that connects the city’s fabric with the waterfront.
- Potential opportunity for secondary cruise terminal, followed by efficient transport interchange.
WEAKNESSES

- Promenade dissects the existing port operations, increasing safety and security precautions.
- Integrating LRT on Quay Street could potentially become an additional barrier, leading to very limited access to the waterfront.
- Proposed light rail station could disrupt existing infrastructure.
- Adding a cruise terminal would require further dredging of channels and sufficient berth space. Furthermore, adding pressure on capacity constraints and disturbing the functional dynamics of port operations.
Conceptual scheme 2

This conceptual scheme retains the LRT that services Quay Street and the train station is relocated on the edge of Customs Street. Shifting the port’s structure further into the harbour and further east of the coastline opens up public access to the water’s edge. The scheme consists of expanding the existing commercial sector while integrating retail and entertainment facilities. Furthermore, the development of residential apartments at the waters edge is protected by wetlands and permeable open spaces to absorb heavy storm events and prevent flooding to the neighbourhood (see Figure 4.2). The remaining reclaimed land of the port is used as a public promenade and a cruise terminal designed near large open green spaces for recreational and events use.

STRENGTHS

• Access to the waters’ edge is enhanced and environmental challenges have been addressed.
• Increased public open space at the waterfront edge.
• Expanding commercial, entertainment and residential living on the waterfront to sustain economic growth and future population.
• Implementing a secondary cruise terminal to support cruise visits and contribute to Auckland’s economy.

WEAKNESSES

• Moving the ports further into the harbour would result in dredging and negatively impacting the marine ecology
• Lack of narrow piers and angles of the proposed port structure may be an issue for berthing larger ships.
• Freight transportation by rail exchange would require modification to carry out existing functions.
• The integration of commercial, residential and entertainment sectors do not relate strongly. Traffic flow and proposed light rail dissect the interrelations of separate functions.
• Limited contribution to the wider context of the waterfront.
**Conceptual scheme 2 - variation**

This variation of scheme two represents a similar concept that demonstrates the integration of commercial and residential housing on the waterfront, complemented by a passive recreational edge that caters to high storm events and flood risks. This concept is adapted through the layering of multiple urban programmes to carry out specific functions. A linear elevated structure over Quay Street assimilates similar functional characteristics as the Highline project. The raised public walkway divides the urban traffic and other elements that impede social values. In addition, reforming the port’s footprint will enable berth occupancy for larger vessels (see Figure 4.3). Relocating the cruise ship terminal adjacent to Queens Wharf would enhance the functional compatibility of the wharves.

**STRENGTHS**

- The elevated structure connects with existing and proposed mixed-use development, while catering pockets of social spaces and large open spaces for events.
- Incorporating a light rail station at the mixed-use precinct would potentially attract public from wider regions of Auckland.
- Implementation of open green spaces at the waterfront would create a major hotspot for passive recreation.

**WEAKNESSES**

- Offers limited public access to the waterfront.
- Lacks integration with proposed functions and existing urban infrastructure.
- A robust programmatic model that lacks spatial flexibility.
- Spatial reconfiguration of the ports will result in further reclamation and destroy the marine habitat.
- Port access will be compromised due to redeveloped environmental edge conditions and transportation networks occupying the hybridized space.

**NOTES FROM CRITICS**

- *The design explorations were visually well established and reflect Auckland’s contemporary challenges.*
- *Concept schemes one and two lack technical requirements and understanding of port operations. Advised not to reconfigure the existing port footprint unless thorough knowledge of technical specifications and logistics are understood.*
• Some of the proposed urban programmes already exist on Auckland’s Waterfront, for example Wynyard Quarter and Viaduct.
• Integrate your proposals using the proposed Waterfront Auckland framework as a basis.
• Integrating a light rail on an arterial road will ideally congest traffic flow and further impede public access to the waterfront.
• Examine the characteristics and urban functions of Barcelona’s waterfront.
4.3 | DESIGN IMPETUS

Following the critique of initial tests, it was critical to understand the complexity and urban functions of the catchment feeding into the POAL. Extensive research of the site context and the catchment identified various programmes, which were inhibited by negative environmental effects. The catchment leading into POAL comprises of an industrial and commercial zone accompanied by townhouses and residential apartments near The Strand railway station.

POAL catchment is equivalent to 290 hectares, of which 122 hectares is permeable surfaces. The remaining 168 hectares of degraded impervious surfaces encompass a significant portion of the catchment. The Strand and Stanley Street are arterial roads that support the commute of predominantly heavy commercial vehicles from the port, contributing to Auckland’s environmental issues. Urban contaminated runoff is identified as a critical issue within the catchment, establishing high concentration points of flood plains at the foot of the reclaimed land. The low-lying floodplains are projected to concentrate up to 24,136 cubic metres of stormwater based on a 100-year average recurrence interval (ARI) statistics. Furthermore, a high volume of contaminated runoff flows through existing stormwater pipes that follow the original geographical alignment of the historical streams, identified on Stanley Street, the Domain and the present railway yard east of the Domain (see Figure 4.5).

A heritage stream study carried out by Auckland Council focused on daylighting opportunities of Auckland’s historic streams. Daylighting a stream poses several social, economic and environmental benefits. In particular, the industrial sector of Auckland would highly benefit from daylighting opportunities, through filtering high levels of contamination as a cost-effective alternative to repairing stormwater pipes. The current stormwater infrastructure will not be able to sustain the city’s growing population, adding pressure on underground services.

Figure 4.4. GIS analysis of Auckland’s hydrology and underground services (Authors own, 2015)
COASTAL INUNDATION

The Waterfront Plan (Waterfront Auckland, 2015) conveys the emerging concern of climate change by outlining a sustainable approach will be made; however, no specific strategy is documented to remediate inundation and storm surge effects. A sea-level rise of up to three metres is predicted at Auckland waterfront by the close of the 21st century (see Figure 4.6). Studies carried out by National Institute of Water and Atmospheric Research (NIWA) have established Auckland waterfront’s mean sea-level rise of 1.74 metres as a vertical datum of POAL, and an annual sea-level rise of 0.15 metres is estimated (NIWA, 2013). Calculations conducted in 2013 for an extreme sea-level rise by NIWA are forecasted to reach up to 2.4 metres in 100-years (NIWA, 2013).

Sustainable and resilient planning techniques need to be integrated at Auckland’s waterfront to survive coastal inundation and heavy storm events. While the low-lying plains of the city and its urban systems are under threat, integrative and strategic planning of the coastal city must take immediate effect. A multi-programmatic model at the port-city interface requires innovative, sustainable and resilient coastal planning that address external and internal issues of the site at various scales.

Figure 4.5. GIS mapping of projected coastal inundation impacts (Authors own, 2015)

Figure 4.6. Simulations of a 3 metre sea-level rise in Auckland (TVNZ, 2015)
4.4 | DESIGN SPECULATION

Analysis

An analysis of underground services within the catchment and the waterfront articulate a complex network between existing infrastructures. According to Auckland GIS, a majority of stormwater pipes are due for a repair having been constructed almost 100 years ago. The pipes within the catchment were constructed no later than 1934, of which many are aligned adjacent to the former Waipapa stream (see Figure 4.7). The design incentive focuses on restoring the Waipapa Stream through sustainable techniques that enhance social, economic and environmental values. The daylighting concept will create a spatial split between existing systems and capture urban runoff while filtering contaminants through treatment devices.

The daylighted stream will become a social amenity while retaining existing urban functions of the industrial zone. Many factors such as the overland flow path, topography and existing infrastructure are major factors that affect the functionality of the proposed stream’s channel flow and distribution of treatment devices (see Figure 4.7). The integration of treatment devices assists with filtering contaminants as well as preventing floodplains.

The design speculation examines possible opportunities to create an accessible waterfront edge for the public, while retaining the port’s existing functions. In (Figure 4.8) the concept of forming a foreshore area at the port-city interface is a utilitarian solution that enables public access, by cutting a channel at the port’s edge.
Figure 4.8. Design experimentations following analysis (Authors own, 2015)
The concept design comprises of five zones that respond to the design objectives outlined in the thesis. Each zone has its individual systematic programme that co-exists with existing and proposed development at the waterfront edge. The design illustrates a new foreshore area at the port-city interface zone that consists of vibrant social amenities surrounded by proposed residential, commercial and business development. The design principles and interventions are identified through case studies to achieve key design strategies of sustainability, resiliency and liveability. The daylighting of the Waipapa Stream is conceptualized through perennial flows down the Auckland Domain and channelling through the treatment train embedded in the industrial zone. The filtered runoff is released at the delta of the new foreshore. Through innovative sustainable and resilient design interventions, the concept seeks to remediate environmental effects, caters to Auckland’s housing demands, expands the economic cluster, and implements quality public spaces.

**NOTES FROM CRITICS**

**STRENGTHS**
- By de-reclaiming industrial land, the waterfront edge is accessible by public to celebrate the daylighted harbour channel.
- Daylighted stream and treatment train release pressure of urban runoff and filter contaminants.
- Permeating Quay Street as a barrier to strengthen links with existing social and entertainment facilities via a public promenade.
- Enriching biodiversity at the edge by implementing relative species to restore the harbour’s marine ecology and creating a social amenity.
- The proximity of proposed development enhances greater links to the inner city and across the waterfront.
- Transforming Captain Cook as a secondary cruise terminal to accommodate cruise visits and contribute to the tourism industry.
- Pedestrian and cycle networks are identified to highlight existing links from the Domain to the waterfront.

WEAKNESSES
- Building infrastructure in front of the road may cause tension between public vs private boundaries.
- The new waterfront estate will encourage mainly rich people and not families.
- The daylighted system conveyed in the concept lacks integration with the surroundings systems.
- Design lacks a comprehensive knowledge of micro-systems within the treatment train. Technical aspects and spatial distribution of treatment devices need to be revised.
- Design interventions lack technical functions due to focus given on too many zones rather than one.
A critical assessment of the design concept revealed many weaknesses and missing pieces to structure a successful model. The design analysis focused on the specificities of the proposed hard and soft infrastructure, regarding its spatial and functional purpose within an integrated framework. The analysis lead to reconfiguring Quay Street, to transform the edge conditions into a vibrant social space. By relieving traffic congestion of Quay Street, an alternative route is examined to accommodate existing and future traffic volumes. An efficient and a productive transport route is established linking Tamaki Drive to Beach Road over the existing railway, which is identified as a barrier for future development. While traffic congestion on Quay Street is a primary barrier itself, there is an opportunity to stack the barriers to vacate prime waterfront land for public use.

An analysis of the treatment train focused on understanding the micro-systems and determining their functional role. A daylighted stream is integrated into the
middle of The Strand that aligns with the existing overland flow path, accompanied by treatment devices to capture and filter contaminated runoff at its source. The industrial catchment is under substantial flood pressure and these sustainable interventions are incorporated to release flood threat.

Resilient and sustainable edge conditions need to be epitomised at the waterfront’s coastline. Potential soft and hard engineering strategies are examined to absorb high levels of flood risks and storm events. Design approaches are made to combine innovative techniques that not only remediate catastrophic events but also enable users to connect with the water.
Design refinement

This proposal explores the spatial functions of residential, commercial, entertainment, business and recreational functions within a hybridized territory. Similar design interventions from the previous concept can be recognized; however, the spatial distribution and the placement have been reconfigured to enhance adaptability and integration. Quay Street has been remodelled as a shared space with a proposed tram extension to Wynyard Quarter. Thus, diverting traffic from east-west through an elevated transport corridor and re-routing the intersection of The Strand, Quay Street and Tamaki Drive. Resilient strategies such as dike systems have been integrated at each end of the proposed foreshore to manage its water level within the inlet for controlled water recreation and prevent coastal inundation from sea-level rise.

NOTES FROM CRITICS

STRENGTHS

• Multiple levels of integrated programmes are rationalized and support the overarching theme.
• A good strategy to permeate Quay Street to create a ‘harbour edge stitch’.
• Strategic integration of soft and hard engineering strategies to remediate adverse coastal effects as well as treating urban runoff.

Figure 4.15. Design refinement plan (Authors own, 2016)
• Creating a foreshore enables a safe passage for public recreation from the industrial port zone.

• Efficient and integrated planning of residential, commercial and entertainment zones as a response to urban challenges.

• Creating a strong pedestrian oriented axis to Wynyard Quarter encourages public transit and foot traffic.

• The treatment system demonstrates its functional use and benefits the city.

• Potential to widen the proposed canal to accommodate a number of social activities and passive recreation.

WEAKNESSES

• Creating a dense neighbourhood at the waterfront could potentially create tension between public and private entities.

• Proposed traffic route above the railway could pose critical consequences for future development. An underground tunnel is a more viable option.

• Need to acknowledge the cultural significance of the site.

• Spatial connection lacking from Auckland Domain to the waterfront.
4.5 | SUMMARY OF DESIGN

The design chapter of the thesis tests multiple opportunities and constraints at the port-city edge, through strategic integration of existing and potential urban development. The proposed design interventions are rationalized from comparative design strategies, principles and findings extracted from the literature review.

Initial tests of the site explored potential design opportunities and constraints at the edge, which reflected a hybrid use of design principles and strategies. However, critiquing these preliminary tests lacked a complex understanding of a working port, followed by an ambiguous design concept. These tests were later developed through an empirical research process to form a design impetus that supports the research question. A thorough analysis of the edge interface and its wider catchment was initiated to resolve Auckland’s environmental challenges via sustainable and resilient initiatives. The design speculation lead to ambitious yet pragmatic design moves to provide social, economic and ecological benefits.

The design development phase encompassed of five conceptual zones, each having its separate functions that mediate through an integrated system at the waterfront. This phase explored the opportunities and constraints at multiple levels to derive a set criterion for further refinement. Multiple design strategies lead to major design interventions that supported and retained urban development. Thus, identifying areas for enhancing social, cultural, economic and ecological values. Further design experiments conducted possible opportunities for a robust and efficient transport corridor to service daily commute, following the reconfiguration of Quay Street into a shared space. This move created multiple design opportunities at the edge for innovative development and supporting the ‘harbour edge stitch’ initiative. Increasing resiliency at the waterfront focused on integrating soft and hard engineering strategies to sustain liveability, social recreation and a working environment at the edge conditions.
The refined design aimed to integrate various programmes along the edge interface. Following the design refinement phase, some opportunities and constraints were procured from the strengths and weaknesses of each concept. These factors were rationalized through design by research and will be critical in shaping the final design proposal.

**OPPORTUNITIES**

- Develop a vibrant and a multi-functional waterfront edge by creating a canal/foreshore to give increased public access to the water.
- Repurposing Quay Street as a shared space to enhance social dynamics, encourage public transport, enhance waterfront liveability and expand commercial and entertainment zones, while connecting the entire Auckland waterfront.
- Modify Captain Cook Wharf as a secondary cruise facility, in return permitting POAL to reclaim further land into the harbour.
- Innovative stream daylighting opportunities within industrial and commercial zones to increase social, economic and environmental values.
- Construct an efficient transport route for daily commuters and heavy commercial vehicles away from the waterfront and proximate to business and industrial sectors.
- Stitch the existing urban city fabric, in particular, the development situated behind the port-related activities.

**CONSTRAINTS**

- Heavy freight transport via trucks and rail need to access the ports. Therefore, a robust built structure needs to be implemented and sustained that does not impede pedestrian activity and social recreation.
- Modifying Captain Cook wharf and de-reclaiming the port’s edge will acquire further dredging and land reclamation, affecting the harbour’s natural biodiversity.
- Redirecting the traffic congestion may create a bottleneck on Beach Road and Customs Street.
5.0 | DESIGN PROPOSAL

OVERVIEW

GATEWAY TO AUCKLAND

ECONOMIC HUB

QUAY PARK COMMUNITY

WETLAND PARK

STORMWATER TREATMENT SYSTEM

DESIGN SUMMARY
5.1 | OVERVIEW
The final design proposal is derived from a criterion consisting of design principles and strategies from the literature review and case studies. The development of the proposed outcome is manifested within the speculative design process. While Auckland’s waterfront is one of the most contentious pieces of land for future development, it needs to transform and adapt to the city’s contemporary challenges. This proposal identifies Auckland City’s key issues that will have major impacts on its waterfront, in particular, the port-city edge interface.

This thesis rationalizes the concept of public and private edge conditions within the confines of urban zones that balance social, economic and environmental factors. The core objective was to reconnect the public to the water’s edge at the port-city interface. This objective is accomplished by permeating Quay Street as a shared space and cutting a channel at the existing port-city edge interface and dramatically daylighting a channel at the harbour. These interventions enhance north-south-east-west flow and encourage public transit along the entire waterfront. A strategic integration of mixed-use development and open spaces have been rationalized as key requirements to reinforce the port-city’s dynamics. This proposal is a solution and a model that can act as a catalyst for the entire Auckland Waterfront at different scales.

The design as a whole is categorized into five sections which exemplify the site-specific character and functional purpose within the existing urban conditions.

Section 1: Gateway to Auckland
(Cruise terminal, waterfront park & cultural centre)

Section 2: Economic Hub
(Retail, commercial & entertainment)

Section 3: Quay Park Community
(Residential living & leisure facilities)

Section 4: Wetland Park
(Passive water recreation & leisure)

Section 5: Stormwater Treatment System
(Stream daylighting, wetland park & detention basin)
Figure 5.1. Design Proposal – Masterplan (Authors own, 2016)
Figure 5.2: Section 1: Gateway to Auckland (Author’s own, 2016)
5.2 | GATEWAY TO AUCKLAND

Cruise terminal, waterfront park & cultural centre

This section encompasses various design interventions which explore sustainable and resilient strategies while retaining the port activities. An extension and revitalization of Captain Cook Wharf as a secondary cruise terminal will accommodate more cruise ship visits, hence, stimulating the city’s economy. This intervention serves as a focal point for tourists arriving in Auckland who are funnelled directly to the existing entertainment interface (see Figure 5.2). The thesis investigated soft and hard engineering strategies to remediate an estimated three meter sea-level rise at Auckland’s waterfront. The implementation of an undulating waterfront park contains three stormwater ponds that filter contaminated runoff offsite before being discharged into the harbour. This intervention also serves as a terraced flood park from sea-level rise and high storm events. This intervention is complemented by a three-meter high dike system, which operate as flood-gates between the park and the ports (see Figure 5.2). The floodgates control the tidal range within the canal via opening and closing during moderate and low tides to allow public access for passive water recreation (see Figure 5.3). The following design interventions led towards deconstructing Marsden Wharf.

Figure 5.3. Dike system functions (Authors own, 2016)
Figure 5.4. Cross-section of stormwater treatment ponds (Authors own, 2016)

Figure 5.5. Cross-section of Cultural Centre and the canal (Authors own, 2016)
The proposal investigates opportunities to retain historic and existing elements to preserve the site’s character and profile. Point Britomart was a former headland at the foreshore where the natives paddled their canoes and wakas. The former headland has been transformed into a new waka landing bay and a viewing deck that feeds into a proposed culture, arts and events centre, which currently operates as a parking building. The cultural centre houses an external waka whare, which is on display to the public (see Figure 5.2). The formation of the vegetated islands resemble the historic Point Britomart headland, further creating narrow channels for passive water recreation. The waterfront park and the canal are designed to create an estuarine habitat through native planting and materials to enhance and restore the cultural identity of Tāmaki Makaurau.
Figure 5.6. View of the waterfront park and dike system (Authors own, 2016)
LEGEND:

01. CONCRETE TERRACES
02. PUBLIC/PRIVATE PARK
03. PEDESTRIAN TIMBER BRIDGE
04. NATIVE WETLAND PLANTING
05. TAPORA STREET MODIFIED INTO A SHARED SPACE
06. 4-STOREY RESIDENTIAL APARTMENT
07. GROUND FLOOR RETAIL INTERFACE
08. CIVIC & PLAZA SPACE
09. COMMERCIAL DEVELOPMENT
10. RESTAURANTS, BARS & CAFÉS
11. HOTEL (ORIENTED FACING THE ENTIRE WATERFRONT)
12. OUTDOOR SEATING
13. WATER CHANNEL
14. LINK TO VECTOR ARENA
15. RETENTION OF PORTS FREIGHT RAILWAY LINES
16. RETROFITTING PORT CONTAINERS AS INFORMATION HUBS
17. VEGETATED ISLANDS (SALTMARSH & WETLAND SPECIES)
18. TIMBER DECK
19. MEANDERING CONCRETE WALKWAY SURFACING THE WATER
5.3 | ECONOMIC HUB

Retail, commercial & entertainment

The design investigated opportunities for major urban development along the waterfront that would enhance the economic and social capital. The zoning of diverse functions and urban development were assessed and rationalized to optimize connectivity, proximity, strategic alliance and open spaces in an integrated framework.

The proposed entertainment and retail zone consists of bars, restaurants, cafes and shops that are situated opposite Vector Arena, creating a coherent connection to the existing event space. This zone will inject vibrancy at the waterfront edge and will enable cultural diversity. The entertainment and retail will be established on ground floor accompanied by offices and businesses on top, catering towards a mixed-use precinct. This precinct offers intimate east-west laneway connections comprising of a retail interface at a human scale.

These intimate laneways feed into an event and plaza space established diagonally opposite to Vector Arena. The composition of this space is subjective and adaptive to diverse social uses. This open space is surrounded by further retail and entertainment facilities on the ground-floor, accompanied by residential living on top. This space is primarily designed as an event space that also accommodates temporary pop-up shops and outdoor seating for the public. By transforming Quay Street as a shared space, the plaza has the opportunity to extend up to the water’s edge to form an enormous event space. Connection to the water is improved by designing concrete terraces that overflow during tidal change, complemented by boardwalks that run along the periphery of the canal. Accessibility to the port’s edge via a bridge allows public the flexibility to interchange and explore the canal from a different perspective. The ports separation from the coastal edge and the shared space will increase safety measures, furthermore, fencing of the territory from the public.

The entertainment, retail and commercial zone serves as an economic and a social hub for the city. This zone’s economic capital is further stimulated via a new hotel development at the prime waterfront, projecting scenic views of the harbour. This
infrastructure will attract existing locals and tourists to reside on prime waterfront estate surrounded by a vibrant entertainment district. Furthermore, this zone positively affects Auckland’s economic capital and increases employment opportunities.
Figure 5.11. View of the retail and commercial precinct (Authors own, 2016)
Figure 5.12. View of the event and plaza space (Authors own, 2016)
LEGEND:
01. LEISURE & RECREATION CENTRE
02. OUTDOOR CHILDREN'S WATER PLAY AREA
03. BASKETBALL COURT
04. PARKING BUILDING
05. OUTDOOR SEATING
06. 3-STOREY TIMBER APARTMENTS
07. 3-STOREY BRICK TOWNHOUSES
08. 6-STOREY HIGH-RISE APARTMENTS
09. INTIMATE LANEWAYS CONSISTING BOUTIQUE RETAILERS & CAFES
10. EXISTING RESIDENTIAL DEVELOPMENT
11. RESIDENTIAL COURTYARD
12. TIMBER BOARDWALK
13. INFORMAL OPEN SPACE
14. EXTERNAL CHILDREN'S PLAY AREA
15. RETROFITTING PORT CONTAINERS AS TOILETS
16. PUBLIC PARK
17. RECREATIONAL BOATING DROP-OFF ZONE
18. BOAT RAMP
19. ACCESS TO THE SHARED SPACE
20. PROPOSED ARTERIAL ROUTE
21. INFORMAL PUBLIC PARK
22. RESIDENTIAL BACKYARD
23. PEDESTRIAN RAILWAY BRIDGE
24. EXISTING STATION PLATFORMS
5.4 QUAY PARK COMMUNITY

Residential living & leisure facilities

While Auckland faces a housing crisis to accommodate a growing population in the city, planning agendas are underway to resolve this issue. However, Auckland is heavily relying on intensification methods within the existing urban peripheries.

The research investigation explores the economic viability of housing development at a prime waterfront estate. A growing demand for residential living in the city is prominent, particularly at the waters edge. This design uses Wynyard Quarter as a case study to comprehend its design principles and strategies used to create a neighbourhood rather than dense living conditions. The proposal follows a similar scheme of using a mixed housing typology that include north-facing 3-storey timber apartments, complemented by boutique retailers and a lobby on the ground-floor. In addition, 3-storey brick townhouses are supplemented with parking garages at the bottom. Furthermore, the residential quarter also includes 6-storey high-rise apartments with east, west and north facing balconies (see Figure 5.14). These apartments are situated behind the row of townhouses and are accessed from the laneways behind. The apartment buildings house boutique retailers and cafes on the ground-floor, which are also accessed by vibrant intimate laneways (see Figure 5.16). The diverse housing typology and material choices create a sense of a neighbourhood within a metropolis. Thus, potentially welcoming a diverse demographic that include families and young adults.

Quay Park Community will encompass a total of 276 dwellings, excluding the 20 existing dwellings situated adjacent the railway lines.

- 3-storey Timber apartment buildings - 9 (54 apartments)
- 3-storey Townhouses (42 townhouses)
- 6-storey High-rise apartment buildings 5 (180 apartments)

Total 276 new dwellings

Existing townhouses (20 apartments)
With a growing population, there is a demand for greater public facilities and spaces in the city. The design incorporates a leisure and recreation centre to the west of the proposed residential development (see Figure 5.17). These facilities will support the city’s long-term sustainability and liveability goals. The proximity of the leisure complex to the surrounding urban development will further encourage foot traffic and public transport while attracting locals from Auckland’s wider context. An external children’s play space is integrated within the new foreshore, situated opposite the timber apartments. Parking buildings are implemented behind the leisure and recreation centre for public using the facilities as well as to reduce on-road parking.

Public transport is encouraged at Quay Park Community by adding a new station stop at the existing Strand Station. This station will be a critical nodal point for future residents, commuters and the general public. The proposal also enables a strong axial link to the existing residential communities and the industrial zone. The revitalized Strand station consists of three platforms which are connected via an elevated pedestrian crossing for an efficient commute (see Figure 5.15).
Figure 5.16. View of an intimate and vibrant residential laneway (Authors own, 2016)
Figure 5.17. View of the Leisure and Recreation Centre (Authors own, 2016)
5.5 | WETLAND PARK

Passive water recreation & leisure

This zone takes many existing factors into consideration, which include ongoing port operations at Fergusson container terminal and a freight rail running parallel to the current Quay Street. An underpass route below Tamaki Drive is serviced by the POAL freight rail to the inland hub in Wiri. The design investigates the opportunities and constraints while retaining critical port-related operations such as the freight rail.

The existing traffic-choked arterial road is transformed as a shared space to stitch the urban fabric and the water’s edge. The design speculation addresses the need for an arterial route and identifies the existing railway as a barrier for future development. A pragmatic solution involved consolidating the two barriers by stacking them one on top of another. The proposal demonstrates a simultaneous dual purpose of an efficient commute from east to west via an elevated transport corridor, while trains continue to service on the ground. The proposed junction between the shared space, The Strand and Tamaki Drive will retain its existing functions. However, the new transport corridor will provide a direct link for commuters and heavy commercial vehicles from Tamaki Drive to Beach Road.

Based on the existing geographical conditions, there was an opportunity to create a wetland park that enhanced amenity values. This zone consists of a public boat ramp, alongside a densely vegetated foreshore edge with native and salt marsh habitat. The coastal edge acts as an informal recreational space that includes a lookout point and connects to a coastal boardwalk along the vegetated edge for public recreational use. Elevated viewing platforms are implemented in the informal park, projecting scenic views from east to west. The eastern end of the canal is gated by a dike system, controlling the tidal flow and volume within.

The freight-rail access from the ports to the inland hubs is supported via an elevated bridge to retain ongoing freight rail functions. Access to the Ports has been confined to a access point at the present Fergusson Terminal, to prevent conflict between public using the new foreshore and ongoing heavy commercial vehicles.
Figure 5.19. Cross-section of the freight-rail bridge over the canal (Authors own, 2016)

Figure 5.20. Cross-section of the highway interchange and the wetland habitat (Authors own, 2016)

Figure 5.21. View of the canal and wetland park from the viewing platform (Authors own, 2016)
Figure 5.22. Section 5: Stormwater Treatment System (Author’s own, 2016)
LEGEND:

01. COMMERCIAL DEVELOPMENT MODIFIED INTO A COMMUNITY CENTRE
02. EXISTING KINDERGARTEN FACILITY
03. OUTDOOR PLAY AREA
04. WATER CHANNEL FEATURE HIGHLIGHTING AUCKLAND’S FORMER COASTLINE
05. EMBEDDED WETLAND PLANTING
06. BIOSWALE
07. DAYLIT STREAM
08. RAINGARDEN
09. DETENTION BASIN
10. GRASS TERRACES
11. RAISED WALKWAY
12. OPEN SPACE
13. ACCESS TO VECOR ARENA
14. EXISTING RAILWAY CAR PARK
15. ACCESS TO EXISTING CAR PARK
16. TRAIN STATION ENTRY POINTS

- - - CURRENT STORMWATER PIPE NETWORK
- - - PROPOSED STORMWATER PIPE CONNECTION
- - - OVERFLOW STORMWATER PIPE
5.6 | STORMWATER TREATMENT SYSTEM

*Stream daylighting, wetland park & detention basin*

The thesis has addressed the issue of contaminated urban runoff within the industrial zone to reach up to 24,136 meters cubed within the next 100 years according to the statistics from Auckland GIS (see Figure 4.4). The design proposal evaluates areas susceptible to flooding in order to adopt a sustainable approach to mitigate high volumes for future generations.

The design speculation and analysis identified areas with opportunities that could host treatment devices. This site recognizes the need for a robust treatment train to filter contaminated runoff before being discharged into the harbour. Design elements and principles from the design speculation phase are mimicked in the final proposal with greater detail. An existing commercial facility situated near the railway car park is modified into a community centre for children. The design rationale is based on the proximity to existing and proposed residential development as well as a neighbouring kindergarten facility. An external play space is designed for safe outdoor play and consists of wetland planting that treats urban runoff while raising amenity values (see Figure 5.23).

Additional treatment devices include rain gardens which are planted at the foot of existing residential apartments between Ronayne Street and Ngahoho Place. An existing parking lot situated at the junction of The Strand and Parnell Rise is identified as an opportune space for a vegetated detention basin to absorb heavy storm events. The detention basin can be utilized as public or play space during dry conditions in comparison to winter, where high volumes of runoff will be detained (see Figure 5.24). Contaminated runoff from a proposed daylighted stream is integrated at the heart of The Strand, spanning across a maximum width of eight meters and running up to 730 meters. The stream is embedded one meter deep in relation to its existing topography and contains overflow pipes leading to the surrounding treatment devices to discharge runoff during intense storm events and prevent overflow. The water will be treated for 48 hours before being released into the harbour through existing and proposed underground service pipes.
While incorporating a robust treatment train to release flood pressure, the daylighted stream also represents Auckland’s coastline before land reclamation. The stream will be vegetated with appropriate native planting to filter contaminants and will spread across one lane to the right. Therefore, commuters in particular travelling south from The Strand and on to the motorway will be constrained to one lane until crossing Parnell Rise. The Strand will become a secondary arterial road and re-route heavy commercial vehicles via the proposed elevated transport corridor.

The proposed transport corridor descends over the existing Te Taou Reserve and intersects with Beach Road. The Te Taou reserve is viewed as a historic landmark within the Tāmaki Makaurau. However, it is isolated from the public and surrounded by cars. This open space is degrading over time and is a major flood zone due to poor infiltration. The design research identifies the scope for potential development within the existing confines while retaining its historic character. The reserve is converted into a flood park that extrapolates comparable design principles and strategies used in the Waitangi Park. Besides operating as a flood park, the open space can also be utilized for social gatherings before attending events at Vector and alternative leisure purposes (see Figure 5.25). A majority of the carpark is retained against the current brick wall and can be accessed from Te Taou Crescent.

Figure 5.23. Cross-section of the proposed Community Centre and outdoor play space (Authors own, 2016)

Figure 5.24. Cross-section of the daylighted stream and detention basin (Authors own, 2016)
Figure 5.25. View of the revitalized Te Taou Reserve (Authors own, 2016)
5.7 | DESIGN SUMMARY

The research by design process explored critical relationships between the city and its urban edge conditions at different scales. A collaboration of literature review, site analysis and design speculation derived a criteria and set design principles outlining opportunities and constraints. The proposed outcome was responsive towards the design objectives while articulating critical design strategies which include connectivity, sustainability, resiliency and liveability. An iterative process during the design speculation phase established common threads as well as identified areas of conflict. Continual examination and critique of concepts strengthened the design framework and progressed upon each scheme. The final proposal is the resultant of this empirical process in response to Auckland’s contemporary political and environmental challenges.

The outcome can be conceptualized as a model that retains a symbiotic relationship between the city and its port while stimulating social, cultural, economic and environmental dynamics at Auckland’s waterfront. The proposal is designed towards achieving a synergy between existing and proposed urban development at a human scale. A strategic integration of diverse multiple programmes proposed within the existing urban fabric enhances connectivity, vibrancy, identity and place attachment. The design framework embedded the protocols outlined in the Crime Prevention Through Environment Design (CPTED) document to create safe open spaces for users throughout the day. The framework also adhered to the Te Aranga principles while designing for sensitive and cultural spaces to highlight the historical significance within Tāmaki Makaurau.

The revitalized port-city edge is influenced heavily by Waterfront Auckland and the council’s planning agenda for the future. The proposal mirrors similar design principles and strategies that expand across to create a waterfront edge. Auckland’s critical challenges are addressed throughout the entirety of the project, which are embedded in the new framework. These systems can adapt, transform or expand over time varying on the social, economic and political climates. Despite the assimilation of a diverse use of programmes, the design preserves its urban character and identity.
This model is a pragmatic and a comprehensive solution towards Auckland’s subjective waterfront development. It is an incentive for urban waterfront development at various scales that pertain similar challenges and scope for injecting sustainable, resilient and liveable conditions.

STRENGTHS:

• Resolving Auckland’s critical issues through a collaboration of diverse programmes that are responsive to existing and future challenges. These programmes create spaces for work and play relationships while stimulating social, economic and environmental values. An integrative approach that fits into current and proposed development framework while strengthening the synergy between the port and city.

• The design can be progressively staged due to the limitations of Auckland’s economic expenditure and to observe the public’s involvement over time.

WEAKNESSES:

• By cutting a linear channel at the ports edge will cause initial concerns, pushing the industry to reclaim its footprint and potentially causing adverse environmental impacts. This limitation is rationalized as a feasible long-term option with mutual benefits while retaining the port industry in Auckland.
6.0 | CONCLUSION
Urban waterfronts are complex sites that have endured many transformations over decades. The historical-geographical patterns of these contested sites are evident in the 21st century following major urbanization. Originally, ports were considered vital economic assets for their host cities until the rise in technological advancements created a shift between port-city relations. The seaports are now perceived as exclusive economic cogs of coastal cities who divide political opinion. Auckland’s burgeoning port industry focuses heavily on their economic capital gains, while maintaining their logistical operations to increase greater performances, efficiency and annual throughput. In saying this, recent studies on POAL have indicated the ports will be reaching capacity constraints despite recording productivity gains each year. While the Ports have been denied consent from reclaiming further into the harbour, politicians have initiated a discourse to relocate the ports in the future.

The thesis consolidated pertinent information from the literature review, which included theories, historic natures of port-cities and case studies which explore contemporary design principles and strategies. The depth of research was crucial leading towards understanding the relationships between urban edge conditions, ecological systems on waterfronts and the socio-economic processes of port-cities. According to Michael Porter, maritime clusters attract further businesses and increase economic capital (Hansen & Clasen, 2010). Waterfront development follows a similar philosophy which foresees clusters emerging on the hinterland that progressively sprawl and create an agglomeration of businesses, commercial and residential areas. The thesis outlines a set of design objectives driven by Auckland’s contemporary issues and the goals attained by relevant planning agendas. An integrative framework is opted for a holistic approach that enables a hybridized spatial use of maritime, business, commercial, residential, entertainment and recreational functions to achieve sustainable outcomes and enhance liveability. These social, economic and environmental opportunities can be identified in HafenCity, Barcelona, Marseille and the present Wynyard Quarter at different scales.

Auckland’s waterfront was analyzed to scope out opportunities and constraints in order to optimize social, economic and environmental values within the existing urban territory. The primary objective was to stitch the harbour back to its city while developing flexible and adaptable urban systems that integrate with the existing fabric to provide social and economic benefits. The port-city edge was examined primarily as a blank canvas and envisaged as a mixed-use precinct to achieve
Auckland’s projected economic goals and liveability ratings. Repurposing Quay Street as a shared space saturates the barrier and reconnects the city to its edge while connecting to various sections of the site. This notion was driven by HafenCity, The Dryline and The Waterfront Plan’s proposal (Waterfront Auckland, 2012). The ports separation from its boundary created a channel that would enable users to connect with the water and have access to the entire waterfront. The new waterfront edge unfolded many opportunities for social recreation, while preserving safety measures and retaining access to the ports. However, the limitations of this design move would allow ports to extend into the harbour to reclaim their footprint.

One of Auckland’s challenges is dealing with climate change, in particular, sea level rise. The analysis of the Dryline project highlighted soft engineering techniques such as a flood mitigation park that offers social and environmental benefits within a mixed-use coastal development. The design proposal addresses the sea-level rise by implementing a terraced flood mitigation park and a flood gate at each end of the ports to prevent adverse impacts from heavy storm events and coastal inundation.

Auckland’s initiative for new housing development has come under scrutiny due to densification methods. The thesis identifies the scope for residential development and is influenced by Wynyard Quarter. The new residential zone shares similar visions of creating a neighbourhood within proximity to an entertainment, retail and a commercial district that injects a vibrant atmosphere at the prime waterfront estate. Increased foot traffic, public transportation and implementing connections to adjacent communities classify as successful attributes of a growing city that will attract a greater demographic and increase liveability.

It was critical to address urban runoff within the industrial zone to release pressure from the coastal edge by using low impact urban design and development (LIUDD) techniques. The Cheonggyecheon stream provided a new perspective to challenge the limitations of existing site conditions. The implementation of a daylighted stream and treatment devices were critical towards absorbing intense storm events as well as filtering toxins and contaminants through natural uptake of vegetation. The treatment devices and the stream also provide natural amenity in a degraded industrial site.

In summary, the thesis exercises key findings and rationalizes the research and design scope for urban development at the port-city interface zone. The sensitive
nature of the city’s edge conditions is crucial to take into consideration for any future development and must strengthen the port-city links. While politicians and the government negate the right to build on the prime waterfront, the current discourse on urban waterfronts suggests the opposite. The design scaffolding and structure is guided by the urbanization patterns of Auckland, to provide sustainable, resilient and liveable outcomes and a long-term solution. The proposal can also be conceptualized in stages, that provide a fundamental structure to shape the following steps in a progressive manner. Further investigation and research in the later stages would allow for an in-depth critique of the complexities surrounding existing urban functions while enhancing social, economic and ecological trends through future development. While ports are perceived as the antagonists of growing coastal cities, their symbiotic relationship with their hosts’ needs to be strengthened and provide mutual benefits. Formation of an integrated framework will determine a flexible human nature and enhance the synergy between the port and its city.


NIWA. (2013). *Coastal inundation by storm-tides and waves in the Auckland region*. Auckland: NIWA.


LIST OF FIGURES & TABLES
Figure 1.1. Characteristics of and trends in the port-city interface (Hoyle, 2000, p. 404).
Figure 1.2. Stages in the evolution of port-city interrelationships (Hoyle, 2000, p. 405).
Figure 1.3. Urban development of city of Antwerp (Merckx et al., 2003, p. 11).
Figure 1.4. Canadian vessel at the harbour of Antwerp IWM, 2016).
Figure 1.5. Port-City of Rotterdam Region (Daamen, 2007, p. 11).
Figure 1.6. Map of Hamburg's HafenCity (Beadeker, 1913)
Figure 1.7. Plan of Auckland waterfront showing the original coastline in 1841 (Auckland Council Libraries, 1900).
Figure 1.8. Perspective of Auckland City in 1840 (Heart of Auckland City 1841 (Auckland Council Libraries, 1900).
Figure 1.9. Tension on Port-City borders. (Merckx et al., 2003).
Figure 1.10. Proposed new spatial model for port-city interface (Wiegmans & Louw, 2011, p. 582).
Figure 1.11. Diagram of city-port connectivity system (Boulos, 2016, p. 977).
Figure 2.1. Sustainability Framework (Algonquin College of Applied Arts and Technology, 2016)
Figure 2.2. Four-dimensional conceptual model of sustainable development (Zhao & Wen, 2012, p. 1385)
Figure 2.3. The production of hybrids in the context of social relations with nature (based on Swyngedouw's theory) (Zimmer, 2010, p. 347)
Figure 2.4. Framework of competitive advantage in an economic cluster (Porter, 2000, p. 20)
Figure 2.5. Marseille's port-city functions (Daamen & Vries, 2012, p. 5)
Figure 2.6. Marseille's revitalized central wharf of the old port (Payyagiste, 2015).
Figure 2.7. Barcelona's Rambla de Mar (Groundspeak, Inc., 2000-2016).
Figure 2.8. Barcelona's Nova Bocana (Daamen & Vries, 2012, p. 5)
Figure 2.9. Hamburg's Rehersieg and Kleiner Grasbrook on the Elbe Island (Daamen & Vries, 2012, p. 5)
Figure 2.10. Development of Kleiner Grasbrook on the Elbe Island (DragonByte Technologies Ltd, 2015).
Figure 2.11. Port of Barcelona in 1981 (Port de Barcelona, n.d.).
Figure 2.12. Port of Barcelona in 2011 (Port de Barcelona, n.d.).
Figure 2.13. PortVell marina (Ocean Port Vell, n.d.).
Figure 2.14. PortVell event space (Ocean Port Vell, n.d.).
Figure 2.15. An aerial panoramic of Port Vell (Iliff, 2007).
Figure 2.16. Port Botany expansion simulation (AECOM, 2016).
Figure 2.17. Port Botany reclamations of a container terminal. (AECOM, 2016).
Figure 2.18. Port Botany lookout point (Fighera, 2011).
Figure 2.19. Port Botany cycle way (Horticuret Innovation Australia Ltd, 2016).
Figure 2.20. Port Botany foreshore beach (Horticuret Innovation Australia Ltd, 2016).
Figure 2.21. Public boat ramp near Port Botany (Jan De Nul Group, 2008 - 2011).
Figure 2.22. Historic aerial view of Port of Hamburg (HHLA / Hamburger Fotoarchiv, n.d.).
Figure 2.23. Redevelopment of former port area for new urban infrastructure (KCAPArchitects&Planners, n.d.).
Figure 2.24. Spatial planning analysis of HafenCity (KCAPArchitects&Planners, n.d.).
Figure 2.25. Marco Polo terraces for public use (HafenCity Hamburg GmbH, n.d.).
Figure 2.26. Panoramic aerial of HafenCity model (KCAPArchitects&Planners, n.d.).
Figure 2.27. Auckland CBD and waterfront in the 1950's (National Library of New Zealand, 2011).
Figure 2.28. Wynnard Central (BBD New Zealand, n.d.).
Figure 2.29. Laneway - artist impression (Waterfront Auckland, 2015).
Figure 2.30. An artist's impression of Precinct Properties (Harris, 2015).
Figure 2.31. Wynyard Quarter (A1T Themes, 2015).
Figure 2.32. Expansion of Manhattan into the harbour (Bjarke Ingels Group, 2014).
Figure 2.33. Mapping of social amenities at Lower Manhattan (Bjarke Ingels Group, 2014).
Figure 2.34. Panoramic aerial of Lower Manhattan (Bjarke Ingels Group, 2014).
Figure 2.35. Panoramic aerial of a revitalized waterfront (Bjarke Ingels Group, 2014).
Figure 2.36. Simulation of a passive recreation zone (Bjarke Ingels Group, 2014).
Figure 2.37. Simulation of a seasonal park acting as a flood barrier (Bjarke Ingels Group, 2014).
Figure 2.38. Conceptual site plan (Seattle Metropolitan Government, 2002).
Figure 2.39. Detail site plan (Kim, 2015).
Figure 2.40. Site section for 100-yr storm level (Kim, 2015).
Figure 2.41. Cheonggyecheon stream waterfall (Kim, 2002).
Figure 2.42. Seoul's Cheonggye stream was once covered by an elevated highway (City Clock Magazine, 2014).
Figure 2.43. Cheonggye stream public space at night (Kim, 2008).
Figure 3.1. Commercial Bay 1852 – Sir George Grey Special Collections (Auckland Council, n.d.),
Figure 3.2. Plan of the town of Auckland – Sir George Grey Special Collections (Auckland Council Libraries, n.d.),
Figure 3.3. Overlapping Plan of Auckland's waterfront in 1841 over present day land reclamations (Auckland Council Libraries, n.d.).
Figure 3.4. Population Density (Statistics New Zealand, n.d.).
Figure 3.5. Population Growth Rates (Statistics New Zealand, n.d.).
Figure 3.6. Auckland city’s grided layout (Authors own, 2015)
Figure 3.7. Existing transportation network and modes (Authors own, 2015)
Figure 3.8. The pre-European shoreline superimposed on a 1950’s map of the inner city (K Road Business Association, 2016).
Figure 3.9. GIS mapping of Auckland’s hydrology (Authors own, 2015)
Figure 3.10. Conventional high and low-tide edge conditions for human interaction (Authors own, 2015)
Figure 3.11. The natural edge showcasing major feature of a beach profile (OC/GEO 103, 1999)
Figure 3.12. Typical saltmarsh vegetation zonation (The Geological Conservation Review, n.d.).
Figure 3.13. Ports of Auckland public walkway (Cash, 2014)
Figure 3.14. Contaminants from eroded wharf infrastructure leaching into the Waitemata Harbour (Authors own, 2015)
Figure 3.15. The Cloud and Shed 10 from the south end of Queens Wharf (Bauer Media NZ, 2016)
Figure 3.16. Westhaven Promenade (Short walks in Auckland, 2015)
Figure 3.17. Contaminants settled in flood plains on Queens Wharf (Authors own, 2015)
Figure 3.18. Extending Ferguson terminal through intensive land reclamations (Ports of Auckland, n.d.).
Figure 3.19. Number of monitored sites with heavy metal concentrations are grouped by location type (e.g. harbour) (State of the environment and biodiversity – Marine, n.d.).
Figure 3.20. Auckland’s waterfront view from Google Earth (Authors own, 2015).
Figure 3.21. Locating Auckland’s waterfront at various scales (Authors own, 2015)
Figure 3.22. The Port of Auckland, POA (Auckland Architecture Association, 2013)
Figure 3.23. Aerial view of the ports (Auckland Council GIS Viewer, 2015)
Figure 3.24. Ports of Auckland public walkway (Cash, 2014)
Figure 3.25. The southern boundary of the customs area of Port of Auckland, on Quay Street (Ingolfson, 2007)
Figure 3.26. Construction works taking place at the multi-cargo wharves (Authors own, 2015)
Figure 3.27. View of the container cranes from Point Britomart (Authors own, 2015)
Figure 3.28. Overlooking at port operations on Fergusson terminal (Authors own, 2015)
Figure 3.29. Containers getting loaded on the freight-rail (Authors own, 2015)
Figure 3.30. Grid layout and mobility patterns of heavy machinery at various terminals (Authors own, 2015)
Figure 3.31. Map of channel depths at Waitemata Harbour (Land Information New Zealand, 2016)
Figure 3.32. Channel width for one-way traffic (Thoresen, 2010).
Figure 3.33. Components of depth (Thoresen, 2010).
Figure 3.34. Layout of berths (Thoresen, 2010).
Figure 3.35. Layout of long piers (Thoresen, 2010).
Figure 3.36. Container throughput (TEU) (Ports of Auckland, 2015)
Figure 3.37. Bulk and break-bulk cargo (Ports of Auckland, 2015)
Figure 3.38. Annual car imports (Ports of Auckland, 2015)
Figure 3.39. Volume of containers moved by rail (TEU) (Ports of Auckland, 2015)
Figure 3.40. Projected container demand and supply capacities (NZIER, 2015).
Figure 3.41. Light vehicle import forecasts (calendar years) (NZIER, 2015).
Figure 3.42. Multi-cargo wharves imports (NZIER, 2015).
Figure 3.43. Port of Auckland asset management in 2015 (Authors own, 2016).
Figure 3.44. Planned development of Auckland’s waterfront (Waterfront Auckland, 2012).
Figure 3.45. Quay Park Quarter – plan showing the consented northern extent of Fergusson Wharf (Waterfront Auckland, 2012).
Figure 3.46. Investigating opportunities for Central wharves development (Transport blog, 2014).
Figure 3.47. Silo Cinema is a magical spot to visit over the Christmas season (Auckland’s Heart of the City, 2015).
Figure 3.48. Public gathering outside Vector Arena (Crawford, n.d.).
Figure 3.49. Artist impression of Wynyard Quarter apartments (Transport blog, 2015).
Figure 3.50. Artist impression of Wynyard Quarter pavilions (Transport blog, 2015).
Figure 3.51. Artist impression of Lower Queen Street – public space and facade (Transport blog, 2016).
Figure 3.52. Artist impression of Lower Queen Street – east/west laneway (Transport blog, 2016).
Figure 3.53. Initial observations of the site through cross-sections (Authors own, 2015)
Figure 3.54. Site analysis – investigating limitations and restrictions (Authors own, 2015)
Figure 3.55. Identifying degraded materials onsite (Authors own, 2015)
Figure 3.56. Site analysis – investigating opportunities and constraints (Authors own, 2015)
Figure 4.1. Conceptual scheme 1 categorized into 3 parts (Authors own, 2015)
Figure 4.2. Conceptual scheme 2 (Authors own, 2015)
Figure 4.3. Conceptual scheme 2 - variation (Authors own, 2015)
Figure 4.4. GIS analysis of Auckland’s hydrology and underground services (Authors own, 2015)
Figure 4.5. GIS mapping of projected coastal inundation impacts (Authors own, 2015)
Figure 4.6. Simulations of a 3 metre sea-level rise in Auckland (TVNZ, 2015)
Figure 4.7. Analysis during the design speculation phase (Authors own, 2015)
Figure 4.8. Design experimentations following analysis (Authors own, 2015)
Figure 4.9. Design development plan (Authors own, 2015)
Figure 4.10. Identifying design elements in each section (Authors own, 2015)
Figure 4.11. Design experimentation of a new transport corridor (Authors own, 2016)
Figure 4.12. Investigating soft and hard engineering strategies (Urban Waterfront Adaptive Strategies, 2013)
Figure 4.13. Design experimentation – integration of various design functions (Authors own, 2016)
Figure 4.14. A diagram conceptualizing the remediation process of the site (Authors own, 2016)
Figure 4.15. Design refinement plan (Authors own, 2016)
Figure 4.16. Cross-sections exploring the design details (Authors own, 2016)
Figure 5.1. Design Proposal – Masterplan (Authors own, 2016)
Figure 5.2. Section 1: Gateway to Auckland (Authors own, 2016)
Figure 5.3. Dike system functions (Authors own, 2016)
Figure 5.4. Cross-section of stormwater treatment ponds (Authors own, 2016)
Figure 5.5. Cross-section of Cultural Centre and the canal (Authors own, 2016)
Figure 5.6. View of the waterfront park and dike system (Authors own, 2016)
Figure 5.7. Section 2: Economic Hub (Authors own, 2016)
Figure 5.8. Cross-section of proposed bridge feature and the canal (Authors own, 2016)
Figure 5.9. Cross-section of proposed bridge (north view) (Authors own, 2016)
Figure 5.10. View of the vegetated islands and terraces (Authors own, 2016)
Figure 5.11. View of the retail and commercial precinct (Authors own, 2016)
Figure 5.12. View of the event and plaza space (Authors own, 2016)
Figure 5.13. Section 3: Quay Park Community (Authors own, 2016)
Figure 5.14. Cross-section of residential development (Authors own, 2016)
Figure 5.15. Cross-section of proposed pedestrian railway bridge and transport corridor (Authors own, 2016)
Figure 5.16. View of an intimate and vibrant residential laneway (Authors own, 2016)
Figure 5.17. View of the Leisure and Recreation Centre (Authors own, 2016)
Figure 5.18. Section 4: Wetland Park (Authors own, 2016)
Figure 5.19. Cross-section of the freight-rail bridge over the canal (Authors own, 2016)
Figure 5.20. Cross-section of the highway interchange and the wetland habitat (Authors own, 2016)
Figure 5.21. View of the canal and wetland park from the viewing platform (Authors own, 2016)
Figure 5.22. Section 5: Stormwater Treatment System (Authors own, 2016)
Figure 5.23. Cross-section of the proposed Community Centre and outdoor play space (Authors own, 2016)
Figure 5.24. Cross-section of the daylighted stream and detention basin (Authors own, 2016)
Figure 5.25. View of the revitalized Te Taou Reserve (Authors own, 2016)

Table 3.2. Comparison of backup storage to berth length (NZIER, 2015)
Full name of author: Riyasp Bhandari

Full title of thesis/dissertation/research project ('the work'):

THE URBAN EDGE: AN INTEGRATIVE APPROACH TOWARDS A SUSTAINABLE AND RESILIENT WATERFRONT

Practice Pathway: Landscape Architecture
Degree: Master of Landscape Architecture
Year of presentation: 2016
Principal Supervisor: Daniel Irving

Permission to make open access
I agree to a digital copy of my final thesis/work being uploaded to the Unitec institutional repository and being made viewable worldwide.

Copyright Rights:
Unless otherwise stated this work is protected by copyright with all rights reserved.
I provide this copy in the expectation that due acknowledgement of its use is made.

AND

Copyright Compliance:
I confirm that I either used no substantial portions of third party copyright material, including charts, diagrams, graphs, photographs or maps in my thesis/work or I have obtained permission for such material to be made accessible worldwide via the Internet.

__________________________

Signature of author: R.P.Bhandari
Date: 20 / 01 / 2017