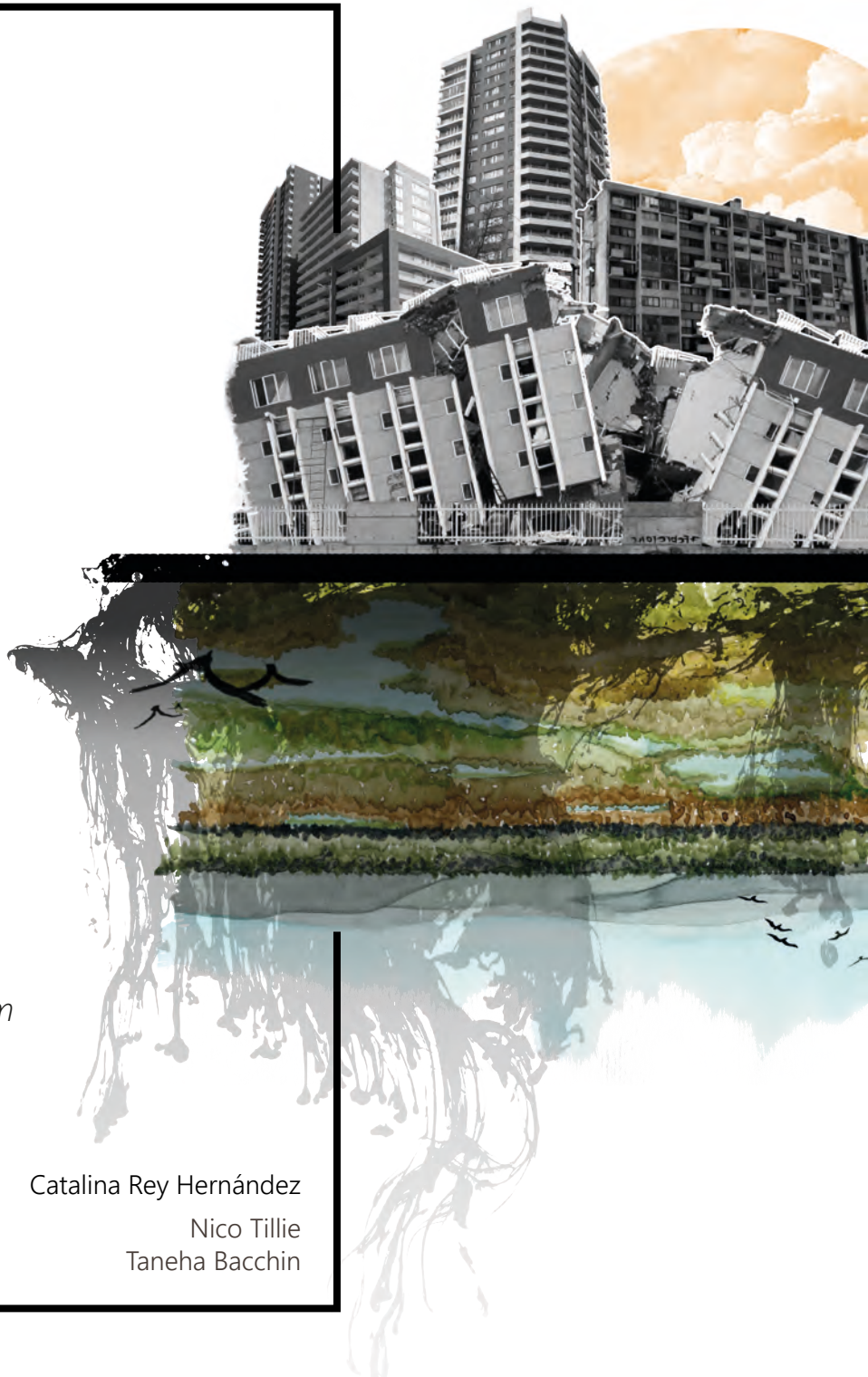
MSc Landscape Architecture Thesis
TU Delft

Rethinking the territory

CONCEPCIÓN, CHILE

Resilient & strategic plan for a vulnerable urban coastal system



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Rethinking the Territory | Concepción • Chile

Resilient & strategic plan for a vulnerable urban coastal system

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To Nico
for all the shared knowledge and for always believing in me and giving me the freedom to dream for a better world.

To Taneha
for sharing my passion for urban and natural landscapes and how to develop them in a resilient way.

It is not the strongest of species that survives, not the most intelligent that survives. It is the one that is the most adaptable to change.

Charles Darwin

Abstract

This research aims to re-envision the city, understanding it as a living system where change creates growth and renewal, and where uncertainty is our new normal.

The continuous struggle between cities and nature, forces human settlements to look for stability and safety, trying to control the dynamics and flows of underlying landscapes. In Chile, this tension is present in many urban settlements trying to deal with the natural dynamics.

Chile, as a territory, is exposed to multiple dynamic natural forces such as the Pacific. With a coast line of 6.435 km, that is defined by the collision of two tectonic plates in constant movement, this regularly triggers a series of natural disasters that affect cities in different ways and degrees in the country. Concepción has been affected severely during the last two decades. Concepción is a coastal urban area that has grown into the flood plain of two river mouths and an ecological important tidal coastal wetland landscape.

Although Concepción is built in a wet soil, city and water never meet; there is a dissociation where one is superimposed on the other. Furthermore, the whole system is increasingly at risk due to the urban pressure of the expanding city, resulting in degradation of ecosystems and natural infrastructure and with that exposing the coastal city to even more frequent and severe natural hazards.

The key opportunity to face the existing challenges does not lie in the primacy of one system upon the other. Both, city and landscape need to interact in a more redefined way, looking for multifunctional structures and a new awareness of the importance of the presently disrupted landscape. What is a new resilient urban landscape backbone?

The following research resulted in a void adaptive network based on design principles: 1.Value the natural system as the base infrastructure for the future city. 2. Use of voids (unplanned spaces) as an emergent, autonomous and self-organized network to create redundancy and multifunctional spaces for risk management. 3. Reformulate the city as a provider of nature: larger green spaces, landscape connectivity and protection of the ecological values of the existing nature.

Applying these steps lead to a resilient spatial framework for the city of Concepción that can provide more stability and safety against natural disasters. The designed backbone was consequently tested in a few natural disaster scenarios and adapted where necessary. This approach can be applied in other cities with similar challenges.

Keywords: *resilience, adaptation, appropriation, flexibility, wetlands, natural disasters, biodiversity, ecological integrity.*

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Part I
Introduction

Chapter 1
Introducing

Context
Fascination

Introducing
context

Chile, as a territory, is exposed to multiple dynamic forces such as the flow of the sea with a coastal line of 6.435 km and at the same time the coastal line is defined by the meeting of two tectonic plates in constant movement: The South American plate, which at its western edge converges and generates subduction zones with the Nazca plate of Nazca.

Thus, this geomorphological aspects of the territory determine a series of natural disasters that affect the cities in different ways and degrees along the country.

In the middle of this vast territory there is the city of Concepción, that has been specially affected during the last two decades, due to several fires and flooding events, earthquakes and its consequent tsunamis.

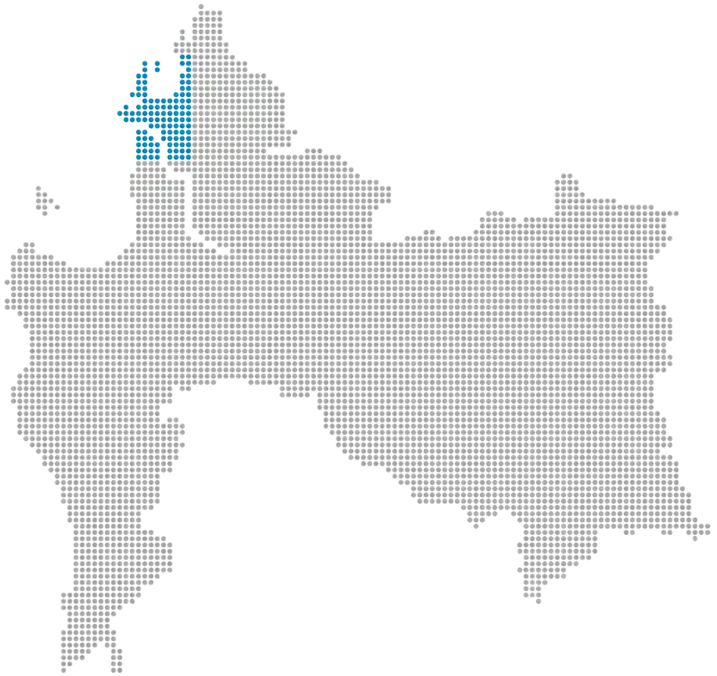
These natural disasters have lead to a process of continuous reinvention of the city and the metropolitan area of Concepción where there is no control of urbanization over nature, generating more risks for its inhabitants.

Latin America
Continental scale

Part I • Chapter 1: *Introducing*

Chile
Country scale

surface _ 765.102,45 km²
coast line _ 6.435 km



Biobío Region
Regional scale

surface _ 23.890,2 km²
population _ 1.556.805 hab
population density _ 64,38 hab/km²

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Introducing
fascination

photo: Cristián Donoso Ulloa

July 2006
Flood by rainfall & overflow of rivers and canals

51.206 victims
22 deceased

photo: Natacha Pisarenko

February 2010
Earthquake 8,8 MW & Tsunami of 10 m waves

2.000.000 victims
525 deceased
23 missing

370.000 damaged houses
133 damaged hospitals
6.168 damaged eductational buildings

photo: https://elchorrillero.com

January - February 2017 (& 2019)
Forest fires

596.000 ha of burned surface
15.000 ha of burned native forest
1.089 damaged houses

Data from the Interior Undersecretary of Chile

As a citizen of this human settlement I had the *opportunity* to witness three major natural events that almost destroyed the city in different degrees: A dramatic flood by rain and overflow of rivers and channels in 2006, the 8,8 MW earthquake of 2010 and its subsequent tsunami with waves of 10 meters high, and finally the forest fires of 2017 that resulted in 596.000 ha of burned surface (forest and native species).

When these kind of events happens, Concepción - as all Chilean cities - recovers itself by erasing what has been destroyed or damaged and it starts building again, on top of the scarred land, forgetting its own natural and urban systems.

In that sense, after these natural disasters, not only humans lose their urban environment, but due to the *need for recovery*, the landscape along with its - potential - qualities, also loses its place in the entire system. In fact, with natural areas are the most affected and destroyed after the reconstruction process.

Thus, in order to face this uncertainty, the city has lost is memory and it is developing an urban expansion over the affected wetland and natural areas, destroying the natural landscape that underlies the city: the territory is becoming a *disrupted landscape.*

As a witness of these events and seeing how the city is dealing with this situation (building more extensively upon the natural areas), the paradigm of the natural disasters started to shift my cognitive perception towards the idea that these are not disasters, but the natural flow of the landscape that is fighting for its own place.

Therefore, in an environment where natural hazards occur periodically with major effects for human settlements, the continuous change and uncertainty is now our *new normality.*

Introducing
fascination

Concepción looks for stability and safety, building on top of the existing layers of ecology that underlie the city.

Part I • Chapter 1: *Introducing*

The territory is becoming a *Disrupted Landscape*.

2

Chapter 2
Defining

Problem statement
Research definition
Research approach
Methodology

Defining
problem statement

In our living environment there is an existing and increasing tension between the *fixed* and the *dynamic*, creating a dichotomy in many aspects of our lives. One of the biggest of these dichotomies in the urbanized areas is the continuous struggling between cities and nature. Human settlements look for stability and safety, we want them *to be fixed over time*, however, there is an underlying aspect that has nothing to do with a static quality: the landscape and nature itself. In that sense landscape has its own dynamics and path of flow, that affects and influences our constructed environments.

As it was mentioned before, Concepción is a territory with a strong story of several natural disasters through time such as earthquakes and tsunamis, fluvial flooding, droughts and fires. Those risks have shaped a number of challenges that the city is facing today related to the urbanization in river deltas and wetlands.

Even though river deltas and wetlands - that predominate as a landscape in Concepción - are the natural areas most affected after these kind of events, these are also the zones where urbanization is projected for the city to grow.

In an environment where natural hazards occur periodically, the continuous change and uncertainty is now our *new normal*.

However, these territories are the areas with mayor flooding hazards and consequently the riskiest areas for urbanization. In that sense, the city "*forgets*" these events and it expands its grounds towards these wetlands and floodplains, putting in danger not only human lives but also the ecological stability of the landscape.

In the light of this dichotomy of natural disasters and urban expansion a new perception and vision about natural disaster makes sense. If we start to understand that in these territories of natural hazards, the continuous change and uncertainty is now our *new normality* which we need to *adapt* to it instead of fighting it.

Hence, with this new concept in mind, we can understand the city as a living system where change creates growth and renewal. And as a system, the city is constantly evolving and stability is scale dependent, it is not a constant phenomenon and cannot define the whole system in time or space.

Given the uncertainty inherent to the territory of Concepción (and the whole world) it is likely necessary to change the way we design and manage interventions in our living systems. Therefore, what is needed are more flexible, adaptive approaches to manage urbanization and design within the systems that sustain us.

Because of that, there is the urgency to propose a strategic urban and landscape plan (merging both, the dynamic and the static) in order to create a city more resilient and adaptive to the natural dynamics and the uncertainty of the future.

Part I • Chapter 2: *Defining*

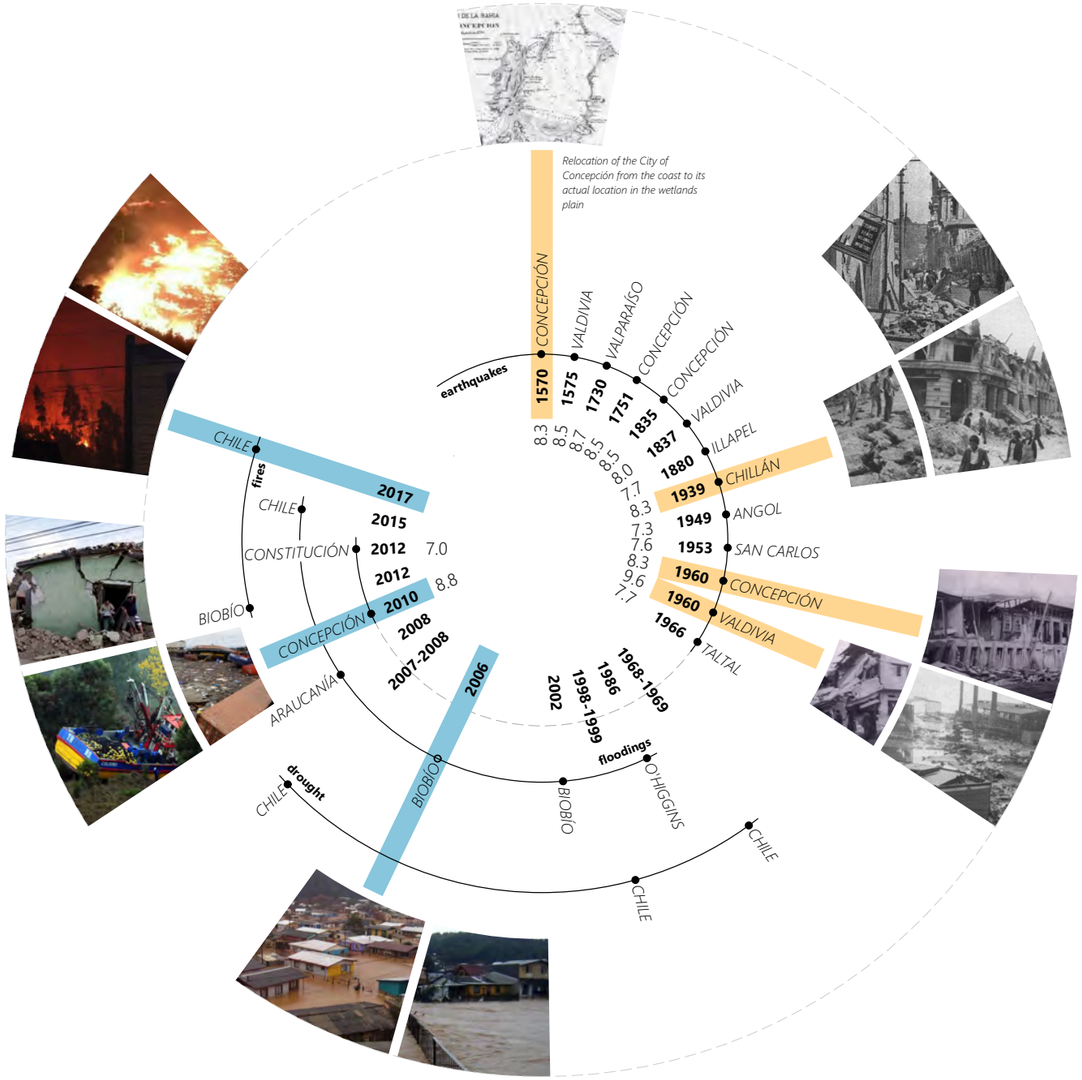


Diagram of natural disaster that have affected Concepción since 1570

Defining
problem statement

Concepción as a vulnerable urban coastal system

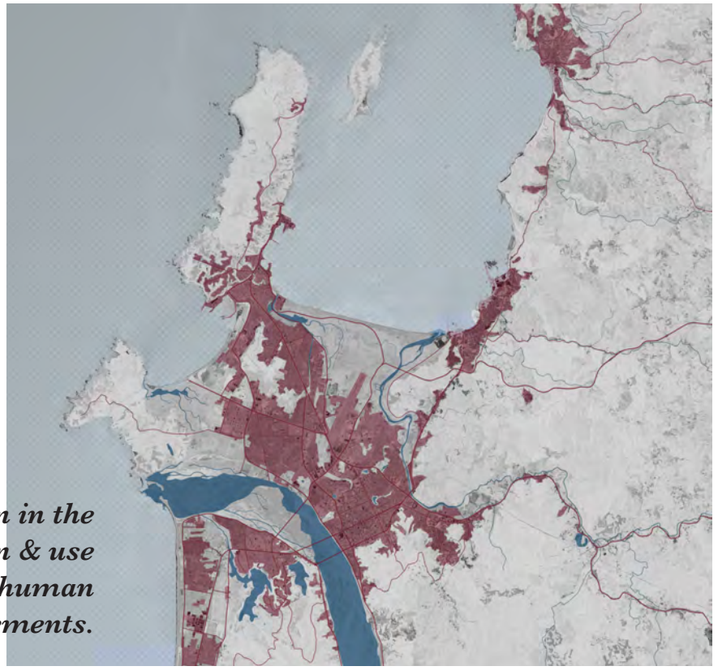
photo: http://megaconstrucciones.net

The metropolitan area of Concepción is a coastal urban area that has increasingly grown in the flood plain of two river mouths and upon an ecological important wetland landscape: the urban settlement has controlled and subjugated the landscape completely to the needs of human society.

Although the metropolitan area of Concepción is built on wet grounds, city and water never meet; there is a dissociation where one is superimposed on the other, generating a vulnerable urban coastal system. This coastal system is increasingly at risk due to the urban pressure of the expansion of the city, degradating the ecosystem and the natural infrastructure and exposing the coastal city and their inhabitants to more continuous and serious natural risks.

Part I • Chapter 2: *Defining*

Plan of Concepción Bay in 1790 by A. Coste



Plan of the Metropolitan area of Concepción Bay in 2018

Expanding urbanization in the delta area of Concepción & use of wetlands as base for human settlements.

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Defining
problem statement

Landscape degradation
Wetlands

A wetland can be defined as an extension of marshes, swamps and peatlands, or a surface covered with shallow water, which can be natural or man-made, permanent or temporary, static or running, fresh, brackish or salty whose depth at low tide does not exceed 6 meters. (Ramsar Convention, 1973)

These are spaces that provide diverse ecosystem services such as: regulation and purification of water, and mitigation of natural disasters and green infrastructure for recreation for the inhabitants of the cities.

Nowadays, the metropolitan area of Concepción is a representative example of the urban growth that is affecting the whole conuntry.

According to Almendras (2010), during the last 50 years, Concepción has experienced a continuous urban expansion as a consequence of its industrial development. This urban and industrial growth has specifically affected areas of ecological value as wetlands and shallow lakes, generating a reduction of soil surfaces that are vital for the existing ecosystems in the wetlands and floodplains of the peri-urban zone. (Almendras, 2010)

In terms of surface, a first consequence of the process of urbanization in wetlands has been the reduction to approximately 40% of the area compared to 1975.

Furthermore, a process of fragmentation has been observed in the landscape areas located inland and around the wetlands. (Smith and Romero, 2009)

In Concepción, the main threats for wetlands areas are:

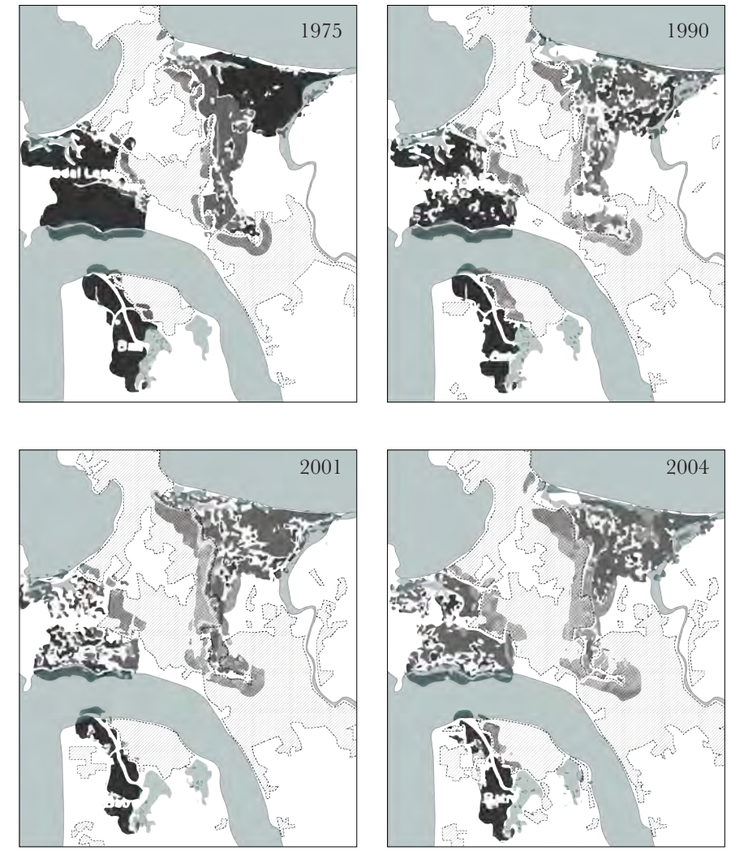
- Lack of protection and research
- Deficient territorial planning
- Pollution by industry and domestic waste
- Land filling for urbanization

photo: https://www.soychile.cl

year	urbanization area (ha)	wetlands area (ha)	annual rate of wetland loss (ha)
1975	3.855,9	-	-
1990	3.242,1	613,83	40,92
2001	2.757,9	484,15	44,01
2004	2.109,1	648,89	216,29
2008	1549,7	560,1	140,03

Data from Smith & Romero, 2009

Forgetting its natural disaster precedents, Concepción is developing an urban expansion upon the existing wetlands, destroying the natural landscape that underlies the city.



Maps adapted from Smith and Romero, 2009

Part I • Chapter 2: *Defining*

Defining
research definition

Research Objective and main Question

Create a Spatial Framework and Landscape Architectural design for the city of Concepción that will be able to deal with uncertainty related to natural disasters.

How to create a possible Spatial Framework for Concepcion to help dealing with untercaitnty of natural disasters which can be replicated on other locations with similar issues?

photo: http://megaconstrucciones.net

Sub Questions

How to understand physical dynamics and uncertainty in the natural & urban landscape of Concepción?

What design principles can be extracted from the vernacular urban tissue to create a new coexistence between city & nature with an adaptative approach?

How to apply the concepts of uncertainty, adaptability and resilience in a cohesive design to deal with the challenges of Concepción?

Which are the implications of the final design in terms of urban, social and ecological aspects? Is it possible to replicate them in other designs for similar locations?

Part I • Chapter 2: *Defining*

The dichotomy between fixed & dynamic

The settlement against the nature

photo: http://megaconstrucciones.net

photo: http://megaconstrucciones.net

In order to address a more adaptive and resilient city it is necessary to change the opposing paradigm of the city against nature.

It is indispensable to investigate and develop designs that will establish a dynamic balance between natural and urban environments, to work with nature and not against it.

In the context of Concepción, the opportunity to face the existing challenges does not lie in the primacy of one system upon the other. Both, city and landscape need to interact in a more redefined way, looking for multifunctional structures and a new awareness of the importance of the now disrupted landscape, to make it again part of the whole living system.

Thus, this research aims to develop a strategic urban and landscape plan to reverse the dissociation between landscape and city with an adaptive and resilient approach in order to enable new human-nature interactions.

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Defining
theoretical background

Resilience theory & praxis
A Critical Framework for Architecture

The concept of resilience can be defined as a "mechanism to manage risk and vulnerability and the capacity to absorb shocks, uncertainty and change through *renewal - organization – adaptation*". (Laboy and Fannon, 2016)

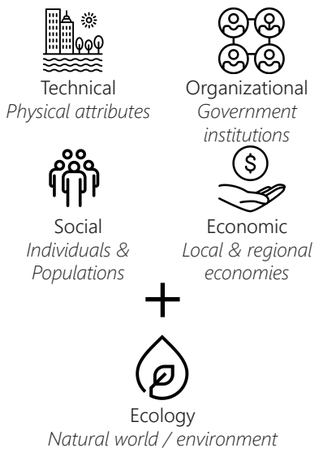
In that sense, resilience is about the capacity of any sreucture to preserve and restore the physical environment's normal function when a shocks or disturbance of limited duration occurs.

In order to build such resilience, it necessary to involve four domains: *technical, organizational, social and economic.* However, resilient human systems include and depend on natural system and resources, therefore it is essential to include an *ecological domain.* **Consequently, the natural environmental system becomes an aspect of the resilience capacity of the entire structure.**

According to Mannakkara and Wilkinson (2014), repair and restoration to the pre-shock state, recreate identical vulnerabilities. Therefore, the design need to focus on building a general resilience to the unpredictable (instead of focusing on specified resilience), in order to *focus on mitigation, resistance and risk management* of specific places for predictable events. (Wu and Wu, 2013)

In order to create such design strategies, first it is necessary to define stable - permanent and modifiable - adaptable elements of the system.

Resilience defined by 4 domains



The natural environmental system becomes a an aspect of resilience of the entire strucutre

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Repair & restoration to the pre-shock state, recreates identical vulnerabilities.
(Mannakkara and Wilkinson, 2014)

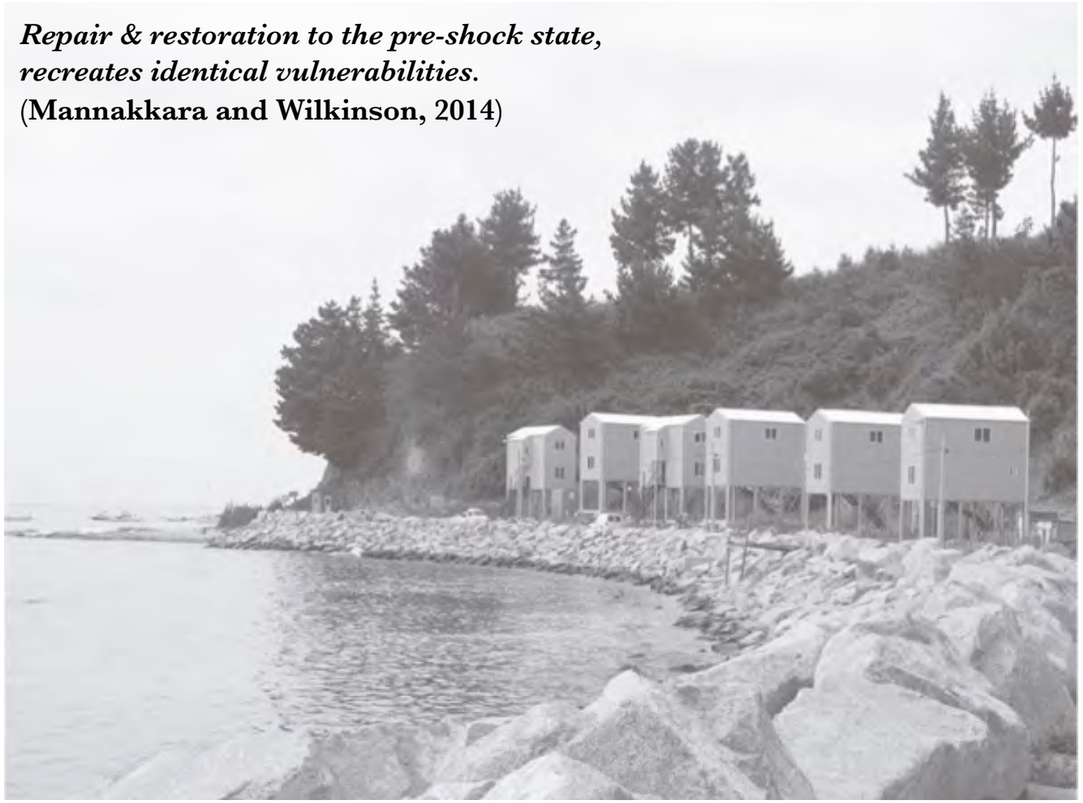

photo: Ignacio Bisbal

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Defining
theoretical background

Resilience theory & praxis
Social-Ecological (Adaptive) resilience

In a social – ecological (adaptive resilience) approach, the design understands and aims to address the consequences of dynamic contexts and systems according to the system's stability. In this way, it is possible to say that **even an unperturbed system is not stable if the context changes around it.** (Laboy and Fannon, 2016)

According to the adaptive resilience approach, the flexibility of a structure consists in the robustness of the system to change in resilience. This approach focuses on *adaptability – transformability – learning – recovery.*

To understand the adaptive capacity of a system we need to be aware that we are involved in complex and dynamic living systems. In that sense, cities are fixed in connected social and ecological systems, which are *"sufficiently complex that our knowledge of them, and our ability to predict their future dynamics will never be complete".* (Berkes, 2007)

Understanding the cities as ecosystems (complex, dynamic, interconnected environments) means that **the urban system is constantly changing and being increasingly vulnerable.** That's why it is necessary to focus on relationships among components and their surroundings

In this sense, dynamic systems are in a constant cycle of adaptation, with resilience levels varying depending on which phase of the change cycle the system is located within. (Laboy and Fannon, 2016)

The adaptive approach not only is flexible to change, but also **anticipates, accepts and celebrates it.** It recognizes the adaptive influence of our actions towards the built environment as a way of constructing a **new normal**.

Therefore, the system creates an expectation of a new face of stability.

However, the cycle of adaptation varies itself through time and scales. Therefore, the adaptive resilient approach uses the concept of *panarchy* which recognizes the complexity of the system by defining that dynamic structures are fixed or nested in one another, focusing on changes within and between systems.

Panarchy as a concept identifies that social-ecological systems function at multiple geographic and spatial scales and the feedbacks operates within and among scales.

In other words, regional resilience is extremely complex, and it varies in scale (local and global) and time (immediate to long term). (Laboy and Fannon, 2016)

Part I • Chapter 2: *Defining*

Four phase cycle of system adaptation & change

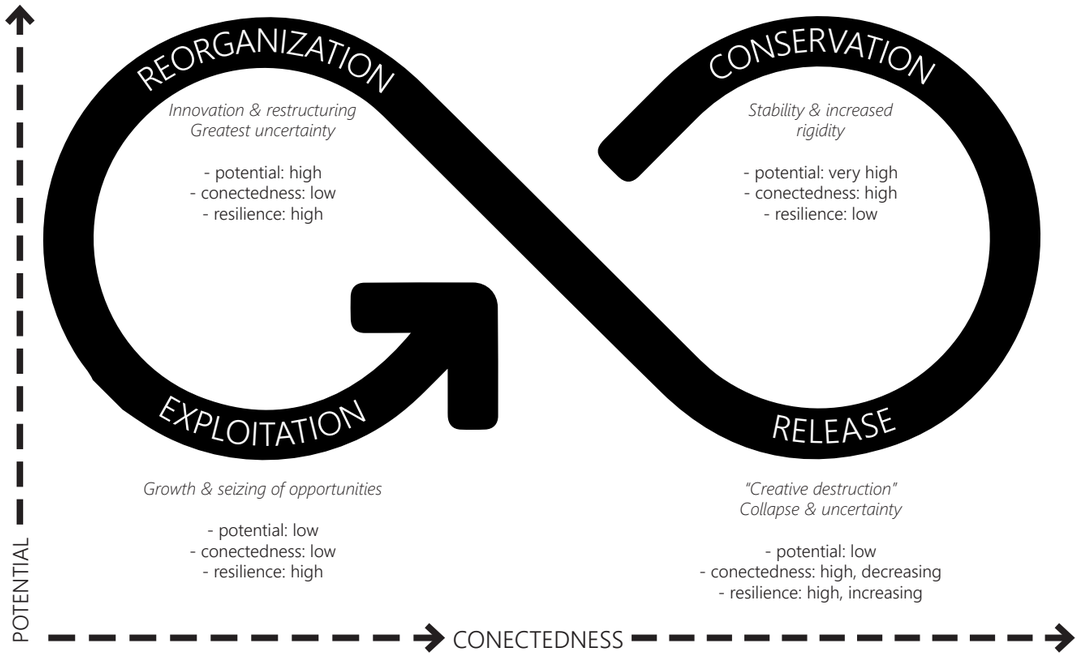

Diagram adapted from Holling & Gunderson, 2002

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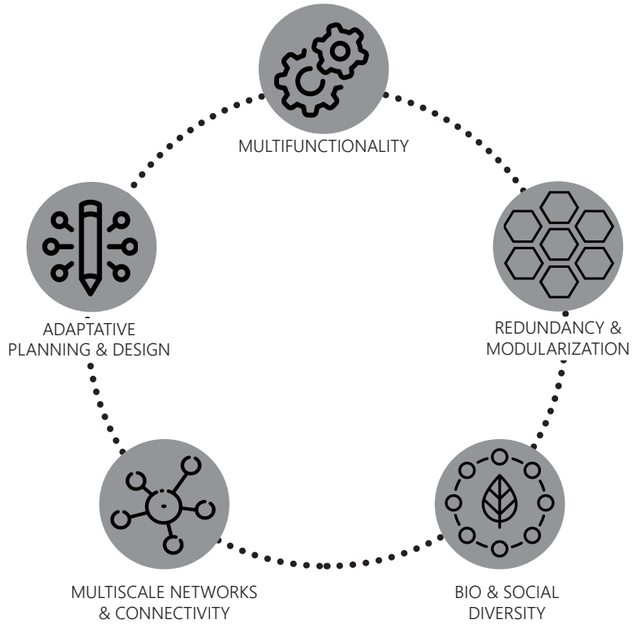
Defining
theoretical background

Resilience theory & praxis
Resilience in Landscape Architecture



Five urban planning & design strategies for building urban resilience
Jack Ahern

According to Ahern (2010) an adaptive design is a process where selected urban-landscape strategies and projects explore innovative practices and methods, using landscape ecology knowledge and research by design, open to create innovation and creativity with the goal of gaining knowledge to apply to future projects.

Five strategies to build resilience and transdisciplinary collaboration:

1. Multifunctionality: Efficient use of space and generation of multiple ecosystem services in one area.

2. Redundancy and modularization: Ecological strategies for risk spreading.

3. Bio and Social diversity: Supports ecosystem services and processes.

4. Multiscale networks and connectivity: Multifunctional networks like greenways, ecological networks, blue-green networks, riverways, parkways, etc.

5. Adaptive planning and design: Plans and policies are developed in a context of uncertainty.

Part I • Chapter 2: *Defining*

Copley synthetized the work of different architect theorists in 7 strategies for guiding infrastructure design (Copley, 2014):

1. Natural system as structure: Design should be in relation to underlying natural systems such as hydrology and topography.

2. Multifunctionality: Infrastructure should perform multiple functions, i.e.: ecological, social, economic, etc.

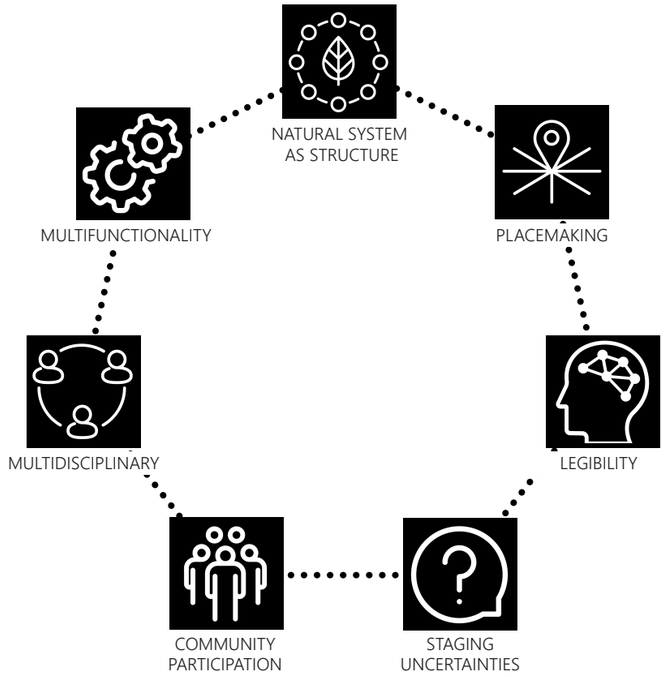
3. Multidisciplinary: The design process should be one of interdisciplinary collaborations.

4. Community participation: Should be enabled through every stage of development and subsequent operation.

5. Place making: Infrastructure should engage with people's sense of place and community.

6. Legibility: Infrastructure should be made legible to the people who are supported by it.

7. Staging uncertainties: The design should incorporate uncertainties and encourage adaptation.



Strategies for guiding infrastructure design developed by architecture theorists
Copley, 2014

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Defining
theoretical background

Swarm Planning by Rob Roggema
Accepting uncertainty

Roggema (2013) states that in our current spatial design approach we lack of flexibility of urban system to cope with uncertainty because we see urban structures as "simple" systems in the sense that the designs are one-dimensional, one-problem and one-solution oriented.

Therefore, it is necessary to understand spatial systems as complex and flexible networks.

In order to achieve this adaptability, Roggema proposes a "swarm planning" based in self-organization, emergence and adaptive capacity as basic principles of design for increasing flexibility, diversity and resilience in natural and man-made systems.

Given that, swarming landscapes will be able to increase resilience of cities and landscape at the same time that will provide attractive and imaginable spatial futures or society.

In the face of natural risks to reduce uncertainty is not a solution in the context of ever changing spatial patterns. That's why urban and landscape designs should be able to change in shape but not in content, being responsive to uncertain circumstances. Then the system will be able to develop resilience and flexibility to deal with uncertainty instead of trying to reduce it.

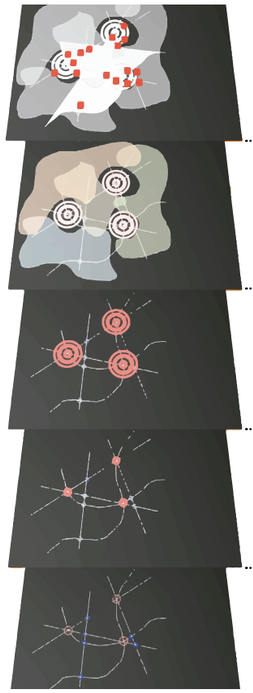
In that sense, swarm planning designs should follow some basic principles:

-Enhance interactions between large number of similar and free moving agents.
-Develop a collective new entity and a coherent larger unity of higher order.
-Create a self-organized system in order to preparing and responding to changing circumstances.
-Develop emerging patterns and structures in order to lessen the impact of uncertainties, complexity and change.
-Enhance diversity of knowledge.
-Increase indirect collaboration.
-Improve adaptive mimicking: coordinate, communicate, copy.

Autonomous, emerging patterns and parallel distributed co-evolution will empower collective self-organization and enhance synchronicity instead of controlled, preprogrammed and hierarchical centralized processes.

Autonomous, emerging patterns and parallel distributed co-evolution will empower collective self-organization and enhance synchronicity.

Part I • Chapter 2: *Defining*



LAYER	SPATIAL ELEMENTS	DESCRIPTION
Emergent ocupation patterns *3 - 10 years* Slow pace dynamic.	_Safe Living _Mix Functions _Landscape Mosaic _City Differences	Space required to deal with climate change.
Natural resources *20 - 100 years* Locations for food, water, energy, nature, etc.	_Natural Resources _Clear Border	Areas for production. Must be safeguarded.
Unplanned space *1 - 10 years* Highly dynamic. Allows change during a hazard when the space is temporarly used differently	_Open Influence _Creative Minority of People _Unplaned Area _Emergent Places	Area surrounding focal points that remains free of specific functions but can be occupied in a sudden event.
Focal points *5 - 10 years* Network linkages	_Focal points	Nodes (cross of networks). Public spaces, landmarks.
Networks *10 - 100 years* Road, electricity grids, ecological network, etc.	_Intensity of Networks	Road, water, ecology and energy networks

Diagram adapted from Roggema, 2012

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Defining
theoretical background

Design with Nature: Nature in the Metropolis by Ian L. McHarg
Suitability approach

As McHarg states, *nature is a single interacting system and changes to any part of will affect the operation of the whole*. (McHarg, 1995)

In that sense, urbanization is disturbing natural processes and their interaction, such as the rate of runoff, erosion and sedimentation. However, urbanization is not a problem of surface but a problem of way of growth.

Urbanization is increasing density within urban areas and extending towards the periphery at the expense of open space, therefore this way of growth is unresponsive to natural processes and their values.

According to McHarg, optimally the natural and the urban system should interact and have their own space in the metropolis, therefore, he proposed a suitability analysis based in eight dominant aspects of the natural processes and their interactions, that will provide insights of permission or prohibition to certain land uses.

1. Surface water (+ riparian land)
Land uses inseparable from waterfronts:
- *-Port & harbor facilities.*
- *-Marinas*
- *-Water & sewage treatment plants*
- *-Water-related industry*

Land uses that won't damage water resources:
- *-Agriculture*
- *-Forestry*
- *-Recreation*
- *-Institutional & residential open space*

2. Marshes
Primary roles:
- *-Flood & water storage*
- *-Wildlife habitat*
- *-Fish spawning grounds*

Land uses that won't diminish the operation of the primary roles:
- *-Recreation*
- *-Agriculture (under restrictions)*

3. Floodplains
Functions unharmed by flooding:
- *-Agriculture*
- *-Forestry*
- *-Recreation*
- *-Institutional & residential open space*

Land uses inseparable from floodplains:
- *-Port & harbor facilities.*
- *-Marinas*
- *-Water & sewage treatment plants*
- *-Water-related industry*

4. & 5. Aquifers & Aquifer recharge areas
Land uses that won't damage aquifers:
- *-Agriculture*
- *-Forestry*
- *-Recreation*

Prohibited land uses:
- *-Industry*
- *-Urban development*

6. Steep lands
Functions unharmed by steep lands:
- *-Forestry*
- *-Recreation*
- *-Low-density housing*

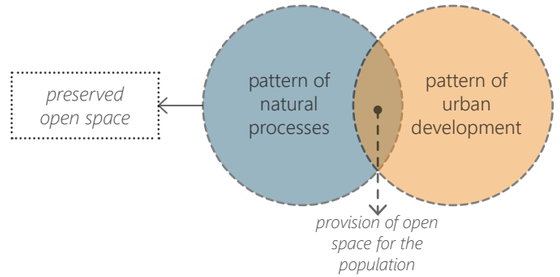
Prohibited land uses:
- *-Agriculture*
- *-Urban development*

7. Prime agricultural land
Land uses that won't diminish their productive potential:
- *-Forestry*
- *-Institutional open space*
- *-Recreation*
- *-Low-density housing*

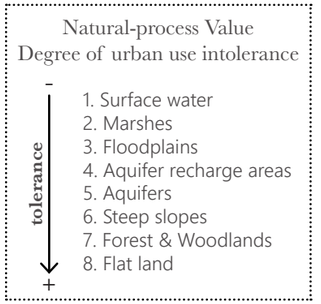
Prohibited land uses:
- *-Urban development*

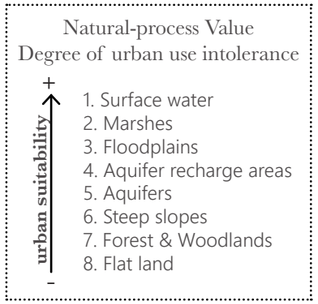
8. Forest and Woodlands:
Land uses that won't damage them:
- -Recreation
- -Forestry
- -Wildlife habitat
- -Low-density housing

Optimal situation: two systems in the metropolitan region



Eight dominant aspects of natural processes





Defining
methodology structure

Research Methodology
Theoretical framework - Research by design - Landscape resilient backbone

The research methodology is conducted by three scopes or lenses: *theoretical framework, research by design and landscape resilient backbone.*

The first lens corresponds to systems of inquiry and it is based in a literature study on theoretical investigations of landscape architecture and urban planning with the goal of a deep understanding of the opportunities and challenges of natural disasters, uncertainty, resilience and adaptability in order to apply those principles in a practical design for the challenges and opportunities of the city of Concepción.

The intention of this literature review lies in comprehending how different theories come together to understand the uncertainty condition of the territory and what they suggest towards creating a more resilient and adaptive city. In that way the revision of these theories offers conceptual tools to understand the challenges and identify potentials to address the objectives defined.

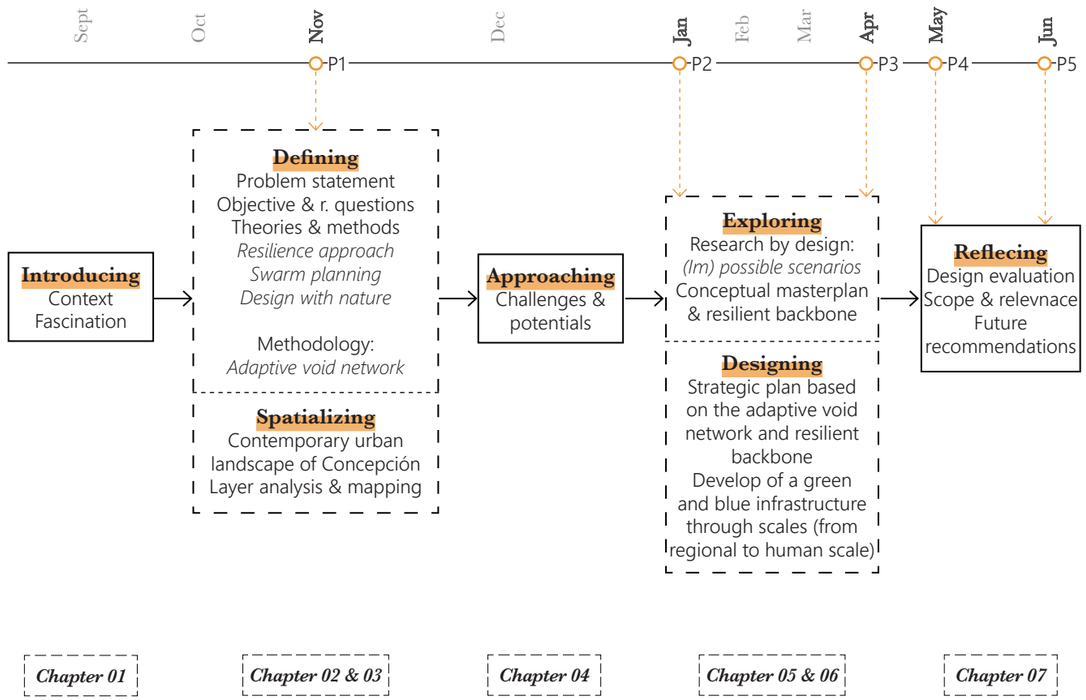
The second lens – research by design – responds to the research strategy and it is based on the exploration of different (im) possible utopias for the territory of tomorrow. These simulations of future visibility create an interpretative research giving an intentional meaning to the possible scenarios.

In combination with the theoretical background, research by design allows to explore possibilities on design and through design as a systematic exploration that reflect on itself in order to create and recreate new scenarios and design opportunities.

Finally, the landscape resilience backbone is the research tactic and method lens, as a way to understand the landscape as process and in context.

This understanding allows to apply a meaningful design (resilient and adaptive) in order to develop a strategic plan based in the proposed adaptive void framework in combination with a green and blue infrastructure. The use of these methods aim to create a resilient backbone for the city with a series of principles and practices to conclude with the design of a possible future scenario through scales (from the metropolitan masterplan to human experience)

Part I • Chapter 2: *Defining*



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Defining
theoretical framework

Adaptive void network
Strategic planning through natural & urban unplanned spaces

Once the territory has been understood, it is possible to create chances to redefine the narrative around uncertainty and vulnerability in order to incorporate natural infrastructure as a backbone plan and to generate new solutions in order to build up the city-landscape duality, merging both in a whole living system.

In order to do that the proposed approach is based in autonomous, emerging patterns and self-organization instead of controlled, pre-programed and hierarchical centralised processes. In that sense, this framework proposes to develop *spatial optionality & redundancy* within the urban and natural territory through the act of mapping the areas of potentiality and the challenges in terms of resources and land uses.

This design through voids framework allows to identify and plan for (in)visible voids in the urban settlement to implement a bottom up building of the city, giving opportunities and potential for spatial adjustments.

The *design-through-voids* framework allows to identify and plan for *(in) visible* voids in the urban fabric

It also allows present realities to be transformed and to create and imagine future potential. In that way the city can be seen as the provider of nature, in the sense that through this method the backbone of the urban fabric will be larger green spaces and connecting green grids, where spaciality is building along with nature and including redundant unplanned space.

Designing with voids is a central step in allowing the city and its elements to become healthier for nature and humans in addition to adaptability to the different futures that may com

Given the conceptualization of the Spatial Framework, it is possible to define strategies and measures for the landscape planning of the territory:

-Value the natural system (mainly wetlands & water bodies) as the base infrastructure for the future city.

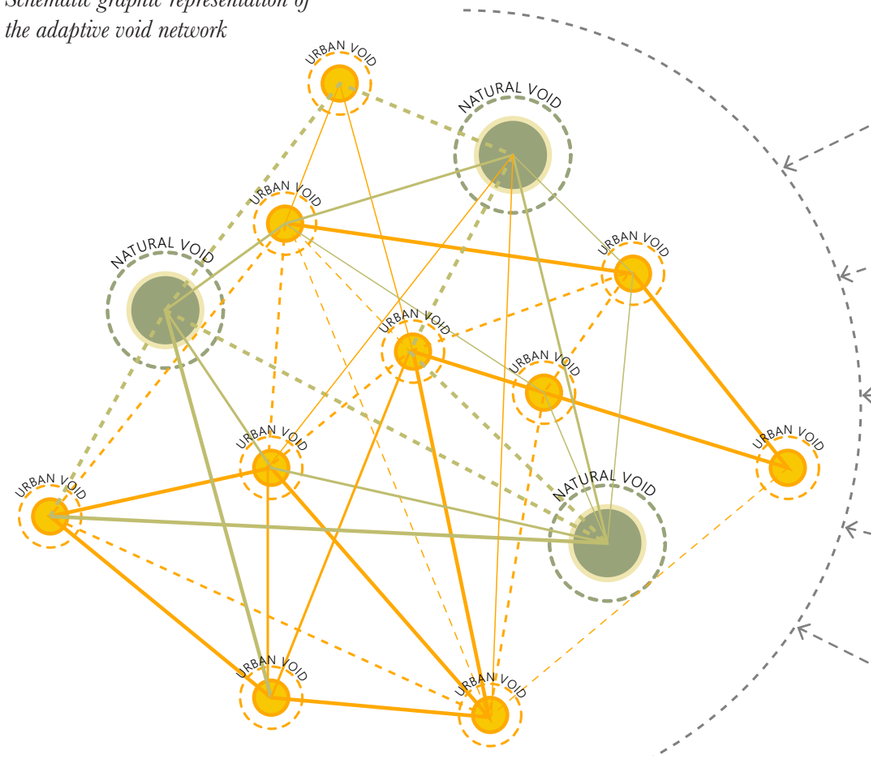
-Use of voids (unplanned natural & urban spaces) as an emergent, autonomous and self-organized network to create redundancy and multifunctional spaces for risk management.

-Complete the void network using a green and blue infrastructure in order to provide a *resilient backbone for the city*

-Reformulate the *resilient backbone* as a provider of nature: larger green spaces, landscape connectivity and protection of the ecological value of the existing nature.

Part I • Chapter 2: *Defining*

Schematic graphic representation of the adaptive void network



Resilience domains

Adaptive void network main strategies for guiding the infrastructure design

Unplanned space (voids) as strategy for building urban resilience within the urban-landscape system of the metropolitan city

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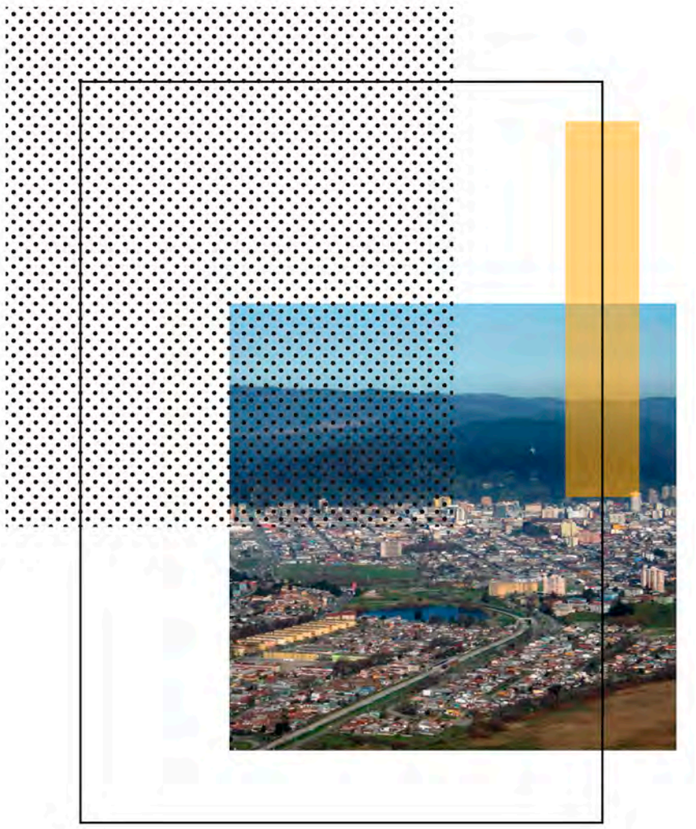
Part II
Research Design

Chapter 3
Spatializing

Contemporary urban landscape of Concepción
Layer analysis
Suitability analysis

Spatializing
contemporary urban landscape of Concepción



In the name of architecture and planning, the stain of Concepción has moved out, taking as much as it can, destroying the underlying nature... and it has given nothing.

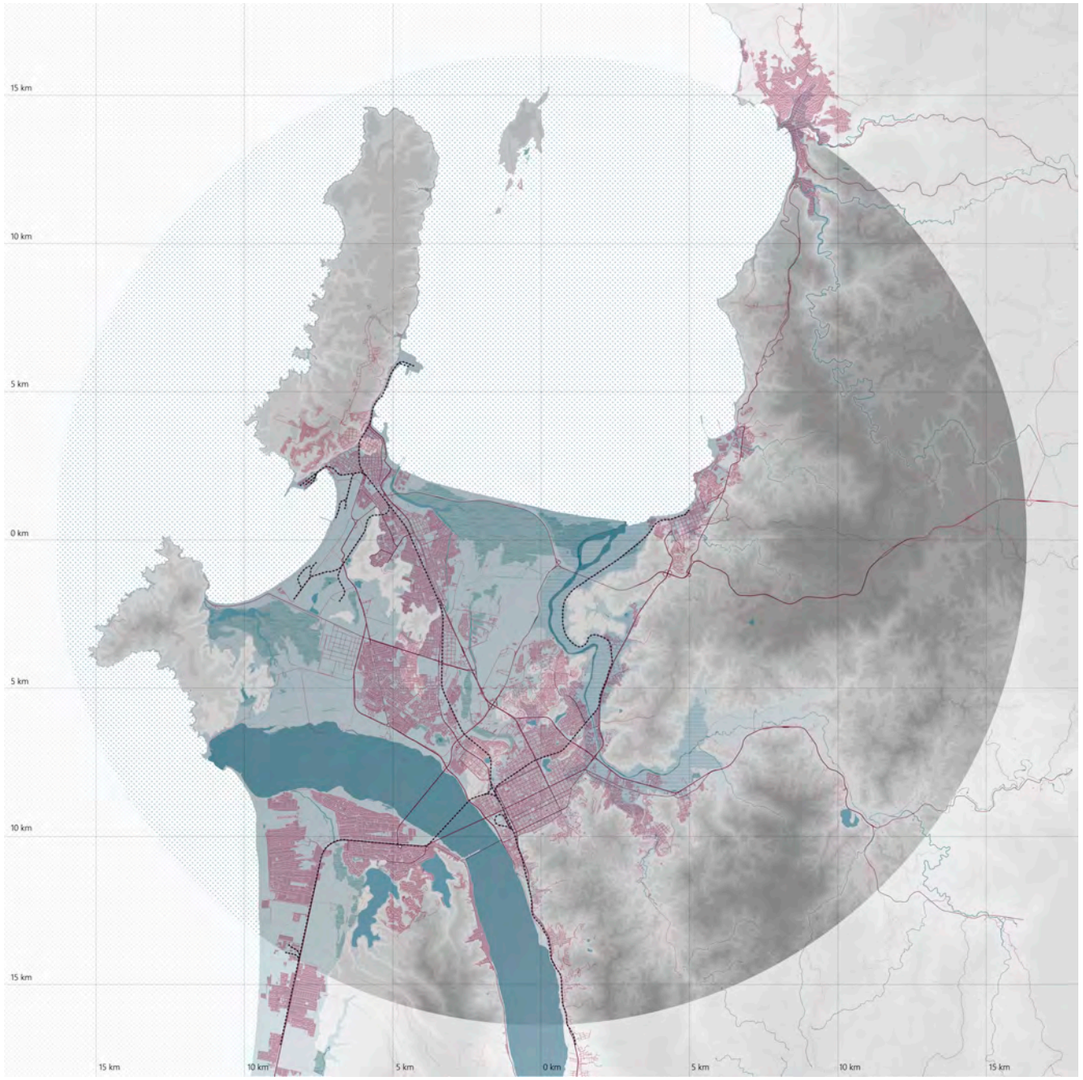
No more wetlands, no more water ground, no more birds or boats... The glory of the wetland's infinite landscape is gone.

The *"need"* of housing is devouring the dignity of the original landscape. The site was complex, with its biological and ecological interrelations. Now, it has been uniform for decades.

Concepción metropolitan scale

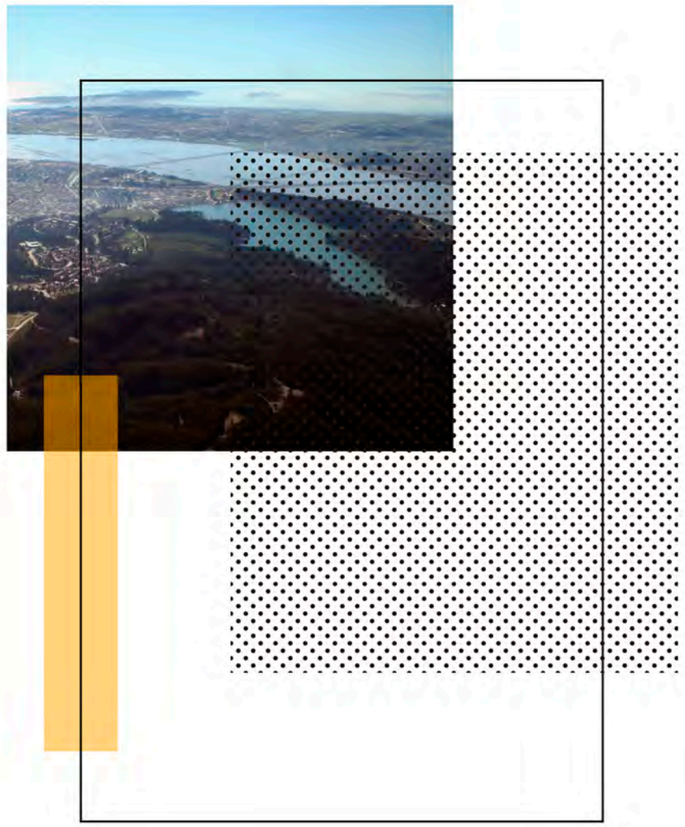
road network
urbanization
water bodies
area below 10 m a.s.l.

0 1 2 3 4 5 km



Data provided by the Chilean Ministry of Cultures, Arts and Heritage

Spatializing
contemporary urban landscape of Concepción

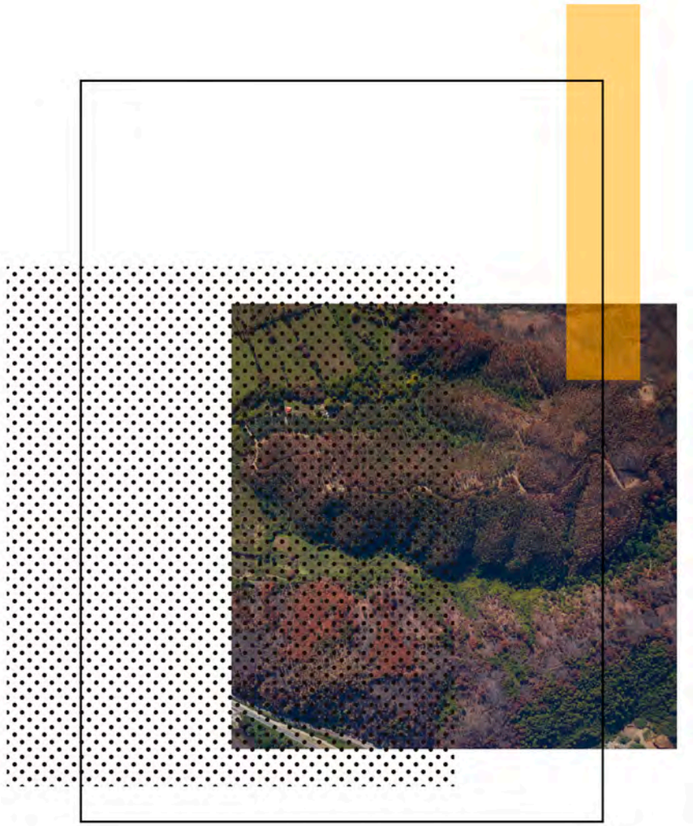


Landscape characterization of the metropolitan area.

0 1 2 3 4 5 km

Data provided by the Chilean Ministry of Cultures, Arts and Heritage

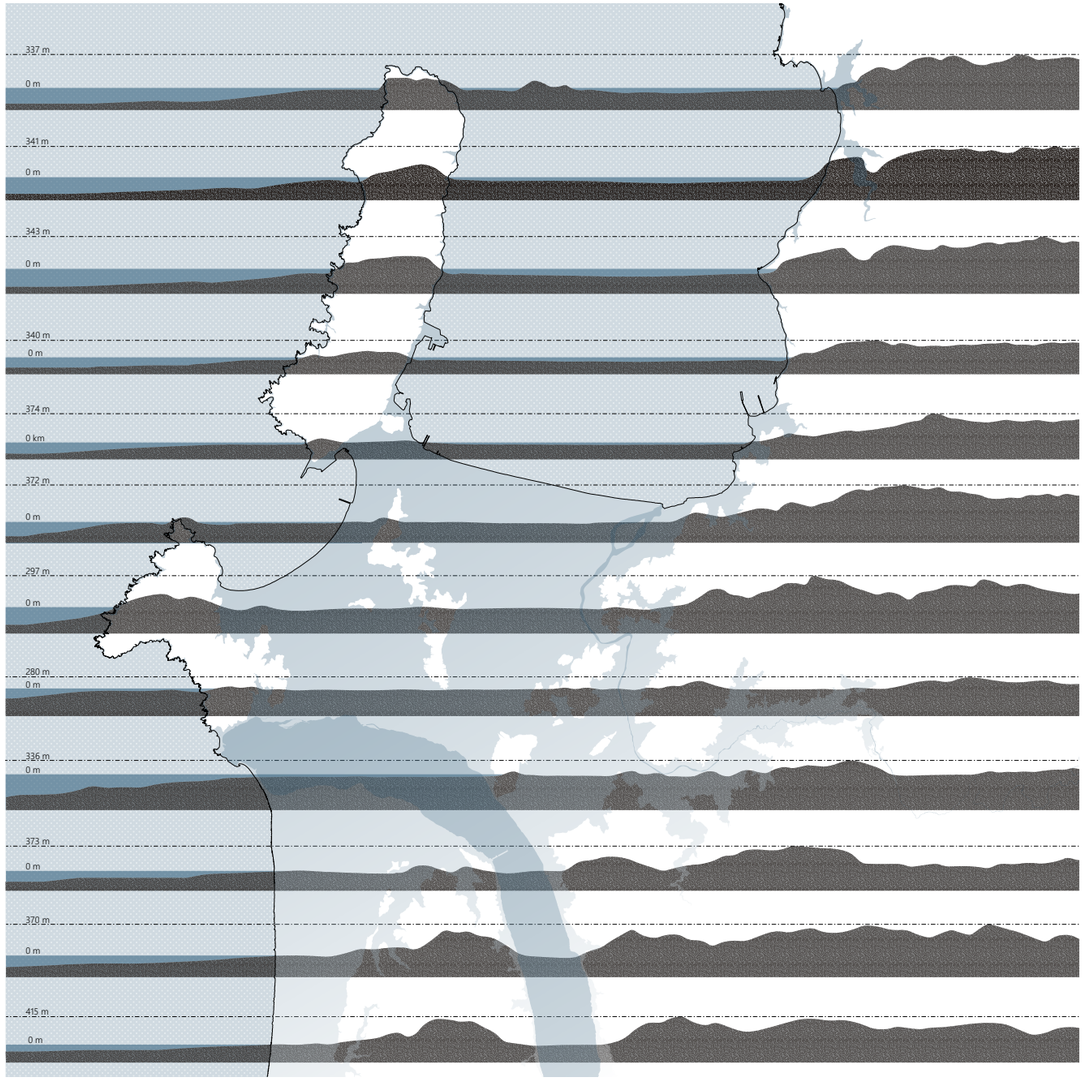
Spatializing
contemporary urban landscape of Concepción



Topographical sections

0 1 2 3 4 5 km

Part II • Chapter 3: *Spatializing*

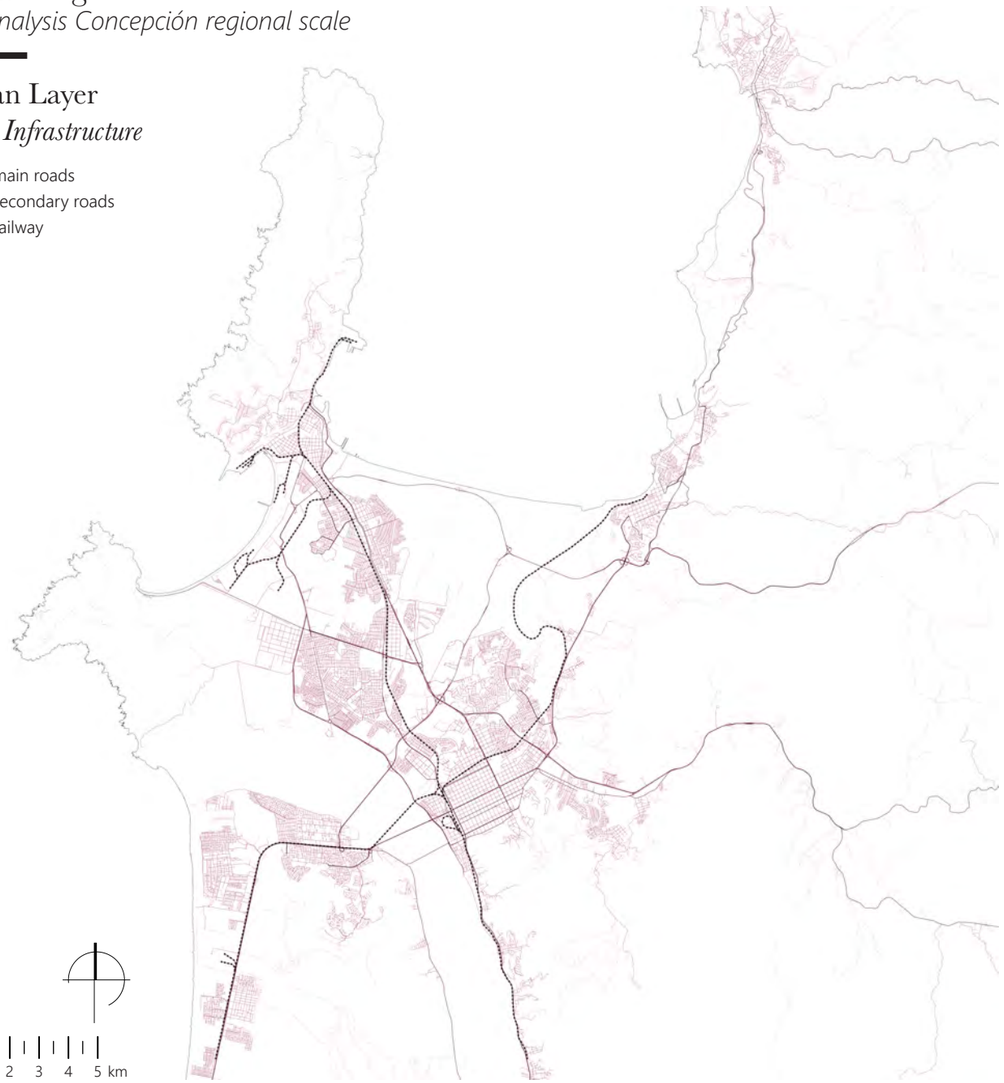


Data from Google Earth

Spatializing
layer analysis Concepción regional scale

Urban Layer
Road Infrastructure

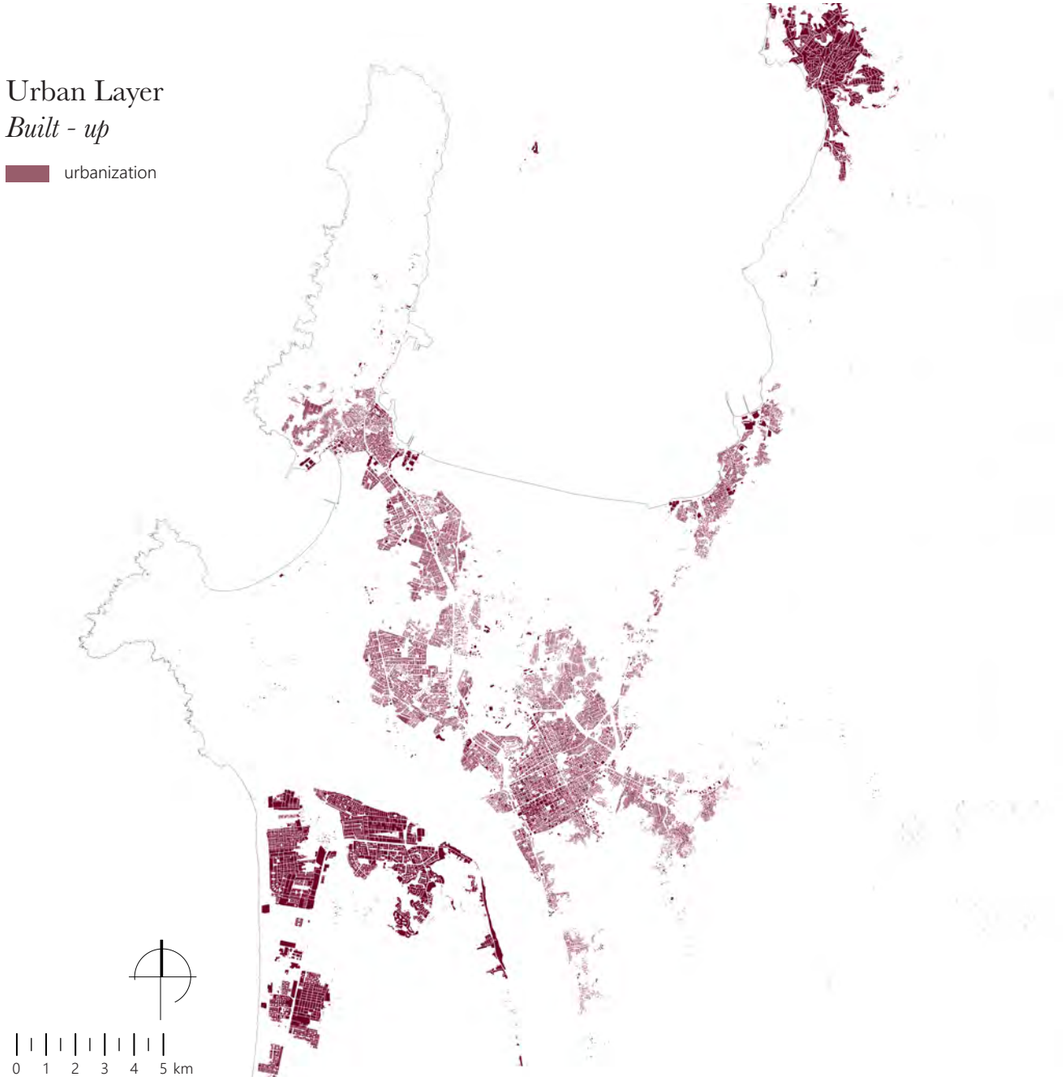
- main roads
- secondary roads
- railway



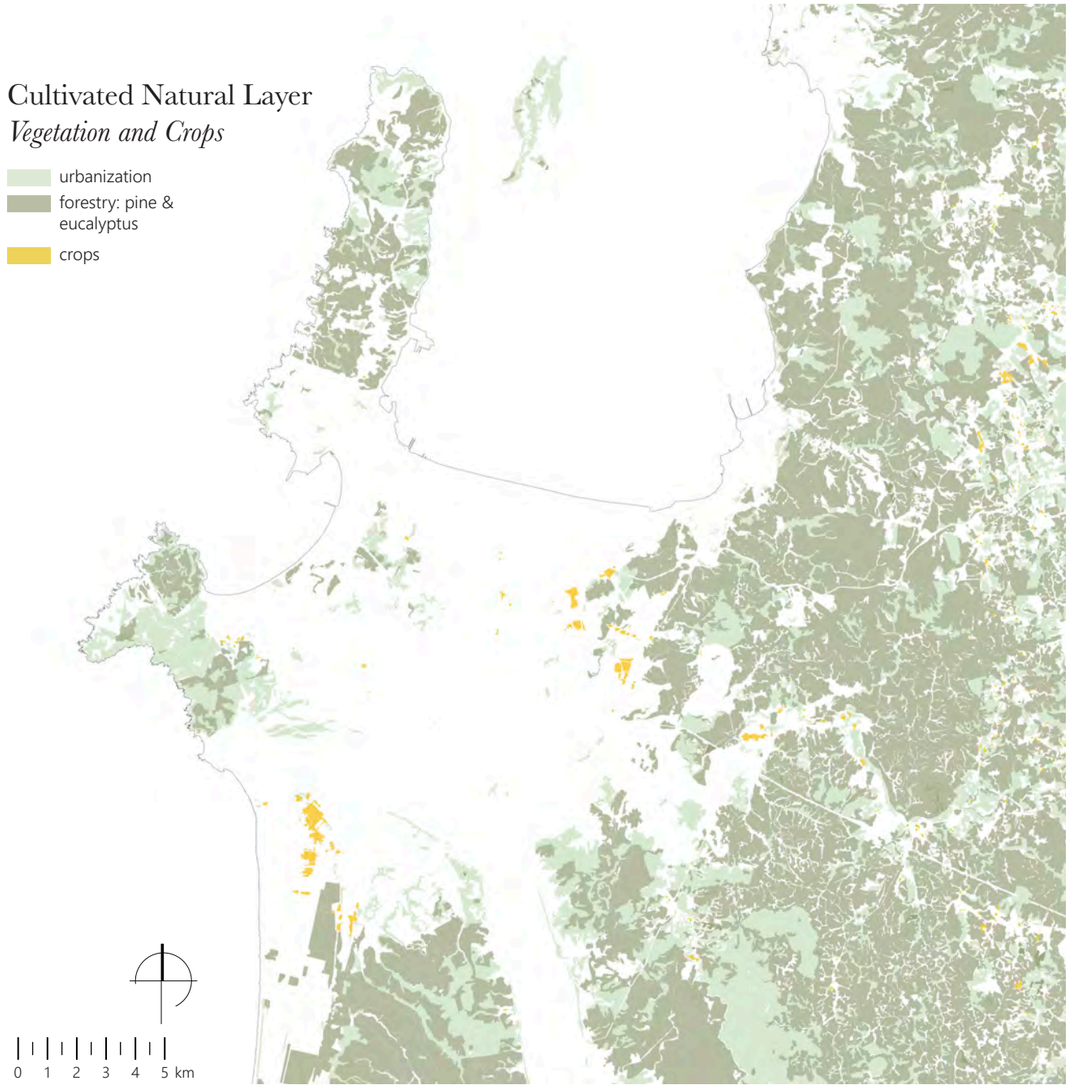
Data provided by the Chilean sub-directorate of Geology

Urban Layer
Built - up

- urbanization



Data provided by the Chilean sub-directorate of Geology



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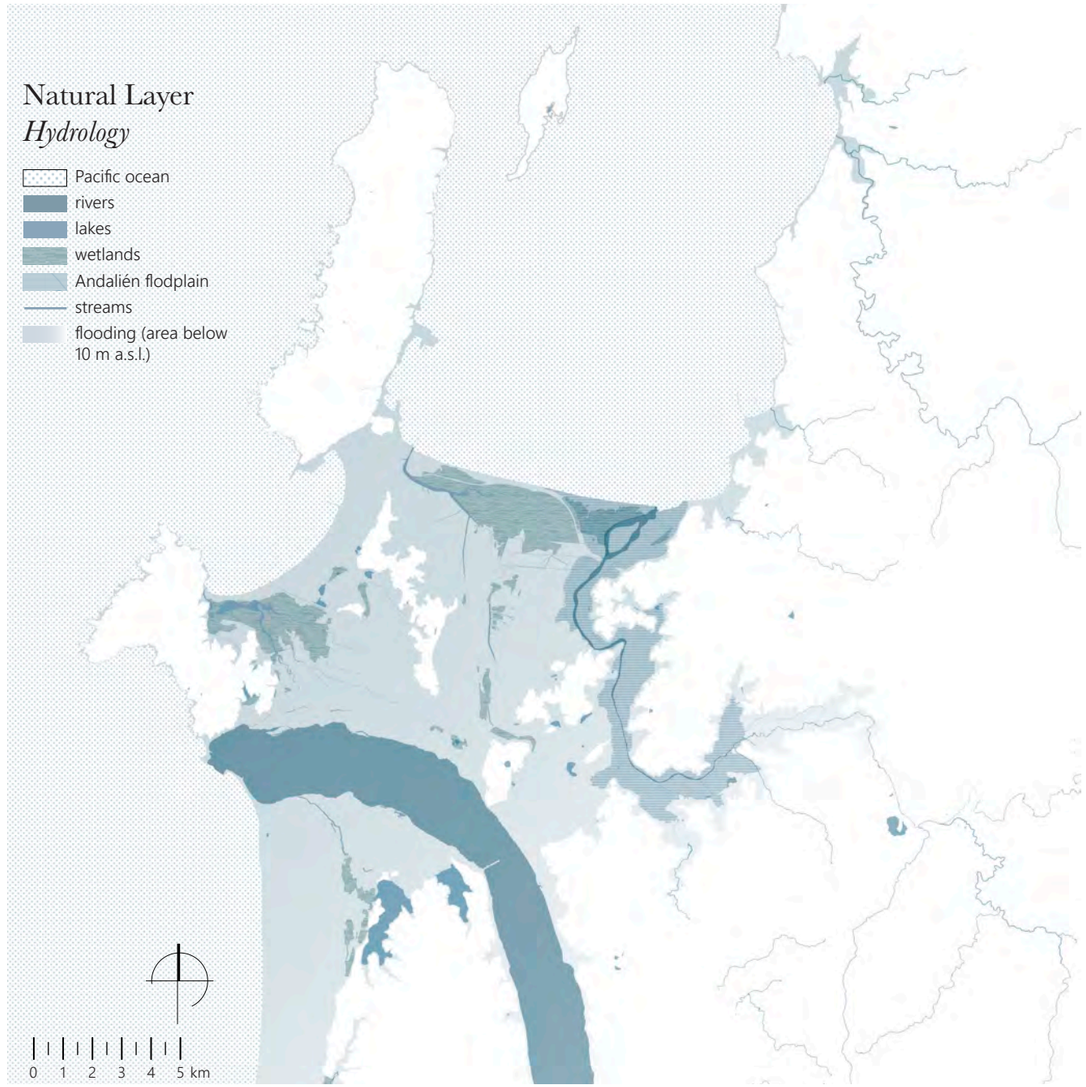

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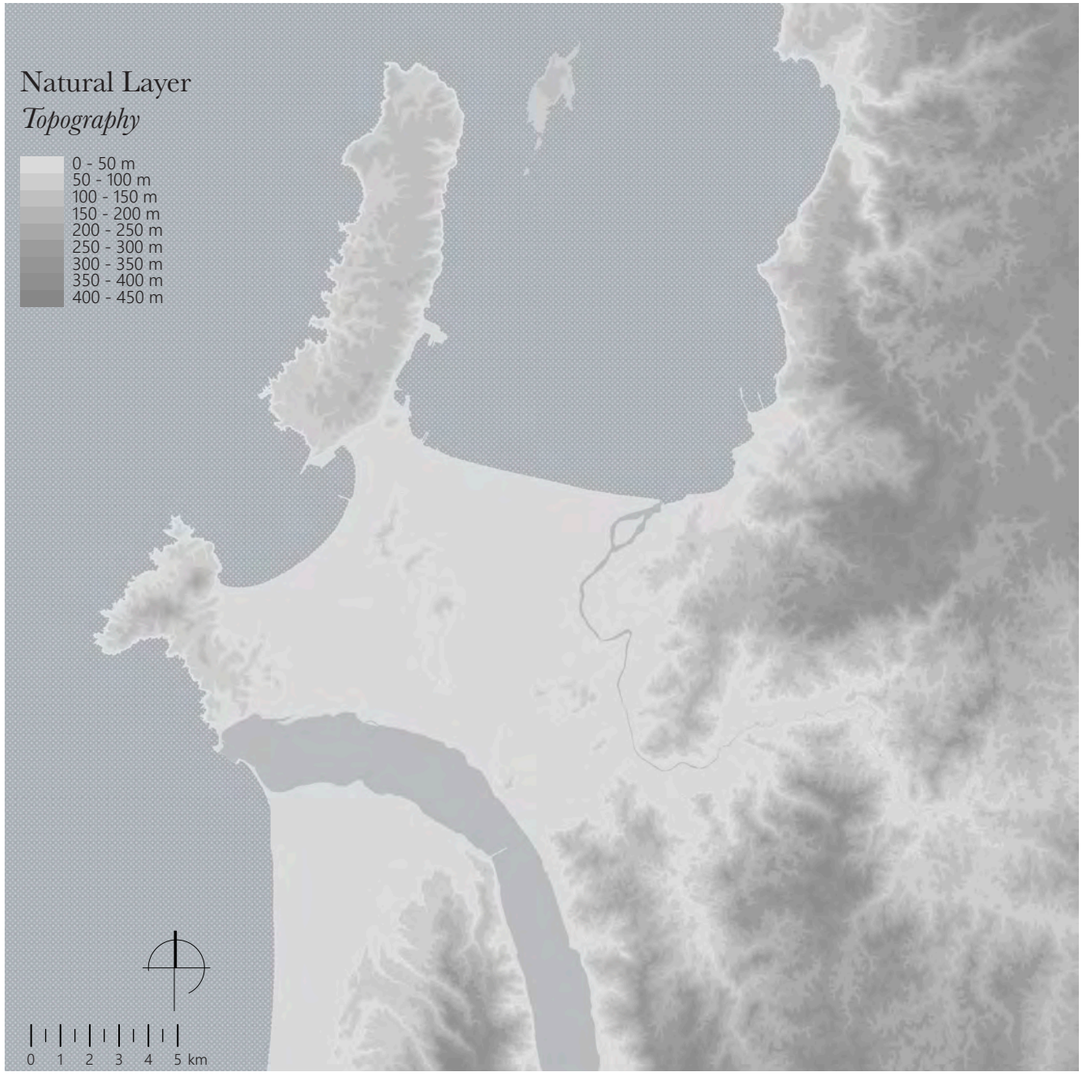

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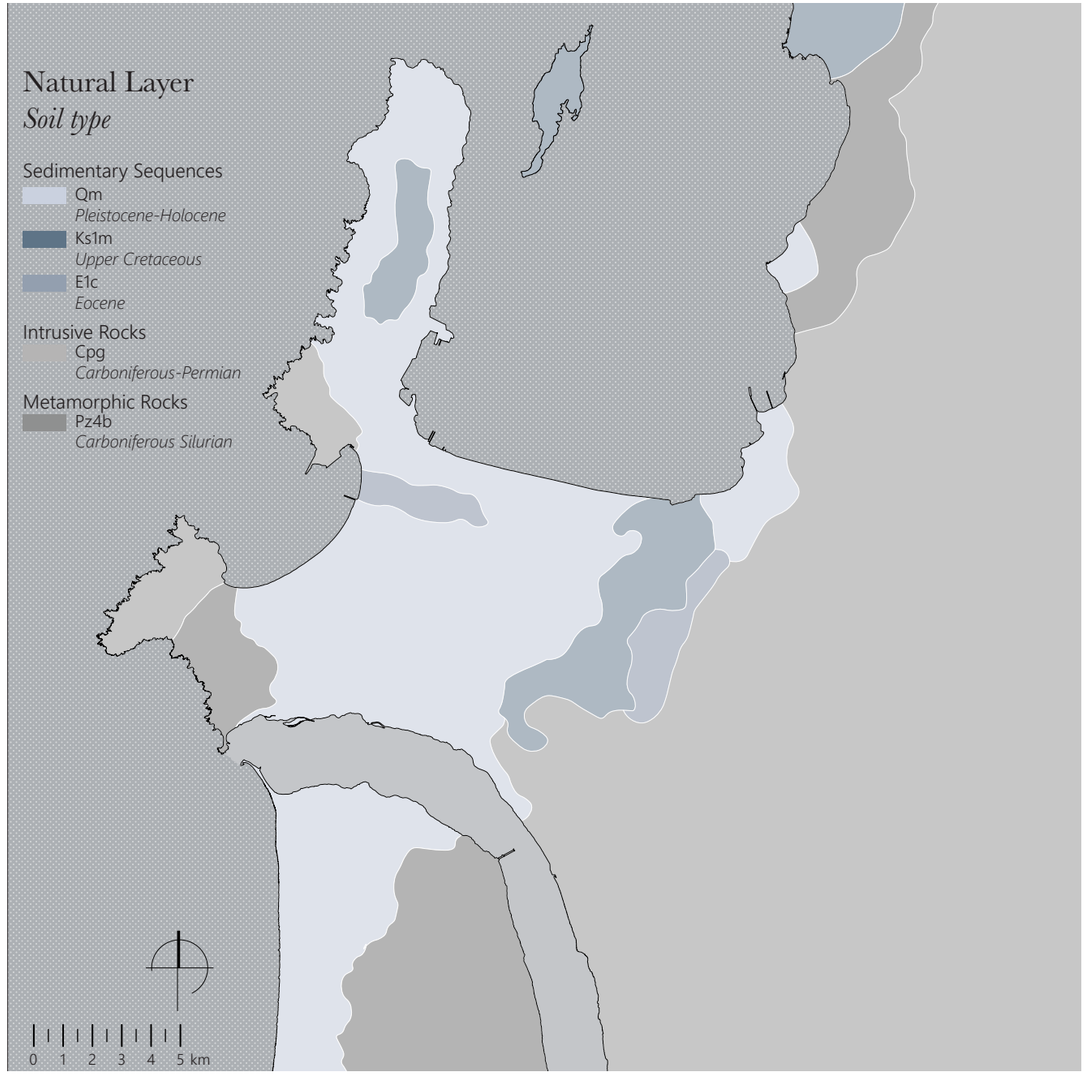
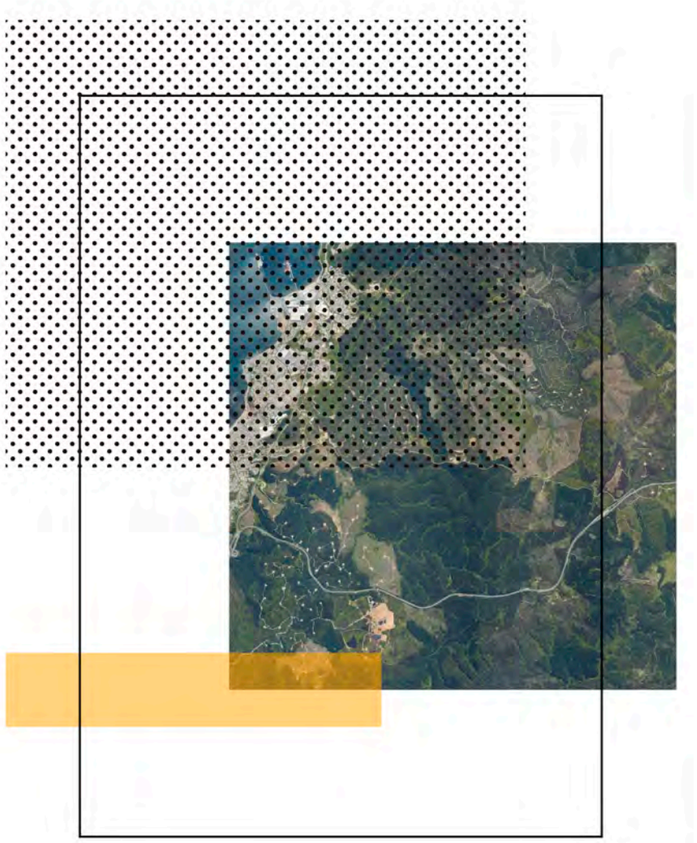


Data provided by the Chilean sub-directorate of Geology

Spatializing

layer analysis of the contemporary urban landscape of Concepción

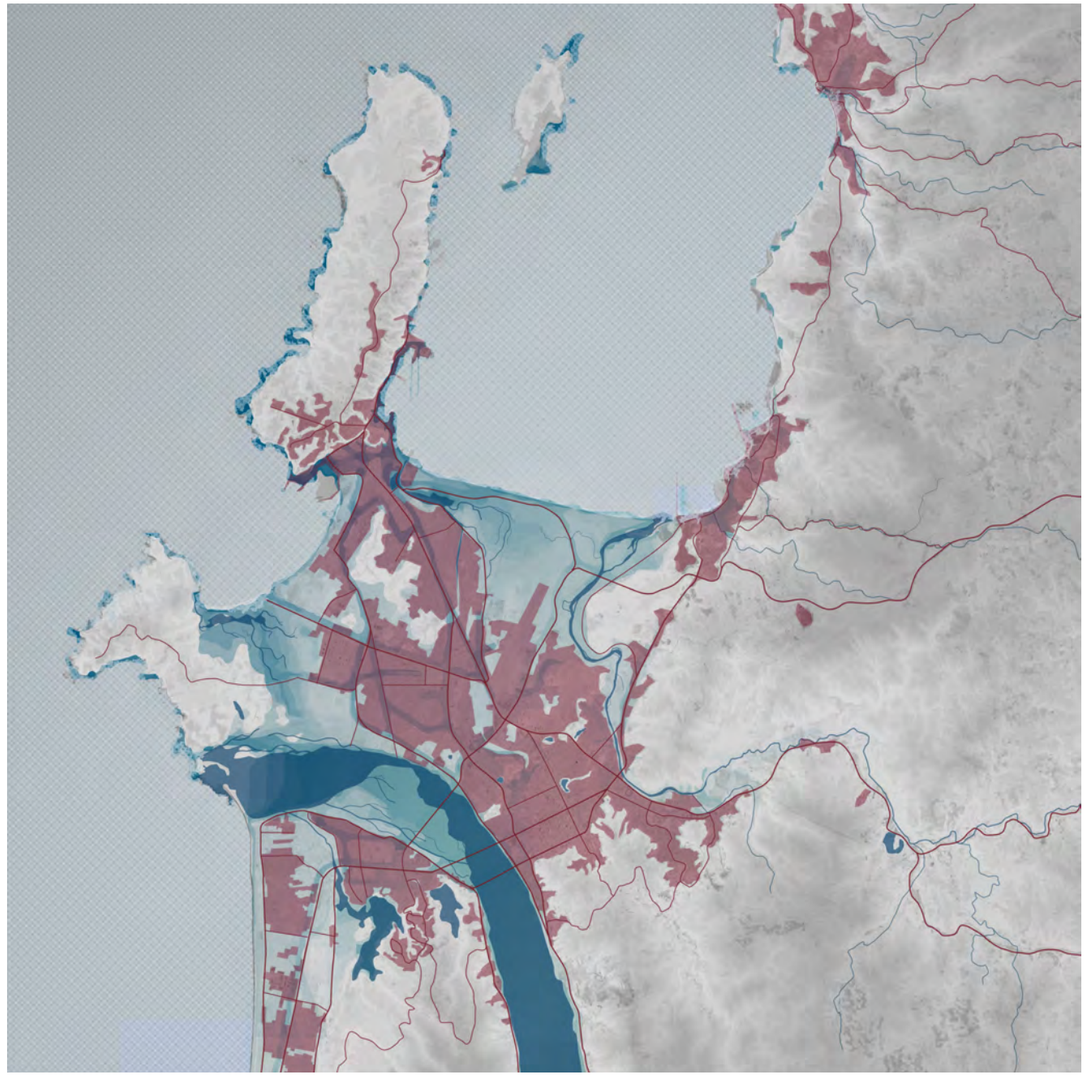


Concepción metropolitan scale

Conclusion map

road network
urbanization
water bodies
area below 10 m a.s.l.
topography

0 1 2 3 4 5 km



Data from Google Earth

Spatializing
Suitability analysis: Permission or prohibition of land uses

Dominant aspects of natural processes
Surface water and riparian land

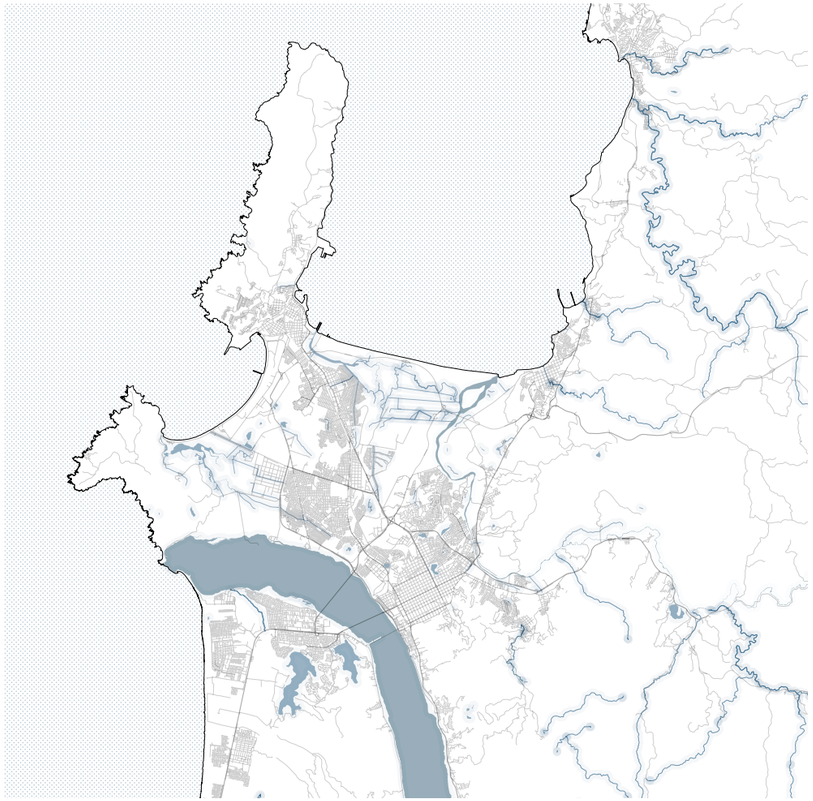
Pacific ocean
rivers
lakes
streams

Land uses inseparable from waterfronts:

-Port & harbor facilities.
-Marinas
-Water & sewage treatment plants
-Water-related industry

Land uses that won't damage water resources:

-Agriculture
-Forestry
-Recreation
-Institutional & residential open space



0 1 2 3 4 5km

Data provided by the Chilean sub-directorate of Geology

Dominant aspects of natural processes
Wetlands and marshes

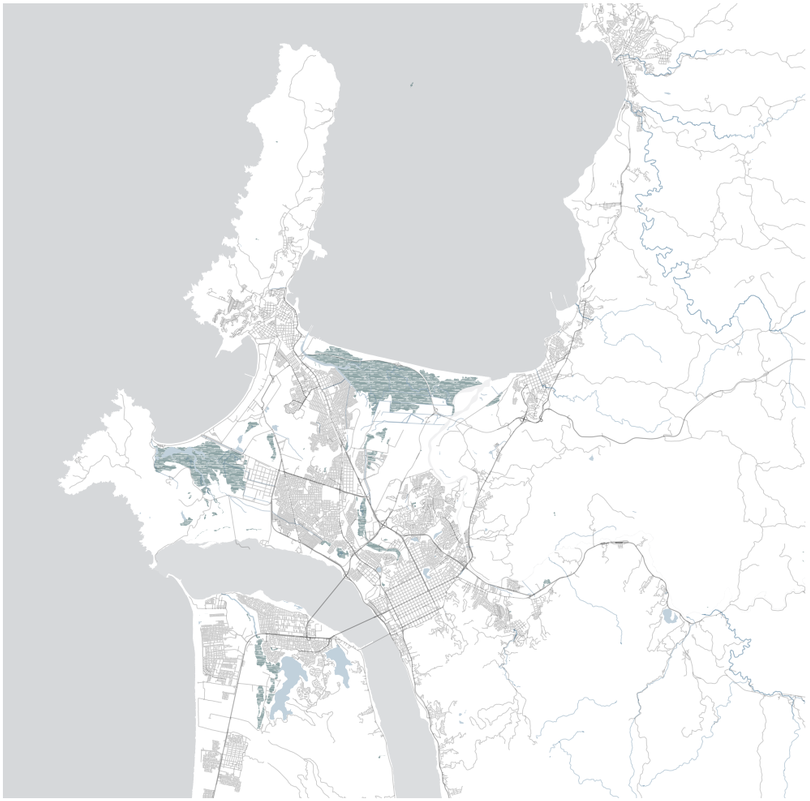
wetlands

Primary roles:

-Flood & water storage
-Wildlife habitat
-Fish spawning grounds

Land uses that won't diminish the operation of the primary roles:

-Recreation
-Agriculture (under restrictions)



0 1 2 3 4 5km

Data provided by the Chilean sub-directorate of Geology

Spatializing
Suitability analysis: Permission or prohibition of land uses

Dominant aspects of natural processes
Floodplains

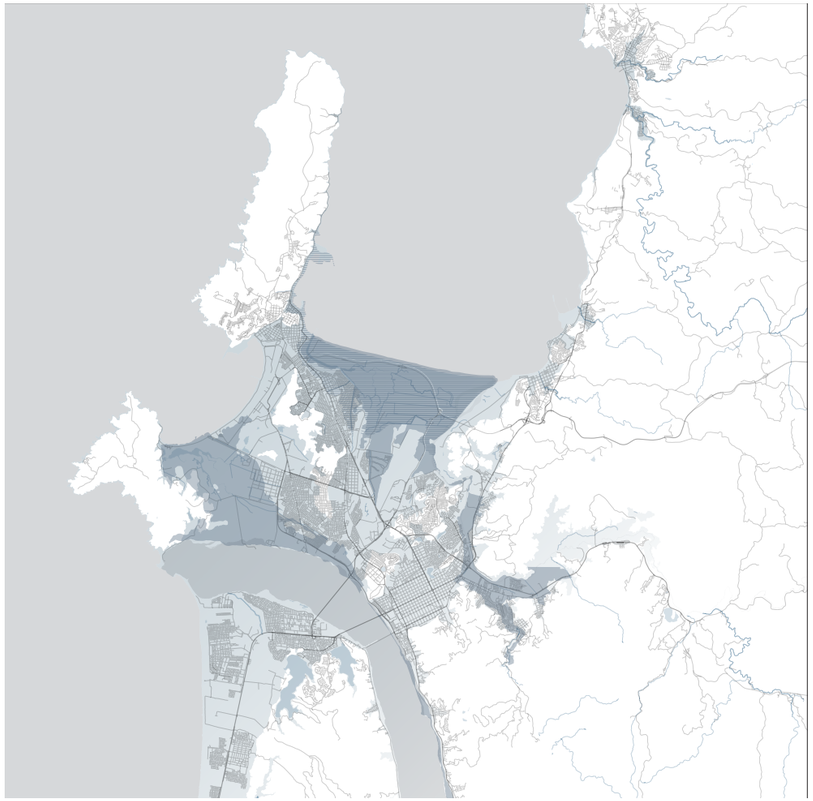
flooded area by tsunami 2010
flooding (area bellow 10 m)
flood area by river overflow & tidal influence

Functions unharmed by flooding:

-Agriculture
-Forestry
-Recreation
-Institutional & residential open space

Land uses inseparable from floodplains:

-Port & harbor facilities.
-Marinas
-Water & sewage treatment plants
-Water-related industry



0 1 2 3 4 5km

Data provided by the Chilean sub-directorate of Geology

Dominant aspects of natural processes
Steep lands

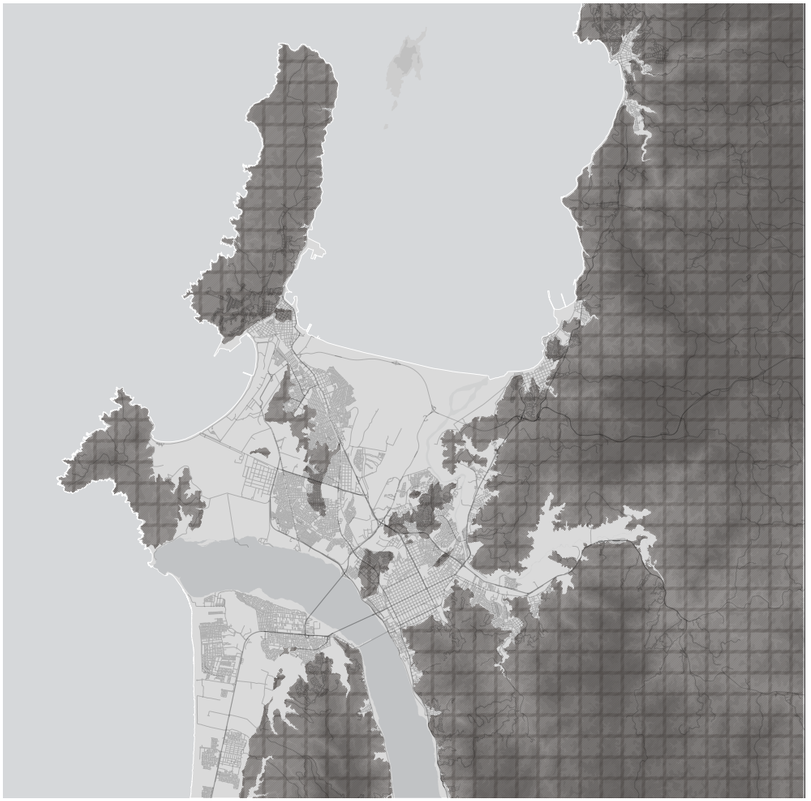
hills

Functions unharmed by steep lands:

-Forestry
-Recreation
-Low-density housing

Prohibited land uses:

-Agriculture
-Urban development



0 1 2 3 4 5km

Data provided by the Chilean sub-directorate of Geology

Spatializing

Suitability analysis: Permission or prohibition of land uses

Dominant aspects of natural processes

Forest and woodlands

native forest
forestry: pine & eucalyptus

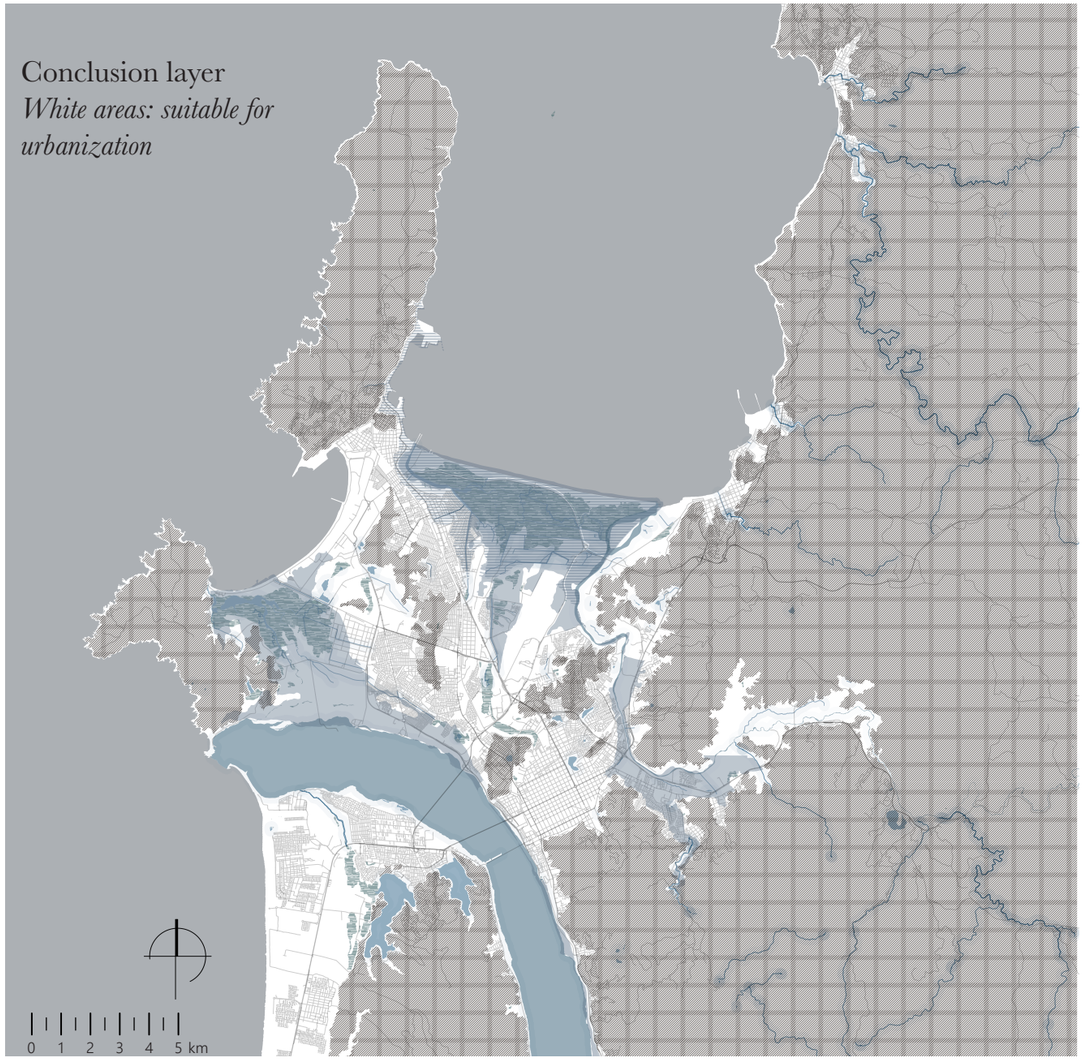
Land uses that won't damage them:

-Recreation
-Forestry
-Wildlife habitat
-Low-density housing

Data provided by the Chilean sub-directorate of Geology

Conclusion layer

White areas: suitable for urbanization



Data provided by the Chilean sub-directorate of Geology

4

Chapter 4
Approaching

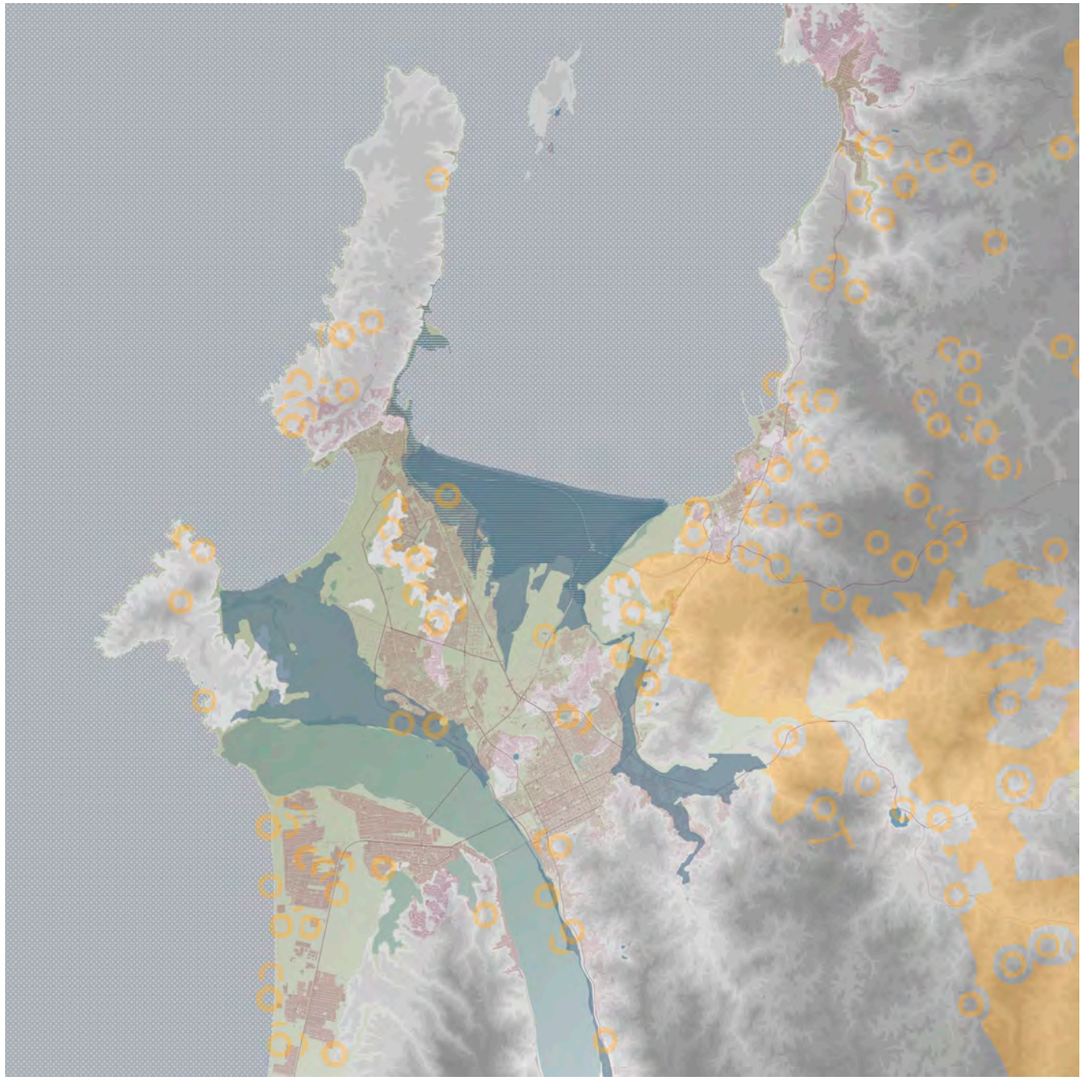
Challenges and potentials

Approaching
challenges: natural risks

Natural layer
Risks & Hazards

- flooded area by 2010 tsunami
- flood area by extreme tsunami scenario (areas below 10 m a.s.l.)
- flood area by river overflow & tidal influence
- burned areas by 2017 fires
- fire foci in 2017

0 1 2 3 4 5 km



Data provided by the Chilean sub-directorate of Geology

Approaching
potentials: natural & urban voids

Because of its history of natural disasters -specially due to the last earthquake and following tsunami- the Metropolitan area of Concepción has multiple empty spaces where it used to be buildings, which –because of economic reasons– remain as voids within the urban fabric.

On the other hand, there are also wetland areas without any function, waiting to be urbanized and (for now) remaining as natural voids.

Instead of seeing these leftover spaces as a problematic situation, the *adaptive void framework* proposes to work with them, not for building what there was before or to continue the urban process, but in order to create *"unplanned spaces"* defined as **areas that remain free of specific functions but can be occupied in a sudden event** (Roggema, 2012).

Therefore, **these *empty spaces* act as highly dynamic zones that allow change during an extre scenario when the area will absorbe the schock of the hazards or will be use temporarily in a different way.**

However, once voids are mapped and identified it is clear that the adaptive void framework need to be adjusted and complemented in order to address reslience, because as it is now, the voids are not conected and it is necessary to overlap them with a potential resilient structure.

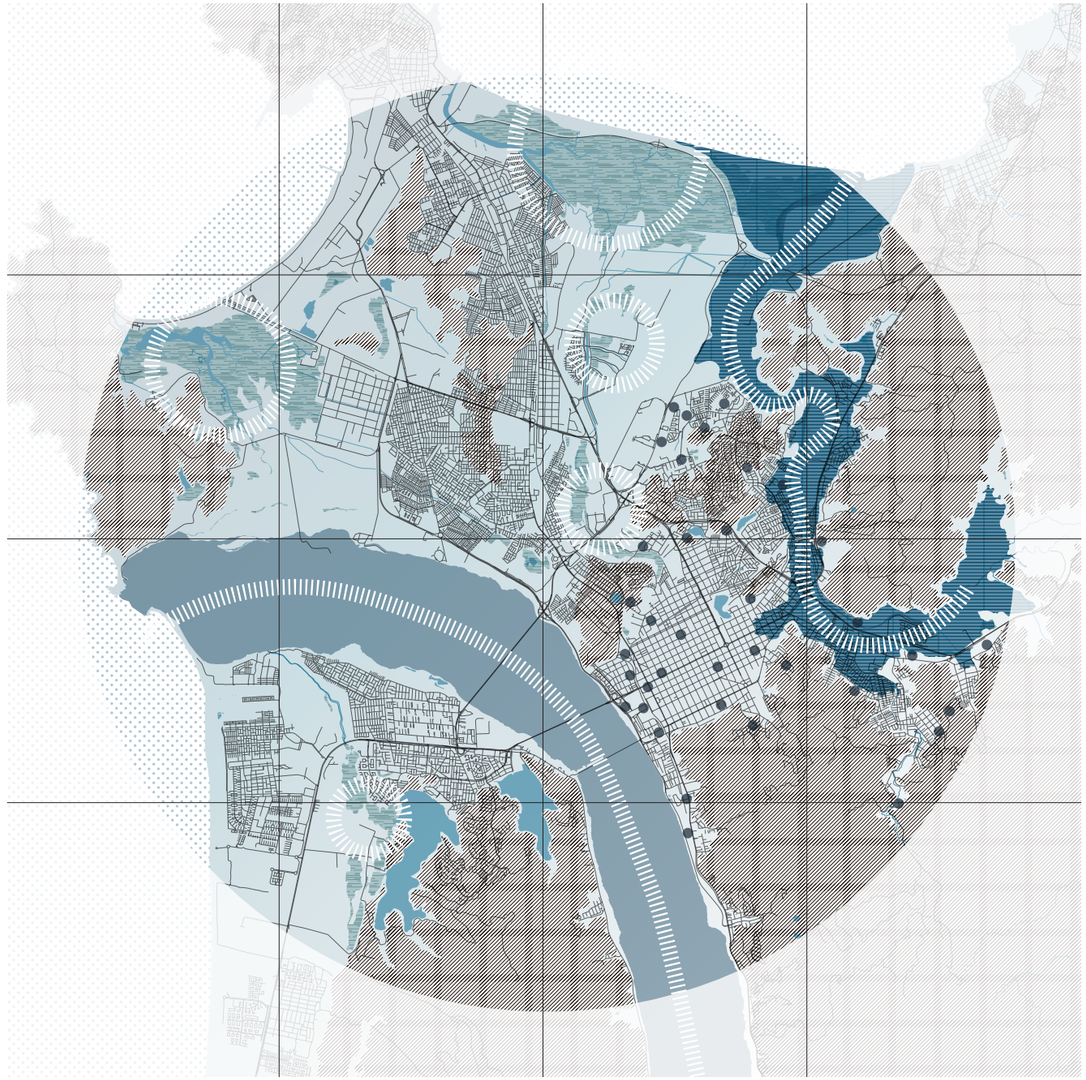
Together, the adaptive void framework and the resilient backbone structure work as a whole system that icorporates a green and blue infrastructure that connect them with themselves and the urband and nature fabric.

This combination will create a more resilient and adaptive city in extreme scenarios, but also will provide livability and healthier open spaces for the inhabitant when the city is in a stable face.

Voids layer
Urban & Natural unplanned spaces

- water bodies
- natural void: Fire safe zones
- wetlands
- natural void: water reservoir - flood *"container"*
- hills / natural void: vertical evacuation
- Andalién flodplain
- flooding (area below 10 m a.s.l.)
- urban voids: abandoned spaces

0 1 2 3 4 5 km

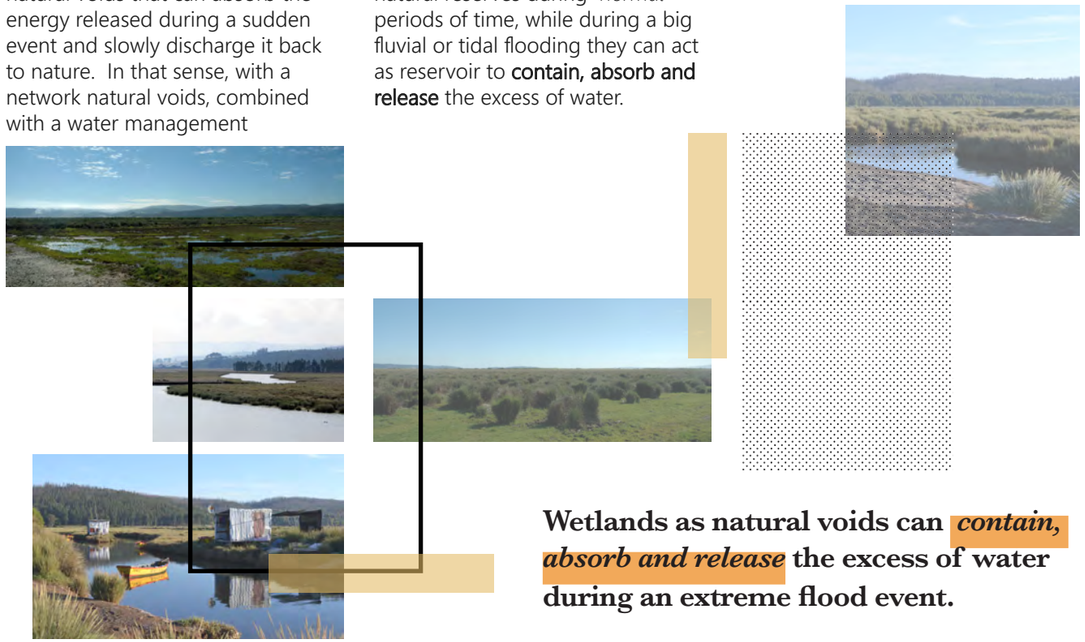


Data provided by the Chilean sub-directorate of Geology

Approaching
potentials: natural & urban voids

Natural voids potentials
Wetlands

The natural wetlands that still remain facing urbanization, are natural voids that can absorb the energy released during a sudden event and slowly discharge it back to nature. In that sense, with a network natural voids, combined with a water management strategy, the wetlands can work as recreational & research areas, and natural reserves during *"normal"* periods of time, while during a big fluvial or tidal flooding they can act as reservoir to **contain, absorb and release** the excess of water.



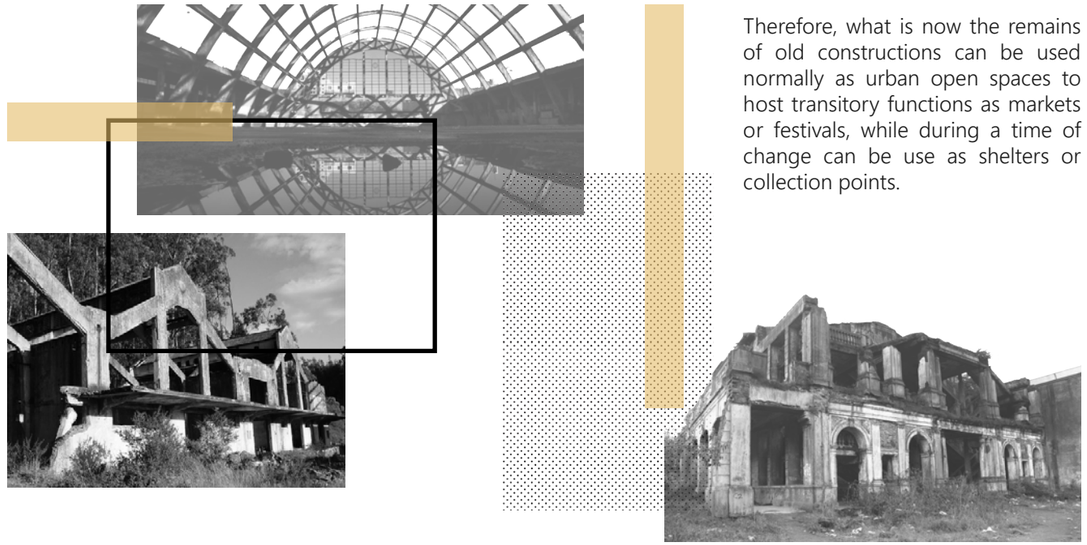
Wetlands as natural voids can *contain, absorb and release* the excess of water during an extreme flood event.

Urban voids potentials
Abandoned spaces

The remains of old buildings can now host temporary functions and create dynamic spaces to be used in emergency situations

The multiple urban empty spaces of Concepción will be used as unplanned spaces to keep them as areas without specific function but as dynamic spaces to be occupied in case of emergency.

Therefore, what is now the remains of old constructions can be used normally as urban open spaces to host transitory functions as markets or festivals, while during a time of change can be use as shelters or collection points.



5

Chapter 5
Exploring

Research by design
Conceptual masterplan &
resilient backbone

Exploring
(im)possible scenarios

Research by Design
(im)possible Concepción

In order to evaluate and imagine different scenarios for the Metropolitan area of Concepción in a time of extremes, the starting point of the design exploration is based on a **research by design approach.**

Through this method, the aim is to propose and imagine, through graphic resources, how the city could function in different *possible-impossible* situations that it might face in a – not so far – future.

Therefore, the following images explores a city in times of extremes where maybe a major tsunami will inundate the harbor, but it can still provide energy for the city due to new renewal energy sources.

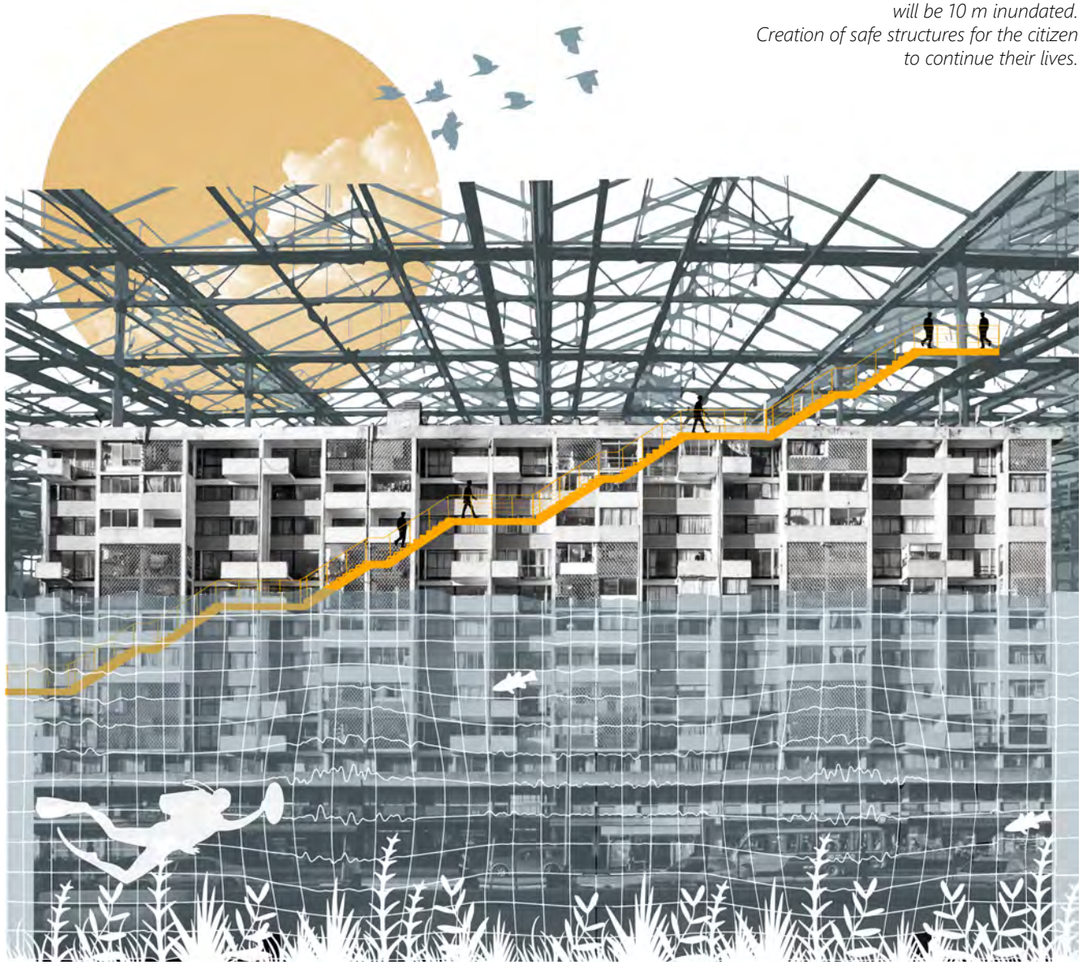
Or in the same tsunami scenario, the citizens continue their lives with normality in a *sky city* based in elevated safe structures.

On the other hand, these scenarios also explore the possibilities of the adaptive void network, visualizing how these urban and natural voids could work in case of a sudden event.

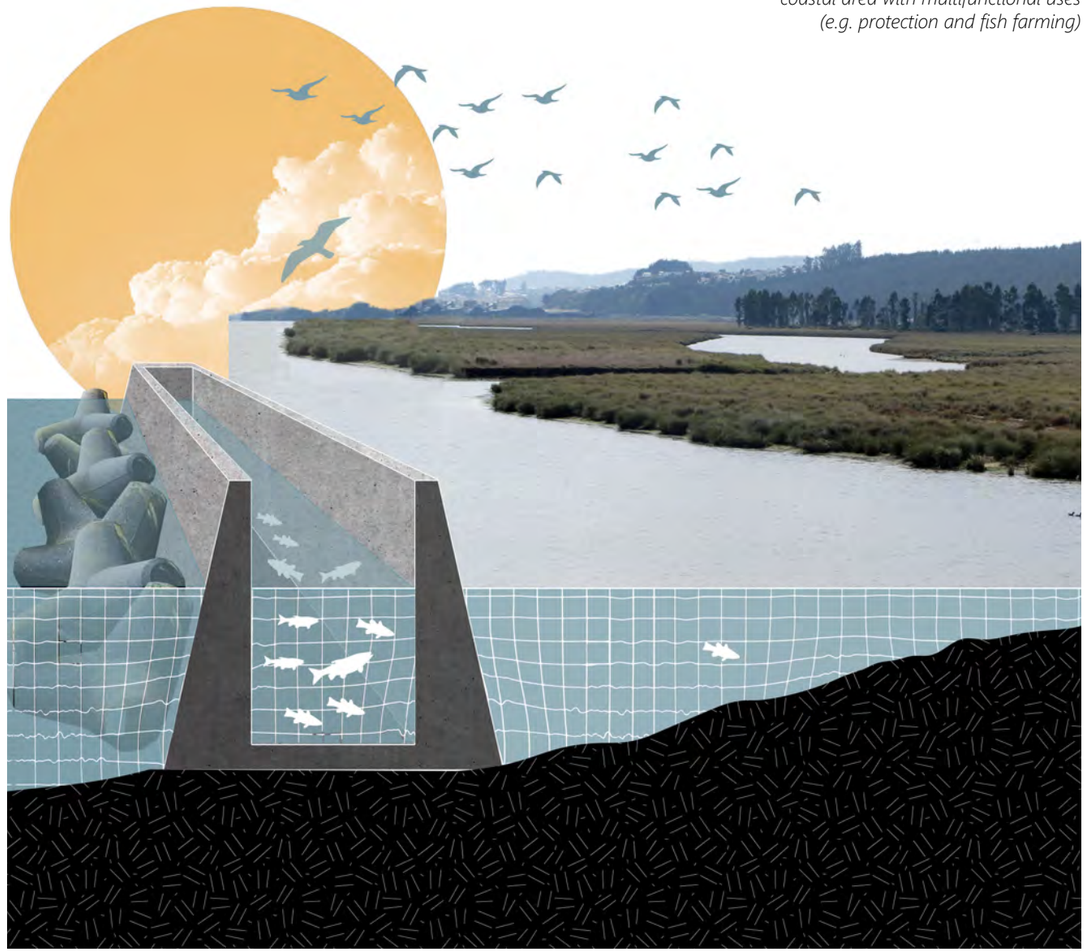
Part II • Chapter 5: *Exploring*

Extreme tsunami scenario where the harbour will be 10 m inundated. Creation of new uses (e.g.renewal energy) for the city to continue functioning.

Extreme tsunami scenario where the city will be 10 m inundated. Creation of safe structures for the citizen to continue their lives.



Tsunami and flood protection on the coastal area with multifunctional uses (e.g. protection and fish farming)

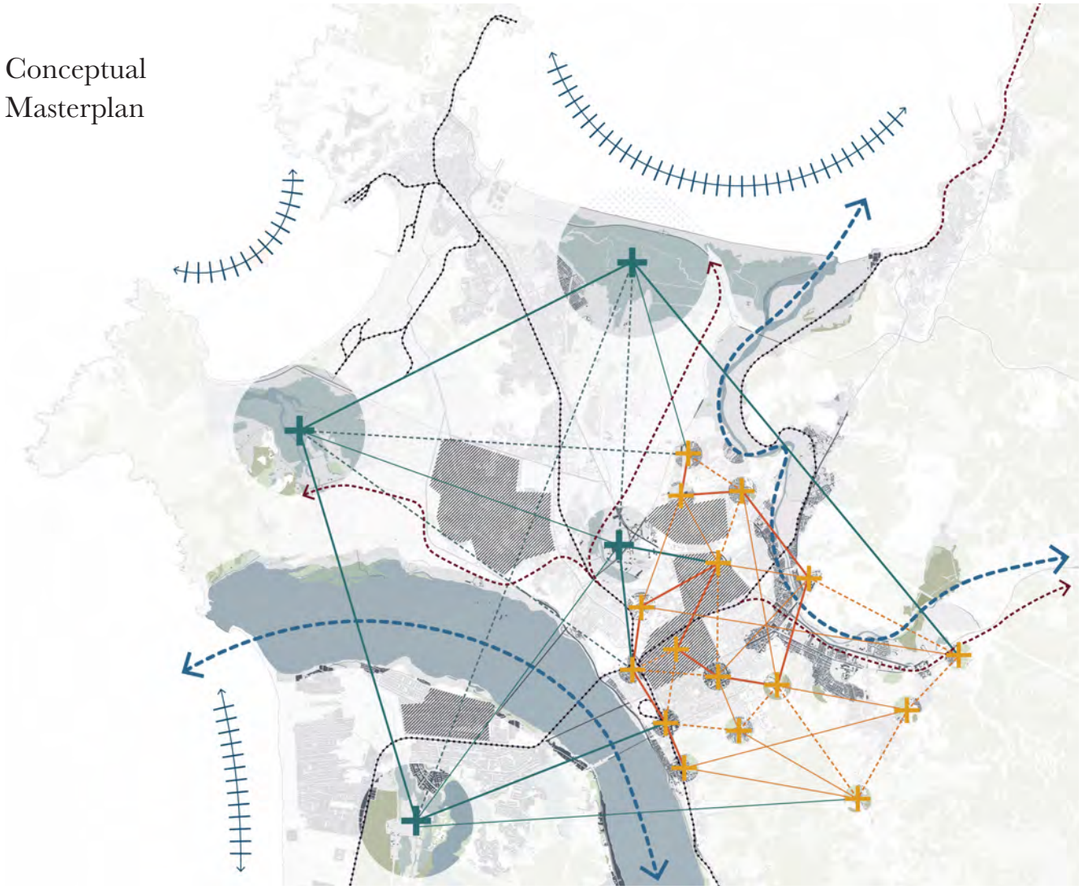


Use of urban voids (abandoned spaces) by giving them new functions and safety structures to be used in case of an emergency (e.g. refugee camp, emergeny market, drinking water, etc.)

Exploring

Strategic and Resilient plan for Concepción: Metropolitan Masterplan

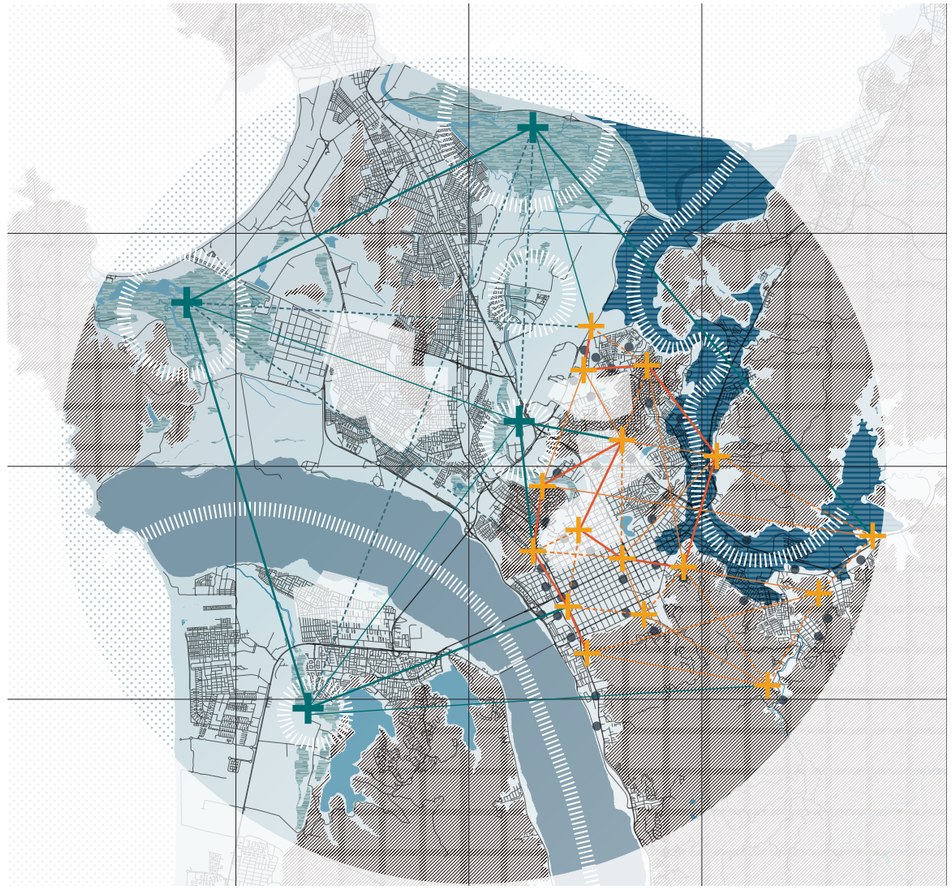
Conceptual Masterplan



landscape voids - wetlands
landscape connections - green corridors
urban void - abandoned space
urban connections - urban corridors

futre urban densification
improvement of river infrastructure
new multifuntctional sea barrier
train reactivation - new railway connections

0 1 2 3 4 5 km



Cross reference map, potential voids and risks +
Adaptive void network

0 1 2 3 4 5 km

6

Chapter 6
Designing

Strategic plan based on the adaptive network & Resilient backbone structure
Green & Blue infrastructure through scales

Designing
Metropolitan Masterplan

After the analysis of possible extreme scenarios for the metropolitan area of Concepción in addition to the proposed adaptive void network, the first reflections reveal that there is a missing link between the voids and the urban and nature network.

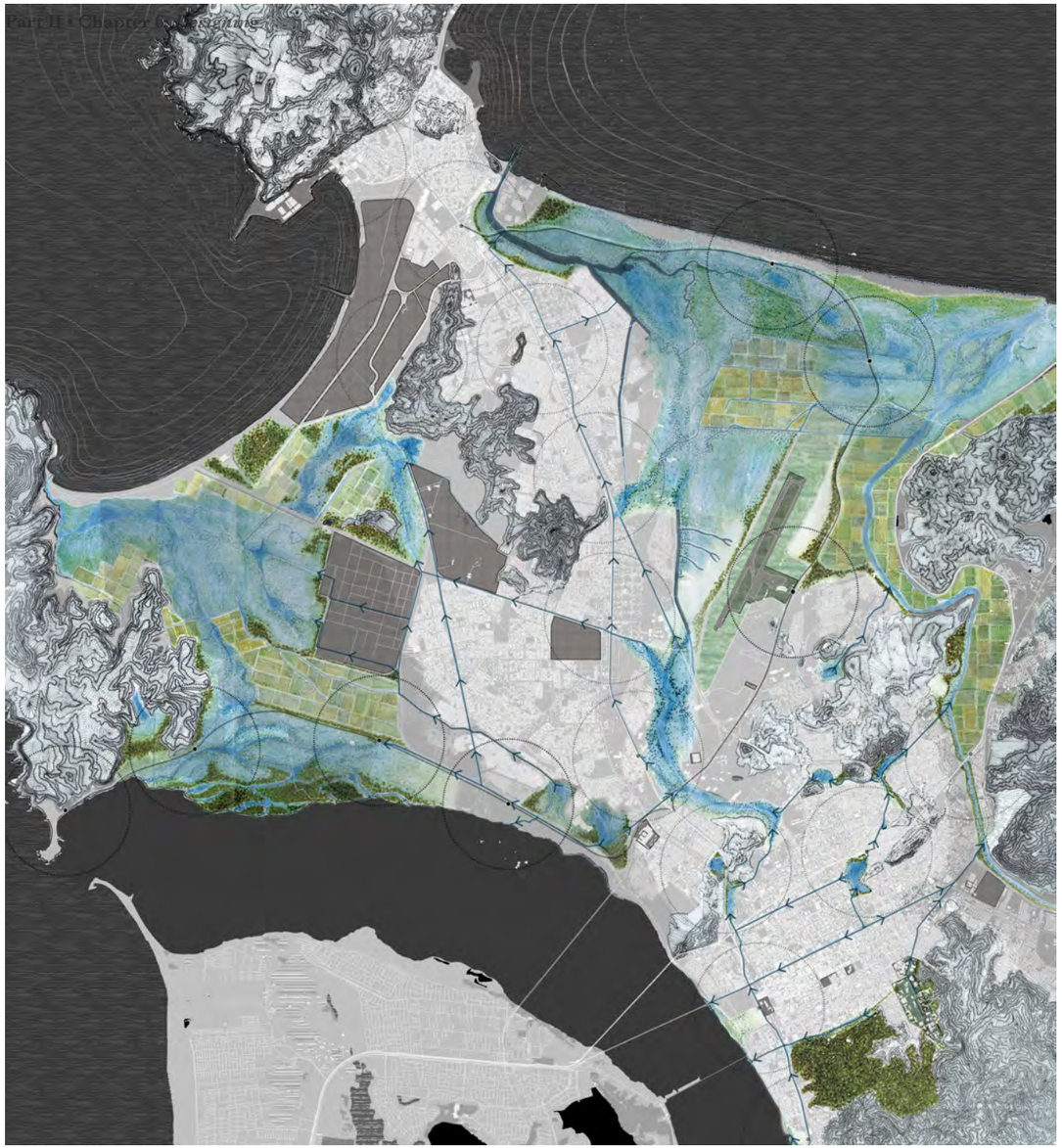
Therefore, with a green and blue infrastructure that use and connect the identified voids, it is possible to develop a resilient backbone as a strategic plan and meaningful design for the city, rethinking the functions and land uses of the territory.

This green and blue infrastructure provides a series of principles and methods to adapt the human settlement for extreme scenarios and at the same time it gives a livability to the city, reformulating the urban fabric as a provider of nature.

Thus, the strategy not only works during times of risk and hazards, but also in stables faces of the territory giving to the inhabitants larger green spaces, landscape connectivity and protection of the ecological value of the existing landscape.

Regional blue & green masterplan for the metropolitan area of Concepción

Part II • Chapter 6: *Designing*



Designing
Metropolitan Masterplan

Research by Design
Proposed typologies for the green & blue infrastrucutre

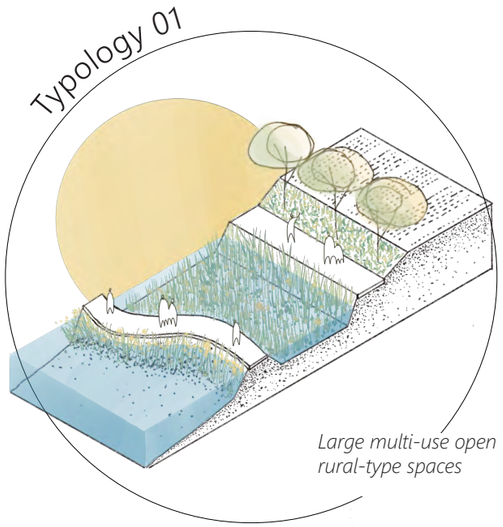
Based in the case study of **The Boston Park System** by Frederick Law Olmsted and in his work on environmental plan and design; the proposed masterplan uses five typologies of urban open spaces as part of a physicaly interconnected municipal park system (involving four municipalities).

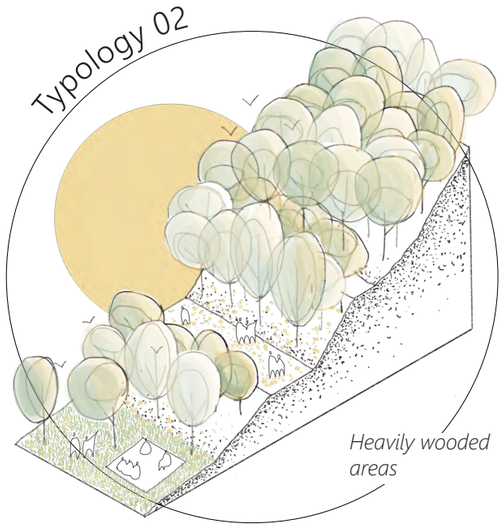
Each typology host a diferenciate function for urban, ecological and social purposes.

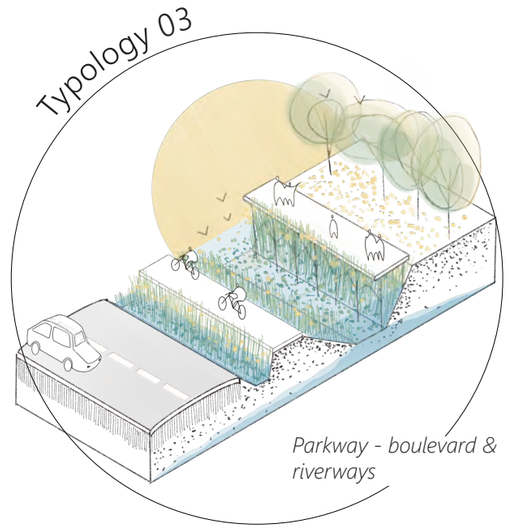
T01: Large multi-use open space: *Planned and designed as part of a physically interconnected metropolitan park system.*

T02: Heavily wooded areas: *Within urban boundaries. Planned for conservation, economic or recreational use.*

T03: Parkway-boulevard & riverways*: Physical links between parks & communities. Linear open spaces*

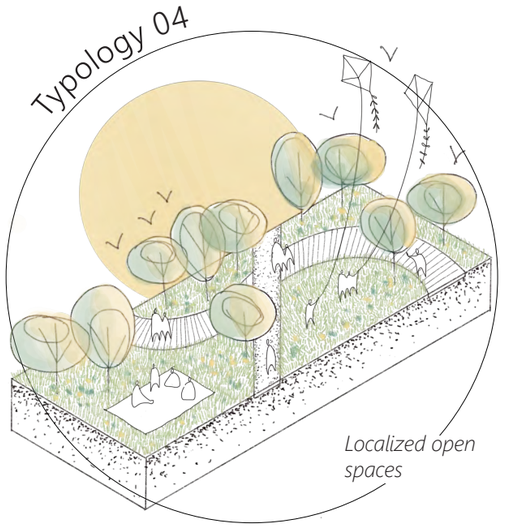


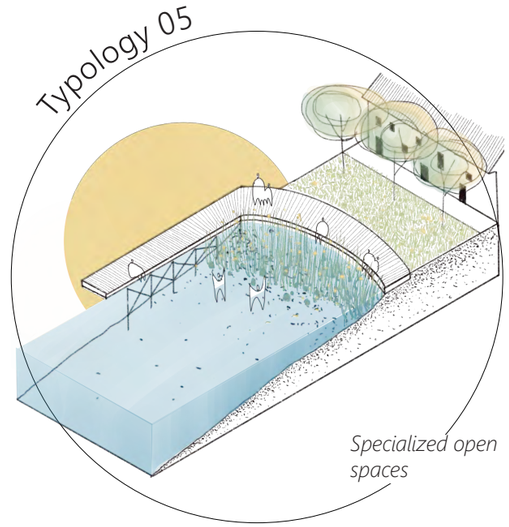




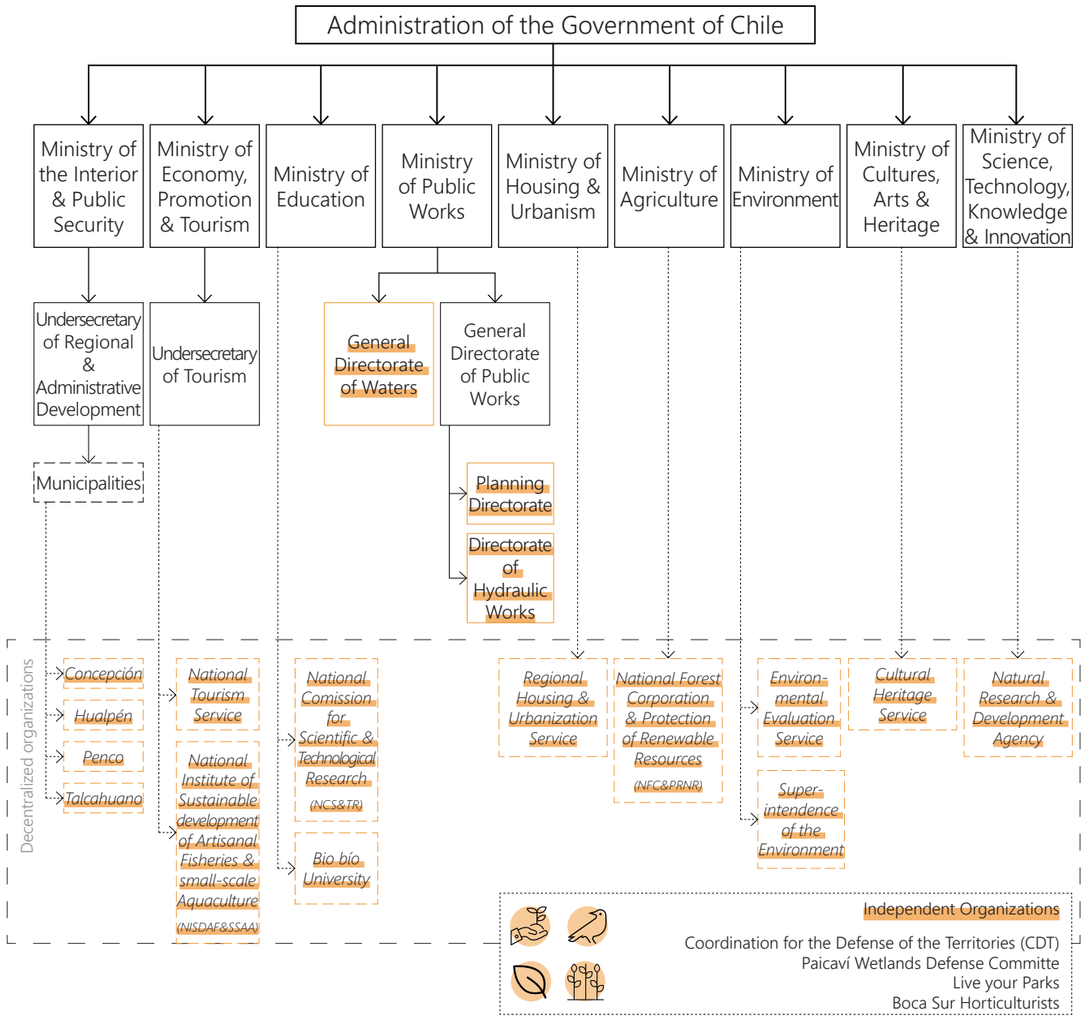
T04: Localized open spaces: *Designed to serve particular neighborhoods or areas whitin the city.*

T05: Specialized open spaces: *Specific recreational functions related to water bodies (lakes).*



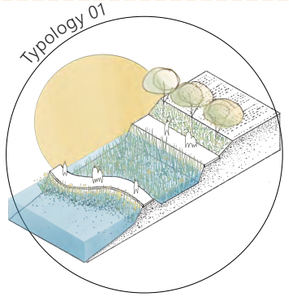


Designing
Stakeholders management structure



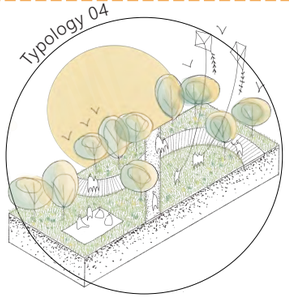
Part II • Chapter 6: *Designing*

Typology 01



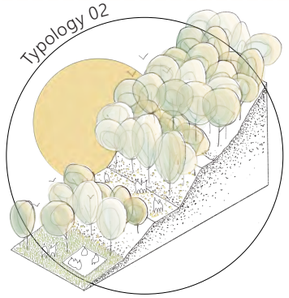
- National Tourism Service
- NISDAF & SSAA
- NCS & TR
- Bio bío University
- Environmental Evaluation Service
- Superintendence of the Environment
- Cultural Heritage Service
- Natural Research & Development Agency
- CDT
- Paicaví Wetlands Defense Committee

Typology 04



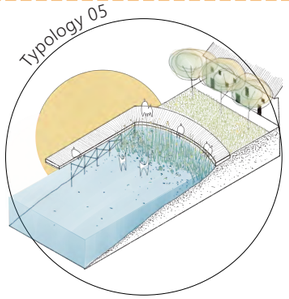
- Planning Directorate
- Environmental Evaluation Service
- Regional Housing & Urbanization Service
- Live your parks

Typology 02



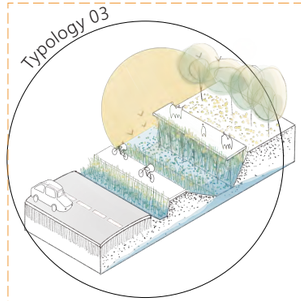
- National Tourism Service
- NCS & TR
- Bio bío University
- NFC & PRNR
- Environmental Evaluation Service
- Superintendence of the Environment
- CDT
- Live your Parks

Typology 05



- General Directorate of Waters
- Planning Directorate
- Regional Housing & Urbanization Service
- Live your parks

Typology 03



- General Directorate of Waters
- Planning Directorate
- Directorate of Hydraulic Works
- Environmental Evaluation Service

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Designing

Green & Blue infrastructure through scales

Test site 1

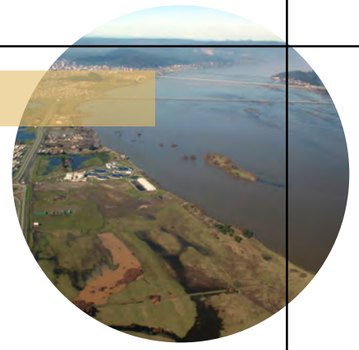
Rocuant wetland tidal park
Coastal open space typology

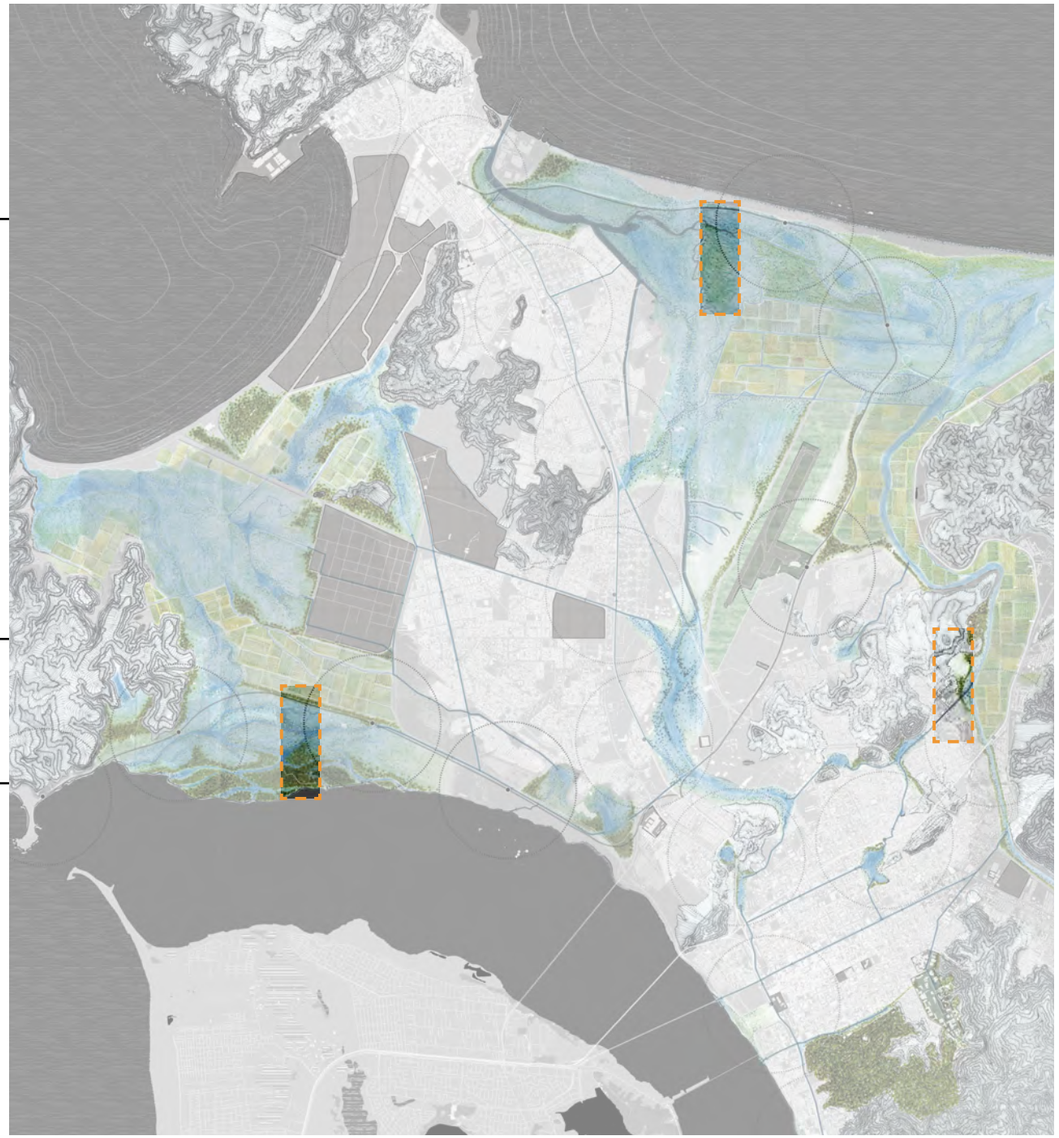
Test site 2

Andalien river banks
Urban - Fluvial open space typology

Test site 3

Biobío river tidal park
Coastal - Fluvial open space typology





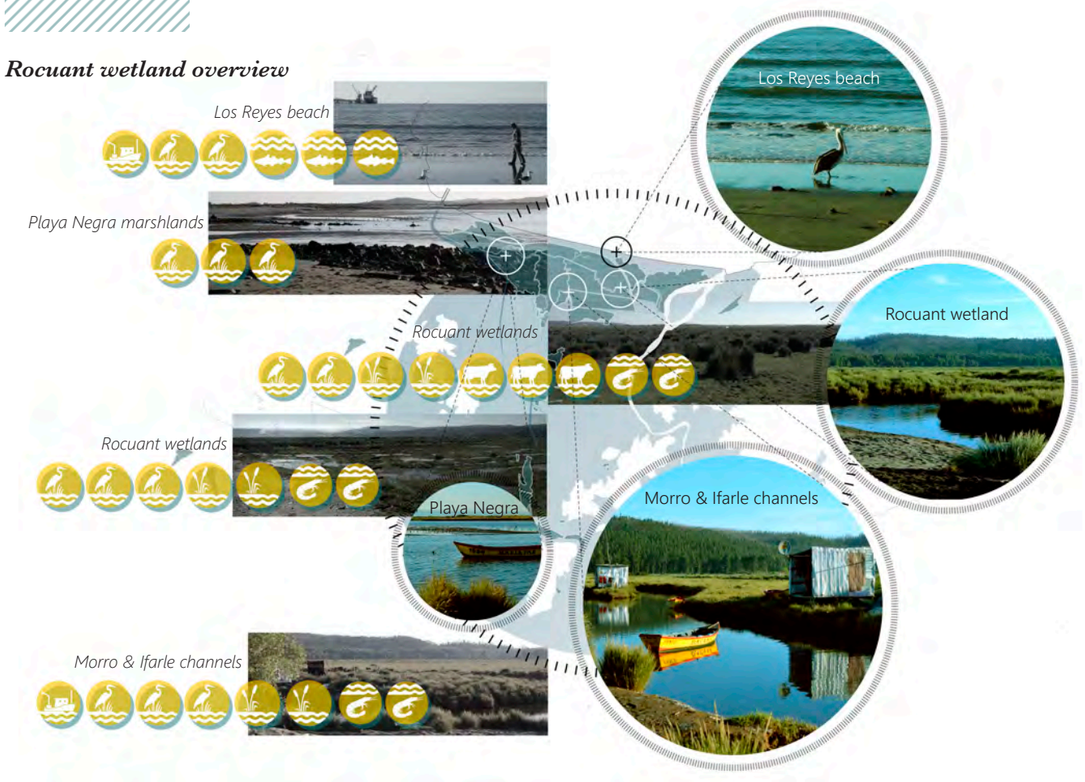
Test site 1

Rocuant wetland tidal park

Coastal open space typology
Wetland zone resilient infrastructure

Test site 1: Rocuant wetland tidal park
Wetland zone resilient infrastructure
Coastal open space typology

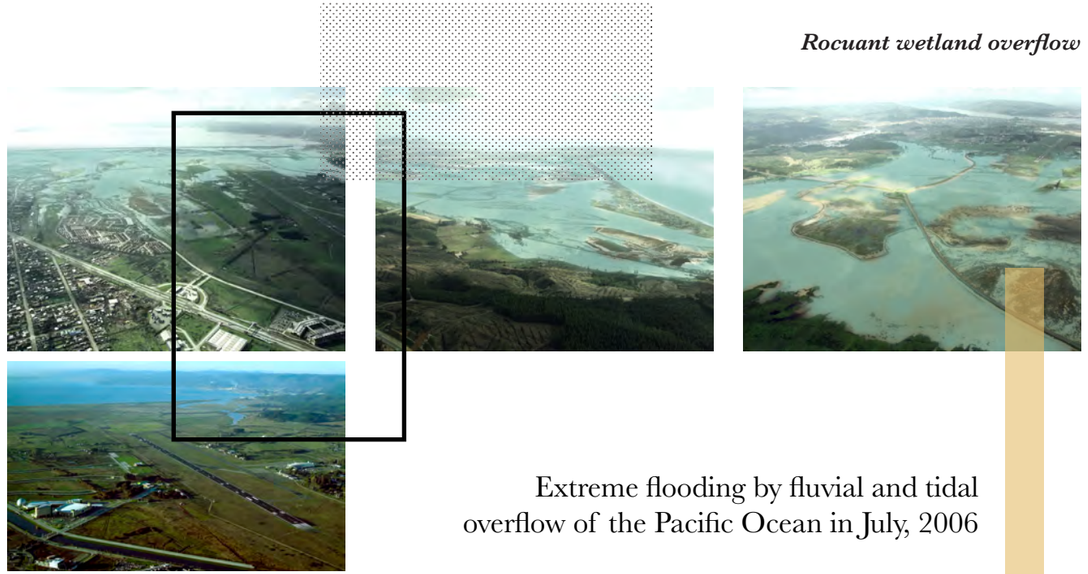
Rocuant wetland overview



Photos and data provided by the Chilean Ministry of Cultures, Arts and Heritage

Part II • Chapter 6: *Designing*

Rocuant wetland overflow

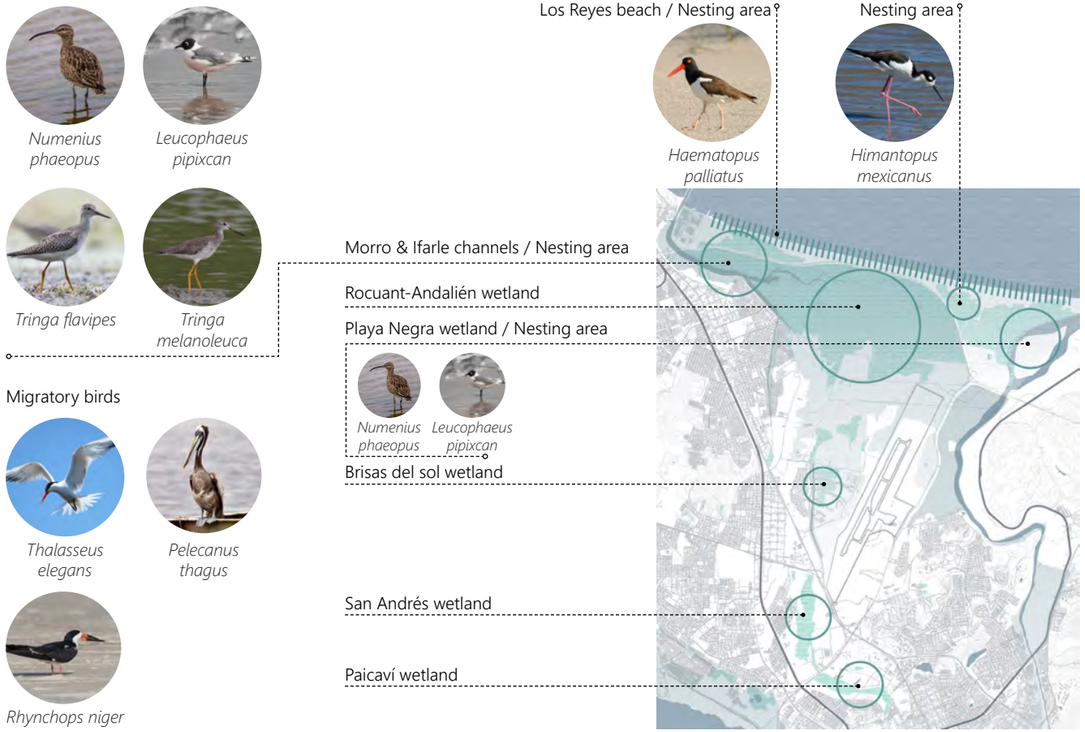


photos: Didier Rousset Buy

Extreme flooding by fluvial and tidal overflow of the Pacific Ocean in July, 2006

Rocuant wetland system

Important bird conservation area



The Rocuand wetland is an important area for the conservation of birds at the global level (IBA, by the NGO Birdlife).

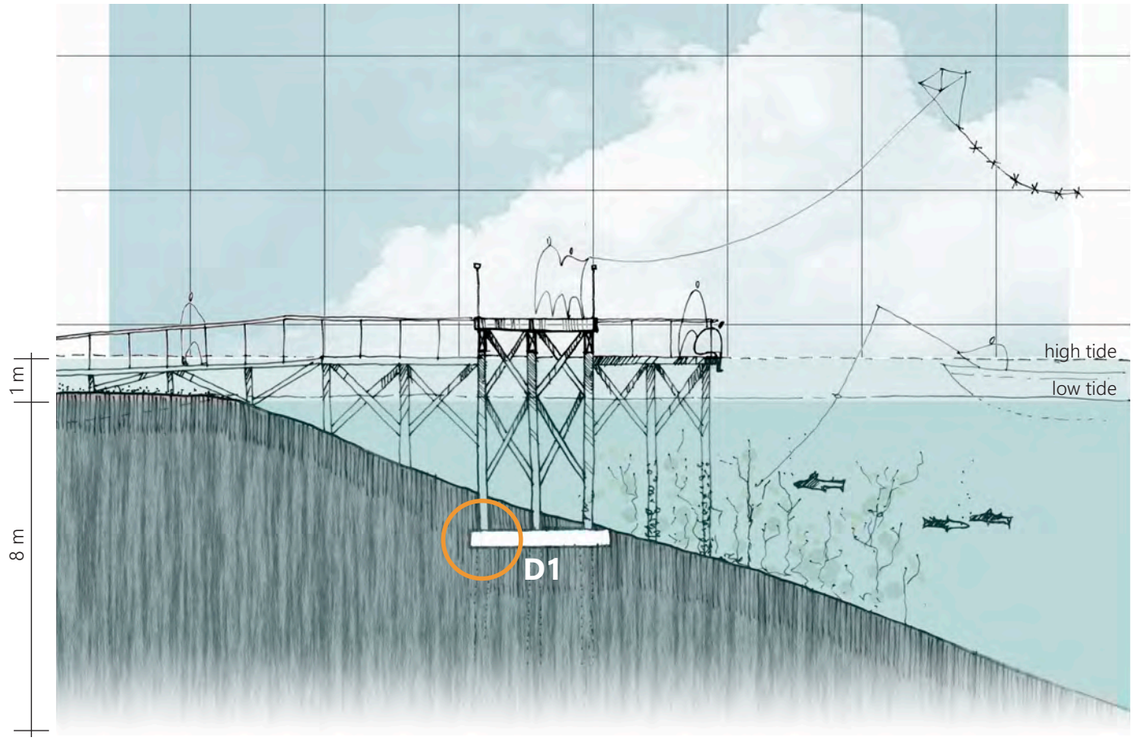
More than 120 species nest and breed in the wetland, and the area has a 25% of the total wild birds of Chile.

photo: Patricio Ortiz Soazo

Test site 1: Rocuant wetland tidal park
Wetland zone resilient infrastructure

Coastal open space typology

Plan of a relevant section of the area



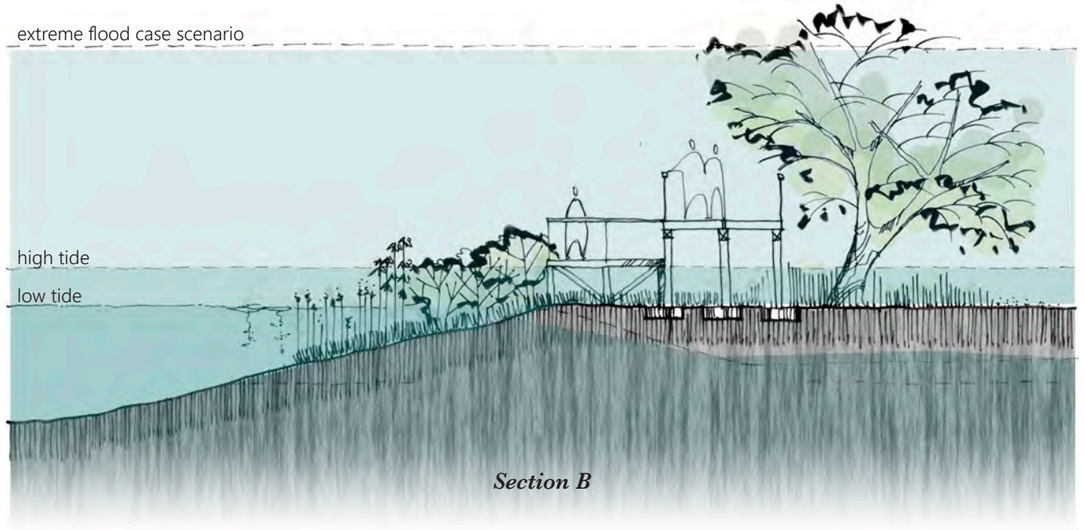
Section A

D1

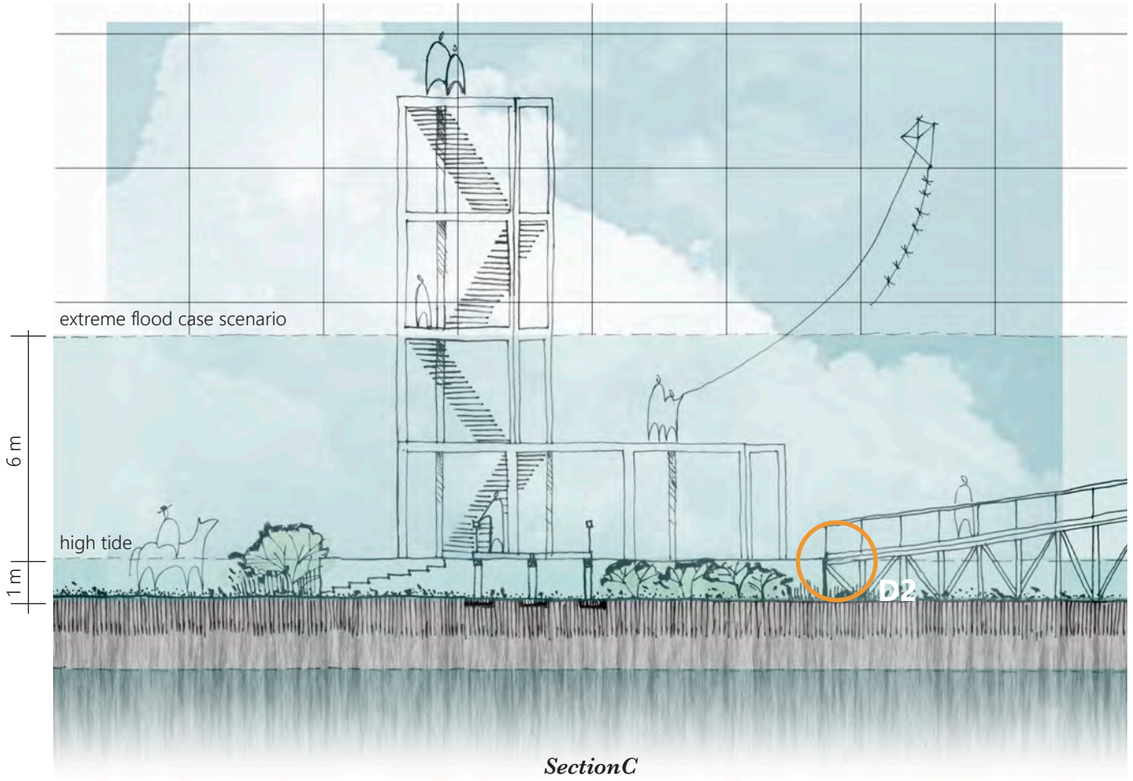
Gracilaria chilensis

Spartina densiflora

Sarcocornia fruticosa

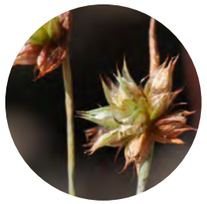


Section B



SectionC

D2

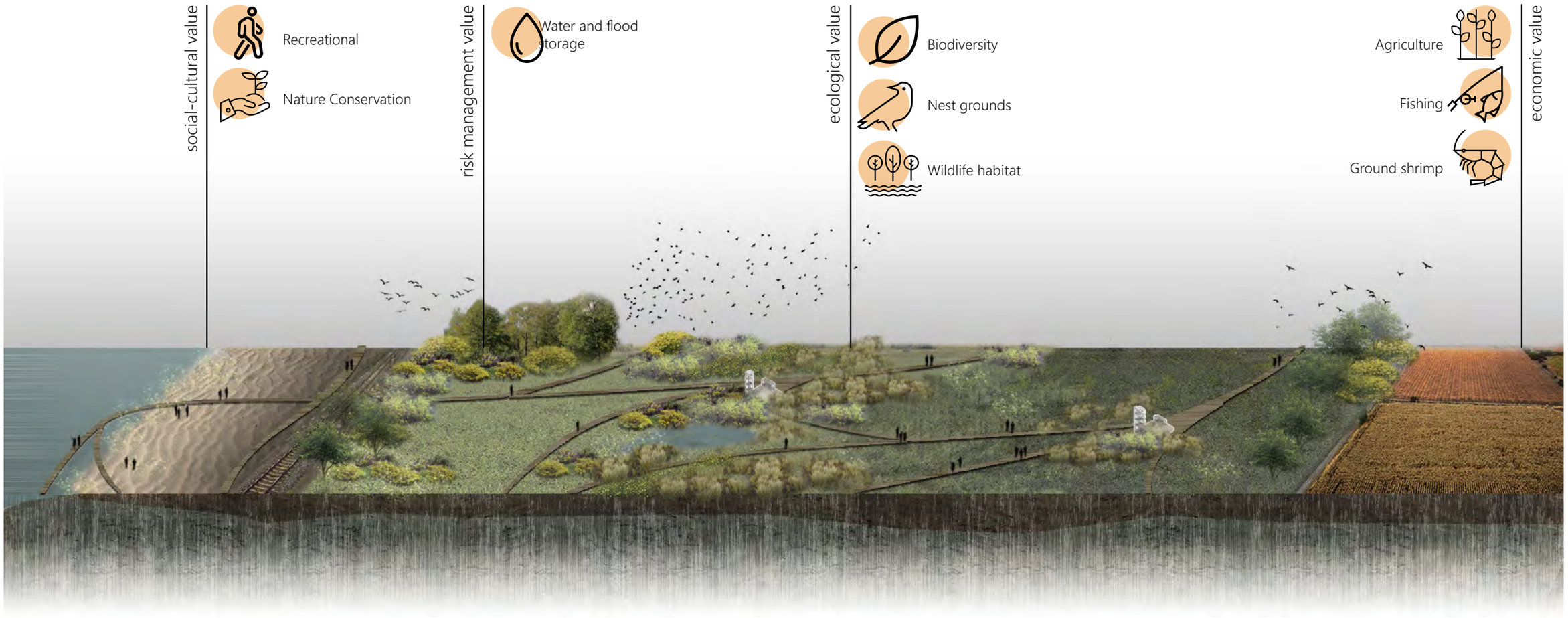


Juncus capitatus

Spartina densiflora

Designing

Green & Blue infrastructure through scales



Perspective section

Design exploration

The unplaned structure

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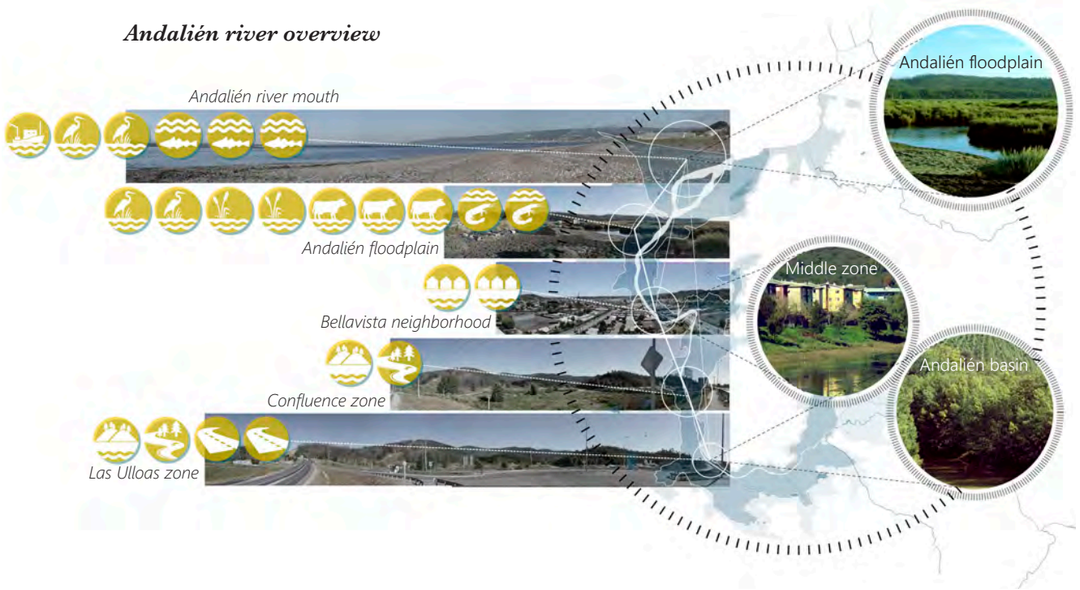
Test site 2

Andalién river banks

Urban - Fluvial open space typology
Fluvial zone resilient infrastructure

Test site 2: Andalién river banks
Fluvial zone resilient infrastructure
Urban - Fluvial open space typology

Andalién river overview



Photos and data provided by the Chilean Ministry of Cultures, Arts and Heritage

Part II • Chapter 6: *Designing*

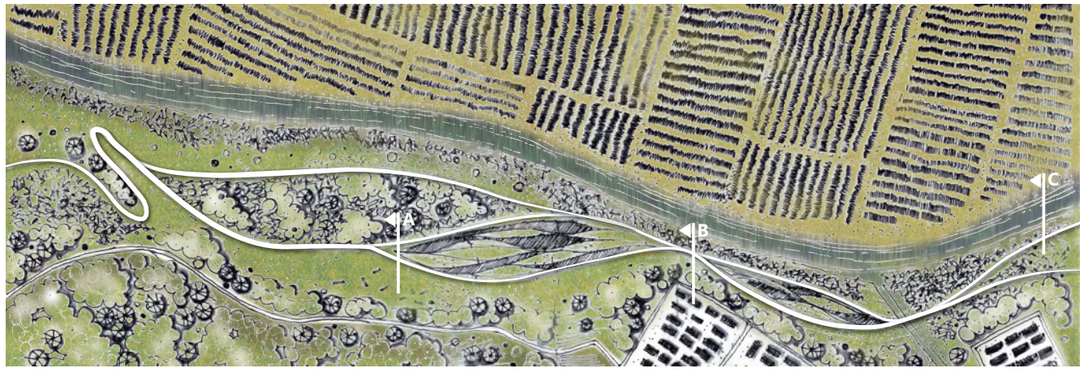
Andalién river overflow

photos: Didier Rousset Buy

Extreme flooding by fluvial and overflow of rivers and channels in July, 2006

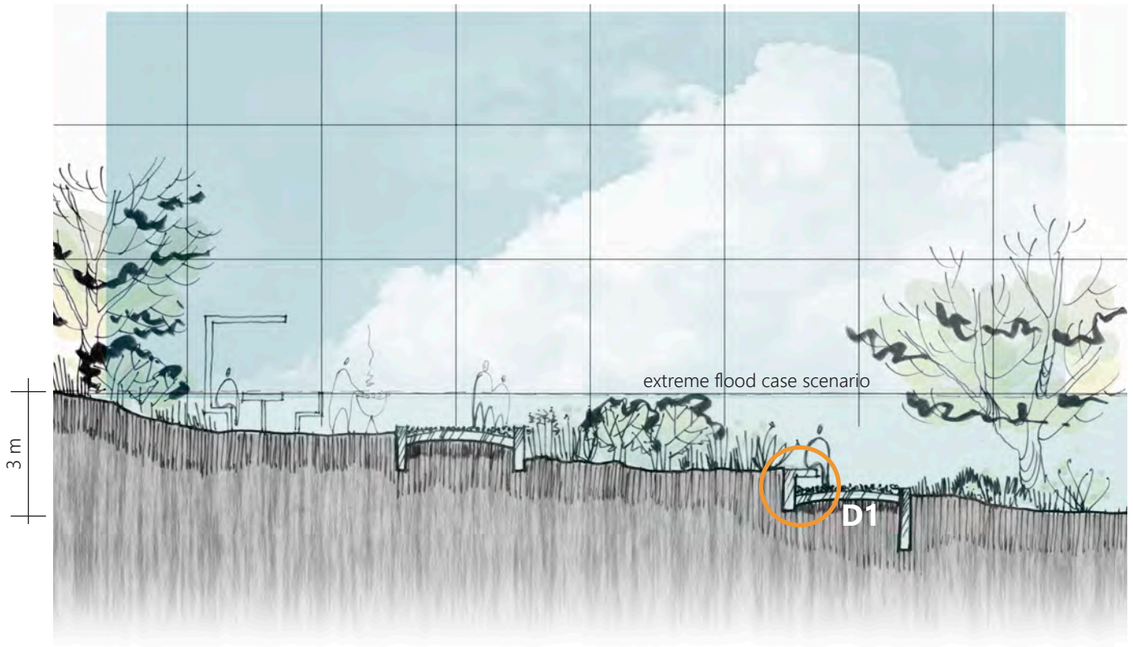
Test site 2: Andalién river banks
Fluvial zone resilient infrastructure

Urban - Fluvial open space typology



Plan of a relevant section of the area

0 50 100 150 200 250m



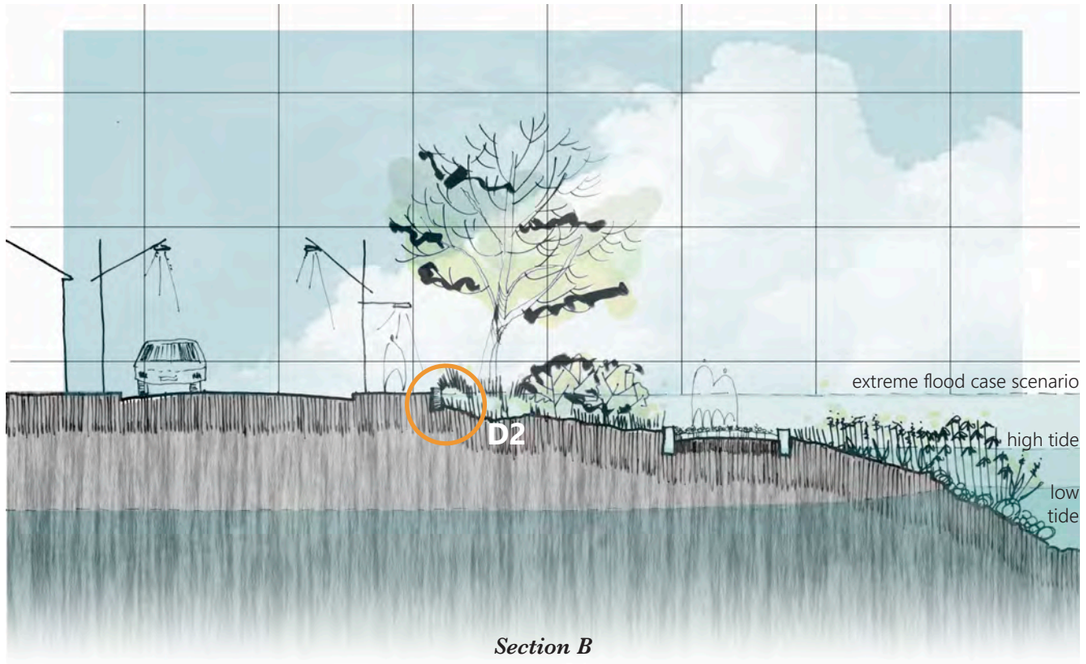
Section A

D1

Gomortega keule

Nothofagus Obliqua

Griselinia scandens



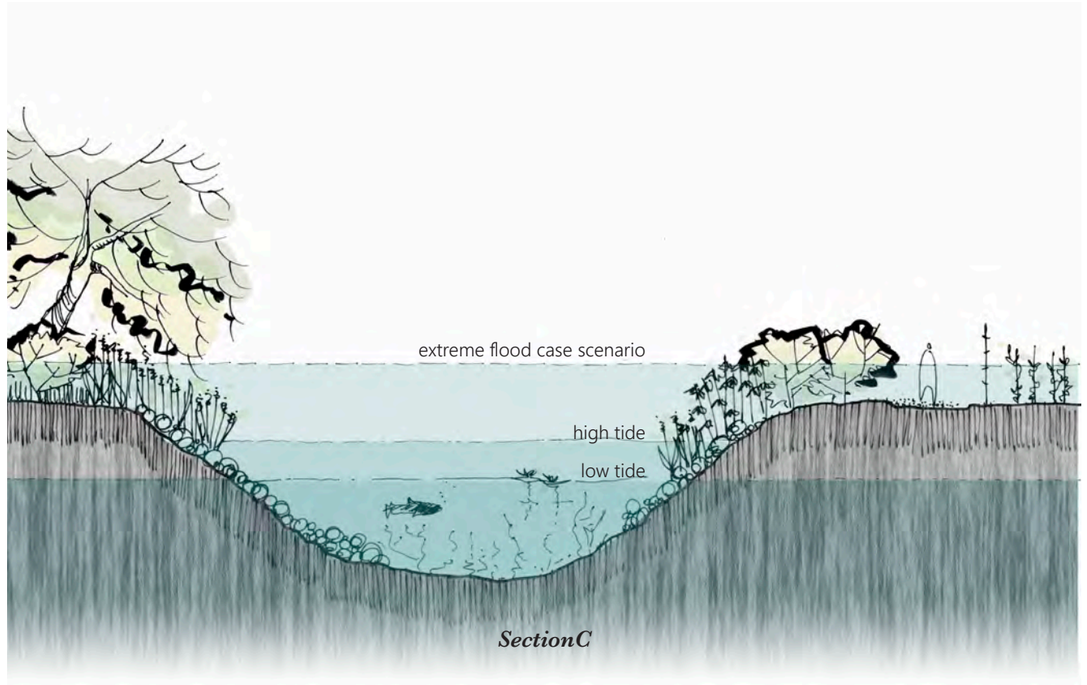
Section B

D2

Nothofagus Obliqua

Sarothamnus scoparius

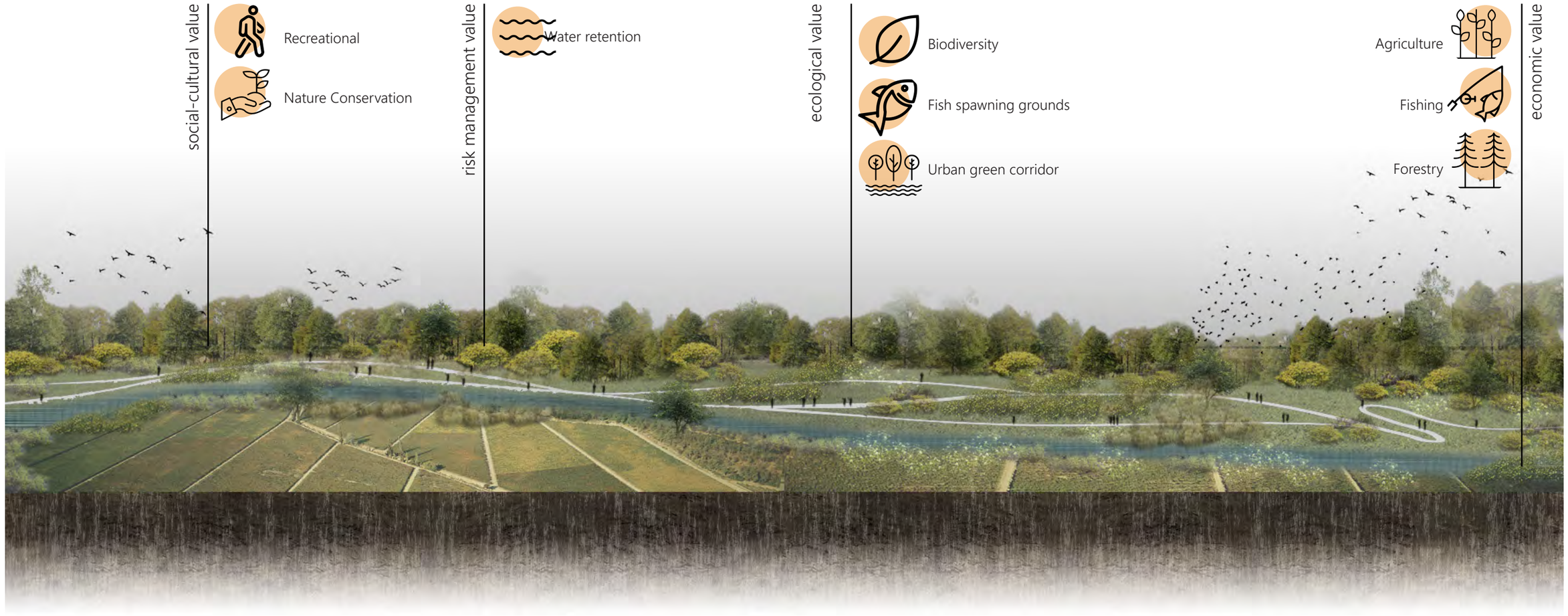
Ranunculus baudotii



SectionC

Designing

Green & Blue infrastructure through scales

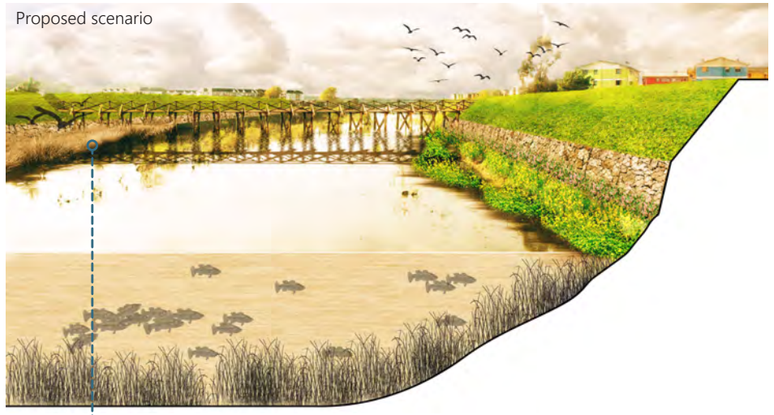


Perspective section

Andalién river: Area under flood risk

Current situation

Proposed scenario



Bahía ambrosioides

Calandrina grandifolia

Cotula coronopifolia

Mimulus luteus

Andalién river: Natural void - unbuilt floodplain

Current situation

Proposed scenario

Bahía ambrosioides

Polygonum persicaria

Cotula coronopifolia

Ranunculus baudotii

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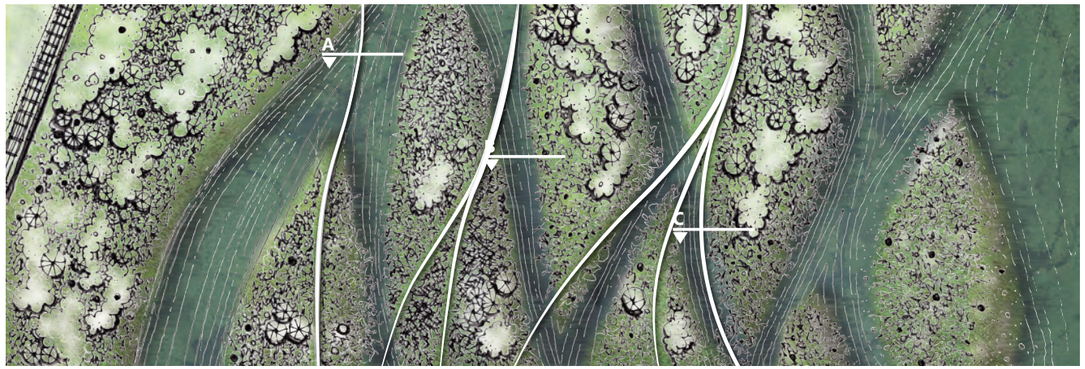
Test site 3

Bio bío river tidal park

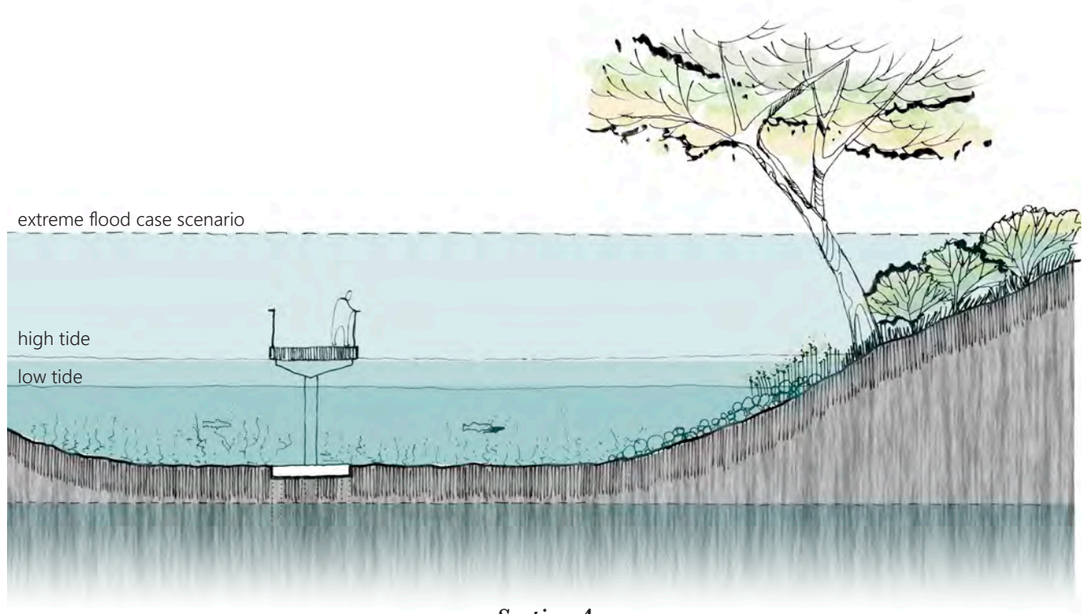
Coastal - Fluvial open space typology
Delta zone resilient infrastructure

Test site 3: Bio bío river tidal park
Delta zone resilient infrastructure

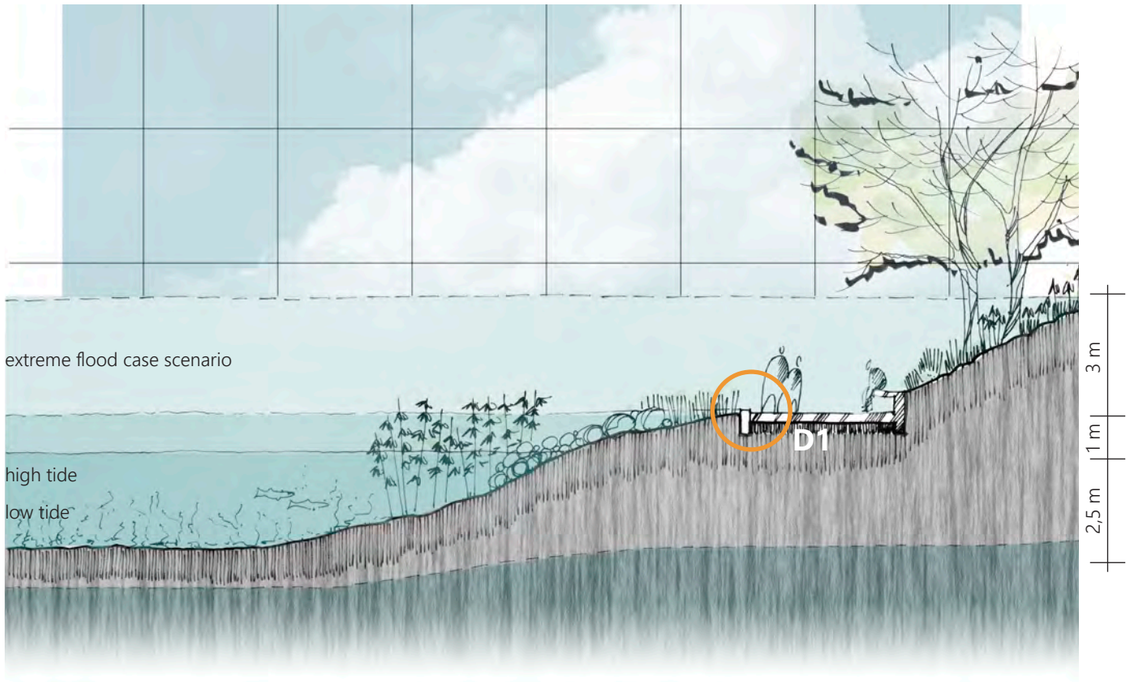
Coastal - Fluvial open space typology



Plan of a relevant section of the area



Section A



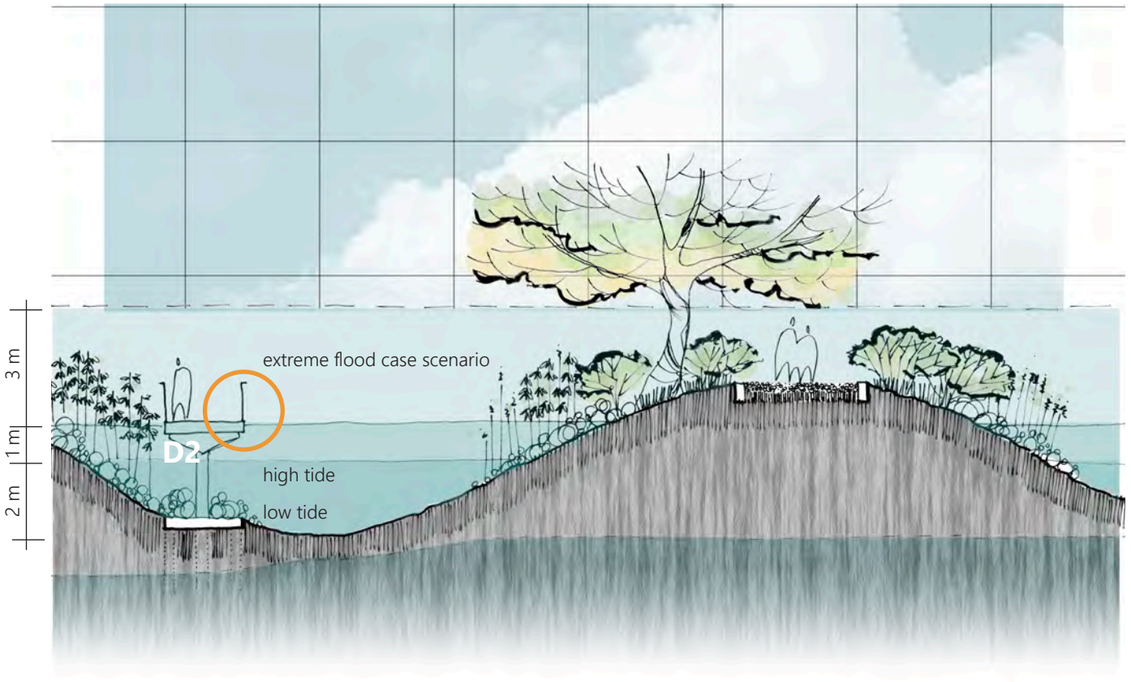
Section B

D1

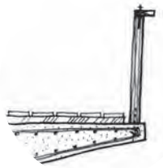
Salix humboldtiana

Populus alba

Mimulus luteus



SectionC



D2

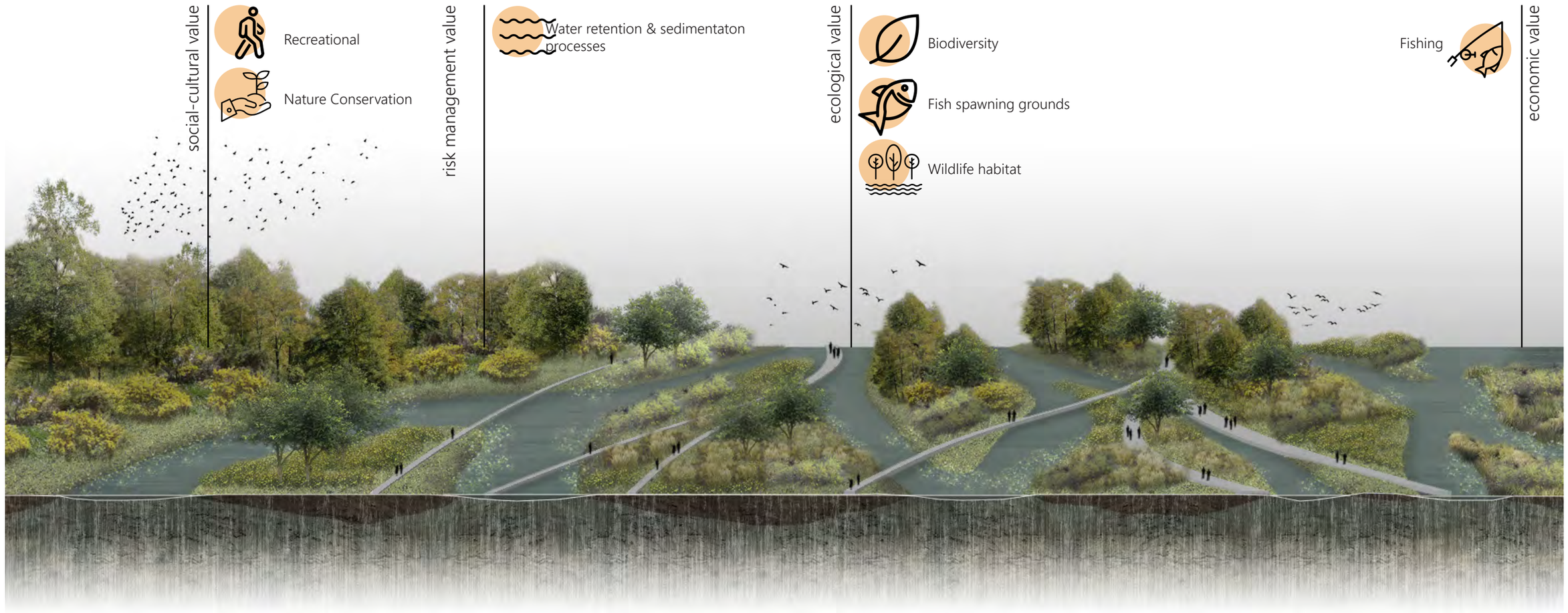
Salix humboldtiana

Populus alba

Sarothamnus scoparius

Designing

Green & Blue infrastructure through scales



Perspective


ARQUEFLUVIAL
ELBOEO

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Test site 4
Urban voids

Structure of the old city market
Structure of the former Enrique Molina Theater

Urban void exploration: Old city market

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Urban void exploration: Former Enrique Molina theater

Part II • Chapter 6: *Designing*

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7

Chapter 8
Concluding

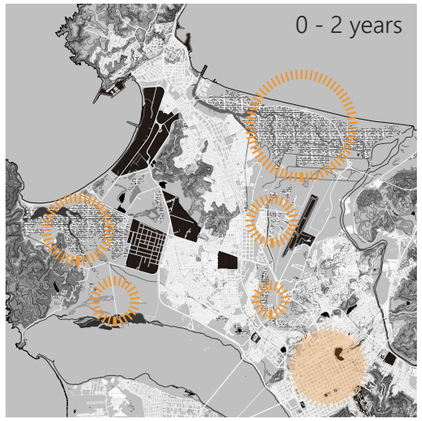
Time developing
Principles extrapolation

Concluding
time developing

1

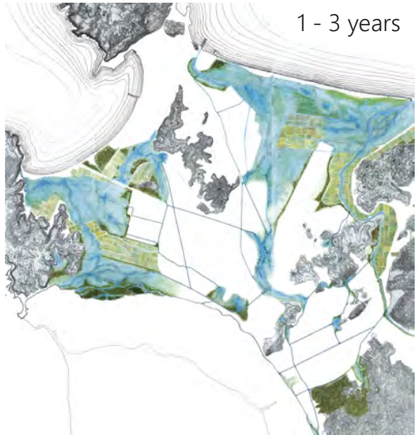
Current situation

2



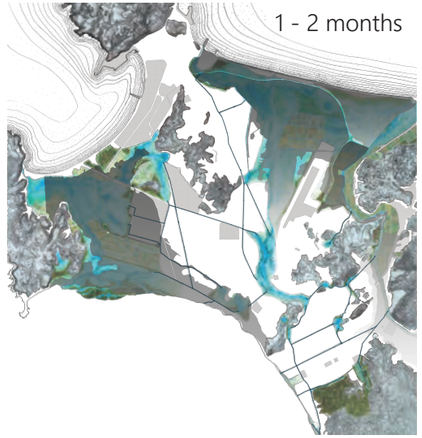
Value of the natural system (wetlands and water bodies) as base infrastructure for the future city

5



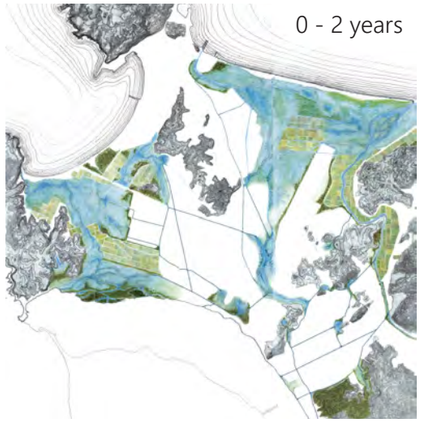
Connection of the natural and urban voids in order to complete the green & blue infrastructure and create the resilient backbone

6



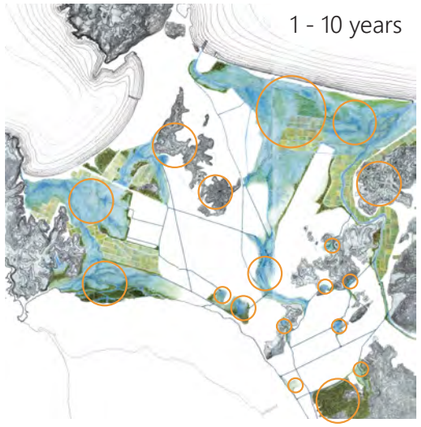
Emergence state
Testing of the resilient backbone

3



Identification and use of voids as vision of an emergent, autonomous and self-organized network

4



Developing of open space typologies according to hierarchization

7

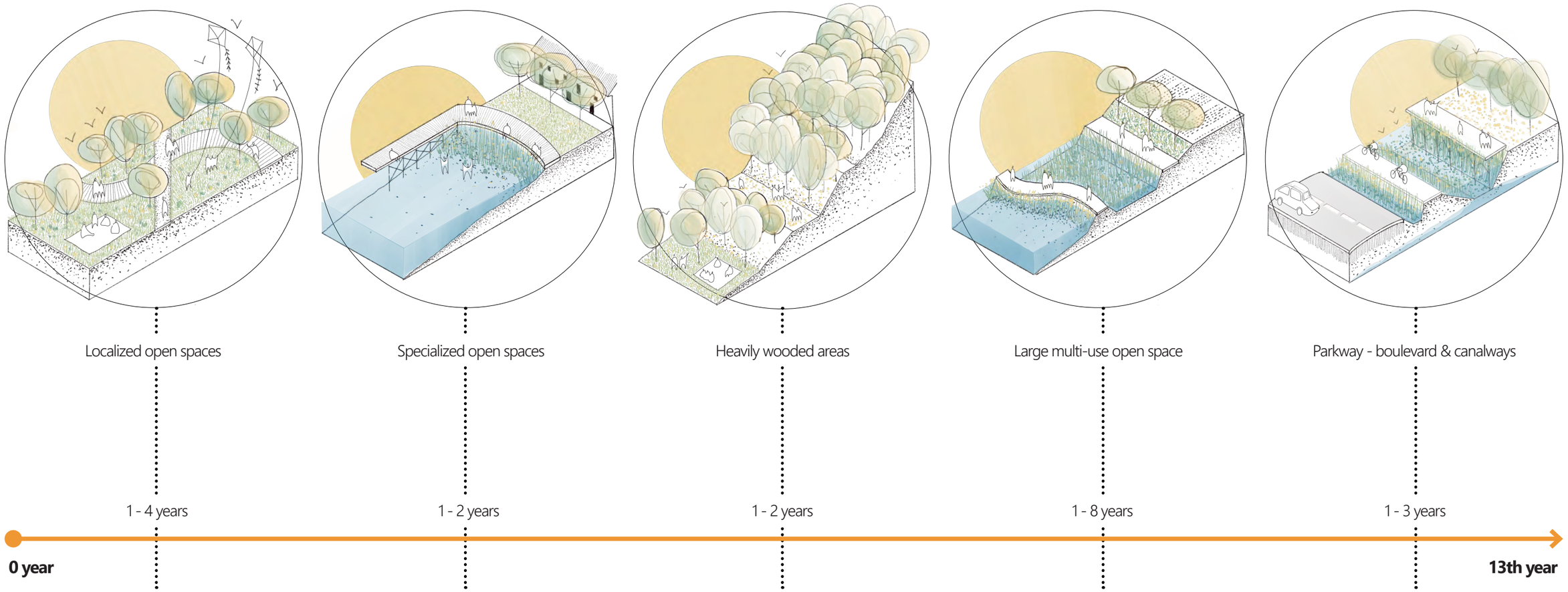
Period of learning and adaptation

8

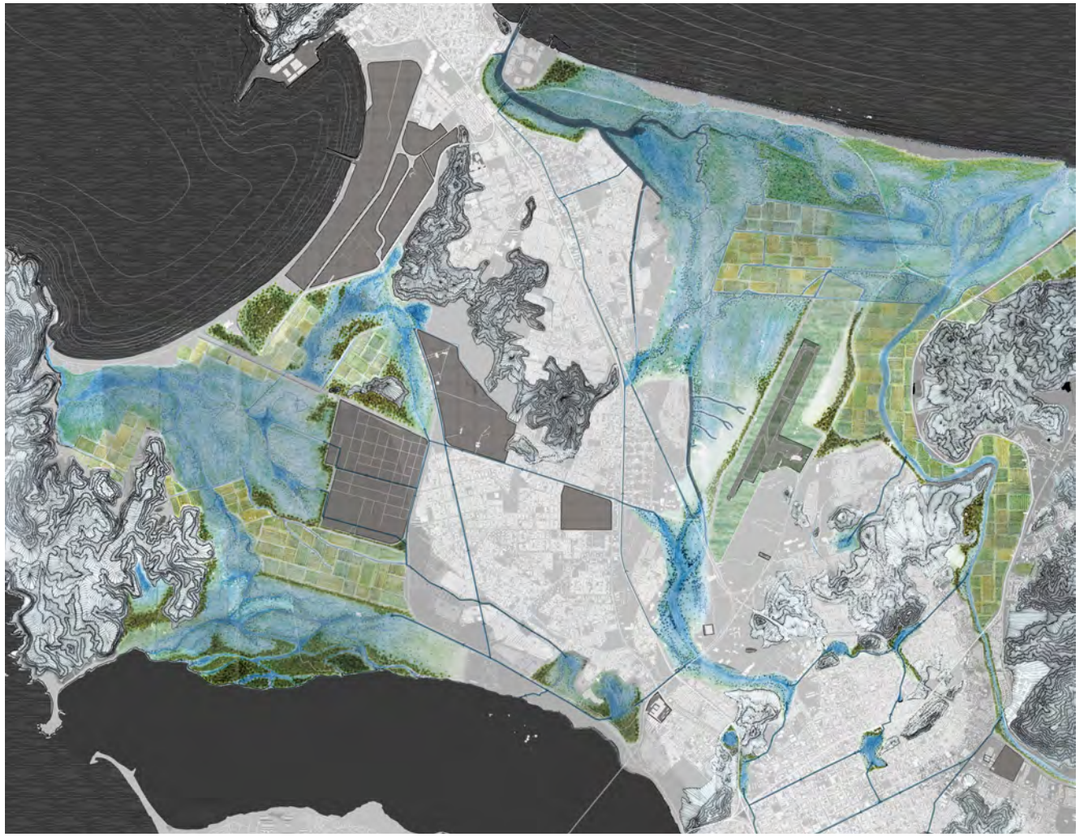
Indentification of critical points to improve for the whole plan

Concluding
time developing

Open spaces (Green & Blue) phasing through time



Concluding
principles extrapolation



Research Objective

Create a Spatial Framework and Landscape Architectural design for the city of Concepción that will be able to deal with uncertainty related to natural disasters.

Part II • Chapter 7: *Concluding*

General planning and design principes that can be applied in similar locations

1st Value the natural system as the **base infrastructure** for the future city

2nd Use of voids (unplanned natural & urban spaces) as an **emergent, autonomous** and **self-organized network** to create reundancy and multifunctional spaces for risk management

3rd Complete the void network usign a **green and blue infrastructure** in order to provide a *resilient backbone* for the area

4th Reformulate the **resilient backbone as a provider of nature**: larger green spaces, landscape conncectivity and protection of the ecological value of the exiting city

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8

Chapter 8
Reflecting

Evaluation of the design proposal
Scope & Relevance
Future Recommendations

Rethinking the territory. Concepción, Chile
Reflection

The continuous struggle between cities and nature has led to human settlements to look for stability and safety, trying to control the dynamics and flow of the underlying landscape. This situation creates a dissociation between both systems where one is superimposed on the other, generating a vulnerable urban-landscape system.

The present research aims to re-envision the perception of the city understanding it as a living system where change creates growth and renewal, and where uncertainty is our new normal. Given the uncertainty inherent to the territory of Concepción, the course of the research looks for a shift in the way we design and manage interventions in our living systems.

Adaptation, appropriation and flexibility are the essential elements of a successful system. In that way, the vision of this project is to create awareness about the idea that cities and landscapes as a whole system can develop the ability to respond to changing environmental conditions making persistence possible.

Evaluation of the design proposal

Relation between research and design

The starting point of the research begins with the fascination of the city of Concepción with all its complexity and vulnerability due to the natural risk and human activities pressures upon the existing landscape.

Through the literature research and the own experience as a citizen of Concepción, it was possible to generate a deeper understanding of the territory not only as an inhabitant but as a landscape designer, comprehending the landscape layers that underlies the city.

The living experience and the literature review in addition to the analysis of the metropolitan area lead to a perception shift about natural disasters, where the main conclusion was that in an environment where natural hazards occur periodically and with major effects for human settlements, the continuous change and uncertainty is now our new normality.

But how can we deal with this new normality if this situation constantly threats the urban life? From this new perception of Concepción reality, an exploration of different theories started in order to understand how to imagine new futures for the city. Therefore, concepts like resilience, adaptation, redundancy, voids and (un) planed spaces were studied as a theory base to go further in the design.

Thus, the research as system of inquiry, was based in a literature study on theoretical investigations of landscape architecture and urban planning with the goal of a deep understanding of the opportunities and challenges of natural disasters, uncertainty, resilience and adaptability in order to apply those principles in a practical design for the challenges and opportunities of the city of Concepción.

The intention of this literature review lies in comprehending how different theories come together to understand the uncertainty condition of the territory and what they suggest towards creating a more resilient and adaptive city. In that way the research framework offers conceptual tools to understand the challenges and identify potentials to address the objectives defined.

This first step created a comprehension about the need of develop a strategic urban and landscape plan to reverse the dissociation between landscape and city with an adaptive and resilient approach in order to enable new human-nature interactions.

Therefore, the research influenced directly the design, which has been shaped through the studied theories in combination to the genius loci of the place, generating a continuous dialogue between the research framework, the specificity of the territory of Concepción and the design process.

Relation between graduation topic, studio topic and master track

The presented project is part of the Flowscapes graduation studio and the Water Circular Stories lab. Both studios are focused in the exploration of special, societal and environmental issues by design research and research by design approaches.

In relation to these topics, the project works mainly with the power of the flow of water in the territory of Concepcion, where the metropolitan water system was analysed in order to understand the different elements of it and its potentials as resilient elements in the whole structure.

Therefore, the research explores how wetlands, marshlands, rivers and water bodies in combination with green elements such as forest

and hills, can create a green and blue infrastructure that use and connect different scales, developing a resilient backbone as a strategic plan and meaningful design for the city, rethinking the functions and land uses of the territory.

This green and blue infrastructure provides a series of principles and methods to adapt the human settlement for extreme scenarios and at the same time it gives a livability to the city, reformulating the urban fabric as a provider of nature.

Thus, the strategy not only works during times of risk and hazards, but also in stables faces of the territory giving to the inhabitants larger green spaces, landscape connectivity and protection of the ecological value of the existing landscape.

That is why, along with the aims of the graduation studio, the proposal looks to discuss infrastructure as landscape and landscape as infrastructure from large to small interventions that interrelate as part of the current development of the territory of Concepción.

Scope and relevance

Choice of research method and scientific relevance

The research method it is based on research by design through the exploration of different (im) possible utopias for the territory of tomorrow. These simulations of future visibility create an interpretative research, giving an intentional meaning to the possible scenarios.

In combination with the theoretical background, research by design allows to explore possibilities on design and through design as a systematic exploration that reflect on itself in order to create and recreate new scenarios and design opportunities.

Furthermore, the landscape resilience backbone is the research tactic and method lens, as a way to understand the landscape as process and in context.

This understanding allows to apply a meaningful design (resilient and adaptive) in order to develop a strategic plan based in the proposed adaptive void framework in combination with a green and blue infrastructure. The use of these methods aim to create a resilient backbone for the city with a series of principles and practices to conclude with the design of a possible future scenario through

scales (from the metropolitan masterplan to human experience)

The relevance of this kind of methodology in a territory like Concepción, lies in the understanding of the landscape and nature that underlies a city that has been built for cars and no for people. A city with a lack of green infrastructure and leisure places, but at the same time surrounded by abundant nature and biodiversity.

Therefore, as scientific relevance, the research contributes to put on focus the importance of landscape in our cities and daily life, and how it can be not only for pleasure but also as resilient protection against constant natural disasters that hit the country. Thus, the proposal is innovative for a city like Concepcion in the sense that there are no projects or major investigations about landscape as provider of a resilient structure for the city instead of understanding he flow of nature as a threat for human life.

Social and environmental relevance

As it was mentioned before, the proposed green and blue infrastructure generates a resilient and adaptive backbone to the city, providing a safer and healthier structure for the metropolitan system. Thus, the design contributes to the developing of human life in the vulnerable coastal system of Concepción, generating a safe network in case of extreme scenarios that works in a resilient way in order to adapt itself and the city to the new conditions.

In addition to the resilient aspect, the proposal also generates a complete infrastructure that connect the urban fabric with the landscape that underlies the city, creating a leisure and recreational network for the inhabitants of Concepción. In that way, the new infrastructure gives conditions of liveability when the territory faces stability periods.

In relation to the environment, the proposed green and blue network clearly provides space for nature within the urban fabric, enhancing biodiversity and giving value to the natural system (mainly wetlands & water bodies) as the base infrastructure for the future city.

Also it reformulates the city as a provider of nature with larger green spaces, landscape connectivity and protection of the ecological dimension of the existing nature.

Ethical issues and dilemmas

The main ethical dilemma of a proposal that aims to reshape the perception of the territory is the

dialogue with the different actors that are involved in such a project.

On one side, inhabitants want more and better green spaces for leisure and recreation, but they also want to live in the "American model" of periphery, "closer" to the surrounding nature. Therefore, they support the process of extensive urbanization, that is currently destroying the natural landscape.

On the other hand, citizens don't trust nature as they have seen it destroying their houses and lives through natural disasters like earthquakes and flooding. Therefore, there is a resistance to understand the landscape as resilient backbone and to use it as a way of protection in extreme scenarios. However, they are willing to live upon former wetlands and areas that are more exposed to natural hazards.

Another difficult aspect to deal with, are investors and real state companies that see the landscape as provider of business and as more ground to build and generate profit of it. Furthermore, for these kind of entrepreneurs, natural disasters are beneficial in the sense that once the city is destroyed they have the possibility of built it up again form cero, taking benefit of the affected population. Although this is a known issue and people are against it, these business are extremely powerful in a capitalist society like Chile, and it is really difficult to develop a project like the one proposed, because it goes directly in contradiction to the interest of the powers that rules the city.

Part II • Chapter 8: *Reflecting*

Future recommendations

Finally, as future recommendations, it is important to mention, that one of the most relevant aspect of the presented research is the possibility of extrapolate the principles and methods used in the territory of Concepción, in order to apply them in other locations with similar conditions and issues.

Furthermore, in order to improve the proposal, and important recommendation for further developments of the design, would be to include a participatory approach during the design processes in order to deal with the mentioned ethical dilemmas.

In that way it will be possible to incorporate the social opinion into the design and create awareness and knowledge for people and from people. Therefore, there will be a better understanding of the territory issues and a better acceptance from the inhabitants to reshape the perception of our cities and the landscape that surround and underlies them.

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References

Aliste, E., & Musset, A. (2014). Pensar los territorios del desarrollo: Sustentabilidad y acción pública en nombre de una ciudad imaginaria. Concepción (Chile), 1950-2010. *EURE (Santiago)*, 40(120), 91-110. doi:10.4067/s0250-71612014000200005

Arévalo, A. V., & Azócar, G. (2016). *Impacto de la urbanización en el humedal Los Batros comuna de San Pedro de la Paz, Región del BioBío*. Concepción, Chile: Universidad de Concepción.

Berger, A. (2009). *Systemic design can change the world*. Amsterdam: SUN.

Espinosa, P., Horacio, J., Ollero, A., Meulder, B. D., Jaque, E., & Muñoz, M. D. (2018). When Urban Design Meets Fluvial Geomorphology: A Case Study in Chile. *Urban Geomorphology*, 149-174. doi:10.1016/b978-0-12-811951-8.00009-6

Guerra, P. S., & Aravena, H. R. (2009). Efectos del crecimiento urbano del Área Metropolitana de Concepción sobre los humedales de Rocuant-Andalién, Los Batros y Lenga. *Revista De Geografía Norte Grande*,(43). doi:10.4067/s0718-34022009000200005

Laboy, M., & Fannon, D. (2016). Resilience Theory and Praxis: A Critical Framework for Architecture. *Enquiry: A Journal for Architectural Research*, 13(1). doi:10.17831/enq:arcc.v13i2.405

Manaugh, G. (2013). *Landscape futures instruments, devices and architectural inventions.* Barcelona: Actar.

McHarg, I. L. (1995). *Design with nature.* New York: John Wiley.

Meulder, B. D., & Shannon, K. (2015). *Water urbanisms - east*. Zurich: Park Books.

Meyer, H., Bobbink, I., & Nijhuis, S. (2010). *Delta urbanism: The Netherlands.* Chicago: Planners press.

Meyer, H., & Nijhuis, S. (2014). *Urbanized deltas in transition*. Amsterdam: Techne Press.

Moor, M., & Rowland, J. (2008). *Urban design futures.* London: Routledge.

Mostafavi, M., & Najle, C. (2003). *Landscape urbanism: A manual for the machinic landscape*. London: Architectural Association.

Palmboom, F. (2010). *Drawing the ground, landscape urbanism today: The work of Palmbout Urban Landscapes.* Basel: Birkhäuser.

Pendall, R., Foster, K. A., & Cowell, M. (2009). Resilience and regions: Building understanding of the metaphor. *Cambridge Journal of Regions, Economy and Society*, 3(1), 71-84. doi:10.1093/cjres/rsp028

Roggema, R. (2013). Swarm Planning for Climate Change: An Alternative Pathway for Resilience. *Swarm Planning Springer Theses*,221-251. doi:10.1007/978-94-007-7152-9_9

Roggema, R. (2013). Developing a Planning Theory for Wicked Problems: Swarm Planning. *Swarm Planning Springer Theses*, 67-89. doi:10.1007/978-94-007-7152-9_3

Roggema, R. (2018). Design with voids: How inverted urbanism can increase urban resilience. *Architectural Science Review*, 61(5), 349-357. doi:10.1080/00038628.2018.1502153

Serrao-Neumann, S., & Choy, D. L. (2018). Uncertainty and Future Planning: The Use of Scenario Planning for Climate Change Adaptation Planning and Decision. *Springer Climate Communicating Climate Change Information for Decision-Making*, 79-90. doi:10.1007/978-3-319-74669-2_6

Final act of the International Conference on the Conservation of Wetlands and Waterfowl, Ramsar, Iran, 3 February 1971, and Convention on Wetlands of International Importance especially as Waterfowl Habitat, Paris, 12 July 1972. (1973). London.

Rethinking the Territory

Concepción • Chile

Resilient & strategic plan for a vulnerable urban coastal system