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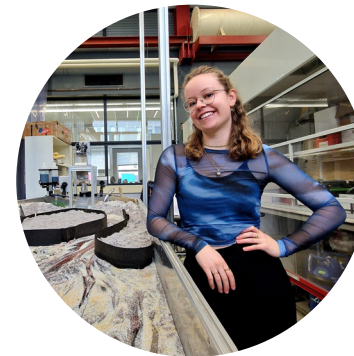
祐天和尚

Rooted Resilience

Redefining coastal resilience in Tokyo Bay, Japan
using a landscape-based approach

Linde Karnebeek
2024

This report is written as graduation project from the Master Landscape Architecture at the University of Technology in Delft. The studio Resilient Coastal Landscapes explores landscape-based design approaches. Design is employed as a research strategy for exploring socio-ecological, cultural and natural principles. Coastal landscapes play a significant role in the world's ecosystems and economy. Especially in times of climate change, coastal landscapes face extreme vulnerability and multiple threats. To ensure a sustainable future, spatial strategies and design solutions are necessary to strengthen natural resilience and restore a dynamic equilibrium. This project is focussed on Tokyo Bay, Japan, where due to rapid urbanisation the logic of the landscape is forgotten. This project explores the potentials of a landscape-based design approach for a resilient landscape.



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photographs are made by the author*

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abstract

Tokyo has a long history dealing with water in the urban landscape. As early as the 6th century, canals have been dug for transport and drainage. Japanese people lived in a harmonious balance with the coastal landscape. This principle is called satoumi, ‘sato’ means people living and ‘umi’ means coastal landscape and describes a productive relationship where humans and nature benefit from the landscape. Due to heavy urbanisation, this principle has been forgotten, and Tokyo has implemented engineering solutions for their flooding problems, such as placing tetrapods in front of the coast, and reclaiming land for industry. By blocking natural processes, the risk of flooding only increased, especially in times of climate change. By studying precedence, such as case studies, this project aims to explore a design solution, using a landscape-based approach. Principles will be derived from literature research, and implemented into context by research through design, an iterative process. One strategy that emerges from this approach is the stimulation of sedimentation and erosion as a means of coastal protection. By allowing sediment to accumulate in certain areas and erode in others, we can create softer edges along the coastline that not only provide natural habitat for flora and fauna but also act as a buffer against wave energy. These places can provide opportunities for human activities such as seaweed farming, revitalising the principle of satoumi into the landscape. In the riverine landscape, softer edges mean a diversity in flow and a gradient for ecology to thrive. Humans and nature can share the landscape, there is no need for a hard border if both are treated with respect. In the urban landscape, cultural quality is increased by respecting the border of the land reclamation, visible in the urban fabric. This will be emphasized by Japanese garden elements, respecting the traditional values of Japan. It’s essential to recognize that the landscape is not something to be dominated and controlled by humans but rather a complex system that

we can learn from and collaborate with. By embracing the principles of landscape-based design, which prioritize multifunctionality and the integration of human and natural processes, we can create landscapes that are not only resilient to environmental challenges but also rich in cultural and ecological significance. This project can be an example on working with climate adaptation, cultural qualities, and ecological importance. Even so, I hope this project can be an inspiration to future generations, on how landscape can provide us the tools for a sustainable future. When enough projects take this approach, there will be lots of different outcomes, each representing a different part on the spectrum of landscape architecture. It is unreasonable to think that this project on its own will make much of a difference, but I like to think that it can spark a new approach towards climate resilience.

Keywords

Japan
Satoumi
Landscape-based approach
Building with nature
Natural processes
Resilience

Highway over Sumida River, Tokyo, Japan



	Abstract	
	01	
12	Introduction	
14	fascination 1.1	
17	location 1.2	
22	blocked system 1.3	
24	research objective 1.4	
26	relevance 1.5	
27	reading itinerary 1.6	

	02	
30	Theoretical framework	
32	landscape-based approach 2.1	
34	building with nature 2.1.1	
35	design and engineering 2.1.2	
36	methodology 2.2	

	03	
40	Satoumi	
42	past 3.1	
44	landscape history 3.1.1	
48	cultural history 3.1.2	
52	satoumi 3.1.3	
56	present 3.2	
58	coastal protection 3.2.1	
60	river management 3.2.2	
62	urban drainage 3.2.3	
64	conclusion 3.3	

04	Strategy and principles	68
4.1	toolbox	
4.1.1	coastal protection	70
4.1.2	river management	72
4.1.3	urban drainage	74
4.2	sedimentation and erosion processes	76
4.3	conclusion	80

05	Design exploration	84
5.1	future	86
5.1.1	coastal protection	88
5.1.2	river management	96
5.1.3	urban drainage	102
5.3	conclusion	107

06	Synthesis	110
6.1	discussion	112
6.2	conclusion	116

Bibliography



01

Introduction

Fascination is a motivation to undertake a research. A foreign **culture** can spark an interest.

A fascination, or inspiration, is what drives the researcher to undertake the research project. The problem statement will be discovered, after which the desired end goal is described. What is the aim of the research and how will this be achieved? This chapter will provide a guide to navigate through this document.





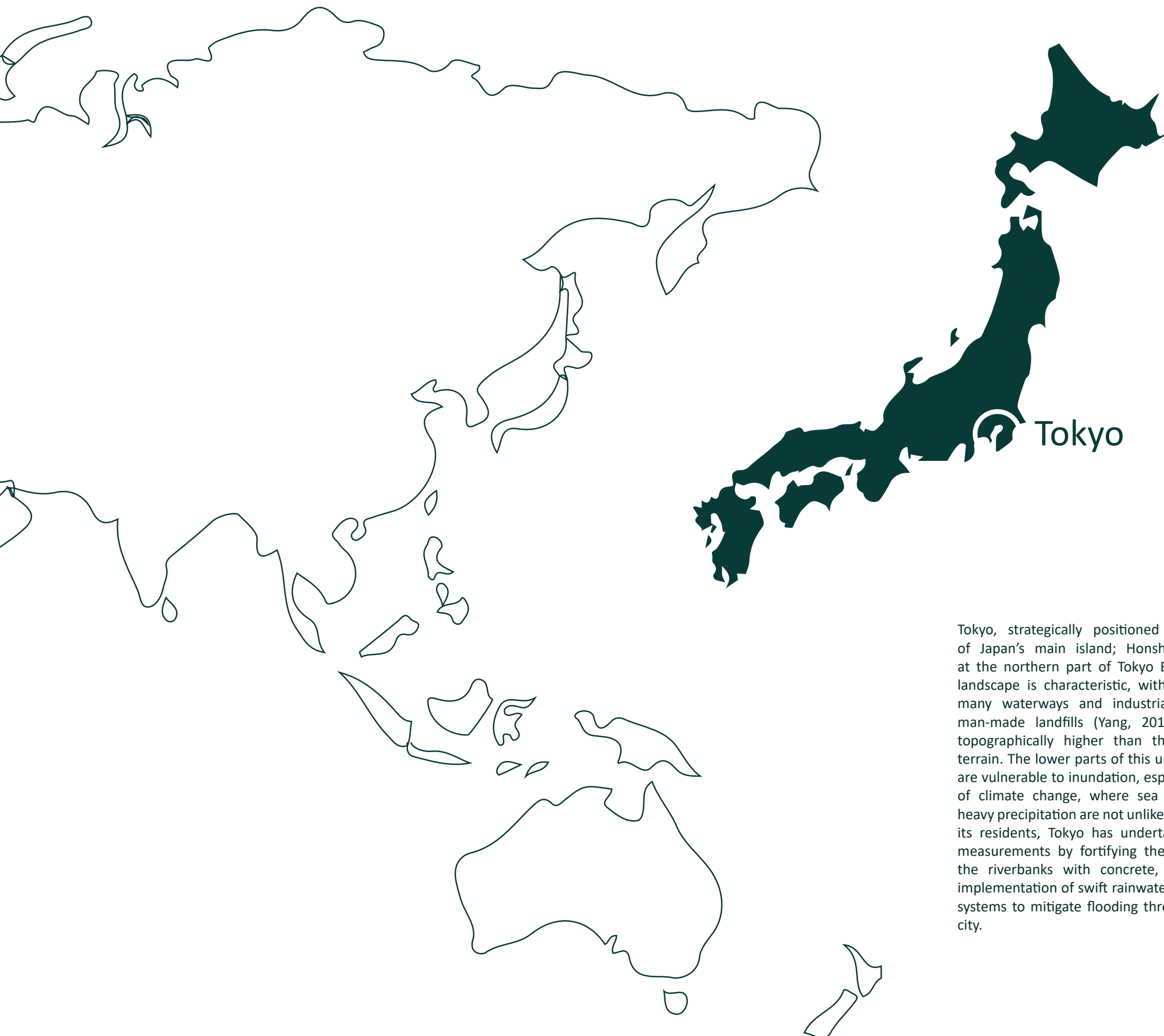
1.1 fascination

北斎漫画

Ever since I first saw the traditional Japanese drawings that first were made in the 6th century, I am fascinated by their culture. Due to Japan being an island, their development is something separate from the mainland. This allowed their culture to fully develop without outside influences. Hokusai Manga, known from drawing *the great wave of Kanagawa*, or *the 36 views on mount Fuji*, has made a lot of these traditional drawing in his lifetime. Hokusai Manga draws human impact on landscape not as negative, but rather as a harmonious relationship which is embedded in the Japanese culture. Hokusai Manga knew how to draw natural phenomena as dynamic, like the landscape. People are drawn doing their everyday activities. Trees are drawn growing against a steep hill, housing was drawn at the foot of a mountain, the viewer experiences the drawings as if he himself was a spectator.

The first drawings date back to 1814, but most of the drawings were published post mortum (HOKUSAI'S MANGA | Princeton University Library, 2014)





Tokyo

Tokyo, strategically positioned at the heart of Japan's main island; Honshu, finds itself at the northern part of Tokyo Bay. The urban landscape is characteristic, with its mozaic of many waterways and industrial waterfronts; man-made landfills (Yang, 2019), which are topographically higher than the surrounding terrain. The lower parts of this urban landscape are vulnerable to inundation, especially in times of climate change, where sea level rise and heavy precipitation are not unlikely. To safeguard its residents, Tokyo has undertaken extensive measurements by fortifying the coastline and the riverbanks with concrete, alongside the implementation of swift rainwater management systems to mitigate flooding threats across the city.

1.2 location

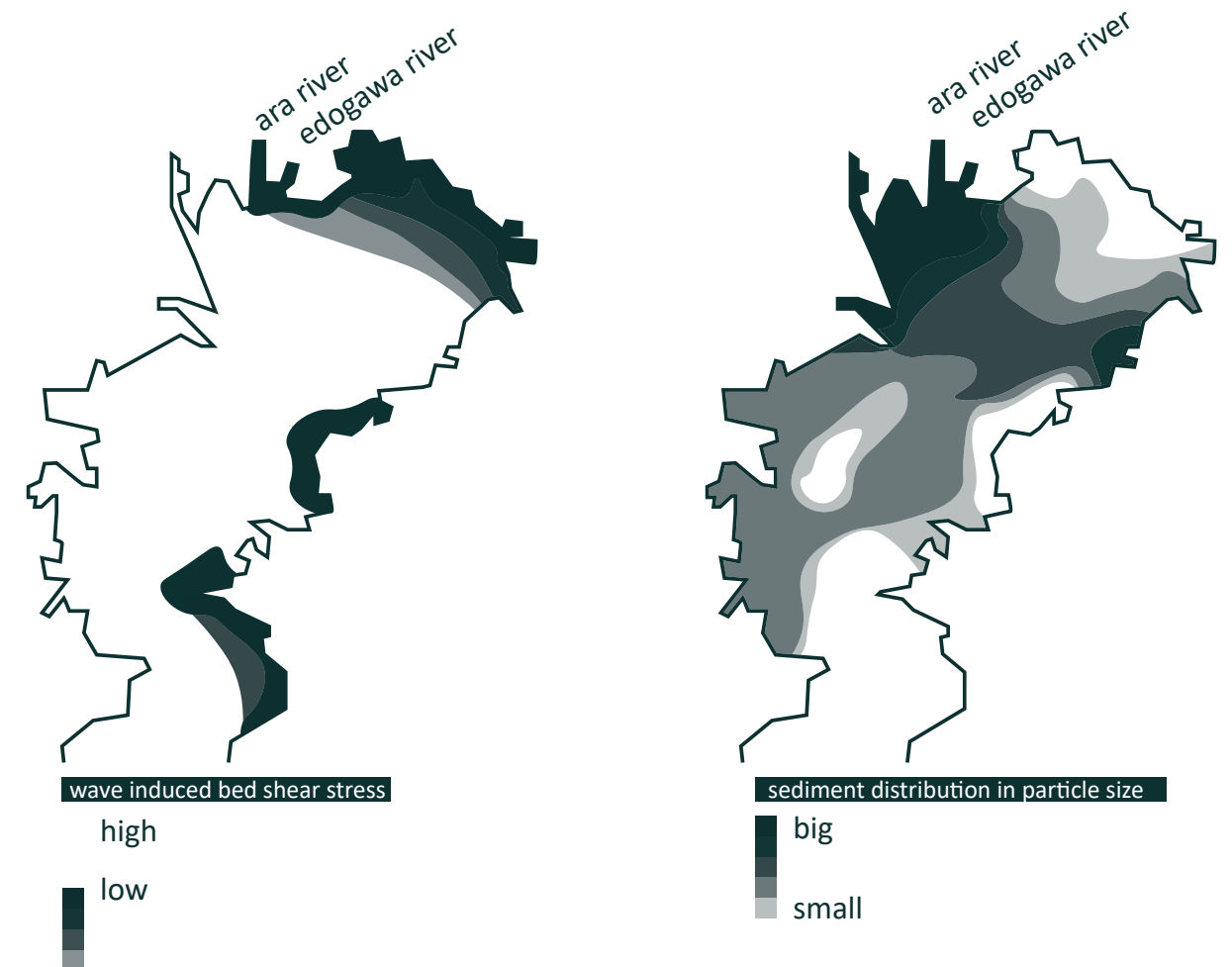




Arakawa and Edogawa river watershed
The processes in the delta are subject to changes in the whole watershed
(Lehner, B., Grill G. (2013))

Tokyo is located where many rivers meet the sea, such as the Arakawa and Edogawa River. All rivers can be divided into an upper, middle, and lower basin, the latter being the area where Tokyo is located. The middle and upper basins contribute to the volume of water flow in the lower basin. The upper basin, often characterized by steeper gradients and higher flow velocities, is a primary source of sediment through erosion. This sediment is transported downstream and deposited in the middle and lower basins. The quantity and type of sediment

carried from the upper to lower basins shape river morphology, floodplain development, and delta formation. Sediment deposition in the lower basin can alter the riverbed. Excessive sedimentation can lead to shallowing of the river, while sediment scarcity can cause erosion and habitat degradation (Lehner, 2013). This project focusses on a small part of the whole basin of the rivers, but it cannot be looked at independently. The whole watershed must be considered in stating conclusions about the changes in natural processes.



Sediment accumulation

Effects of sedimentation and erosion in Tokyo Bay
(Rasmeemasuang, T., & Sasaki, J. (2008))

Tokyo Bay is subject to many natural processes, such as sedimentation and erosion. Mostly the northern part, near the Ara and Edogawa River is a highly dynamic landscape, both in sedimentation and erosion. The Ara River is an artificial river, suggesting that the original dynamics of the landscape were altered enormously as a result. This will be the study area, due to the high dynamics and large changes in the landscape. The dynamics in sediment distribution can be explained reasonably by the fact that the bigger particles are transported closer to the river mouth, and the smaller particles are distributed further seawards (Rasmeemasuang & Sasaki, 2008). The current from the river will be the strongest, transporting particles seawards, until the force of the wave matches that of the river, creating a balance, changing the direction of

the sedimentation distribution (Amunugama & Sasaki, 2018). This results in high sedimentation, mainly consisting of bigger particles near the river mouth.

On the other hand, as a result of wave bed shear stress, erosion rates are also high. The concrete causes the waves to be reflected, resulting in scouring, erosion close to the coastline. The impact of the waves higher in shallow water, having relatively more influence than in deeper waters (Rasmeemasuang & Sasaki, 2008). Due to the river mouths being slightly deeper than the surrounding coastline, the net sedimentation rate is positive, meaning a total accumulation of sediment near the river mouth.



View on Chitose, Tokyo, Japan

1.3 blocked system

The flood defenses can be divided into three categories; coastal protection, river management and urban drainage. The three categories fully cover the threats from the sea, the rivers and the sky. The system cannot be looked at separately, for it would not be a full description of the system. Furthermore, a full description provides a structural and systematic research, resulting in a systematic solution.

Coastal protection

At the coast, either tetrapods or concrete walls are common. Tetrapods have a high wave breaking capacity due to their peculiar shape (Baird, 2016). They appear in all shapes and sizes, the biggest being at the highest erosion rates. The tetrapods naturally interlock with each other creating high stability. Because of their wave breaking capacity, tetrapods are more likely to be placed where the sea current has the most impact on the coast. The current in Tokyo Bay enters from the south, but takes a curve towards the west, making the north-west coastlines the most vulnerable. Tetrapods were originally used to prevent erosion, but research suggests that it causes greater erosion than if the coast had been left alone (Saengsupavanich et al., 2022). Despite the debatable usefulness, Japan has altered their coastline enormously. Of the 35.000 km coastline, approximately 50% is altered, meaning artificial or semi-natural coastlines (Hesse, 2007).

Not only the government, but also the people of Japan started to love tetrapods. A 21-year-old student claimed to love them because of their contrast with nature: *"I think the attraction of tetrapods lies in their contrast with nature. The material of a tetrapod is concrete, and its shape is formal, which can't be found in nature. The tetrapod is a symbol of artificiality. Setting hundreds of tetrapods on a big scale that matches that of nature is simply art,"*
- Kobori Motohiro (2007)

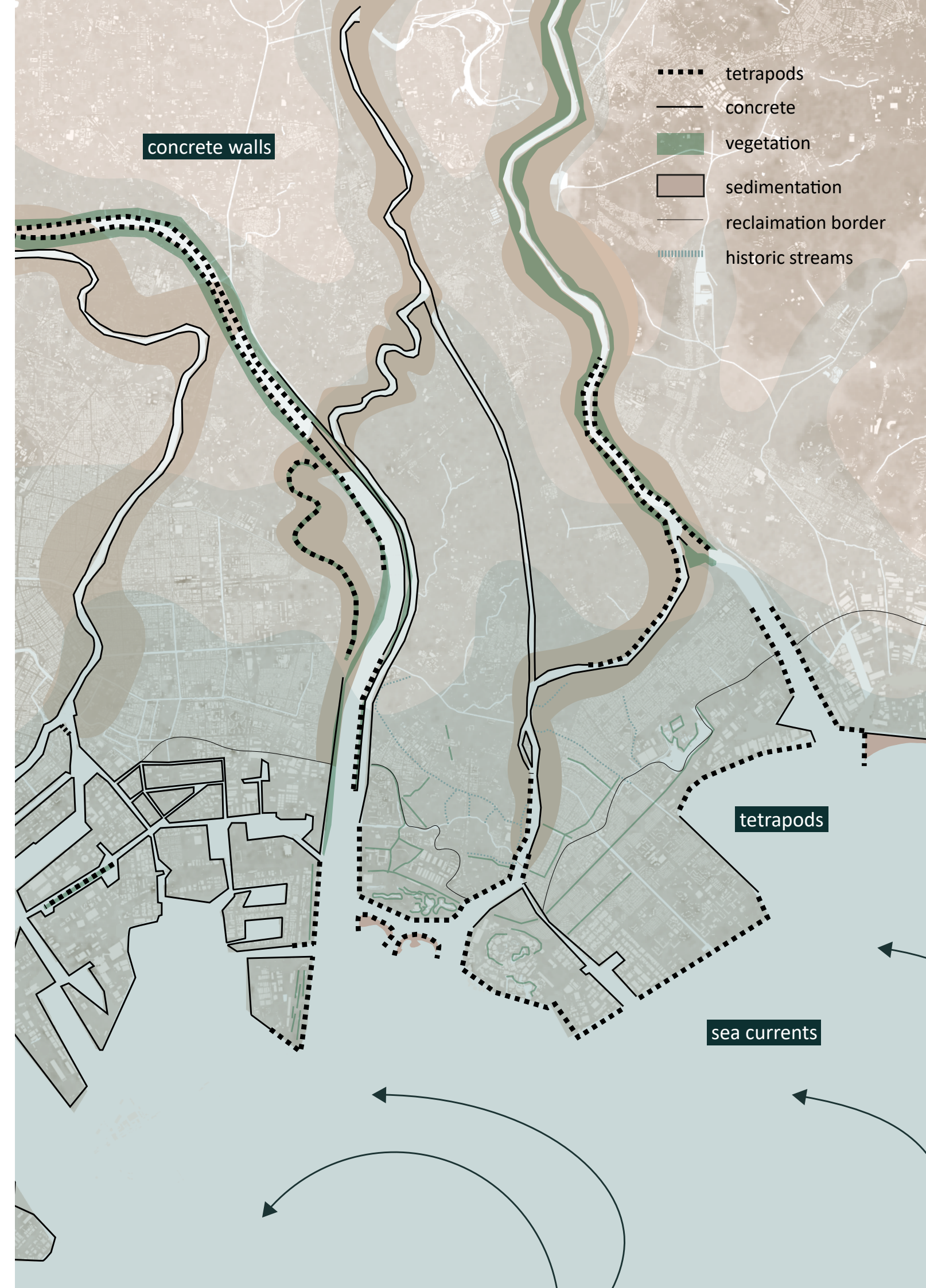
Although there are people who love them. Tetrapods are also known to create a sense of fear, for why would they be placed in a stable environment?

River management

River management in Japan is mostly defined as the maintenance of dikes, sluices, and levees. The goal is to fight floods, and drain the land behind the levee (Atsumi, 2009). This suggests a strict border between the river and the land, in management as well as spatially. The riverbanks are mostly used by sports, the most popular sport being baseball in Japan. These green areas look sustainable, and nature based, but due to the sports fields, and combination with concrete, biodiversity rates are expectedly low. The management suggests that the faster to get rid of the water, the better. This mindset blocks the natural course of the river, not allowing it to develop as a healthy system (Atsumi, 2009). The combination of concrete with a green area is most common.

Urban drainage

In the city, standing rainwater is common due to non-efficient drainage in times of excessive precipitation. Tokyo has lost 22% of its green spaces between 1965 and 2003. Green spaces are mostly essential in slowing down runoff, lowering the burden on the urban drainage system (Urban Stormwater Management and the Role of Civil Society | Research | the Tokyo Foundation for Policy Research, 2023). While the shoreline was expanded for industrialisation, concrete became extremely popular in both the river and rainfall management due to its effectiveness. In the urban fabric, the historic identity is slowly being forgotten, historic streams of the delta are being filled in. The border of the land reclamation, however, is visible in scale differences in the urban pattern.



1.4 research aim

What is the potential of a Landscape-based design approach for flood defenses in Tokyo Bay, Japan, that integrates protective, ecological, and cultural values through building with nature?

RQ1 // Analysis; *to understand the context*

How does the flood protection system work and what are the related challenges and potentials from a landscape perspective?

RQ2 // Strategy; *to explore the possibilities*

Which landscape-based design principles and strategies can be applied for flood defenses?

RQ3 // Design; *to implement into context*

Using research through design, how can these principles be implemented in context in Tokyo Bay, Japan?

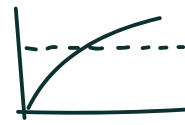
RQ4 // Reflection; *to relate back to the objective*

How does the new landscape relate to protective, ecological, and cultural qualities?

Choosing research questions is a critical step in any research project, necessitating a thoughtful approach to analysis, strategy, design, and reflection. Analysis involves understanding the current problem field, as well as identifying challenges and potentials, for further exploration. Strategy comes into play by considering the overarching goals of the research, aligning questions with the desired outcomes, and determining the principles useful for implementation in the design phase. This provides a systematic approach which can be easily reflected on in the last phase of the project. Design not only encompasses possible solutions to the problem field, but also accounts for spatial relations, and how they affect stakeholders in the given location. These questions are deliberately categorised to enlarge the relevance in the academic world. Other research can understand easily and expand on this project because of the reflection. This question ensures not only the relevance in the academic world, but also relates the results back to the objective. These four questions give the project a direction to work in, them being a reminder of the research aim.

1.5 relevance

Climate change is not something that we don't know anything about. Addressing climate change in the realm of landscape architecture presents a multifaceted challenge that extends beyond mere acknowledgement of its existence. In addition to aesthetic appeal, landscape-based designs must prioritize resilience, sustainability, and functionality in the face of climate-related uncertainties. It requires a paradigm shift in design philosophy, moving from reactive approaches focused on mitigating consequences to proactive strategies that enhance adaptive capacity (Van Bergen, 2022). For so long, solutions towards climate change have been dealing with the consequences, not with the heart of the problem. If we keep ignoring that our solutions so far are not sustainable, it's like lighting a candle to the sun. The shift towards adaptive capacity can be an example on how protective, ecological, and cultural qualities can all be incorporated into one design, one that aligns with the aspirations of the younger generation eager to forge a more environmentally conscious future. Furthermore, the building with nature theory is not the most conventional way of designing, so this project hopes to inspire landscape architects to discover new ways of thinking. Slowly, the shift towards adaptive capacity becomes recognised, and together we revolutionise the world of landscape architecture.



Threshold capacity
learn from the past



Coping capacity
short reaction time



Recovery capacity
build for future



Adaptive capacity
future resilience

Principles how a landscape reacts in a extreme situation
(Van Bergen, J., & Nijhuis, S. (2020))

1.6 reading itinerary

The report consists of 6 chapters in total, where all research questions get answered. Starting with an introduction of the location, motivation of the project, and the problem field. Moving into the analysis of the project, a conclusion is given where the strategy and design begins. The theoretical framework provides understanding about the methodology and why the landscape-based approach strategy is applicable. Looking through this lens, a toolbox is described which spatial factors, which can be implemented by design in the fifth chapter. The project is concluded with a discussion and reflection, the lessons learned and the relation to past and future research.

01 Introduction // The first chapter is a discovery of the location, and the inspiration that sparked the beginning of this project. A general overview is given, without too much detail yet, but enough to give an idea what the project is about. The goal is to interest the reader to continue reading, after a first glance of the content. Diving further into the project, the problem statement is addressed, a specific description of the problem field. The research objective is derived from the problem field and is related to the scope of the academic world. Why is this research relevant?

02 Theoretical framework // With the problem statement clear, which direction to move in from here? From now on, every research that is done is in line with the desired achievement. The strategy provides a 'handle' to hold on to during the research. Continuously, this strategy lies at the backbone of every action. Additionally, the way this strategy is applied in practice is explained and which methods will be used to achieve the objectives.

03 Satoumi // Historic background is given, with focus on the spatiality of the landscape. The changes over time are explained, resulting in an understanding of the logic of the landscape.

From this chapter, it becomes clear why the landscape changed, and why that resulted in the problems we encounter nowadays, both in the cultural and physical world. Furthermore, a first nudge is given towards the potentials and challenges of the landscape.

04 Strategy and principles // With the approach of landscape-based design, this chapter starts of with a toolbox full of principles on how to achieve the main objective. A distinction is made between protective, ecological, and cultural qualities of the landscape, to fully incorporate all the elements that fit into the landscape-based approach. The principles are based on past research, as well as knowledge gained from the site visit.

05 Design exploration // In the next part, the principles will be implemented by design, making a distinction between coastal protection, river management, and urban drainage. The totality of the design will be explained, and why this is necessary. This chapter forms an answer to the main research question, not only providing a solution to the problem, but also being a strategy for similar problems in different contexts.

06 Synthesis // The concluding chapter in the project discusses the relation of this project to the academic world, as well as the master programme of the TU Delft. Giving insight to past and future research, the relevance of this project is explained. The method is also discussed, giving an honest reflection on the framework. The lessons learned are described in the reflection, which serves as a tool to challenge assumptions. Being both personal and professional, the reflection gives the project its synthesis. Naturally, the conclusions are stated as answers to the research questions, ensuring that the research achieved the intended aim.



Kiyosubashi-dori Avenue, Tokyo, Japan



02

Theoretical framework

Landscape-based approach;
using the principles of Building
with Nature for exploration and
implementing these findings
into design

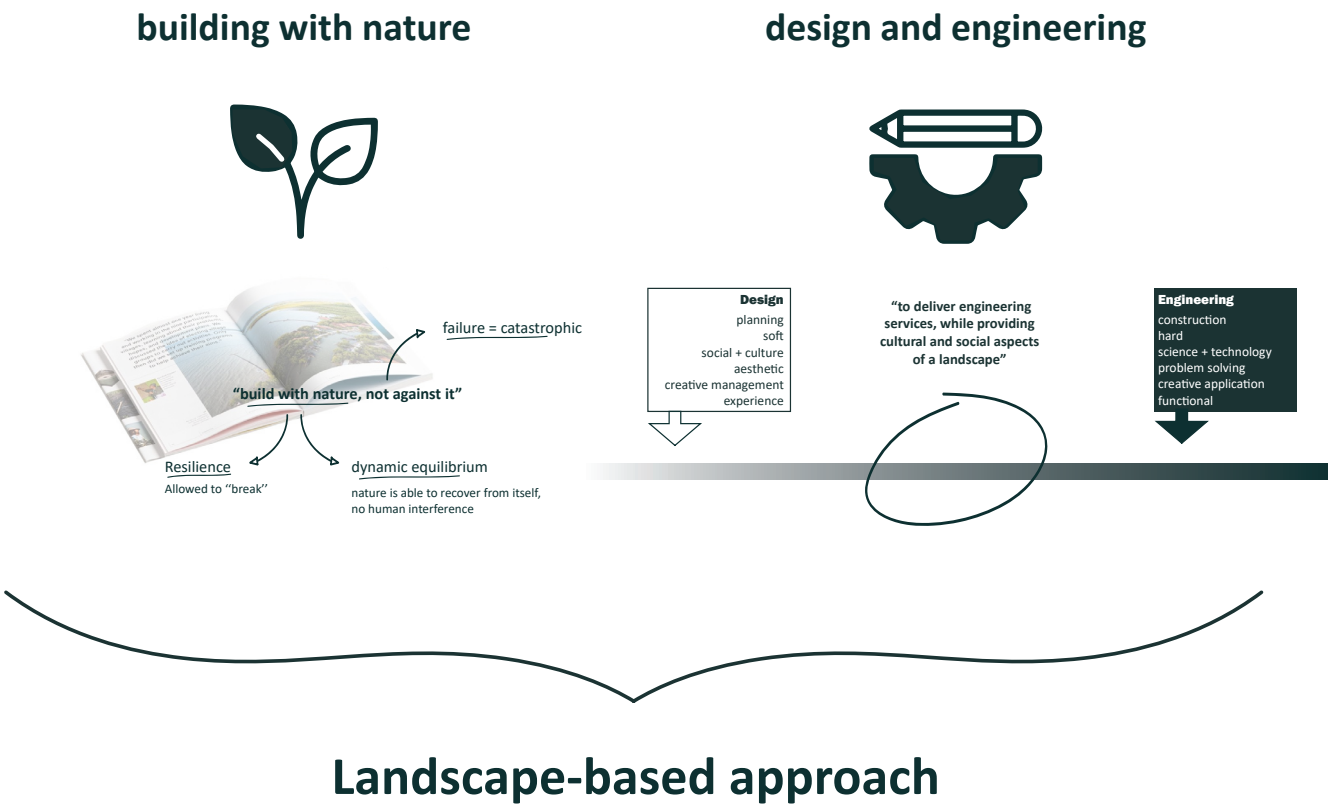
The objective is the aim of a research. What is the researcher trying to achieve? A framework, is part of the methodology. In scientific work, it can provide necessary tools to achieve the research aim. What theories support the claim? What perspective is used to react to the problem statement? A strategy helps define the objective, limiting unnecessary research, creating a straight and clear storyline.



2.1 landscape based approach

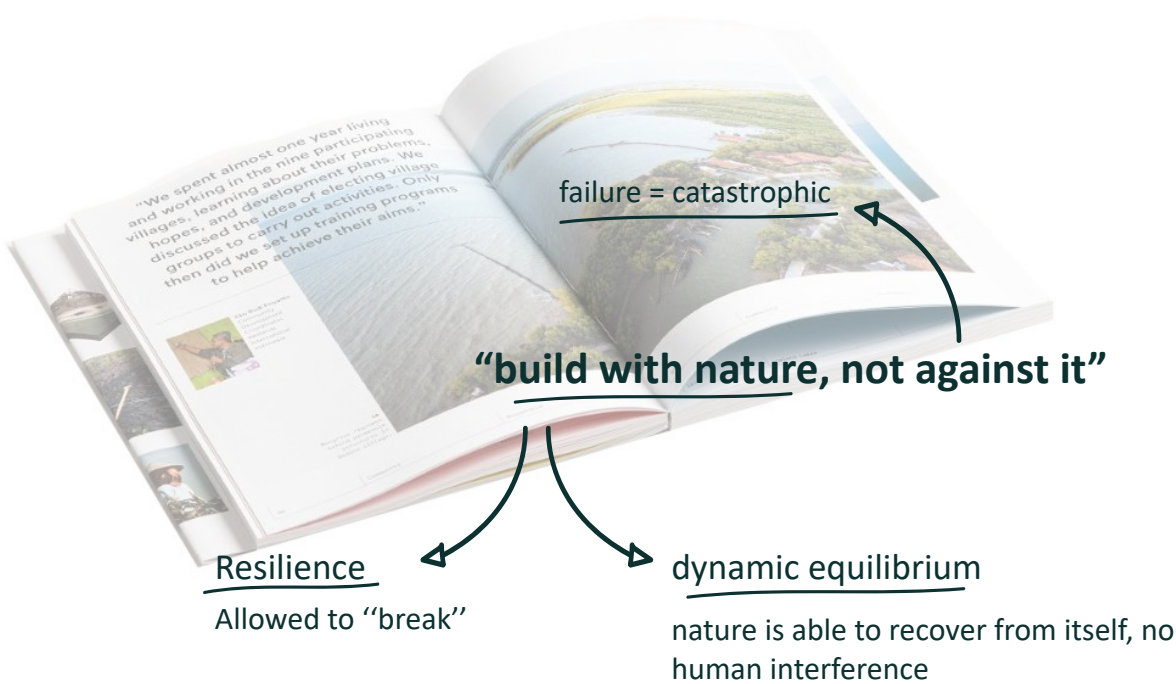
The landscape approach entails the totality of the landscape. The approach is interdisciplinary, taking not only nature into account, but all stakeholders that interact with the system. It can be compared to gardening. When we try to fully control the growth of plants, the garden will not survive unforeseen circumstances and the reproduction system may suffer. But by neglecting the plants, it will end in chaos and decay. Just like gardening, landscape architecture should be focused on finding the perfect balance between controlling and letting, ensuring a resilient landscape (Nijhuis, 2022). As landscape architects we have a responsibility to let this resilience be rooted into our landscapes once again. Human influence has led to negative impacts on nature in recent times, but landscape architecture can mitigate these influences to protect and preserve nature while designing for the benefit of local communities. It cannot be a coincidence that this principle explains a similar view towards landscape as the Japanese do with Satoumi. By comparing these theories, one can conclude that the knowledge necessary to maintain a healthy system has been known for thousands of years. We should not invent something new but look back to our ancestors and rely on our natural relationship with landscape.

In this project specifically that is translated into using design and engineering, and the theory of building with nature. Design and Engineering tells us about the combination of two disciplines, while building with nature tells us about the way we should design with nature.



2.1.1 building with nature

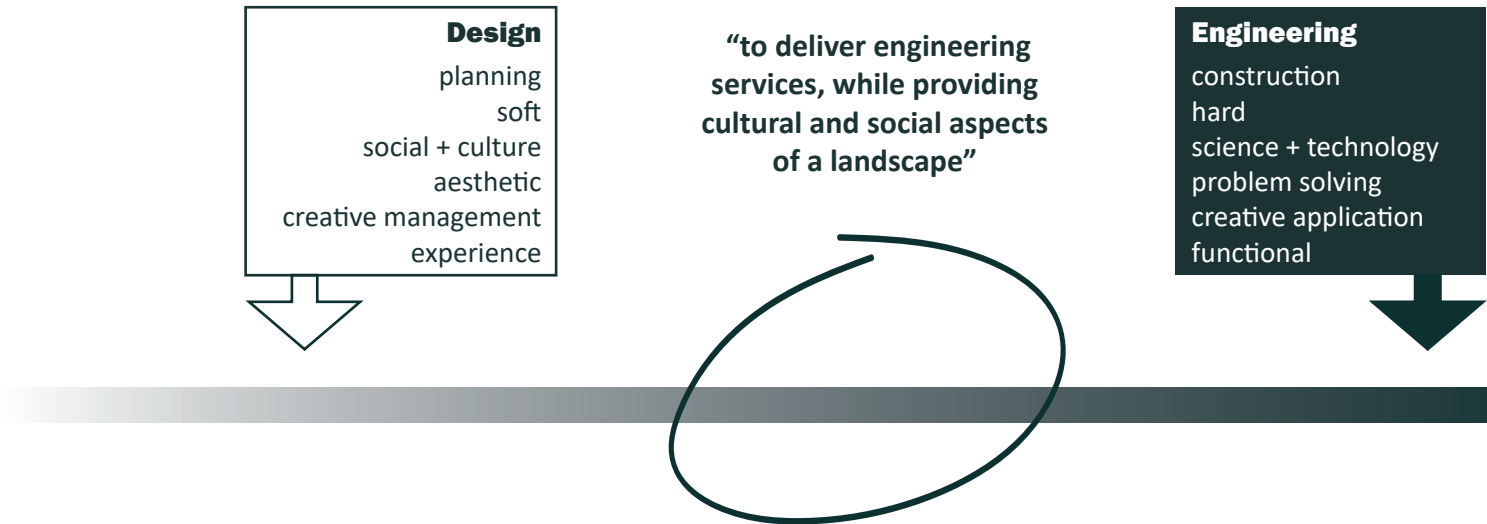
Building with nature is a theory that we have to build with nature, not against it. Building against nature could prove catastrophic, blocking all natural processes. With nature would mean natural resilience, the landscape is allowed to break, because it is able to recover from itself. It is a dynamic equilibrium, where no human maintenance is needed. Van Bergen (2020) describes this as adaptive capacity. The landscape has a certain resiliency, where intervention is not always necessary because it is a buffer for change. By using this theory in the landscape-based approach, interdisciplinary is ensured. The approach entails the totality of the landscape, viewing nature not as option, but as a crucial part in the landscape system.



2.1.2 design and engineering

A suggestion on how to apply this landscape-based approach in practice, might be the use of the spectrum of design and engineering. Design fuels creativity while engineering provides the structural backbone. Successful projects find equilibrium, where innovative design meets the practicalities of construction, ensuring longevity and functionality. Mitsch (1996) was one of the first to mention this mindset, he called it ecological engineering; *“There are a great number of environmental and resource problems that need an ecosystem approach, not just a standard technological solution.”*
- Mitsch 1996

In 2020, the initiative of Ecoshape mentions a paradigm shift from a problem solving approach to a opportunity approach. That way, engineering services can be delivered, while providing cultural and social aspects of a landscape.



2.2 methodology

Different forms of research contribute to a comprehensive research project. In every phase, a different method is relevant. Starting off with literature research, a general image is formed about the problem statement. This is complemented with a site visit, which happened very early in the process of this graduation project. Site visits are invaluable to research because potential challenges and opportunities can be identified that might not be apparent from maps or descriptions alone. Site visits allow direct engagement with the people involved and a better understanding of the situation, not only physical, but also cultural and emotional. By observing behaviour of people in the landscape, a feeling arises about how people use their surroundings, how a design can incorporate cultural quality, additional to being a solution to the problem statement. While literature research continued throughout the whole process, another form of research was used, moving slowly into the design phase.

Case-studies can be a helpful tool in a design process. Firstly, one starts to copy precisely what is found in a case study in their own project. In the process, it will automatically become clear what works and what needs some change. Of course, not every project can be copy-pasted, so more research is needed what can be done instead. The research is not entirely done beforehand. Analysis is a part of the research, naturally, but there is more to it. During designing, other problems, questions or ideas come up, needing background information. It can be seen as something parallel to design, rather than two separate things. This description matches the definition of research-through-design. It can be compared to prototyping which is defined by Stappers (2014) as: ‘will undergo testing and development during implementation.’ The word is traditionally used in material design but is recently adopted for ‘paper design’ which simply means drawing on paper. Due to the constant

testing and changing, the ‘right’ solution will be found. There is not one solution to every problem, but every researcher is a bit biased by the analysis done beforehand. Being a process of trial and error, the right solution that fits into the context of the research will surely be found, at least if all the options are being explored.

Overall, the landscape-based approach is used as a lens to look through. This means that every case-study, scientific paper, or site visit is critically looked at how the information can be helpful. Many studies will be collected to get a complete idea about all stakeholders involved, this being nature and culture. Rather than prioritizing one aspect over another, whether it be nature or culture, the focus is on understanding the totality of the landscape and the relationships between its various components. At every stage of the research process, the central question revolves around how the acquired information contributes to landscape-based design. This entails not only understanding the existing conditions and dynamics of a landscape but also envisioning its future trajectory and identifying opportunities for sustainable management and development. By integrating knowledge from diverse sources and disciplines, the landscape-based approach offers a robust framework for addressing complex environmental and societal challenges while fostering resilience, adaptation, and regeneration within landscapes.



Bamboo in between buildings Tokyo, Japan

里海

03

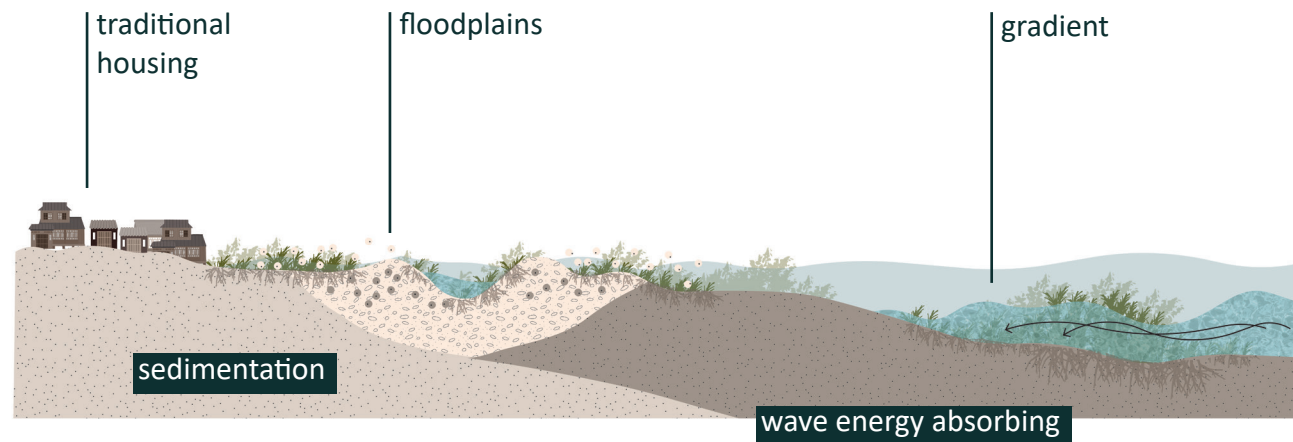
Satoumi

Sato means ‘people living’ and **umi** means ‘sea’. It shows the beneficial relationship of humans with coastal landscape.

The history of the landscape is to be fully understood before defining the strategy and principles to design with. The past and present is compared and a conclusion is drawn, based on the problem statement. Inspired from traditional Japanese culture, the cultural and physical history is closely intertwined.



3.1 past



Satoumi

A balance between natural processes and resiliency, and human maintenance.

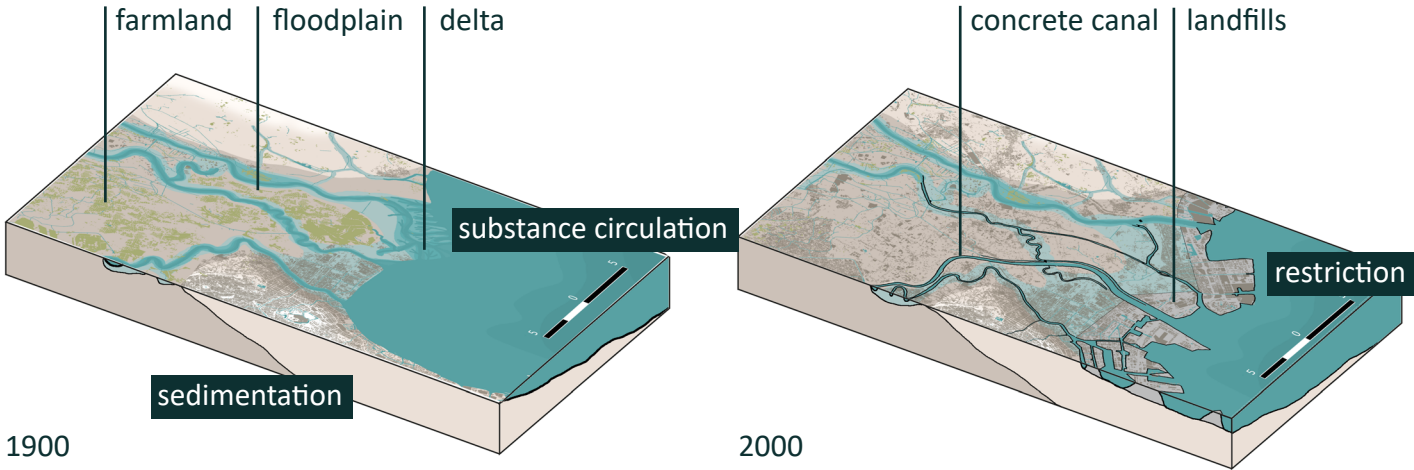
With respect to nature and human impact, the landscape could develop in a natural way, one where the landscape protects itself. There was no human maintenance necessary, except the constant human influence, dependent on seasonal changes. Humans understood the landscape, and lived off of it. The landscape in turn, has enough room for changes in sedimentation, waterlevel, or ecology. Natural sedimentation in the river was possible because there were no restrictions. The coast was protected because of a natural gradient, not distorted by concrete placement.



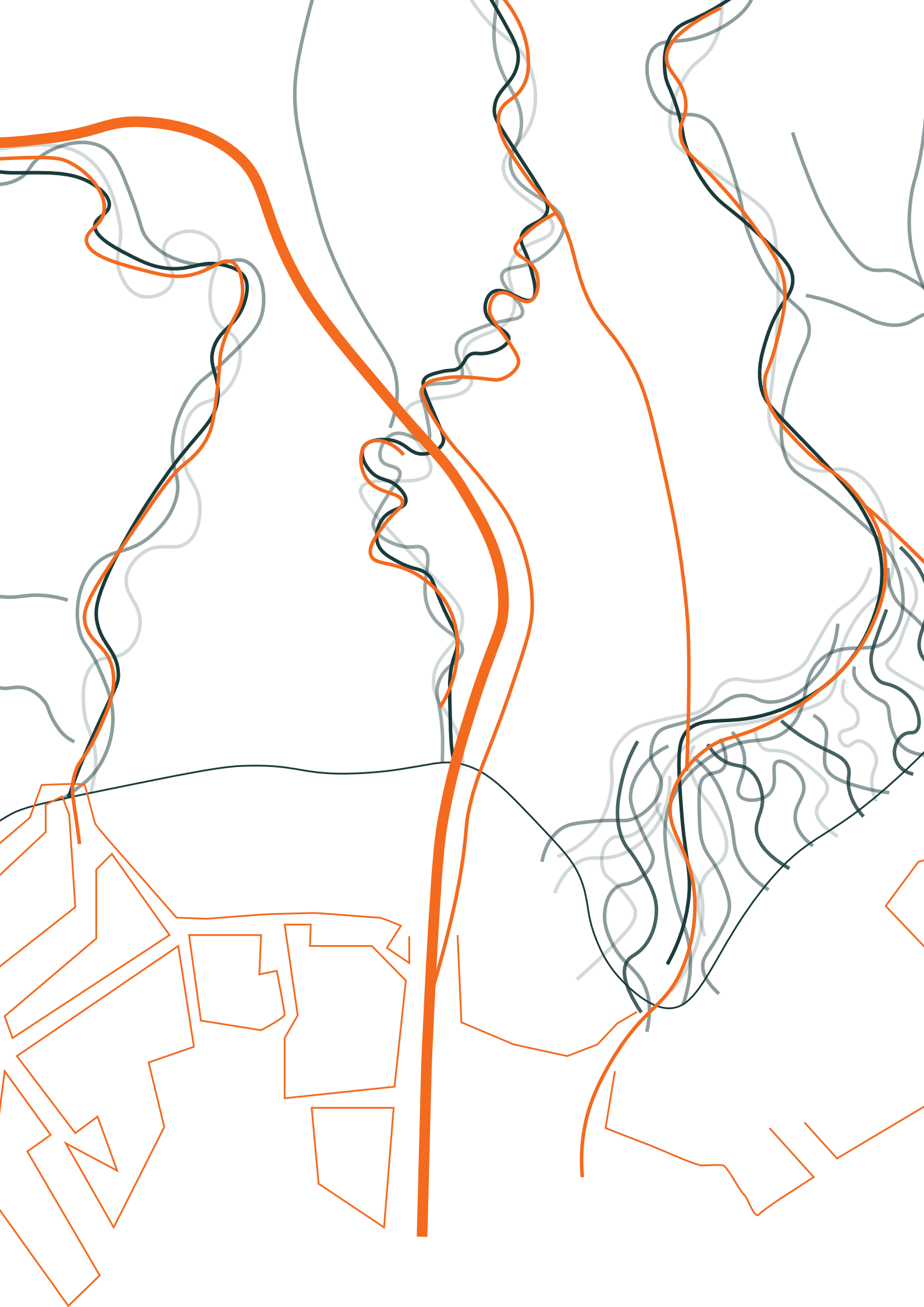
3.1.1 landscape history

The landscape has a totally different quality when comparing 1900 to 2000. Agriculture took place near the rivers, sedimentation flows are not restricted, and the river meets the sea at a delta, the most gradient landscape imaginable. If the current situation was projected on the historic map, the change is immediately visible. The coastline has expanded due to man-made landfills, where mostly industry takes place. Most of the agriculture has disappeared, making place for city expansion. This phenomenon is known as coastal squeeze; *‘the loss of natural habitats or deterioration of their quality arising from anthropogenic structures or actions, preventing the landward transgression of those habitats that would otherwise naturally occur in response to sea level rise in conjunction with other coastal processes. Coastal squeeze affects habitat on the seaward side of existing structures.’*
- Environment Agency, 2021

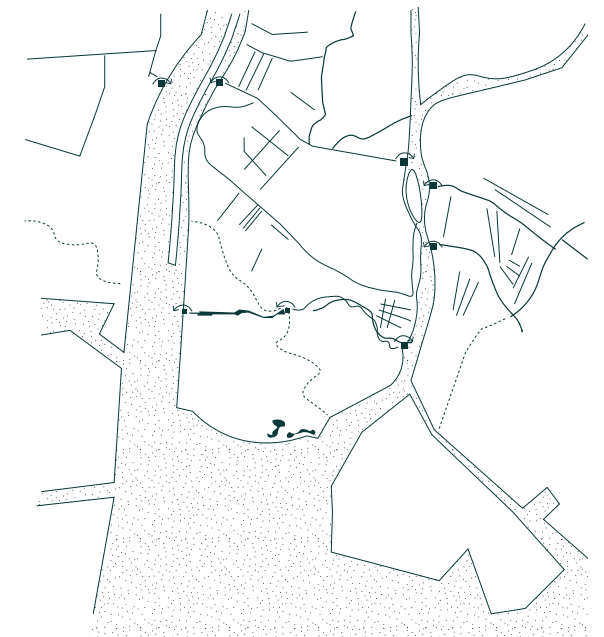
In essence, this means that due to seaward progression, a lot of the original landscape has been lost. Both the ecology and the cultural qualities of the landscape are subject to this change. The substance circulation which can be found in a natural landscape, is both about human and animal behaviour. A concrete wall prevents a habitat for animals, but also won't attract human actions such as farming or recreation. Both actions are necessary for preservation of natural landscapes. The restriction of the landscape leads to restriction of animal behaviour, including us as humans, which is not benefitting the longevity of the landscape.



Time comparison
Historic map from 1900 with projection of current situation shows the enormous difference the landscape underwent in less than a century.
(Kenji Tani, labororium of human geography, Faculty of Education, Saitama University. (n.d.))



1900



2000

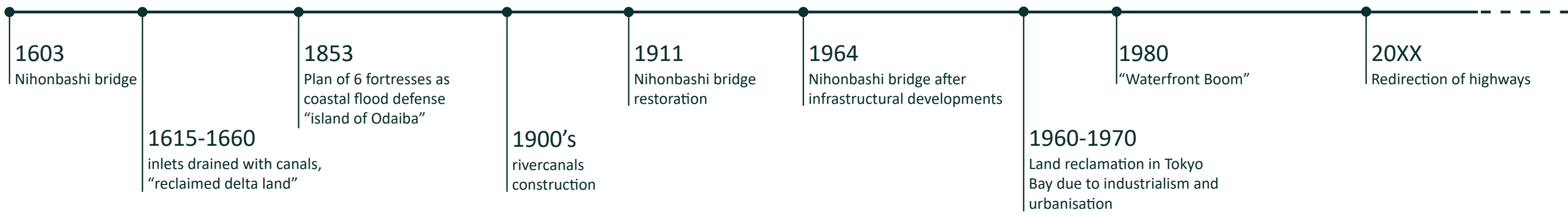
Watersystem

Whereas in 1900 the landscape was a gradient between water and land, in 2000 the distinction is very clear. The water has no room for freedom, every canal is connected to the river with a pump, to get rid of the water as fast as possible. The drainage pattern from the agriculture from 1900 became the urban pattern in 2000.

Lots of new canals are dug to enlarge the discharge capacity (De Graaf & Hooimeijer, 2014). The natural river courses are still visible due to their sedimentation, whereas the canals are restricted, not being able to put sediment on their floodplains. The Ara river, a newly dug canal crosses Naka river, causing an old river arm to appear, altering the course of the water indefinitely. The Ara river was dug to enlarge the discharge of the Sumida river. Also Edogawa river runs a new course, due to a canal that connects the river to the sea at a earlier stage. The newly dug canals are all a results of the seaward progression. Without a new coastline, the river did not have to be extended. Furthermore, the agricultural situation in 1900 made use of the natural landscape properties, whereas in 2000, this is completely forgotten. The pattern of the paddy fields is still visible in the urban fabric, but

the function has been lost. Instead of drainage on land, the landscape has been equipped for fast transportation of the water. Every canal is connected to a pump that lets the water flow into the river. This fixed landscape is so different from the original state, it is like its stuck in time., unable to move and adapt. It is natural for a river to change its course now and then, it is even necessary for maintaining a balance in the system. In conclusion, the water has no room for change anymore, creating a fixed situation that contradicts its natural situation.

3.1.2 cultural history



Tokyo has a history of water management (De Graaf & Hooimeijer, 2014). The earliest canals were made in the 1600's, the canals which we know now were made in the 1900's. The Nihonbashi bridge is of cultural significance, being in a geographical tactical place for trade (Krishnan et al., 2019). After the second world war Japan had a lot of reconstruction to do, which resulted in enormously rapid industrialisation. Highways were built on top of Nihonbashi bridge, and enormous landfills were realised to expand the coastline.

Kenzo Tange was one of Japan's famous architects to suggest such huge plans. Japan realises that in the future to be climate resilient, a different approach is needed, instead of solving everything with more concrete. There are plans to remove the highways on top of the canals and bring nature back in Tokyo Bay.

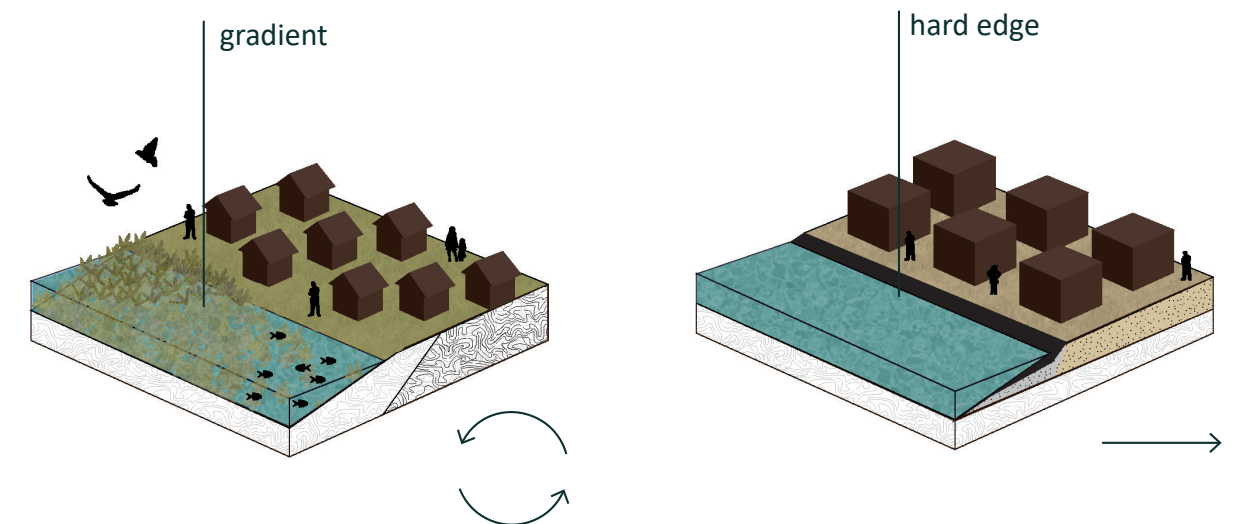


Nihonbashi bridge, Tokyo, Japan

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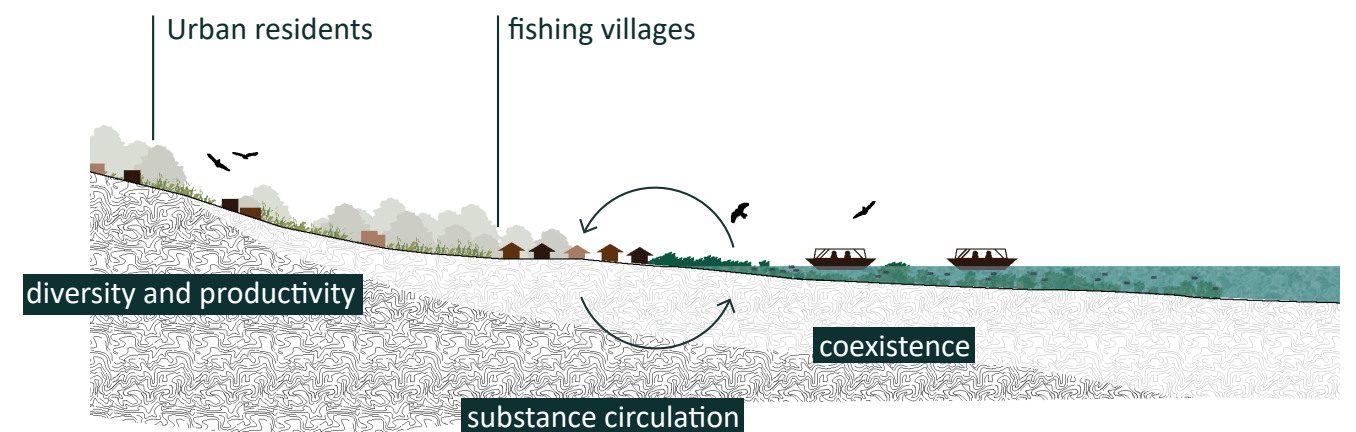
3.1.3 satoumi

Sato means ‘people living’ and umi means ‘sea’. It shows the beneficial relationship of humans with coastal landscape. Satoumi is a Japanese principle that describes a coastal landscape where humans interact with nature. It is about coexistence, diversity, and substance regulation (Uehara et al., 2019). Before heavy industrialisation and flood defenses as can be recognised now, Tokyo was characterised with a satoumi landscape. A gradient in the landscape was common, where natural processes secured the natural resilience of the landscape, with enough room for extreme events, not causing much damage. Rice fields in particular prevent floods and landslides, it being a natural dam that temporarily stores rainwater. Rainwater can slowly permeate the soil, which works as a filter to clean the water. The retained water also helps reduce high temperatures due to the evaporation in the fields (Rice Fields as Eco-existence | OMUSUBI GONBEI, n.d.). In a satoumi landscape, human intervention is not seen as bad, but rather as a helpful tool to sustain productivity and resiliency. However, since approximately 40% of the world’s population lives within 100 km of coastal zones and its population is expected to continually increase, coastal zones are pressured. (The United Nations, 2017). Satoumi could be a succesful example how to deal with coastal management. Due to heavy use of concrete, the satoumi landscape has been lost, and Zylstra (2014) pointed out that there is an urgent need for people to reconnect to nature. This is confirmed by research that proves that people receive health and well-being benefits from improving this relationship, as well as experiencing positive emotions when being around significant water bodies (Kong et al., 2022) (Sandifer, Sutton-grier, & Ward, 2015).



Gradient vs. hard edge

While a gradient provides natural resiliency and productivity, a hard edge prevents accesibility to the coast.



Satoumi section

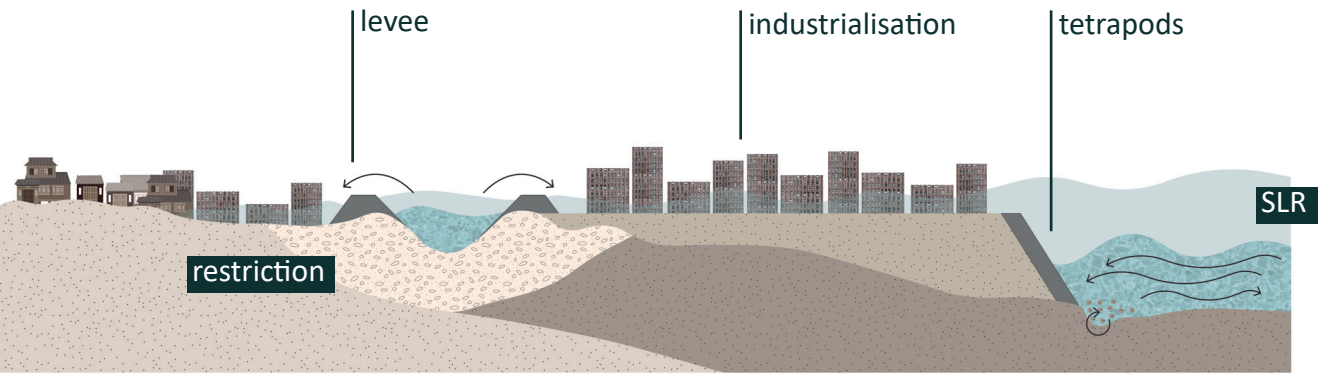
Different settlements can sustain in the coastal zone, while coexisting with nature, creating a balance between natural processes and human maintenance.

Japanese people have a strong connection with water



Although Satoumi is very promising, not every initiative of reviving this management has been successful.(Uehara et al., 2019). The modern changes that were inevitable should be taken into account when planning with this so-called ecosystem approach. Ecosystems are not the only systems that should be included in this management. We must also be aware of all the actors having influence on, and being influenced by these ecosystems. This will be further explained in chapter 3: strategy.

3.2 present



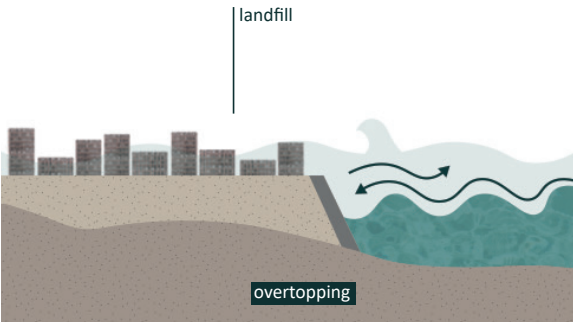
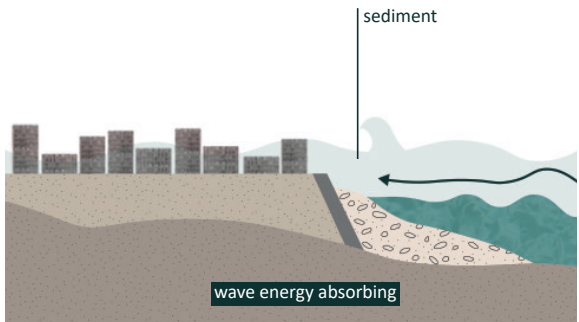
Blocked system
Trying to prevent flooding with concrete has caused a higher risk of flooding by not allowing natural processes to be balanced.

After the second world war, heavy urbanisation and industrialisation caused the need for more room, hence the land reclamation. The natural system is restricted by concrete solutions to solve the floodrisk. People have forgotten the respect towards the landscape, dominating the action on nature, rather than establishing a balance between them and nature.



Japanese girl in Tokyo (2023)
people crossing the street at Tokyo station

3.2.1 coastal protection

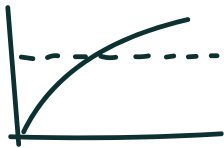


At the coast, mostly hard edges can be found, with sporadically an addition of sedimentation. A hard edge is considered protective because it reflects wave energy, preventing damaging the land. The threshold capacity however, has a protection limit that causes wave overtopping in extreme scenarios. Concrete in Japan has another function than flood defense, because of the probability of an earthquake, with a possible tsunami as result. Tetrapods have a high wave breaking capacity, allowing the tsunami to be partly broken down, lowering the risk of damage.

The flood defenses are based on a so-called threshold capacity. The management takes the worst catastrophe from the past, and bases the safety policy on protecting in that scenario (Van Bergen, 2022). This is fully based on trusting that the next extreme scenario would never be worse than before. When a catastrophe would be worse than accounted for, the flood defenses would be useless, exceeding the limits of protection. Trusting this principle is relatively safe, because the return period of these scenarios are long. But if it happens anyway,

the land would not be prepared. With the rising threat of climate change, the predictability of these scenarios decreases. This means that the chance of exceeding the limit also increases.

Sedimentation however, absorbs wave energy, also preventing damage, while allowing for a flexible protection limit. In a storm surge, the sedimentation is likely to be eroded, because of the energy of the waves dissipating. The land however, replenishes the sedimentation flow when restoring the natural balance. This allows the system to break without causing significant damage.

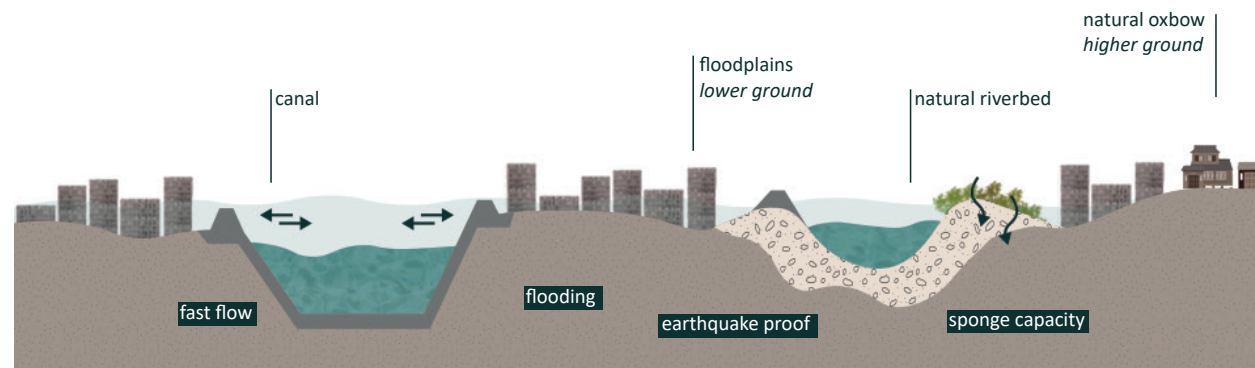


Threshold capacity
learn from the past



Tetrapods in Tokyo, Japan
Photo by Cameron Allan McKean (2014)

3.2.2 river management



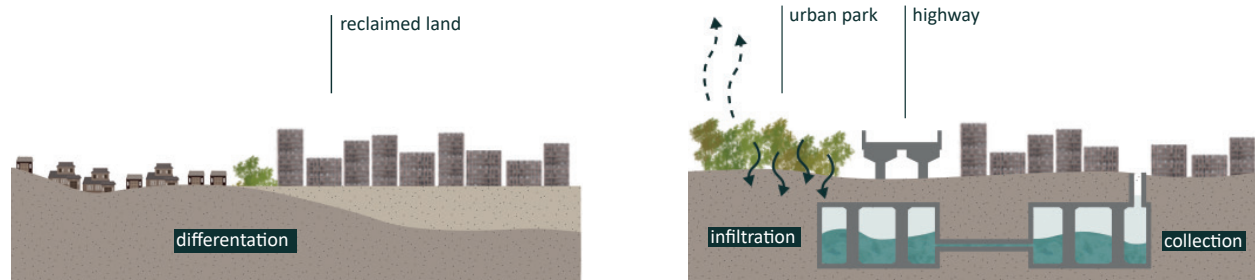
At the riverbanks, the sedimentation of the natural river courses is visible, as opposed to the newly dug, much bigger, canals, built with concrete walls, which restricts the addition of more sedimentation. This enables fast flow, which is beneficial for fast discharge, but also results in high peak flooding. What also becomes clear is that building on natural higher grounds will give us natural protection from floods. The traditional buildings are built with respect towards the floodplains of the river, not being placed directly next to the river, whereas the modern buildings filled up these empty spaces.

Concrete has only been described as negative up until now, but in Japan, concrete has a positive side. Due to a high probability of earthquakes, concrete dikes are necessary because they won't collapse under stress. Normal dikes would collapse, resulting in a high risk of flooding because of a possible tsunami.

Canalised waterway with concrete walls, Tokyo, Japan
Photo by Ben young



3.2.3 urban drainage

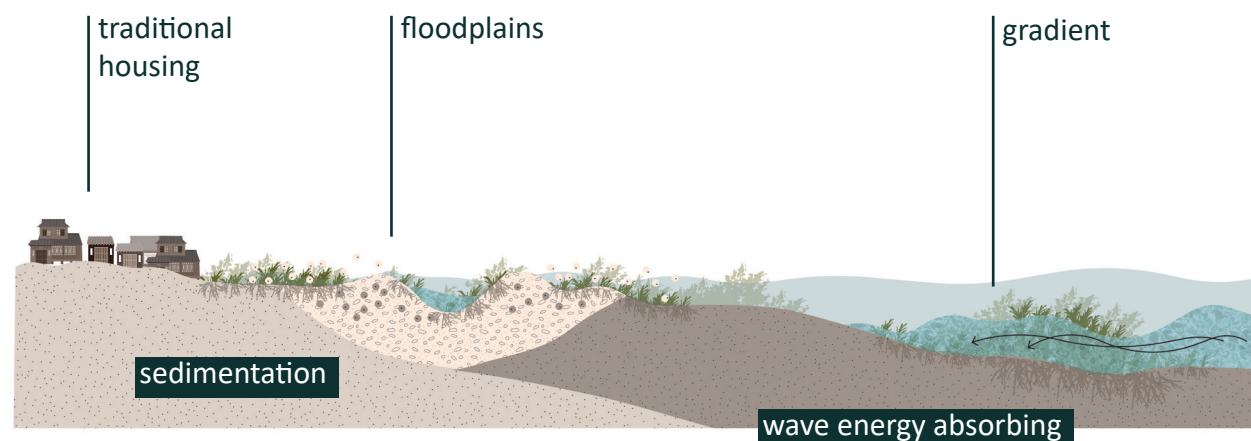


The consequences of the economic growth in Japan that led to land reclamation, is still visible in the landscape today. The difference in scale is not immediately visible due to it being covered with tree lanes, but the areas have a completely different experience. Whereas the old part has small individual buildings, the new part has bigger more repetitive buildings, such as apartment blocks. The land used to be part of a big delta, but since economic growth, has urbanised completely. The old streams of the delta are not all visible anymore, losing a connection to the identity of the landscape. Traditional Japanese culture had to make place for big highways, creating a barrier between the city and the coast. Some of the old canals however, are still visible, these are emphasized by tree lanes or bridges, creating garden-like landscapes.

Tokyo has a lot of invisible infrastructure, them being underwater rainwater collectors. The drainage is not the problem, but the mindset is. Everything is monitored, influenced and managed by humans. Rainwater is being led into these containers and stored here. It seems that as long as no one notices excessive rainwater, the problem is solved. But the fastness in which these operations are managed, have no respect to the natural system of the landscape.

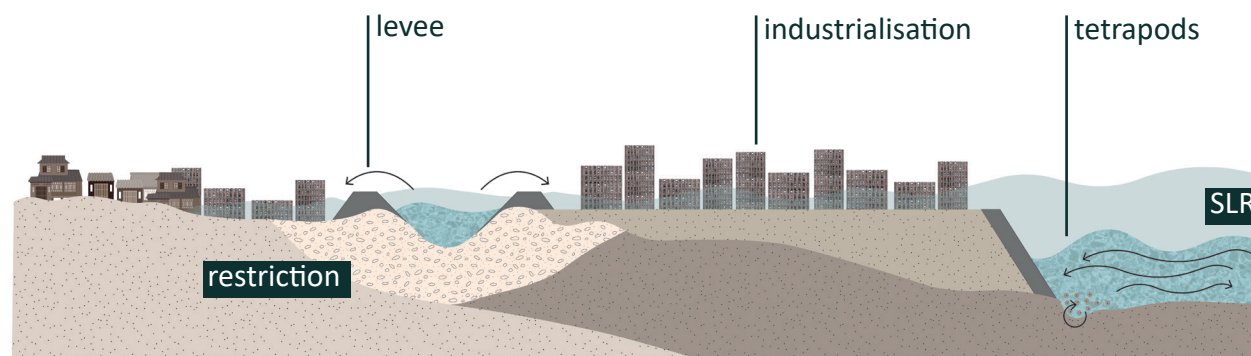
Every rainwater collector is monitored and managed by a control room, Tokyo, Japan
Photo by Christoffer Rudquist (2017)





Satoumi

A balance between natural processes and resiliency, and human maintenance.



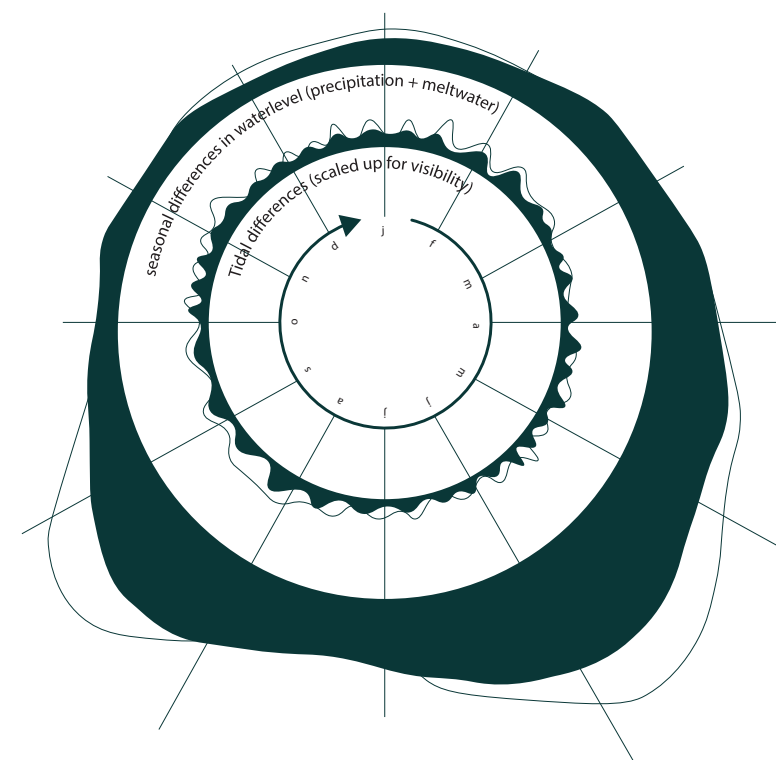
Blocked system

Trying to prevent flooding with concrete has caused a higher risk of flooding by not allowing natural processes to be balanced.

3.3 conclusion

To conclude, the coastal landscape has changed enormously over the past years. Due to city expansion and industrial development the rivers had less and less room, causing frequent flooding. Engineering solutions have tried to prevent floods by making hard edges along the coastline and riverbanks, only to increase the risk of flooding. Gradients could absorb wave energy, lowering impact, sedimentation caused natural higher grounds, providing safe places, but the heavy use of concrete has blocked the natural system completely. In the satoumi landscape, human influence was considered beneficial for nature, and nature could influence human actions, but nowadays that relationship is lost, perceiving human action as negative impact on nature. What is needed to rediscover a natural balance, maybe refer back to the satoumi landscape the japanese so beautifully describe?

Although the landscape did change enormously, changes are also natural in the system. Seasonal differences in water level are more than likely because of variety in precipitation and meltwater from the mountains. The wettest periods are in june-july, with another peak in september. Japan has dry winters, because of temperatures below 0 degrees celsius. Also minor differences are natural, such as the tides. Ebb and flow will follow each other four times a day, because of rotation of the earth relative to the moon. Also, changes over longer periods of time occur, especially with climate change being a pressing issue. The changes in the landscape are important to understand prior to the design phase.





Traditional and modern buildings in Tokyo, Japan



04

Strategy and principles

An understanding of the **landscape logic** with principles
how to translate the analysis
into design

What principles can be used to be implemented in design? These are derived from preceding case studies, literature research or experimenting. The principles are presented in a toolbox, distincting three categories: protective, ecological and cultural qualities.

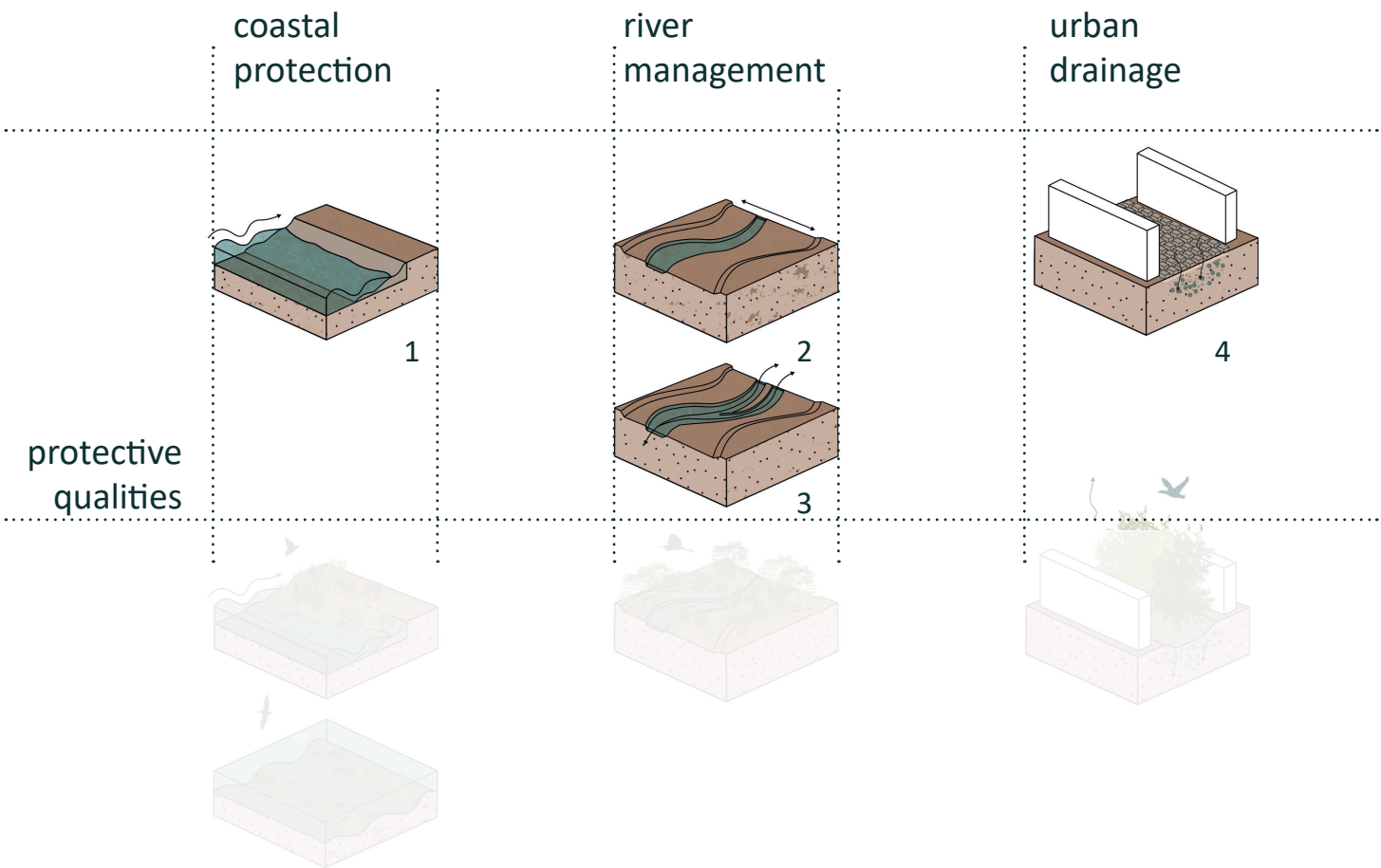


4.1.1 toolbox

protective qualities

By studying case studies as precedence for a design project, insights can be gained on how other designers approached similar problems, showcasing different solutions, techniques, and methods. It can serve as an example on how challenges were handled, or what should be approached with caution. Furthermore, case studies can serve as evidence to support design decisions. When presenting designs to clients or stakeholders, referencing similar successful projects can lend credibility and help justify design choices. One of the projects that sparked inspiration for this one, is the Zandmotor (sand engine) in the Netherlands. This project supports the idea of building with nature, making use of natural processes, specifically sedimentation, in a case of coastal protection. Realised ten years ago, the continuing research stated that the project can be viewed as successful, because under the influence of waves, wind and currents, the sand that was deposited on the coast of The Hague, strengthened the Dutch coast significantly (Rijkswaterstaat & Ecoshape, 2014). Another strategy is decreasing the erosion, preventing damage on the coast. Dermentzoglou (2023) researched the influence of salt marshes on wave energy damping. By absorbing the wave energy, the height of the waves is reduced, lowering the risk of wave overtopping, and preventing erosion. This vegetation is also expected to grow with sea level rise, providing a long-term solution. Expectedly, other forms of vegetation could be used to achieve the same effect, but salt marshes turned out to be the most efficient because of their habitat in saline environments.

In river management, the project of room for the river in the Netherlands provided strategies on mitigating flood risk. Basically, by creating more room for the river, more water can be stored, lowering flood risk. The strategy is in contrast with getting rid of the water as fast as possible, namely holding and storing the water to lower the peak of a potential flood. In this scenario, more differentiation is created, allowing a flexible and thus resilient system (Ministerie van Infrastructuur en Waterstaat, 2024). The same principle can be explained for urban drainage. When slowing down rainwater run-off, the system has more time processing excessive precipitation. In this case, permeability will allow for infiltration, preventing standing rainwater in the street (Water-permeable Pavements | Urban Green-blue Grids, n.d.).



1. Sedimentation

The sediment absorbs the energy of the waves, lowering the impact on the coast. Natural processes will restore the balance between sedimentation and erosion, recharging the natural protective value of the coast, lowering coastal squeeze (Rijkswaterstaat & Ecoshape, 2014). When adding vegetation, erosion and wave overtopping is being prevented. (Dermentzoglou 2023).

2. Floodplains

Allowing certain areas to flood prevents flooding in vulnerable places. Giving the river room to account for changes in discharge. The river can behave in a natural way, finding its own main stream, while still setting boundaries to protect the city (Ministerie van Infrastructuur en Waterstaat, 2024).

3. River bypass

Giving the water a second floodway can lighten the discharge capacity, lowering the risk of flooding. Creating different streams can also create different ecosystems (Ministerie van Infrastructuur en Waterstaat, 2024).

4. Permeability

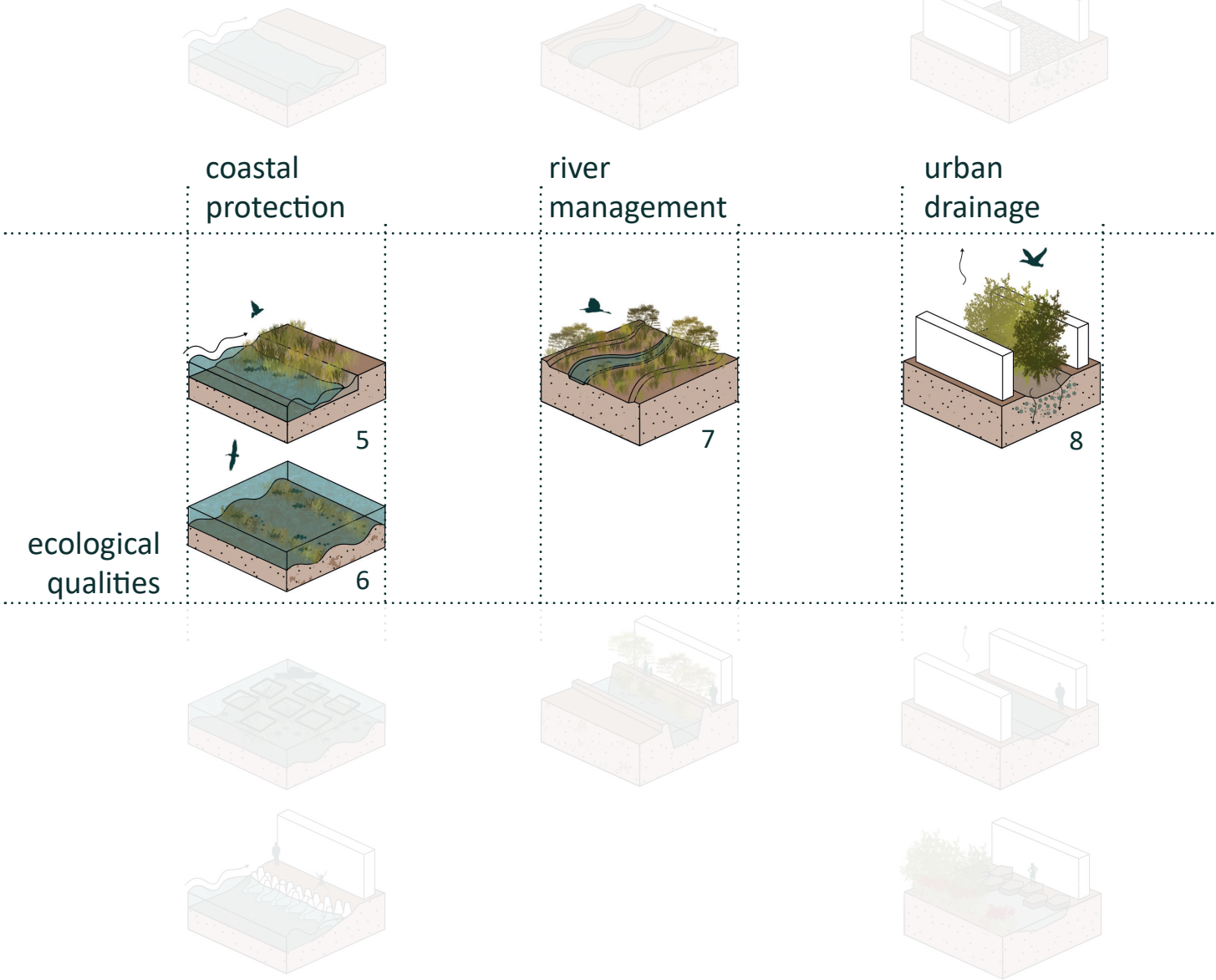
The water seeps into the soil, effectively preventing any accumulation of stagnant rainwater. The urban infrastructure functions like a sponge, readily absorbing excess moisture and promoting drainage (Water-permeable Pavements | Urban Green-blue Grids, n.d.).

4.1.2 toolbox

ecological qualities

The sedimentation that benefits coastal protection, will create gradients, which is beneficial for ecology (Cleland, 2011). Additionally, the salt marshes or other types of vegetation will absorb wave energy and as a result, will create shelters inside these ecosystems. Small animals such as (shell)fish, will settle here, attracting a variety of birds, attracting human recreation. Furthermore, salt marshes will trap sediment, strengthening the coastal protection, further stimulating ecological growth (Ecoshape, 2020a). Salt marshes have a high natural resilience, being able to grow in a lot of environments. Salt marshes like *Carex lyngbyei* (Lyngbye’s sedge) will be combined with vegetation that is native to Japan, such as *Castanopsis cuspidata* (Japanese chinquapin), or *Persea thunbergii* (Japanese bay tree). These trees are suitable for saline environments, in a moderate marine climate. Japan specifically has dry winters and wet summers. Although almost all of Japan’s original vegetation has been lost due to human action, evergreen broad-leaved forests predominate (Song, 1988). To provide a healthy ecosystem, also submerged vegetation plays a role. To stimulate this, seabed scaping can be done to create even the smallest of variety in the seabed. Variety means attraction of different species, stimulating rich biodiversity (Ecoshape 2020a). Vegetated flood plains can be compared to vegetated foreshores. Because of freshwater, a larger variety of plants will be able to grow, their roots trapping sediment and pollutants. Furthermore, plants do not only trap sediment, but also slow down the flow of the river, lowering peak discharge, mitigating

flood risk. Besides river management, the same applies to urban drainage. Vegetation in the streets contributes to rainwater catchment, slowing down run-off (Cooling by Increasing Urban Greenery | Urban Green-blue Grids, n.d.). This catchment will partially be absorbed by the trees, where in turn, the leaves will evaporate moisture. Due to evaporation, vegetation has a cooling effect. Cooling will mitigate the urban heat island effect, but also attract small species such as birds and insects. The concrete jungle is disrupted by greenery, creating passageways for these species, preserving biodiversity.



5. Vegetated foreshore
Vegetation not only helps lowering wave impact, but also creates a gradient, which is beneficial for ecosystem development. Tidal differences will benefit biodiversity (Ecoshape 2020a).

6. seabed scaping
Marine ecosystems provide a submerged wavebreaker as well as biodiversity and clean water. The minimal differences in height create different circumstances for sunlight, wave impact and more. The diversity strengthens resilience (Ecoshape 2020a).

7. Vegetated floodplains
Vegetation can retain water, decelerating the flow, lowering peak discharge. The dynamic waterlevel in the floodplains results in a diverse ecosystem. The roots of the plants can collect polutants, increasing water quality (Ecoshape 2020a).

8. Vegetation in the streets
Vegetation helps reduce high temperatures, due to evaporation via leaves. Vegetation increasing sponge capacity via infiltration, also lowering rainwater run-off. The concrete jungle will be interrupted, creating corridors for variety of species. (Cooling by Increasing Urban Greenery | Urban Green-blue Grids, n.d.)

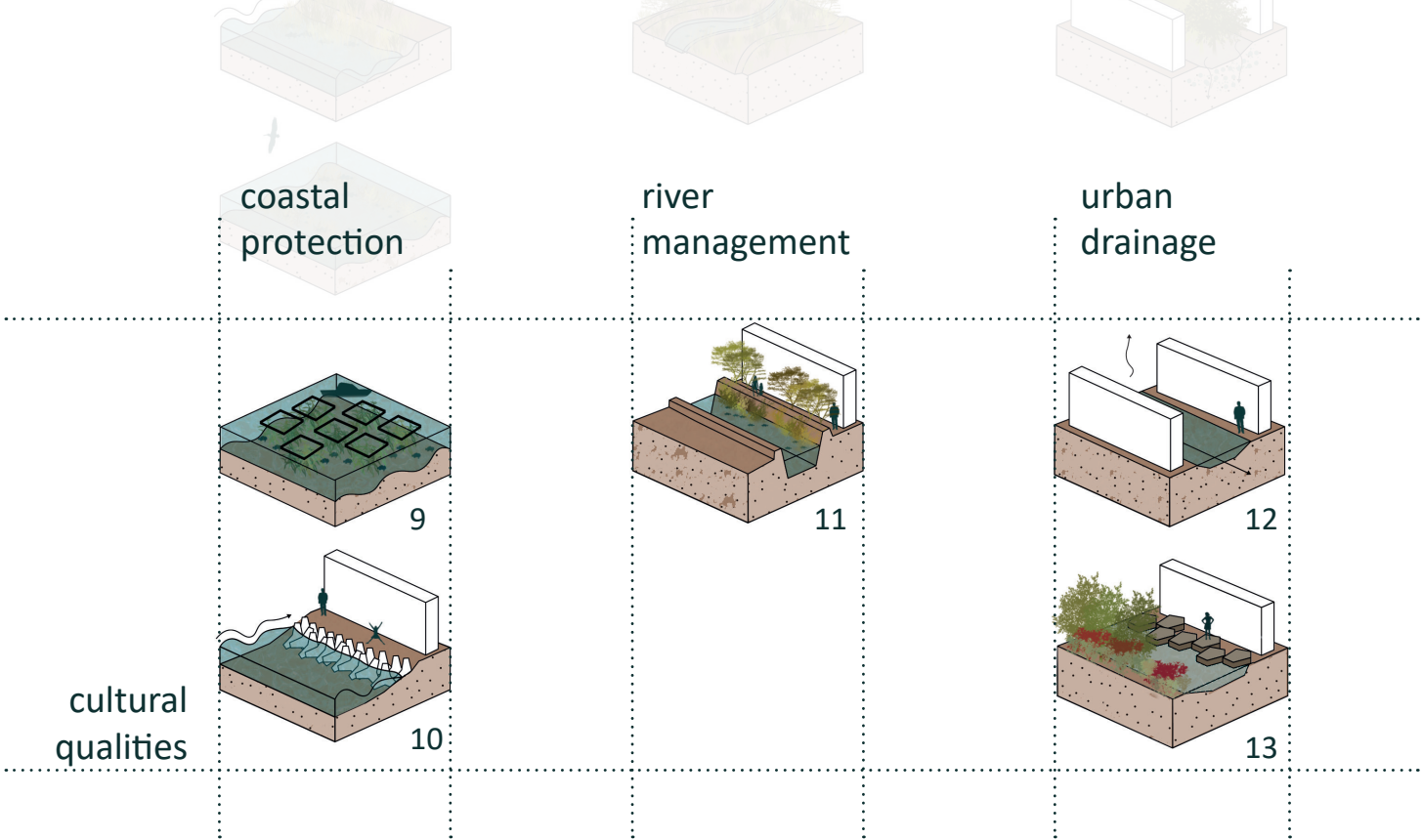
4.1.3 toolbox

cultural qualities

Satoumi is a coastal landscape is where both nature and humans influence each other positively. An example of satoumi is aquaculture, where shellfish, mussels, or seaweed can be harvested. Aquaculture provides food, and in the event of a market, economic growth, as well as stimulating nature development (Ecoshape, 2020a). Especially in combination with seabed scaping, were the ecology gets a boost, aquaculture can result in a thriving ecosystem, both for nature and humans. If it is practiced in mass production, the quality of satoumi decreases, a balance between human control and nature preservation is necessary. Additionally, the reefs function as a (submerged) breakwater, contributing to coastal protection. With aquaculture, tetrapods become unnecessary, but with the cultural value these objects hold, surely not useless (Hesse, 2007). The objects can get a new function, for example in urban context, creating awareness for the people about the new landscape. They can accompany the canals in the city, which also have historical value, because of Tokyo’s rich history of living with water (Yoshida, 2014). The history can be emphasized by making room for human activity, like a living wall along a canal, where pedestrians have priority instead of the many highways of Tokyo.

The Japanese have mastered the art of gardening, with their famous Japanese gardens which all consists of at least a water, stone, and green element, which respectively are symbolic for life, rest and nature (japanese-tuinen.nl, 2017). Most gardens have sacred value, so does the vegetation. The Japanese bay tree is very popular, because it is used as bonsai tree (Song, 1988). In every Japanese garden, it is likely to encounter at least one of those trees. The Japanese chinquapin grows edible nuts, which can be harvested by humans. The dead wood of these trees creates perfect circumstances for mushrooms to grow, especially shiitake, a Japanese delicatessen. Both trees accommodate opportunity for human action, additionally to them being native to Japan.

In conclusion, referring to the history of Japan adds cultural quality to a landscape, but human activity in combination with nature preservation is the most important factor for a sustainable satoumi landscape.



9. Aquaculture
 Providing the people with farming opportunities increases economic growth, as well as stimulating the relationship between the land and the water, and the development of marine ecosystems. Aquaculture could be expanded with fishery and/or fish farming (Ecoshape 2020a).

10. Tetrapods
 Tetrapods are an engineering solution to coastal protection. These objects hold cultural value, and could be viewed as art. They have protected the people of Japan for so long, the people have a sense of trust (Hesse, 2007).

11. Living wall
 With lack of room in urban context, the floodwalls of the canals can be used multifunctionally, both ecologically and culturally. Citizens can experience the water in the city (Yoshida, 2014).

12. Open water
 Referring back to the history of Japan, canals can store, retain and transport water. Open water also reduces high temperatures, while restoring the cultural identity of Japan. Awareness is created, which sparks curiosity and involvement (Yoshida, 2014).

13. Japanese garden elements
 Three elements are crucial in a Japanese garden: water, stone and greenery. This art of performing perfect control is sacred to the Japanese people (japanese-tuinen.nl, 2017).

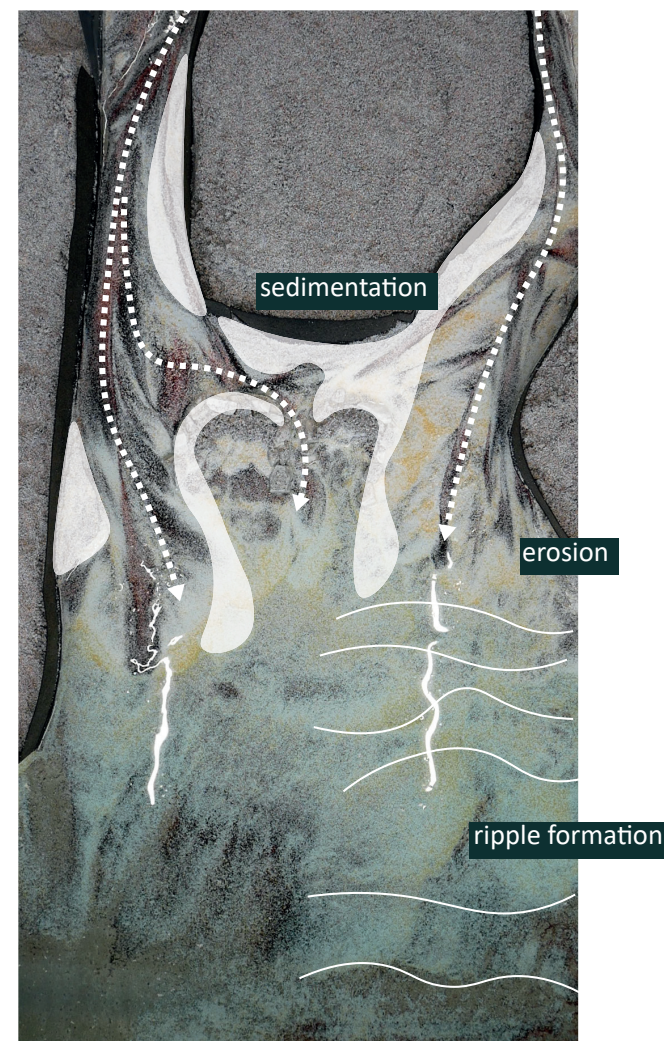
4.2 sedimentation and erosion processes

Sedimentation and erosion process are inextricably linked. The analysis about sediment distribution and bed shear stress showed a highly dynamic landscape. Following the building with nature theory, natural processes can be of help in a design process. With the landscape being so dynamic, an experiment was conducted to determine how these processes work and how they could be used as a spatial component. The faculty of Civil Engineering and Geosciences at the University of Technology in Delft facilitated the space and materials for the experiment. Such a table is called a flume, where the discharge, the sediment input, the wave energy, and the slope are adaptable. These variables are not easily scaled up or down, so where normally the research would contain precise calculations, this experiment was mainly used as design input. It can be seen as a tool to deal with uncertainty. Although the experiment will not fully take that away, assumptions can be made that can be related to the research objective.

The conducted experiment shows sediment behaviour over time. The experiment is shown both in concrete pictures, as well as abstract drawings. The difference is important to mention because different drawing techniques show different outcomes. While the section shows the principle of sedimentation and erosion, the dotted drawings express the spatial quality. The balance of sedimentation should stay the same, meaning that erosion inevitably means sedimentation somewhere else. The different stages in time show these spatial differences. The landscape is literally changing, and therefore the experience of it. The dotted drawing show exactly this. While every dot is the same size, the placement of these dots together makes a pattern. Although a line could never get the same effect, it beautifully shows the principle of the sedimentation balance. Different drawing techniques result in different information. To fully understand the site and use it as input for design, photos are used as a basis to draw upon for clarification.

Top view of model during experiment

Flume @Faculty of Civil Engineering and Geosciences

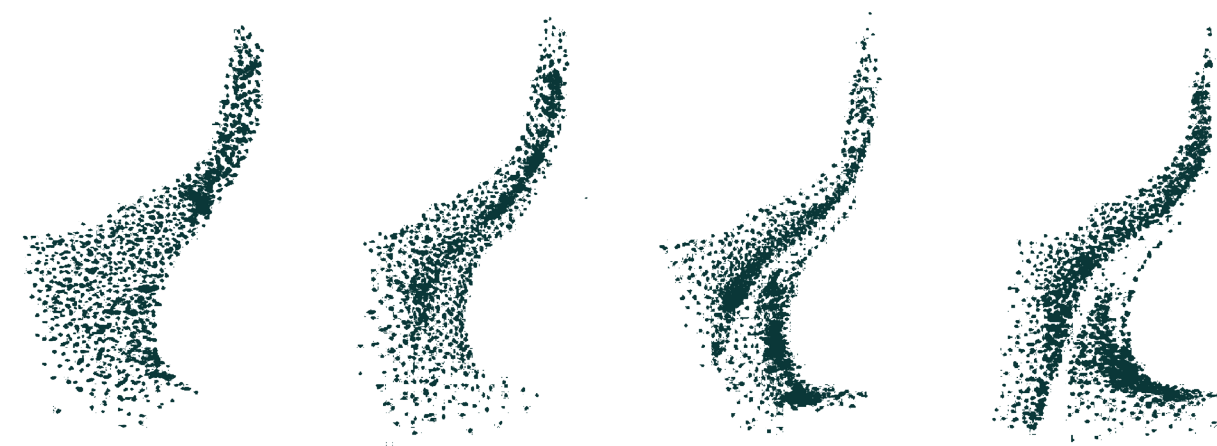


Just as anticipated, the forces of erosion exert their influence predominantly on the outer curves of the landscape, while sedimentation takes hold in the inner curves, manifesting a natural equilibrium of geological processes. Consequently, the outer curve adopts a steep profile, sculpted by the force of water carving into its terrain, while the inner curve assumes a gentler slope, providing fertile ground for the emergence of diverse gradients for ecological development.

The image above shows that the flow originating from the Ara River slightly turns eastward, giving rise to a stream that meanders through the heart of the landscape. Over the passage of time, the transport of sediment towards the sea results in elongated landforms.

With the progression of sediment flow, a delicate balance between its energy and that of the waves begins to take shape, stopping the expansion as equilibrium is achieved. Yet, the motion of the waves persists, reflecting energy back into the environment, stimulating the formation of horizontal patterns that intersect the elongated islands created by the river.

Beneath the surface, this dynamic interplay between sediment and wave energy continues to sculpt the seabed, resulting in the emergence of relief and contours. This intricate process, known as ripple formation, serves as a motivation to the development of seabed scaping, providing a fertile ground for ecological diversity to flourish and thrive.



Trough time

Visualisation technique on how sediment behaves influenced by sedimentation and erosion. The outer bend has a faster flow, resulting in erosion. The sedimentation settles in the inner bend. The flow will find its way through, creating a main stream.

Due to the stimulation of natural processes, this landscape can take on many forms. Over time, the landscape will change, presenting an ever-evolving geological transformation. The aim is not to prevent this unavoidable process from happening but stimulating change necessary to maintain a balance between sedimentation and erosion. However, through strategic design interventions, a certain degree of influence is possible, steering towards outcomes that align with overarching objectives. In doing so, the landscape will not only be preserved, but will cultivate environments that optimize safety, foster biodiversity, and cultivate the essence of Satoumi; a delicate balance between human activity and the natural world.

5.3 conclusion

The toolbox is divided into the categories of protective, ecological, and cultural qualities, despite the initial division of coastal, river and urban landscape. This is chosen deliberately, because in this way, a comparison can be made between the different landscapes, on the same principle. For protective qualities, this means ensuring room for the water, either in the floodplains of the river, or in the streets of the city. Sedimentation at the coast creates a buffer zone what can adapt to the tides and potential storm surges. These principles are adapted to climate change because they are flexible on the capacity of water they can take. Protective principles are applicable in a wide variety of contexts.

Ecological quality is created by gradients, which means the increased diversity of the ecosystem. The diversity calls for an understanding of the context because different climates cause different conditions that will attract different species, which ensures resilience because of the garden theory of Nijhuis (2022). It is important to mention that ecology extends below surface, thus marine ecology is also mentioned. Seabed scaping will stimulate the growth of ecosystems, contributing to the gradient. Furthermore, with ecology, a reference can be made towards traditional Japanese culture by choosing vegetation that is similar to a Japanese garden.

Culture is the principle that is the least generic, for every context has different cultural values. In this case, tetrapods make for a characteristic landscape, as well as seabed farming. Japan is famous for eating seaweed, so cultivating is a traditional practice. Human activity also plays a role, creating vegetated spaces where pedestrians have priority.

Together, these principles contribute to the idea of a landscape-based approach, considering the totality of the landscape, with all its actors and stakeholders.

Highway over canal in Nihonbashi, Tokyo, Japan





05

Design exploration

Principles translated into **design**,
creating a complete **storyline**
throughout the **scales**

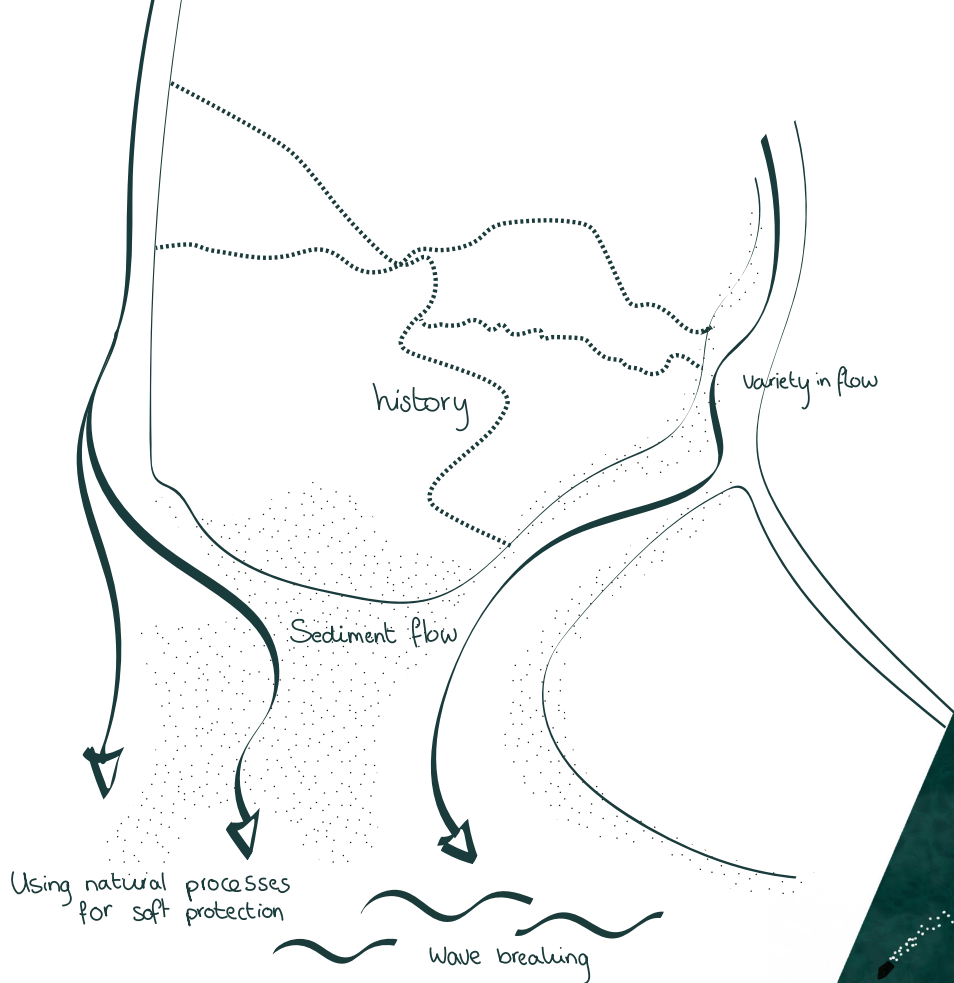
The design is the product of the research,
the answer to the research objective.
With different visualisation techniques, a
complete story is told, rather than pointing
to a map. Research-through-design is a
journey of exploration, this chapter shows
the results of the process.



5.1 future

In the design exploration, the principles that were described in the previous chapter, are being implemented into context, using research through design. The choices are based on the concept, three landscapes that are connected to each other. Water flows from the Ara and Edogawa River into Tokyo Bay, creating two main streams which are met by the sea by the breaking of the waves. When sedimentation is stimulated, islands start to take shape at the foreshore. A lee area is created at the heart of the landscape, due to the two rivers flowing at the outside. In contrast with the present situation, the sponge capacity can be increased by opening the existing waterways towards the rivers, letting water in at hightide, letting water out in excessive precipitation. Whereas the former landscape was stuck in time, this one is able to breathe. To use the historic value of the landscape, old canals are being restored, increasing cultural activity. Despite the debatable success of the land reclamation, the history is literally visible in the landscape still, the border can be emphasized by making it an important ecological corridor, adding an extra vein to the system. This being the original coastline of the landscape, awareness can be created by drawing people’s attention. The traditional art of the Japanese garden offers a great scala of design element, which can be used in the public space. This design will already rely on natural processes, something the Japanese are not yet familiar with, so respecting their culture helps them trusting the landscape. Furthermore, functions are kept to create a recognizable landscape. Japanese people appreciate information as a form of trust. The design will use the functions such as the bird watching centre and sealife to show the new landscape and how it is established. Linking the design to the current landscape helps to settle in this specific location. New places can be

added upon the exsisting ones, using the current landscape as the backbone that holds the future developments together. Although the design can be seen as a pilot or strategy, that does not mean it is placed randomly. Also the accessibility is kept in the current state. A visitor might arrive by public transport via metro or boat, or by private transport via car or boat. Because the people of Tokyo already know about the functions to be found in this location, they will automatically be drawn to the landscape and discover the evolution of a traditional satoumi landscape with a modern sense of place, where the relationships between humans and nature can be rebuilt.



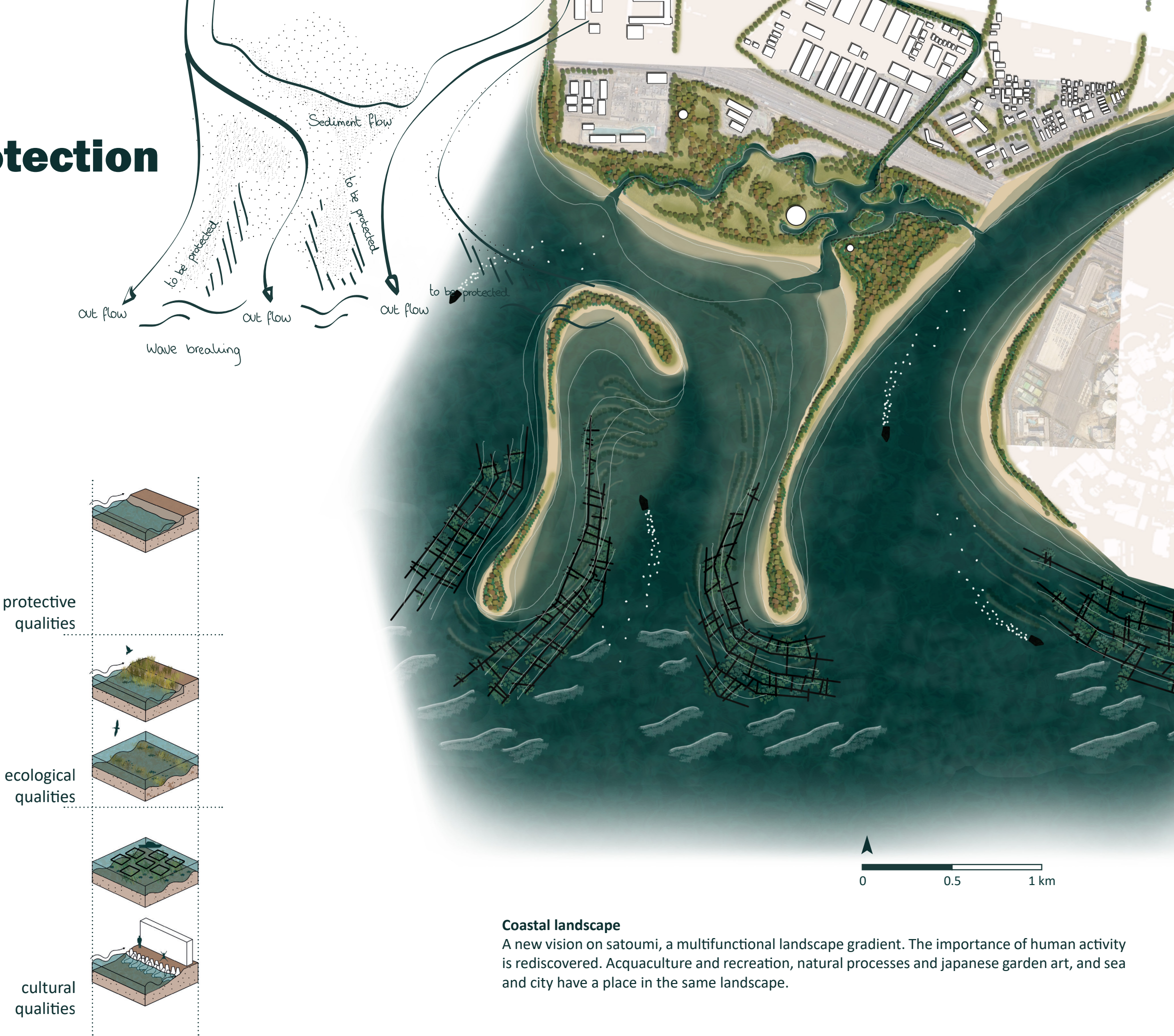
Connected
The riverine landscape, urban landscape and coastal landscape are connected to eachother. The edges have become soft, a gradual transition from water to land is created. The landscape is accessible with either metro or boat, and former functions are kept to contribute to recognizability for the visitor.

5.1.1 coastal protection

In integrating the principles derived from the toolbox with the insights obtained from the experiment, one already could imagine a landscape being formed. Delving into the details of the two rivers, the Ara River's course diverges into two distinct channels, meandering inward and encircling one of the sediment patches. This divergence fosters diversity within the landscape. The outer currents, propelled by their greater force, induce erosion along the islands, sculpting contours that are in contrast with the smoother terrain.

Conversely, at the core of the landscape lies a stiller area, resulting in a gentler gradient. This gentle slope offers fertile ground for the cultivation of ecological gradients, providing an optimal environment for biodiversity to thrive. Here, a multifunctional gradient unfolds. Salt marshes, partially submerged, further enhance the landscape's biodiversity, their presence shaping unique ecosystems that contribute to its resilience.

Even the subtlest distinctions within the terrain can enhance diverse ecosystems. Much like a gardener strives to strike a balance between chaos and control to nurture flourishing plants, this landscape must also find its equilibrium. The importance lies in the combination the protective, ecological and cultural qualities, where all influence each other positively. The elongated shape of the islands can be explained by the dominance of river currents over sea currents, which transport sediment outward, gradually forming elongated landmasses. However, as these landforms extend into the sea, they encounter the force of wave energy. This collision with the dynamic forces of the sea leads to a widening of the island ends, as they confront resistance and the threat of erosion. To safeguard against this erosion, protective measures are necessary to protect from disappearing. This is where the



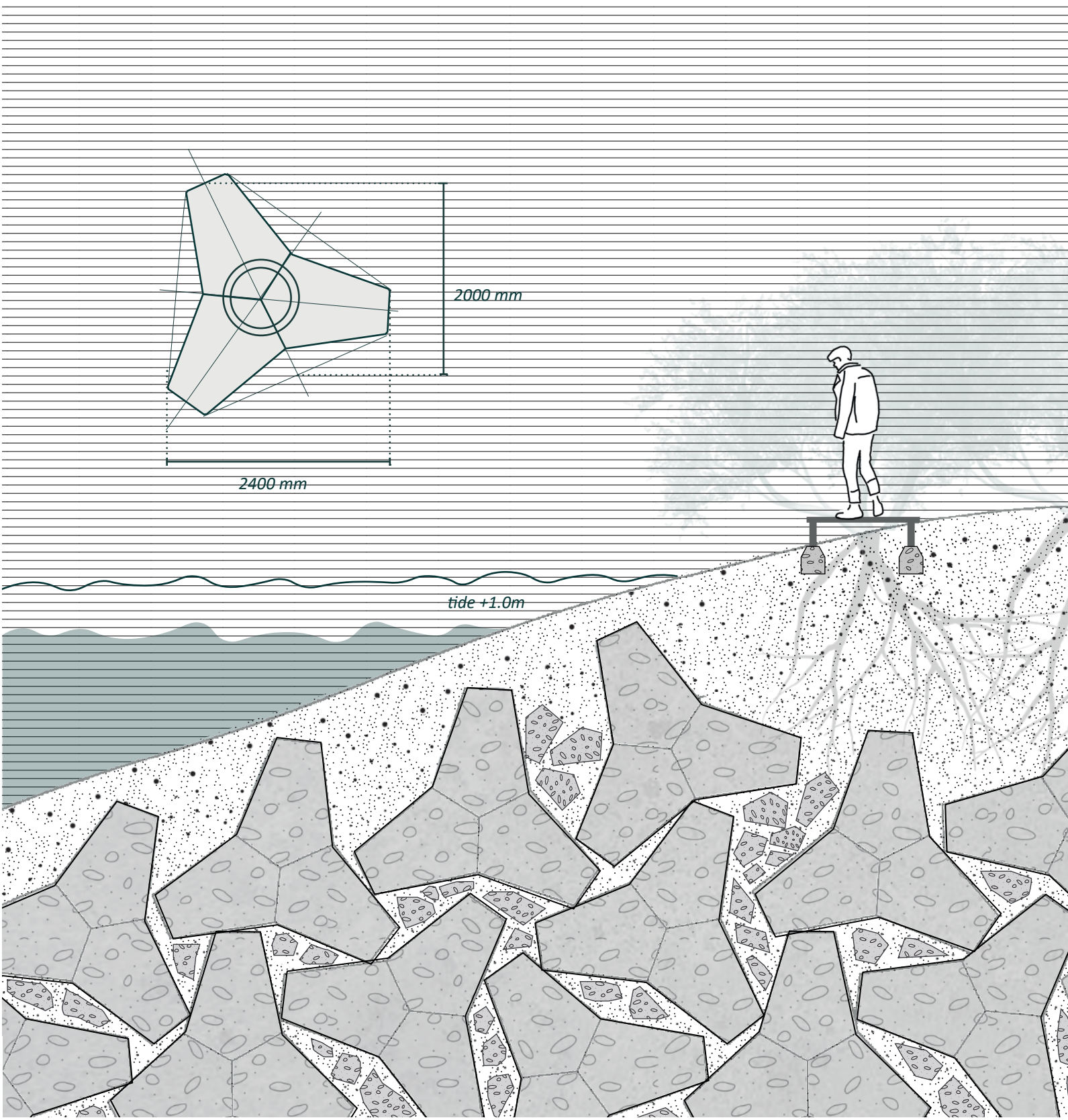
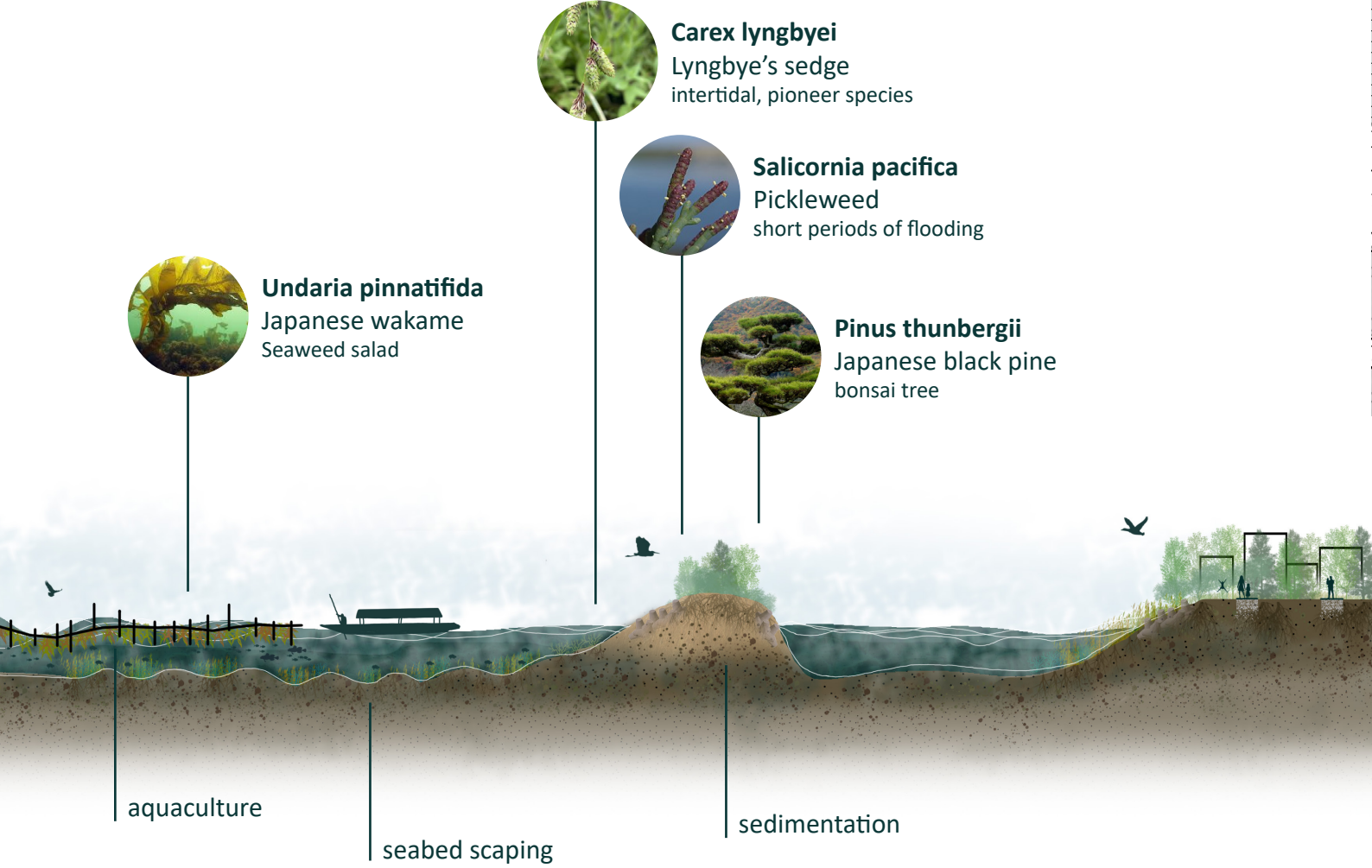
Coastal landscape
A new vision on satoumi, a multifunctional landscape gradient. The importance of human activity is rediscovered. Aquaculture and recreation, natural processes and japanese garden art, and sea and city have a place in the same landscape.

landscape-based approach truly offers handles for designing multifunctional landscapes that seamlessly integrate both protective and cultural elements. In this context, the area presents an ideal situation for synergizing protection with cultural significance.

Drawing inspiration from Japan's rich tradition of aquaculture, where practices such as seaweed cultivation have flourished for centuries, innovative solutions are being created. For instance, the cultivation of seaweed within wooden grids not only serves economic purposes but also doubles as a natural defense mechanism for the islands. These wooden grids effectively reflect wave energy, acting as a buffer against erosion and safeguarding the islands' delicate ecosystems.

Moreover, the seasonal fluctuations in seaweed growth further enhance this protective barrier, as the flourishing vegetation reinforces the resilience of the landscape. Thus, through the integration of traditional practices with modern innovations, a harmonious symbiosis is achieved, where cultural heritage intertwines with ecological quality to create a landscape that is both resilient and culturally vibrant.

Culture is not only about activity, but also about people holding value to certain places, or objects. In the coastal landscape these objects are tetrapods. As long as sedimentation continues to strengthen the coast, tetrapods



Detail 1:50
Tetrapods are used to strenghten the islands made through sedimentation. Erosion will be prevented, sedimentation stimulated. Even the force of a typhoon cannot erode the island away.

Boardwalk
wood + concrete foundation
Sedimentation
Tetrapods + concrete rubble

are losing their protective value, but gaining in historical value, because when talking about the future, the present situation will be the past. These objects will remain an icon in the Japanese culture, becoming remnants of another era in the landscape history. Respecting the attached value, the tetrapods will be symbolic for the slowly but everchanging landscape.

Japanese people hold value to knowing whether a place is safe or not. Placing objects that are permanent, such as a watchtower, suggest that this place has a low dynamic and thus is a safe place to stay. With design elements such as these, the landscape gives reassurance that there is room for recreation, rather than a landscape you would want to move away from.

Placing objects close to the water, something the Japanese are not used to, a new relationship with the water can be established. Trust can be rebuilt, promising landscapes with a positive experience.

While Satoumi may be rooted in the past, its principles hold timeless relevance. The landscape-based approach emphasizes the delicate balance between natural processes and human interventions. In coastal landscapes, human activities are not only integral but also pivotal for ensuring sustainability, provided they are conducted with a deep respect for the preservation of natural ecosystems. The influence of Satoumi extends far beyond its immediate impact.



Culture

With a sense of safety, the coastline can be experienced in a new way. With people visiting, they establish a new relationship with the sea. They don't fear the water anymore, but they experience a sense of trust and enjoyment.



Satoumi

Human maintenance and nature development are influenced by each other positively. One needs the other, to maintain sustainability. Human influence is not perceived as negative, but rather as a act of balance.

For instance, the ecological benefits derived from practices like seaweed farming reverberate throughout the ecosystem, nurturing not just plant life but also fostering animal life. The cultivation of seaweed not only enhances ecosystem health but also attracts fish, thereby creating opportunities for sustainable fisheries. Yet, the ripple effects extend even further. The thriving underwater ecosystem serves as a magnet for life above water, providing a vital habitat for seabirds. Birds play a crucial role in maintaining ecosystem balance by preying on insects that may pose a threat to seaweed cultivation, thus protecting yields and ensuring the resilience of the ecosystem.

Satoumi encapsulates the profound interconnectedness of ecosystems, illustrating how every component, including human beings, plays a pivotal role in sustaining the delicate equilibrium of coastal landscapes. By embracing this perspective and integrating it into our management practices, we can forge a path towards sustainable coexistence, where human activities enrich rather than deplete the natural world.



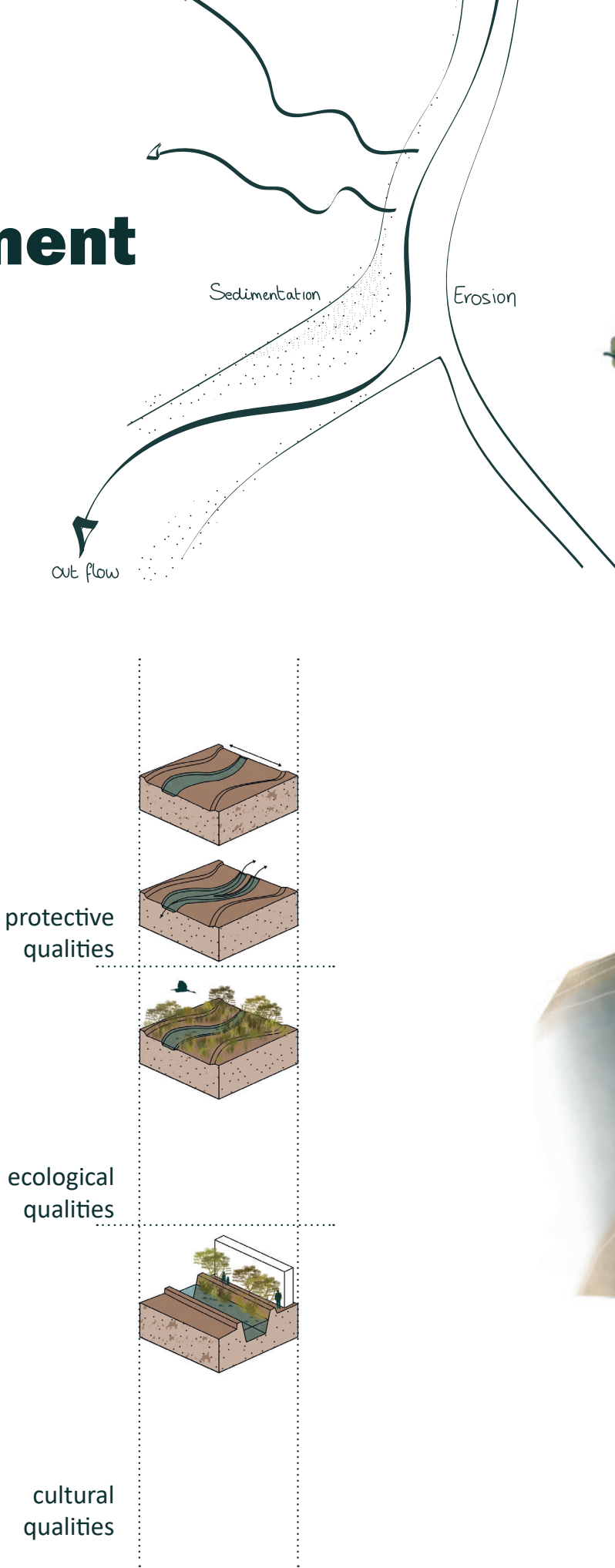
Satoumi

A landscape where ecological, protective and cultural qualities collide. Satoumi is the combination of human and natural action, a sharing of the landscape, in past, present and future. Elements from the past and present form the landscape of the future.

5.1.2 river management

In the riverine landscape, the mindset from getting rid of the water as fast as possible towards a mindset where water can be stored, or hold, is the most important regarding protective quality. Diversity can be achieved in alternating flow speed or changes in riverbed proportions. When changes are made in the speed, the riverbed may also change due to sedimentation and erosion, and when the riverbed changes, speed is also adjusted, depending on available space for the water. Regarding the limited space in the riverine landscape, the opportunities mostly lie around the edges. The sedimentation pattern is based on the results of the experiment, creating gentler gradients in the inner curve and a steeper slope in the outer curve, which is similar to that of the coastal landscape, where erosion is predominant where the flow is the strongest. Due to this sedimentation pattern, the riverbed is smaller than the original, creating a narrower passageway for the water. Instead of flowing directly to the sea, diversity in flow speed is achieved, because of the effect of a funnel.

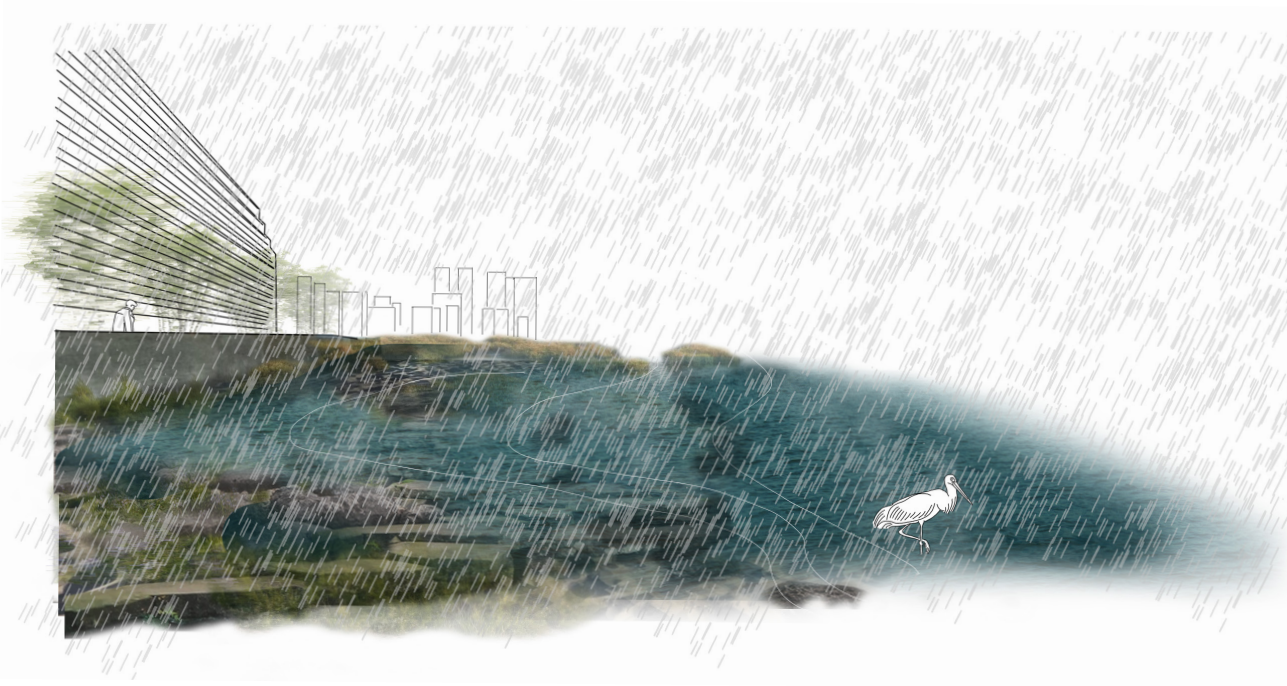
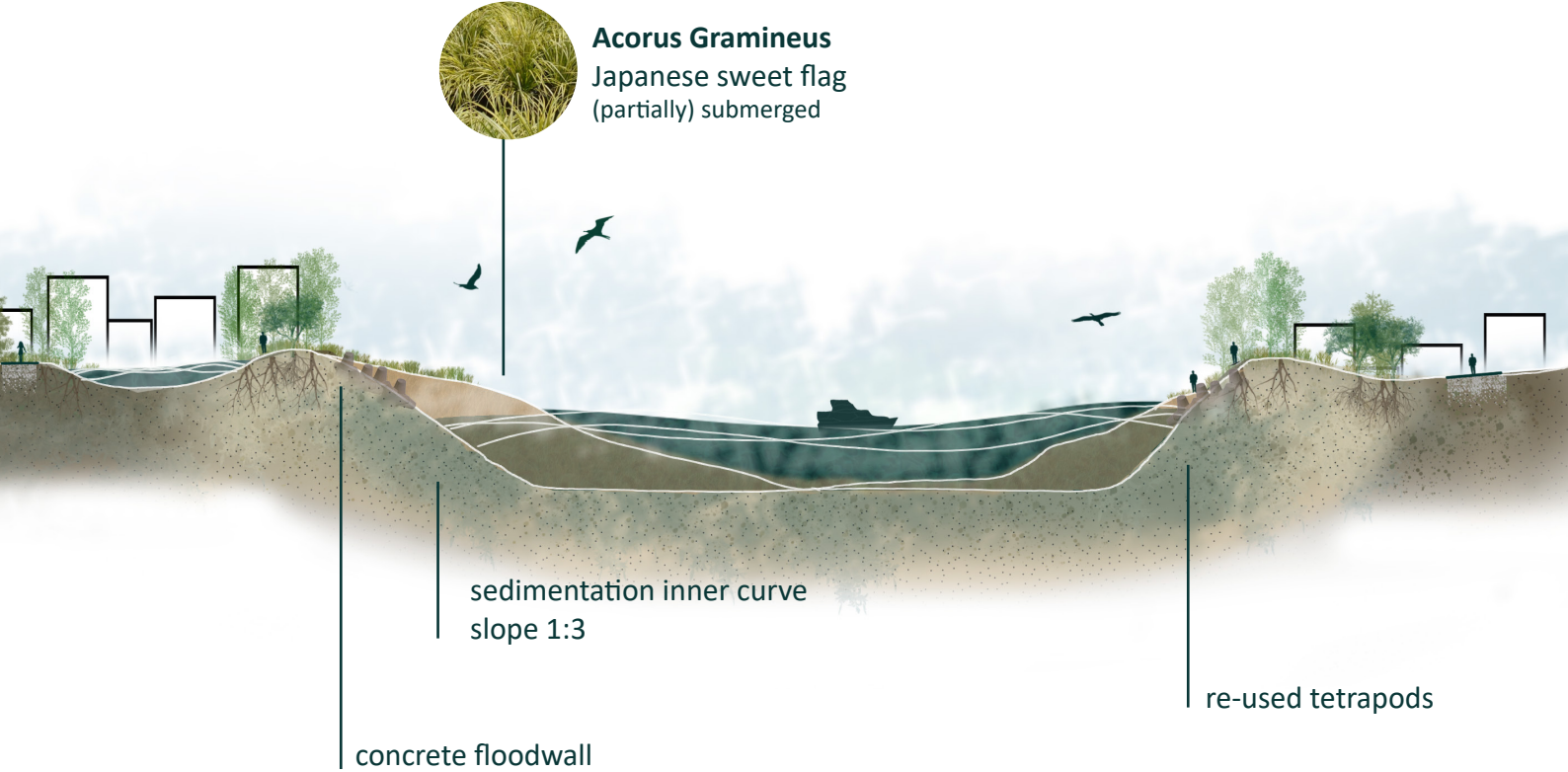
The same width of the channel with a narrower stream, result automatically in edges that are not always occupied by water, resembling the natural floodplains of rivers. Pioneer species will settle here first, holding down the sediment, creating stable conditions for other species to settle. Vegetated floodplains will be a gradient, because different areas will be flooded irregularly, creating differences in the ecosystem.



Riverine landscape
Softening and opening the edges is the basis of this landscape. Flexibility and change is allowed. Humans and nature share the same landscape, respecting each other, letting each other change and develop over time.

Further stimulating the diversity, the landscape will look different in hightide than it does in low tide. The water is allowed to take up more space when needed and revealing low areas in dry periods. Without human intervention, the sedimentation can develop as naturally as possible, creating opportunities for human activity. Therefore, the trust in natural resources proves beneficial. As the natural processes will create different landscapes over time, the landscapes are just as much human as they are natural. When stopping to control the natural processes, and learning to respect them, we learn to live together in harmony. It can be seen as a spectrum. There is no hard border where the landscape suddenly belongs to something else. The spectrum may vary throughout the

year, nature taking up more space in periods of flooding, but this is compensated in dry periods, when humans are allowed to explore more of the landscape than they normally do. The old protective value of the tetrapods is sometimes still visible in low tide, when the top of the tetrapods peak trough the sedimentation. When humans and nature have lived together for a long period of time, they start to understand each other. Flooding is not seen as a problem anymore, because there is room for fluctuations. This contributes to the adaptive capacity, where even humans learn to behave adaptive, resulting in a sustainably relationship between humans and nature.



Satoumi
The riverine landscape is just as much nature as it is human. During a dry period, humans can access the riverbank more easily, experiencing the landscape. In a wetter period or during a storm, nature temporarily takes over. Instead of a hard division between them, human and nature can share a landscape.



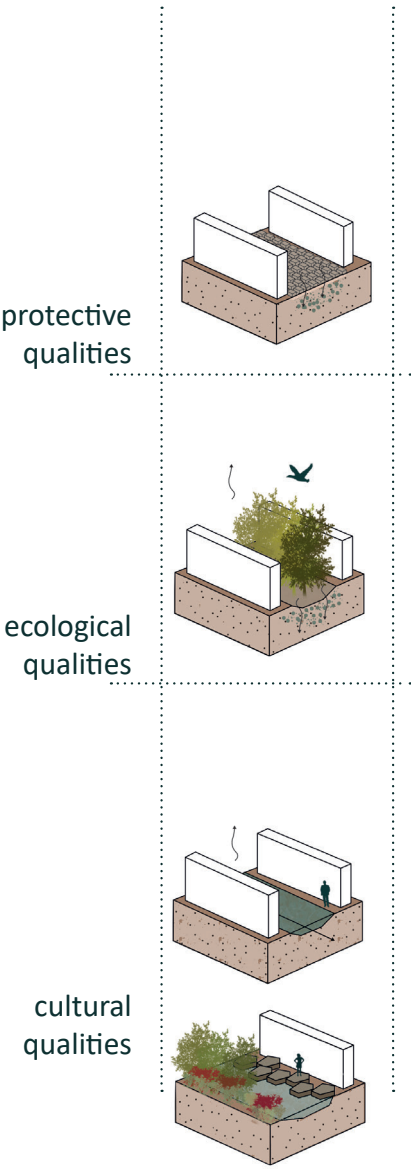
Satoumi

A landscape where ecological, protective and cultural qualities collide. Satoumi is the combination of human and natural action, a sharing of the landscape, in past, present and future. Elements from the past and present form the landscape of the future.

5.1.3 urban drainage

The original water system designed solely for rapid water removal from urban areas often neglects the relationship between natural landscapes and urban infrastructure. However, the innovative approach of the new landscape design draws inspiration from the city's existing urban fabric, historical features, and canals. Rather than simply flushing water away, it weaves a network of ecological corridors throughout the city, not only do they function as drainage channels, but they also act as vital components of the city's ecosystem. By incorporating elements such as permeable surfaces, open canals, and vegetation, the landscape becomes a sponge, capable of absorbing and managing rainwater more effectively. Imagine a single raindrop falling from the sky. Instead of immediately being whisked away by concrete channels, it may land on a leaf, trickle down the trunk of a tree, and eventually seep into the ground. Alternatively, it might land directly in one of the open waterways or on a permeable street surface, gradually making its way to the canals. Each drop takes a unique path, influenced by the diversity of the landscape. This diversity in routing ensures that the peak of precipitation is spread out over a longer period, reducing the strain on the drainage system that gains valuable capacity to handle larger volumes of water without becoming overwhelmed.

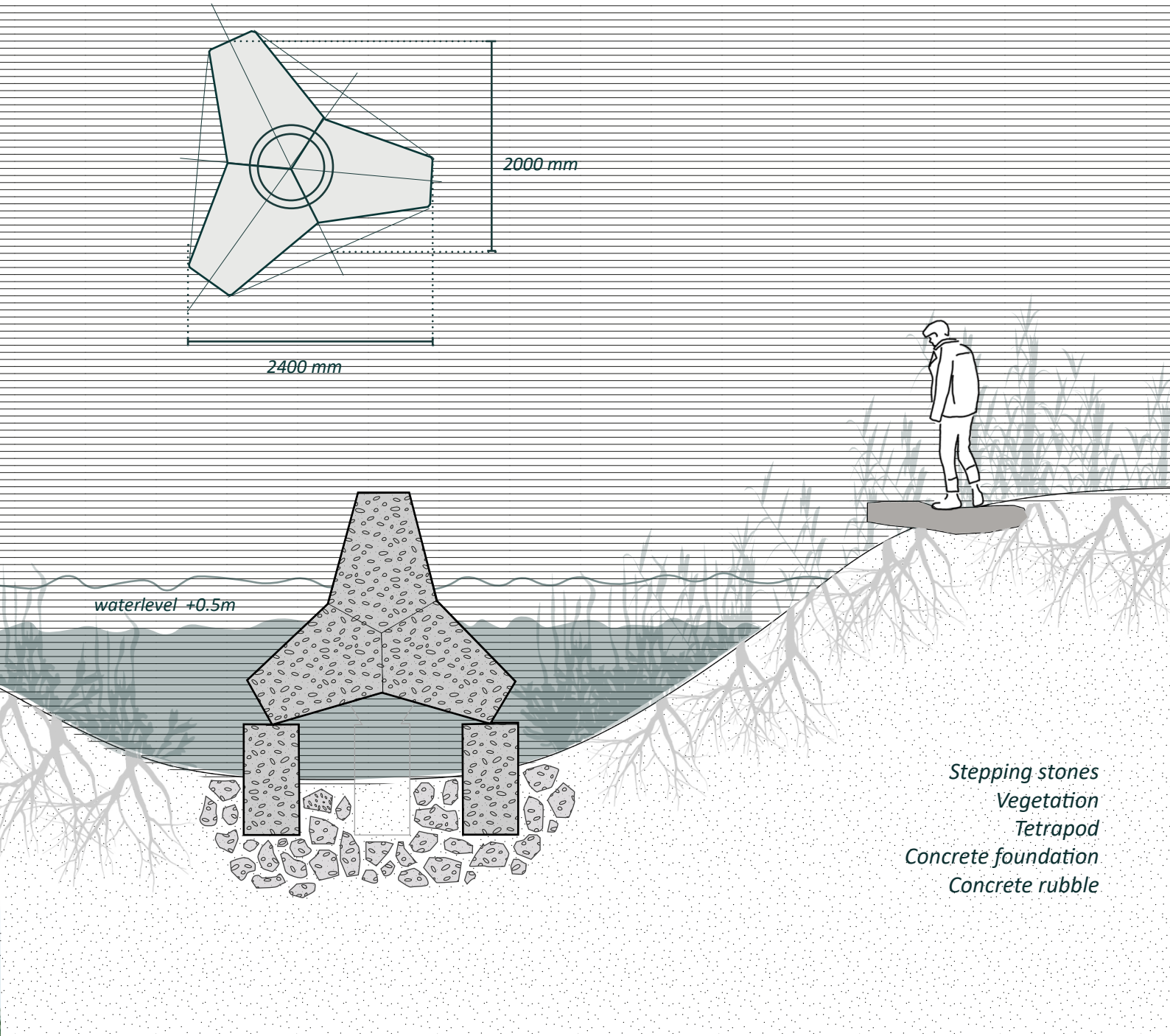
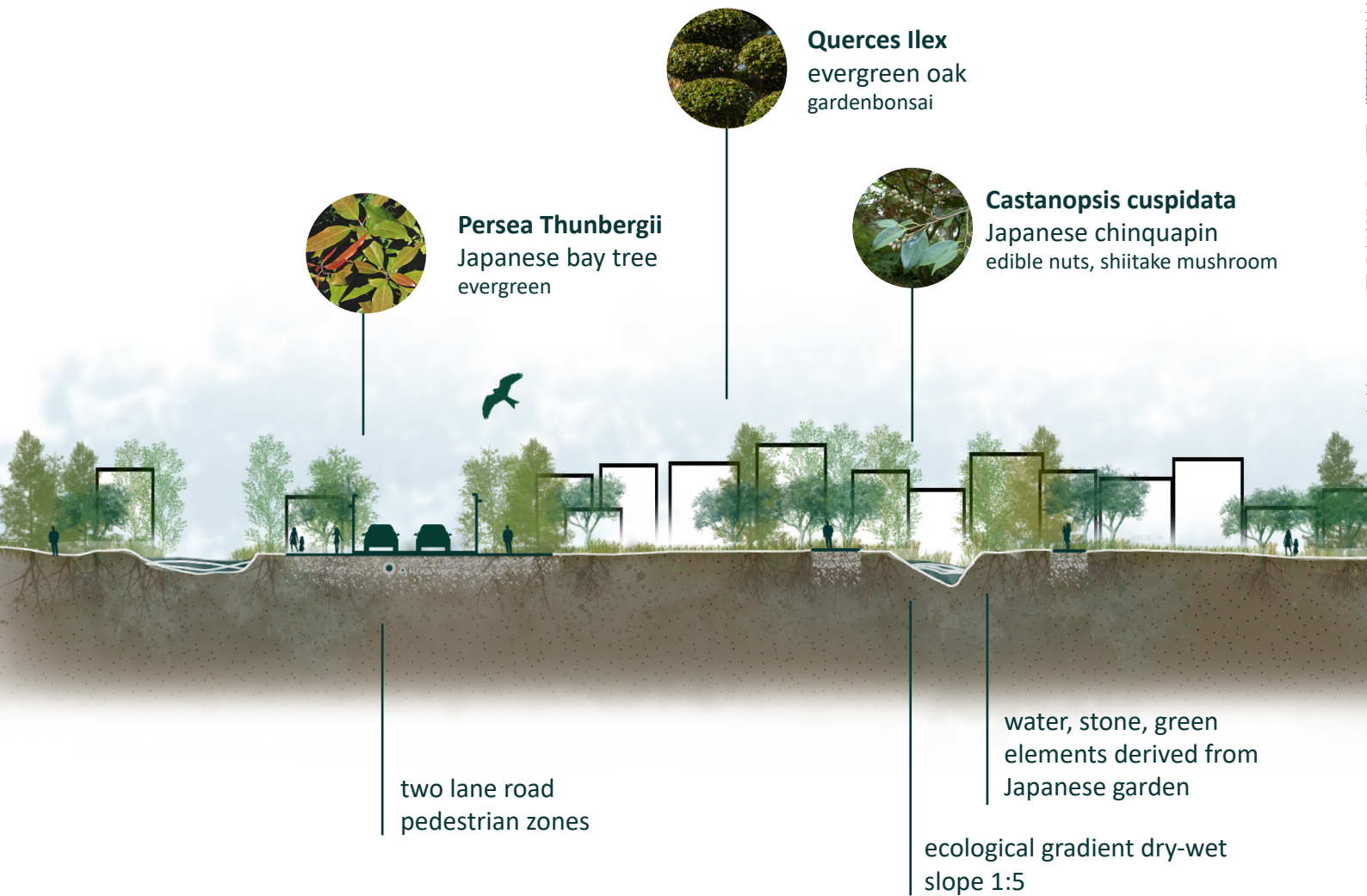
Moreover, by relying on natural processes and conditions to manage water, the landscape gains inherent protective qualities. Rather than depending solely on human-engineered solutions, such as dams and flood barriers, the landscape itself becomes a resilient barrier against flooding and other water-related hazards. In essence, this approach not only enhances the functionality of the urban water system but also fosters a healthier and more sustainable relationship between the city and its natural environment.



Urban landscape
This landscape characterises itself by the long thin green veins throughout the city. Here, design interventions are used to emphasize history in the landscape. History, human activity and urban drainage make for a multifunctional landscape.

Cultural activities can be generated by accurately choosing species to grow in the landscape. The original vegetation of Japan, despite having almost all disappeared due to human activity, has some interesting potential. The Japanese bay tree for example, is perfectly suitable in the streets. The evergreen tree will give a natural character to the city, making for a healthy public space. More room for pedestrians will result in the opportunity for people to experience the landscape more closely. Taking inspiration from Japanese gardens, the evergreen oak will be placed as a reference to the art of bonsai. The Japanese closely intertwined with their history,

so this tree will be respected by the Japanese. Furthermore, the Japanese chinquapin, also native to the area because of its saline resistance, grows edible nuts that can be collected and harvested. The dead wood of the tree fosters an ecosystem where mushrooms like to settle, in particular the shiitake mushroom, a Japanese delicatessen. Combining the public space with opportunities for cultural activity will result in a rich landscape full where humans and ecology comfortably reside.



Detail 1:50

Tetrapods are seen as a monument of cultural history. They mark the reclamation border that runs straight through the city. Even though they still evoke a sense of fear, they also remind us of past times, and a different mindset of the future.



History

Reclaimed land is clearly visible when looking at a map of Tokyo, but not that obvious at eyelevel. The border will be emphasized, respecting Japan's history, giving the people awareness of their history. The landscape can be experienced through time, not only in its current state.

Zooming in further into the historical aspects of the landscape, the border where the land reclamation begins is very clearly visible due to scale differences of the urban fabric. This line crosses the land from the Ara to the Edogawa River, being an opportunity for a canal. This line is emphasized more than the others, creating a strong spine that holds up the structure of the network. The border has important historical significance because it shows where the old coastline was situated. Tetrapods are used to emphasize the historical value of the place, much like a monument of past times. Because this border is relatively far from the sea, tetrapods are not what is expected in this area. The reclamation border will not only be visible from the sky, but can also be experienced as a visitor.

5.3 conclusion

In conclusion, the journey through the intricate landscapes of coastal, riverine, and urban environments has illuminated the multifunctional gradient between natural processes and human interventions. Drawing upon insights from diverse disciplines, ranging from ecological principles to cultural traditions, an interdisciplinary approach to landscape design emerges, one that seeks to harmonize protective qualities with biodiversity, while honouring the delicate balance of these ecosystems.

From the elongated islands shaped by the forces between river currents and sea waves to the intricate gradients sculpted by sedimentation patterns, to the canals that accentuate the cultural history, each aspect of the landscape tells a story of resilience and adaptation. Through innovative practices such as seaweed farming and the cultivation of vegetated floodplains, we unlock the potential for sustainable coexistence, where human endeavors enrich rather than deplete the natural world.

Satoumi serves as a red thread that binds the whole story together, whether it is about cultivating, farming, or experiencing, reminding us of the impact we have on our ecosystems, and how to act carefully. By embracing this management, the landscapes of the future will thrive as an equilibrium between biodiversity, resilience, and cultural heritage. As we navigate the complexities of a rapidly changing world, let us learn from the lessons of the past while embracing the innovations of the present, weaving a narrative of consciousness and reverence for the landscapes that sustain us. Let resilience be rooted into our landscapes once again.



Wadakura-mon, Tokyo, Japan



06

Synthesis

Looking back on the process, **what** can be learned? **How** did the approach help to answer the research aim, and **why**?

A tool to challenge assumptions. It critically analyses an experience. A reflection is subjective and can be personal. In academic writing a reflection helps to relate the research to the scientific world. Other researchers should read the discussion and conclusion and understand how the project relates to future and past research.



6.1 discussion

Scope

The graduation project topic explores the possibilities of a landscape-based approach in preserving and improving ecological conditions of coastal landscapes. The project advocates a shift from threshold to adaptive capacity, meaning a natural resilience which can be learned from applying the landscape-based approach. In essence, adaptive capacity enables systems to navigate within safe operating spaces, avoiding or mitigating the crossing of critical thresholds that could lead to undesirable and potentially irreversible changes. By enhancing adaptive capacity and respecting threshold capacities, we can promote the resilience, sustainability, and long-term well-being of both human and natural systems in the face of uncertainty and change (Van Bergen, 2022). The theoretical framework of Landscape-based approach is constantly explored, educated, and developed within the master track of Landscape Architecture. The track is not only about designing landscapes, but predominantly focusses on thought process that is necessary for these spatial relationships, dealing with the increasingly pressing issues of climate change. An interdisciplinary approach is instrumental to successfully strategize this shift to adaptive capacity, in all aspects of the built environment. Tokyo Bay is a highly urbanised area, calling for a multi-focused approach, considering protective, ecological, and cultural quality. The master programme of AUBS teaches this interdisciplinary way of thinking, in the projects as well as in communication, being an international programme (MSC Architecture, Urbanism and Building Sciences, n.d.). During my trip to Japan, I immediately realised that their view on landscape architecture has a completely different historical evolution than ours. Because of the wealth of western cultures many automatically believe that we know best, but for landscape projects to be successful, I think it is very important to reflect on our ideas and constantly try to prove them repeatedly,



Threshold capacity
learn from the past



Coping capacity
short reaction time



Recovery capacity
build for future



Adaptive capacity
future resilience

Principles how a landscape reacts in a extreme situation

(Van Bergen, J., & Nijhuis, S. (2020))

to make sure you have the best conclusion possible. I think my generation also holds a lot of anticipation towards climate adaptation, so this is the right time to write this report. We all know that climate change is a real threat, which surpasses national and international differences, but the challenge now is how to adapt our built environment to these constantly changing conditions. This project is an example of how to move away from static landscape to a more dynamic and thus resilient landscape. If we give nature the chance to recover by itself, no human interference is needed, and a natural balance will be reached. This implies a healthy landscape within a healthy ecological system. This project shows some inspirational possibilities if we combine the planning of design and the technology of engineering. If we want to be adaptive to climate change, we must change our mindset and build with nature, not against it. Landscape architects have the power and responsibility to surpass cultures and make our home a better place.

Subjectivity

Furthermore, every project is subject to cultural aspects that sometimes are forgotten. This project specifically, tried to copy a theory that is not Japanese by origin, in a site with a rich cultural past. By respecting their ideas about heritage, and specifically landscape architecture, it will not be just a toolbox being spatial, but a full design that takes all stakeholders into account. Therefore, the combination between natural processes and the Japanese culture is so relevant in this project. I think the conscious decision making is so important here. With that I mean the realisation that every site is different, that only a full understanding of the landscape history and landscape logic is sufficient prior to design. Research through design allows for evaluation during the process, which force the designer to deliberately think about choices made and why. In contradiction, subjectivity could play a role here, relying on the designer's intuition and expertise. Subjectivity can be minimized by working in a team. The more interdisciplinary the work, the more subjectivity gets filtered out.

Additionally, subjectivity is something that cannot be prevented, because of cultural bias. My experience in this project was definitively biased. I realised that I had been designing with a western view on landscape architecture, even when I tried to be open-minded toward the Japanese culture. I think I still am open-minded, but that I still miscomprehended some aspects. In the research, tetrapods play a large role as cultural objects, something the Japanese have respect for. In real life, I discovered that tetrapods are perceived as something dangerous, for why would they be placed somewhere that is already safe? The Japanese learned to move away from these objects, rather than being attracted by them. In the design I am using tetrapods as spatial objects to refer to heritage, but I think now that the Japanese would disagree with this mindset. That does not mean I cannot use them, but I would need to tread more carefully around the subject. It can be compared to monuments of war, which can also evoke controversial feelings. One might be triggered by seeing the monument, but that does not mean they are important for society to remember past times. Tetrapods could also play a symbolic role in the landscape. For they are native to the area, they show the nature of the place. So, I can still use them as spatial objects, but I also have to acknowledge that the Japanese maybe would not be encouraged to visit them. For example, it could be seen as a landscape to move through, instead of a place to relax in. To achieve a state of relaxation, the Japanese need reassurance that it is safe to do so, for example by placing permanent objects. These objects would not be placed in a highly dynamic environment, thus stating a safe place to move in. To conclude, design elements can be used to change the perception of the visitor. By placing tetrapods, this would mean a temporary visit, by placing permanent objects such as buildings, this would mean a landscape where people experience a sense of trust and safety.

Future and past research

On the one hand, copying precedence into context until it fits would make for great transferability. The methodology lends itself for doing the same but making it fit for a specific context. In theory, the starting point could be the same for every project. Research through design would show which direction to move in from there. That automatically explains why it would not be great for transferability. The iteration of so many options suggest a solution that fits perfectly, which cannot be translated into a generalisation. I think there is a distinct difference between translating the design or translating a strategy in scientific value. In essence, the methodology can be used in the same sense, but the outcome will be different for every other problem. This project can be an example on working with climate adaptation,

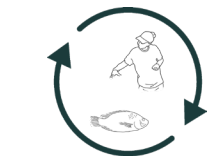
cultural qualities, and ecological importance. Even so, I hope this project can be an inspiration to future generations, on how landscape can provide us the tools for a sustainable future. When enough projects take this approach, there will be lots of different outcomes, each representing a different part on the spectrum of landscape architecture. It is unreasonable to think that this project on its own will make much of a difference, but I like to think that it can spark a new approach towards climate resilience. When together we have established a broad database of similar projects, that database can serve as an example for designing. Like said before, interdisciplinary work filters out subjectivity.

Satoumi

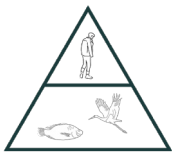
Satoumi describes the balance between human and ecological needs, living with and from the land. Sato means “people living” and umi means “sea” or “coastal landscape”. The Japanese tried to describe the productive relationship, where both landscape and people benefit from each other. It is about the appropriately maintained material circulation, the performance of integrated and comprehensive management of the landscape, and the conservation of diversified ecosystems and natural environments. Ann Whiston Spirn (1984), in her essay “The Granite Garden”, agrees; *‘It is the consequence of a complex interaction between the multiple purposes and activities of human beings and other living creatures and the natural processes that govern the transfer of energy, the movement of air, the erosion of the earth, and the hydrologic cycle. The city is part of nature.’*

This proof argues that we are part of nature, and not two separate entities. Humans knew how to make use of the natural conditions of the landscape without compromising the ecological balance. But what does this mean in the modern world? In the last decades, due to an accelerating growth of population which resulted in rapid urbanisation and industrialisation, we have forgotten to look to the interconnectedness of human communities and natural systems. I want to make a comparison to the essay of Denis Cosgrove (1984), “Landscape as cultural product”, that we have alienated ourselves from the landscape, where a statistical weighting of the landscape value can be achieved. The opposite can be said in non-western cultures, where the feeling and emotions of the landscape become a language themselves. I think the oblivion of interconnectedness of human communities and natural systems is not due to rapid urbanisation, but to the view of western culture on the world. We cannot force our once successful management to function the same in a completely different context. The landscapes Europeans have defined as “natural” are a product of long-term management and maintenance by local communities. The European definition of “landscapes without

human interference” has been proven disastrous for the natural balance. If we look to landscape with this knowledge in mind, landscape quality could be defined as the respect towards natural systems and not trying to control them, but to use them in the way they function best. It can be compared to gardening theory of Nijhuis (2022), where a balance of chaos and control is necessary for plants to flourish. As landscape architects we have a responsibility to let this resilience be rooted into our landscapes once again. Human influence has led to negative impacts on nature in recent times, but landscape architecture can mitigate these influences to protect and preserve nature while designing for the benefit of local communities. It cannot be a coincidence that the gardening theory explains a similar view towards landscape as the Japanese do. By comparing these theories, one can conclude that the knowledge necessary to maintain a healthy system has been known for thousands of years. We should not invent something new but look back to our ancestors and rely on our natural relationship with landscape. A suggestion on how to apply this in practice, might be the use of the spectrum of design and engineering. Design fuels creativity while engineering provides the structural backbone. Successful projects find equilibrium, where innovative design meets the practicalities of construction, ensuring longevity and functionality. Whereas design is the intentional shaping of the landscape, engineering can be unintentional design. If we must believe John T. Lyle (1985), in his essay “design for human ecosystems”, unintentional design very commonly creates difficulties, but I believe otherwise. We just stated that the landscape can take care of itself, as humans we want to find a balance in cultivating. In that regard, wouldn’t it be healthy for the system to not experience full control, but to simply apply the exact amount of human influence? Doesn’t that mean that some parts may be left undesigned, to create, for example, a satoumi landscape?



satoumi
respect towards the
landscape



anthropocene
human acts like a god



multifunctional
landscape gradient
human and nature share
the same landscape

past

present

future

6.2 conclusion

RQ1 // Analysis

How does the flood protection system work and what are the related challenges and potentials from a landscape perspective?

Tokyo has a long and rich history dealing with water in the urban landscape. As early as the 6th century, Tokyo has been digging canals for transport and drainage. In that time, despite the man-made canals, Japanese people lived in a harmonious balance with the coastal landscape. This principle, called satoumi, has been forgotten over the past recent years. Due to the increasing likeliness of excessive precipitation, flooding and storm surges, protection measurements were necessary to keep the citizens of Tokyo safe. As a consequence of urbanisation, the traditional landscape, such as rice fields, slowly started to disappear, expanding the coastline with man-made landfills. An expanding city meant less room for the water, resulting in engineering solutions to flooding problems. Especially after World War 2, which Japan lost, efficient, less costly solutions had priority over preserving the system of the landscape. As a result, concrete can be found everywhere in the urban landscape, especially tetrapods. With their high wave breaking capacity, they have protected the coast of Japan against floods and erosion. Concrete is a cheap, strong material, which can be applied in mass production. In the rivers, at the riverbanks, in the canals, at the coast, concrete has been a multifunctional solution to threats from the water. Although concrete has been effective in protecting Tokyo so far, the outlook is less positive. With concrete being a in a fixed position unable to adapt to its environment, natural processes are being blocked. In a satoumi landscape, the landscape was able adapt to necessary change, whereas now, the landscape is stuck in time. In a scenario of a flooding, the water could surpass the boundaries of the river, flowing into the land, without damaging the city. Nowadays, room for

the water has disappeared, causing immediate overflowing during a storm surge. In essence, by trying to protect Tokyo from flood risk by placing concrete, the risk of flooding has only increased in an extreme scenario.

RQ2 // Strategy

Which landscape-based design principles and strategies can be applied for flood defenses?

The concept of deriving strategies from studying precedence, particularly through case studies, is a powerful approach that allows us to learn from both successful and unsuccessful interventions in various contexts. By understanding the dynamics of natural processes and how they interact with human activities, we can develop more sustainable and resilient solutions for coastal protection and landscape management. One strategy that emerges from this approach is the stimulation of sedimentation and erosion as a means of coastal protection. Instead of solely relying on hard infrastructure like seawalls, embracing the natural processes of sedimentation and erosion can offer a more dynamic and adaptable approach. By allowing sediment to accumulate in certain areas and erode in others, we can create softer edges along the coastline that not only provide natural habitat for flora and fauna but also act as a buffer against wave energy. Furthermore, integrating features such as seabed scaping and aquaculture into coastal protection efforts can enhance the ecological value of the landscape while also serving practical functions. Seabed scaping, for instance, can mimic natural underwater topography, providing habitat for marine life and enhancing biodiversity.

Every strategy serves multiple functions and contributes to the overall quality of the landscape. For example, while gradients may primarily support ecological development, they

also play a crucial role in coastal protection by absorbing wave energy and reducing erosion. By considering the interconnectedness of different elements within the landscape, we can create sustainable solutions that address both human needs and nature preservation.

RQ3 // Design

Using research through design, how can these principles be implemented in context in Tokyo Bay, Japan?

At the core of the design approach lies the influence of sedimentation and erosion processes, which are fundamental to shaping coastal landscapes. An experiment was conducted that simulates the reality, and by strategically intervening in these patterns, such as encouraging sediment deposition to form islands or mitigating erosion, a degree of control can be exerted over coastal dynamics. Aquaculture emerges as a key component in this strategy, serving as both a protective barrier and an ecological enhancer. Placing aquaculture strategically in front of vulnerable areas can effectively dissipate wave energy, safeguarding the islands formed by sedimentation. Moreover, by leveraging the natural gradients created by these islands, ecological diversity is enhanced by introducing vegetation. This not only stabilizes the slopes but also provides habitat and contributes to the overall resilience of the ecosystem.

Incorporating elements inspired by Japanese garden design into urban landscapes further enriches the multifunctional gradient of the landscape. These green corridors not only serve as havens for biodiversity but also offer spaces for human recreation. By drawing upon Japanese cultural influences, both in urban and coastal settings, the landscape becomes a dynamic tapestry that transitions seamlessly from wet to dry, from urban to coastal, and from cultural to protective realms.

RQ4 // Reflection

How does the new landscape relate to protective, ecological, and cultural qualities?

Protection got a new definition in the new landscape. Where protection meant fixed and strong, now it means adaptable and changeable. The flexibility is what makes the system strong. The protective qualities cause a sheltered area between the islands, allowing for more diversity and ecology to thrive. When ecology is stable, the protective quality has increased, and humans are more likely to interact with the landscape, enhancing cultural quality.

It's essential to recognize that the landscape is not something to be dominated and controlled by humans but rather a complex system that we can learn from and collaborate with. By embracing the principles of landscape-based design, which prioritize multifunctionality and the integration of human and natural processes, we can create landscapes that are not only resilient to environmental challenges but also rich in cultural and ecological significance. These are landscapes where ecological quality increases because of protection and cultural quality increases because of ecology.

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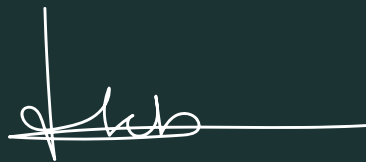
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