MUTUAL INSTRUMENTALITY

Master thesis by
Sonne Andersson

U+A/DL-studio fall 2011
Supervisor: Ana Betancour
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External sensor: Jørgen Hauberg

Chalmers School of Technology, department for Architecture

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During my studies the question of how the urban planning relates itself to the natural elements has been re-occurring. The notion of how we through our instrumental approach to the environment have caused climate change and other kinds of devastating effects on both our own and other species habitats. In what ways has our way of looking at the nature changed from past times (post-industrial) to today? What alternatives can we offer for the future? These questions acts as the starting point of my thesis work.

Historically our standpoint towards nature has been a strictly instrumental one. The value we have ascribed nature has strictly been based on what we have been able to force it to perform in our favor. Since the industrial revolution we have relied on technological solutions to shape the nature that surrounds us to shape the nature into a strict and reliable environment. By studying the shores of the Göta river and the changes they have undergone gives us an insight as to how our demands towards the river has changed to suit the expectations of our different societies from the birth of Gothenburg up until present time.

During the 18th century much of what today makes up Gothenburg was vast fields of reed. These areas served a double purpose. Firstly they functioned as a strategic barrier of defense against political and geographical enemies and secondly the fields also served as buffer zone for the rise and fall of the

Gothenburg water ways 1790[01]

Gothenburg water ways 1820[02]

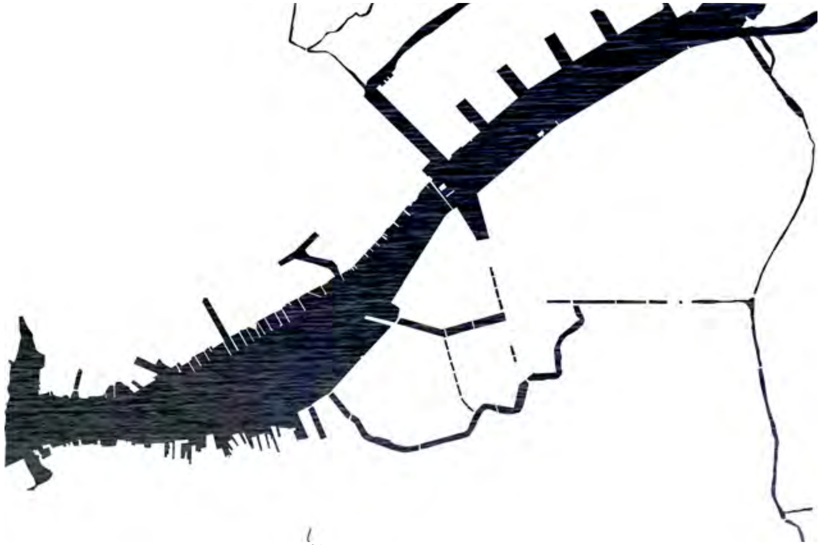
Gothenburg water ways 1860[03]

rivers water level at a safe distance from the walled city. The water served as a barrier of defense also towards the mainland. Double layers of moats kept any attacker at bay. Canals crisscross the city core acting as a constant reminder of the heritage of Dutch planning that is present in the city.

Principally, it can be said that the main purpose of the river is to function as a barrier between the city and its surroundings. A divider that defines the city and differentiates the ones within from the ones outside. At the same time much of Gothenburg gathers its livelihood from the river. The surrounding fisherman villages are engaged in hectic commerce with the city and the contours of small piers can be seen jutting out into the river, reshaping its appearance.

The role of the water as a line of defense gradually declines during the 19th century and the map from the era shows a moat that has been reduced and parts of its extent has been reshaped to accommodate the growing city. The areas that once were defined by city walls can no longer supply enough space for the process of urbanization. Trenching is being undergone to free up even more land for this, resulting in a continuous reduction of the reed lands surrounding the river. Piers on the north side of the river tells of the same process taking place there as well.

The scale of the businesses that has been housed within the city has successively grown over the centuries. The 20th century saw the great expansion (and collapse of the shipyards). These wharfs has, and continues to, influence the self image of Gothenburg. Furthermore they are the main factor that has



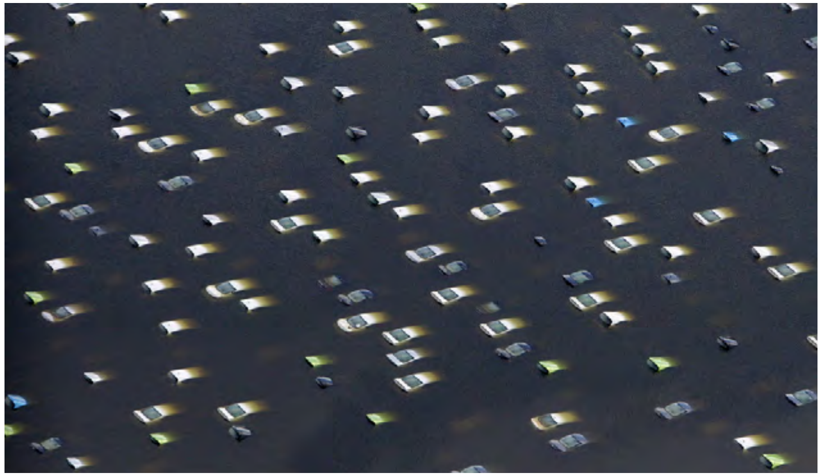
Gothenburg water ways 1890[04]

Gothenburg water ways 1921[05]

shaped the rivers edges into the large scale sites and spaces that they are today. Concerning the urban scale of the 20th century, much can be attributed to the industrial logic that was to build huge freight ships and tankers during a 50 year period in the city. A similar approach was applied to city planning to confront the issue of a rapidly growing metropolis.
A look at the map reveals that the city still had a great deal of contact with the water. The canals that now have been decked to give room for the tram traffic were during this period still in use. The same was true for the canal that connected the river with the medieval city at Lilla Bommen.

The first half of the 20th century meant a much higher level of exploitation of the river banks. Only a narrow belt to the north east along what will later become Ringön still consist of wetlands and reed fields. The reed fields that once used to function as a buffer to the temporary changes in the water level has been replaced by a system of dams and streams upstream along the Göta river. One consequence of this is that the areas that earlier used to interact with the river now has been moved upstream, away from the city. An environmental out sourcing of sorts resulting from the growth of the city.

Eastern Scheldt Storm Surge Barrier, Netherlands[06]



Flooded car-field, Thailand[07]

Actions and consequences

The planning methods that has created the city we are surrounded by is in many ways the reason that we experience climate change. Human activities has affected the amount of greenhouse gasses in the atmosphere. Our excessive use of hydrocarbon fuels, partly relating to our societies dependency on cargo traffic and climate regulating systems. This change is expected to increase its effects over the upcoming century. Along with rising global temperatures the weather is expected to oscillate to a larger degree during the following years. The consequences here in Gothenburg is an increase in the amount of torrential precipitation during certain periods of the year. A projection on the results from this could during the autumn of 2011 be read in SvD, a large Swedish newspaper. Here the climate researcher Per Holmberg claimed that no-one will willingly live in Gothenburg (or anywhere else along the Swedish west coast) in a 100 years.[2] Alongside this the need for new systems to manage our water flows within the city are requested.[3]

A climate that fluctuates between greater extremes will in Gothenburg result in a risk of the water system being overloaded. The systems that today regulates the water level and the water supply will in the future not be able to ensure a steady and reliable climate like that we currently are used to. Countering the more extreme weather with the same approach of brute force, like the solutions we can study in both the Netherlands and in England is only one of several approaches as to how we can relate to the changing climate. In these places, as well as other areas around the globe, huge climate regulating solutions are implemented to stabilize any fluctuation in the environment, to ensure that we are in control of our surrounding. Applying systems with the same logic in Gothenburg may be a possible solution, since the geographic location of the city opens up for this, as the city is located in a river outlet by the sea. Barriers and dams could be important parts of the answer as to how Gothenburg can adapt to the future. However questions regarding the suitability of the solution must be raised. Since water masses may occur from rising sea water levels as well as floods pushing down from upstream as a result of intense rain along the catchment area of the river. Furthermore, the industrial systems, like the Thames Barrier and different storm water surges


Maaslantkering Storm Surge Barrier, Netherlands[08]

Köln Flooded, Germany[09]

in the Netherlands all suffer from a distinct flaw. They are a continuation of the way of relating to the environment that is the cause of many of the problems that we now must tackle. The philosophical issues aside, the dangers inherent in a continuous expansion of urban settlements that rely on a regulated environment are evident in cases when the defense systems break down. The intensity of a ruptured dam is greater and more destructive than a natural flood, and this must also be taken into account when we choose how we desire our urban settlements to relate to its surroundings.

Globally as well as locally the environment is causing trouble in human settlements, resulting in huge human as well as material losses wherever a disaster strikes. The strength and humility that our species show at disasters like these are a great asset and a sign of how far we as a people have come. Nonetheless, one can't deny that many of these problems, aside from both material and knowledge-related poverty, are resulting from a systemic approach that presupposes a steady and fully controlled environment.

Looking forward

Exploring and developing alternatives to the current way of handling climate issues is one of the great challenges for our generation, in order to ensure that we may continue to prosper and develop, as individuals as well as a society. Aside from minimizing the consequences of climate change, handling the effect that inevitably will arise is vital. In our dealing with the environment, maybe we will have to reassess our assumptions as to what we demand from the environment. In reevaluating our current standpoints, we may find new advantages and benefits. Could many of the issues that arise at the horizon today, in the future be evaluated as important steppingstones in a new way of relating ourselves to our surroundings?
The point here is not to find one solution for all cities, but to explore one possible route among the multitude of different solutions that we must develop. Different cities requires different solutions, this is one of many possible path for Gothenburg.

Adapting to flooding, Thailand[10]

Thames Barrier, UK[11]

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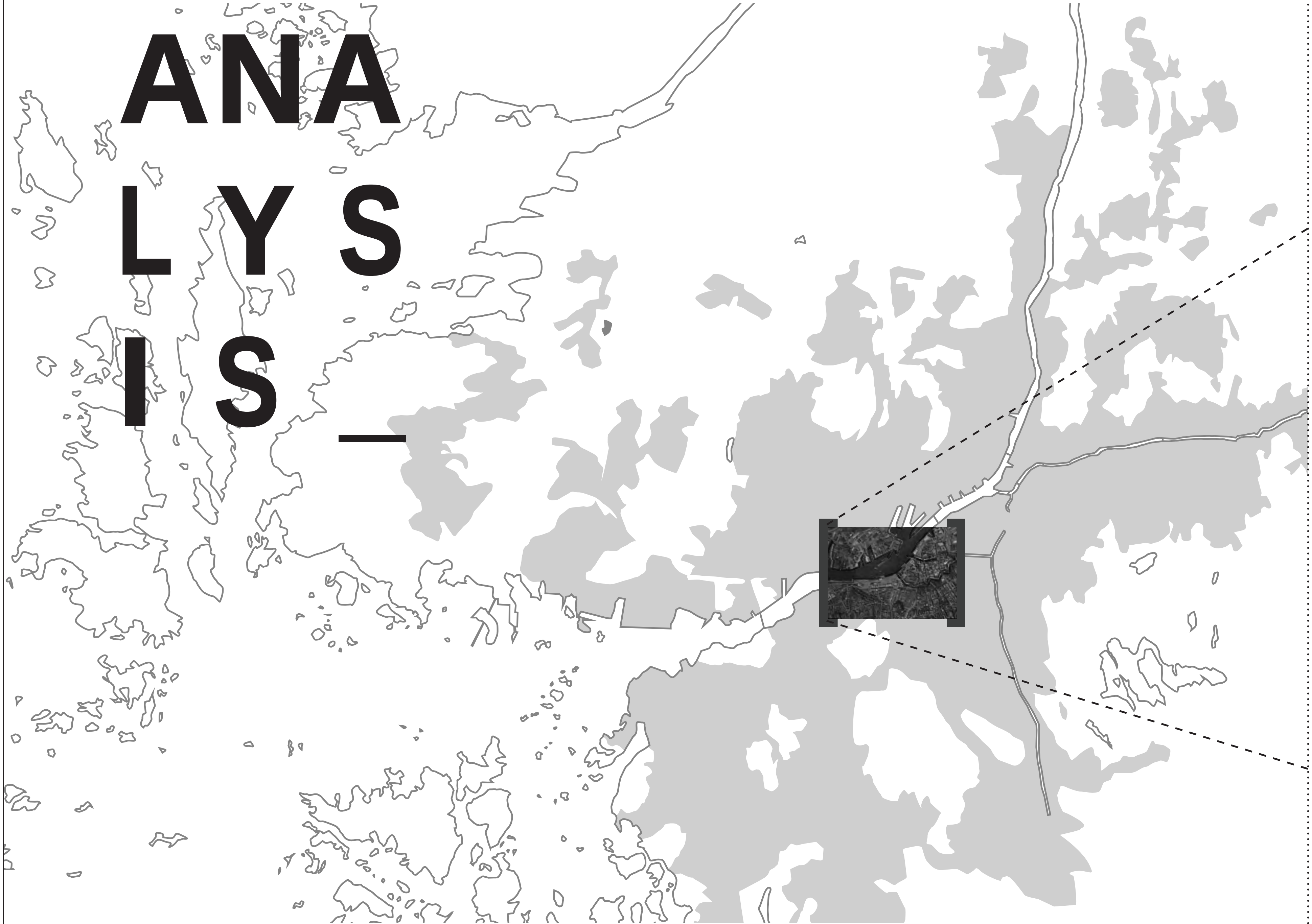


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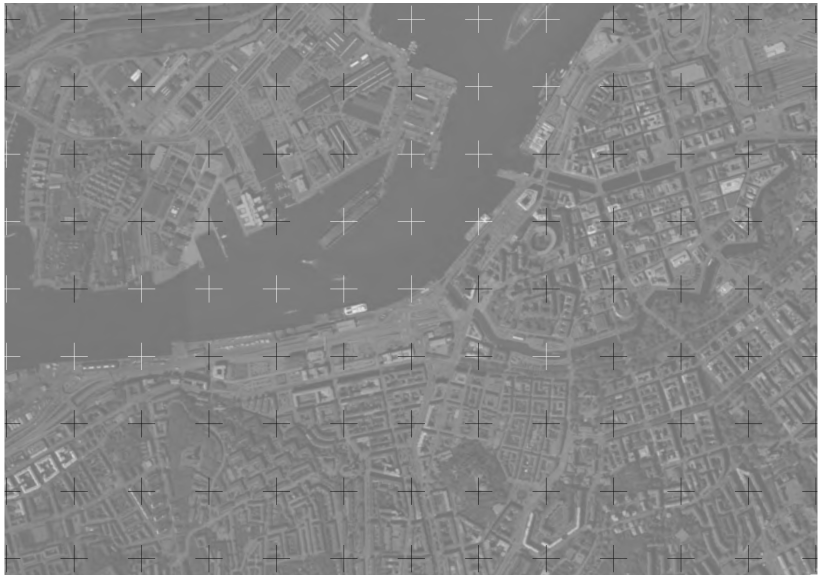
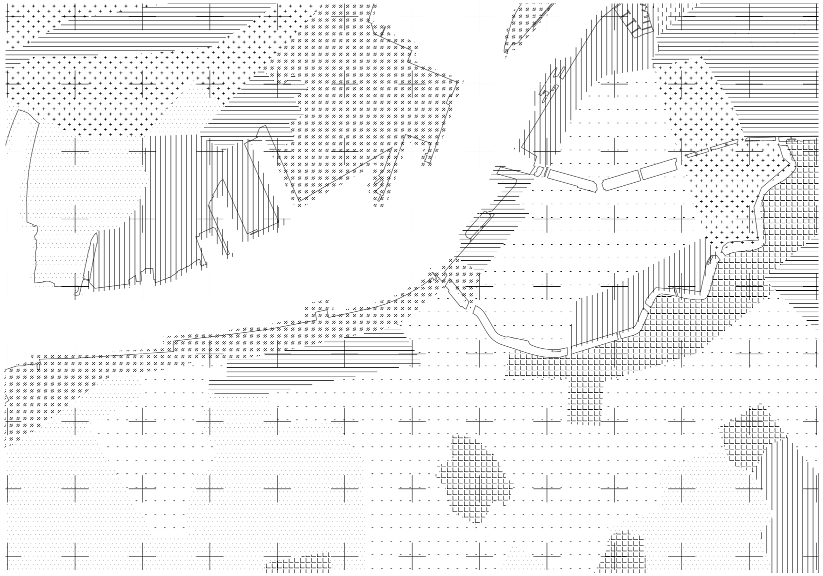


Map of the central parts of Gothenburg, with the river, the piers, the mote and the green hills as the defining elements of the urban situation.

Figure ground mapping of the area.

Location of public places.

Building heigths of the different areas of the city.



Program mixes within different parts of the city.

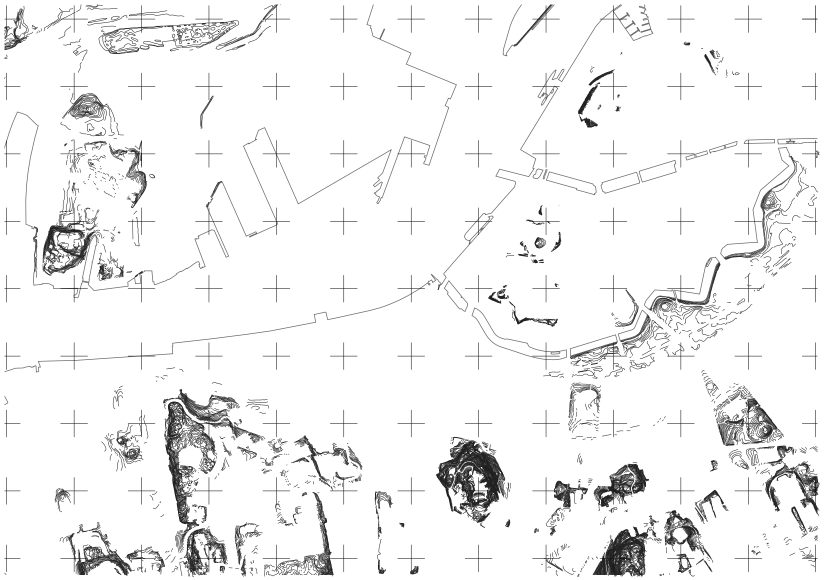
Built structure

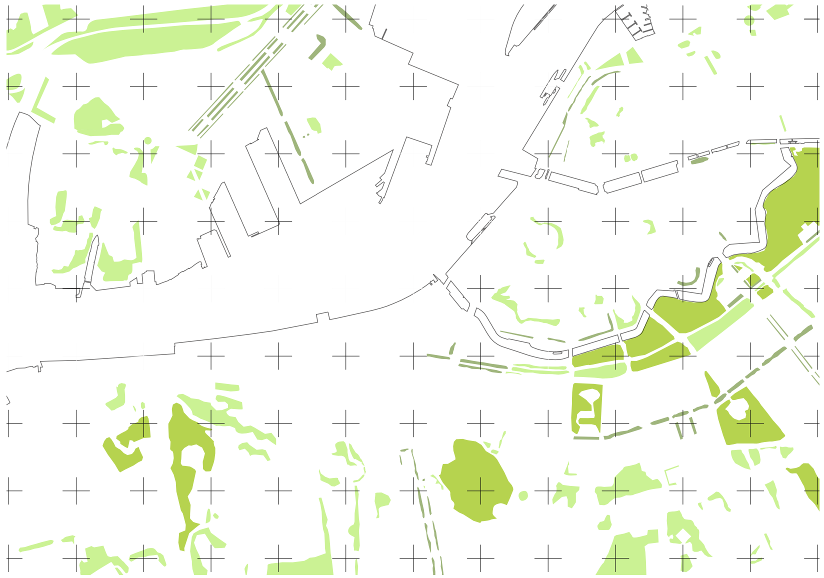
The study area is part of central Gothenburg, a city founded in the early 17th century. Traces if the built structure from this time can still be found throughout the city. As regarding the presence of water in the city center, the moat is often the most evidence one ever gets that Gothenburg is a harbour city.

Much of the city center turns its back to the water and the hill Kungshöjd that is situated between the river and the city core. This has the direct effect that the city is never quite experienced as a river city, even though the city has to cope with the consequences of being one in terms of urban barriers as well as flooding issues etc.

Examining the structure of the built mass, tells a story of how the city, in its form still carries traces of the time when more of the every day life was relating to the water. Big expanses of empty land along the bays tells of loading and unloading of cargo and fish as well as an active ferry-traffic close to the city core.

The compact city with its blocks are mixed up with green and grey spaces with either recreational or infrastructural functions.

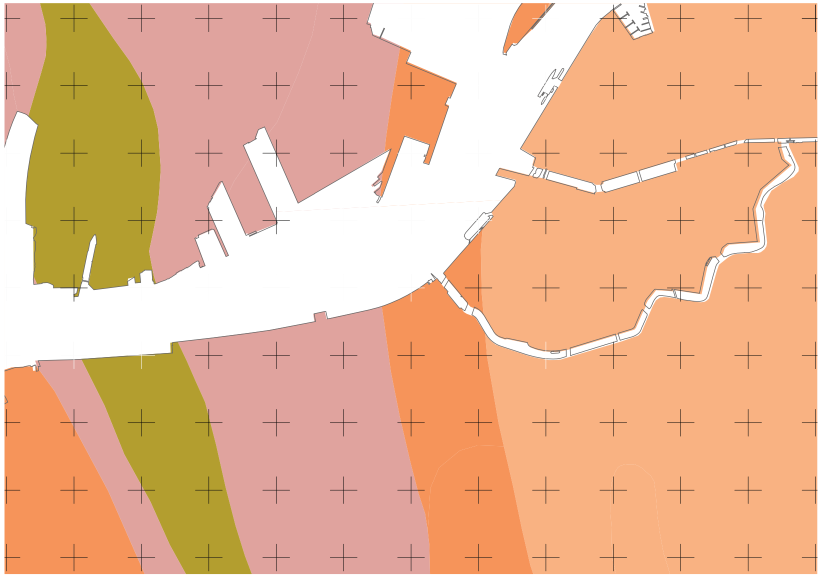

Exposed bedrock and untreated slopes.


Green structure.

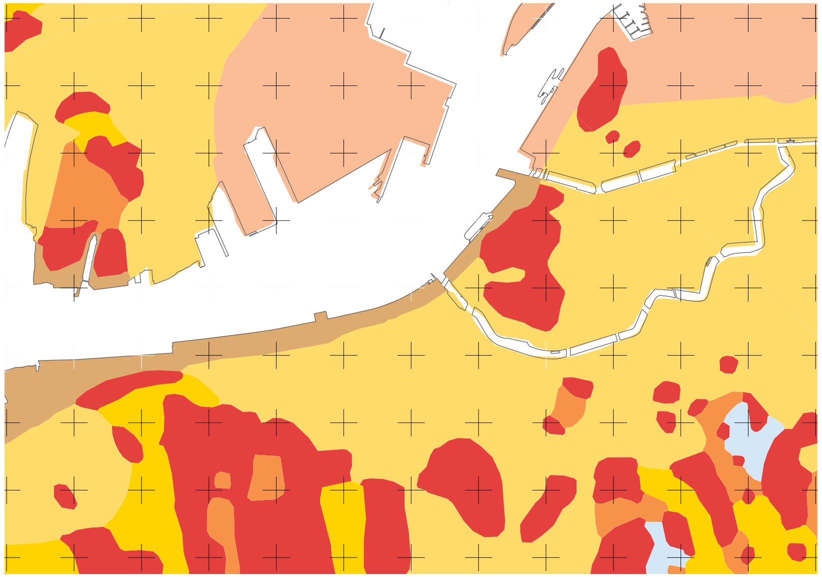
Environment in the city

The environmental systems of the site are both present and not. In themselves they are often passive and silent agents that the city act upon, part of the site as it once was or as it has been turned into by human intervention.
The green structure and the sites with exposed rock are the systems where the interaction between city and nature is the most evident in terms of built mass, but the river and its modified channel also manifest in a very distinct way how human activities has affected the area.
Other systems, like the geologic conditions of different parts of the site are not as dynamic and are therefore considered something that man simply relates to, not being able to influence.

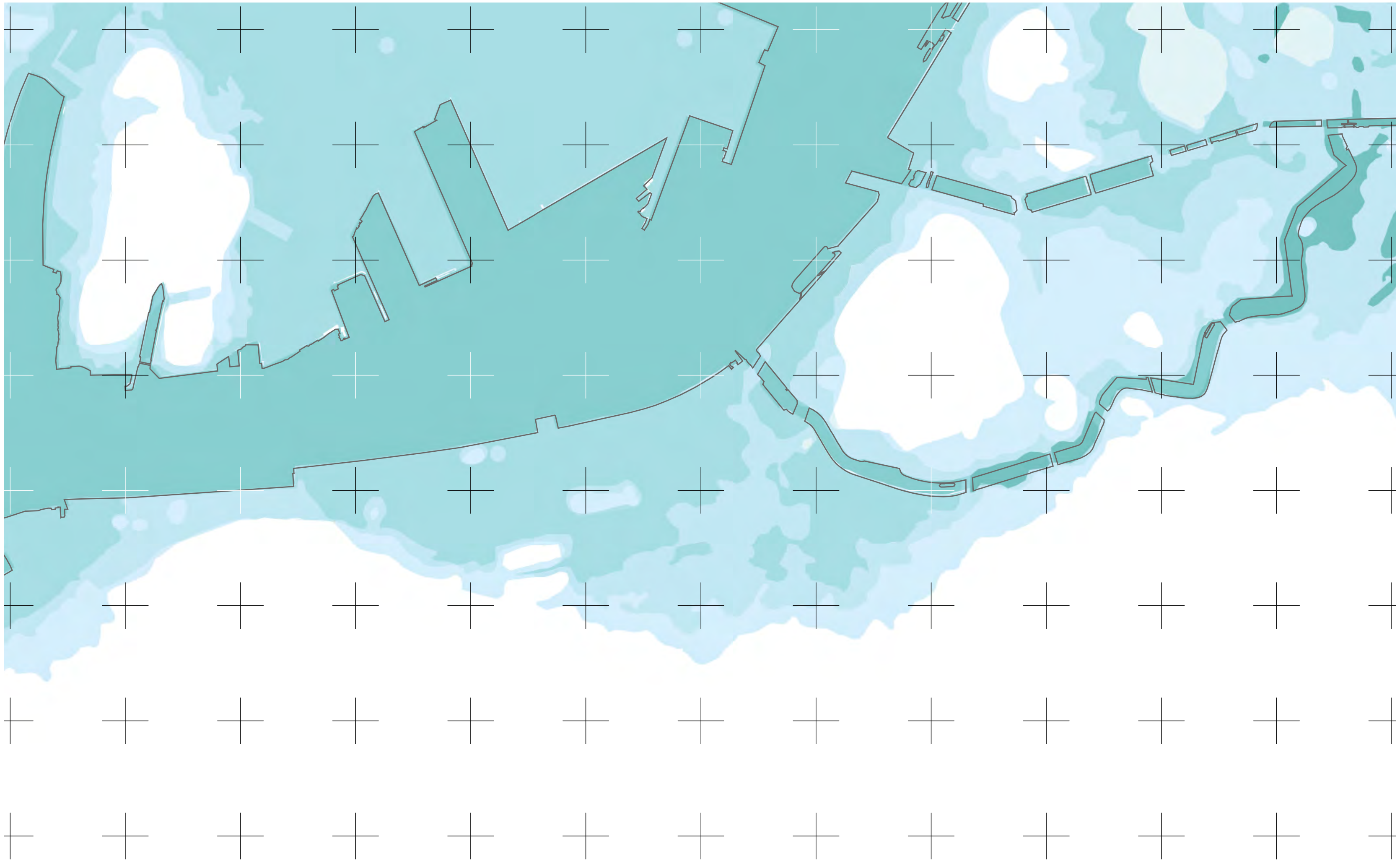
Flooding scenarios are highly relevant to the site and the city as a whole, being a river city. The level of flooding relates to expected sea level rise as well as certain occations of extremely high water flows. Both centennial storms and other kinds of extreme water events are relevant for these projections. The areas influenced by a flood constitute larg parts of the city center as well as much of the river banks, both to the north and south side of the river. Incidentally, these areas are also the ones that are most desirable to exploit for new construction or that already are occupied by valuable property or infrastructure.



Geological data showing the rock-types that constitute the foundations of the city.

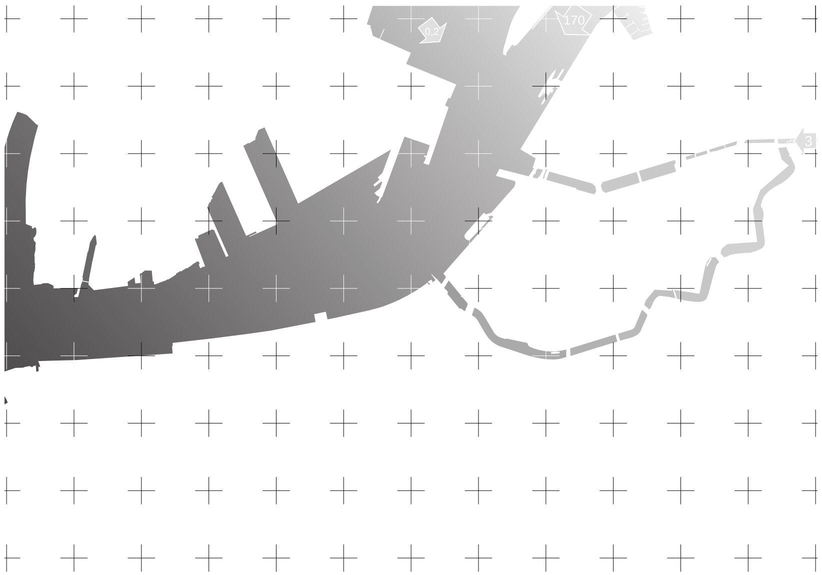


Mapping of the geological data of the city, showing the different kinds of soils, clays and bedrock.



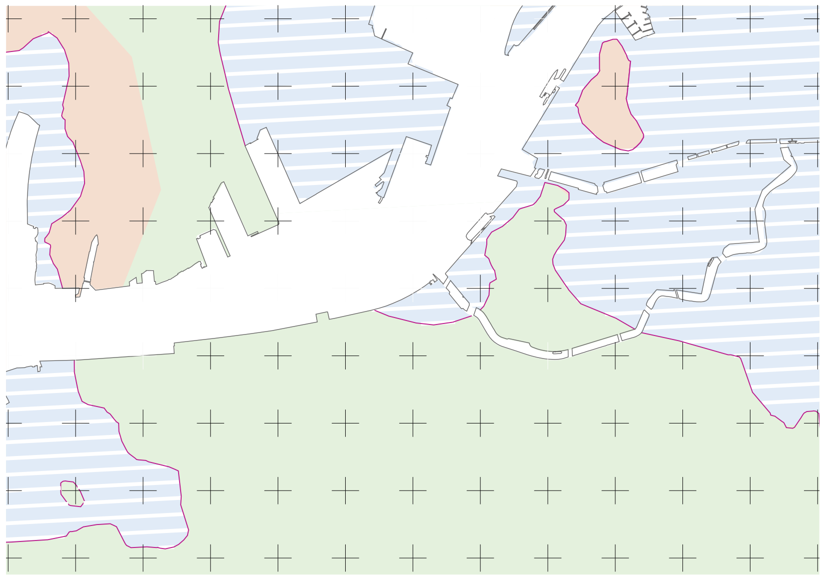
Flooding affected areas at various levels of flooding.

+11,8 m	+12,8 m (+1m)
+12,3 m (+0,5m)	+14,8 m (+3 m)



The river and other water-ways.

Transmission from salt to fresh water



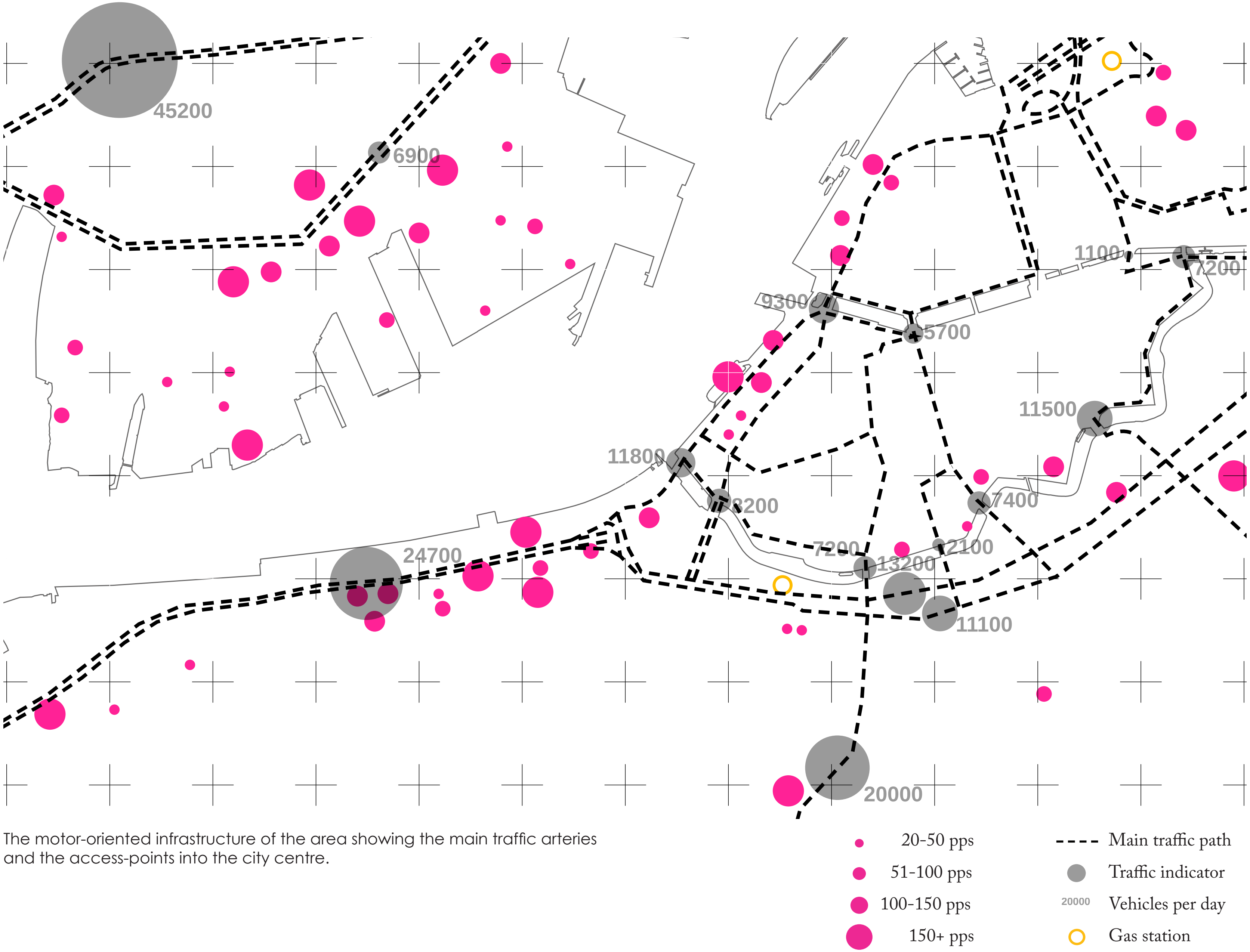
Ground water.

Extraction 600-2000 l/h

Ground water sealed

Extraction 200-600 l/h

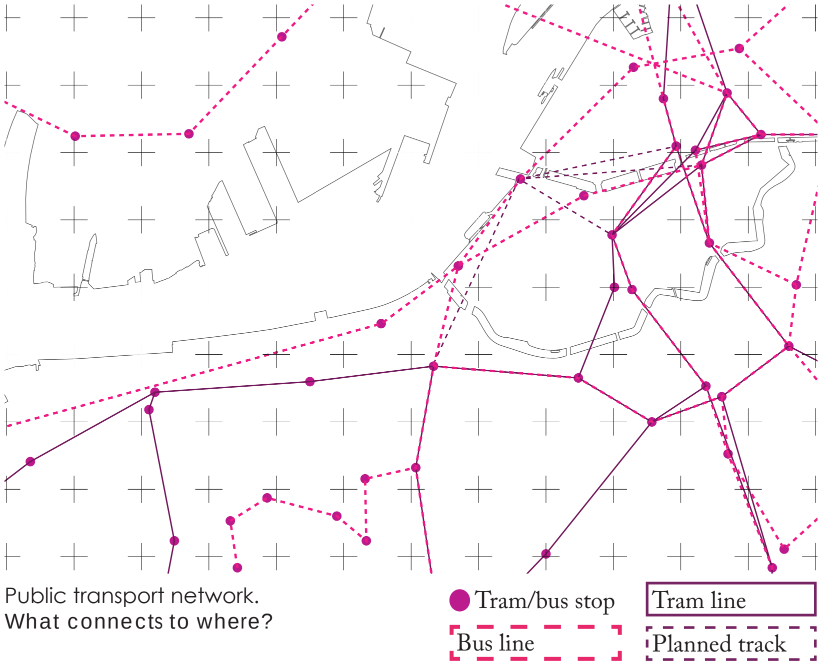
Groundwater basin



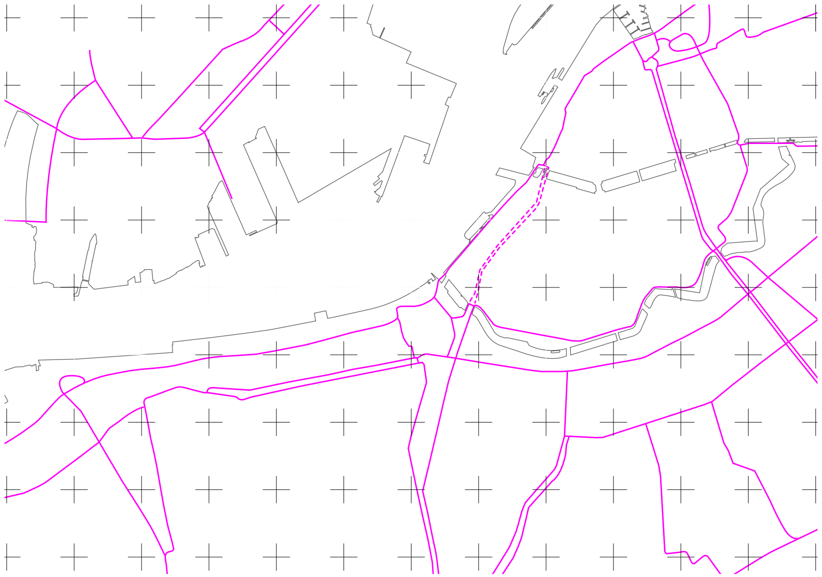
The motor-oriented infrastructure of the area showing the main traffic arteries
and the access-points into the city centre.

Infrastructure

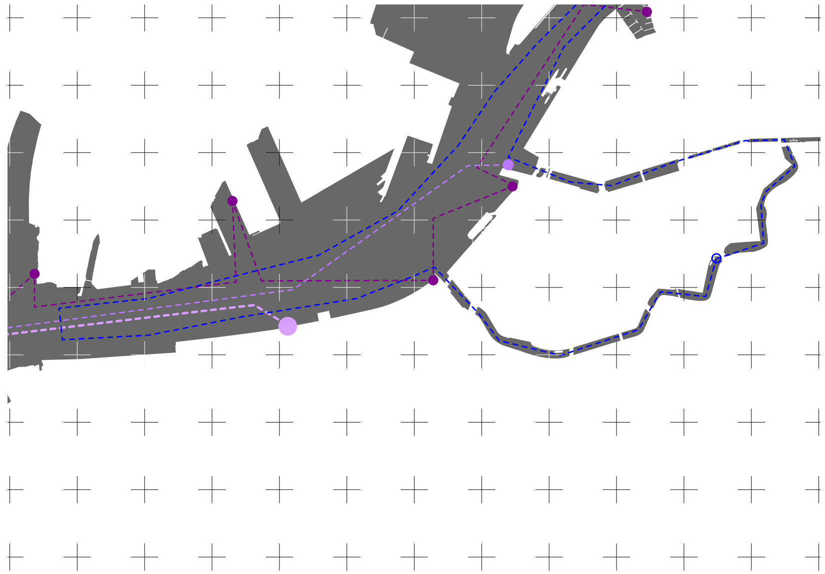
Roads and other means of communication create a city that is either easy to live in, or that make it difficult for its inhabitants to get around.
As far as Gothenburg is concerned, the infrastructure is mainly organized around automotive traffic. Something that could startle visitors, since the automotive infrastructure is neither very accessible or a quick way to get around. This said, the pedestrian network is functioning, although it often is mixed with bike paths without any clear rules as to where whom should be. Pedestrian activity functions well in the city clock structure that make up significant parts of the city, however it is severly lacking in many of the fringes between the separated dense parts. These areas are often where the automotive infrastructure is dominating the site. Many of the car-routes are the source of or intensifyiers to the barriers that divide the city.
The network of bike paths is rether marginalized, relating, and possibly the source to why there are so few people that commute by bike in Gothenburg. Globally and nationally, the infrastructure of Gothenburg is filling its purpose, with train traffic about to be expanded and ferry and freight traffic supplying functioning mass transport.



Public transport network.
What connects to where?



Network of bike paths.



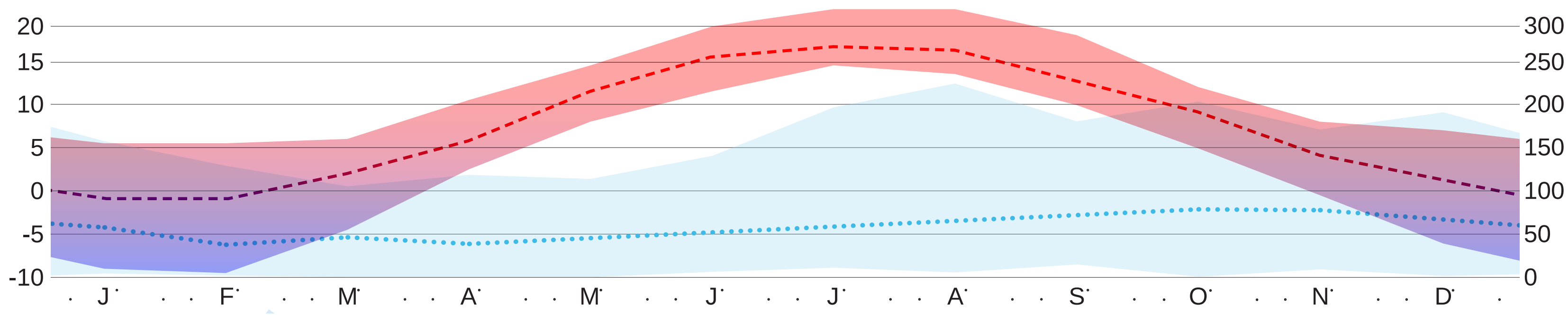
Waterborn infrastructure.

Pedestrian network.

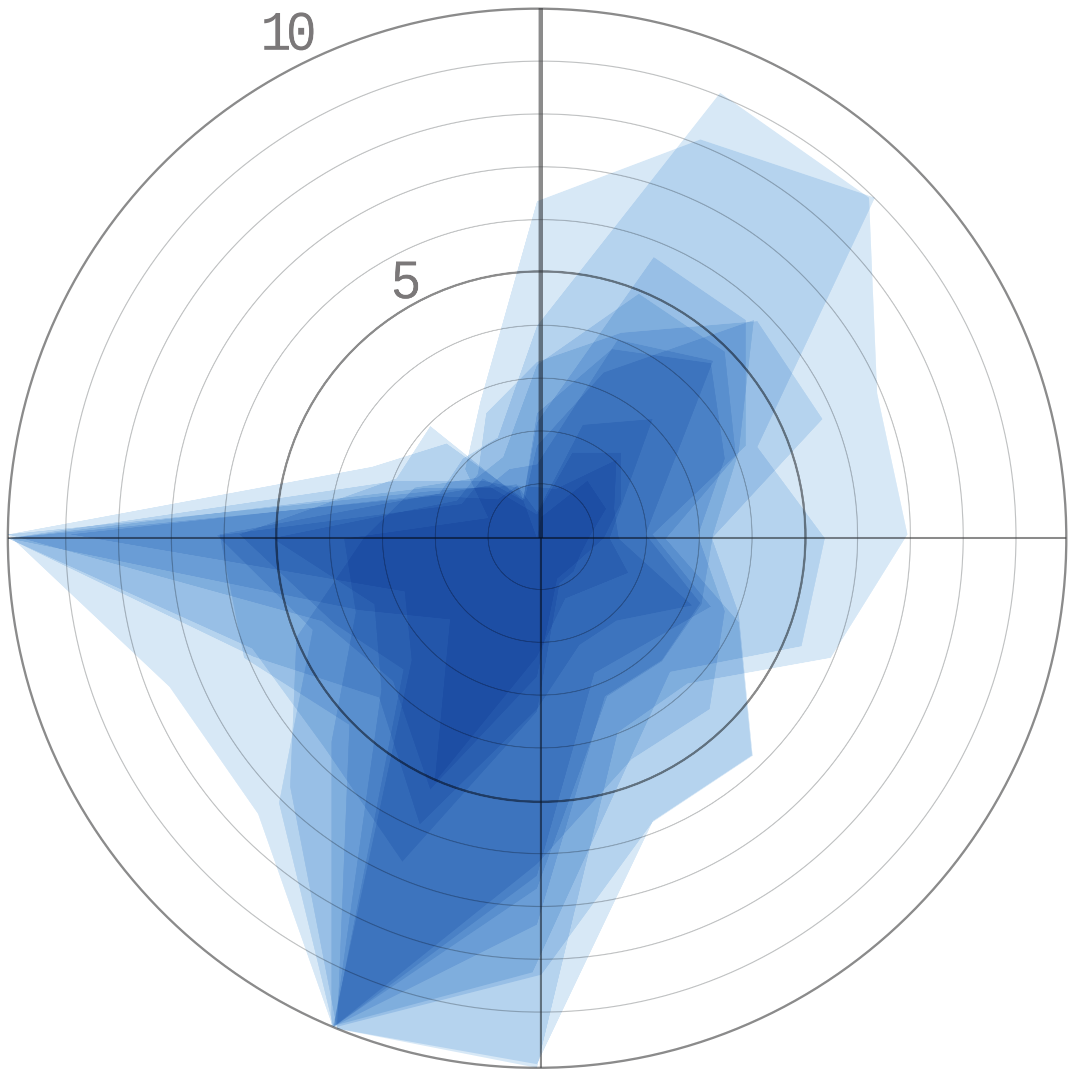
Main commercial streets.

Climate

Understanding the climate is a relevant part of understanding the site as a whole. The fluctuations of the temperatures as well as the amount of rainfall is an essential knowledge to have when planing in a site that is as exposed to the weather as Gothenburg is. This is even more relevant when dealing with the piers and shores of the river. At these locations the climate is allowed to play out its full spectrum. This is the places where the nature is unaltered and sometimes can be considered to be rather raw.
The weather graphs should also be read in relation to the projections regarding future changes in the climate that stipulates that the weather will oscillate more. The wet periods will see more rain, and the dry periods will be even drier. The predictions regarding the wind can be said to follow the same pattern. The winter storms are likely to be even harsher, which in turn will result in higher water levels during the windy periods resulting from sea water being forced into the river mouth.
This will further periodiclly increase the water level, that already is projected to rise during the coming decade. Knowing when this monemtary increase will take place, allows us to understand with a certain level of preciseness when problems with rising water levels will occur in the city.



Annual average (dashed lines) and total interval temperature and rainfall in Gothenburg



Windrose describing the wind speed (in m/s) in different
directions during the months of the average year.

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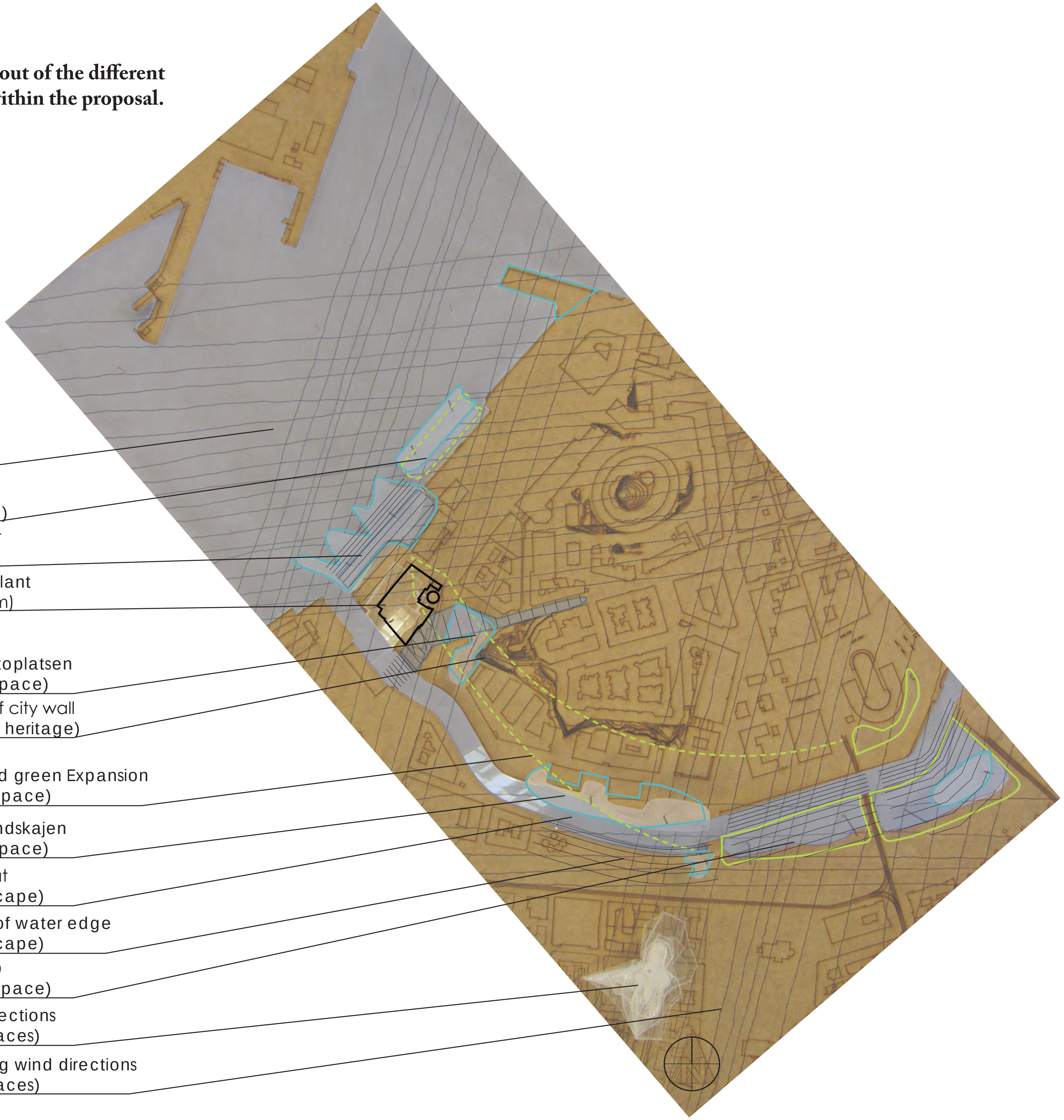
PLOT
What if the project could act as an interface for a new relationship between the city and the elements of nature?

While at the same time act as a bridge between the urban anatomy and the social spaces of the city?

Strategic model
Showing the overall layout of the different zones of intervention within the proposal.



Site photos

Within the site a variety of spaces, as well as approaches to the water can be found. This palette can be improved further, establishing a new relationship to the water within the city.

Many interesting in-between- spaces can be found around the site.

Views to the river is framed in several of the in-between spaces by the district heating plant, but physical access still suffers from earlier emotinal barriers.

The site experiences the constant prescence of water, exposing it to the elements in a very interesting way. This exposure also sets the foundations for a starting point for a social programme that grants access to the river front.

Following Kungsgatan from the city centre, the road runs downhill into the facade of the Rosenlundsverken, making it an excelent situation to connect the bussinesses filled city centre with the service/culture-oriented area around Järntorget.

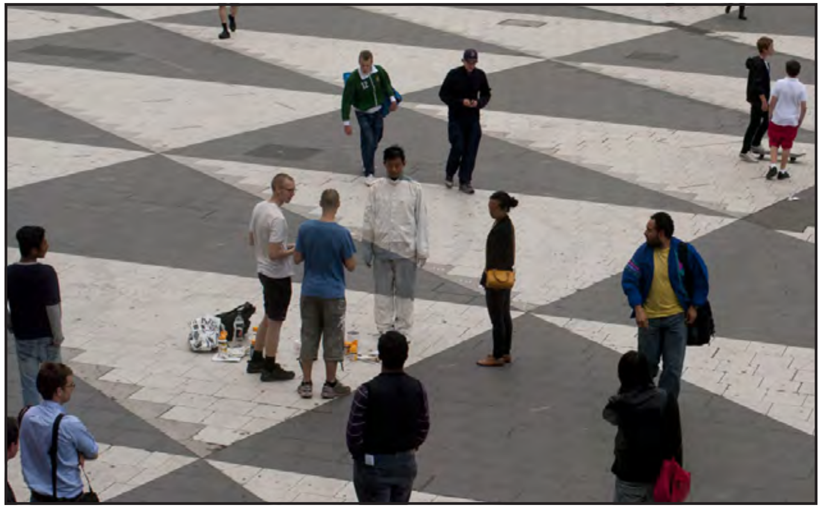
The moat is in many ways the most direct contact that Gothenburg establishes when it comes to the citys relation with water. Working with this body of water to change the perception of the role that water plays in the urban landscape is essential.

When seen from the river the site shows a new face.
The area is suddenly spacious, rather than the narrow and confined urban spaces that cling between the buildings and the water.

The area by Feskekörka is working with narrowing the gap between urban fabric and water, but could be even further developed.

Remains of the old city wall are part of the different traces of Gothenburg history that enrich the area.

Inspiration for the project is collected from the borderland between art and architecture.



The blurring of boundaries is a tool to redefine and reshape the conception of how we define what is the city and what belongs to nature.

Sergels torg (under production)

[Liu Bolin][12]

Re-defining the image of natural processes as well as integrating them into the urban structure effectively shows the benefits that can be gained from them.

Blur Building

[Diller Scofidio][13]

The Intervention that relates to human (urban) stimuli as well as input from the natural elements is a medium to a new appreciation of nature.

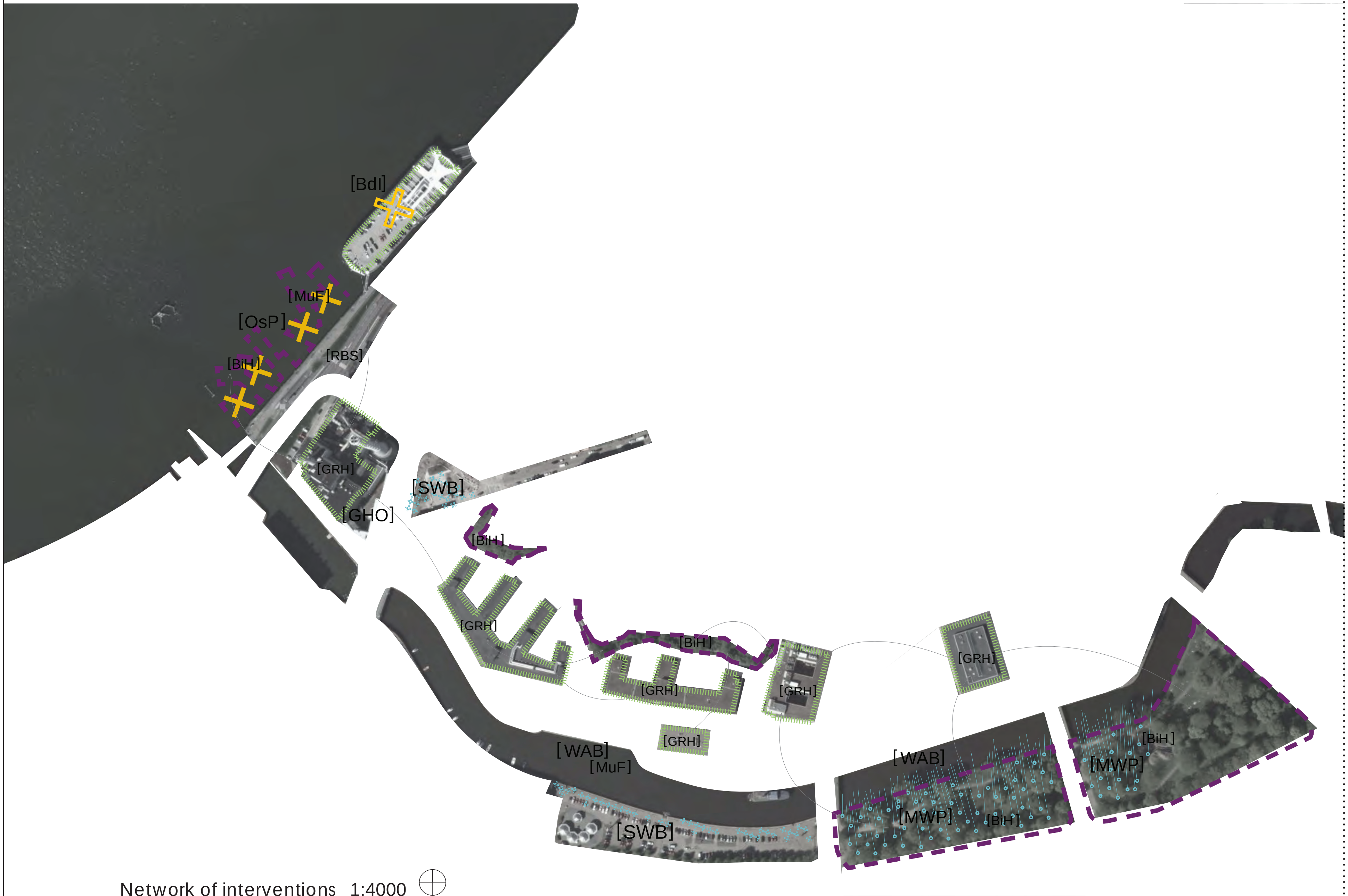
Rhinoceros (Stranbeest)

[Theo Jansen][14]

Could the project invite the urban dweller into the location of activity and open views to the complex reality of the urban situation and offer an understanding of how the city is assembled and interrelating?

Hylozoic Ground

[Philip Beesley][15]



Network of interventions _1:4000

[OsP]

Osmotic Power Plant
The power plant utilise the potential energy in the transition of fresh water to salt water to generate electricity.[16]

[BdI]

Biodiversity Incubator
P-arken is transformed into a mobile floating park, that can be used to infuse ecosystem-boosts wherever it is placed.

Adaptable Architecture Gallery [Taller 301][17]

[MWP]

Mist Water Purifier
Water from the moat is distributed like a cloud of mist over the park, to irrigate the parkland while purifying the water.

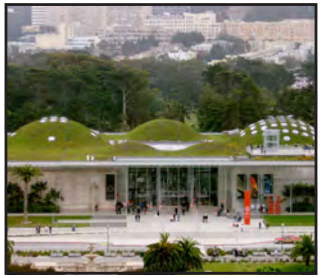
Diagonal Mar Parc [Enric Miralles][18]

[BiH]

Bird Habitats
To enable birds establishing new territory in the area, new habitats is ensured, both naturally and artificially, incorporated into built structures.

Spontaneous city [London Fieldworks][19]

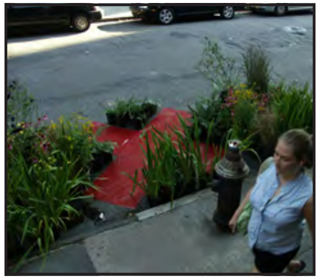
[GRH]



Green Roof Habitats offer space for biodiversity within the citys existing shape, without compromising the citys existing patterns.

California Academy of Sciences [Renzo Piano RPBW][20]

[SWB]



Surface Water Basins
Small scale water treatment stations inserted into the landscape to treat the surface water quality to affect the local water quality of the moat and river.

NoPARK, NYC [Environmental health clinic][21]

[MuF]

Mussel farms are introduced as purifying filters to improve water quality, while at the same time supplying nutrients for the city dewllers.[22]

[WAB]

Water Access Bridge
Bridges and stairs are introduced to bring people closer to the water and strengthen the notion of Gothenburg as a river city.[23]

[RBS]

Reed Bed Square
Between the osmotic plant and the district heating plant a new transition from water to town is established. [24]

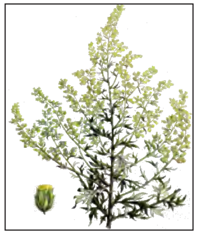
[GHO]

Green House Office
Housing the new offices for the district heating company as well as educational hydroponic farming. [25]

Ecosystem restoration 1
Flora
As an innitial step in the biosystem restoration process, green roofs are inserted. The roofs are planted with seeding plants, native to the region. These roofs will act as an extension of the green belt, and improve the biodiversity in the city centre.

Seeding plants


Cornflower
Centaurea cy-anus


Mugwort
Artemisia vulgaris


Dandelion
Taraxacum


Common Fumitory
Fumaria officinalis


Common Groundsel
Senecio vulgaris


Cowbane
Cicuta virosa


Sow Thistle
Asteraceae


Shepherd's-purse
Capsella bursa-pastoris


Field Penny-cress
Thlaspi arvense


Goosefoot
Chenopodium

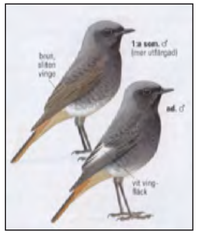

Chickenwort
Stellaria media

Ecosystem restoration 2
Birdlife
A range of bird species has, in cooperation with an ecologist and ornithologist been identified as having potential to be restored into the urban ecosystem.

Inland birds

Lanceolated Warbler
Migratory
Insectivore

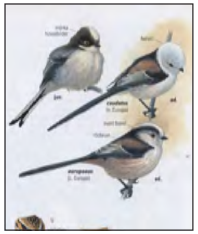
Pied Flycatcher
Migratory
Insectivore



Black Redstart
Migratory
Insectivore

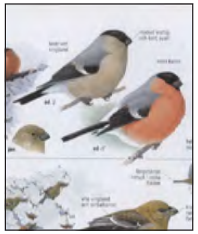
Willow Warbler
Migratory
Insectivore

Short-toed Treecreeper
Sedentary
Insectivore



Long-tailed Tit
Sedentary
Insectivore

Eurasian Nuthatch
Sedentary
Insectivore/ Granivorous



Eurasian Bullfinch
Sedentary
Granivorous/ (Insectivore)

Shore birds

Eurasian Oyster-catcher
Migratory
Seafood/ Insectivore

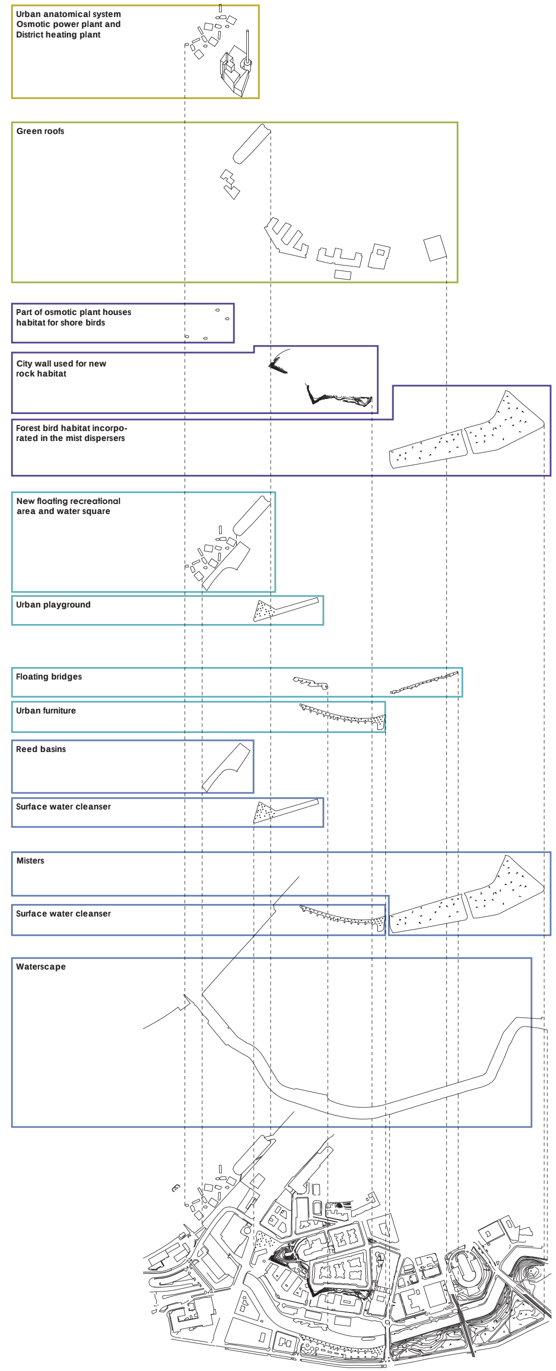
Little Grebe
Migratory
Lesser fish

Whooper Swan
Sedentary
Water plants

Common Kingfisher
Sedentary
Lesser fish

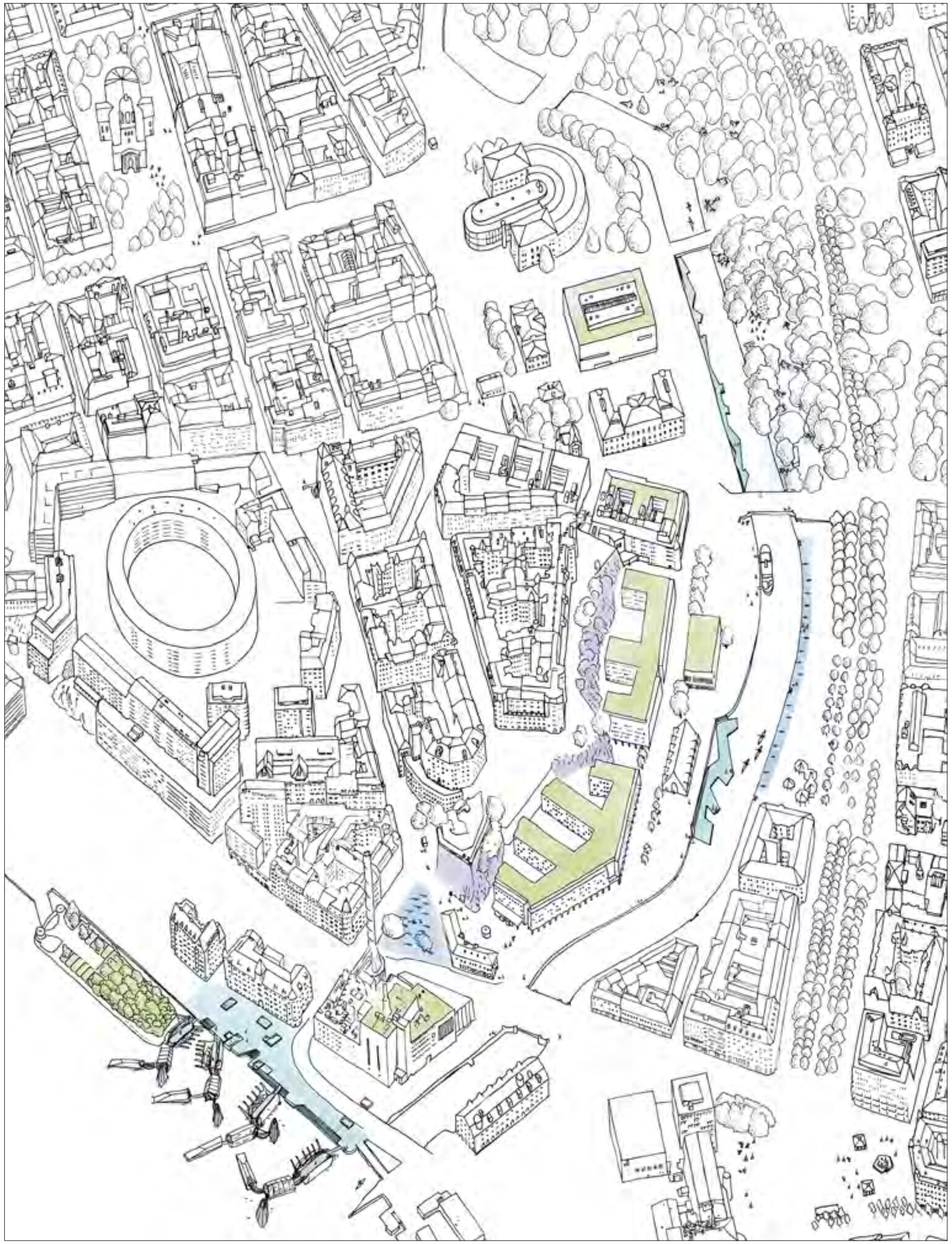
PRO POS AL_

Exploded Axo

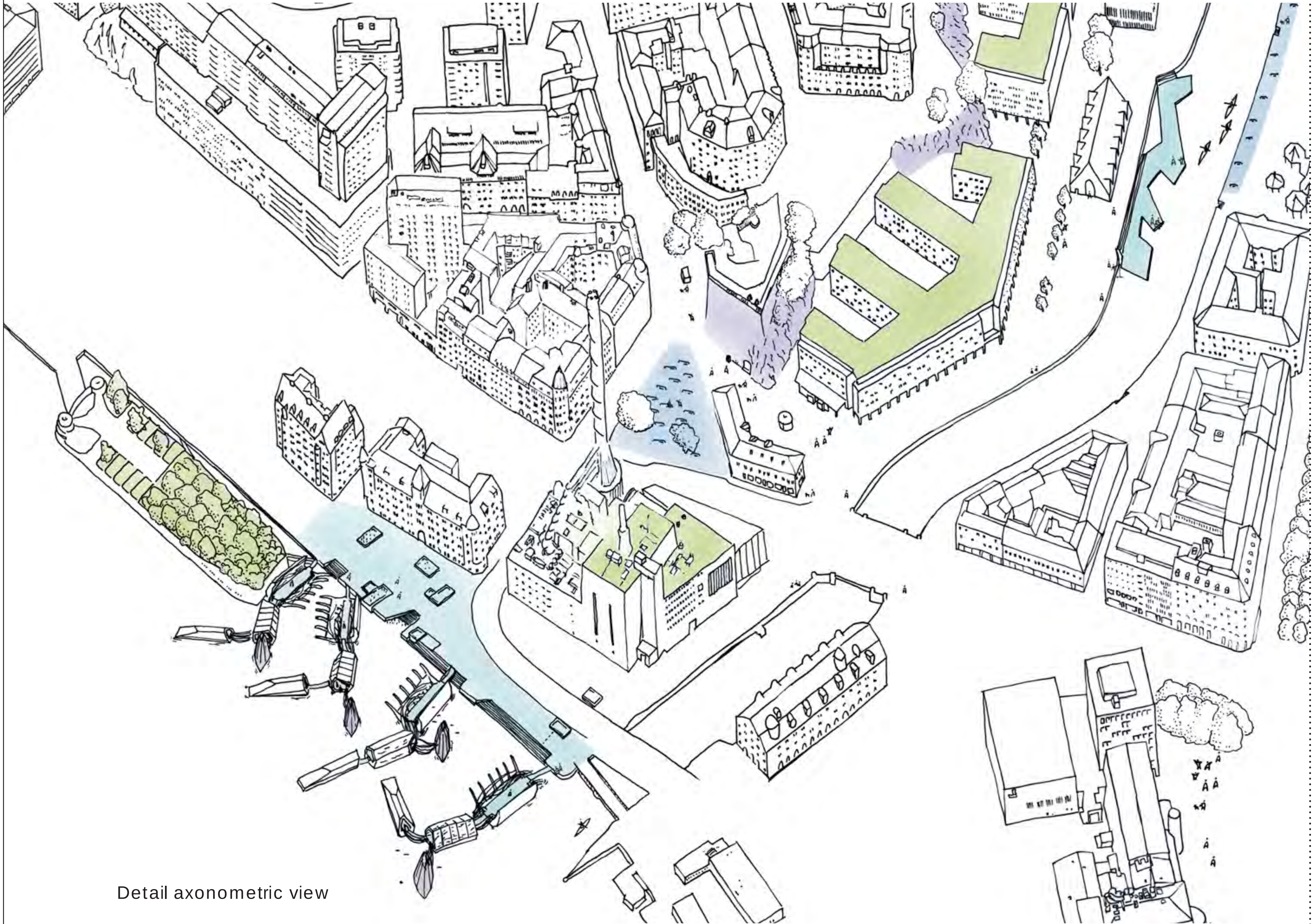


Parts forming a whole

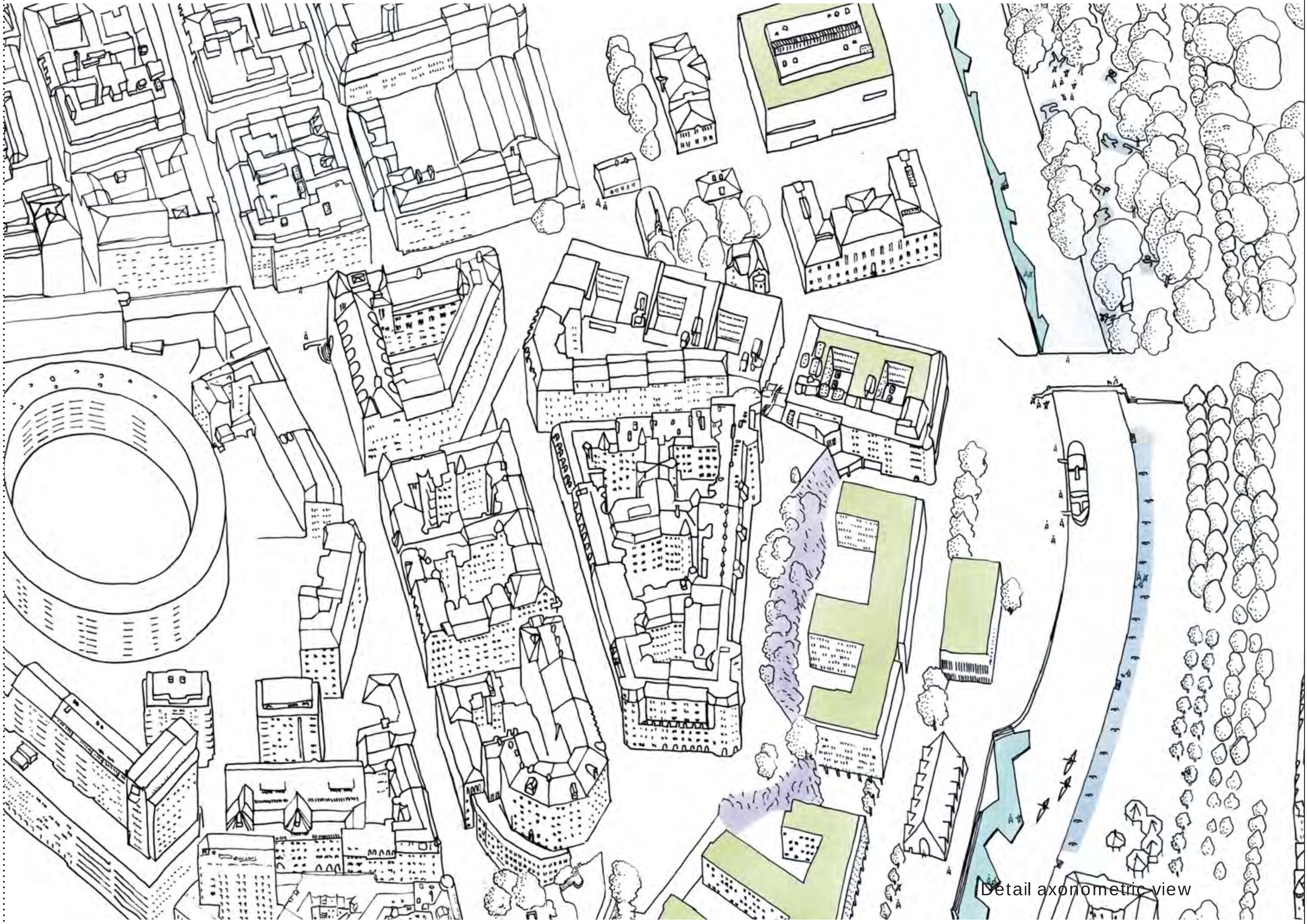
At various places in along the stretch of intervention different sets of programmatic functions are inserted. Many of the functions work as parts of networks that relate to similar issues or questions.
The moat and the water ways of the site is the starting point. Originating from this is a series of water purifying systems. The systems manifests itself in the shape of water pipes that drag water from the moat and distribute it in the park belt along the moat, using the natural purification of the soil to clean the polluted water or as water cleansing buffers along the narrow parking space to the south and Esperantoplatsen. Reed basins along the river also serve the same purpose along the promenade along the river.
New social spots are inserted, to intensify the contact with the water, both at the moat and by the river.
On both sides of the moat the urban structure is used to incorporate new biodiversity boosts. Bird habitats are improved and green roofs planted with native plants help strengthen the biodiversity of both plans and insects in the area, reshaping a functioning ecosystem both on land, in the air and under the water surface.
In front of the district heating plant the osmotic power stations harvest energy that is fed back into the grid as well as being used to light the site and directly communicate the energy output.



Axonometric view from west



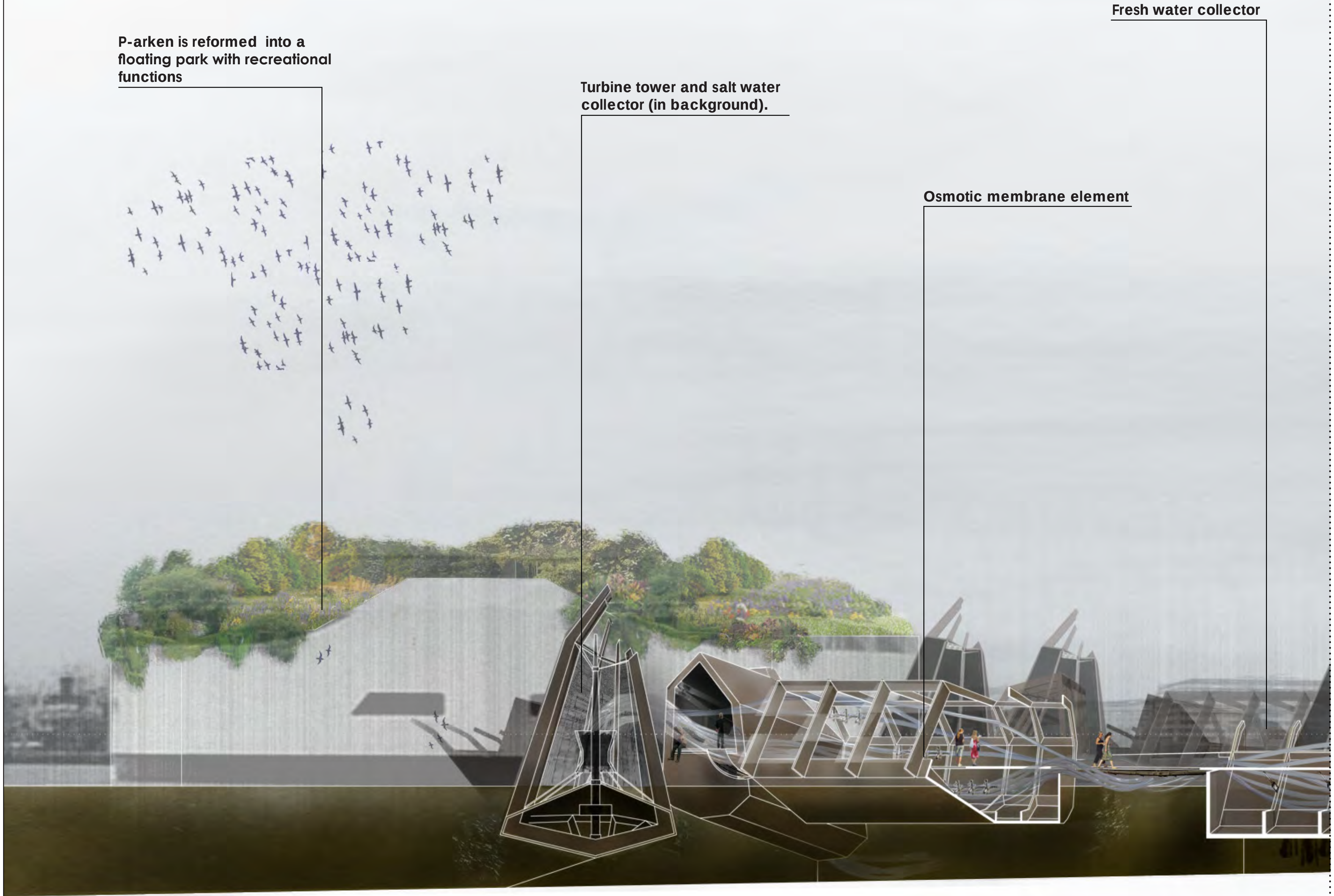
Detail axonometric view

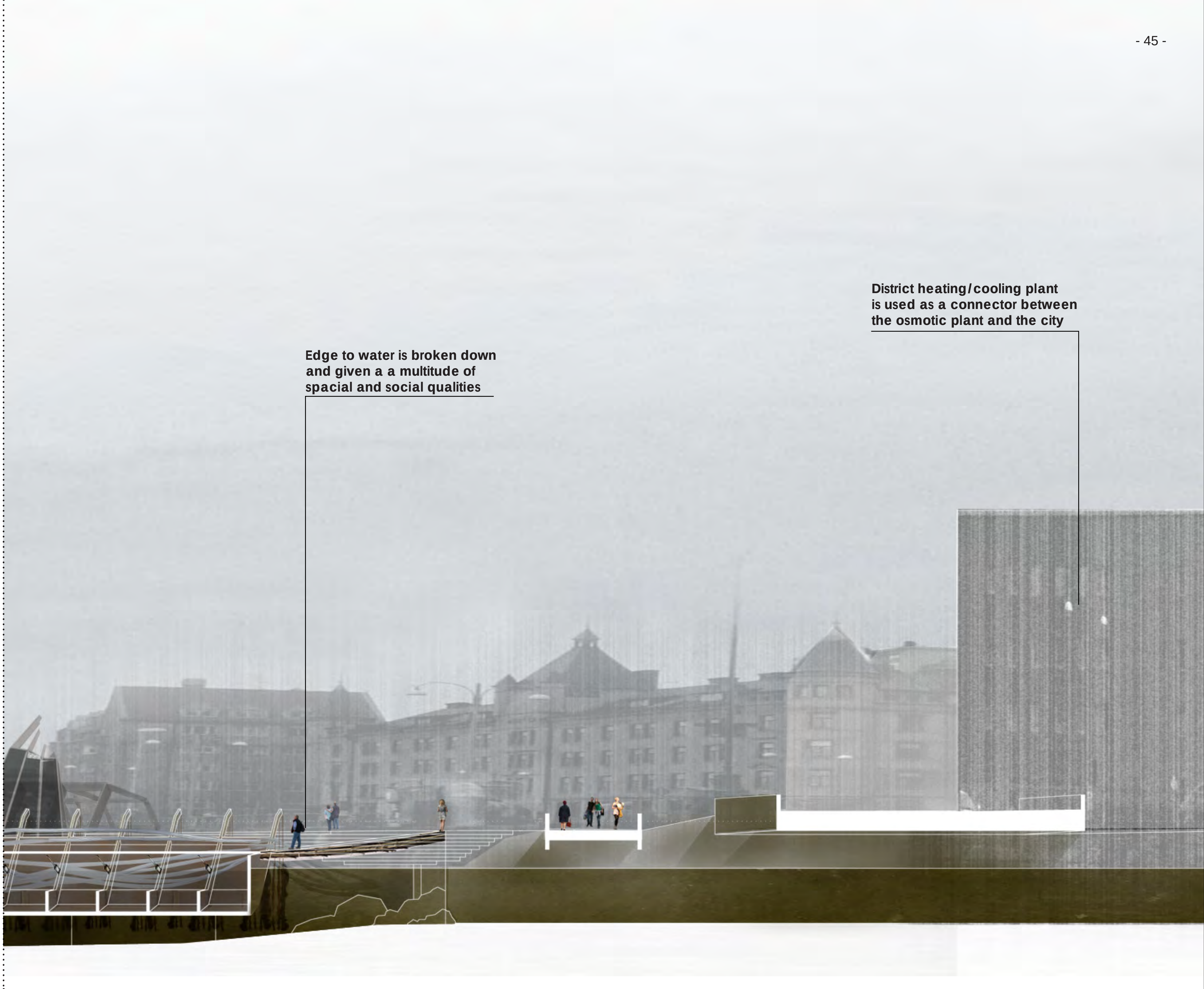


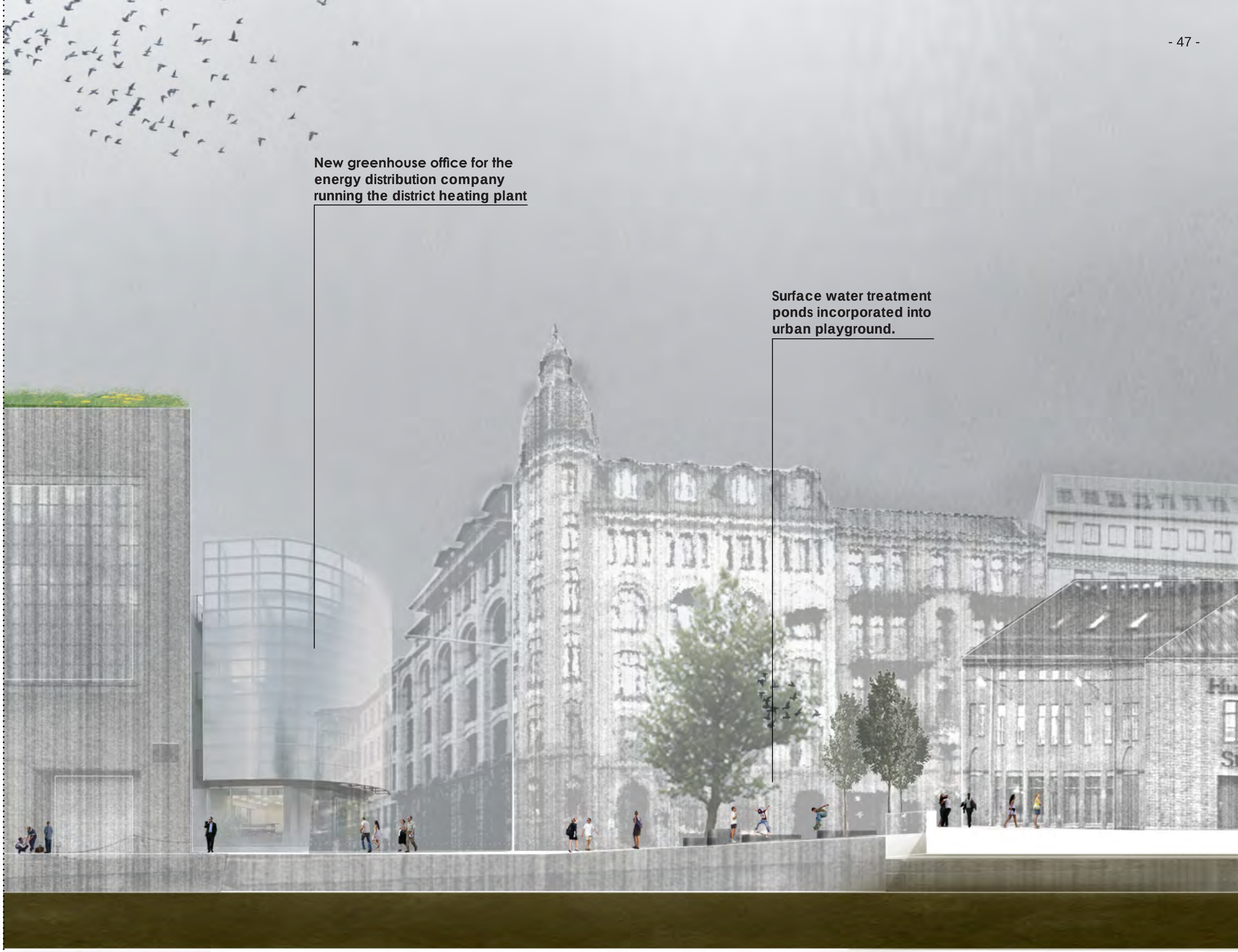
Detail axonometric view

Spacial section _1:1000

Spacial section _1:250




District heating/cooling plant
is used as a connector between
the osmotic plant and the city
Edge to water is broken down
and given a a multitude of
spacial and social qualities


New greenhouse office for the energy distribution company running the district heating plant
Surface water treatment ponds incorporated into urban playground.


Sun off


Green roofs to improve
urban biodiversity


Cliff wall with nests
to improve the living
conditions for birds.

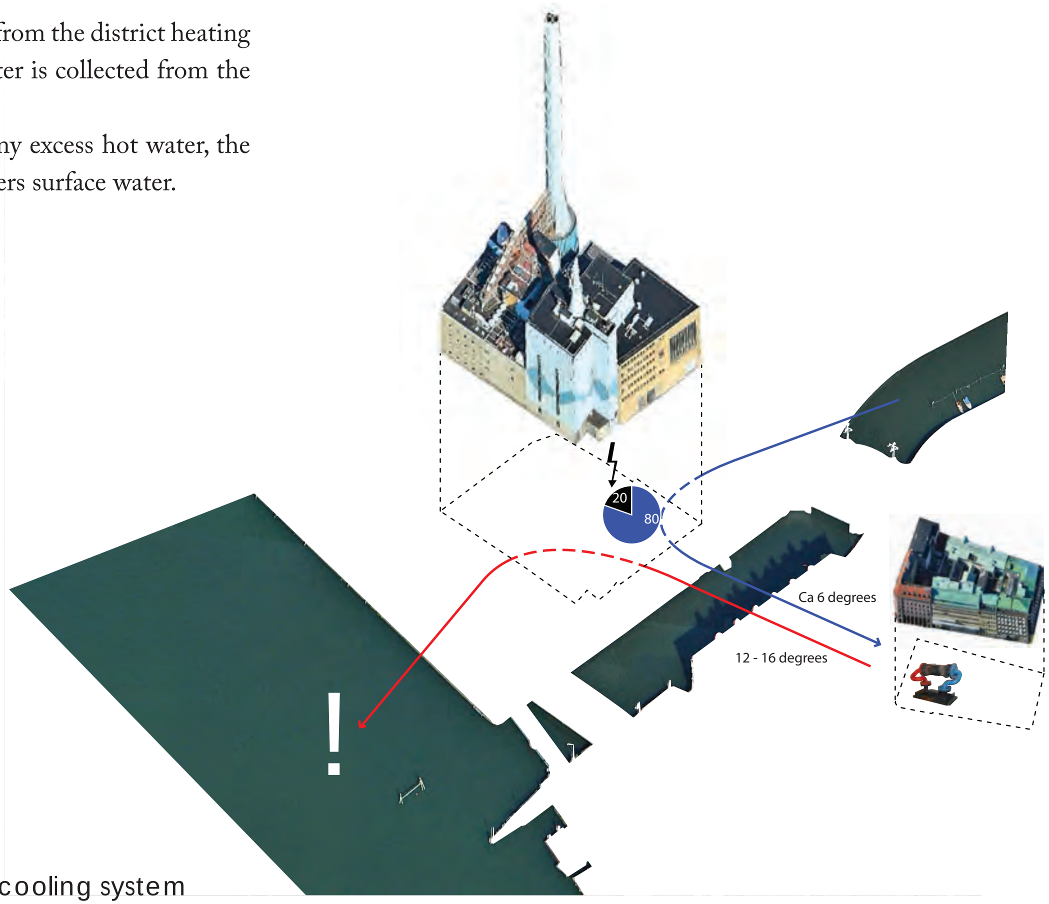

Bridge for water access incorporated with mussel farm.
The green roofs create a new potential for urban production, such as bee keeping
On the south river bank surface water is treated by sandfilters and plants. This is integrated with urban furniture.
PREERA

The osmotic powerplant

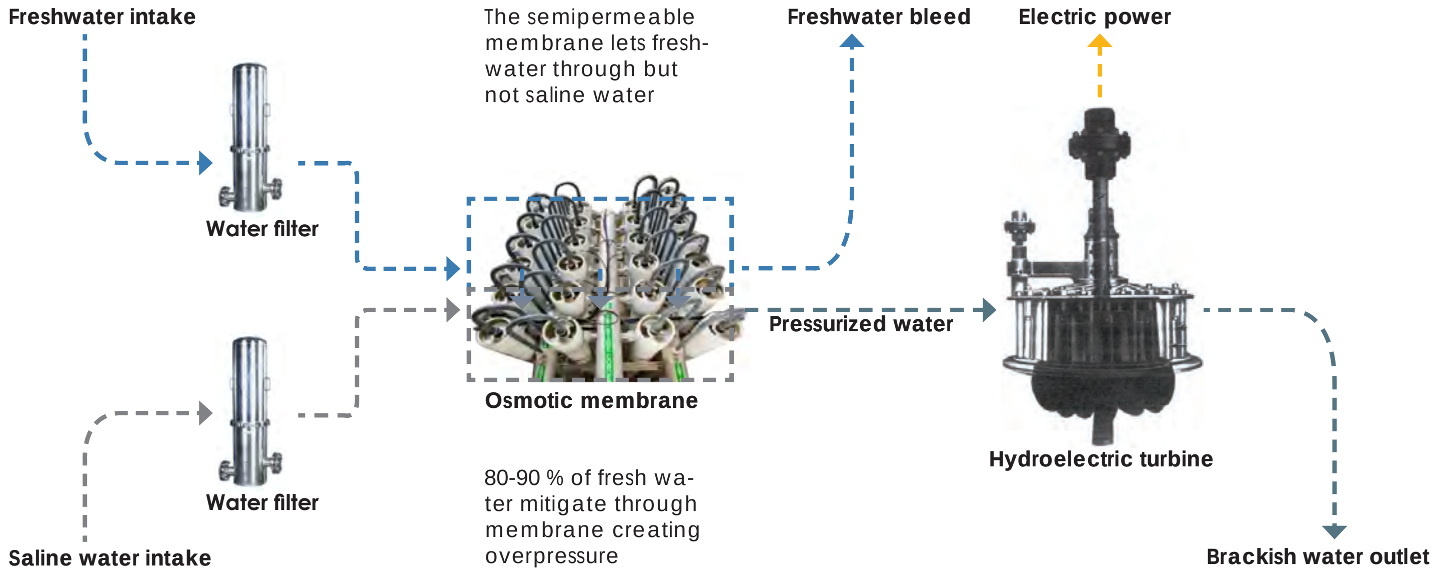
A hybrid between the old piers of the city´s riverfront and the ships that once were built here, the plant fuse parts of Gothenburg´s history to create something new.
he structure is divided into four separate elements, to facilitate the understanding of the systems that are at work in the plant. Each of the elements correspond to a specific part of the osmotic process.
From these smallest units, a bigger system is constructed, that can be expanded or shrunk as the needs and conditions changes.

The osmotic powerplant utilizes the excess hot water from the district heating plant as the main feedstock of freshwater. Saline water is collected from the bottom of the river, where the salinity is the highest.
When the district heating plant does not produce any excess hot water, the fresh water intakes instead collect water from the rivers surface water.

The osmotic plant constantly monitors the water quality, relating to chemicals and other pollutants, and communicates this by altering the colour of the light that it is lit with. This light is powered by a percentage of the energy the plant produces. Since the electricity output changes over the year with different climate conditions the light varies its intensity correspondingly.



District cooling system

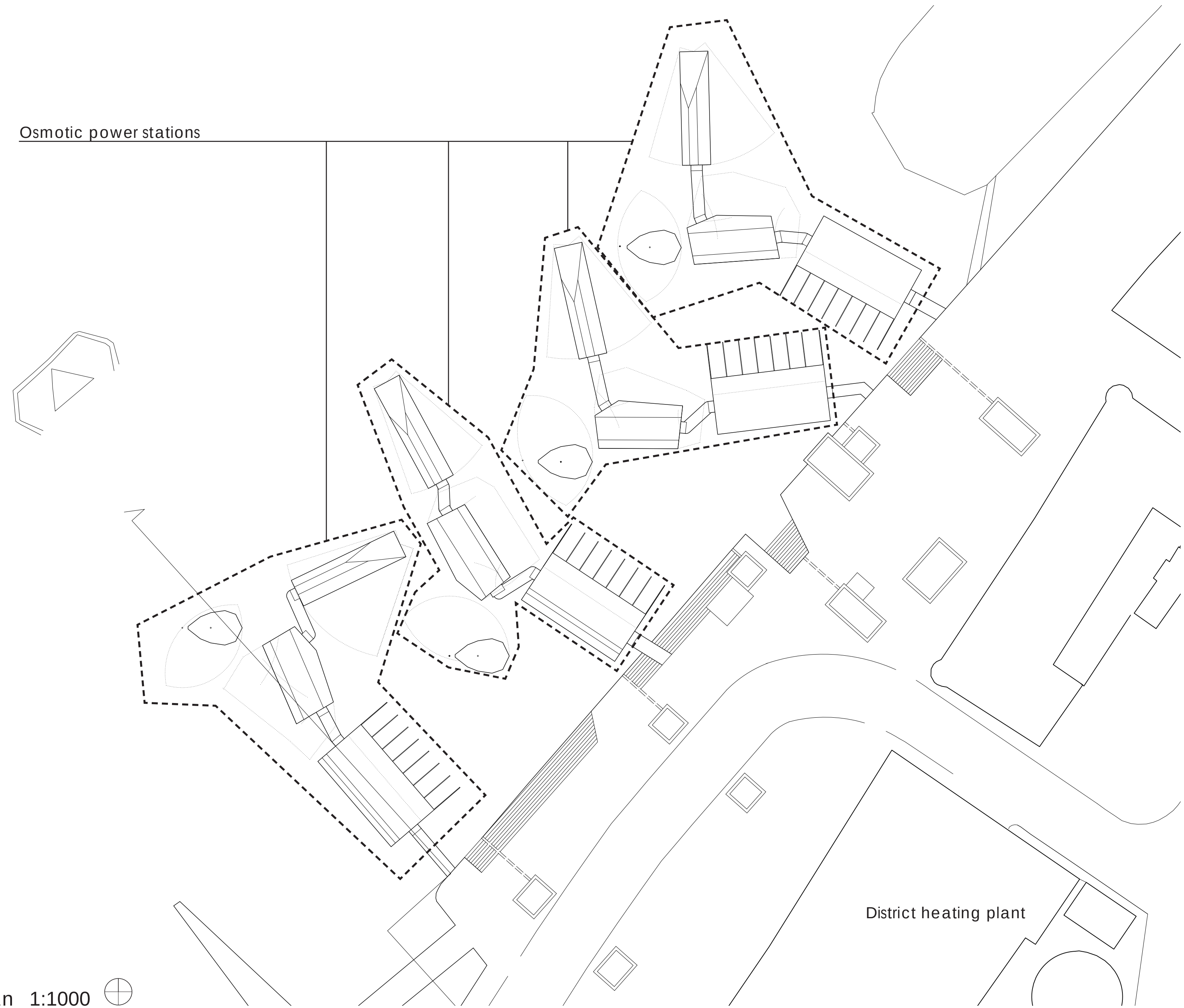


Osmotic power plant principle

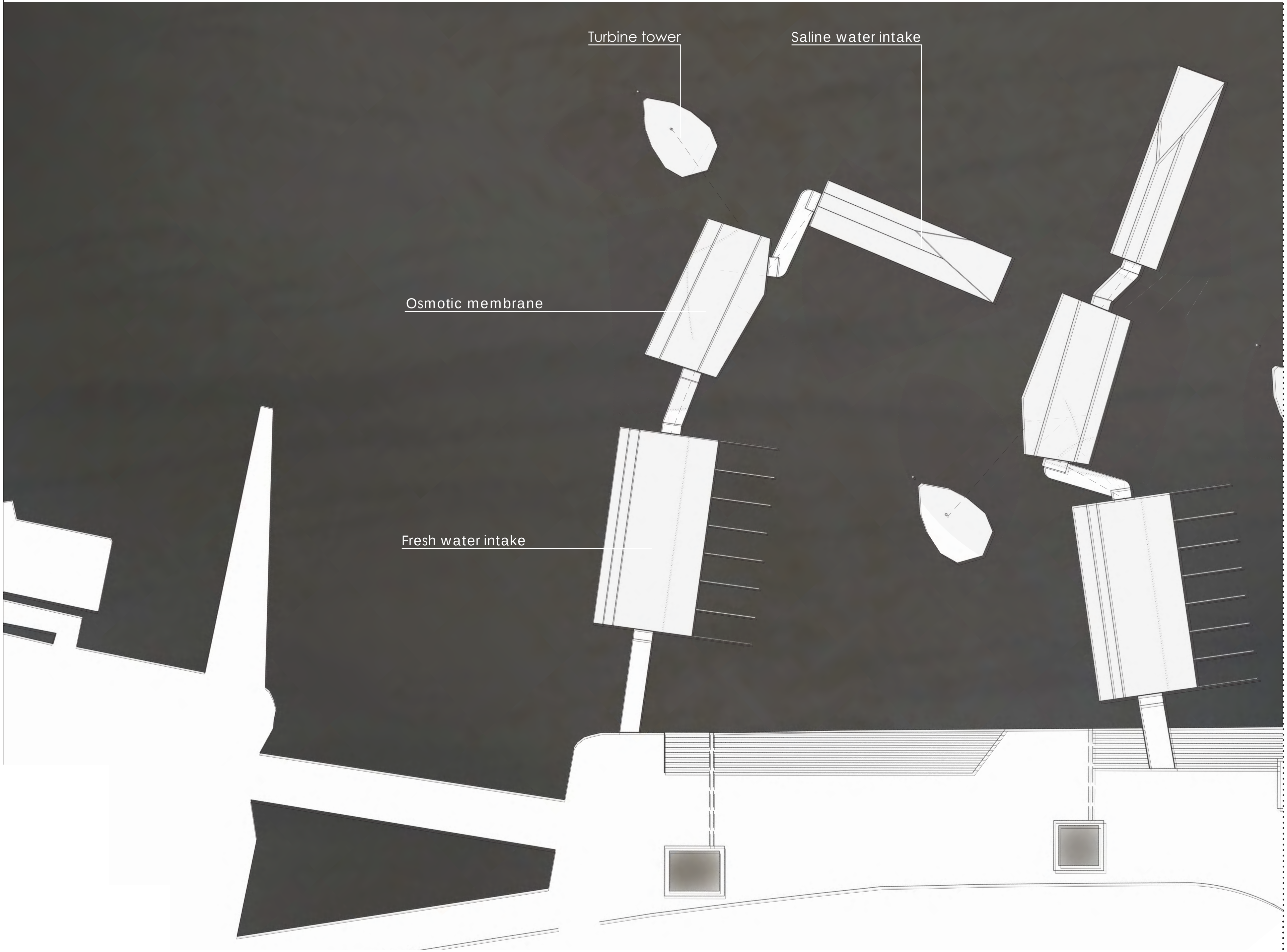
Osmosis as a model for design

The different phases of the osmotic process is interpreted into four different modules that are assembled into one power station. The amount of stations can then be seen as a bigger set of modules, that can be added to or reduced from, all in relation to the space available.

The parts of the power station is structured after the flow of water. The three "outer" elements all represent different stages of the water, fresh, salt and brackish water. The fourth element is the one where the osmotic process is taking place, this is the central one and the one where the fresh and salt water is allowed to mix through filtering membranes. As the fresh water "strives" to even out the differences in salinity on the different sides of the membrane, it flows through the membrane. The salt molecules can not pass through the membrane, due to its construction. The flow of fluid results in a naturally induced overpreassure in the salt water side of the membrane. High preassure builds up and can then be led to a turbine. After passing through this electric turbine the brackish water is discharged back into the river while, at the same time, electricity is extracted that is fed into the urban electricity grid.



Site plan _1:1000


Turbine tower
Saline water intake
Osmotic membrane
Fresh water intake

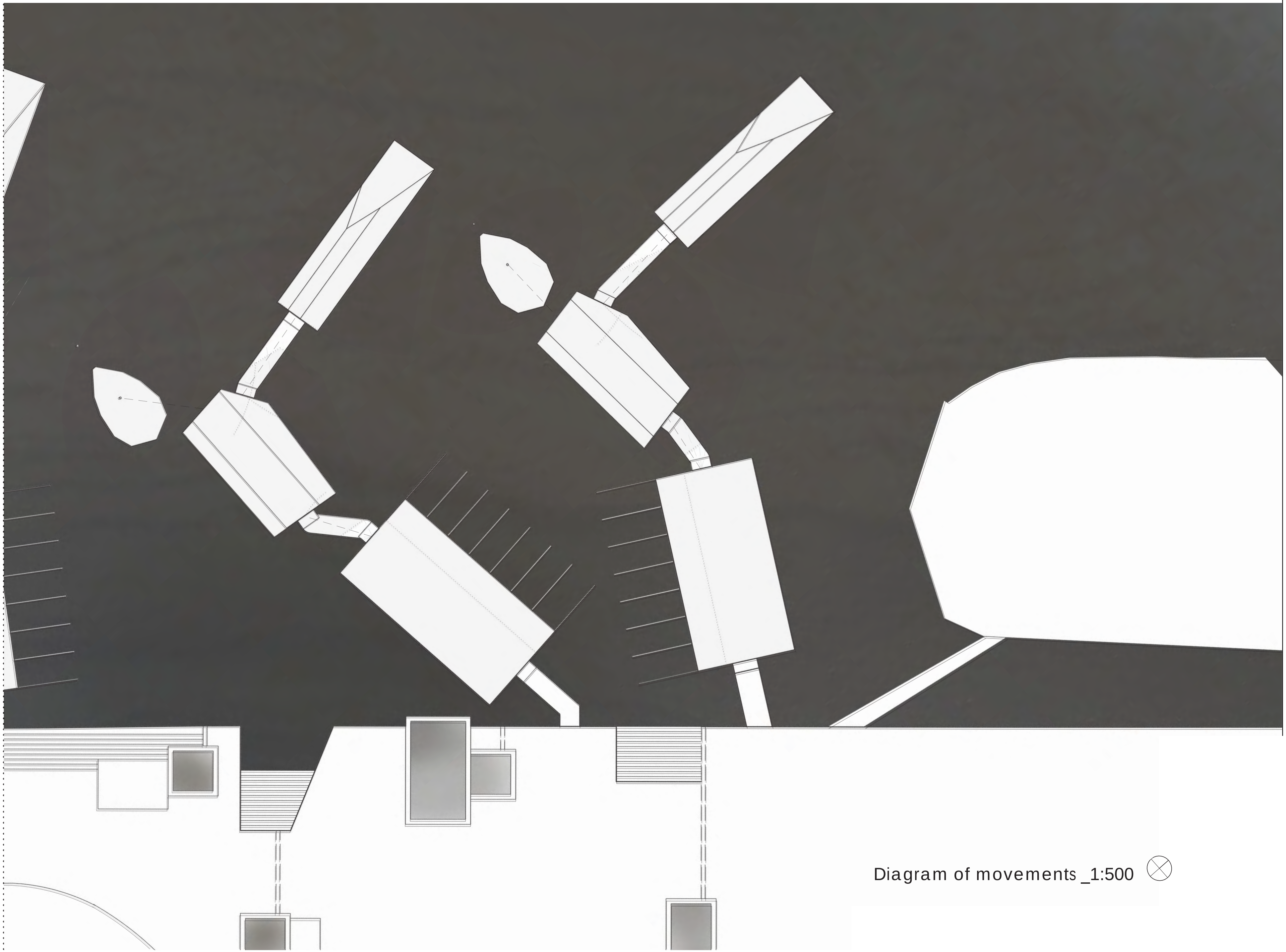
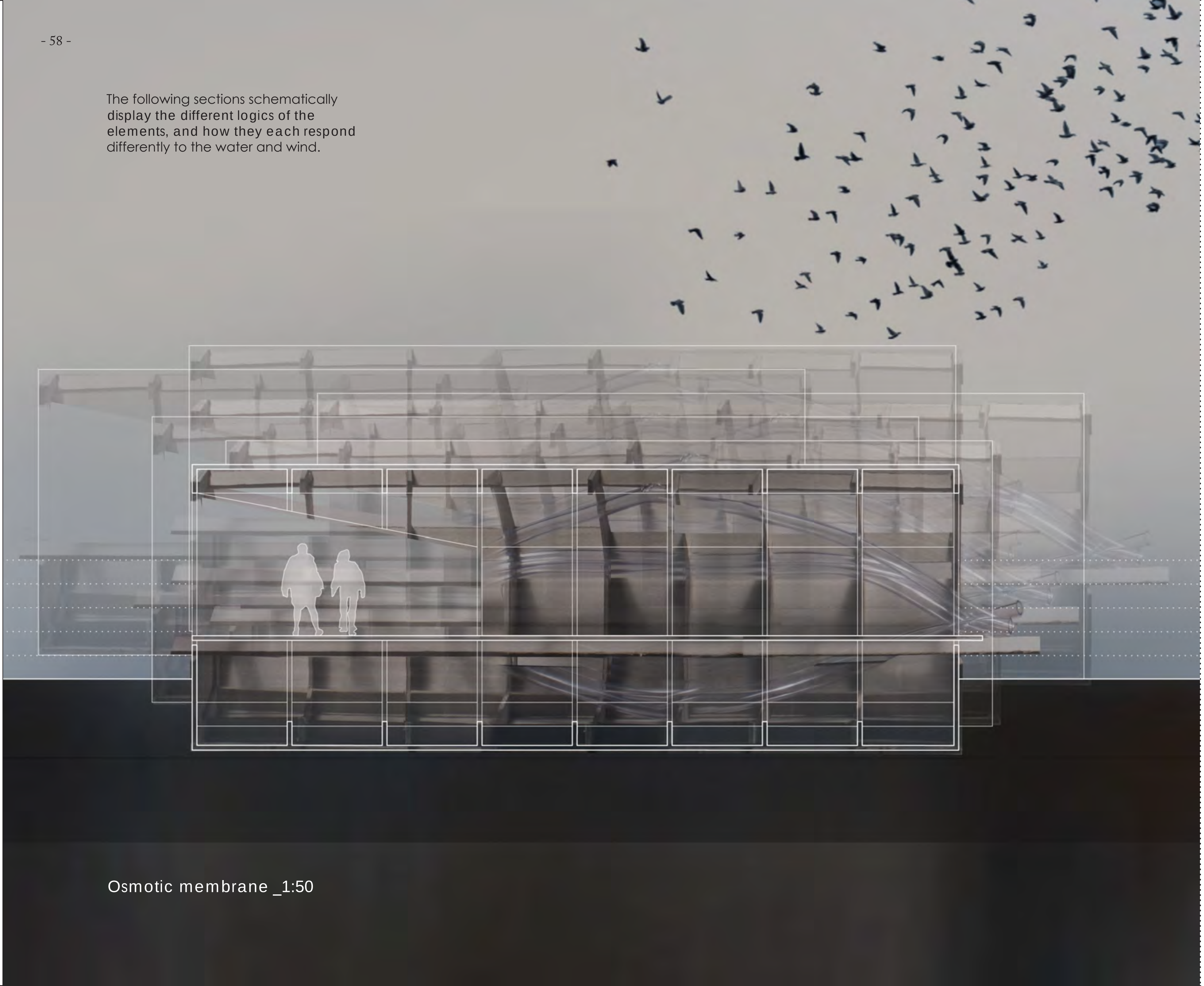
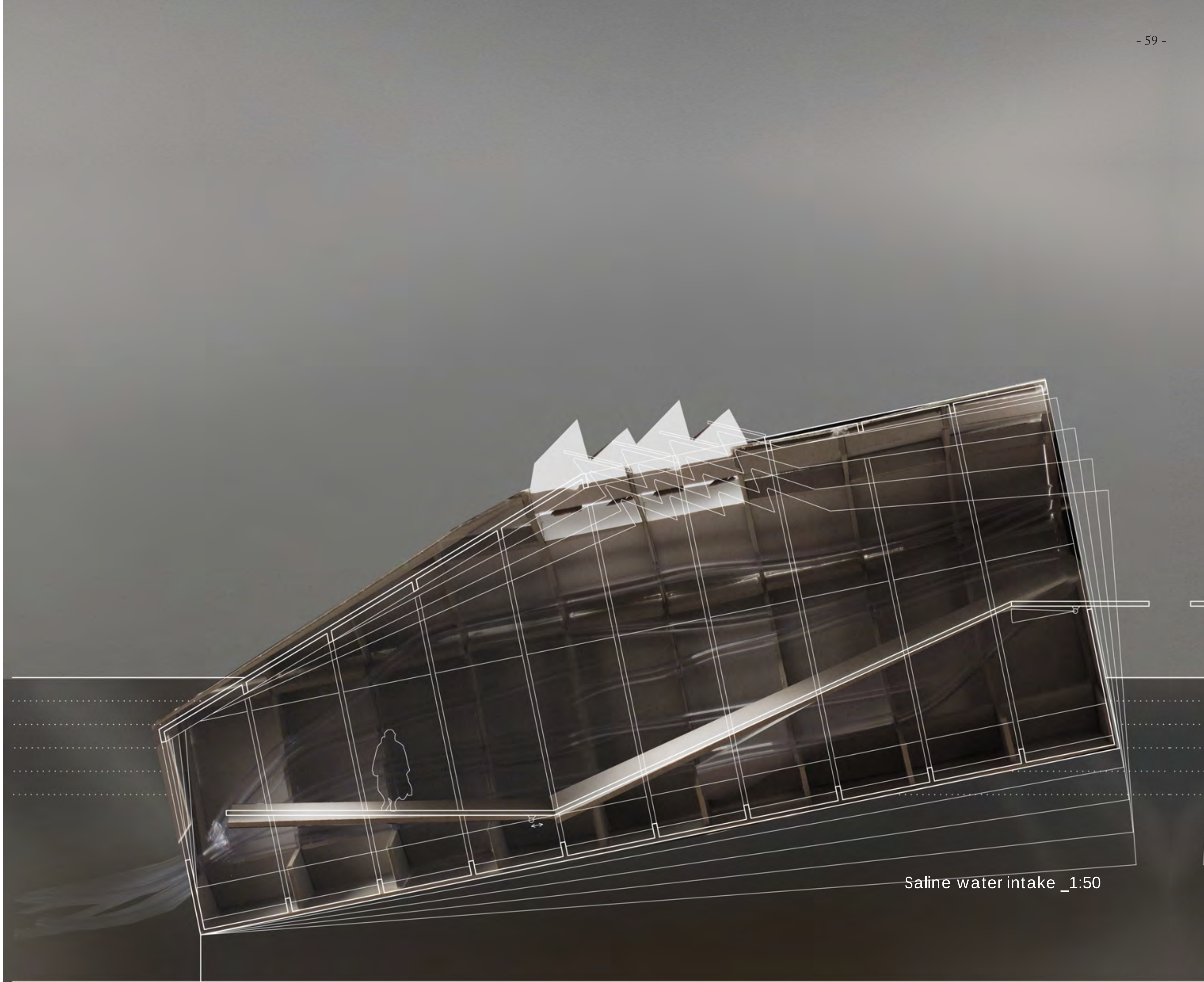


Diagram of movements _1:500

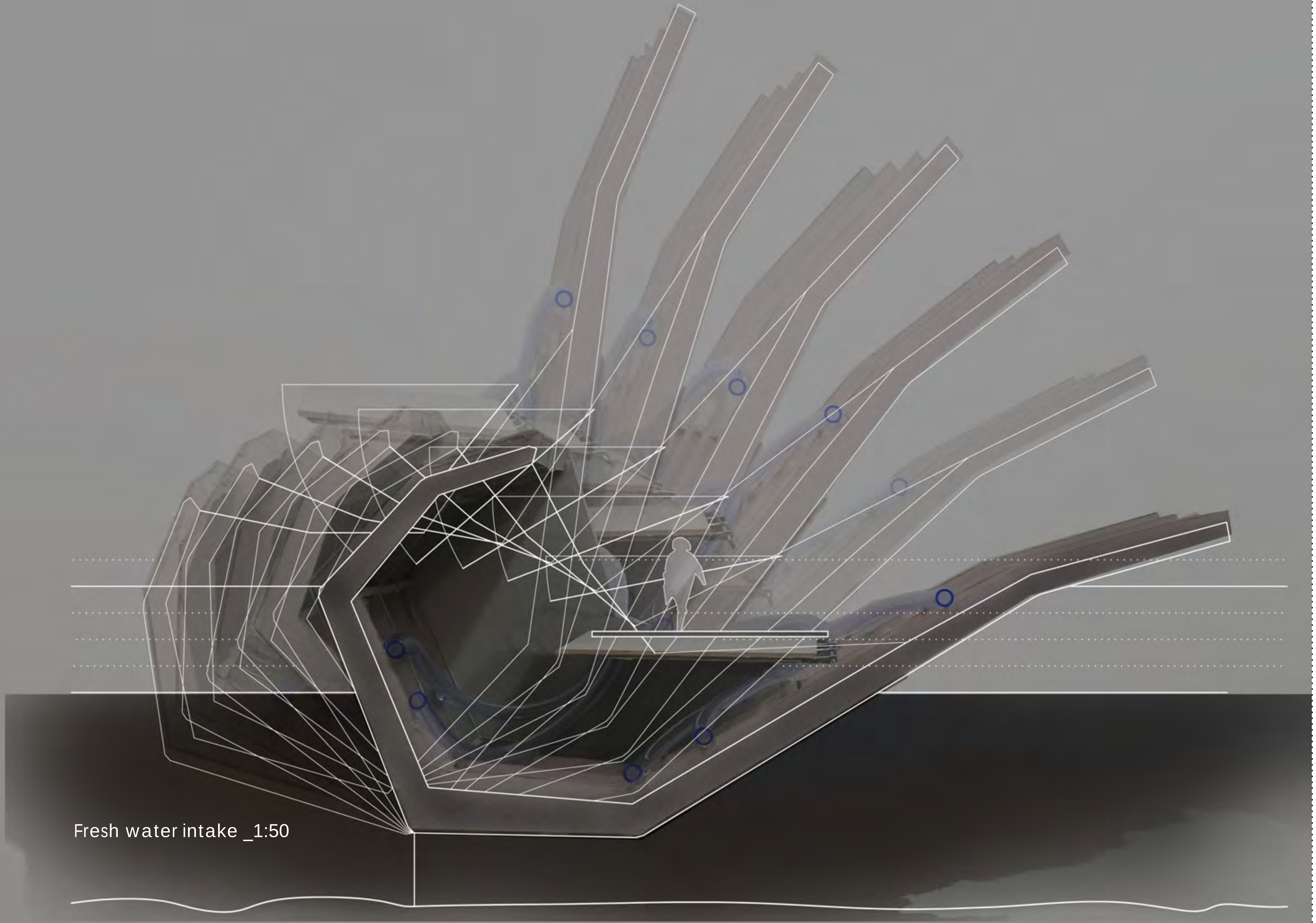
The following sections schematically display the different logics of the elements, and how they each respond differently to the water and wind.



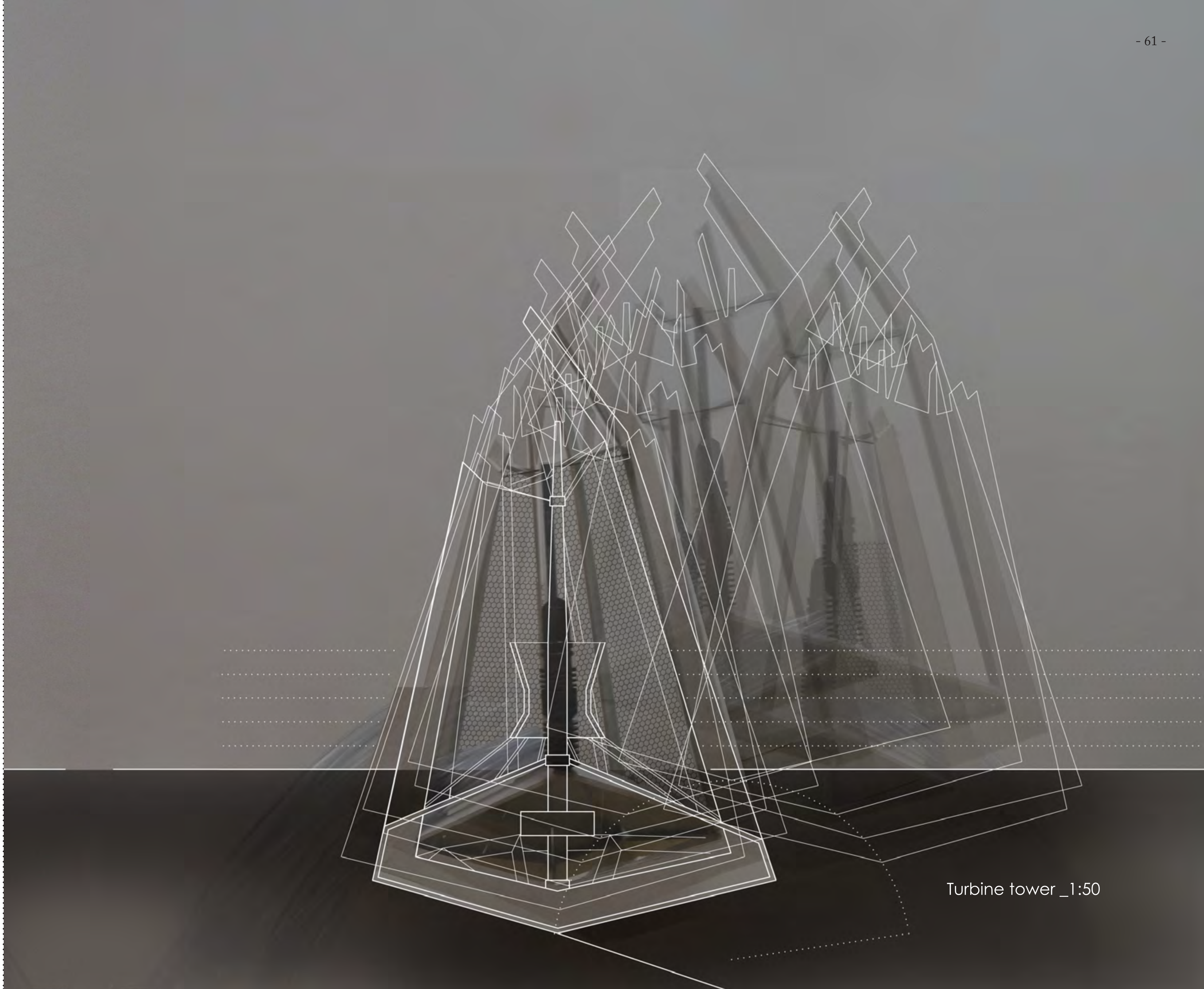
Osmotic membrane _1:50



Saline water intake _1:50



Fresh water intake _1:50



Turbine tower _1:50

The power plant in its total

The connection between the different elements and how they relate to each other at a specific water level. Relating to the water level and how the winds are flowing the relation will reveal itself differently, the water engulfing or rising up the different osmotic elements. Not only a passive agent, the changes tells a story of the water and its relation to the city.
Through the incorporated public walkway that passes through the plant, the city's energy network is made visible and understandable. Expressing this relationship and allowing the urban dwellers to take part in it explores the possibilities of a city that is expressed rather than simplified. Taking steps in this direction may allow for a higher awareness as to how different metabolic processes within the city are shaped and interdependent of each other.
A series of interventions that act as acupuncture needles, aiming to relate the city to its inhabitants as well as to the water that we so much depend on by addressing questions not in every part of the city but in the sites where they are thought to have the greatest impact.

This is my thesis.

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Acknowledgements;

To all wonderful and helpful people that has aided me in different ways throughout the thesis work. To mention just a few; *Alexander Aderklint, Simon Farsi, Karin Lindwall* and *Josefina Söderberg* all deserves great thanks, both for valuable input and for bringing thai-food and great cheerfulness during the last hectic days of work.
Thank you, Biochemistry-PhD *Eva Albers* and biologist *Morgan Johansson* for great input on the complex realities of the city-nature relationship and metabolism.
More than anything I want to thank my mother and sister that has helped me in so many ways I can´t begin to describe it. You two are great!
Last and maybe the most, I want to thank *Ana Betancour*, *Joaquim Tarrasó* and *Carl-Johan Vesterlund* for your tutoring and great support throughout the thesis.