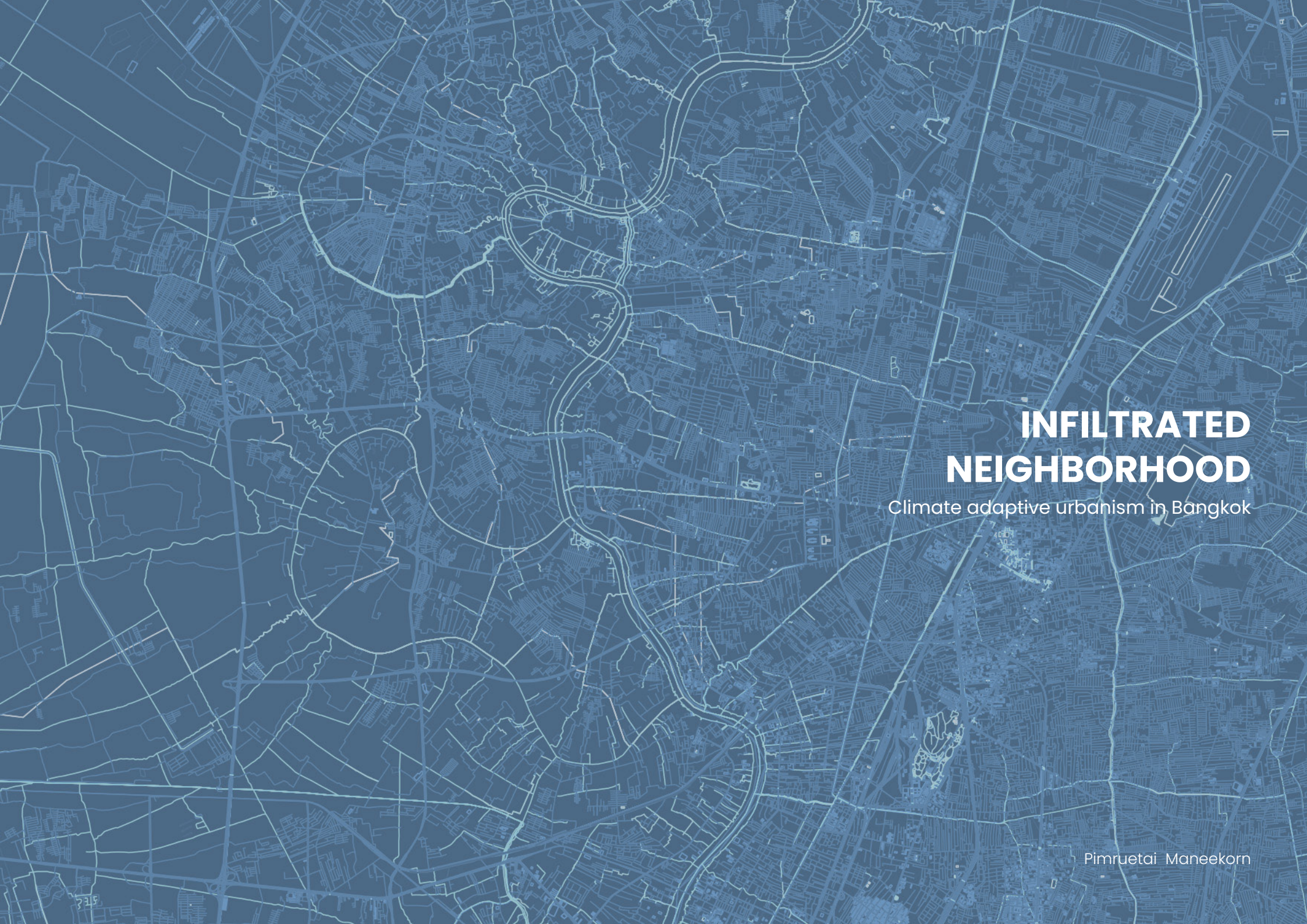

INFILTRATED NEIGHBORHOOD

Climate adaptive urbanism in Bangkok

Pimruetai Maneekorn

Master Thesis Report (May, 2021)
ASBM 01 - Degree Project
Sustainable Urban Design
School of Architecture, Lund University

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Thank you so much for taking part in my growth.

LIST OF CONTENTS

figure 01. Water and lifestyle of the Bangkokian in the past.
Source: oknation (2016)

PROJECT SUMMARY

Under the rapid urbanization of Bangkok, the water town on a floodplain, has changed into a jungle concrete of high-rise buildings and road structure that has adopted from the West but does not cope with the water-related traditional way of living of the Thai people. Consequently, Bangkok has been facing more frequent and more severe impact of urban flooding while people neglected and forgot their own existing treasure, canals and river, that can play an important role in dealing with the unforeseen water situation.

This thesis will try to find a solution for the city to deal with flooding and support the socio-economic of the informal settlements along the canal. Rather than introducing a new infrastructure, the thesis tries to work with the existing structure in the city, like canals, and suggest a more resilient lifestyle that can take place in the city as an example to shift people's perspective of how people perceive the importance for the canal in relation with flooding.

figure 02. Water and lifestyle of the Bangkokian nowadays.
Source: onbnews (2020)

OBJECTIVES

- To study the role of the canals in Bangkok to find the solution for an area that affected by the sea-level rises.
- To explore the theory of sustainability of climate-adaptive infrastructure that can apply to the community and improve quality of life of the people that live by the canals.
- To explore an open space along the canal that has potential to support future flood risk and can provide a diverse public life.

RESEARCH QUESTION

01 How an area can provide a diverse public realm and has an ability to cope with water in a more sustainable way ?

02 How can the living condition of the informal settlement by the canal be improved ?

figure 03. Water-related lifestyle
Source: terrabkk

figure 04. Flooding in Bangkok
Source: PPTV (2011)

figure 05. Flooding in Bangkok
Source: theurbanis (2011)

INTRODUCTION

Flooding is one of the major issues in Thailand, especially in Bangkok. The capital city of Thailand has been through many inundated water events since around 1780 and together with the climate change that is happening around the world, it only urges the action urban flooding to happen more often and affect severely on the city and the people.

Bangkok has been trying to deal with excessive water in the city for many ways, but flooding is not only the environmental disaster but also a class issue. People with lower income and need to stay outside the water wall, in the outskirt of the capital city, is the first group that will need to sacrifice and flee their home when flooding comes. Secondly, another group of low income who lives in a slum or an informal settlement along the canal will inevitably have to face a serious affect from urban flooding. While Thailand considered as one of the developing countries, they still struggling on finding an efficiency way to deal with water in a long term.

Around two hundred years ago, Bangkok's history has shown its lively, dense and efficient network of river and canal. At that time, flooding was not considered a major issue of the city at all. This is an interesting opportunity to remind people again on a more sustainable way to live with water, based on our memory from a storytelling of our grandparents on the traditional way of Thais that connect to the water.

The study area of this thesis situated in Bangkok, along Khlong Prem Prachakorn or Prem Prachakorn canal which is one of the main canals of the city that play an important role in discharging excessive water from the Northern of Thailand to the main river, Chao Phraya. Beside the canal, mostly in the middle of the canal, is an informal settlement that vulnerable to both flooding and water overflows so the research scope of this thesis will focus on landscape urbanism as the main knowledge to envision the city with opportunity to develop based on its roots over the new situation of water sensitivity and a modern context.

PART 1

Understanding the city

figure 06. South-East Asia map
Source: http://www.anthonylovenheimirwin.com/blank-southeast-asia-vector-map

Thailand was never a European colony, so even though the city is very Western on the surface, deep down it's very Asian. It's quite enigmatic, and I like that.

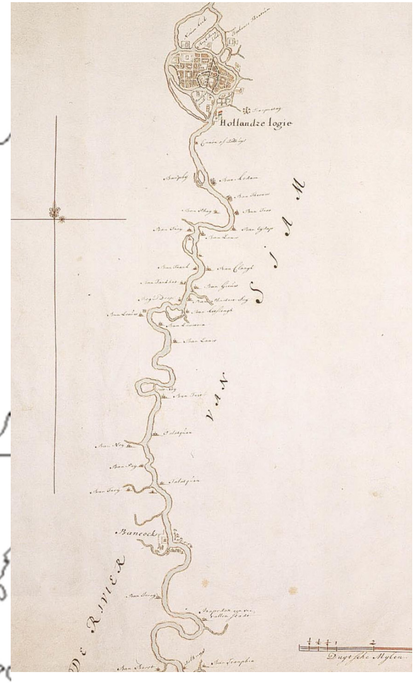
I can't get to the bottom of Bangkok, and I never will.

Lawrence Osborne
British novelist and journalist,

THE VENICE OF THE EAST

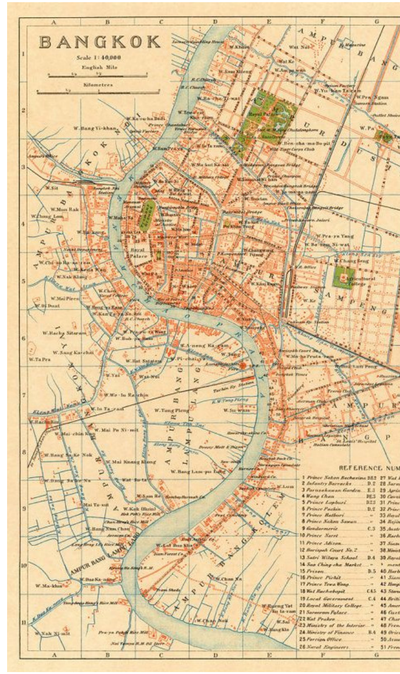
Bangkok historical map

figure 06-08. Historical map
Source: Royal Thai Armed Forces Headquarters, Bangkok historical map from 1880-1931 (1999)



17th century

1888



1920






figure 09-14. Historical photo
Source: Anake Nawigamune, Old Photos of Bangkok / autoinfo.co.th / travel.mthai.com / matichon.co.th / lifestyle.campus-star.com

THEN

In the 19th cenruty, Bangkok has known as *'The venice of the East'*. According to its main river, Chaophraya river, and extensive network of canals that flow through the city. In the past, water was life for the people. It was an important factor in everyone ways of life, from city planning to daily uses. Open spaces near the canal or the river functioned as a public spaces for public activities to take place on;

- **Planning**
  city barrier
  city protection
  create hierarchy of the city
- **Daily uses**
  transportation system
  traditional logistic
  local market
  settlement
  cultural events
  recreation
  agricultural events
  aquatic farming
- **Utility**
  drainage
  flood control
  water supply
  agricultural irrigation






figure 15-20. Photo of Bangkok
Source: blog.tripzii.co / bangkokattractions.com / posttoday.com / estopolis.com / brandinside.asia (2020)

NOW

Even today, on the periphery area of Bangkok, especially on the southern, people still interact and make use of water in their daily life. But in the city like Bangkok, water has decreased its importance. Only the main river still holds its value as a noticeable path of the city. Other canals and waterways are neglected and polluted with urban activities.

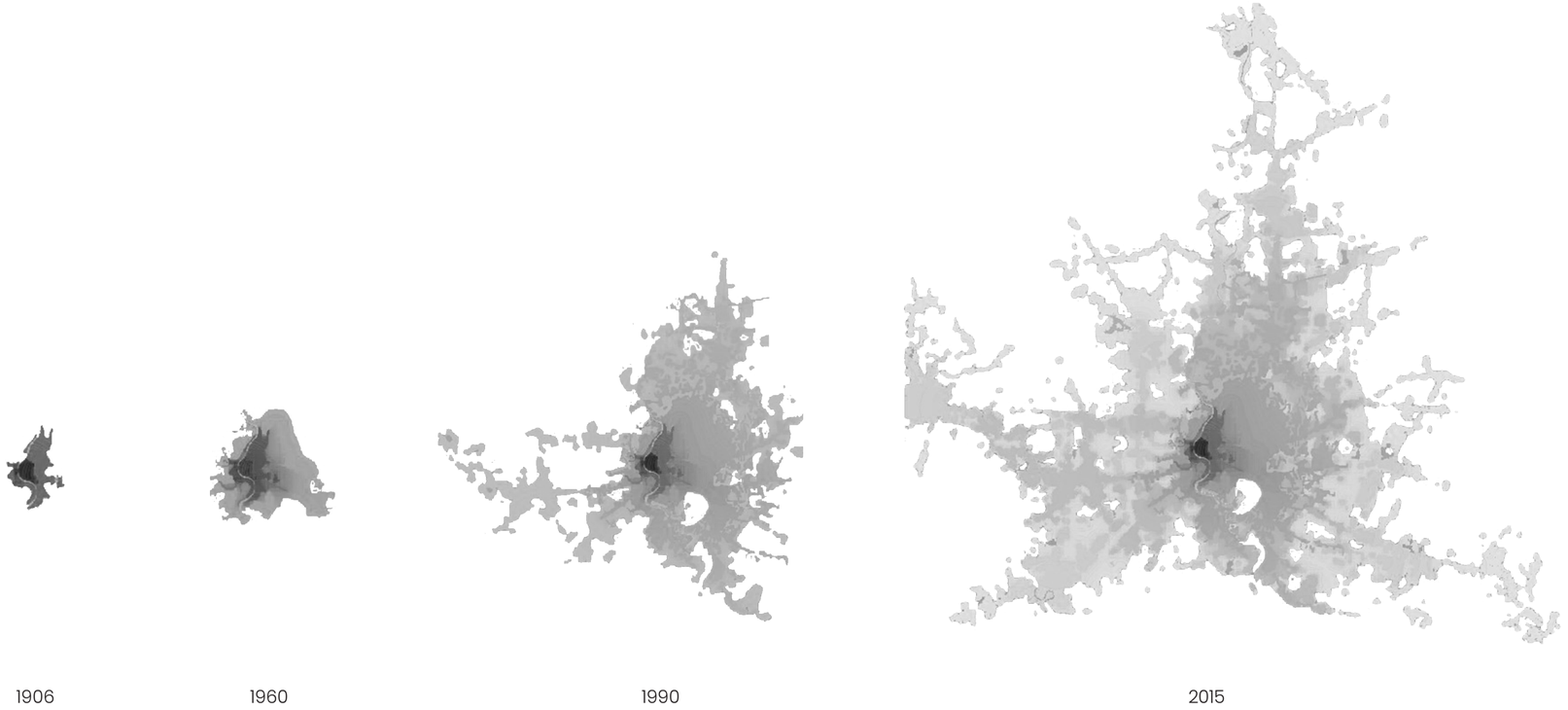


figure 21. Urbanization of Bangkok
Source: NYU Marron Institute of Urban Management (2014)

BANGKOK URBANIZATION

Bangkok has been the capital city of Thailand for more than 200 years. The excessive growth of the city started at around 1950-1960 with the increasing of industrial and economic development which lead Bangkok to become almost the only center of economic activities. Most of the development nowadays based in the capital city. Consequently, the city grown up into one of the world's populated city with registed population of 10.7 million people (World Bank, 2021), considered to be a primate city.

Rapid urbanization and urban population growth is causing the exceeding demand of infrastructure thus developments forced to happen even on waterway or canals which is beyond the capacity of the city and the river city has faced many events of urban flooding ever since.

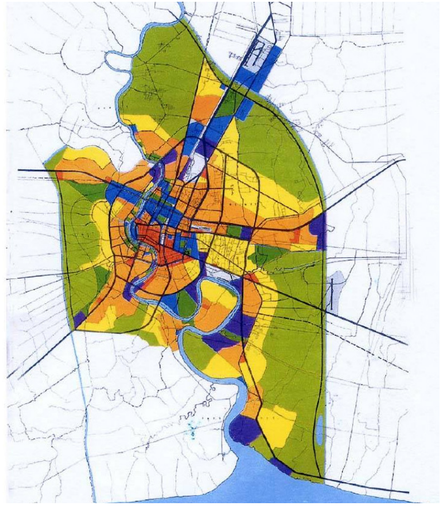
LAND USE DEVELOPMENT

Bangkok's land use development plans illustrate how the government plan the city to expand. The 1st plan, also called the Litchfield plan, was planned to compact the city to its inner core and provide argicultural area around as much as possible to allow downpour from the North of the city to discharge to the gulf of Thailand

While at the second plan was revised to serve the expansion of population that rose unexpectedly at that time. This plan is the start of the city to grow on the East and West, on the existing waterway.

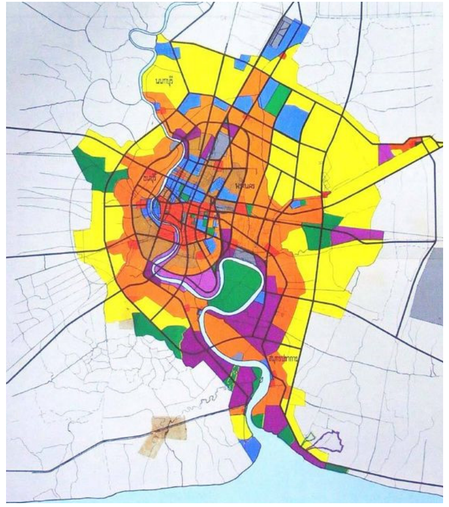
Nowadays, the city grow according to the holistic plan of the 2nd city plan which mean it developed on the existing waterway. Bangkok is now like the big rock that blocks flooding from the Northern to the sea.

figure 22. Litchfield plan
Source: CPD,BMA (2015)

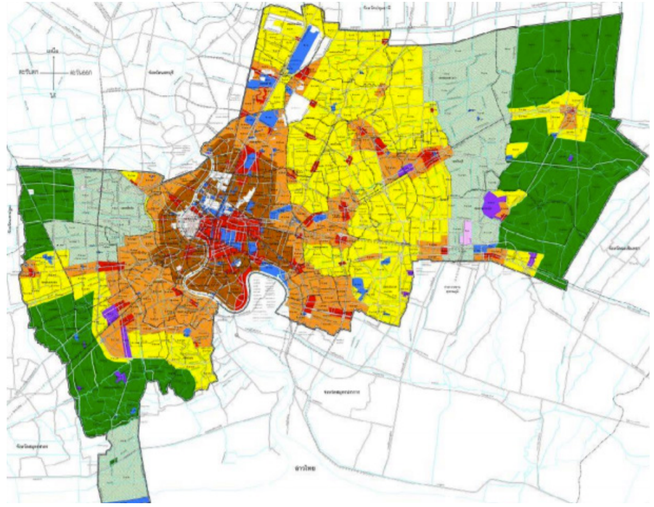


1st Bangkok greater plan, 1960

figure 23. Revised Litchfield plan
Source: CPD, BMA (2015)

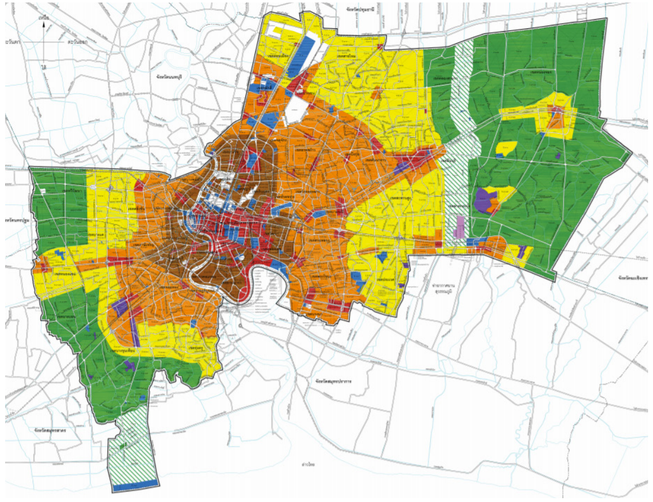


2nd city plan, 1972



current plan, 2013 - 2020

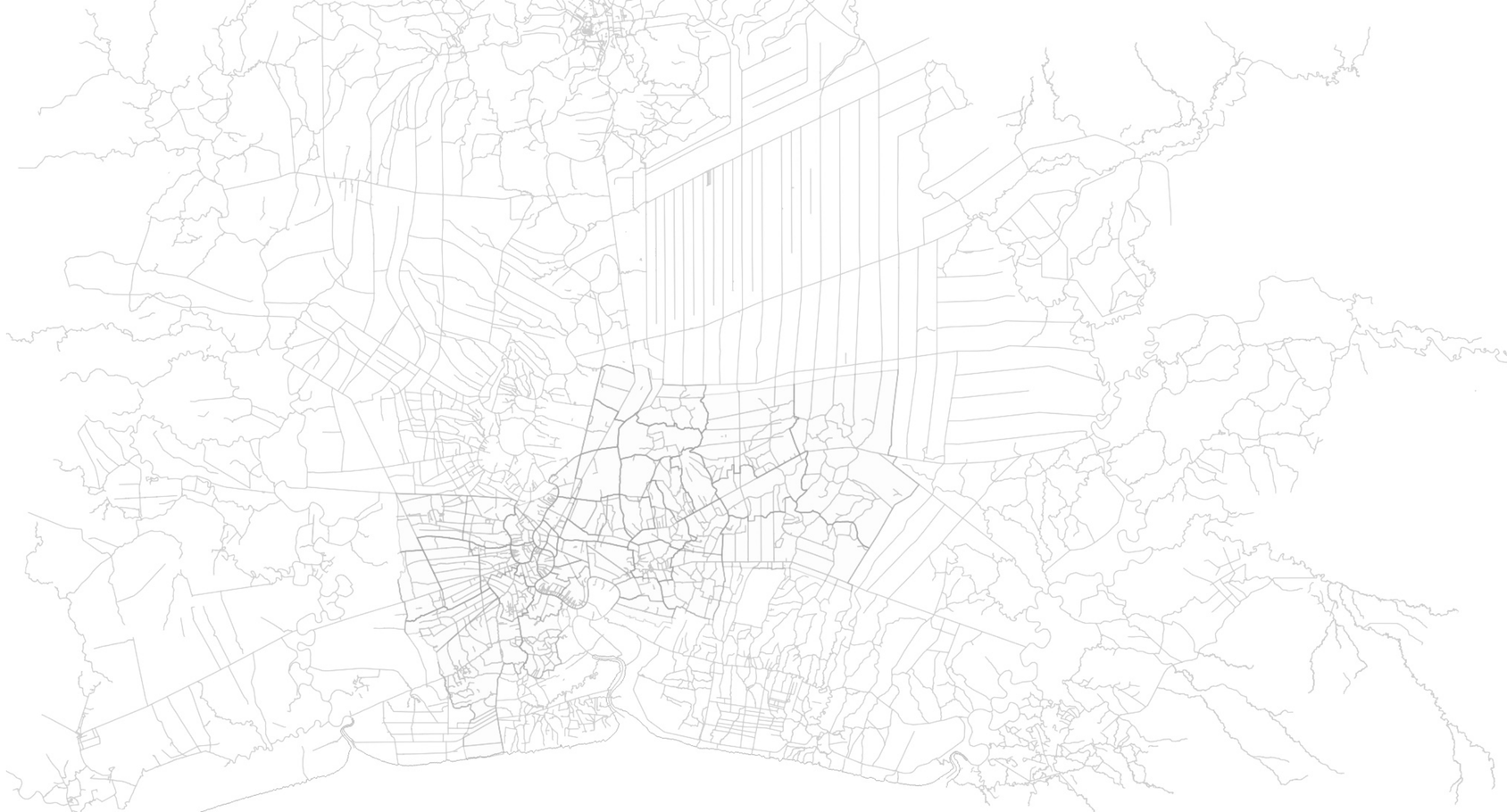
figure 24-25. BMA land use plan
Source: CPD, BMA (2016)



new draft, 2021

PART 2

The canal network



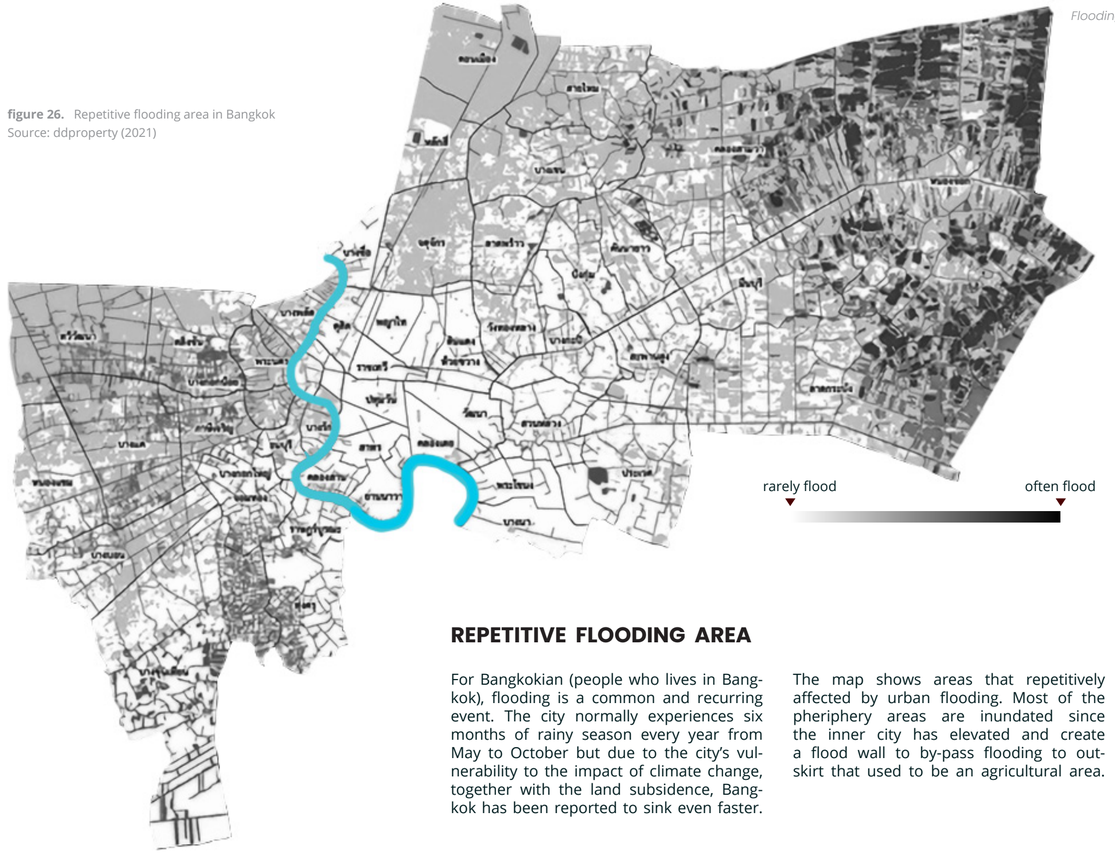


figure 26. Repetitive flooding area in Bangkok
Source: ddproperty (2021)

REPETITIVE FLOODING AREA

For Bangkokian (people who lives in Bangkok), flooding is a common and recurring event. The city normally experiences six months of rainy season every year from May to October but due to the city's vulnerability to the impact of climate change, together with the land subsidence, Bangkok has been reported to sink even faster.

The map shows areas that repetitively affected by urban flooding. Most of the pheriphery areas are inundated since the inner city has elevated and create a flood wall to by-pass flooding to outskirt that used to be an agricultural area.

WATER FLOWS

Chao Phraya river is the main water system in Thailand and also the main river that run through Bangkok. The river flows from the north to south with total drainage into the basin through Chao Phraya river around 24,100 million cubic meters per year.

direction of ground water flow

river or stream

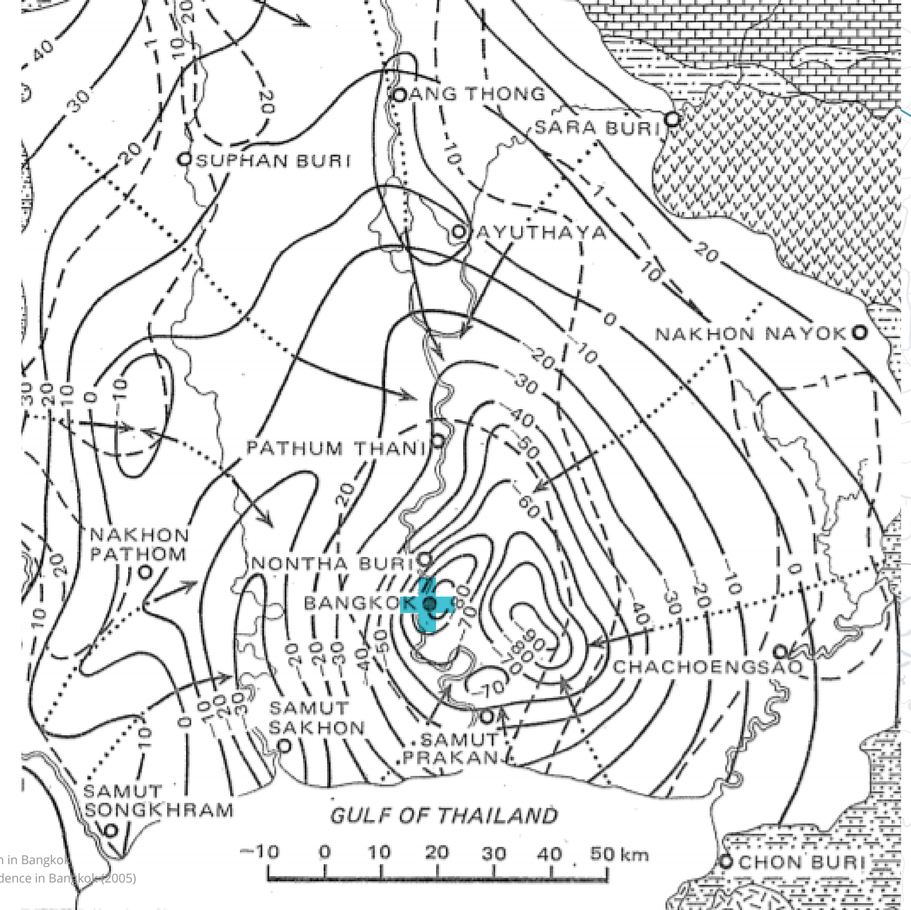
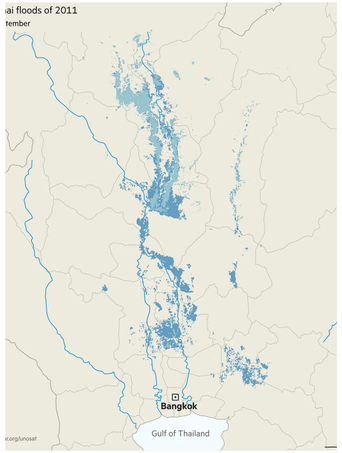


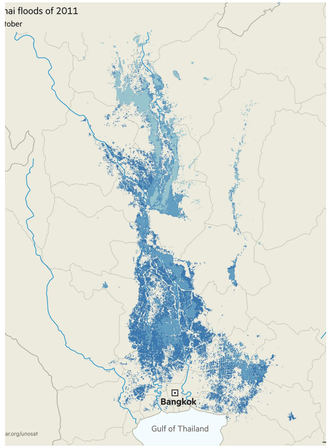
figure 27. Contour line and groundwater flow direction in Bangkok
Source: N. Phien-wej, P.H. Giao, P. Nutalaya, Land subsidence in Bangkok (2005)

CANAL NETWORK

Khlong or canal has been taken part to shape the community and the city's form and function for a long time. As stated that Chao Phraya river is the main river of the country, most of the canal that distributed from the river drain water to Chao Phraya. Meanwhile, some part of these canals would flow to the agricultural area in the outskirt of Bangkok, outside the water wall. This leads to flooding along the main water drainage canal in the city and the area outside the city's dyke.

figure 28-30. Flooding in 2011
Source: asianews (2011)





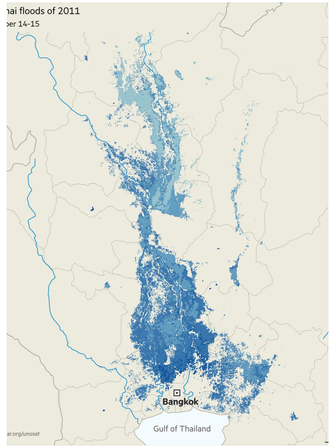


figure 31-35. Flooding map in 2011
Source: econstor (2011)

FLOODING IN 2011

One of the most severe flooding in Bangkok was between August and September in 2011. During the monsoon season, the river carry high run-off water and spreaded along Thai's main river artery, affected 12.8 million people, caused 728 death and damaged around 17 000 sq.m. agricultural area and almost 10 000 factories.

Flooding in 2011 caused with record heavy rainfall throughout 6 months of monsoon season, together with tropical storm remnant from the North and insufficient management of the dam water that overlapping and release more water causing an area about 30 000 sq.m. to be inundated with floodwater.

Mentioned by many researches, Thai flood of the magnitude of 2011 is predicted to happen again within 10-20 years.

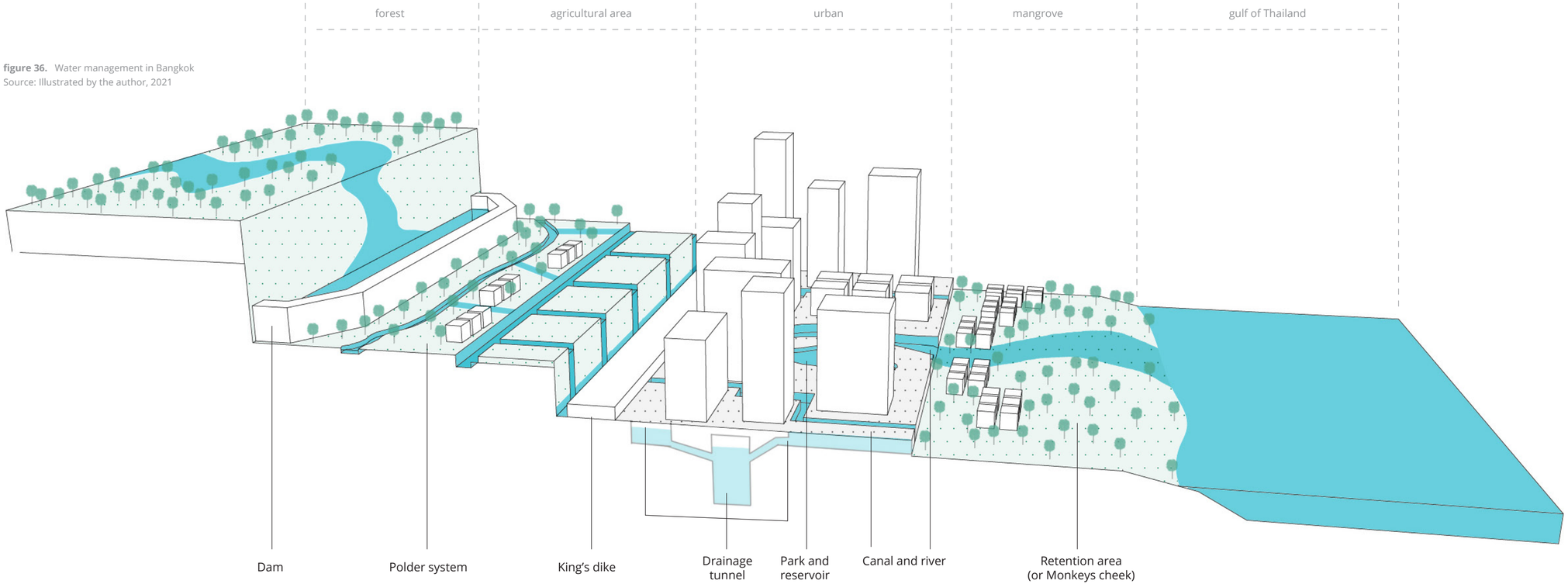
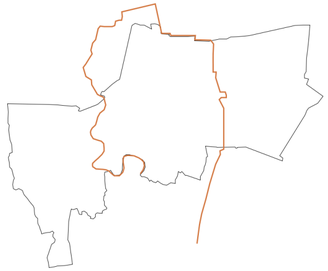


figure 36. Water management in Bangkok
Source: Illustrated by the author, 2021



WATER MITIGATION

The diagram illustrates how water is treated from it sources, running through the city and discharge to the gulf of Thailand. Focus on the area around Bangkok, some of an agricultural areas use polder system to mitigate and slow down water. When flooded, the dike around the core of Bangkok would try to prevent a huge amount of water and by-pass waterway to overflow outside the water wall. In the city, the administrative promoted drainage tunnel under the road structure and having some big open green spaces, together with canal network help water to flows easily. At the Southern, on the outskirt of Bangkok, retention area and mangrove work together to slow down the water and discharge it to the sea.

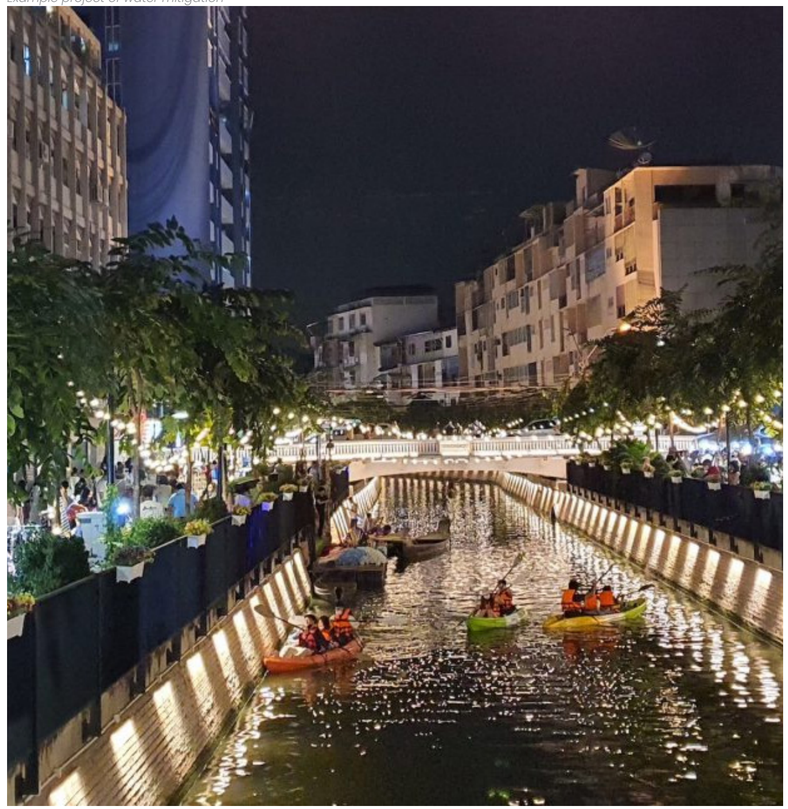


figure 37. Ong-Ang canal
Source: thaipost (2020)

ONG-ANG WALKING STREET

canal system + pipe jacking

TYPE: Commercial walking street
SIZE: about 2 km. length
PROJECT OWNER: BMA (Bangkok Metropolitan Administration)

BACKGROUND: A dug moat since 1782, used for trade and travel from the countryside. Later, the area along canal was covered with market and as other canals in the city, it was polluted by sewage and trash from households and the market.

PURPOSE OF THE PROJECT:
- Reclaiming the waterfront
- Making more accessible neighborhood
- Bringing life back to the historic area

CANAL RESTORATION:
- Dredging the canal
- Keep the existing historic wall but decorate them to be safer and more attractive.

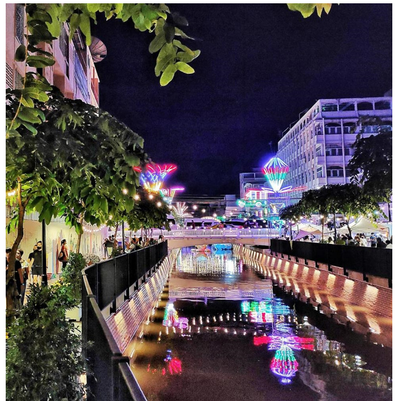


figure 38-39. Ong-Ang canal (up left, bottom left)
Source: chillpainai (2019)
figure 40-41. Old photo of Ong-Ang canal (up right, bottom right)
Source: mgronline (2020)

PROS:
+ The project has preserved and has an ability to display the existing lifestyle of the area.
+ Introduced the new night life activities that synergized to the old one.
+ The area and community along the canal is more lively and attractive.

CONS:
- People are kept away from the water
- Small variety of the canal edge can leads to a small choices to cope with different scenario of water situation
- Lack of sustainability aspect.

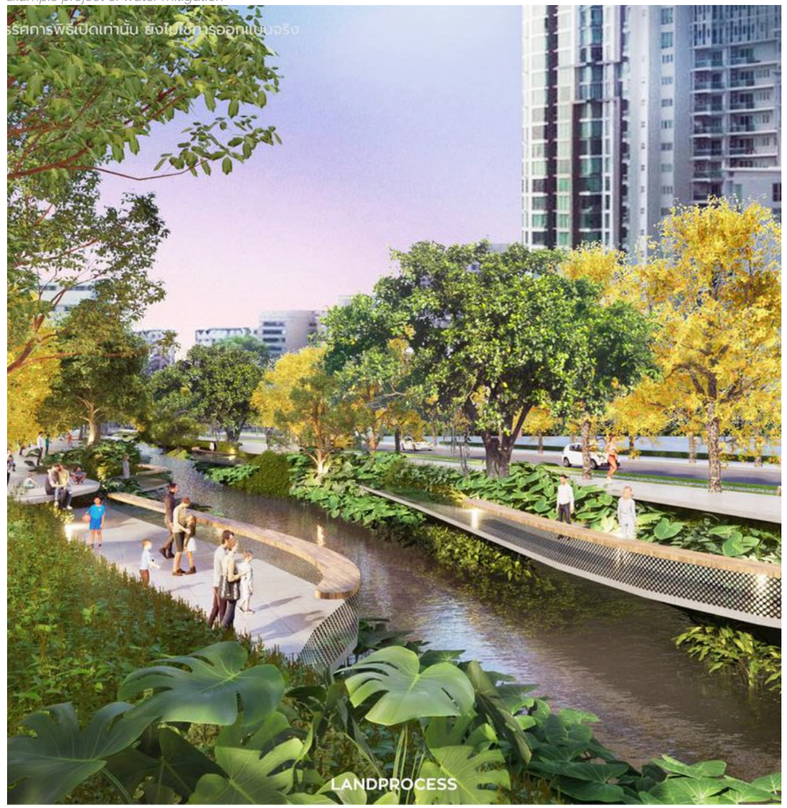


figure 42. Chong Nonsi canal project
Source: realist (2020)

CHONG NONSI
CANAL PARK FOR ALL

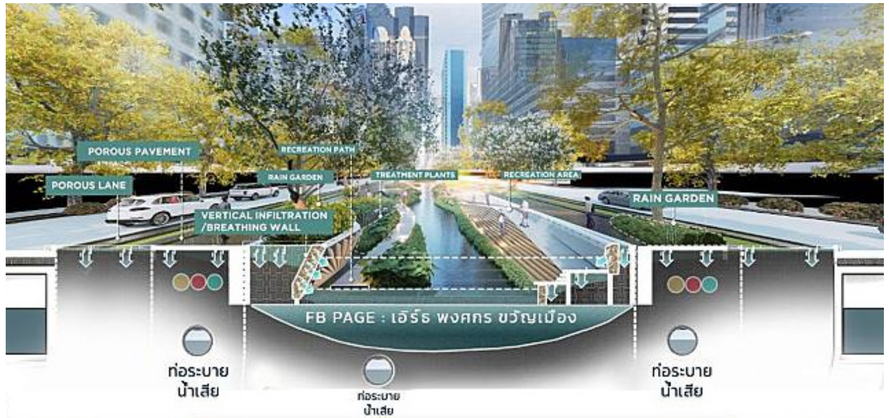
canal system + pipe jacking + water infiltrate

TYPE: Public linear park
SIZE: 4.5 km
PROJECT OWNER: BMA (Bangkok Metropolitan Administration)
LANDSCAPE ARCHITECT: LANDPROCESS
EXPECTED TO FINISH: Middle of 2021

BACKGROUND: Chong Nonsi canal is an abandoned canal in the central of Bangkok. Due to the administrative plan to restore the canal in the city and promote more publid green space to the residents, Chong Nonsi canal has been projected to be the first linear park in the heart of the city.

PURPOSE OF THE PROJECT:
- Create an urban resilient blue and green infrastructure.
- Restore canal system back to nature.
- Introduce the underpass park.
- Connect each part of the city and the canal in many layers.

figure 43-44. Photo of Chong Nonsi canal
Source: onbnews (2020)
figure 45. Vision of Chong Nonsi canal project
Source: landprocess (2020)



PROS:
+ Universal design
+ Concern about other living matters.
+ Landscape urbanism that sync with the residents and the city.

CONS:
- Limited of accessibility due to the location inbetween two main roads.
- Lack of sense of belonging, may leads to more of maintenance from the administrative on site.

LAD PHRAO CANAL

canal system + tunnel

TYPE: Residential project
SIZE: about 2 km. length
PROJECT OWNER: BMA (Bangkok Metropolitan Administration)

BACKGROUND: Lad Phrao canal has been dug over 200 years ago for agricultural purpose and was always been home for many communities until now. It is one of the main canal that use for water drainage from the Northern of Bangkok.

PURPOSE OF THE PROJECT:
- Providing more suitable housing to replace the informal settlement by the canal
- Improve the water quality
- Prepare for the new boat route

CANAL RESTORATION:
- Create treated wall to prevent flooding
- Dredging the canal to improve water quality

figure 46. Lad Phrao canal
Source: posttoday (2016)

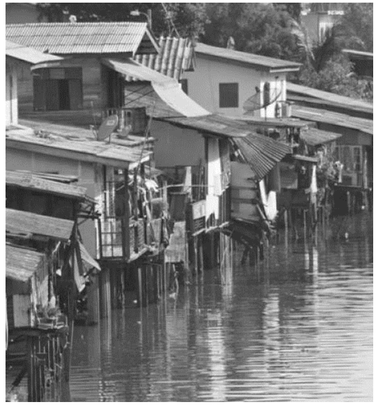


figure 47. Old photo of Lad Phrao canal (up right)
Source: thairat (2018)

figure 48-49. Lad Phrao canal (up left, bottom)
Source: ch3thailand (2019)

PROS:
+ Provided better housing for the existing informal settlement.

CONS:
- The project is not site specific.
- It has no relation to its context.
- The development seperated people from the water and decrease water-related life-style of the residents.
- Lack of sustainability aspect.

PART 3

Khlong Prem Prachakorn

figure 50. Prem Prachakorn canal
Source: Governor of Bangkok's facebook (2021)

Khlong Prem Prachakorn

KHLONG PREMPRACHAKORN

Prem Prachakorn canal was dug in 1869, around 150 years ago, to shorten the route from the inner core of Bangkok and Ayutthaya, which was the earlier capital city, and expand the area of cultivation. The canal flow from Ayutthaya - Pathum thani - Bangkok and run through many different character of urban space along the canal from an agricultural, industrial, residential to the center of cultural in the inner core of Bangkok, with the total length of 50,8 km.

According to the canal development plan from BMA, Prem Prachakorn canal has divided into 3 areas of development; 1) Where the area along canal has been improved according to the administrative plan. 2) Where the canal has been invaded and polluted by the informal settlement. 3) Located in the agricultural and rural area, mostly polluted by the industrial.

- commercial
- high density residential
- low density and agricultural
- industrial
- government
- medium density residential
- agricultural conservation
- cultural conservation
- military
- low density residential
- rural and agricultural
- canal development
- sky train line
- Prem Prachakorn canal

CONCEPTUAL PLAN

The Bangkok municipality recently published a conceptual plan for the next 7 year which illustrated the intention to increase density on the residential area and tie each nodes of activity with public transportation network so the city would mainly developed based on the sky train network. The area around the site is projected to be denser, surrounded with many commercial node and located in the middle of the two goverment nodes. An area would grow to be a destination for more people to settle in.

figure 50. Mucinipality conceptual plan
Source: BMA (2021)

Importance of Khlong Prem Prachakorn

recreation open space
water retention
green street
Prem Prachakorn canal
coastal preservation
natural waterway reservation area
open space along the water

GREEN NETWORK

The amount of green space per capita in Bangkok has been rising for the past 5 years according to the trends of climate change and flooding that happened more often. Currently, green spaces in the city is at around 3-4 sq.m. (considered the city's non-registered population) per person which is still below WHO (World Health Organization) standard of 9 sq.m (2019). However, regarding to the Covid-19 situation in a crowded city like Bangkok, more than 9 sq.m. per person of open green spaces is required in the city.

BMA and Faculty of Architecture, Chulalongkorn University, developed a green network for Bangkok Metropolitan area focused on creating green patch along the road and canal structures to link open green spaces together. With this intention in mind, a researched area in this thesis will be in need of more variety of public green spaces to serve the incoming residents in the future.

figure 51. Green public spaces map
Source: BMA (2021)

Importance of Khlong Prem Prachakorn

WATER FLOWS

This water flows diagram illustrated the waterway around a researched area. Since Chao Phraya river is the lowest point in the city, water would mainly flows to the river where the central business district is located.

On the Prem Prachakorn canal, there is a branch canal called 'Bangkhen canal' that seperated from the river and flows cross the main canal at the researched area caused an area to be vulnerable to overflow flooding from the canal.

Importance of Khlong Prem Prachakorn

Laksi district

1.

2.

3.

4.

Images of site context

figure 51-54. Visual image of site surrounding
Source: Google map, Taken by Waipot Maneekorn

1.

2.

3.

4.

Images of site context

figure 55-58. Visual image of site surrounding
Source: Google map, Taken by Waipot Maneekorn

1.

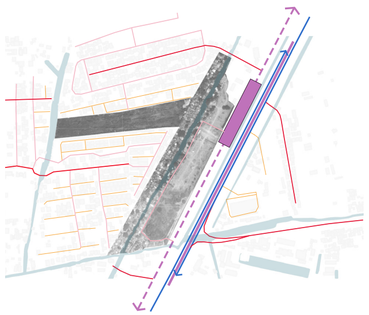
2.

3.

4.

Images of site context

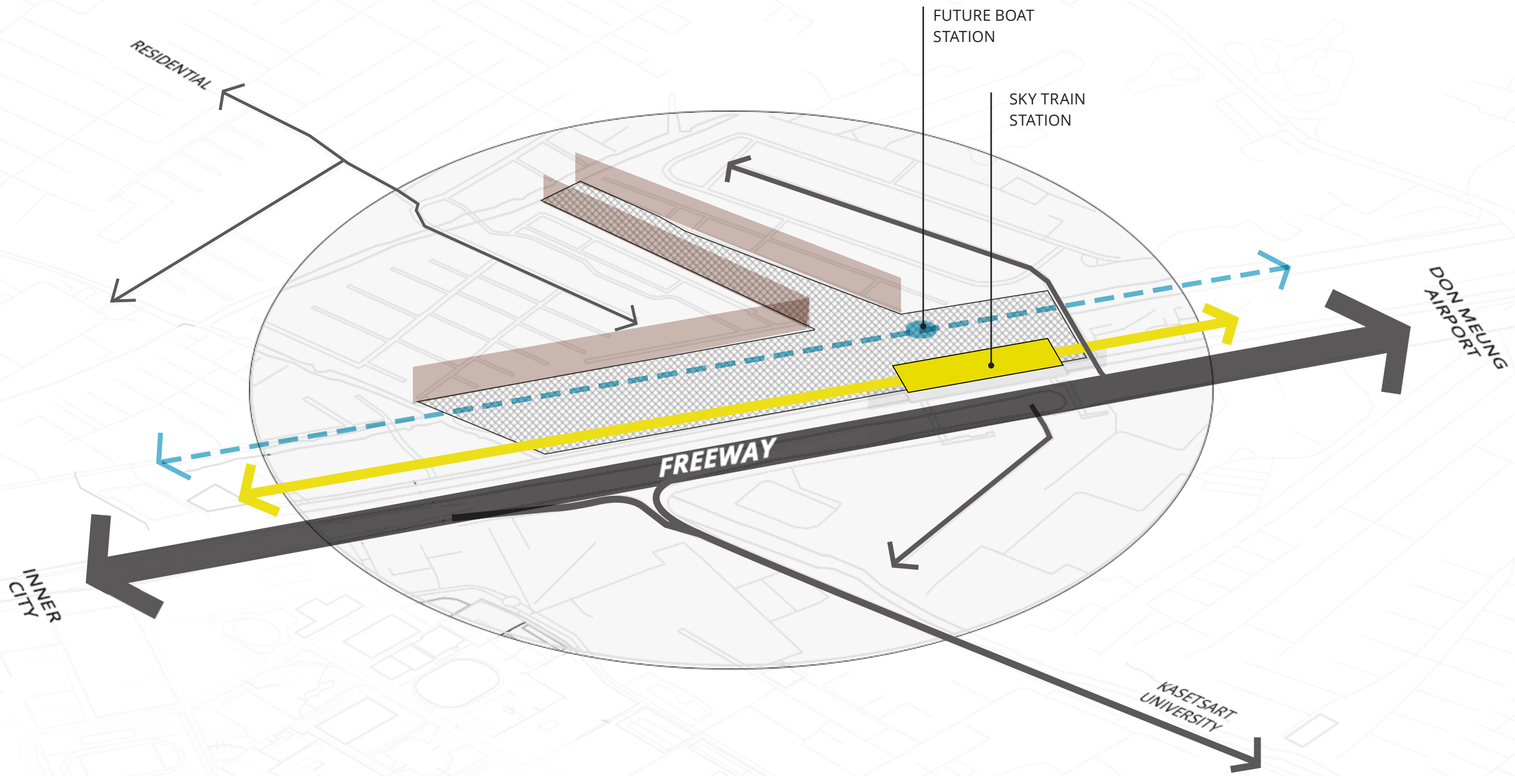
figure 59-62. Visual image of site surrounding
Source: Google map, Taken by Waipot Maneekorn



ROAD STRUCTURE & ACCESSIBILITY

The site is surrounded with variety of public transportation (train, sky train and future boat stop), freeway and highway and also neighbouring with residential area. However, regarding the fact that most of the time there is freeway congestion and the residential areas are gated community, the site accessibility is limited.

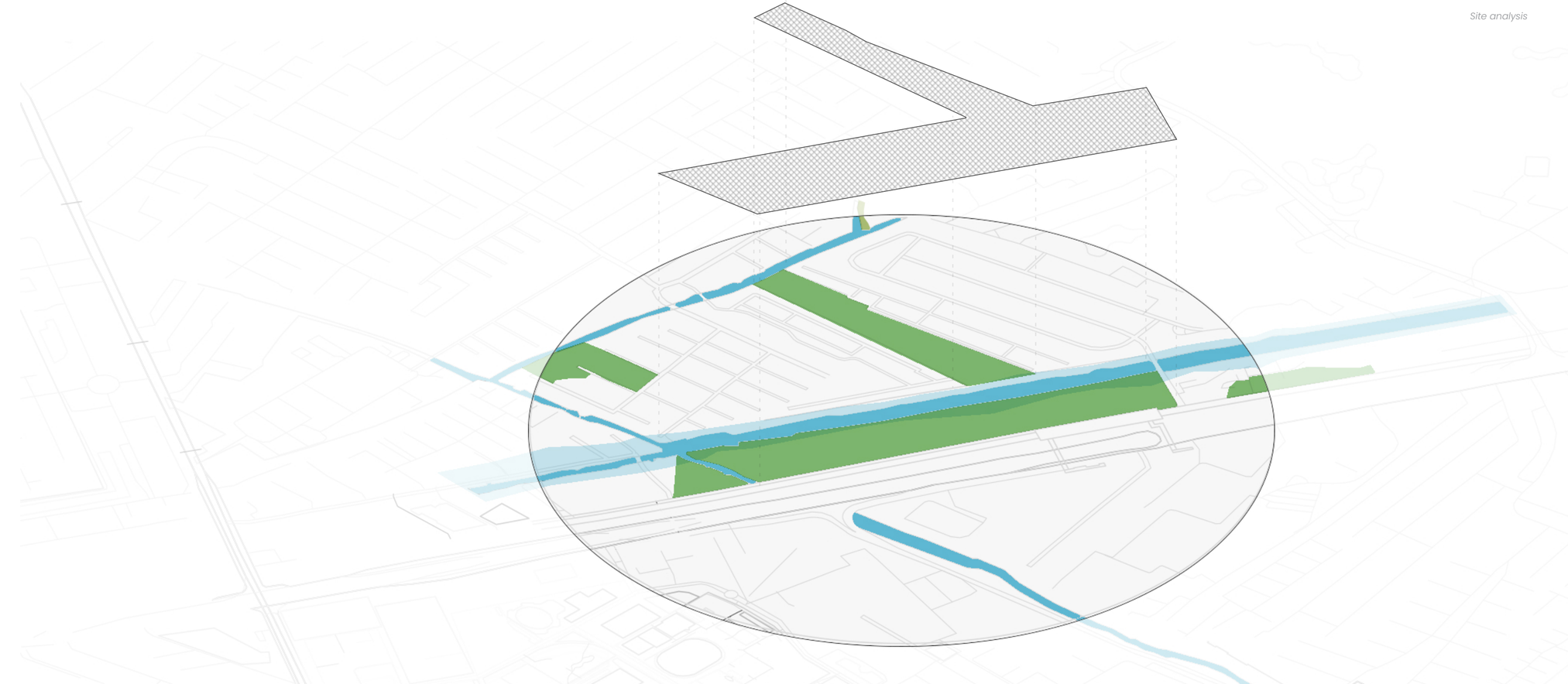
Within the site, since an area is unused, there is only a small street for motorcycle or only one car lane along the canal that only for the informal settlements and serve local users.



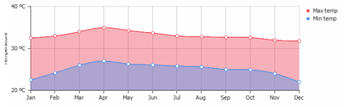
BLUE - GREEN INFRASTRUCTURE

The main blue structure of the site is the main canal, Prem Prachakorn canal, that also connect to Bangkhen canal, the branch canal from Chao Phraya river and a small distributary canal on the west of the site. These blue network usually cause overflow flooding on site.

The most fertile landscape on site is mainly on the west in the middle of residential area. The area is incidentally preserved by the surrounded canal and an unaccessible from the gated community. While a bigger area near by the freeway is mostly unused with a natural wetland on the south where two canals meet.



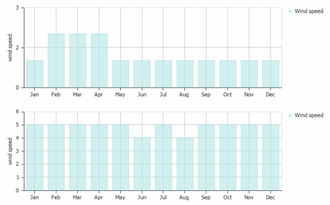
TEMPERATURE



SUN HOUR

WIND SPEED

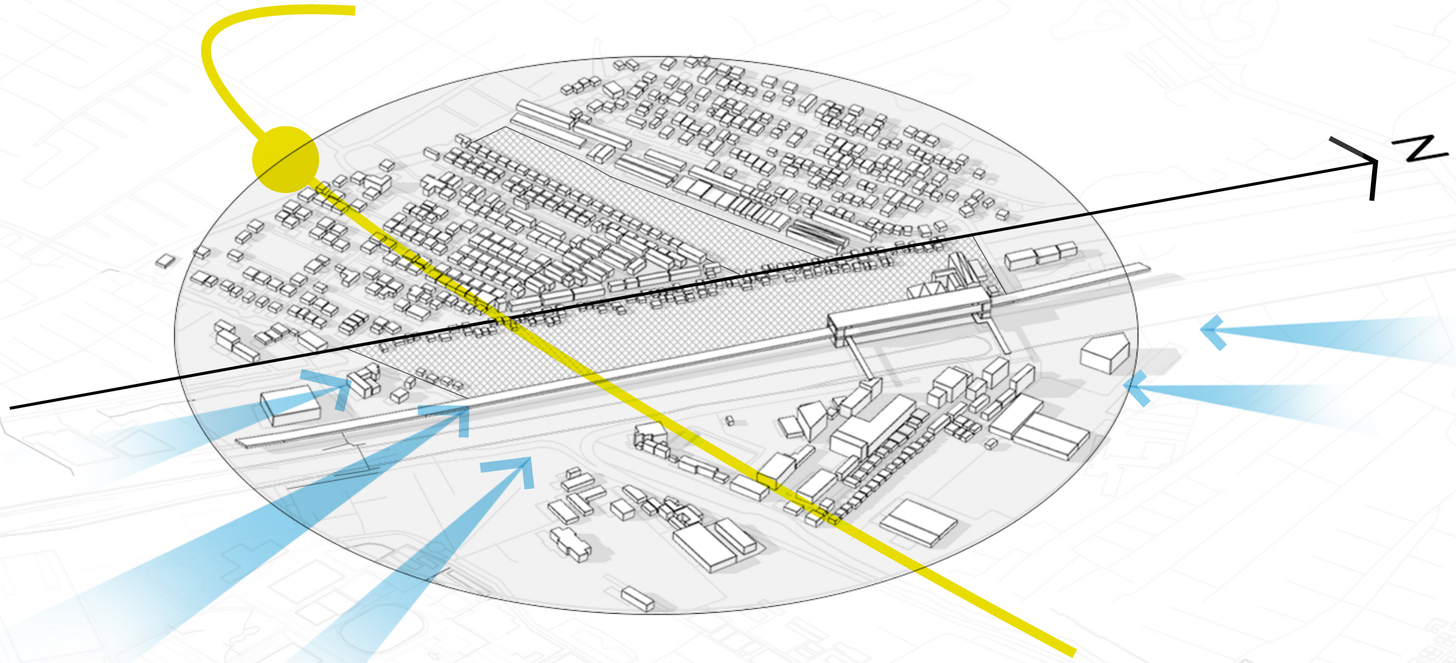
Bangkok - Copenhagen



MICROCLIMATE

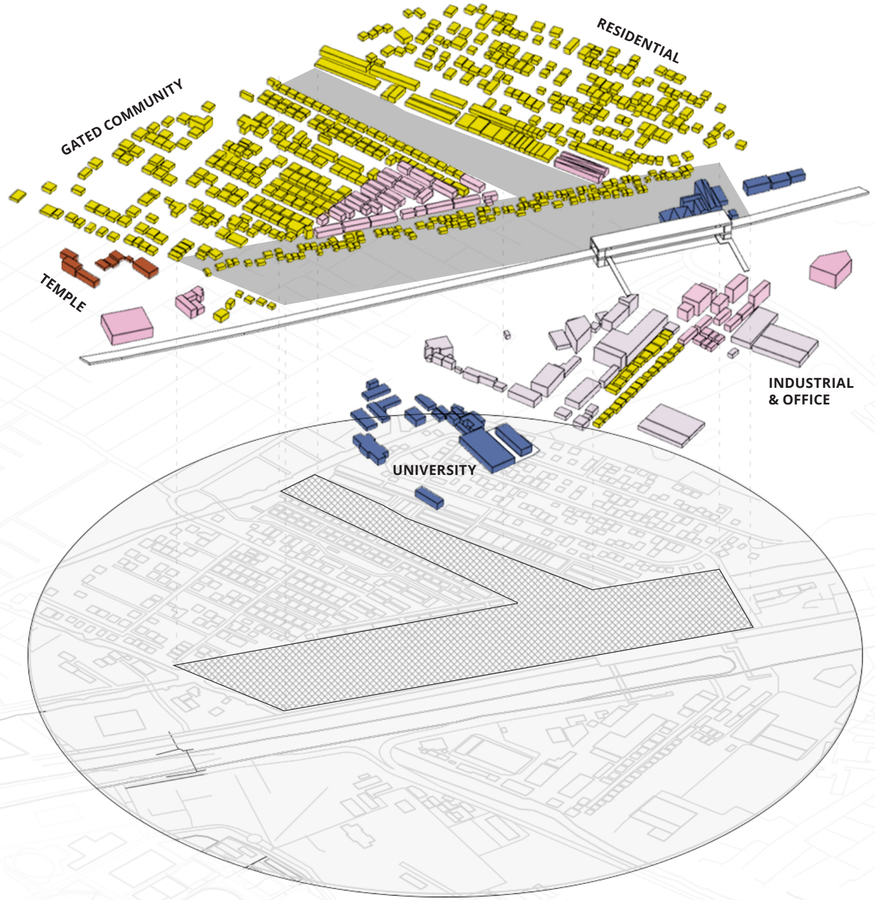
Bangkok is located in the tropical wet-dry climate with the 3 distinguished seasons; hot, rainy, dry and relatively cold. The average temperature is about 30-34 celcius with an extremely long sun hour comparing to Sweden. Thailand also has a low wind speed, especially in the metropolitan area like Bangkok where all the wind is blocked by high-rise buildings.

On site, the prevailing wind is from the sout with cool wind from the North-East in between Dec-Feb and the monsoon or typhoon wind blow from the South-West in June-Nov.



LAND USE CONTEXT

The function of the area around the site is medium density residential with 3-4 stories height. Most of the residential buildings are gated community and informal settlement that lie along side the canal. While the west of the site is attached to many communities and has a possibility to access for local, on the east, next to the freeway, the site is more open to public and hardly access due to the complexity of road structure. At the same time, these road structure increase an opportunity to draw more of non-local people to the site.



CONCLUSION OF SITE ANALYSIS

S

- close to the natural water body
- accessible to the main trans portation mode of the city
- advantage the cool wind from the canal
- hold a big green open space

W

- constantly facing water over-flow from the canal
- water contaminated from households
- canal invasion by the infor-mal settlement
- monotonous character of the residential land use
- residents uses water for util-ities and polluted the natural water resource
- limited accessibility

O

- upcoming main boat route as another transportation mode
- the sky train will bring more people to the site
- according to the city's plan, the area will grow denser

T

- pollution from the sky train
- noise pollution from the boat
- local users' privacy invaded when the area is developed

WATER

	QUALITY	OVERFLOW / RAINWATER	CANAL INVASION
PROBLEM			
SOLUTION	• canal improvement	• retain • irrigate • catch • infiltrate	• better and adequate community • introduce set back from the water body

PEOPLE

	LAND TURN-OVER	MONOTONOUS CHARACTER	POLLUTED COMMUNITY
PROBLEM			
SOLUTION	• better and adequate community • introduce set back from the water body	• more activities • gathering space • more dynamic on site	• better and adequate community • set back from the water body

CURRENT IMAGE OF THE DISTRICT

Asking people living in the district of how they see thier place, people mostly responsed with *'Government complex', 'Market', 'Housing'* and *'Train station'.* These words can describe some of the character of the district and how people perceive the area from the inside. While asking people in general, they would describe Laksi district as only *'Government complex'.*

Those group of words are quite precise since the district is mostly covered with residential area with a small spot of markets and the most noticable place that draw people to the district is the government complex.

" FILL IN THE MISSING PIECES "

attractive + climate adaptive

public open spaces + flow of movement

VISION IMAGE OF THE DISTRICT

'Fill in the missing piece' is the concept to complete what the district still lack of in order to better the quality of life of the residents and support the future growth of the area. This thesis could provide more climate-adaptive green open spaces that flexible enough to support water situation in the future, along side with the sustainable housing for informal settlements on site. The project could outsized the importance as a catalyst for urban regeneration and offer a new perspective to deal with urban flooding to the people.

Water urbanism

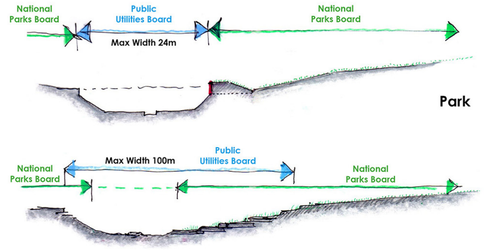
CASE STUDY

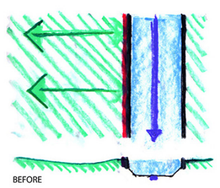
CASE STUDY
Bishan-Ang Mo Kio Park

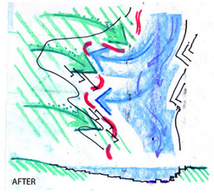
Location: Bishan, Singapore
BY: Ramboll Studio Dreiseitl

Bishan – Ang Mo Kio Park is one of Singapore's most popular parks in the heart of the city. It was constructed in 1988 as a leisure destination and green buffer between the residential new towns of Bishan and Ang Mo Kio. However, the park has detached with the drainage canal as a harsh line. In 2006, Singapore has a a long-term initiative idea to transform water bodies in the country beyond their functions of drainage and water supply, into communual vibrant green area, new spaces for community bonding and recreation for the citizens.

In that case the designed of Bishan Pask has based on a floodplain concept, allowing many activities to take place on site when the water level is low and using the green spaces to function as a retention area to carry the water flow downstream. The alignment of the river channel integrates varying widths to create diverse flow patterns, natural and diverse habitats for biodiversity.







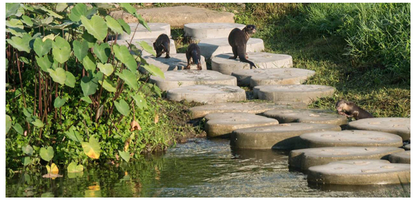


figure 63-68. Bishan Ang-Mo-Kio park, Singapore
Source: ramboll (2012)

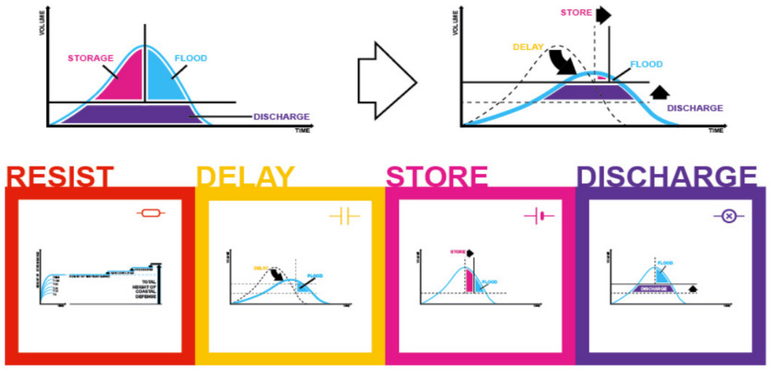
Case study

CASE STUDY
Resist-Delay-Store-Discharge

Location: Hoboken, New Jersey, USA
BY: OMA

Jersey City has suffering with both flash flood and storm surge. Before the project was conducted, Hoboken city also faced the devastation of Hurricane Sandy so the project focuses on establishing resiliency through urban environment that not only protects coastal neighborhoods, but also the entire city.

As OMA has stated, “Our comprehensive strategy deploys both hard infrastructure and soft landscape for coastal defense (resist); recommends policies to enable the urban fabric to slow down water (delay); a green circuit to trap water (store) and water pumps to support drainage (discharge).” (OMA, 2013), the project mainly focus on managing water for both disaster and for long-term growth to provide a more sustainable in term of water-sensitivity to cope with many different scenario regarding water in an unforeseen future. The project has illustrated various of infrastructure that can deal with different water situation in the city and at the same time, creating a circuit of water to flow freely and giving precedence to the blue network, seeing an ability of nature that can be adapted to the urban lifestyle of people and vice versa.



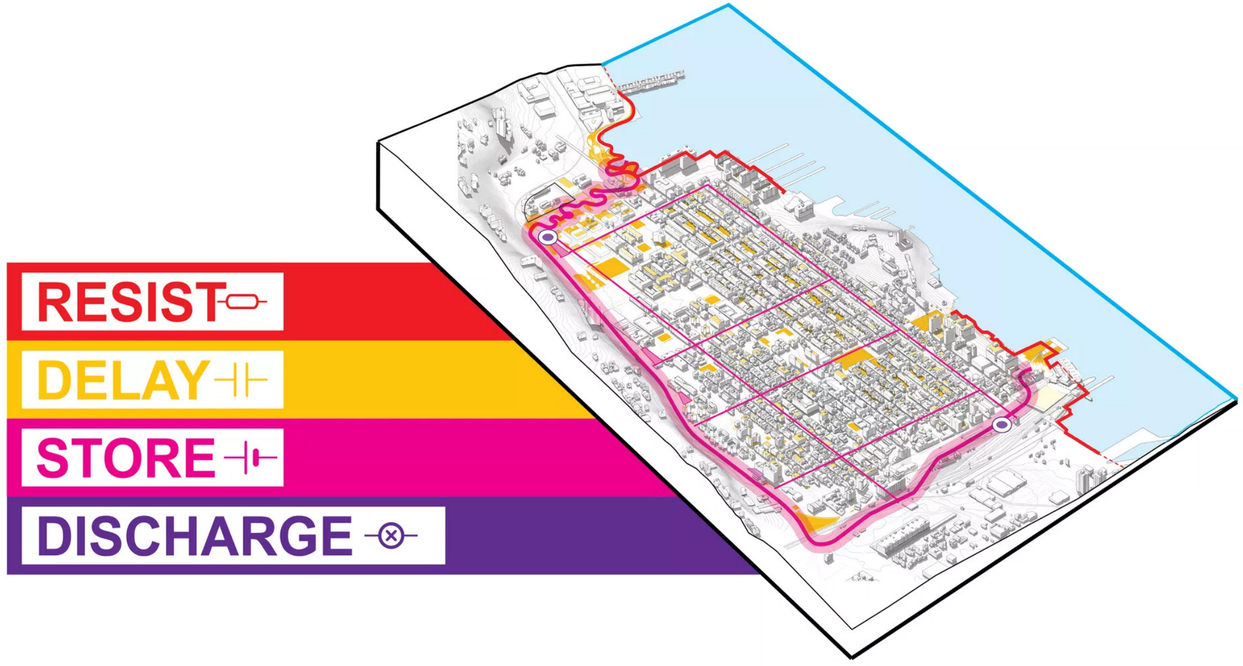


figure 69-72. Resist - Delay - Store - Discharge project
Source: OMA , archdaily (2013)

CASE STUDY
Gowanus Canal Sponge Park

Location: Brooklyn, New York, USA
BY: dlandstudio

The Gowanus canal cut into one of the densest cities in the world. Over 150 years of intense human use, the canal has been sullied with toxic industrial waste. Regarding its' background, the project *'Gowanus Canal Sponge Park'* purposed plan is to convert around 47 000 sq.m. of contaminated brownfields into an urban waterfront park. The design dedicated around 30 000 sq.m. to greenways and recreational open spaces while the remaining has turned into wetland basins to remediate the polluted existing landscape and waterbody. The design incorporates natural systems of native selected plants to filter and slow toxic runoff water from households and streets and manage harmful pollutants before discharge it to the Gowanus Canal.

The project offers a great example of contaminated water management of a canal in an urban context that illustrated the importance of the canal together with activating waterfront and revitalize the neighborhood along the canal.

The blue infrastructure and how the project has perdicted an area to be dealing with overflow and stromwater.

figure 73-75. Gowanus canal Sponge Park
Source: gowanusbydesign, asla (2017)

Water urbanism

CASE STUDY

PART 4

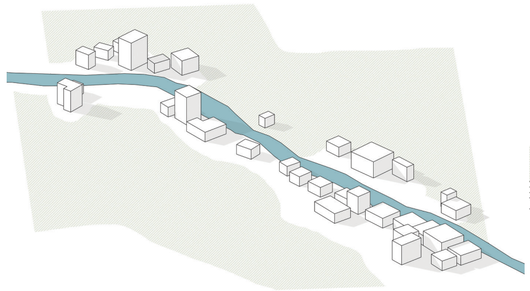
The Infiltrated Neighborhood

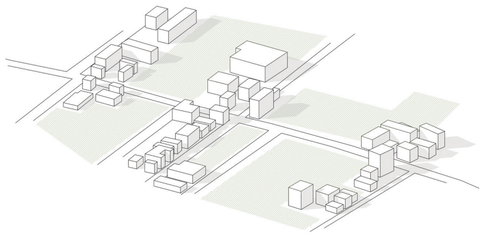
SITE AREA, Google Earth, 2021

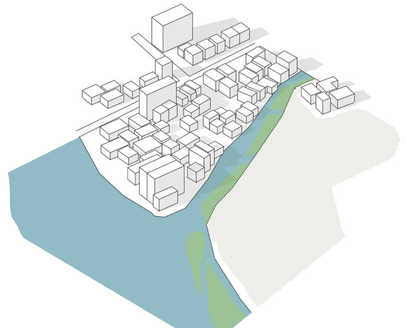
POROUS NETWORK

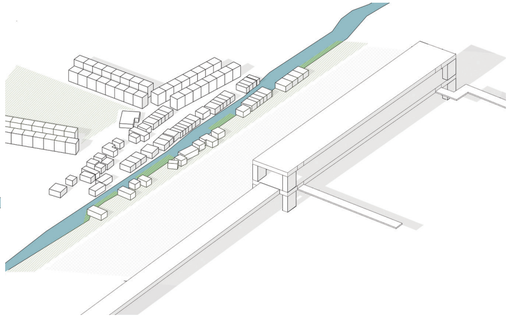
Prem Prachakorn has been neglected and make light of its' flooding situation since the canal has installed many of pumping system and drainage tunnel but since it frequently catch a huge amount of water, the area along the canal would inevitably face flooding. Subsequently, Water-based urbanism in Bangkok is an urgent issue. Water naturally wants to flow and allowing it to penetrate in the urban area can alleviate damage of urban flooding in the future.

In consequence, the vision would aims to increase the city's capacity to adapt to the natural flow of water. Focus on helping drainage and absorb water, especially flooding from the Northern of Thailand and stormwater in the district, also filter and improve water quality and quality of life of the people living along the canal.









VARIETY OF OPEN SPACES

Bangkhen canal is the branch canal that link between the main canal, Prem Prachakorn canal, to the river and has a various of spaces with great opportunity to regenerate to show the importance of the green porous network.

1) a vacant space near the river can contribute to a huge green spaces, focusing on dicharge water from the canal. 2) green spaces inbetween the community void can increase the area's ability to absorb excessive rainfall. 3) an unused open spaces can increase water absorbent along the canal and regenerated into more public spaces for recreation. 4) an open spaces in the middle of mixed use area in the urban context require an ability to deal with complex of urban context, water, people and public transpotation.

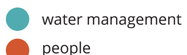
STRATEGY

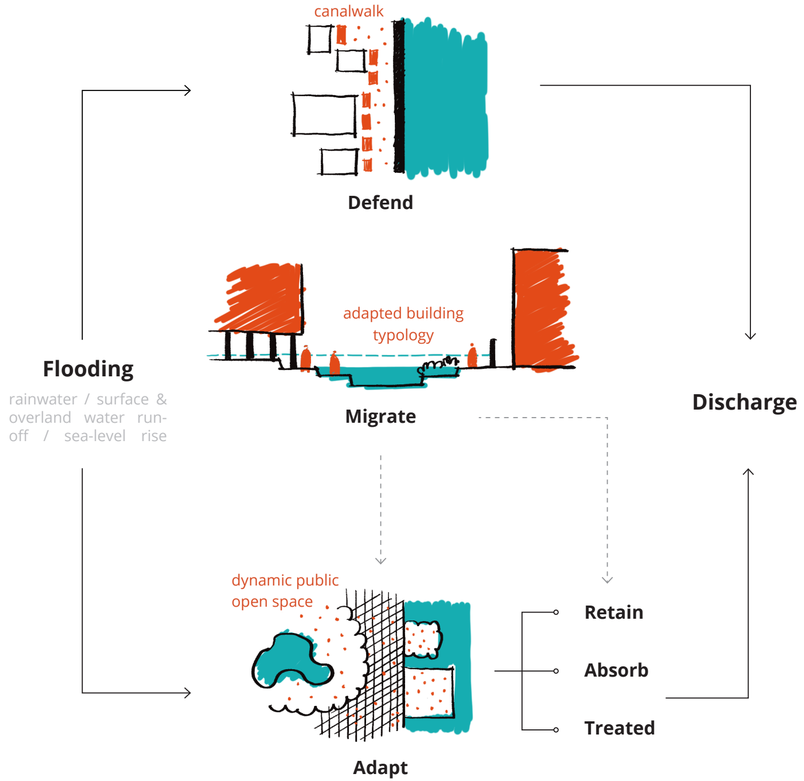
The concept integrated urbanism with landscape that focus on bringing back the city's root both by making place for water in the city and by allowing people to live sustainably with water as they used to. It could imply a mentality shift in the way of thinking people generally have today about water and flooding. Though larger and more holistic aspect of infrastructural intervention is still necessary to manage flooding in the city, a smaller intervention is not less important since it can communicate to people more on a local scale.

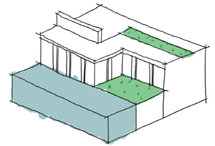
Defend is the most common way to prevent the build environment from water overflow but at the same time, the infrastructure should both function as a public place and protect flooding.

Migrate means to retreat infrastructure and housing to safer ground and allow water to migrate easier on the canal.

Adapt consists of three more strategies of how water can be treated in different ways on site before discharging it to the canal.





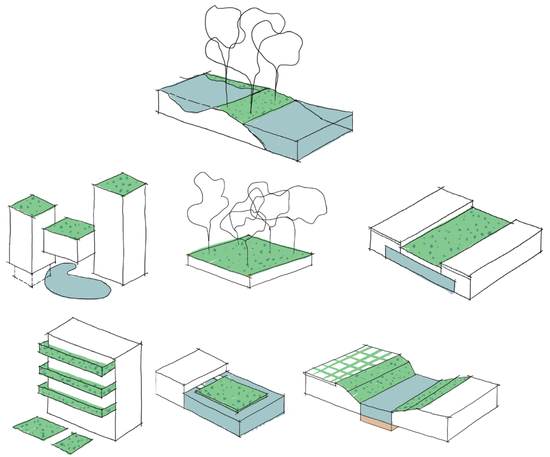


Defend

- treated wall
- delay water with vegetation
- allow people to walk on the promenade

Migrate

- water tunnel
- canal improvement
- reconstructed canal
- improve water quality



Adapt

Retain
- wateway
- water body
- floodable green infrastructure
  - wetland
  - pond

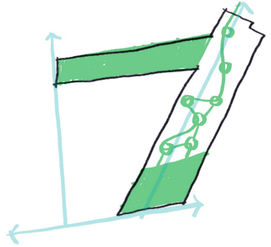
Absorb
- green roof
- urban farming
- vegetation cover
- pervous pavement
- wetlands
- rain garden

Treated
- biotopes in planter
- water recycle
- floating wetlands

DESIGN PHASES

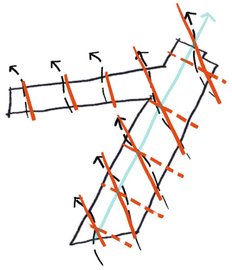
I. Blue-green infrastructure preservation

Since the first priority is to manage blue infrastructure on site, the existing green spaces is the main element that can cope with overflow and stromwater from the canal. The design would start with preserve the existing natural elements as much as possible.



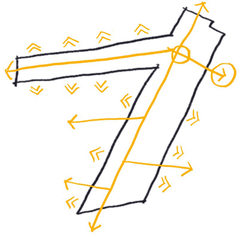
II. Wind alignment

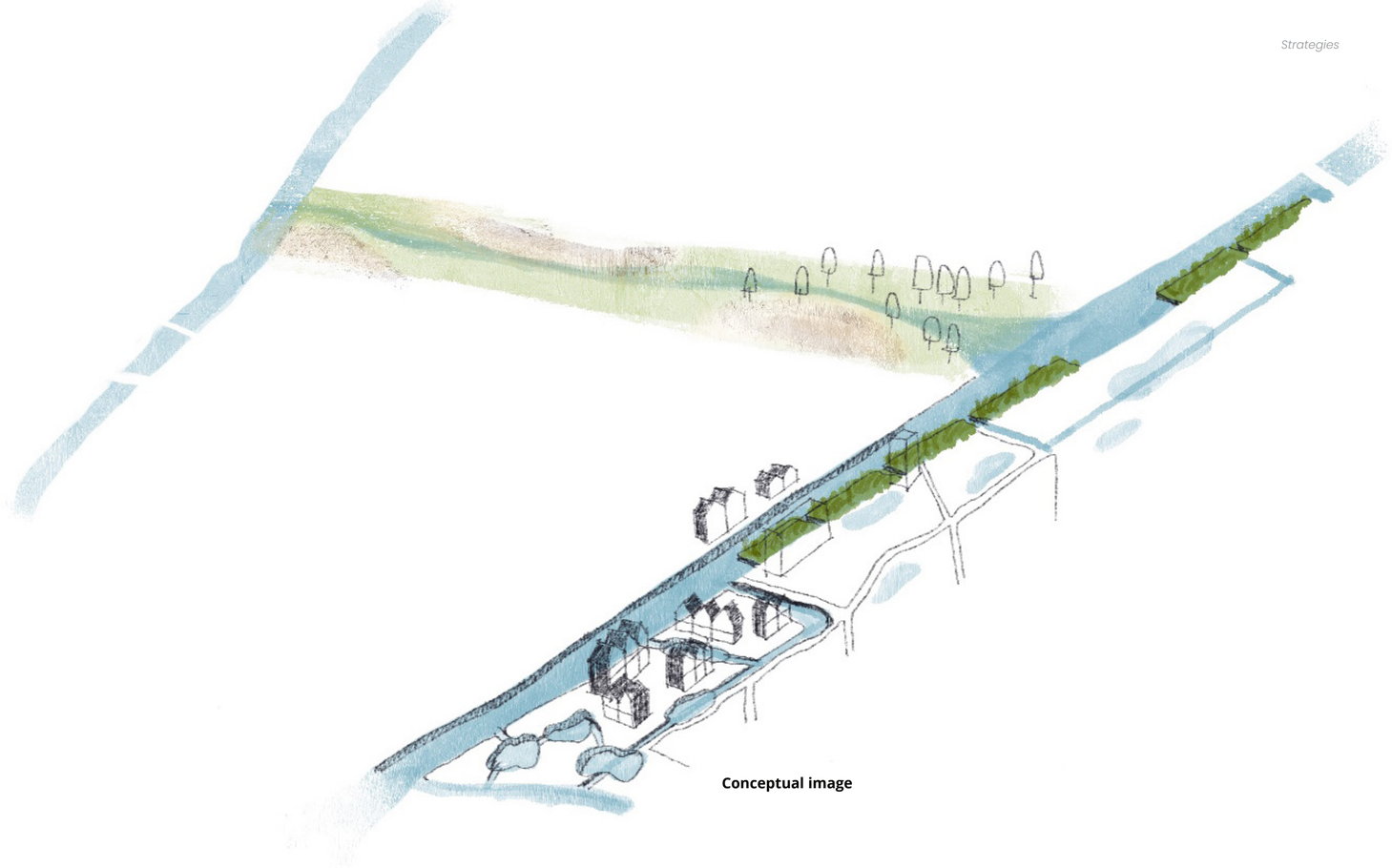
Regarding the site's location in the middle of the city, surrounded with high-rise buildings and medium-density residential, and the microclimate of Bangkok, the building block will align with wind direction and placed buildings faced water to gain a natural wind on site.



III. Connectivity

To ensure accessibility of the site, the main connection is drawn from the sky train staion - future boat stop - to the rest of the residential area on the west, across the existing wetland and distributary canal, and proposed the gated community around to open up and infiltrated to the new development area.



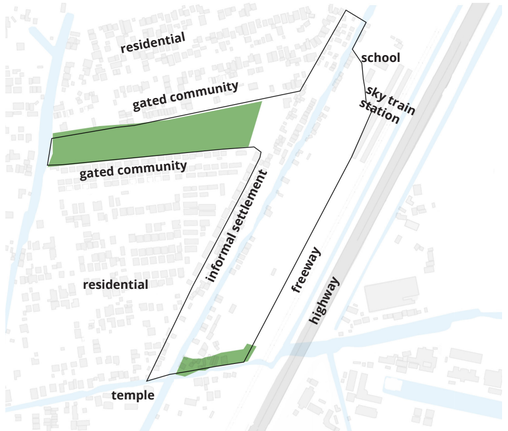


Conceptual image

DESIGN PHASES

CONNECTING GRAY AND GREEN

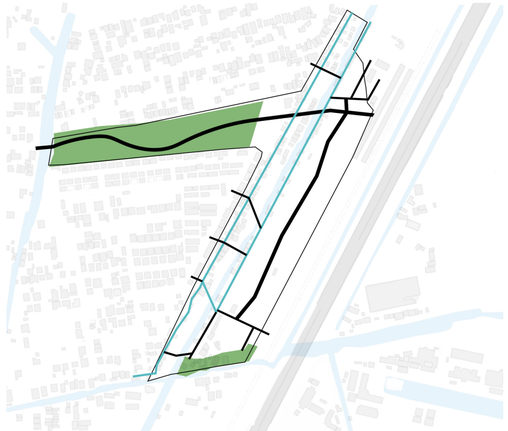
Existing condition



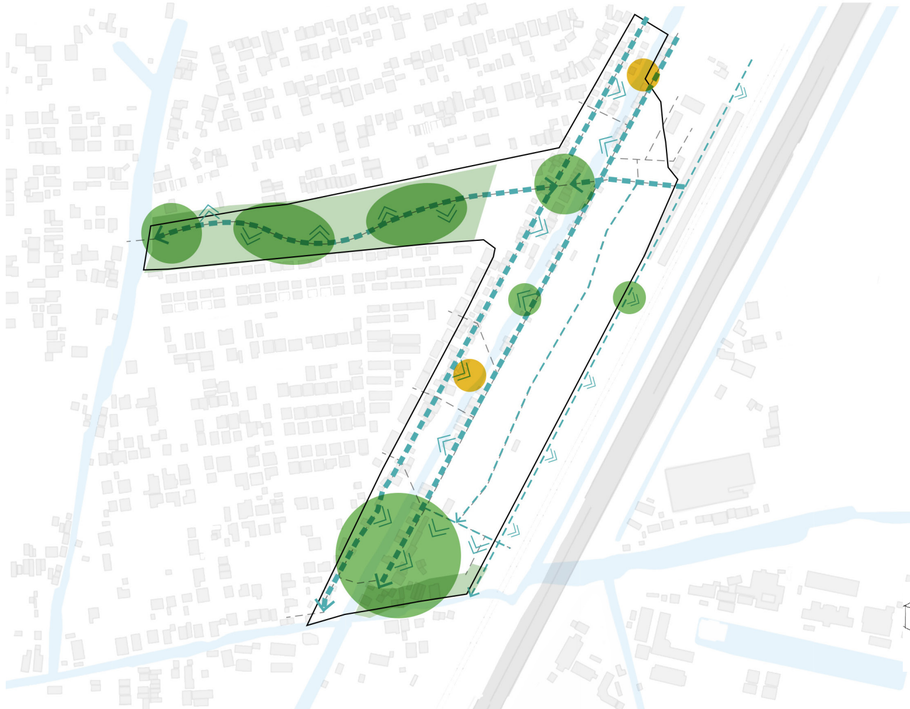
Introducing connection ahead throughout the site in order to tide the new development area together with the existing condition. Create a strong and main connection between existing green infrastructure and the new public transportation stop (boat and sky train).

Drainage from the roads and adjacent community toward the existing green spaces and canal creating the guide for the green network on site. Also create spaces along the canal to urge people to interact with their own valuable natural condition.

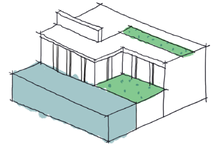
Connectivity



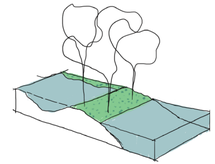
existing green area
primary road
secondary road
promenade



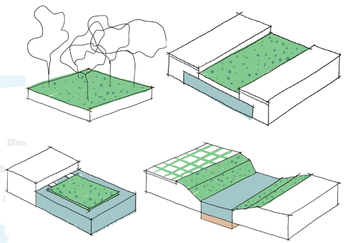
defend
migrate
adapt



treatedwall could be designed to be flexible and has more than a defended function



constructedwetlandisneededtocopewith excessive water when the water level rise.

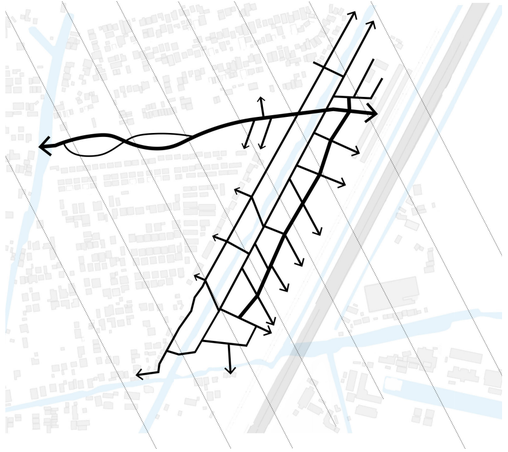


some small intervention adapted to support heavy rainfall and overflow water

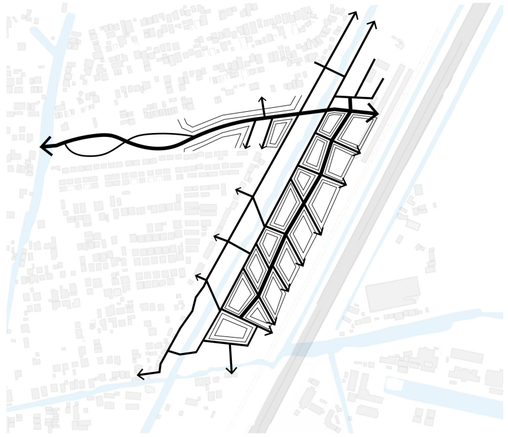
DESIGN PHASES

DESIGNED WITH MICROCLIMATE

Wind alignment



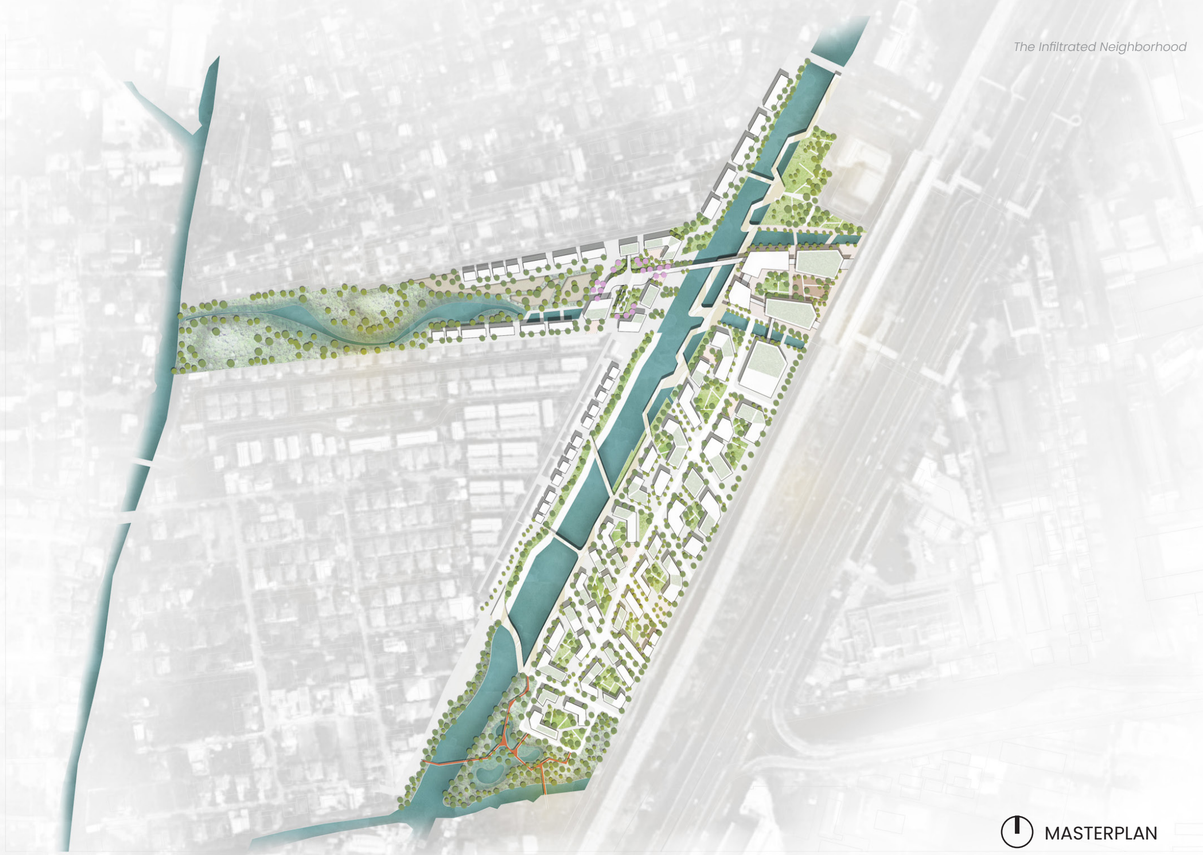
Urban expansion



primary road
secondary road
urban growth

Align buildings with the wind direction to comfort the building block and allow open spaces on the south to face all-day sunlight. At the same time, continue the existing grid from the surrounded community can help create harmonious of the new development area.

The bigger block is located around the key place of the site, the transition of public transportation area, to generate the area and support more of activities and people that will visit an area in the future.



MASTERPLAN

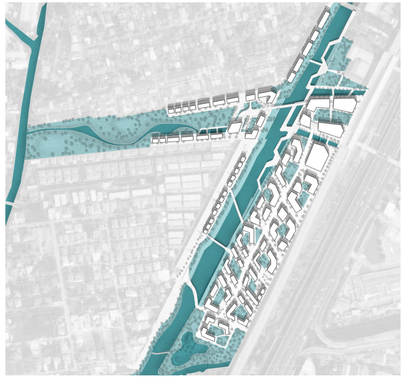
MASTERPLAN

FIGURE AND GROUND

Density:
According to the municipality's plan that projected an area to grow denser, the development will increase density on site from 0,3 residents/sq.m. (with existing population on site around 3 200) to 1,2 residents/sq.m. or up to 25% with mid-rise residential and mixed-use buildings.

Blue and green infrastructure:
More of the green infrastructure, like garden, park, wetland and blue infrastructure, like waterplay park, retention pond and canal improvement that widen the existing waterway have been introduced to increase ability of water absorbance on site so that the site's existing capacity from 97 000 cubic meter has been raised around 20% to 120 000 cubic meters.

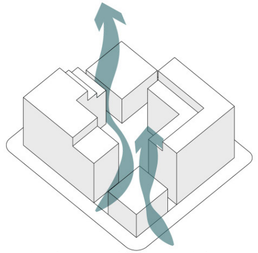
Flooding situation:
In a crisis event of flooding, whether from stormwater or overflow from the canal, with the new proposed blue and green infrastructure, the site will be able to flooded up to 210 000 cubic meters or 75% more than the proposed water retaining capacity, this has been calculated from 3 meters of water-level rise which is when the site hit a critical stage of flooding.



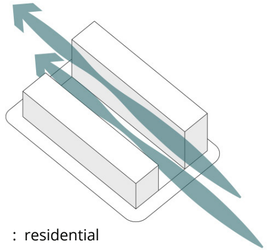
MASTERPLAN

BUILDING TYPOLOGIES

Wind alignment

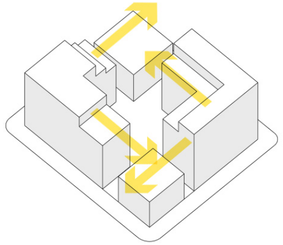


: mixed-use and commercial

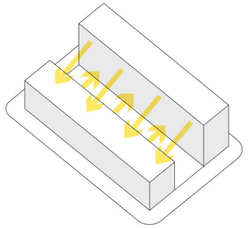


: residential

View framing

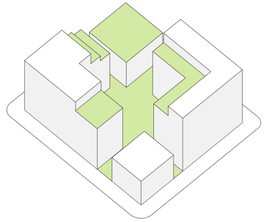


: mixed-use and commercial

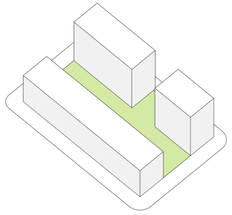


: residential

Green pocket

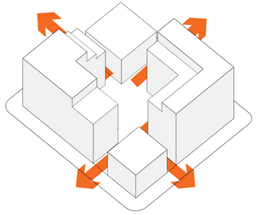


: mixed-use and commercial

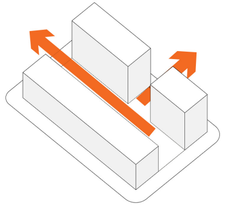


: residential

Privacy



: mixed-use and commercial

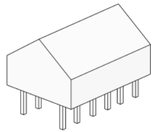


: residential

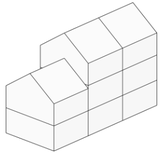
MASTERPLAN

BUILDING TYPOLOGY

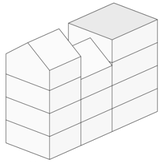
Existing building on site



: informal settlement

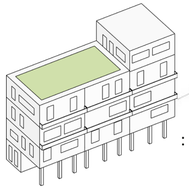


: rowhouse

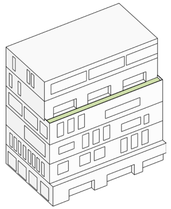


: office and mixed-use

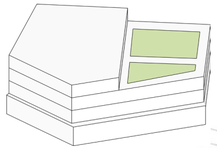
Proposed building



: residential - shared rooftop
approx. 290 sq.m. / fl.
FAR 1.3



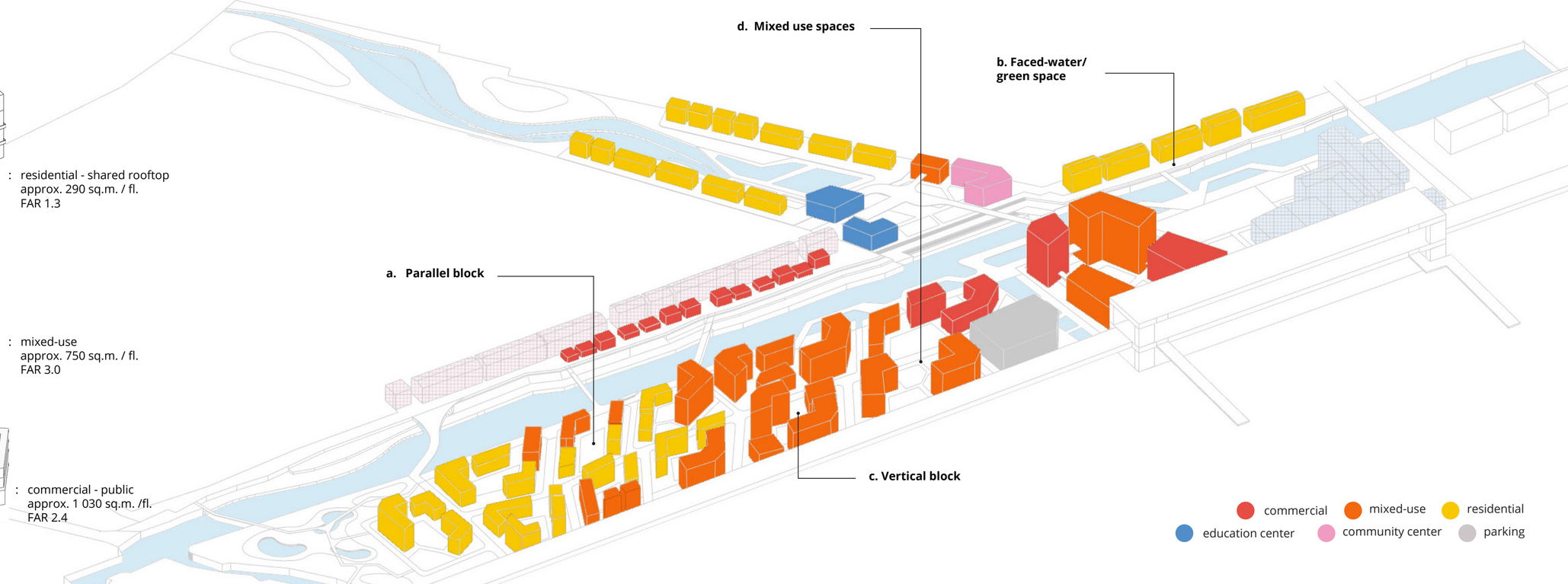
: mixed-use
approx. 750 sq.m. / fl.
FAR 3.0



: commercial - public
approx. 1 030 sq.m. /fl.
FAR 2.4

The Infiltrated Neighborhood

BUILDING BLOCK TYPOLOGIES



MASTERPLAN

BUILDING BLOCKTYPOLOGY

To generate the existing informal settlement, it is necessary to incorporate commercial, business, mixed-use and residential on site in a more sustainable way and be able to gentrify an area without invade or displace the existing community. The overall goal is to slowly infiltrate the new development into an urban fabric by respecting the existing environment.

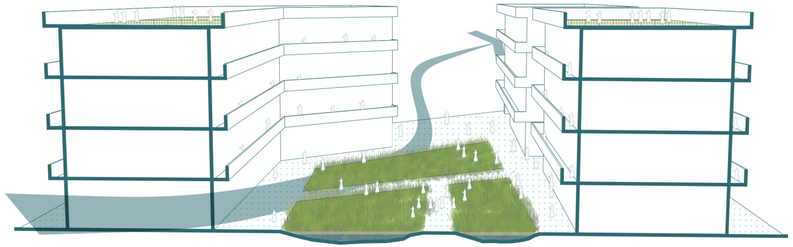
a. Parallel block
Mostly residential with mid-rise buildings that accommodate housing unit. Provided small green area in the middle to guide natural wind flow and to be a common spaces.

b. Faced-water/green spaces
In order to get the full wind from open spaces and canal, some mixed-use and residential buildings are oriented facing the void area.

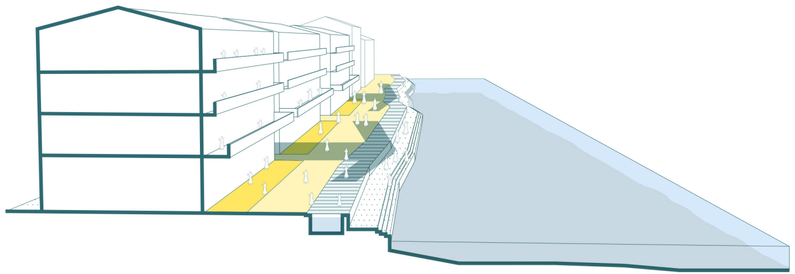
c. Vertical block
The development need to densify an area to cope with the future urban expansion, some of the residential and mixed-use block will need to grow vertically to fit on site. Therefore, more pocket green spaces on the rooftop is provided to substitute the small green pocket on ground.

d. Mixed-use space
Most of the mixed-use blocks share a common spaces between them so that people's movement can flow freely on site and indirectly increase safety of the pedestrian.

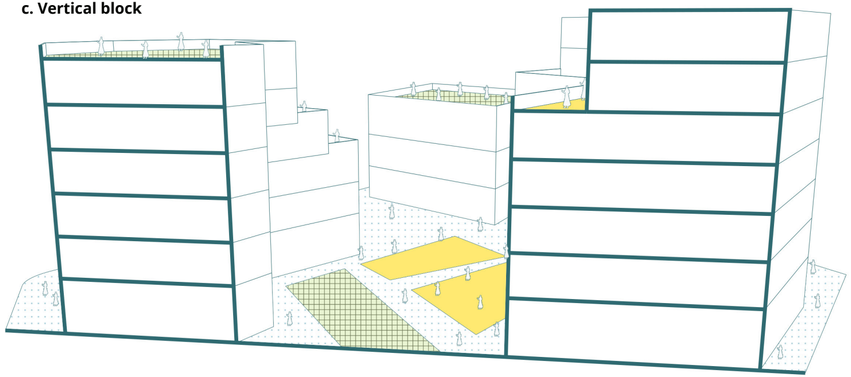
a. Parallel block



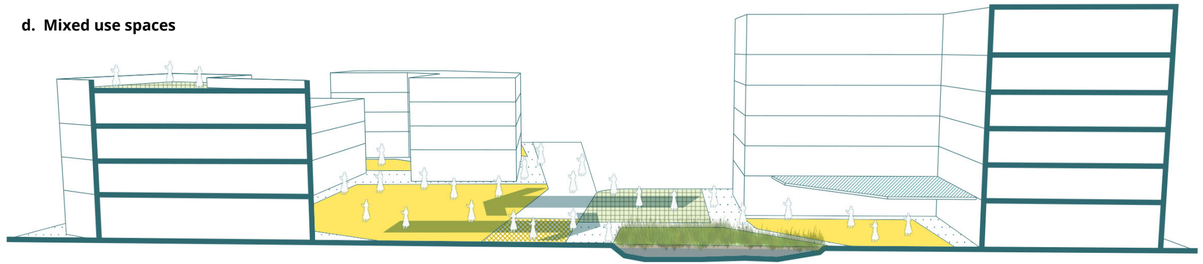
b. Faced-water/green space



c. Vertical block



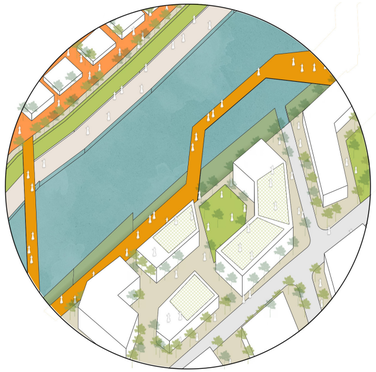
d. Mixed use spaces



The Infiltrated Neighborhood

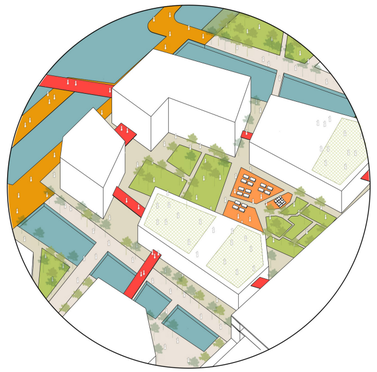
MASTERPLAN

OPEN SPACES TYPOLOGY



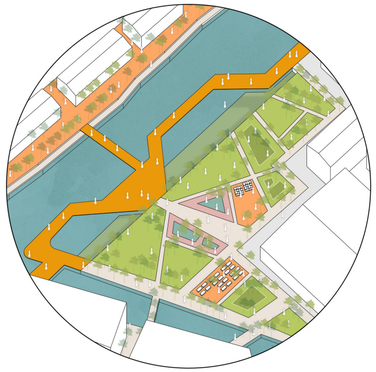
Promenade

Mainly to generate people around the canal. The promenade main elements consist of elevated bridge and promenade walk in different levels that can offer distinguished experience for the users.



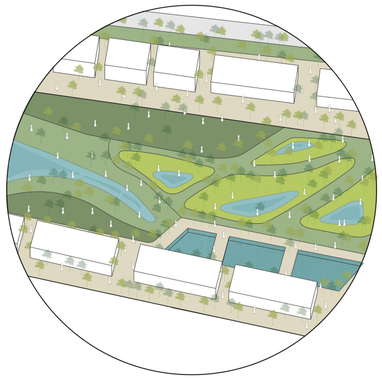
Transitional plaza

A key place that function as a welcome gateway and an exist gate for the district. Connect to the sky train staion both on ground and with an elevated bridge that even go cross the canal to a wetland area.



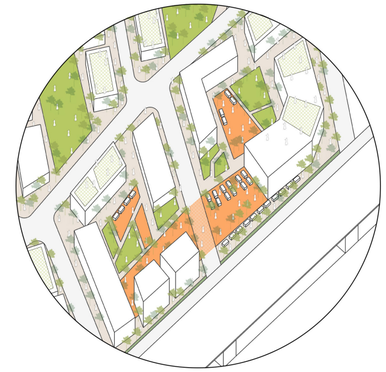
Playground and park

Create a connection to the existing school. Allow kids and adult to have flexible activities together. Also, located close to the main square so that people have more option of public spaces to choose.



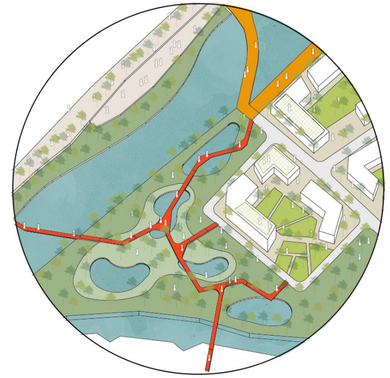
Wetland

From the preserved most fertile green space on site, this wetland area help connecting the main canal to the distributary canal and also provide new natural open space to the community.



Outdoor market

A market square close to a freeway is provided a commercial stop for people who is on the sidewalk, attracting people outside the site to flow in an d create dynamic to the aea.

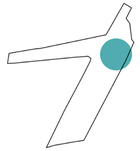


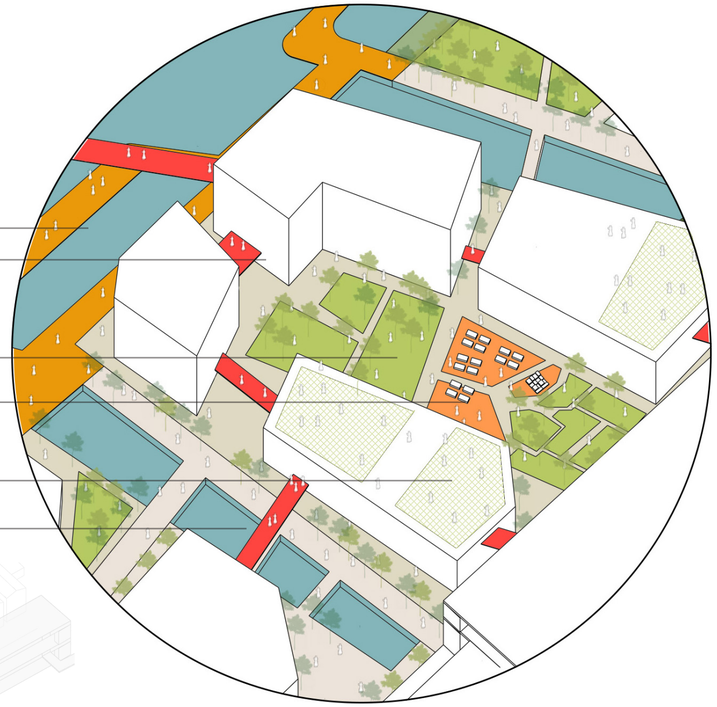
Constructed wetland

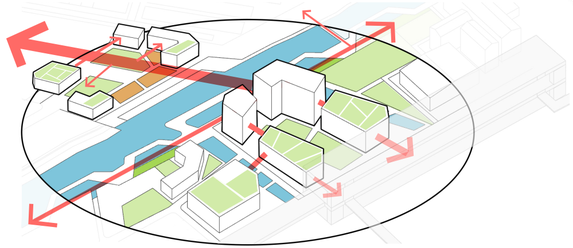
Located at the south end of the site, adjacent to both main and branch canal. The constructed wetland is prepared to be flooded with both stormwater and overflow water from the canal. At the same time, a learning route (red bridge) is provided to urge people to walk throughout the area with new experience.

KEY PLACES

I. TRANSITIONAL PLAZA

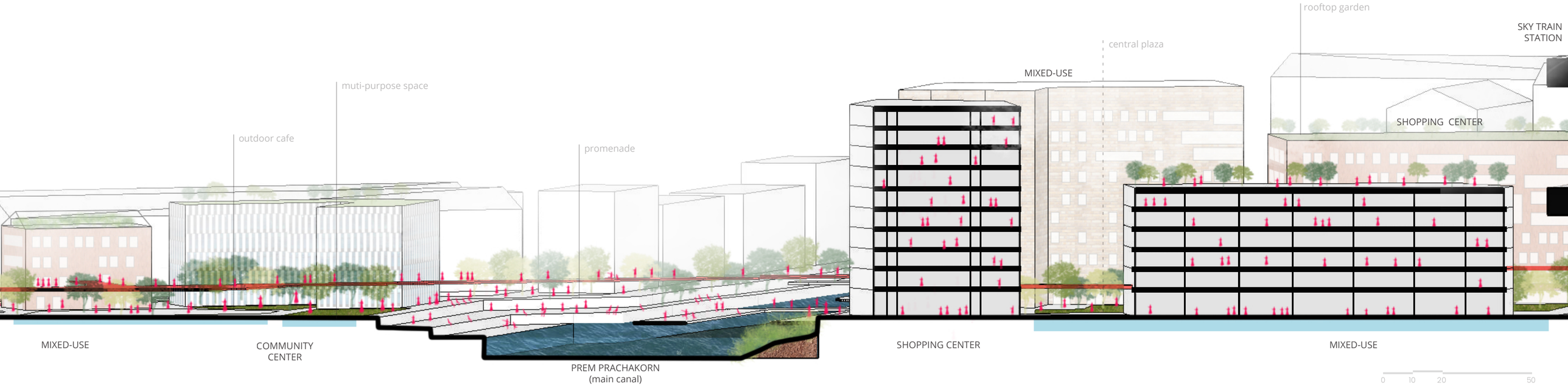






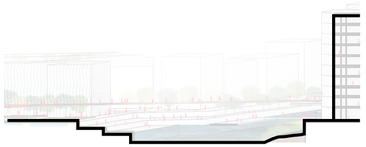
The Infiltrated Neighborhood

The Infiltrated Neighborhood

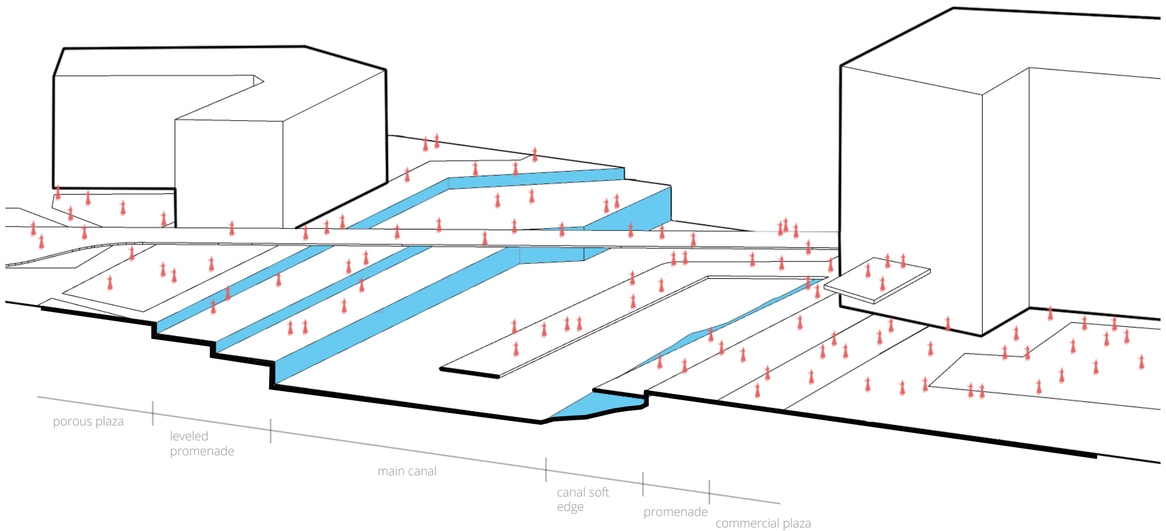


I. TRANSITIONAL PLAZA

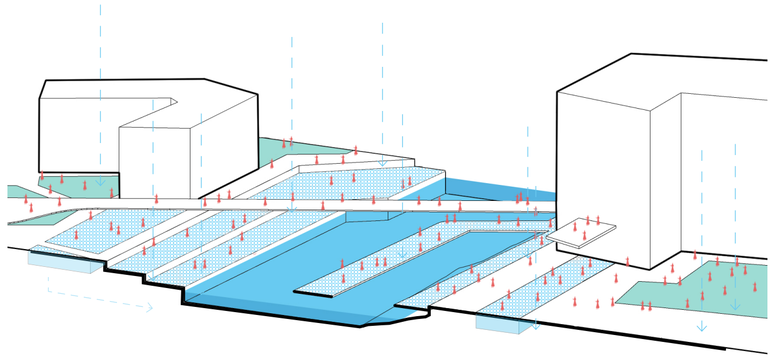
WATER MANAGEMENT STRATEGY



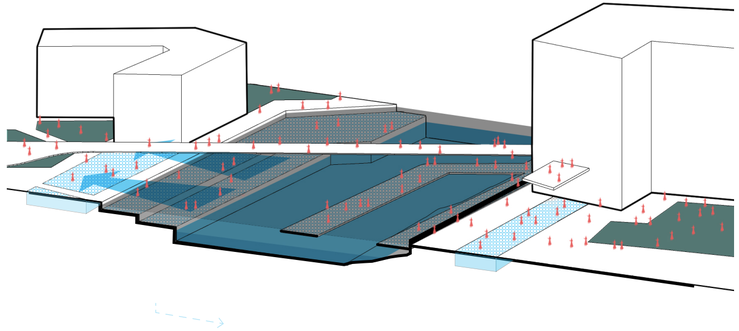
Defend



Adapt



Flooding situation

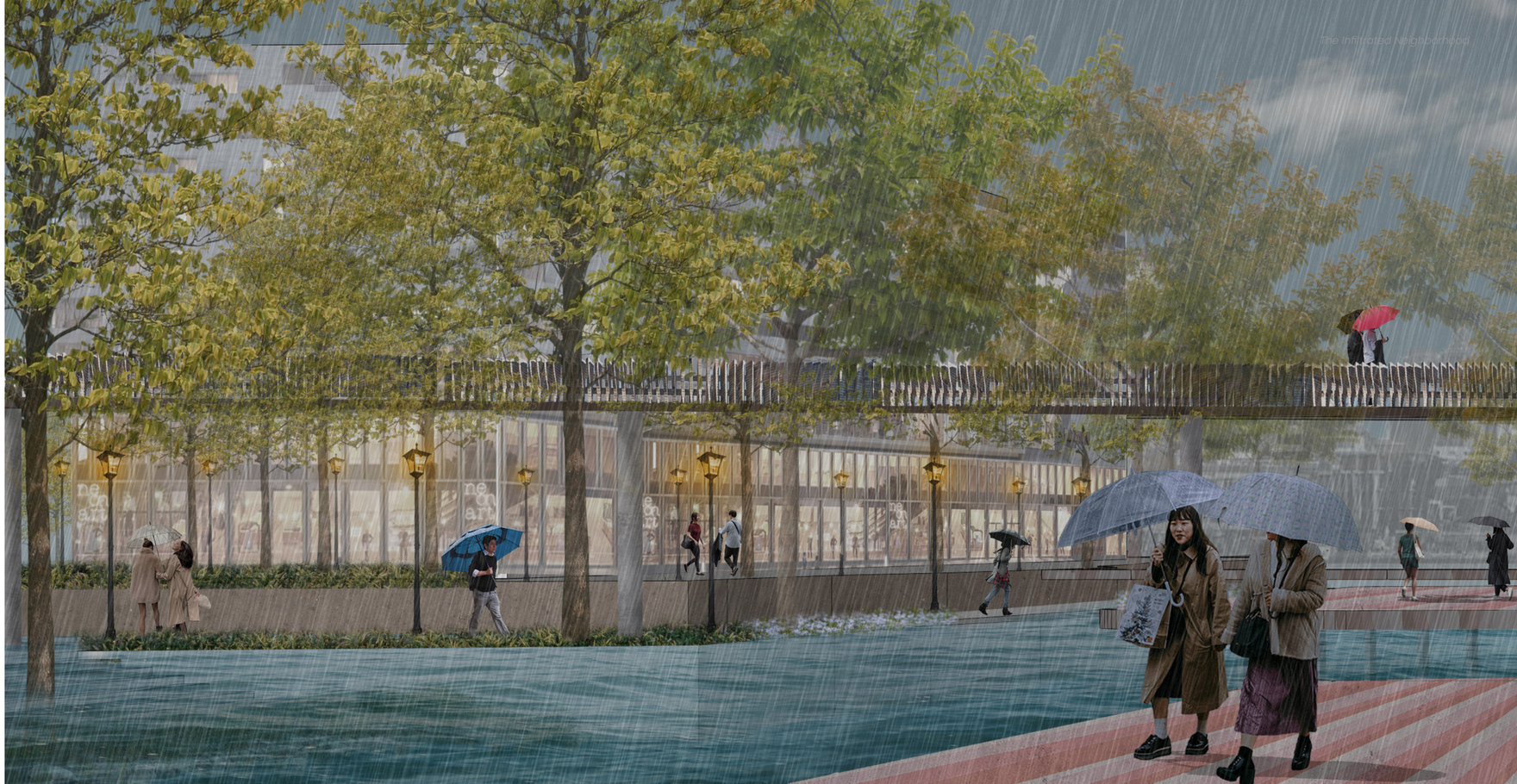


Transitional plaza

Active ground floor residential - Promenade -
Main canal - Elevated bridge along the canal (from left to right)

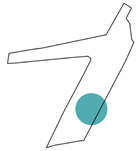
Transitional plaza with +3.00 m. water level rise

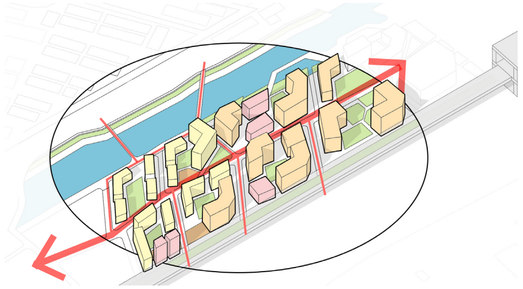
Active ground floor residential - Promenade -
Main canal - Elevated bridge along the canal (from left to right)



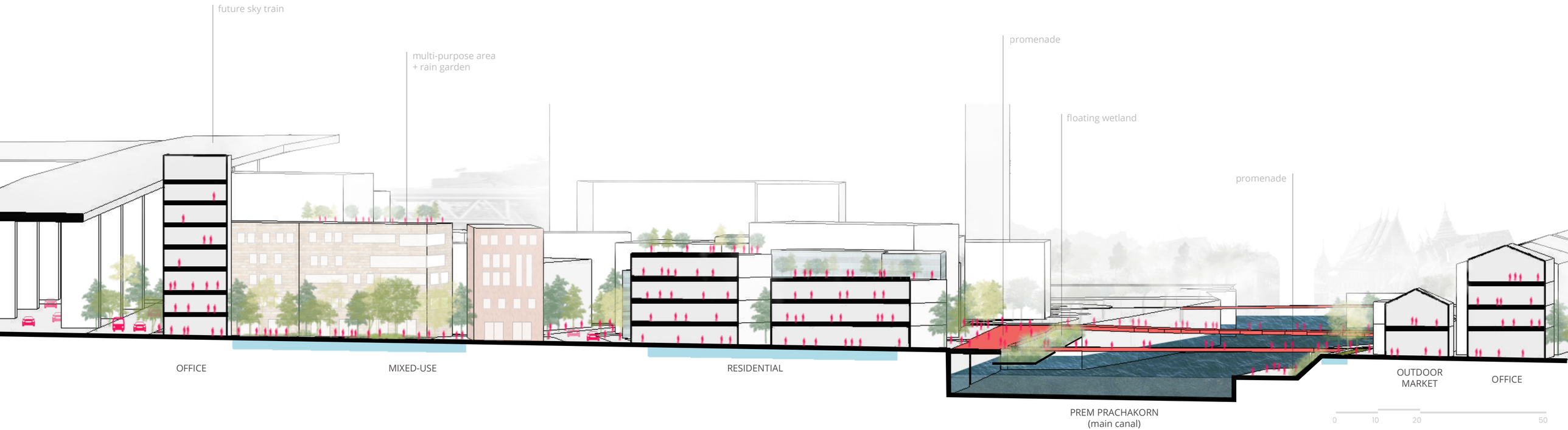
KEY PLACES

II. THE COMMUNITY



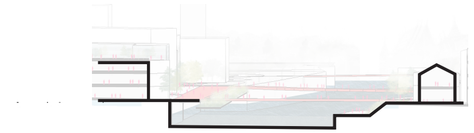


The Infiltrated Neighborhood



I. THE COMMUNITY

WATER MANAGEMENT STRATEGY



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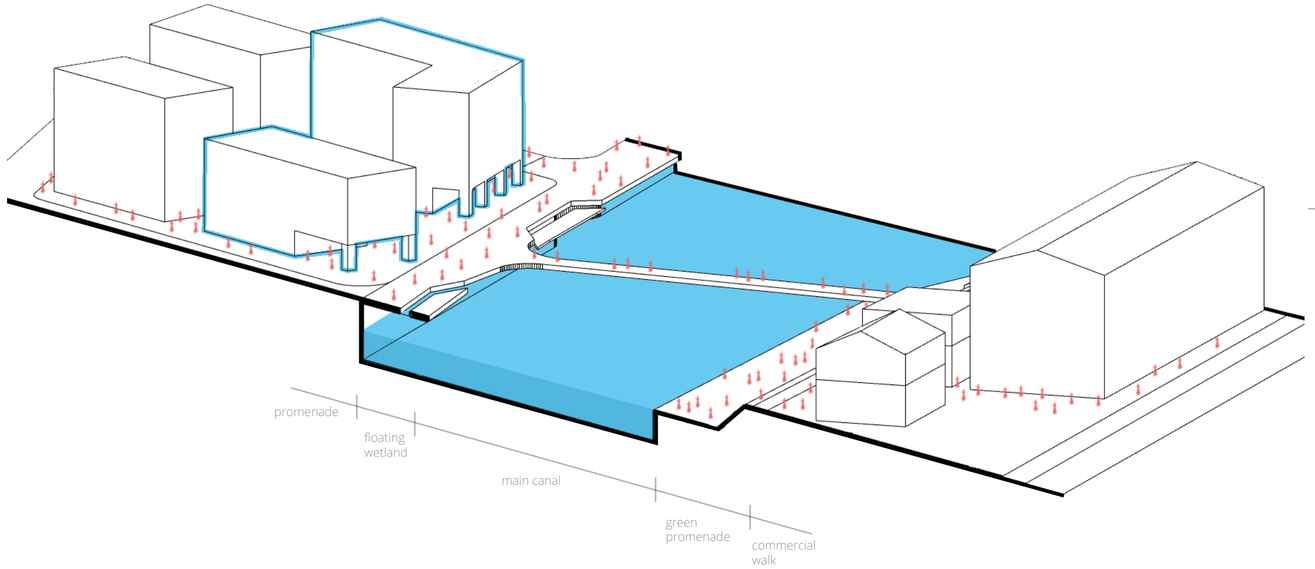
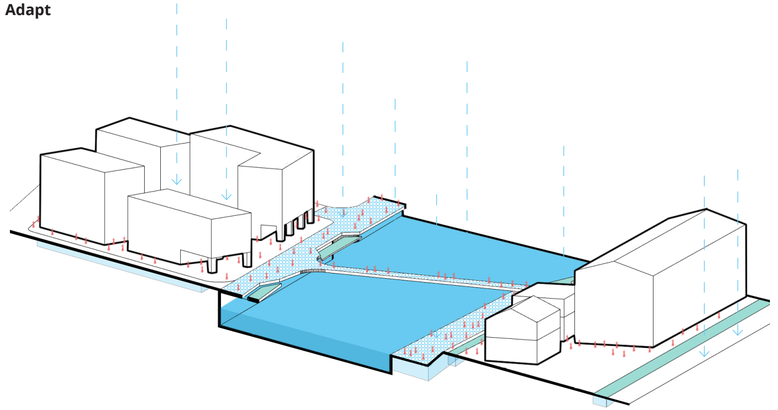
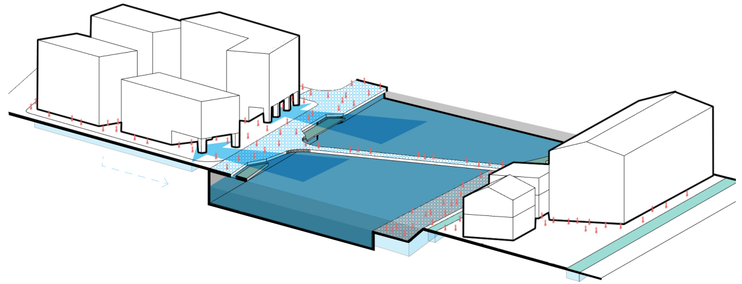


Adapt

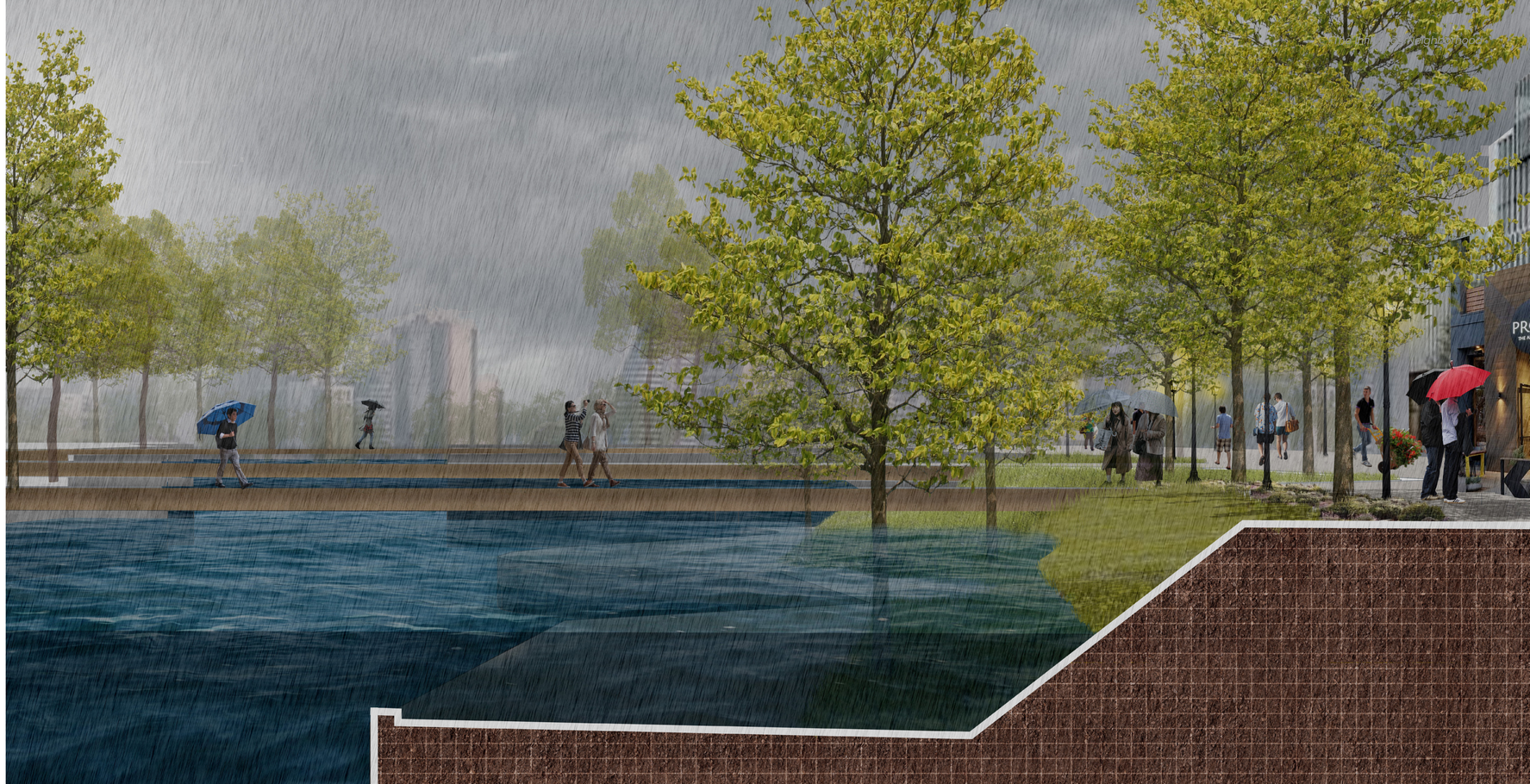


Flooding situation



The community

Promenade - Main canal - Floodable promenade - Cafe (from left to right)



The community with +3.00 m. water level rise

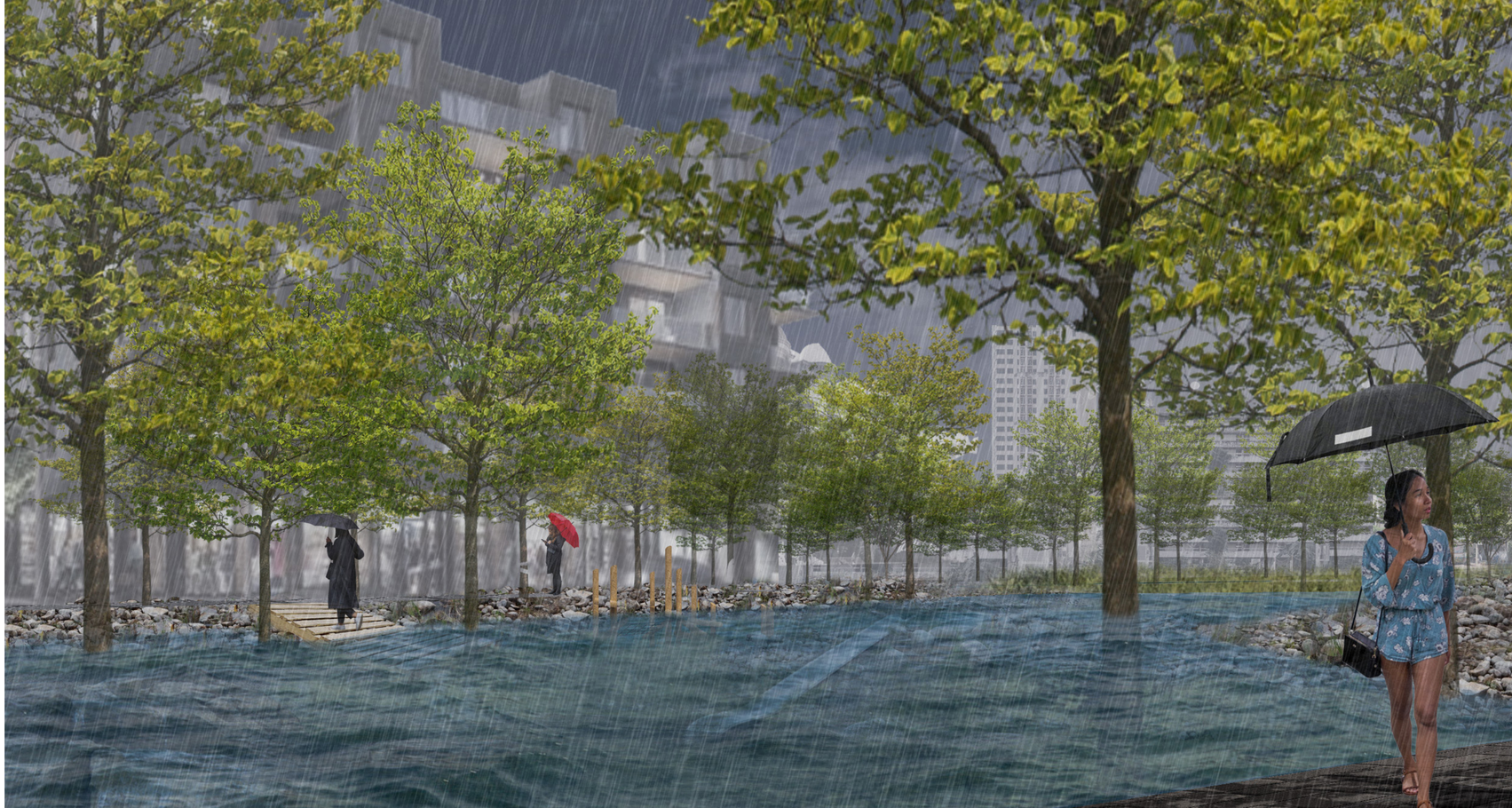
Promenade - Main canal - Floodable promenade - Cafe (from left to right)

The community with +3.00 m. water level rise

Active ground floor residential - Wetland and park (from left to right)

The community with +3.00 m. water level rise

Active ground floor residential - Wetland and park (from left to right)



The Infiltrated Neighborhood

PHASING OF DEVELOPMENT

Phase I.
Canal infrastructure

Creating a complete network of canal by tie up the existing canals together to set the foundation for future the development.

Phase II.
Extension of green network

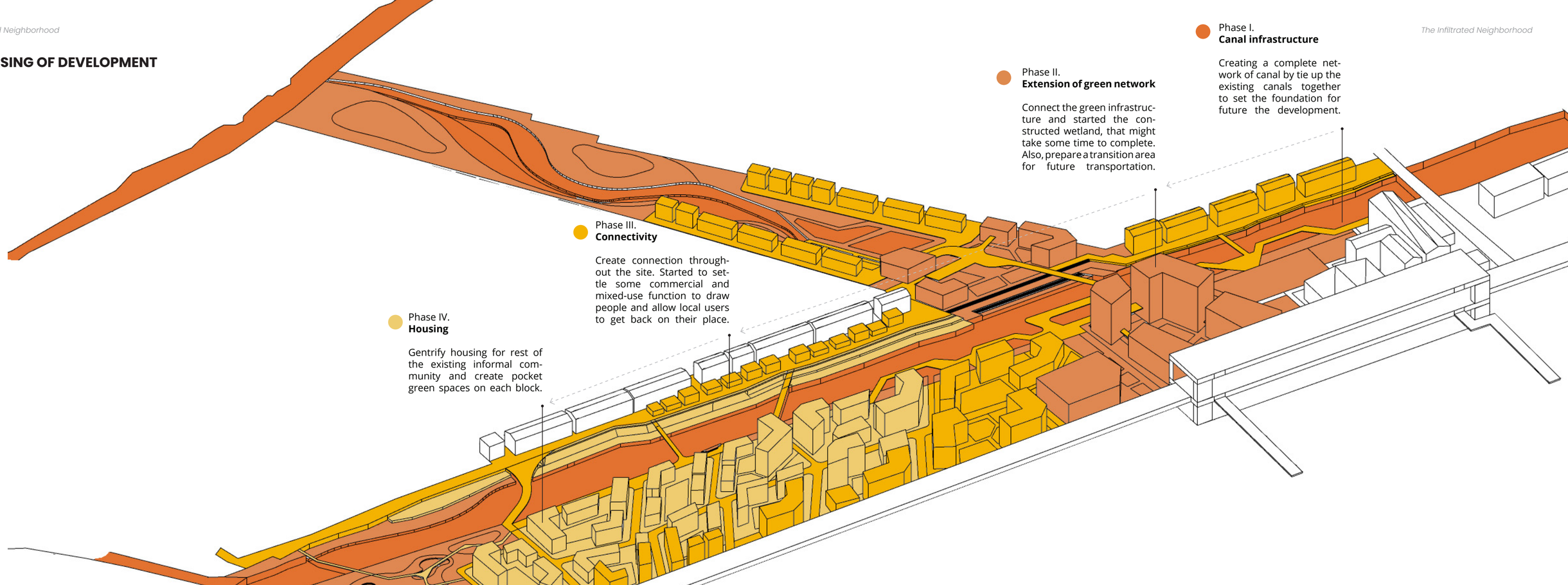
Connect the green infrastructure and started the constructed wetland, that might take some time to complete. Also, prepare a transition area for future transportation.

Phase III.
Connectivity

Create connection throughout the site. Started to settle some commercial and mixed-use function to draw people and allow local users to get back on their place.

Phase IV.
Housing

Gentrify housing for rest of the existing informal community and create pocket green spaces on each block.



REFLECTION

This thesis explores climate-adaptive infrastructure that applicable in context of Bangkok, especially in an area that affected by urban flooding and can caused severe damages. It has proposed a public realm that has an overlapping of context whether mobility, sustainable environment and management and social aspect of the informal settlements. Through the processes of theory, references case study and the city's analysis, it is clearly seen that considering the tools to cope with an urgent urban issue that influenced by many different aspects of the context should be constructed with the utmost different tools as well.







I. Objective and research question

The result of the thesis has reached the objective through developing the design intervention;

- *To study the role of the canals in Bangkok to find the solution for an area that affected by the sea-level rises.*

In general, canal network in Bangkok is rarely connected throughout the city which leads to decrease water flow. Many urban areas have suffered flooding due to the fact that water cannot even flow naturally as it used to be in the past, so the thesis proposed to re-connect the water network in the city together with finding a way for the urban life to take place at the same time.

- *To explore the theory of sustainability of climate-adaptive infrastructure that can apply to the community and improve quality of life of the people that live by the canals.*

Strategies and toolbox that works back and forth between water management and public spaces in the city has tie into each other to react on the climate change issue and in regard of rapid urbanization, the proportion of residents on site has proposed to double in the future with more of proposed public spaces.

- *To explore an open space along the canal that has potential to support future flood risk and can provide a diverse public life.*

Since water has flow through many different open spaces in Bangkok, there is more than one solution to shift these places into water-responsive area. Therefore, the thesis chose to work in an area with complex context to act as a catalyst for the community.

- *How an area can provide a diverse public realm and has an ability to cope with water in a more sustainable way ?*

The strategies were analysed to response to water-sensitive area together with combining activities of the people that is flexible in many different events. The result shows that a way to live with water in the urban context can be developed through different tools of climate-adaptive infrastructures.

- *How can the living condition of the informal settlement by the canal be improved ?*

Generally, replace the existing informal settlement with new buildings is the best solution for the administrative at the moment. However, demolish the existing informal settlement community also taken life away from the area, the thesis has proposed a method that allow local residents to stay on site as a community in a new small block of development while also increasing density of the area at the same time.

II. Challenges and limitation throughout the process

There are, absolutely, challenges to work remotely due to the covid-19 situation now, especially with the process of interview and on-site data collecting. However, this can reflect into research information from the administrative in the procedure of crisis management and public participation in the urban redevelopment project.

Since Thailand has collected less digital database, mostly not yet up to date and some data is limited to only governors, there is difficulty to find an authenticated information. Moreover, the municipality has small amount of hard proof of public participation in any development that related to the community which one way can explain the distrust from the residents when there is a project in their living area. Also, it could leads to a distrust from outsider whether the collected interview from the municipality is reliable or not.

However, according to the Thai culture, people has a nature of sharing their lifestyle and they have a strong community group or organization so the interview from small amount or the residents can tell a story of their neighborhood as well as how people interact to each other in a place.

III. Social and cultural aspect

This thesis is based mostly on secondary data from the municipality, with other pieces of information on social network and a small amount interview from the local residents in the district due to lack of opportunity to visit the informal settlements. Thus, the result still has to work more on social aspect of the local residents' needs to clarify public spaces more in-depth.

IV. Small detail intervention

In a water-sensitivity area, the holistic vision of it is as important as a small intervention to promote a porous city. A vision of water management between the main canal that link to a branch and distributary canal or even a river of the city has been introduced to illustrate a water system that run through Bangkok. District-scale intervention like connecting between Prem Prachakorn canal and distributary canal or having constructed wetland at the most vulnerable to flooding area on the south affect other communities around the site. On-site intervention as rooftop garden, community garden or floating wetland all response to water situation differently and deal with water in a different way. Still, a smaller scale of designing that shows concern toward water on site can be develop even more in a further step, for example, leveling pathway or building's ground floor to evade stormwater.

V. Conclusion

Many canals in Bangkok that affected by urban flooding, environmental changes, urbanization and canal invasion and pollution still on their way to find the best solution from these issues. Overall, the regeneration of informal settlement along the canal in Bangkok depends much on the municipality to generate so that working both top-down and bottom-up with cooperation from various parties is needed to develop the city sufficiency and efficiency.

However, there is more than one method to cope with different scenario of flooding, urban growth, small scale topography and the existing cultural character that needed to be addressed in the context of Bangkok so I believe that each place along the canal of Bangkok can illustrated themselves in a various interesting design. In a further aspect of development along the canals, the extension of this thesis including study more on every scale of socio-economic can shift people's perception of the canal and open spaces around to see an importance of a porous public realm that is essential for water city like Bangkok.

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