HARBIN THERMAL PARK

Transforming an abandoned thermal plant into green infrastructure

TUDelft 2018 Landscape Archtecture Studio: Flowscape

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CONTENT

1. Introduction

1.1 Problem statement

75%

1930s — Started to built

1940s — Most advanced industrial plants in China

1980s

Now — Decline

Manufactured sites

Old northeast industrial base

NORTHEAST

NORTHWEST

NORTH

PEKING

EAST

CENTRAL SOUTH

SOUTHWEST

INDUSTRY

Iron and steel | Agricultural | Textiles
Aluminum | Electronics | Cement
Copper | Transportation | Chemicals
Tin | Shipbuilding | Tires
Lead | Engineering
Major industrial area

55%

till 2020

Solar energy

Wind energy

Nuclear energy

REPLACE

Thermal power

6.26%

Growth rate

Urban Expansion of Chinese cities 1980-2010

Produced by Beijing City Lab (www.beijingcitylab.com)
Mapped by Dr LONG Ying

Urban2010/Urban1980
1.03 - 1.66
1.67 - 2.10
2.11 - 2.74
2.75 - 3.68
3.69 - 26.40
Provinces

0   1,000   2,000 Km

It is widely believed that the industrial-based economy is no longer the main theme for most modern cities. Firstly, according to the current trend of development, the world in the early 21st century is "approaching the information era from the industrial era, advancing from the industrial society to post-industrial society and marching from urbanization to an urban century" (Conservation and adaptive-reuse of historical industrial building in China in the post-industrial era). Secondly, as the related technology, the mode of transportation, and living and working habit of employees are changing in such a rapid speed, which causing the buildings and infrastructures in certain areas in cities lost their functions. Thirdly, during the process of urban development, the city I expanding in a fast speed. For instance in northeast China, "In 1999, the urban area in the country was 21,524.54km2, increased to 31,780.97km2 in 2008, with an average annual increase of 1,739.6km2 and an average annual growth rate of 6.26%, showing a very high growth rate." (Spatial - temporal Difference Analysis of Driving Forces of Urban Construction Land Expansion in China). The industrial land originally located on the edge of the city gradually becomes inside the city, and the urban environmental pollution is becoming a huge problem.
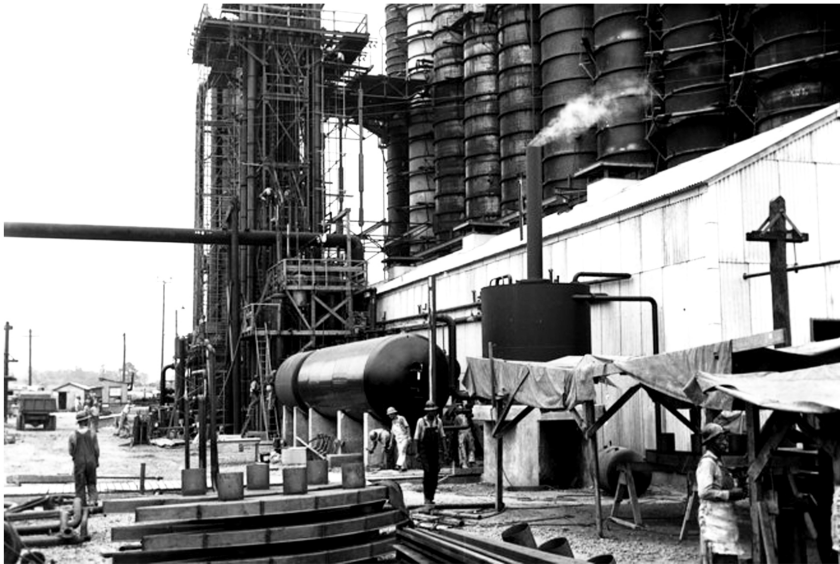
This phenomenon is causing a lot of troubles. Many industrial sites are quite dangerous because of the contamination and the industrial leftovers. Various industrial activities contribute heavy metals to soil environment directly or indirectly through the release of solid wastes, waste air, and wastewater, that making the site dangerous(Contamination, chemical speciation and vertical distribution of heavy metals in soils of an old and large industrial zone in Northeast China). Meanwhile, some industrial leftovers also pose a threat to people, such as naked rebar and towers, or abandoned buildings that under the risk of collapse.
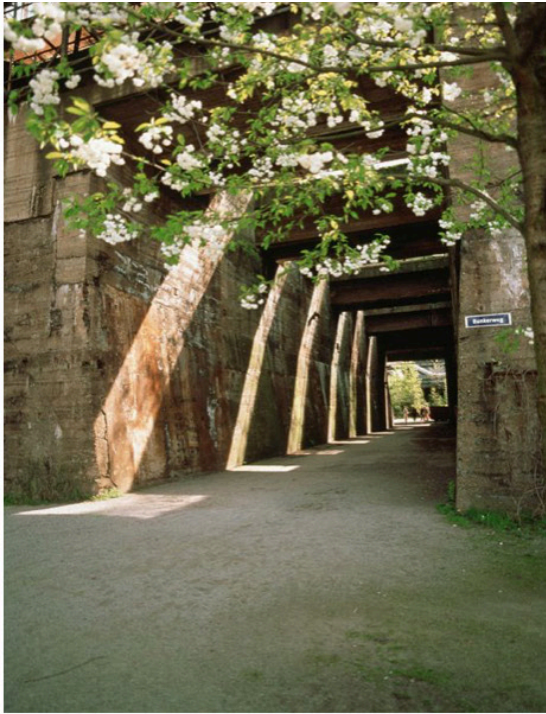
But the post industrial sites also have great potentials. In most build urban area, it is very difficult to have more green space although many Chinese cities lacks enough green space(Analysis of problems in urban green space system planning in China). However, these post industrial sites have potential to become green spaces. Also, these industrial sites also have their own beauty, it is also a potential to show this industrial people to people.

In order to find out a solution for this phenomenon, I take Harbin thermal plant as an example. Harbin Thermal Power Plant is a abandoned factory that located on the fringe of the city. With the development of the city, this place has gradually become a part of the urban area. In the future urban development, the industrial zone is moving out, and the green space is moving in, and the site will become a wasteland in the city.

1987

In 1987, the city all located in the railway, outside the city was farmland and small villages. There was a wild green corridor along the Songhua river, and the city was embraced by the green area.

1997

During 1987 to 1997, the city grew larger but still inside the railway. The green corridor on the east side of the city was cut off by the urban area. The Acheng district and the Shuangcheng district appeared. On the north of the Songhua river was still farmland and natural area.

Shuangcheng
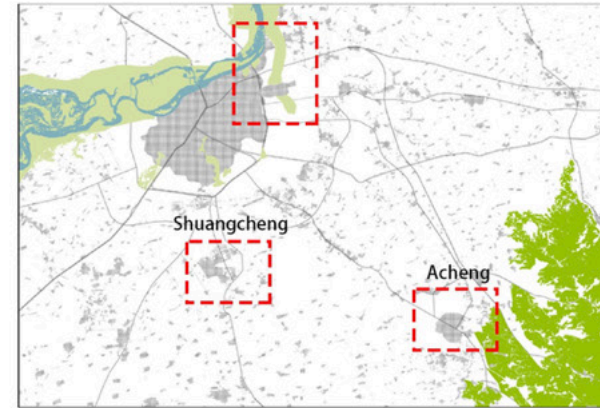
Acheng

2007

During 1997 to 2007, the city was growing in a fast speed, and it expanded out of the railway. The Acheng district and the Shuangcheng district grew larger, and the urban area expanded to the other side of Songhua river. The city was no longer embraced by green area.

Shuangcheng
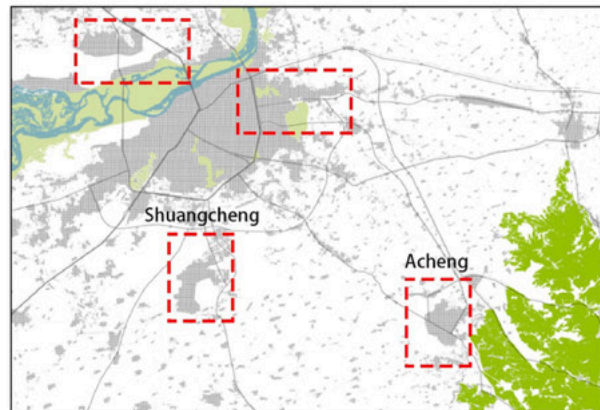
Acheng

2017

During 2007 to 2017, the city grew even faster. The Shuangcheng district grow together with the main area of the city. The north part of the river became a large urban area. The branch of the urban area to the Acheng area was becoming larger. The railway is no longer the boundary of the city.

Shuangcheng
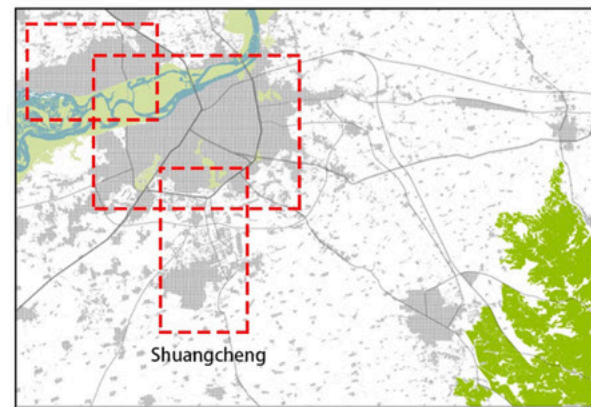
1.2 Hypothesis

Biological habitat — Solana Ulcinj – Venice Biennale 2016 — LOLA Landscape Architects

City square — Midland Railway Square — PLACE Laboratory

Museum — Museum of Steel — Surfacedesign Inc.

Arts & cultural campus — Bethlehem SteelStacks — Arts + Cultural Campus

Park — High Line, Section 2

GREEN INFRASTRUCTURE — DON VALLEY BRICKWORKS

There are many possible solutions for the post industrial site. In the past years, many post industrial sites were transformed into biological habitat(Solana Ulcinj, Venice Biennale 2016), city square(Midland Railway Square, place laboratory), museum(Museum of steel Surface design), arts and cultural center(Bethlehem steel stacks arts and cultural campus), park(the High line park) and etc. But located in Harbin, which used to be a industrial city that surrounded by many industrial sites, does it have a potential to become green infrastructure that not only serves the local area but also serve the city as a whole?

My hypothesis is to transform the post thermal power plant into green infrastructure by landscape means, to change the barely contaminated soil into meadows and woods; and the shanty factories into buildings with new functions that is full of vitality; and the original industrial system into a green system, continue to serve the city from industrial use to recreational and ecological use.
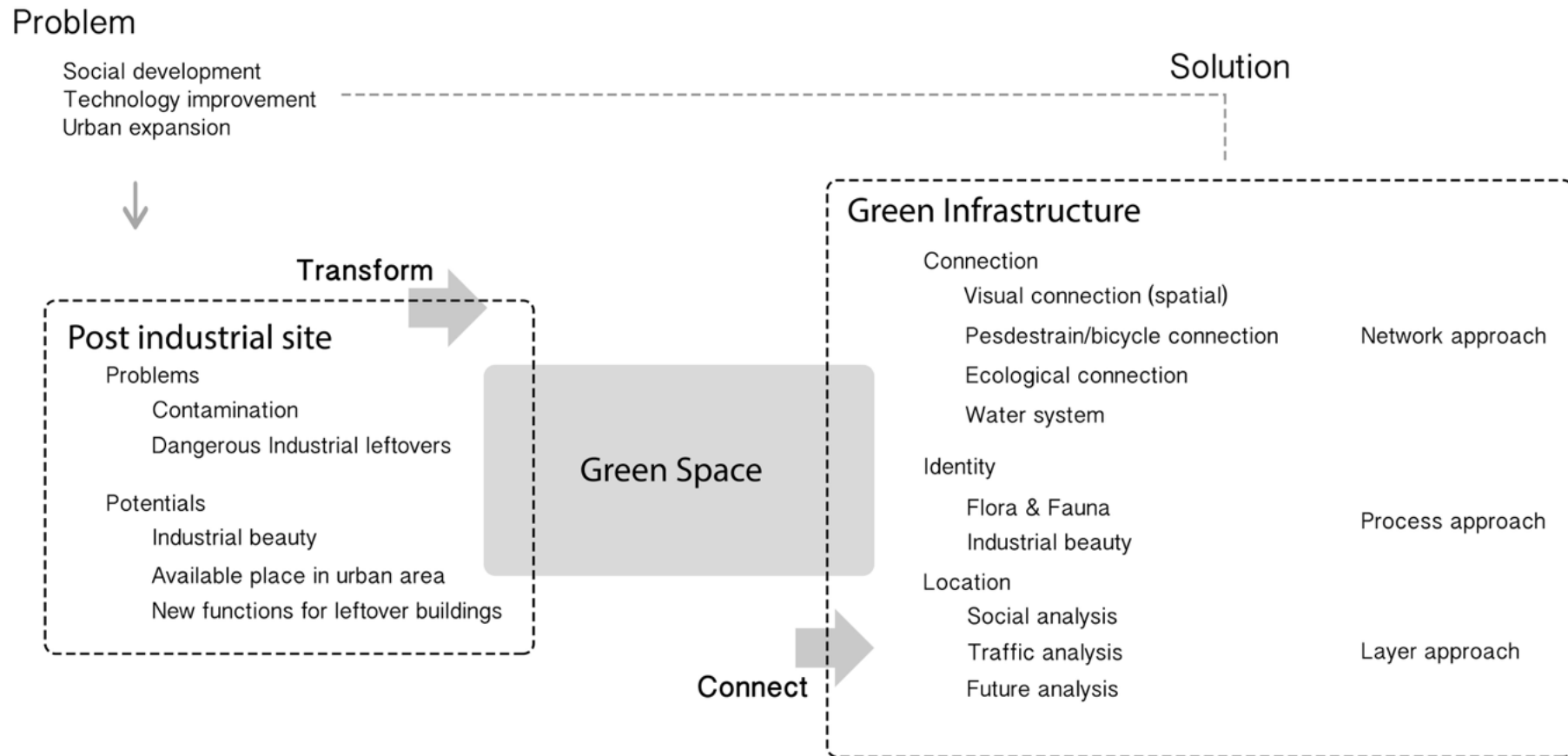
My research goal is to explore the possibilities of post industrial sites to transform them into green infrastructure by multi-scale approach, making them not only benefit the ecology system in city scale, but also urban environment in local scale, while remaining the industrial beauty of the site.

In order to reach the goal, several questions need to be answered: First is about understanding the research object. To transform industrial site into green infrastructure, first we have to understand what are manufactured areas? What are the important factors of manufactured areas? What is green infrastructure? What are the important factors of Green infrastructures?

After this, the next question will be what we can do with it. What design principles do I need to know to transform a manufactured site into green infrastructure? What cases do I need to analyze in order to derive needed design principles?

At last, these design principles need to be applied in the design to reach the goal: How to apply design principles into Harbin thermal power plant?

1.4 Approach

I will do this research by design means. To translate a post industrial site into green infrastructure, first have to solve the contamination problem and deal with the industrial leftovers. Then, in order to make it part of the green infrastructure to increase its value, new connections need to be found to place it in a larger green context.

To deal with the contamination by a landscape means, I will apply phyto-technology method in the design. Phyto-technology, which use "vegetation to remediate, contain or prevent contaminants in soils, sediments and ground water," has the potential to solve the problem in a "less expensive way", and also can create beautiful and educational landscapes(Phyto: Principles and Resources for Site Remediation and Landscape Design). Then, from the spatial analysis, I will find out and reserve the industrial beauty of the site. Then translate the site into a desirable green space and give new functions to the leftover buildings.

To connect the green space to the larger context, I will analyze the larger green context by network approach to improve the connection of the green patches in order to make a better "living habitat", a "pedestrian network", a better "water system"(Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review)··· Then, I will use layer approach to analyze the context, find out its relationship with the city, and process approach to find the steps it will take during the time.

1.5 Relevance

The scope of the study is the abandoned thermal power plant and its surrounding area. The expected final result will be the strategies it takes to transform the thermal power plant into green infrastructure, and the larger planning for the green infrastructure in city scale. Also, when zoom in the local scale, the spatial design for the site, how people perceive the new landscape and the industrial beauty. To reach this goal, some elaboration drawings like site plan in both scales, the strategic drawings ,sections, perspectives and technical drawings will be needed.

urban

industrial

wasteland   dangerous

......

pollution   Problem Field

Hypothesis

Research Objective   Research goal & questions

Site choose   Approach

Discussion   Research design

Site

application   Site analysis based on related theories

Principles that are needed   Background theories

case study

2.1 Background theories
### 2.1.1 The Post-industrial landscapes

The post industrial sites, as Micheal Hough states, are related to "emerging efforts to address the legacy of contaminated and derelict lands that have been left by past industrial activity". According to this description, one important theme is how to deal with the contamination, and the other one is how to remain the characteristic of the past industrial activity.

One powerful solution to deal with contamination could be phytotechnology, which is "the use of vegetation to remediate, contain or prevent contaminants in soils, sediments and ground water, and/or add nutrients, porosity and organic matter. It is also a set of planning, engineering and design tools and cultural practices that can assist landscape architects, site designers, engineers and environmental planners in working on current and future individual sites, the urban fabric and regional landscapes. "(Defined by Kirkwood and Kennen as an expansion of previous definitions). The advantages of this method are that it is less expensive in comparison with other industrial-based approaches, and has high public acceptance. In addition, it is a natural, low-energy, visually and aesthetically pleasing technology, and has many ancillary potential benefits. But it also has limitations: many contaminants cannot be remediated by phytotechnologies, some soil/climate conditions are not favorable for their application, and the process is limited to relatively shallow contamination sites and is dependent on the adaptability and climate zone of the plants that can be used… etc.

This process of remediation takes some time. Several steps will be needed to clear the contamination, and it is related to the method that is chosen.

To remain the characteristic of the past industrial activity, one solution is to keep the spatial icons, which is proved to be "a very effective tool for establishing an initial overview of the characteristics of visual material." (The semiotics of landscape design communication: towards a critical visual research approach in landscape architecture). Also, for the leftovers, some buildings are well-remained and has potentials to be reused. Thus, the spatial character of the industrial plants and the maintenance of the left buildings need to be accessed.

2.1.2 The Green infrastructure
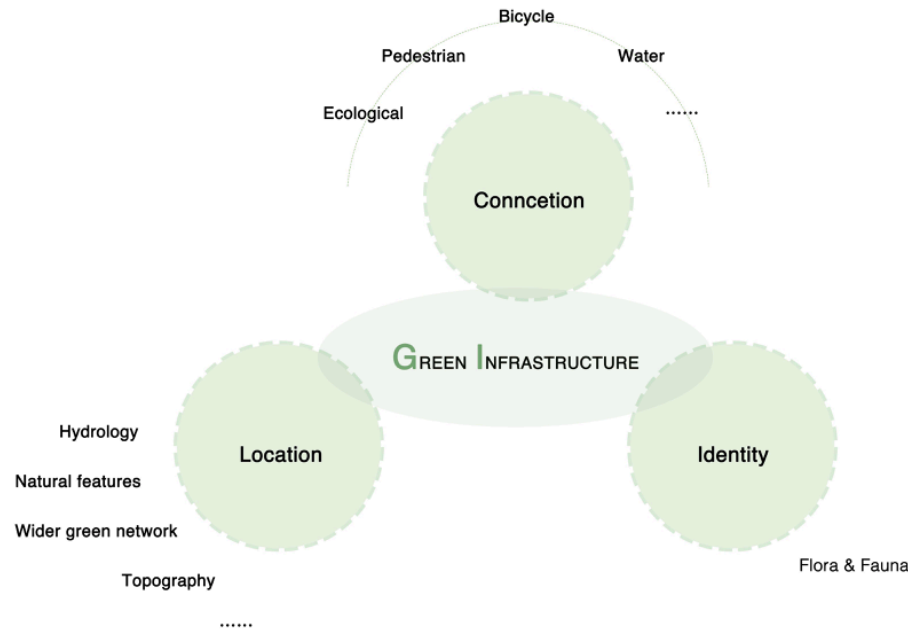
The Green infrastructures, as defined by the European Commission, is "the use of ecosystems, green spaces and water in strategic land use planning to deliver environmental and quality of life benefits. It includes parks, open spaces, playing fields, woodlands, wetlands, road verges, allotments and private gardens. Green infrastructures can contribute to climate change mitigation and adaptation, natural disaster risk mitigation, protection against flooding and erosion as well as biodiversity conservation. " Several aspects need to be addressed in this definition, and the first one is "connection".

The connection here means to connect green areas that shifts between scales in order to make them a whole system. In ecology aspect, this connection helps to create a better living habitat for multiple species. Also, a complete walking system provides a good environment for pedestrian movement, cycle routes, core paths and etc. The water journey is also important here, to connect the surface water and manage the rainwater in order to make them a better system that not only prevent flooding but also provide beautiful water landscape for people.

Another important word here is "identity". It is related to landscape character, the flora and fauna, the wildlife habitats and etc. The identity is what makes the green infrastructure unique.

The last word is "location". The location and surroundings, the natural features, the topography, natural undulations, the hydrology, the wider green networks···. It is about how the green infrastructure is placed in the existing context and how it serves people.

2.1.3 Conclusion

Then green infrastructure, as a green system that shift between scales, consists of different green elements from pocket park to urban forest. Thus, the industrial park that is transformed from the abandoned industrial plant, should be put in a proper location in the larger system, in other words, what is the function of it at the corresponding scales is? In the scale of industrial park, the function is fundamentally about providing a suitable and sufficient green spaces for recreation, amenity and conservation purposes, and a coherent infrastructure of green and green-grey links that provide routes and pathways for multiple purposes(Green infrastructure planning guide).

Also, considering the identity of the industrial park, the process of transition and the educational purpose should also be taken into consideration, and to preserve the industrial beauty will add to the identity of this place.

2.2 Research approach

In order to transform the thermal power plant into green infrastructure, I will analyze the site from two main aspects: the green infrastructure aspect and the post-industrial area aspect, then combine them to get a conclusion.

2.2.1 Deal with the post-industrial site

To deal with the post-industrial site, I first will analyze the contamination of the site to find a proper way of phytotechnology to deal with the contamination: the the climate/soil condition, the types of pollution, and the degree of contamination. Then pick a proper way to deal with it, and find out the time it takes and steps it needs to clear the pollution.

Then evaluate the existing buildings, find a visual icon that can keep the industrial memory, and find out which buildings have potentials to be reused and which have not. Then find design principles to see how to give new functions for the left buildings.
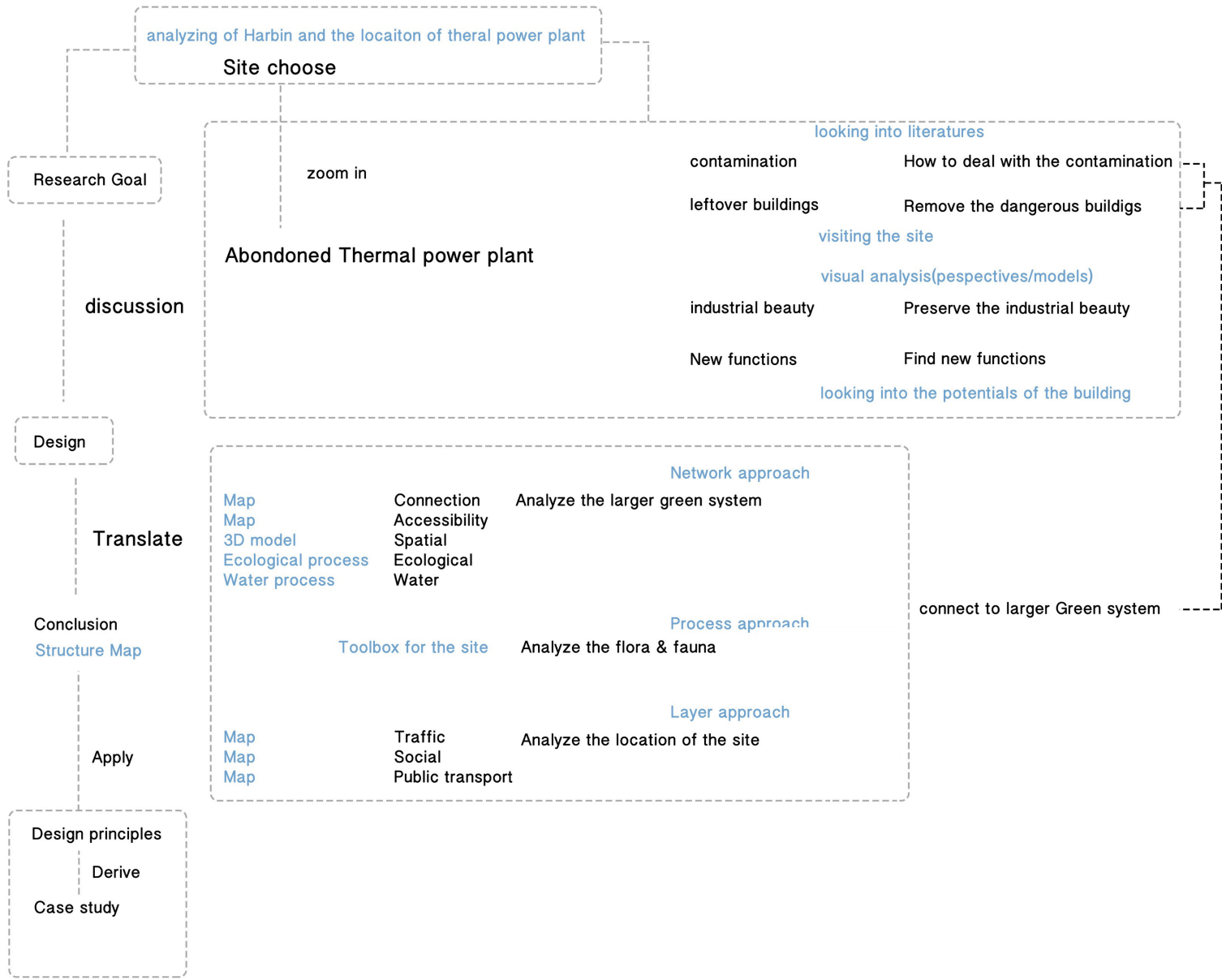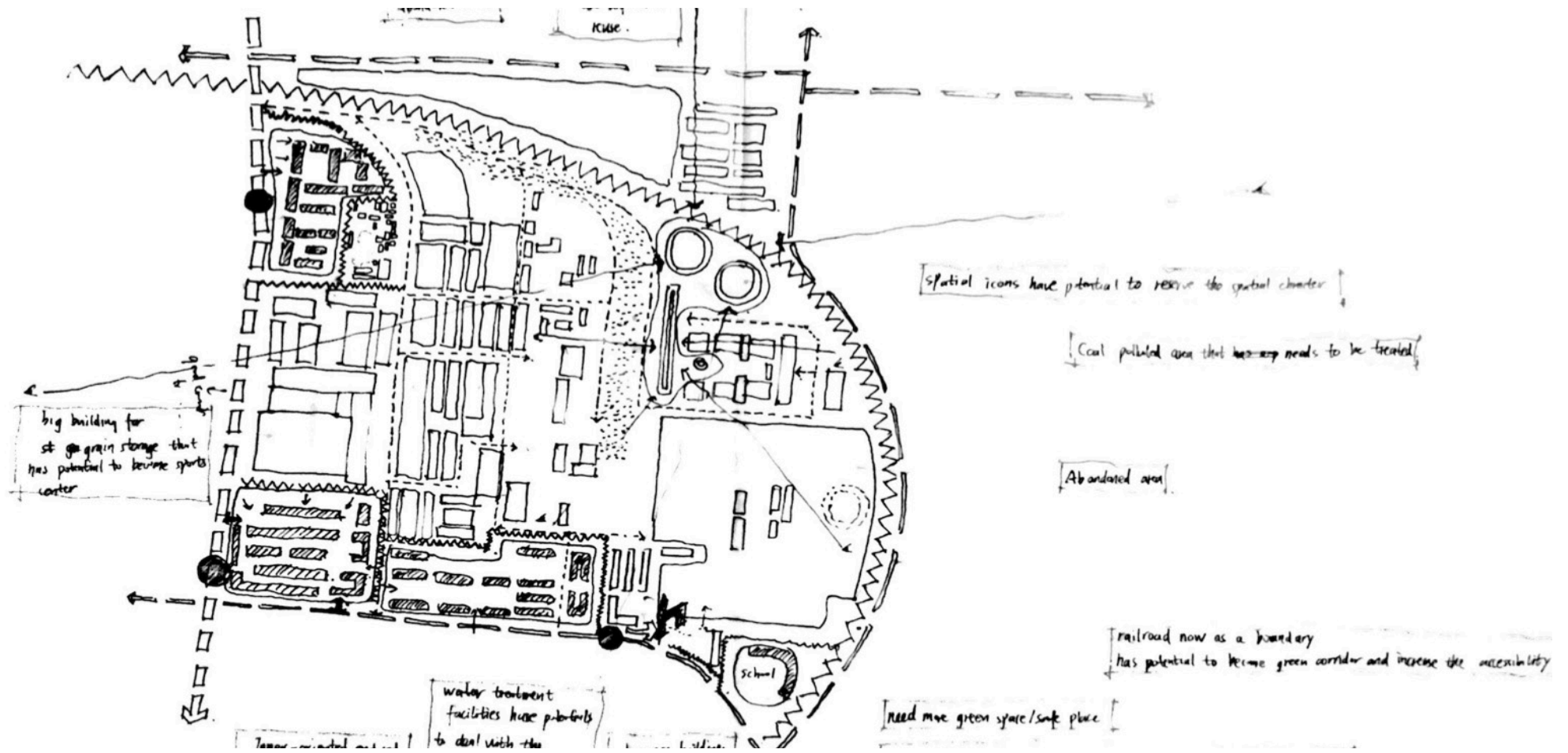
2.2.2 Transform it into green infrastructure

To transform it into green infrastructure, I will first analyze the connection of the existing green spaces, the identity of the site, and the context of nearby area. To improve the connection, the network approach could be used to analyze the site: the accessibility of the existing green space and how they are connected, the existing water system and etc…·.To improve the identity, the process approach will be useful: the life cycles of the plants and the spatial characters of them; the life cycles for the animals living in this area···And use layer approach to analyze the content, and overlap them to come up with a structure map.

2.2.3 Conclusion

To reach the research goal, multiple means have to be used in analysis and design: the layer approach, the process approach ,the network approach··· And also need to find informations through literature reading and site visiting.

2.3 Research design

Site choose
analyzing of Harbin and the locaiton of theral power plant

Research Goal

zoom in

looking into literatures

contamination — How to deal with the contamination

leftover buildings — Remove the dangerous buildigs

visiting the site

Abondoned Thermal power plant

visual analysis(pespectives/models)

industrial beauty — Preserve the industrial beauty

discussion

New functions — Find new functions

looking into the potentials of the building

Design

Translate

Network approach

Map	Connection	Analyze the larger green system
Map	Accessibility	
3D model	Spatial	
Ecological process	Ecological	
Water process	Water	

connect to larger Green system

Process approach

Conclusion
Structure Map

Toolbox for the site — Analyze the flora & fauna

Layer approach

Map	Traffic	Analyze the location of the site
Map	Social	
Map	Public transport	

Apply

Design principles

Derive

Case study

Handwritten annotations on sketch:
- house.
- spatial icons have potential to reserve the spatial chamber
- Coal polluted area that ... needs to be treated
- Abandoned area
- big building for st ... grain storage that has potential to become sports center
- railroad now as a boundary has potential to become green corridor and increase the accessibility
- water treatment facilities have potentials to deal with the ...
- need more green space / safe place
- School

3. From industrial site to green infrastructure

3.1 Site snalysis

1-2 floor buildings that used to be warehouse and small workshops

The railway(south part)

The railway(north part)

The coal transportation corridor


The coal-storage area

3.1 Site snalysis

3.1.1 Green system analysis

The abandoned Harbin power plant is located between two city-scale green areas. Now both of them are inner-oriented and have closed boundary, which makes them difficult to be reached. So the power plant has a potential to be a junction to connect the existing green patches, creating linear park system to provide a place for passive recreation. Many linear activities could take place here, such as biking, jogging and walking.

3.1.2 Traffic and accessibility analysis

Secondary road

Subway station

Site

Main road

Bus station

Railway

Majia river
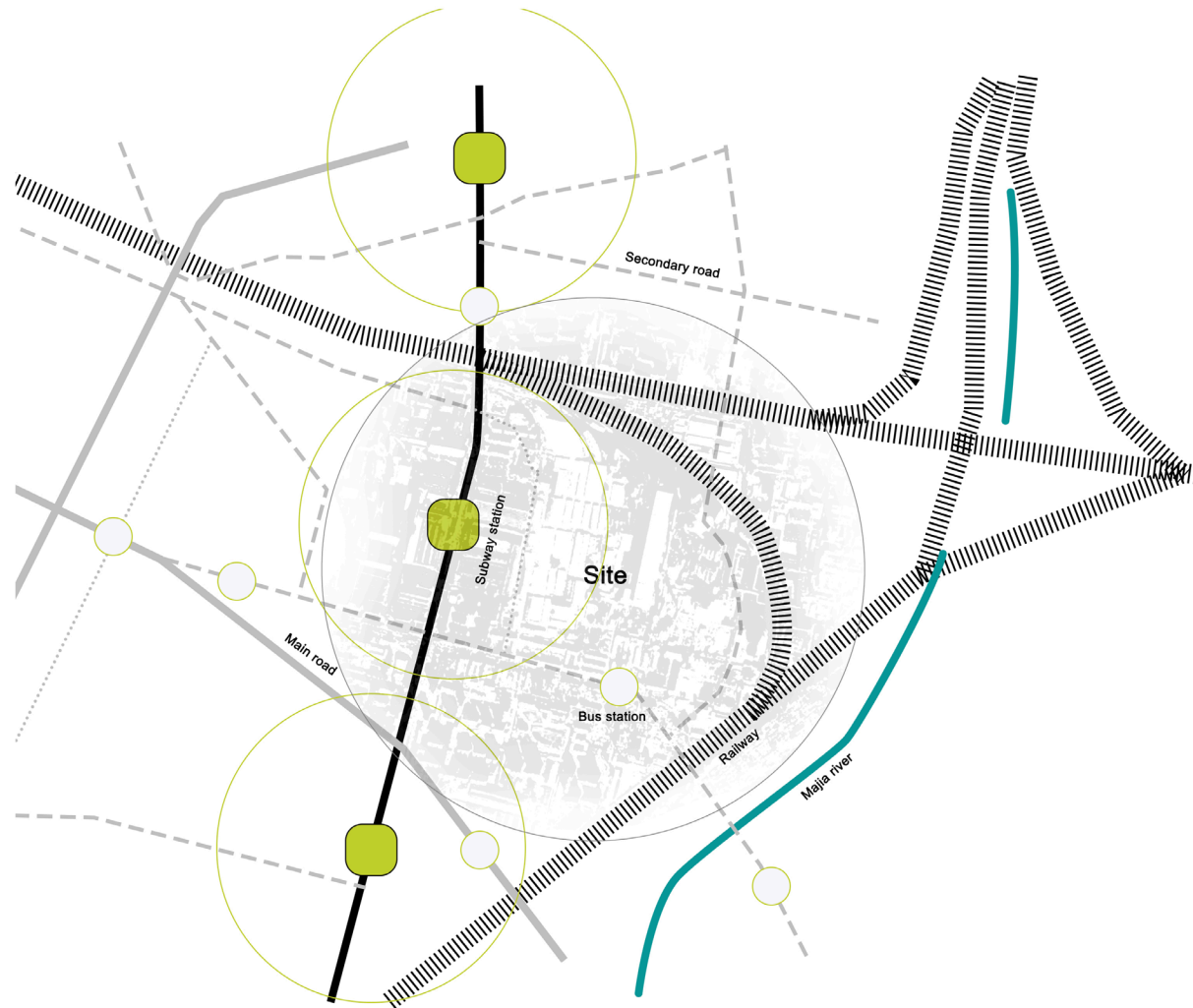
Located on the edge of the city, it is difficult to reach this area by public transport. In addition, the power plant used to be an enclosed area with boundary which has to be broken to make new connections. Most people come from the inner part of the city, which make that side important to become an entrance for this area. Also, to stimulate the future development of this area, where is the pioneer part towards satellite city.

3.1.3 Water system analysis

Songhua River

Xinyi River

Majia River
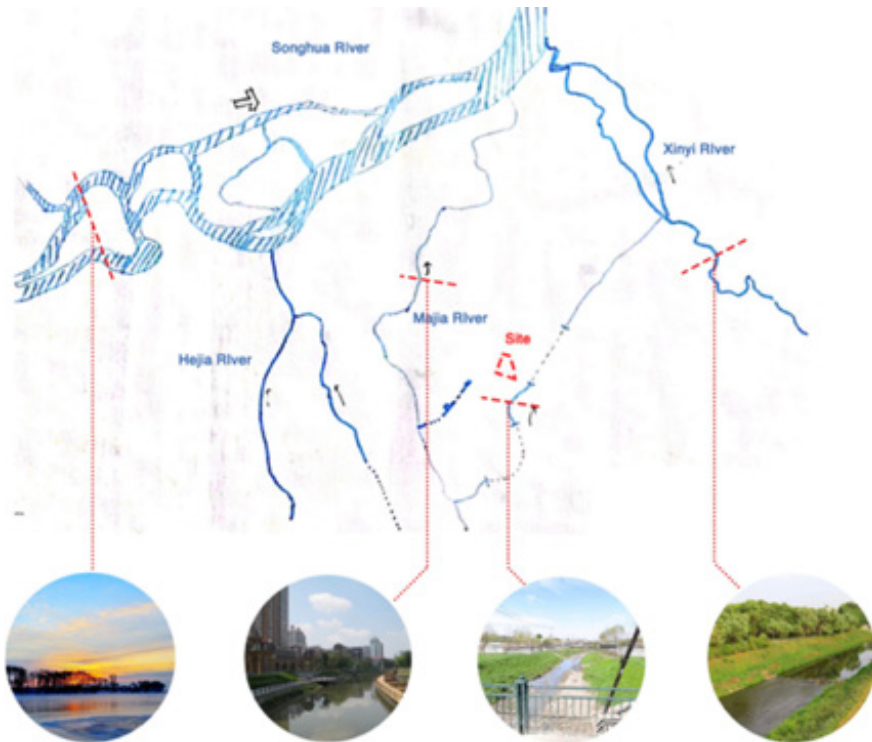
Site

Hejia River

Bridge park

Creating new waterbody:
-- to bring water in
-- to collect rain water
-- to create new landscape
-- to deal with contamination

Common condition
-- contiminated area near river

wetland
rainwater
pond
road
sewage--clean water

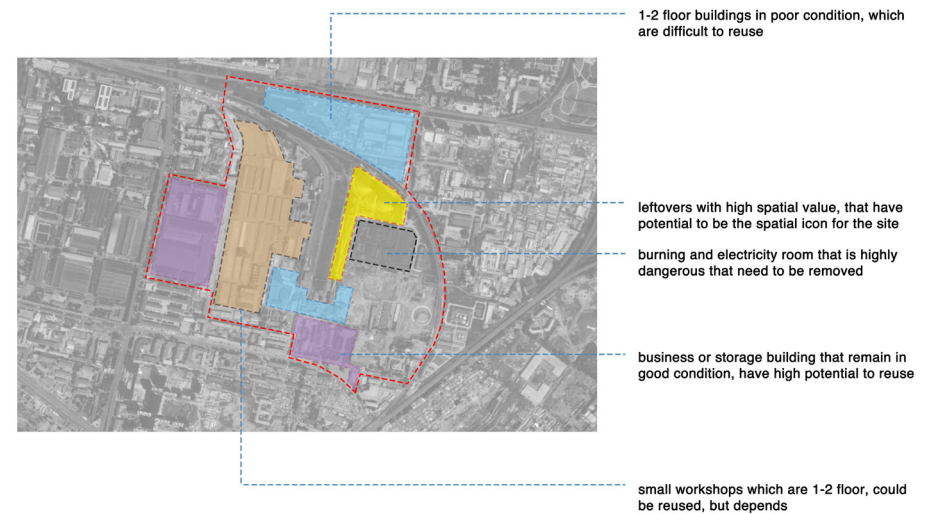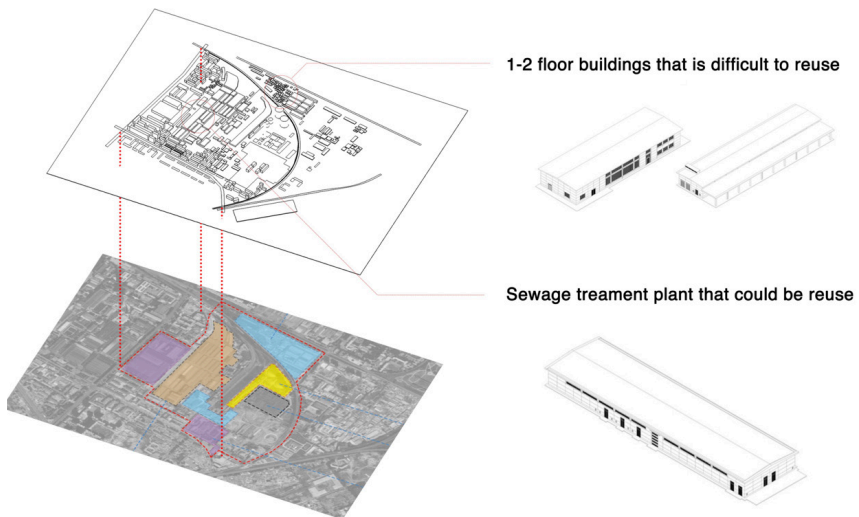2002   2005   2007   2009   2018

Site

2009

2018

The site is located near a branch of Majia river. Now the rainwater in the site is not collected, just goes into the drainage system directly. It has a potential to connect the rainwater in the site, and let it go into the Majia river.
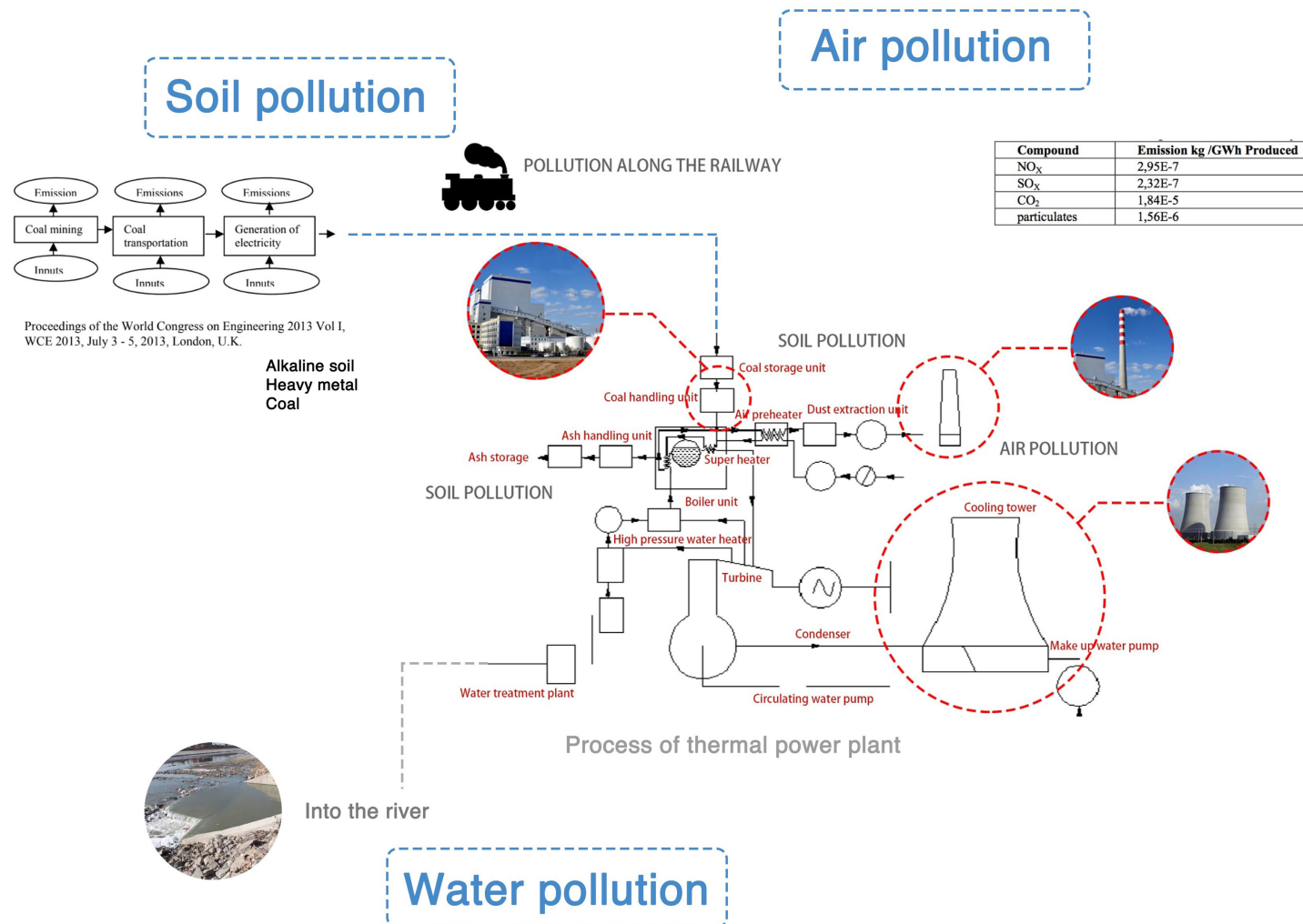
3.1.4 Leftover buildings analysis

Potential to become spatial Icions

Business buildings

Grain storage building
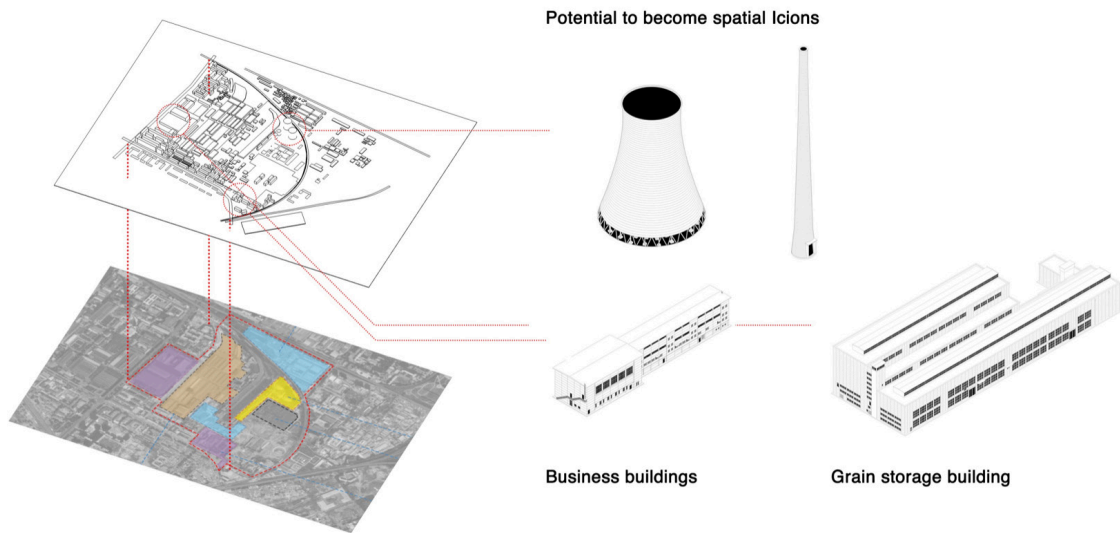
Some of the leftover buildings have potential to be reused, and some of them has potential to become spatial icons.

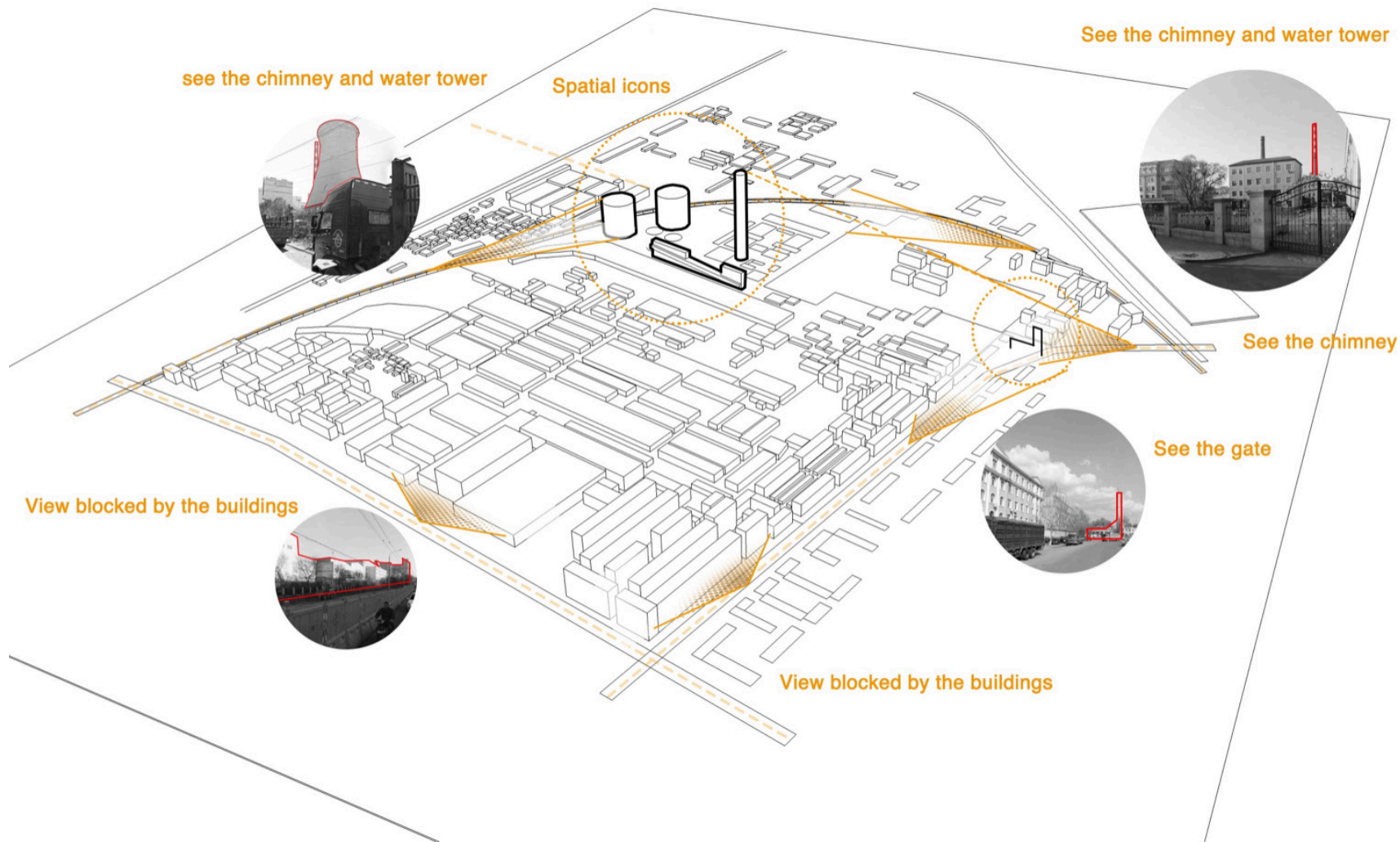1-2 floor buildings that is difficult to reuse

Sewage treament plant that could be reuse

1-2 floor buildings in poor condition, which are difficult to reuse

leftovers with high spatial value, that have potential to be the spatial icon for the site

burning and electricity room that is highly dangerous that need to be removed

business or storage building that remain in good condition, have high potential to reuse

small workshops which are 1-2 floor, could be reused, but depends

3.1.5 Contamination analysis

Soil pollution

Air pollution

Water pollution

POLLUTION ALONG THE RAILWAY

Compound	Emission kg /GWh Produced
NO_X	2,95E-7
SO_X	2,32E-7
CO_2	1,84E-5
particulates	1,56E-6

Emission — Coal mining — Innuts

Emissions — Coal transportation — Innuts

Emissions — Generation of electricity — Innuts

Proceedings of the World Congress on Engineering 2013 Vol I, WCE 2013, July 3 - 5, 2013, London, U.K.

Alkaline soil
Heavy metal
Coal

SOIL POLLUTION

Coal storage unit

Coal handling unit

Air preheater   Dust extraction unit

Ash handling unit

Ash storage   Super heater

AIR POLLUTION

SOIL POLLUTION

Boiler unit

High pressure water heater

Cooling tower

Turbine

Condenser   Make up water pump

Water treatment plant   Circulating water pump

Process of thermal power plant

Into the river

The main pollution of soil is cadmium because of the dissolve of the battery plate, and the coal pollution. The pollution in air and water is mainly the SOx and NOx produced by coal burning. To deal with the cadmium and the coal contamination, I have to find a proper method to deal with it.

3.1.6 Spatial analysis

see the chimney and water tower

See the chimney and water tower

Spatial icons

See the chimney

See the gate

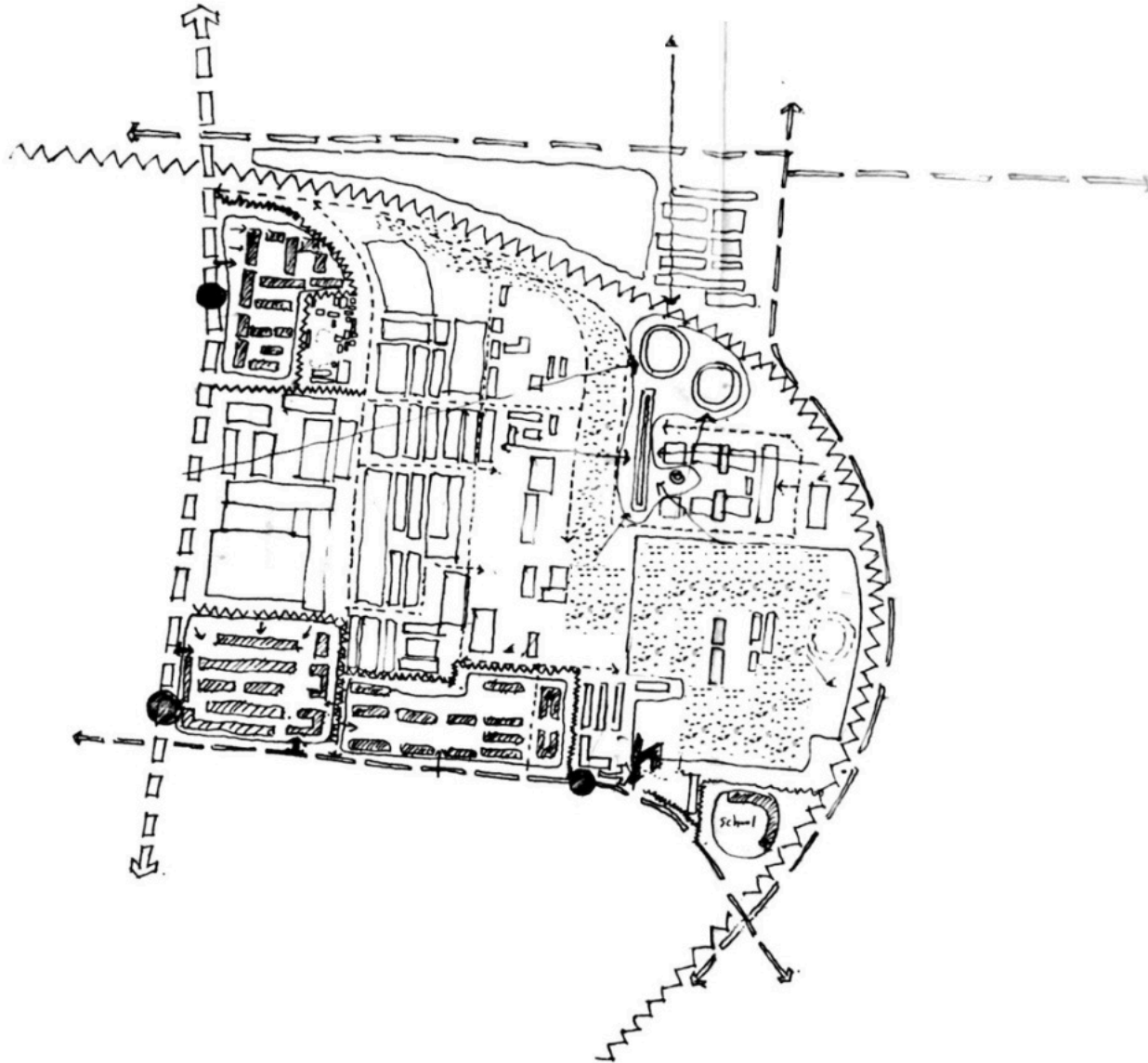View blocked by the buildings

View blocked by the buildings

This drawing shows the important spatial icons of the site.Along the railway has the best vision for the spatial icons, but it is now only for cars and trunks. But in most busy streets, the view is blocked by buildings. So this problem is, in the most used streets, the spatial icons are invisible. How can we play with it and make them landmarks for new routes?

3.1.7 Social analysis

In city scale, tie site points to satellite city which makes it a potential area for future development. In local scale, near the site are high density residential nearby but inner-oriented, lack of public green spaces and community center for indoor activities. Also, the site is a place of collective memory: the industrial park was important for stuff and their families who are mowing still living near it.

high density residential area

Low density residential area

high density residential area

Low density residential area

Attached factories

site

Low density residential area

high density residential area

Stuff residential area

Stuff residential area

high density residential area

3.1.8 Conclusion

As a conclusion, I came up with a structural map. From the structure map we can see the clear zones of the site, which has a potential to connect them by an axis, the potential green corridor to connect to other parks. Also the subway station as a potential entrance, the spatial icons, the abandoned railway which has potential to become a bicycle route, and contaminated area which needs to be treated.

3.2 Concept and intentions

Then I came up with my concept drawing. From the previous analysis, three main structural lines could be found in the site. The first one(line 1) is a commercial axis that starts with the subway station, and end with a plaza. This axis also serves as a spatial connection to connect different zones in the site. The second one(line 2) is a blue-green infrastructure that connects to other green spaces in Harbin. The third line is a bicycle route that transformed from an abandoned railway. There will be three plazas where the lines meet to connect them as a whole.
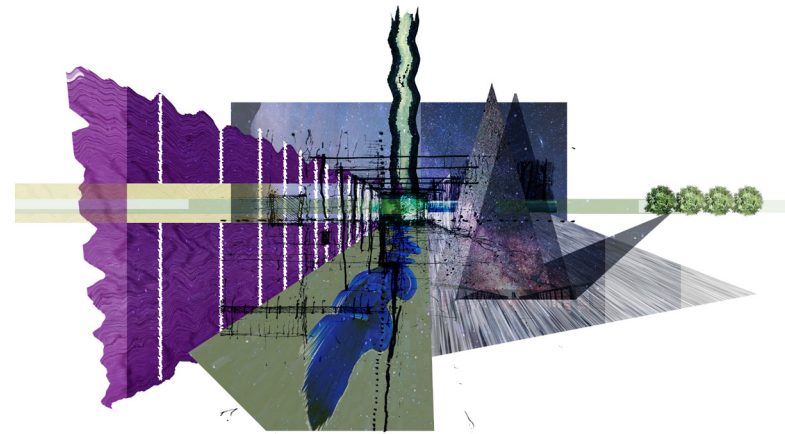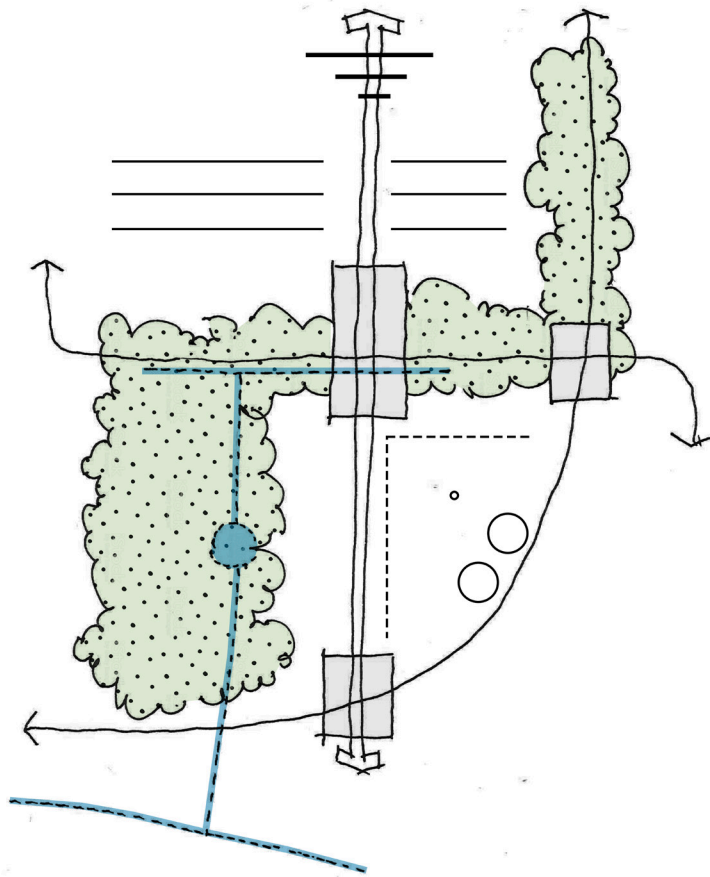
In order to translate the conceptual design into a design, I made it more artistic to try the possibilities and find out the method I would like to apply on the design: the design will be a industrial park about phyto-remediation, enhancing the industrial beauty, rainwater purification, axis design···.
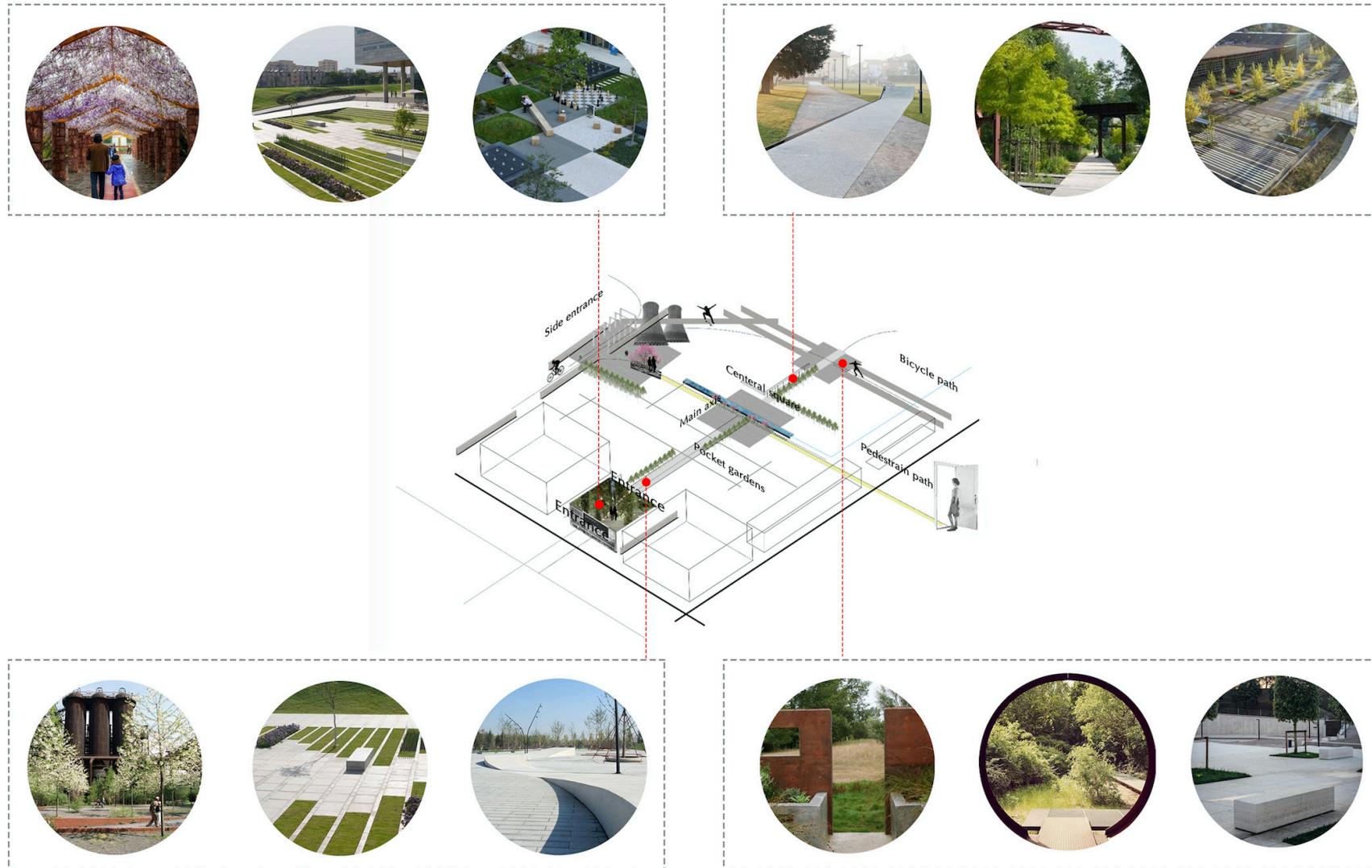
Then I tried to find some intention spatial atmospheres of the design. Above is some possibilities how the axis could be. In the entrance it could be a commercial feel plaza that attract people, and in the center it could be a open square, then it will be a path where people can see the industrial beauty. In the end of the axis it will be a industrial feeling square but not as formal as the entrance.
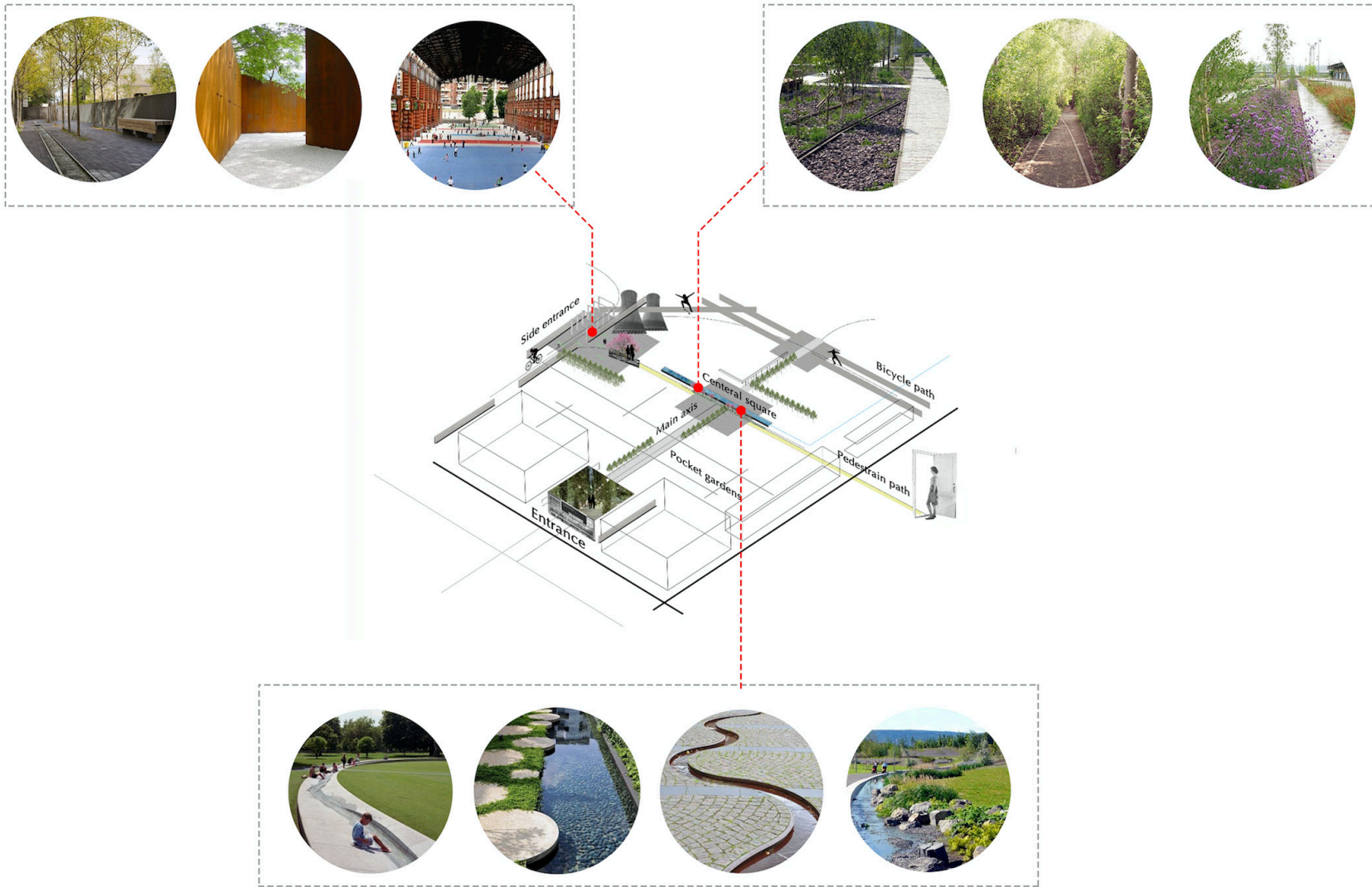
The intentions for the blue-green infrastructures is to make it a recreational place with its functional use. Meanwhile, remain the industrial beauty by remaining some industrial leftovers and make contrast with them. The side entrance will be a enclosed space to make contrast with the huge scale cooling tower, and the waterbed could be urban feeling or more natural.

3.3 Design principles from case study

In order to find out how to if my idea will work and test my idea, I looked into some examples to derive design principles for my design.

3.3.1 Design principles of green infrastructure

Design Principle: Connection   Connect the park to the larger green system

Scale anayisis

RIVERWAY

JAMAICA PARK

BROOKLINE

OLMSTED PARK

BACK BAY FENS

BOSTON

ARNOLD ARBORETUM

Emerald Necklace Parks

Harbin Institute of Technology

Harbin

Majia River

Pavilion Park

Harbin Botanical Plant Park

Botanical Garden

natural forest

Harbin industrial necklace parks
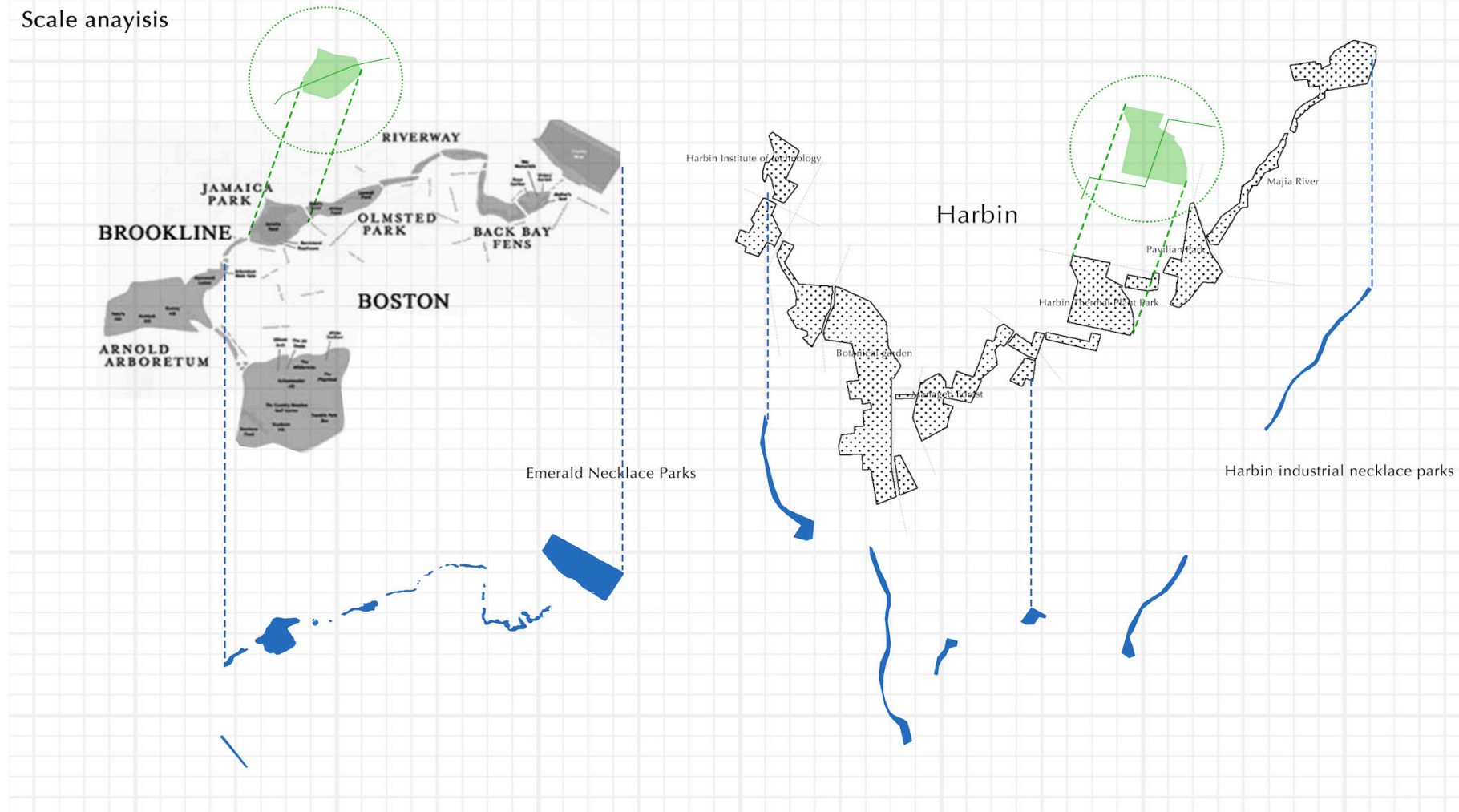
First I looked for principles to see how make the park benefit the city in larger scale. Then I derived the following principles: the green necklace servers not only as a recreational place for many linear activities like jogging, walking or riding, but also a blue-green infrastructure for stormwater collection. Also, some parks play an important role in the green necklace, connecting to other parks by green corridor to become a green system.

3.3.2 Design principles of commercial axis

Design Principle: Axis In these projects, the designer use an axis to organise the landscape zones.

Scale anayisis

Zhongshan shipyard park

Parc andré citroën

Harbin power plant park
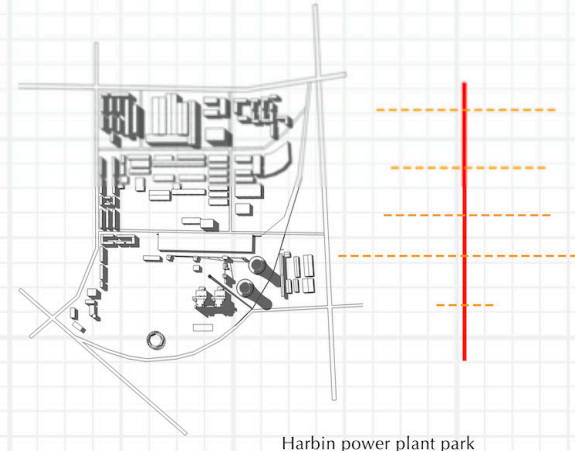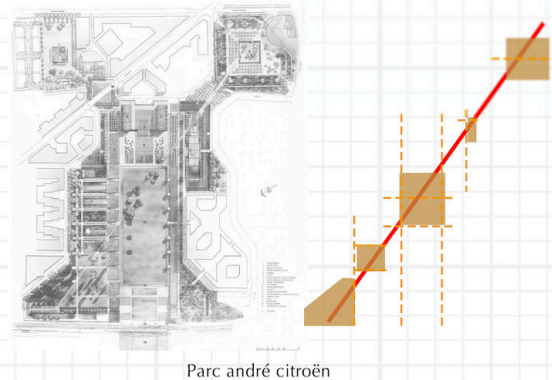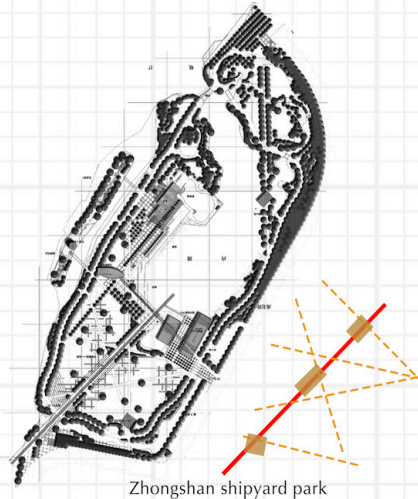
Design principles:

----length:2 km
----connect to the urban context, start with the entrance and end with an open view of the lake
----cut through different landscape zones which have unique spatial characters
----make interventions between zones to enhance the spatial character
---- using the same design language of all new elements
---- organise the traffic system
---- design square where other roads meet the axis

Design principles:

----length: 1.7km
----connect to the urban context, start with the entrance plaza and end in garden
---- using the same design language to make spatial continuity
---- cut through different landscape zones
---- organise the traffic system
---- make interventions between zones to enhance the spatial character
---- landscape elements along the axis

Design principles:

----Length: 1.3 km

 Then I looked into two examples to derive design principles for axis design.
In project Zhongshan shipyard park and Parc andre Citroen, the designers used axis to organize the design as a whole. The axis cut through different landscape zones, and cut through different landscape zones. Visitors can experience different spatial characters through the axis. Functionally, the axis serves as a important traffic element to organize the traffic system, and use squares where other liner landscape elements(for instance: road) meet the axis.
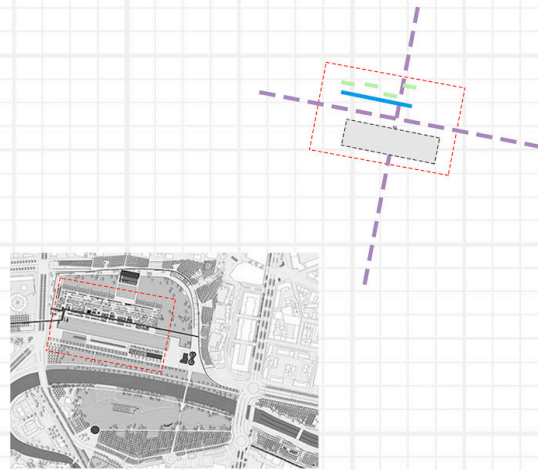
3.3.3 Design principles of square

Design Principle: Square In these projects, the designer use an square to integrate different elements
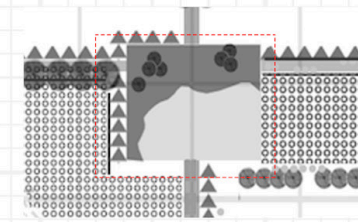
Scale anayisis
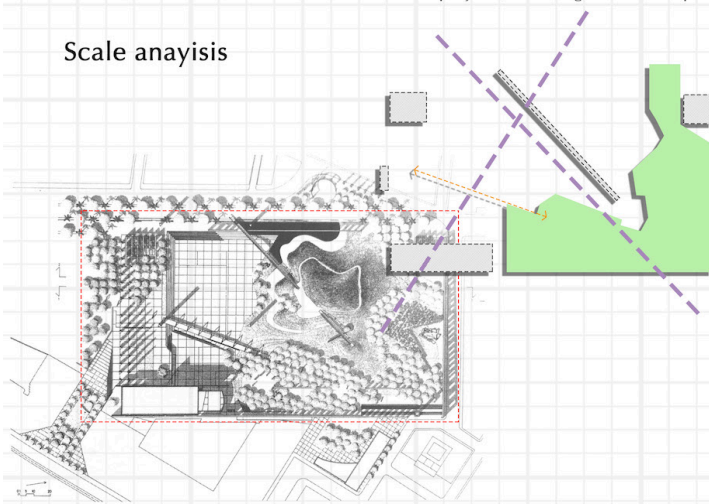
Parc del Clot

Zollhallen Plaza

Harbin power plant park

Design principles:

----emphasise the industrial leftovers by
making contrast between hard and soft, pasto-
ral and the urban, and new and old
----use diagonal linens to keep the plan togeth-
er and link the area with its surrondings
----play with water as sound barrier and air
coller
---- make visual conections to important visual
icons

Design principles:

----integrate landscape elements from 2 direc-
tions
----waterbody goes through the plaze as an im-
portant landscape element
----parallel grassland to emphasis the order
----emphasise the industrial leftovers by
making contrast with soft plants

3.3.4 Conclusion

I derived design principles from 3 scales: the urban scale, the park scale, and the plaza scale. These principles from 3 scales work together to transform the abandoned industrial site into green infrastructure. In urban scale, the industrial site is considered in a larger context, connect to other parks to form a green-blue system. Then zoom in the local scale, a commercial axis can be used to organize the plan, and serve as the backbone for many future possibilities. For the abandoned railway, it has a potential to become a bike road. When these lines meet together, a plaza can be designed to link the them together.
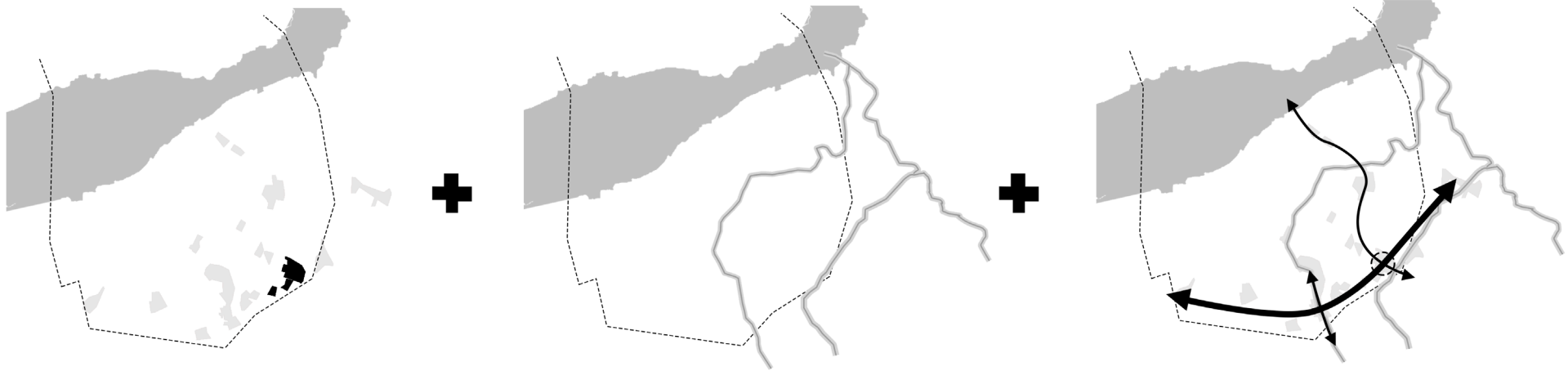
Zoom in smaller scale, I found projects to see how to make square as a connection of important structure lines. I derived the design principles from Parc del clot and zollhallen plaza: They both emphasize the industrial beauty bu making contrast. For instance, making contrast between hard and soft, pastoral and urban, new and old. Also, they use diagonal lines to keep the plan together and link it to the surroundings. It is also possible to play with water and visual connections and etc to make the plan even more interesting.

exhibition

connect to RD school

4. Harbin thermal power plant

4.1 Site Plan

Existing green space
Potential green space
River green
Existing green corridor
Potential green corridor

Main entrance

Subway station

Side entrance

Side entrance

Side entrance

N

Site Plan: Harbin thermal plant park

0   80   160

40   120   200

The thermal power plant used to be an abandoned site of the city, dangerous, contaminated and not open to the public. In order to make it benefit the city again, I found many possibilities for it. Among all the possibilities, I am interested in transforming it into green infrastructure most. Then I analyzed the site from many layers to find out the potentials and problems of the site. As conclusion, I came up with a structural map and a potential map.

Then I made a conceptual drawing to clarify my initial design idea which mainly consists of 3 structural lines. What are the lines? And what method will I apply to achieve the goal? Then I made a more artistic drawing to give an answer. Then I found some possible spatial atmospheres for most important design elements.

To make my design come true and to know if it will work or not, I looked into some projects in 3 scales to derive design principles that I can apply in my site. The site plan is a result of the application.

4.2 Design Elaboration

4.2.1 Rainwater system
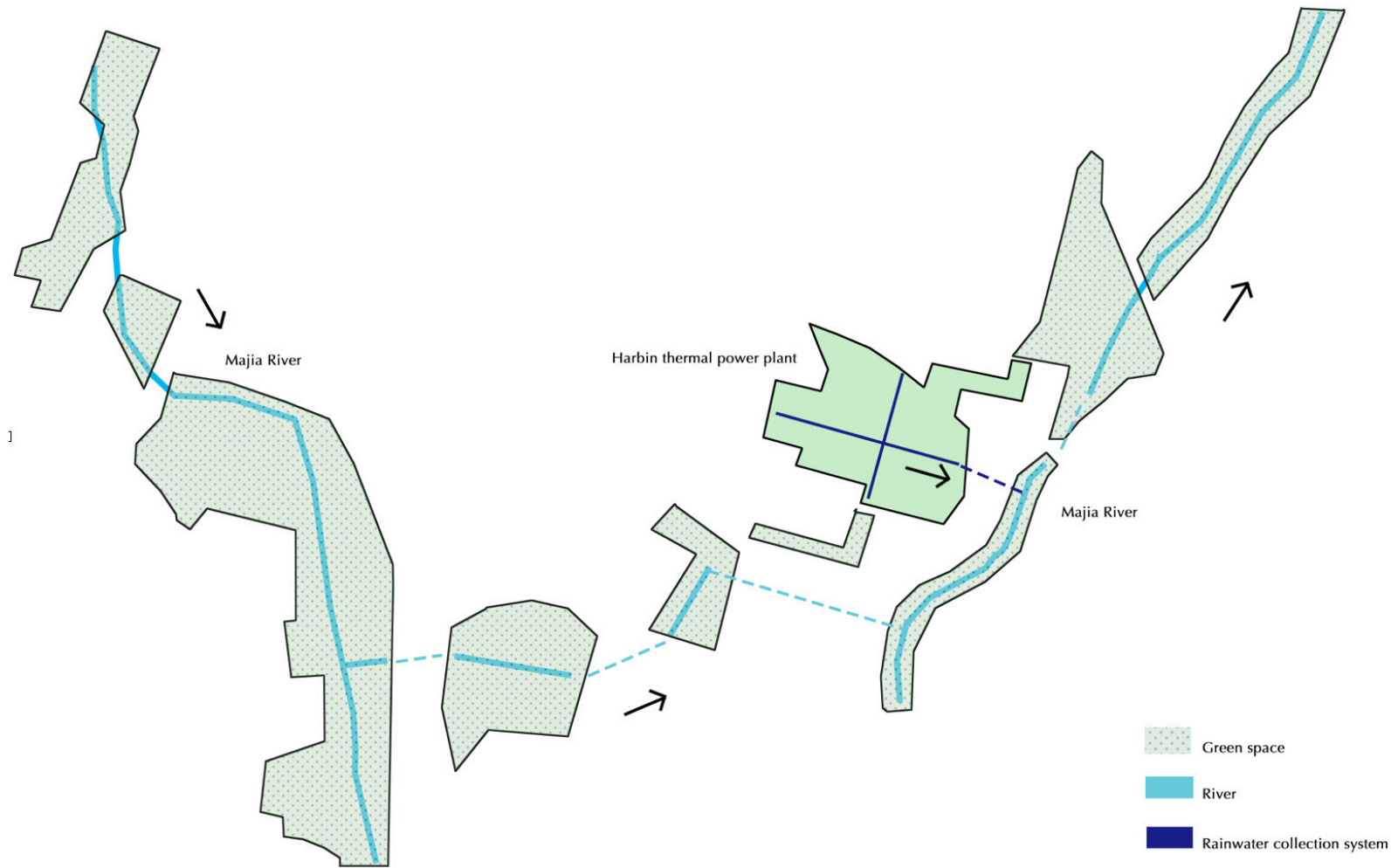
The rainwater system of the park is a part of the green-blue infrastructure in Harbin. rainwater It connects to the Majia river and becomes a part of the larger water system. Zooming in the park, all the rainwater in the park is gathered in bio swales, and goes into the rainwater system. There are rainwater purification systems at the end of the bio swales, making the rainwaters in the system purified and could used for recreation. There is also a reservoir that transformed from an cooling tower base, used to store water when rainstorm. When there is too much water, or during winter, the sluice is open to let the collected rainwater goes into the river.
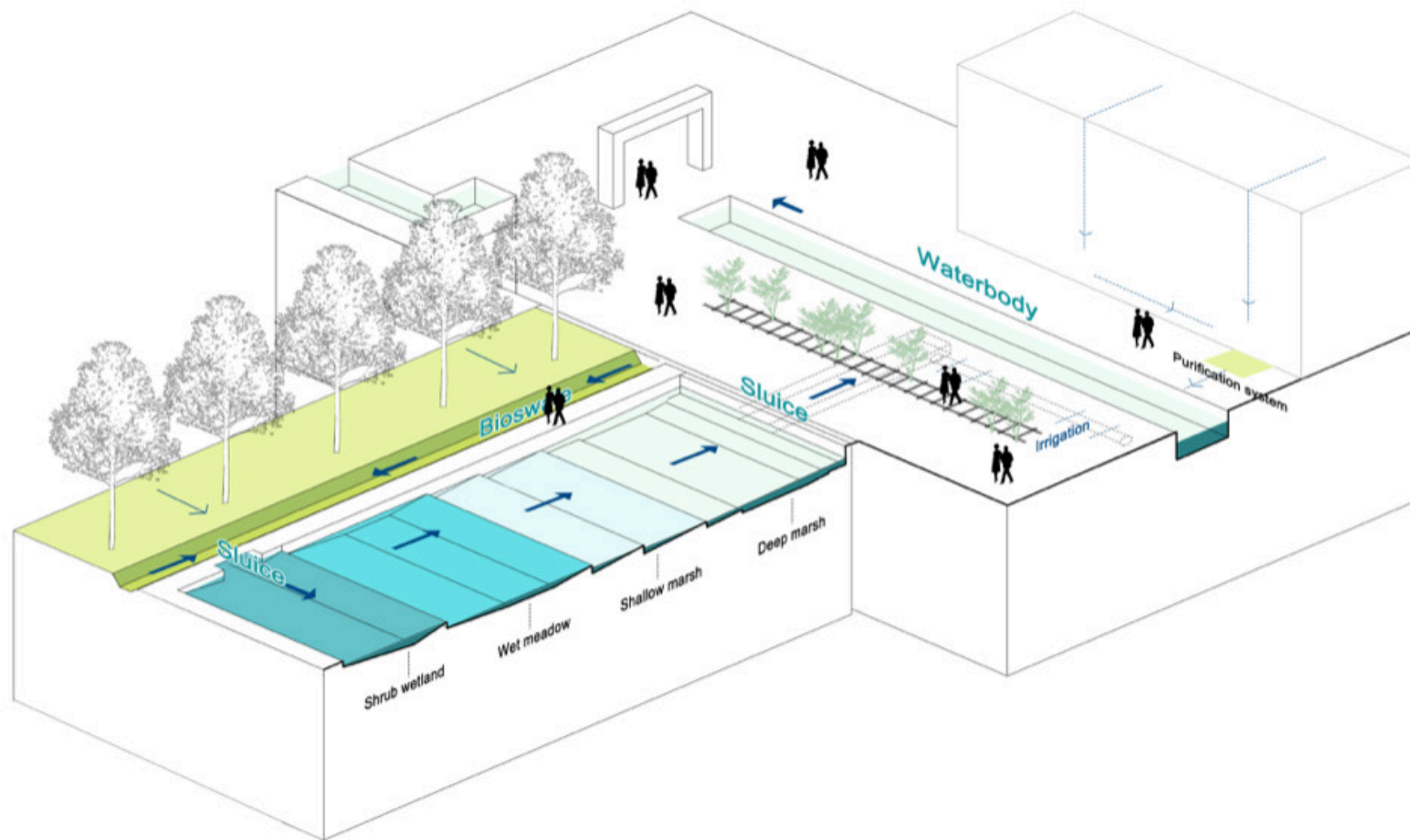
Then I take one part as an example to show how the rainwater purification forms and how it is connected to the bios wale and rainwater system. The purification consists of 4 pools: the shrub wetland, the wet meadow, the shallow marsh, and the deep marsh. The rainwater comes from the bioswale, and stay in each pool for 3 days, then goes into the next. The rainwater on the roof are purified by the purification box near the building.
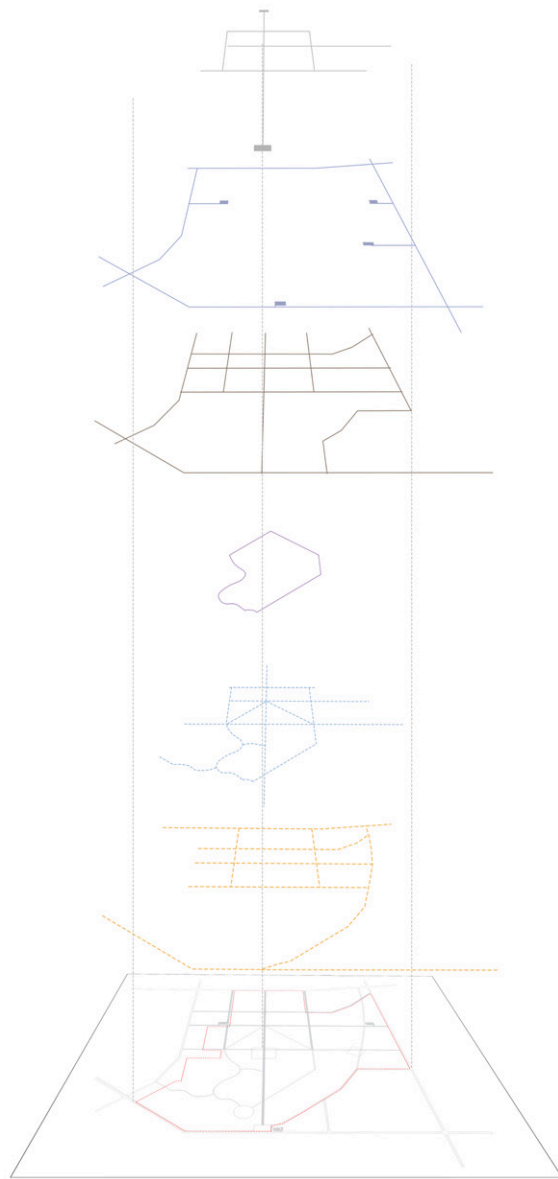
4.2.2 Movement and stay system
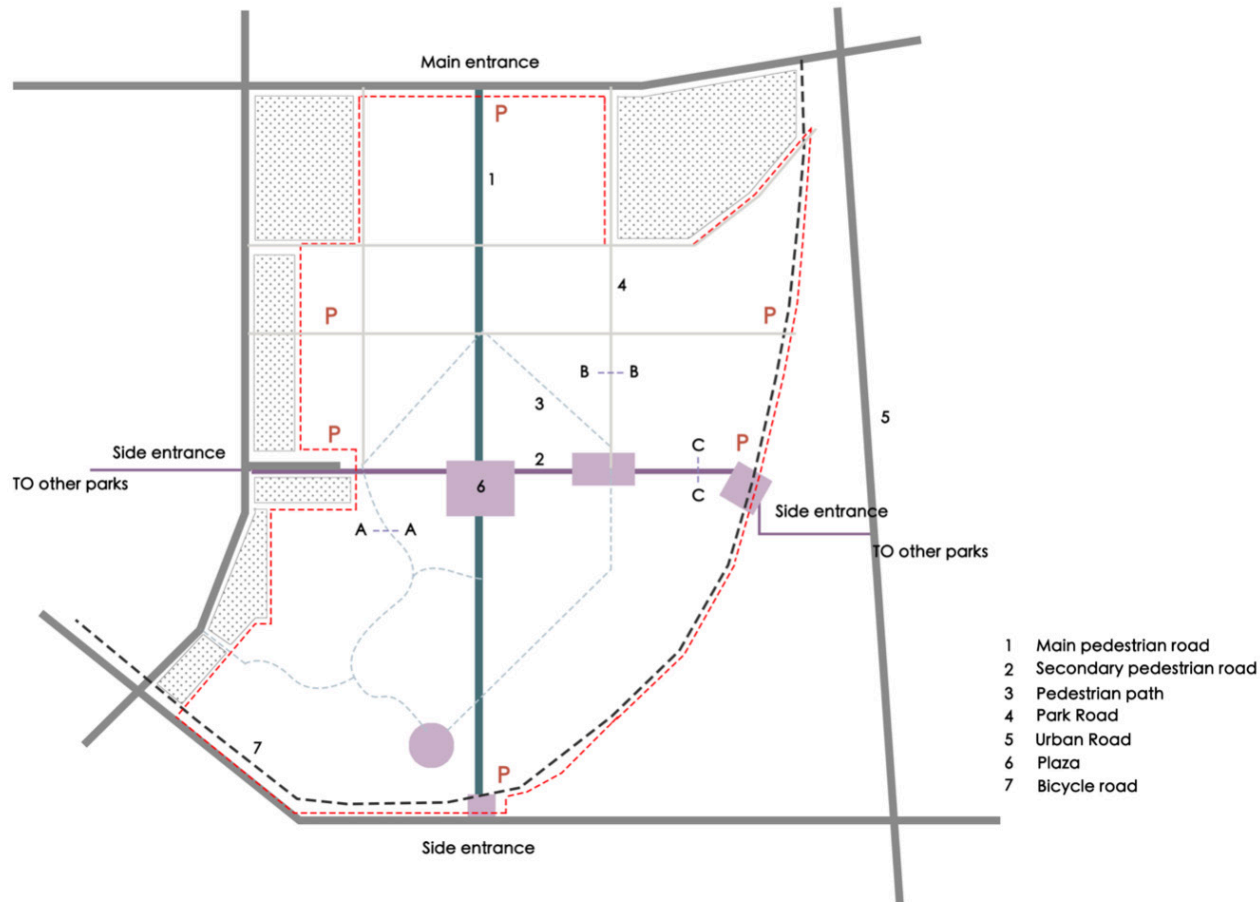
Above is the schematic drawing of the movement and stay system. The main entrance is the start of the axis, where is a subway station. There are also 3 side entrances, and all the entrances have parking area for cars. However, the cars are not allowed to go across the park, because that will interrupt the walking experience.
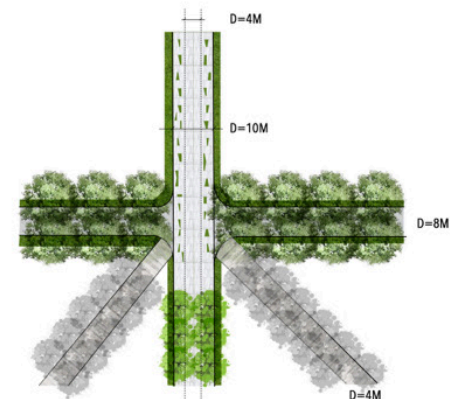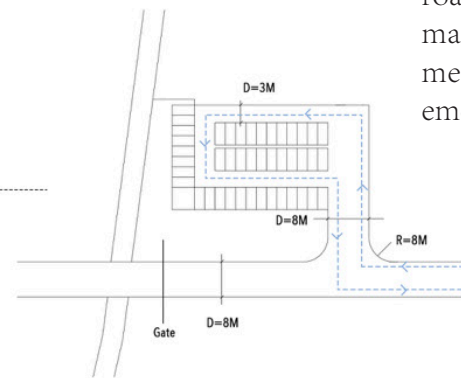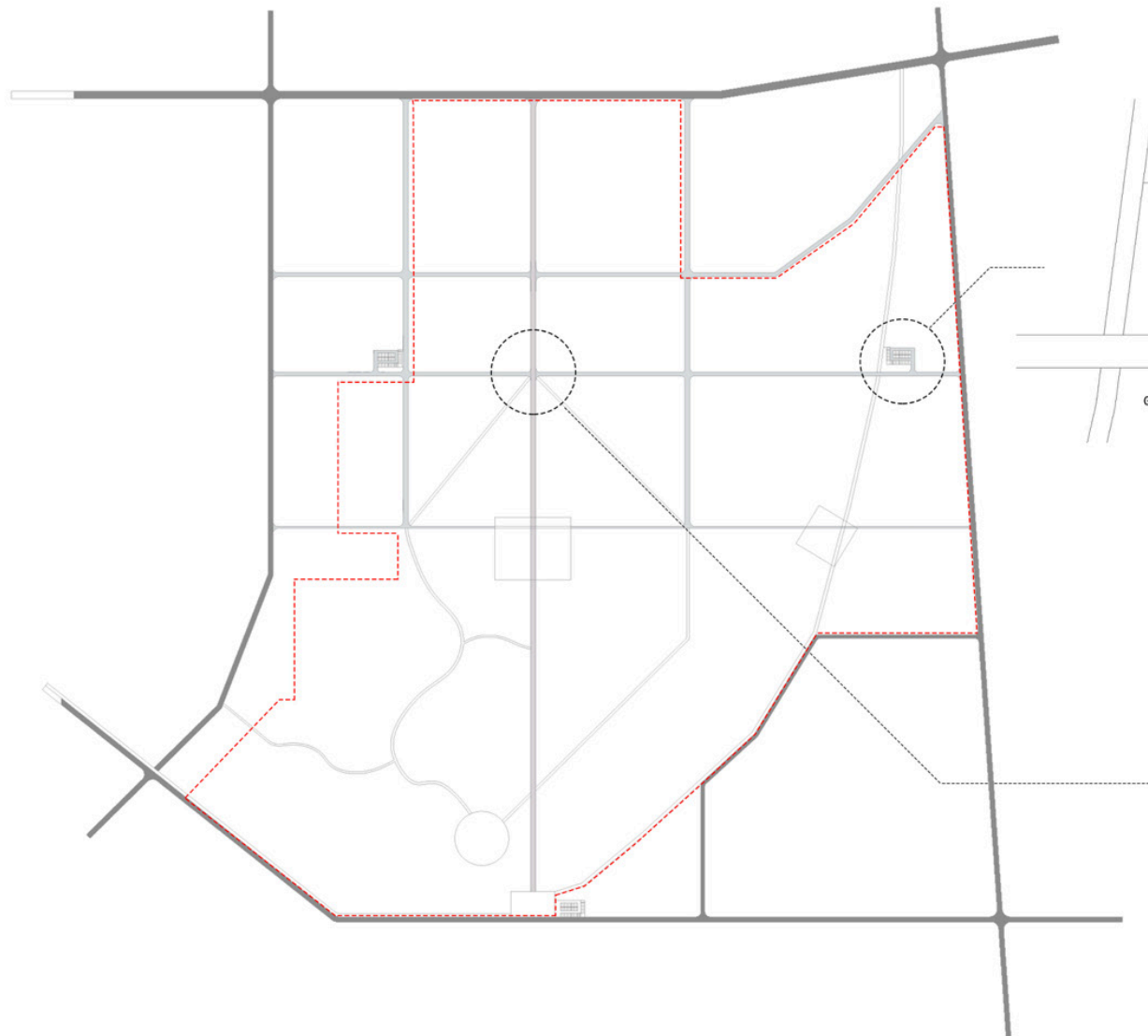
Then I elaborate on the road system in this drawing. The width for the main roads are 10 meters, and for the park roads are 8 meters. The turning radius for roads that for small cars are 8 meters, while for the road for fire protection are 12 meters. The main entrance have hard pavement for 4 meters, which is used for electric cars or emergency use.

D=3M

D=8M

R=8M

Gate

D=8M

D=4M

D=10M

D=8M

D=4M

Electric car

Private car

Fire protection

Jogging

Walking

Bicycle

Road system

To see how people use the road system, I separate them into different layers:

Bicycling: The main bicycle route is transformed from the abandoned railway, which connect to the existing bicycle paths to become a whole system. Also, some park roads can also be used as bicycle roads, providing multiple means of transport in the park.

Walking: All the path in the park is available for walking. Visitors comes from the main entrance (by subway or bus or etc) can experience the park through the axis. The blue-green infrastructure provide another direction to experience the site, which is a special industrial feeling perl of the whole green necklace.

Jogging: A circular route is designed for jogging and other circular activities. The route goes through a forest, a revenue, and open grassland, which makes the experience more interesting.

Fire protection: Some roads are designed for fire protection. The roads that open for fire pumper have 12m turning radius.
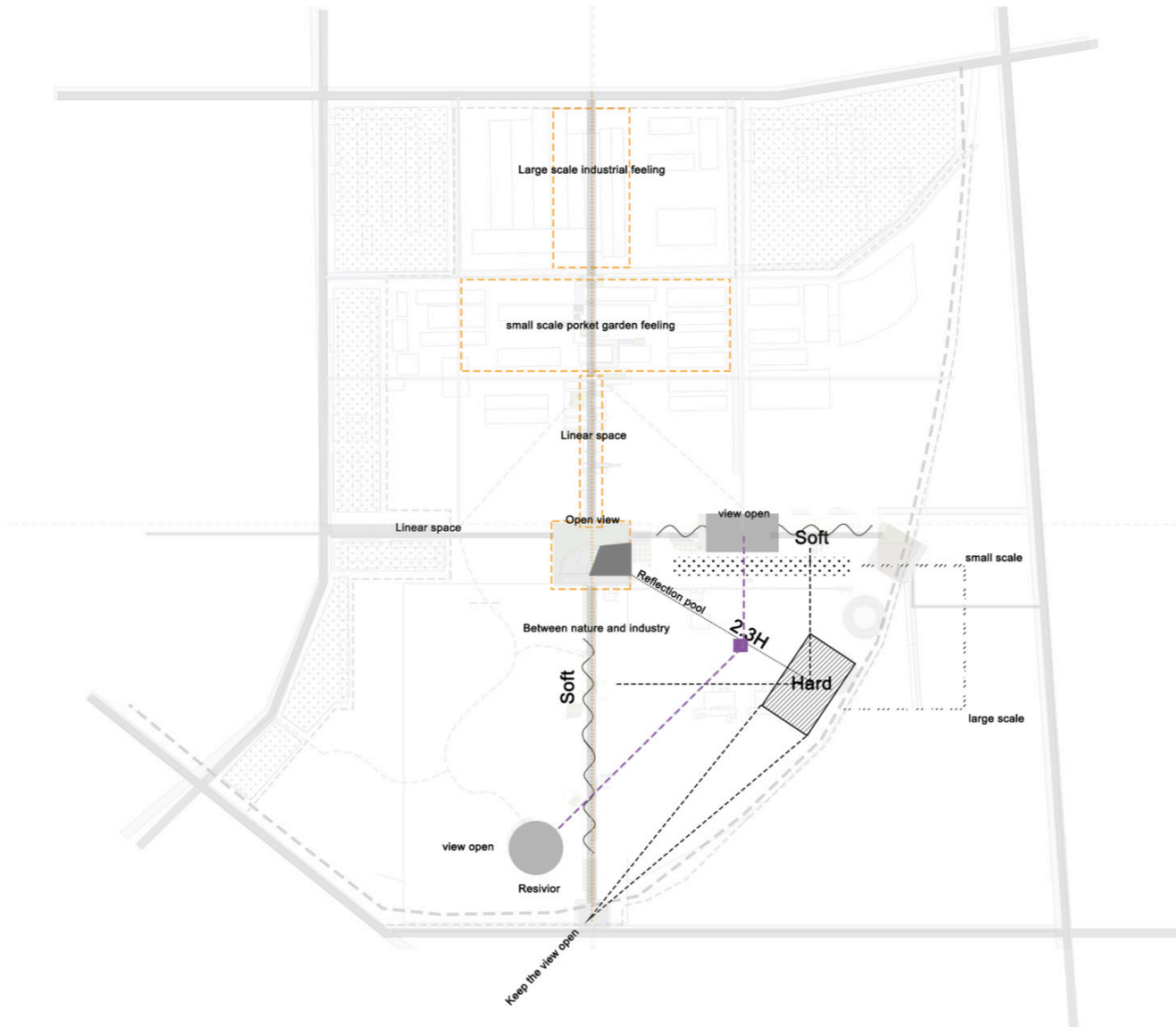
Private car: Usually private cars are not allowed to enter the park. However, visitors can drive cars to the side entrance and park cars there. There is no parking area in the main entrance in case of the traffic congestion.

Electric car in park: electric cars only for inner park transport, for visitors.
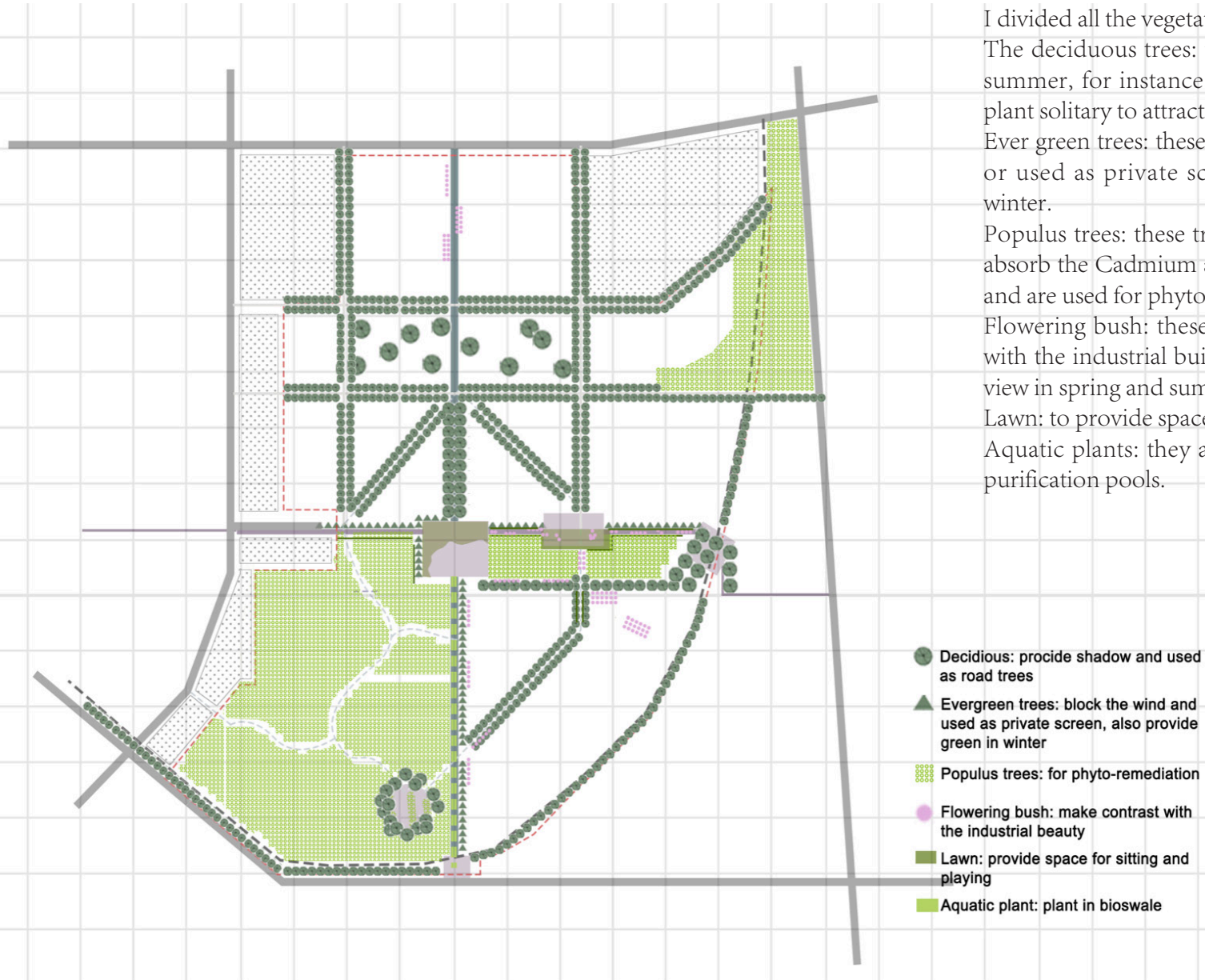
4.2.3 Spatial layer

The spatial concept for the park consists of 3 main ideas: The different spatial characters along the axis, the contrast between industrial leftover, and the visual connection of visual icons.

The axis cut through different landscape zones which following the old structure of the site. At the start of the axis, visitors can experience the narrow path between the tall industrial buildings, then goes into pocket feeling space which makes big contrast with the previous one. Then they enter a linear space which is formed by trees, and will have an open view of the plaza and the whole park in the end of the axis. If they continue with the axis, they will enter a more natural area between natural riverbank and industrial pipes, and end the axis at an informal plaza.

In the park I aimed to let people enjoy the industrial beauty by making contrast between the large and small, hard and soft, grey and vibrant color.

Also, I designed some visual connections of the important visual icons. In the central plaza, a reflection pool is designed to provide a better view for the cooling tower and the chimney. A path is reserved to leave the view open. The chimney can also be seen in two pathways, one of which connect to a lawn, and the other to the reservoir. The basic idea is to provide a good view for the industrial leftovers in the resting points.

4.2.4 Vegetation layer

I divided all the vegetations in the park into 6 types.

The deciduous trees: these trees can provide shadow in summer, for instance, as street trees. They can also be plant solitary to attract view.

Ever green trees: these trees can block the wind in winter or used as private scree, and provide some green in winter.

Populus trees: these trees are fast-growing trees and can absorb the Cadmium and coal contamination in the soil, and are used for phyto-remediation in the park.

Flowering bush: these plants are used to make contrast with the industrial buildings. They can also provide nice view in spring and summer.

Lawn: to provide space for sitting and playing

Aquatic plants: they are planted in bio swale and water purification pools.

Decidious: procide shadow and used as road trees

Evergreen trees: block the wind and used as private screen, also provide green in winter

Populus trees: for phyto-remediation

Flowering bush: make contrast with the industrial beauty

Lawn: provide space for sitting and playing

Aquatic plant: plant in bioswale

1.light-loving plant, water plant

Alnus sibirica

Salix sachalinensis

Acer ginnala Maxim.

2.cool-loving plant, fertile soil loving

Pinus tabuliformis var. mukdensis

Lonicera maackii (Rupr.) Maxim.

Tilia amurensis Rupr.

3.light-loving plant, cold resistant, can not live in water

Morus alba L.

Amygdalus persica f. rubro-plena

4.hadow-loving plant, cold resistant, fertile soil loving

Picea koraiensis Nakai

Padus maackii (Rupr.) Kom

Acer mandshuricum Maxim

5.light-loving plant, dry resistant, cold resistant

Syringa oblata Lindl.

Ulmus pumila L.

Acer saccharum Marsh

Gleditsia japonica Miq

Larix gmelinii （Rupr.） Kuzen

6.phyto-remediation plant

PopulusL.

7.light-loving plant, cold resistant, fertile soil loving

Albizia kalkora (Roxb.) Prain

Sorbus pohuashanensis

Sorbaria sorbifolia （L.） A. Br
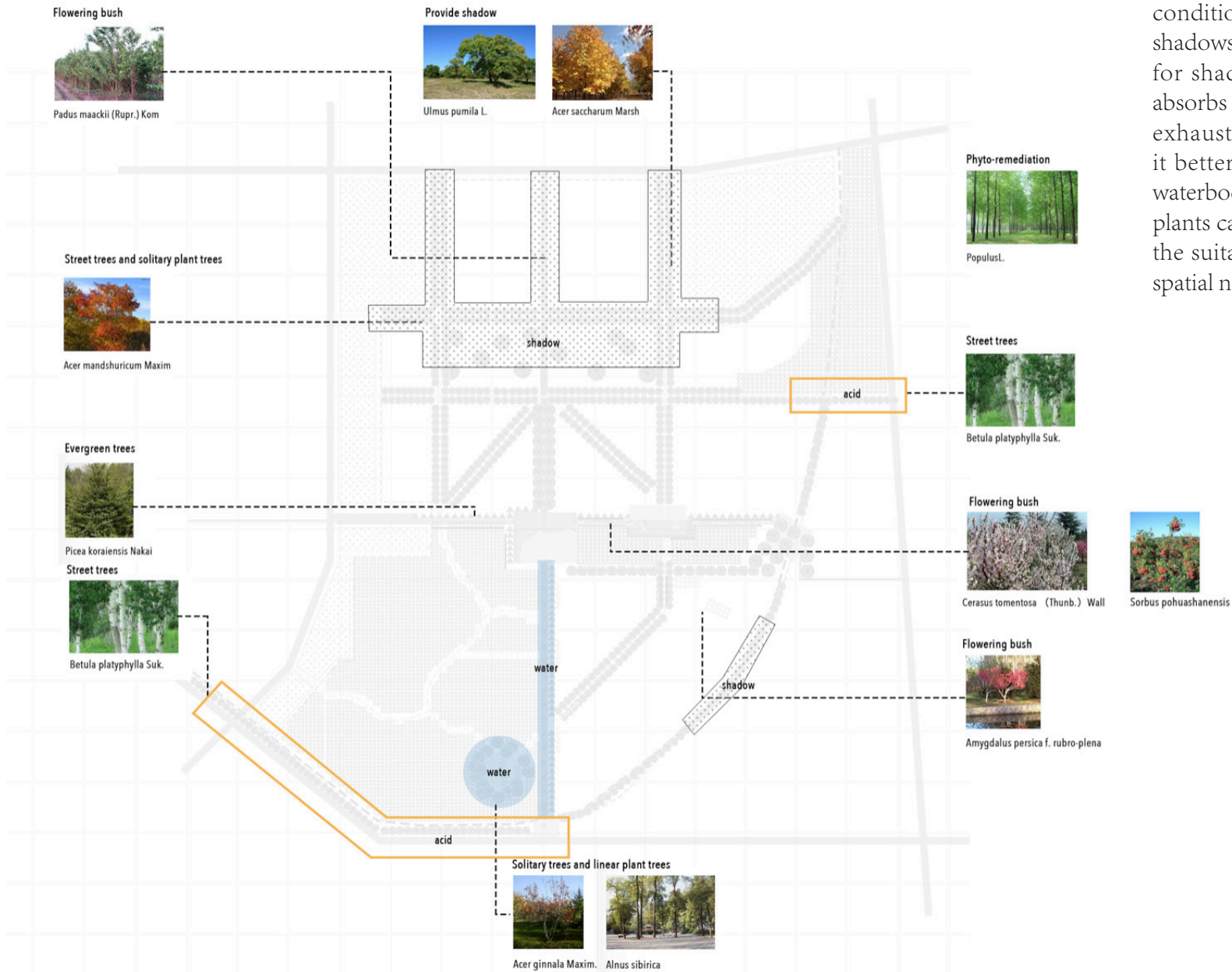
Cerasus tomentosa （Thunb.） Wall

**8.light-loving plant, cold resistant, acid-soil loving**

Betula platyphylla Suk.

Located in Harbin, which has a quite special weather condition, what spices can be used? I looked into the literatures and divided the trees into 8 groups according to the ecological preferences.

1.light-loving plant, water-loving

2.cool-loving plant, fertile soil loving

3.light-loving plant, cold resistant, can not live in water

4.shadow-loving plant, cold resistant, fertile soil loving

5.light-loving plant, dry resistant, cold resistant

6.phyto-remediation plant

7.light-loving plant, cold resistant, fertile soil loving

8.light-loving plant, cold resistant, acid-soil loving

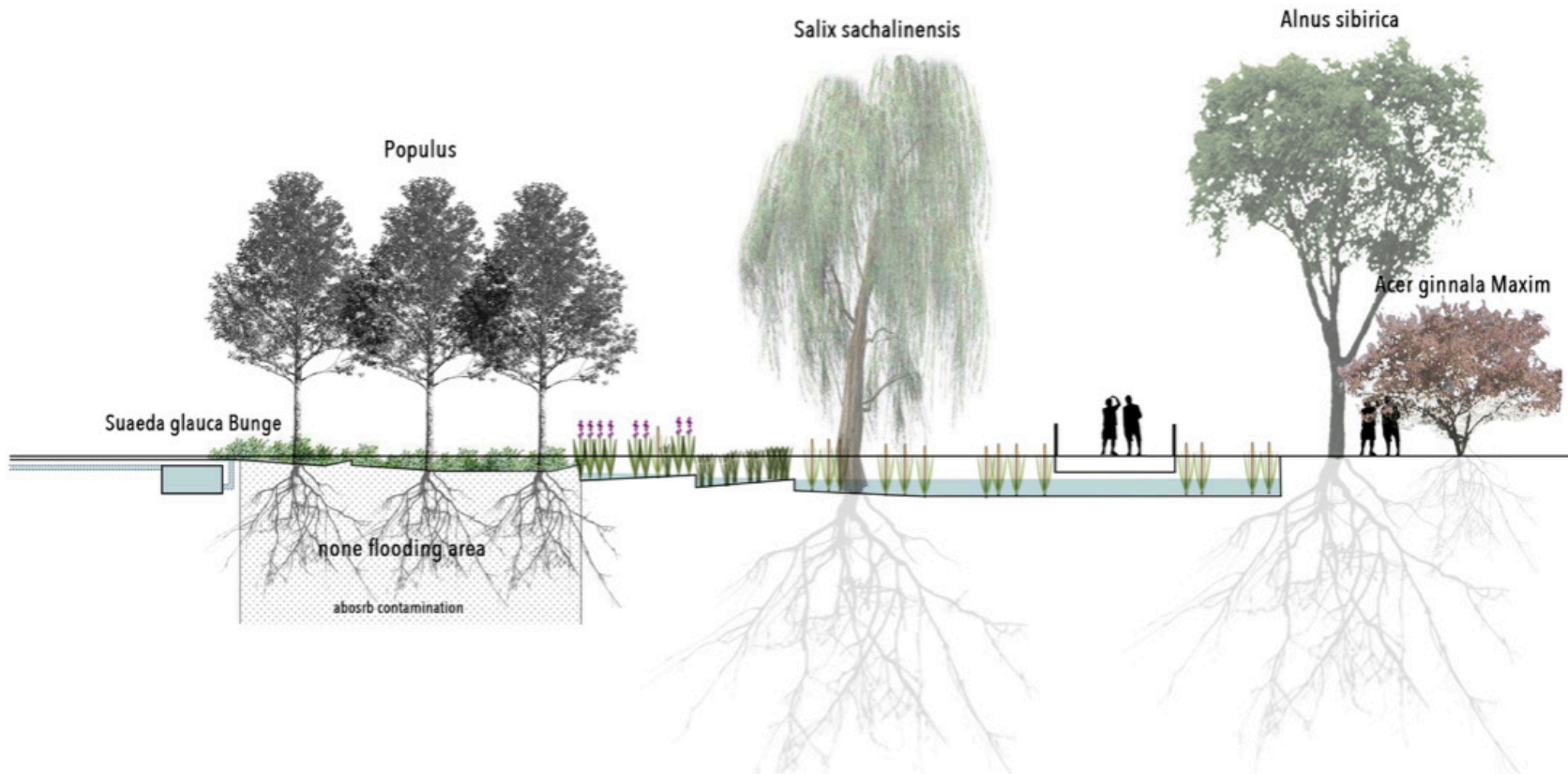Flowering bush

Padus maackii (Rupr.) Kom

Street trees and solitary plant trees

Acer mandshuricum Maxim

Evergreen trees

Picea koraiensis Nakai

Street trees

Betula platyphylla Suk.

Provide shadow

Ulmus pumila L.

Acer saccharum Marsh

shadow

shadow

water

water

acid

acid

Solitary trees and linear plant trees

Acer ginnala Maxim.   Alnus sibirica

Phyto-remediation

PopulusL.

Street trees

acid

Betula platyphylla Suk.

Flowering bush

Cerasus tomentosa (Thunb.) Wall   Sorbus pohuashanensis

Flowering bush

Amygdalus persica f. rubro-plena

To find the best spices, I analyzed the ecological condition of the site. Some areas are under the shadows of buildings, providing a dog condition for shadow-loving plants. Soil long the road absorbs the CO_2 and SO_2 from the automobile exhausts, making the soil acid, which makes it better to plant acid-loving plants. Near the waterbody the soil are more wet, so water loving plants can grow well there. Then I come up with the suitable spices for the site according to the spatial need and the ecological condition.
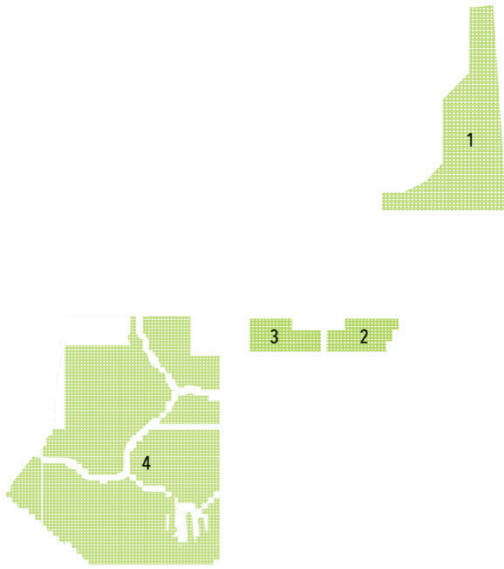
1

2
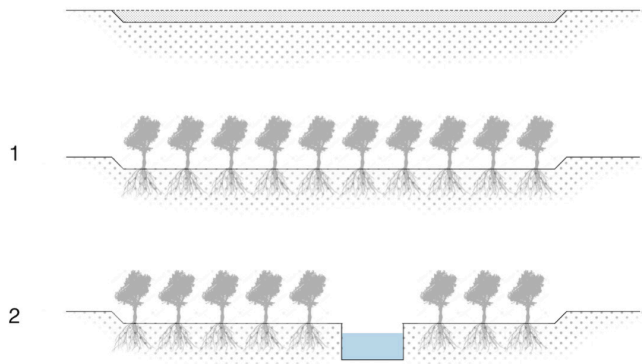
Then I elaborate on the phyto remediation strategy. The strategy of phyto-remediation is to dig the most polluted soil on the surface, then plant populous trees and suaeda glauca bunge to absorb the contamination. As fast growing plants, they can absorb the nutritions and contaminations in a fast speed when they grow fast. When they grown up, they will be cut down for other use. Then repeat this process serval times until the indicator plants can grow.

And in some places, the contaminated soils are just moved away to create waterbody.

The section shows how the phyto method works together with other landscape elements. In the polluted area, rainwater are not allowed to penetrate into the soil to prevent the pollution of ground water. Rainwater from other places are collected to create a waterbody and provide a good living condition for some pieces like sail sachalinensis, and alnus subirica.

Salix sachalinensis

Alnus sibirica

Populus

Acer ginnala Maxim

Suaeda glauca Bunge

none flooding area

abosrb contamination

Growing of Populus Trees
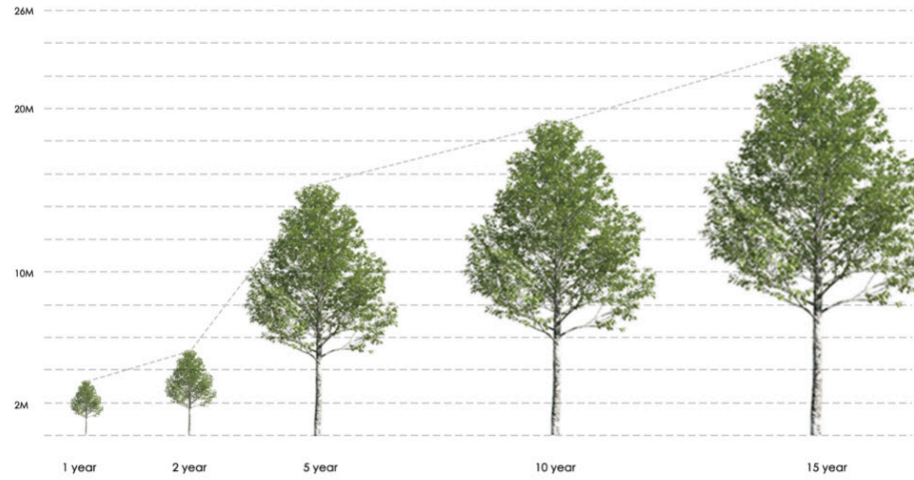
The populous trees shows a dramatically change through time. So I analyzed the process of it and the possible spatial atmospheres it can create. I divided the phyto-remediation areas into 4 parts, and provide different manage strategies for each part.

Part 1: for part 1, the idea is to provide a good space for bicycle riders. This it should be a bit higher and dense to provide shadows. So I plant populous trees every 5 meters, and harvest them every 15 years. So during the most times, it can provide a good spatial quality for people.

Part 2: for part 2 and 3, they are near the blue green infrastructure, which do not have future use for development. So it is not hurry to clean the soil, and it can be interesting to make difference of them to make people aware of the process. Also, they serves as a contrast with the industrial buildings, and the view blocker. So for part 2 and 3, the trees will be planted 4 meters. For part 2, it will be harvested every 3 years, and for part 3, it will be harvested every 10 years.
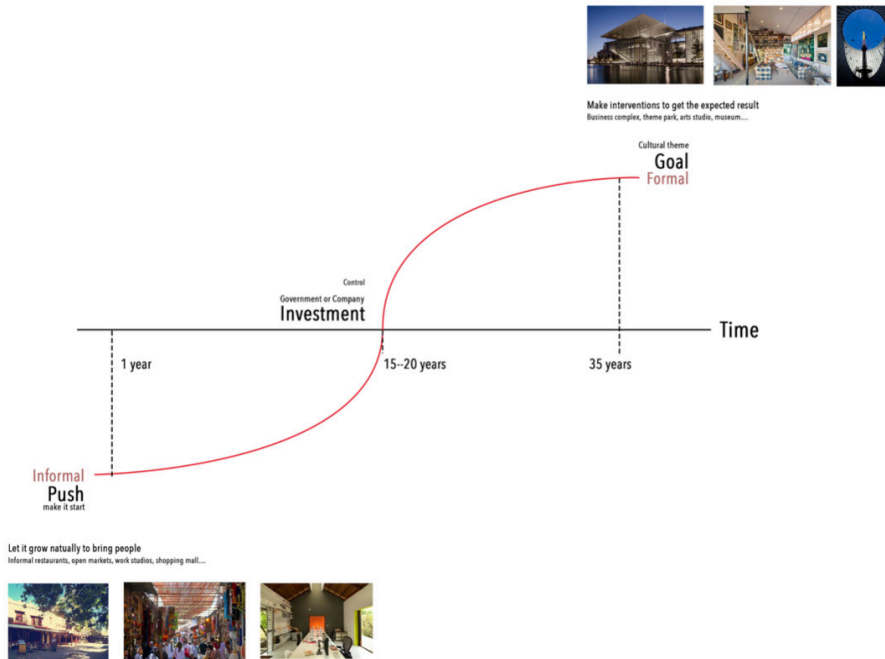
Part 4: In part 4, the area needs to be fast purified and then open for possible future uses. So it will be treated in the most effective way, let the trees grow in the most fast speed. So it will be harvest every 3 years to keep the process effectively.
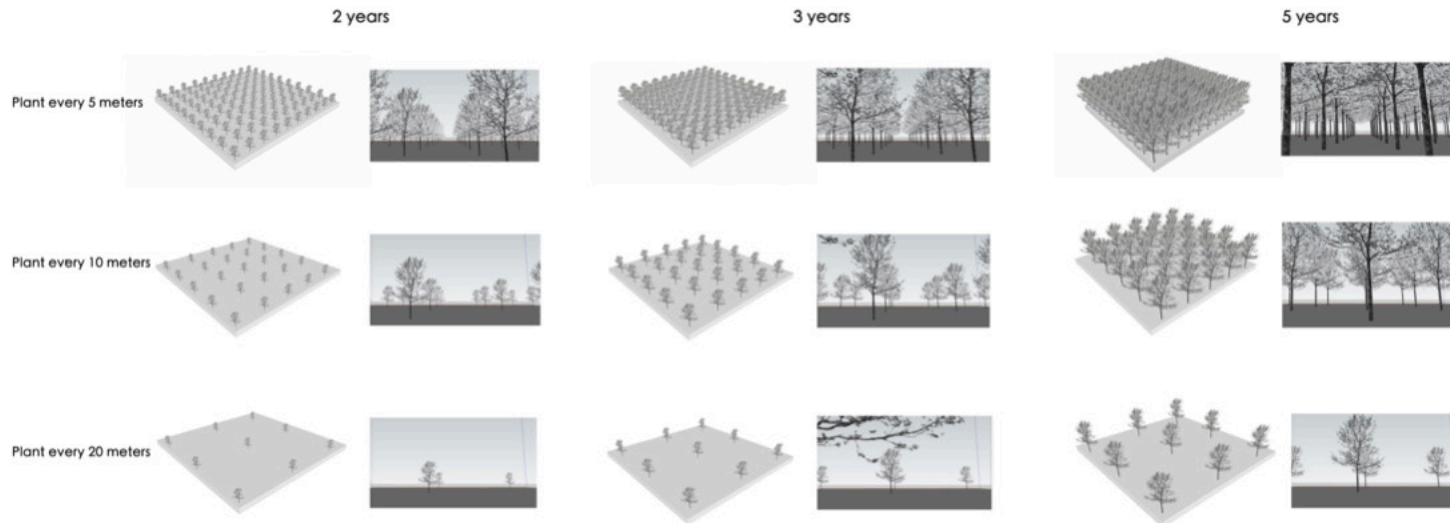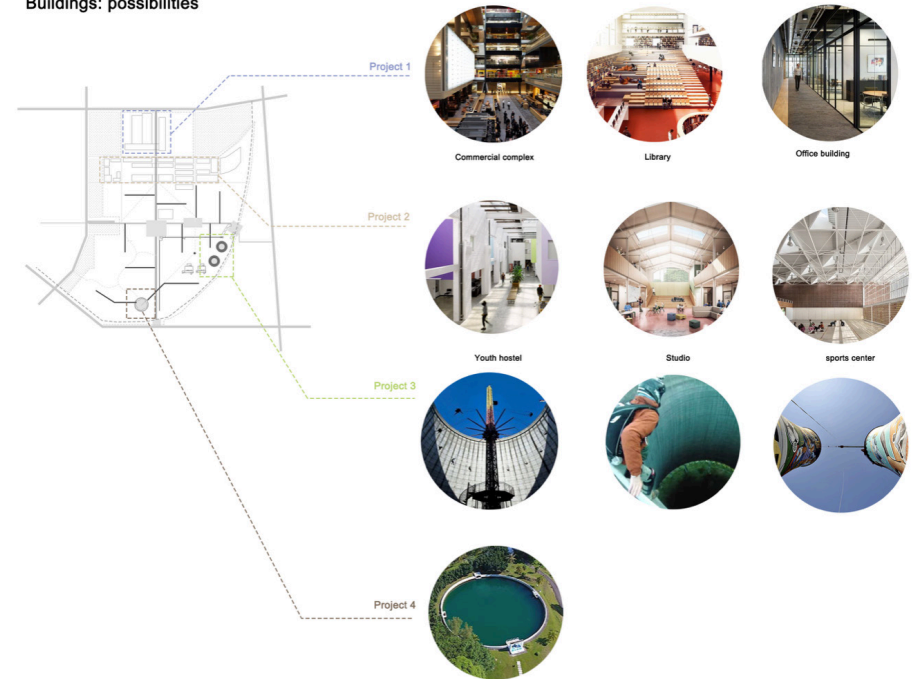
4.2.5 Building layer

In the design, I divided the buildings for 3 groups: new built buildings, reused old buildings, and removed and buildings. The new buildings are for essential functional use: service areas like cade&food and community. Some old buildings are in good condition or have potential to be reused, so I leave them for future possibilities. On the contrast, some old buildings are in poor condition and very hard to reuse, so I just removed them for future development.

New buildings

Reused old buildings

Removed old buildings

1-7 Possibilities for future development

Make interventions to get the expected result
Business complex, theme park, arts studio, museum....

Cultural theme
Goal
Formal

Control
Government or Company
Investment

Time

1 year   15--20 years   35 years

Informal
Push
make it start

Let it grow natually to bring people
Informal restaurants, open markets, work studios, shopping mall....

Buildings: possibilities

Project 1

Commercial complex   Library   Office building

Project 2

Youth hostel   Studio   sports center

Project 3

Project 4

The possibilities for the functions will show a trend from informal to formal. This process will happen naturally, so I just need to push it to let it happen, and intervene the investment in 15-20 years to lead it to the desired future which is a cultural theme complex. The first push will be to open the buildings free to public to attract people.

Then I listed the possible uses for the buildings. In some buildings I have a strong concept so I just made decisions, but other parts I just leave the process to happen naturally.
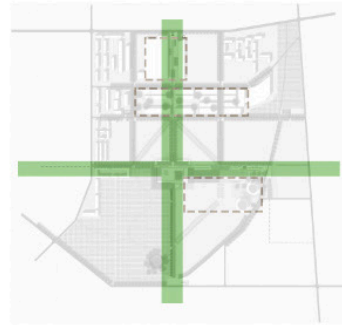
4.2.6 Phasing strategy

1 YEARS

Remove the most polluted soil, creating a dug area which becomes new waterbody
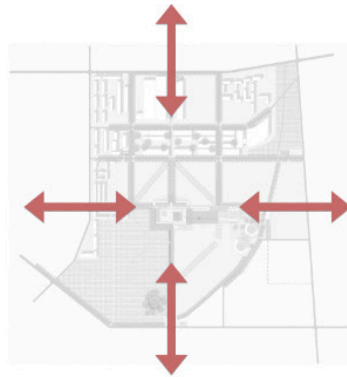
2 YEARS

Break the boundary and increase the accessibility of the site

3-4 YEARS

The backbone is finished, and some informal functions will take place in the feltover buildings.

15-20 YEARS

All the infrastructures are built, and new functions of the buildings are funded by the government.

30 YEARS

Culture theme complex

I aimed to make the industrial park a self-sustaining park. The project is a phased plan that will gradually change the site into 5 short-term phases:

—— Break the boundary and increase the accessibility of the site (from 1st year)
In this period, the site and soil preparation will be done. Later, new road will be constructed to increase traffic capacity. In this way, the site will be no longer an enclosed abandoned inner-oriented space in tie city, but a part of the city.

Some leftover buildings that are not polluted can provide a place for multiple uses for citizens. For instance, the 2-floor buildings could be used as artist studios, or indoor recreational space for community. They will be open to the citizens, to active this place.

—— Remove contamination from soil and creating new waterbody (from 2nd years)
In this period, the most polluted soil will be moved away, creating a dug area which becomes new waterbody. The new waterbody connects to the nearby branch of Majia River, and only flows when there is a lot of stormwater. A leftover of cooling tower base will be transformed into a reservoir, connecting to the river by a sluice.
Meanwhile, the polluted soil is also being treated with phyto-remediation method. 2-years Populus trees grow in a fast speed that can absorb nutritions as well as contaminations from the soil. In 3 years they will remain this fast speed, then they will be cut away and be used in a proper way. Then this process will be repeated for 3-5 times until all the contamination are removed.

—— Create backbone of the site (from 4th year)
In this period, I aimed to design the infrastructure to create a backbone for the site. The railway that goes along the site will be transformed into a linear traffic space, a bicycle route in summer and an ice-skating route in winter. The route will be a hard and fast path for traffic.

Also, a walking path will be designed to connect two large green areas in order to create a coherent green system to create a linear park system to provide a place for passive recreation. Many linear activities could take place here, such as biking, jogging and walking.

The main entrance for the site will be a subway station. From the station, an axis is created to connect different zones. The axis will be a soft wide path for strolling. At the end of the axis, there will be a way to the branch of Majia River and rural area for future development.

There will be 3 squares where the 3 paths meet.

—— Find new functions of the leftover buildings (from 6th year)
In this period, the infrastructures are build by the fund of the government. That provide places for many activities such as campus buildings, parking, deciduous forest, security, information centers, housings, recreational water, gardens, meadow lots, sports fields, wetlands and outdoor theatre. Landscape elements will be planted incrementally over time as funding permits, gradually building up the park's mass into a flexible patchwork of planted clusters separated by open undesignated areas.
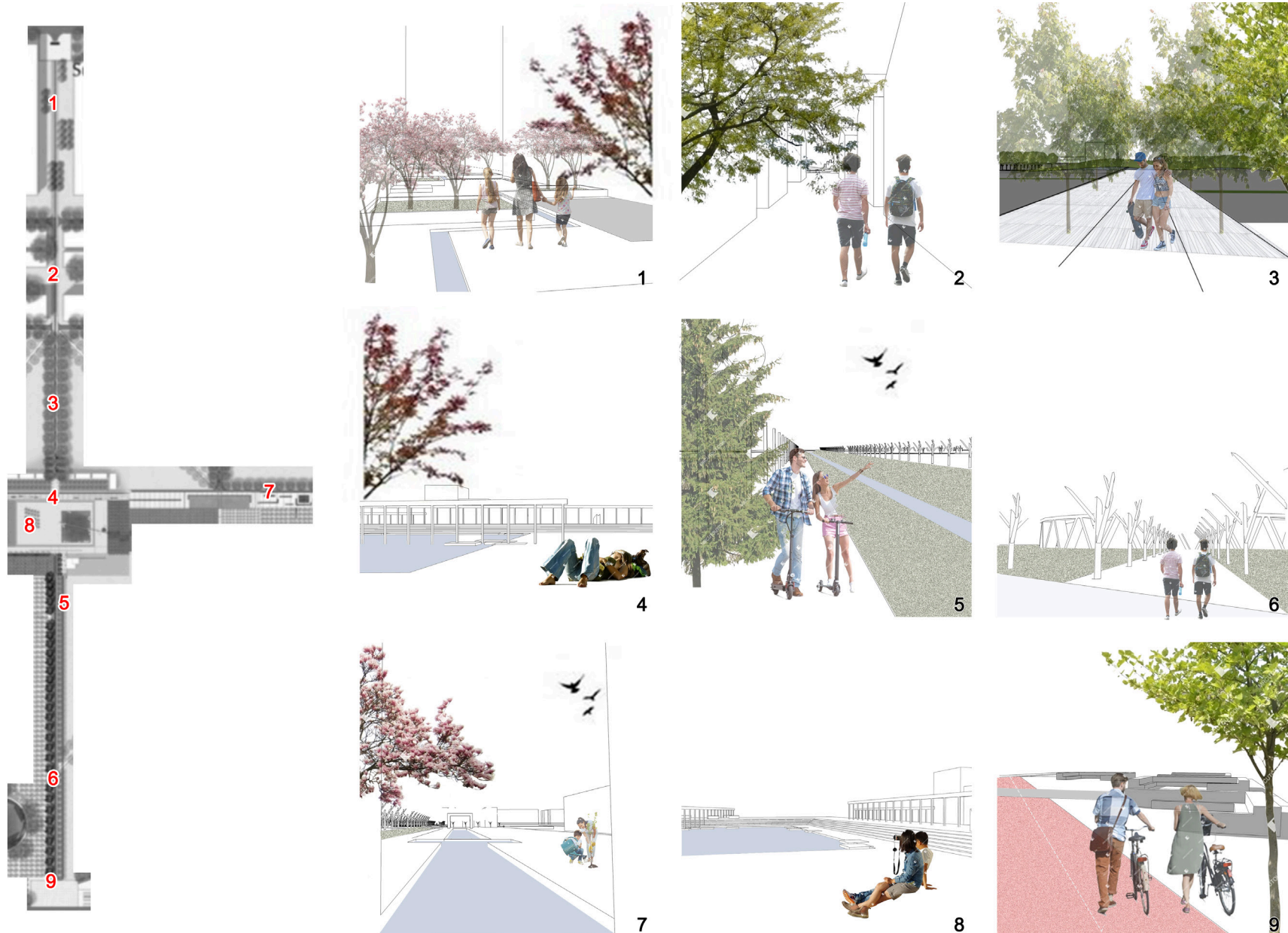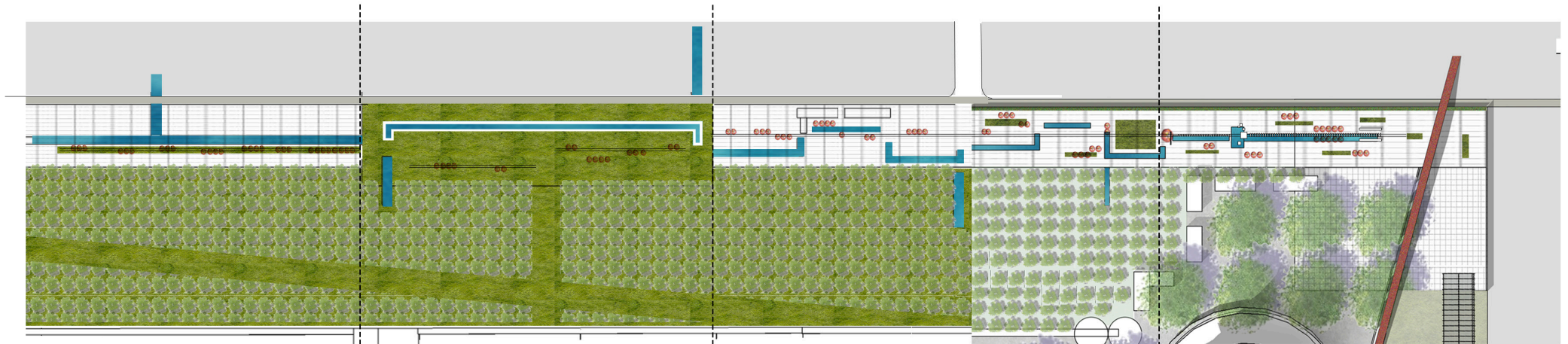
4.3 Detailed design

Site Plan: Harbin thermal plant park

I will elaborate on the following details because they are important in my design: the 3 backbones and where they meet.
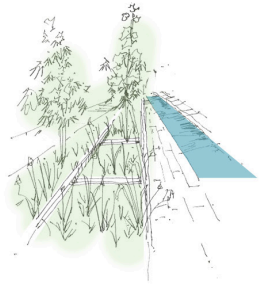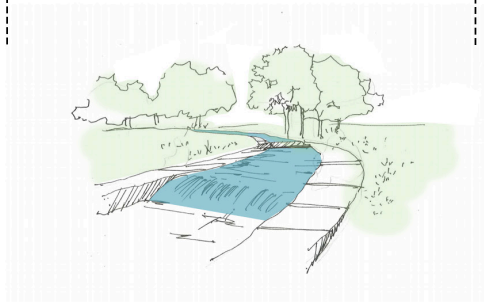
4.3 Detailed design

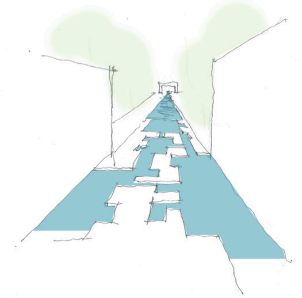### 4.3.1 The main axis

4.3.2 The blue-green infrastructure

Zone A

Zone B

Zone C

Zone D

2m

4m   3.5m   2m

0.1M   1.5M   0.8M   2M   0.8M   5M

ROAD

10M

2.5M

12M

30M
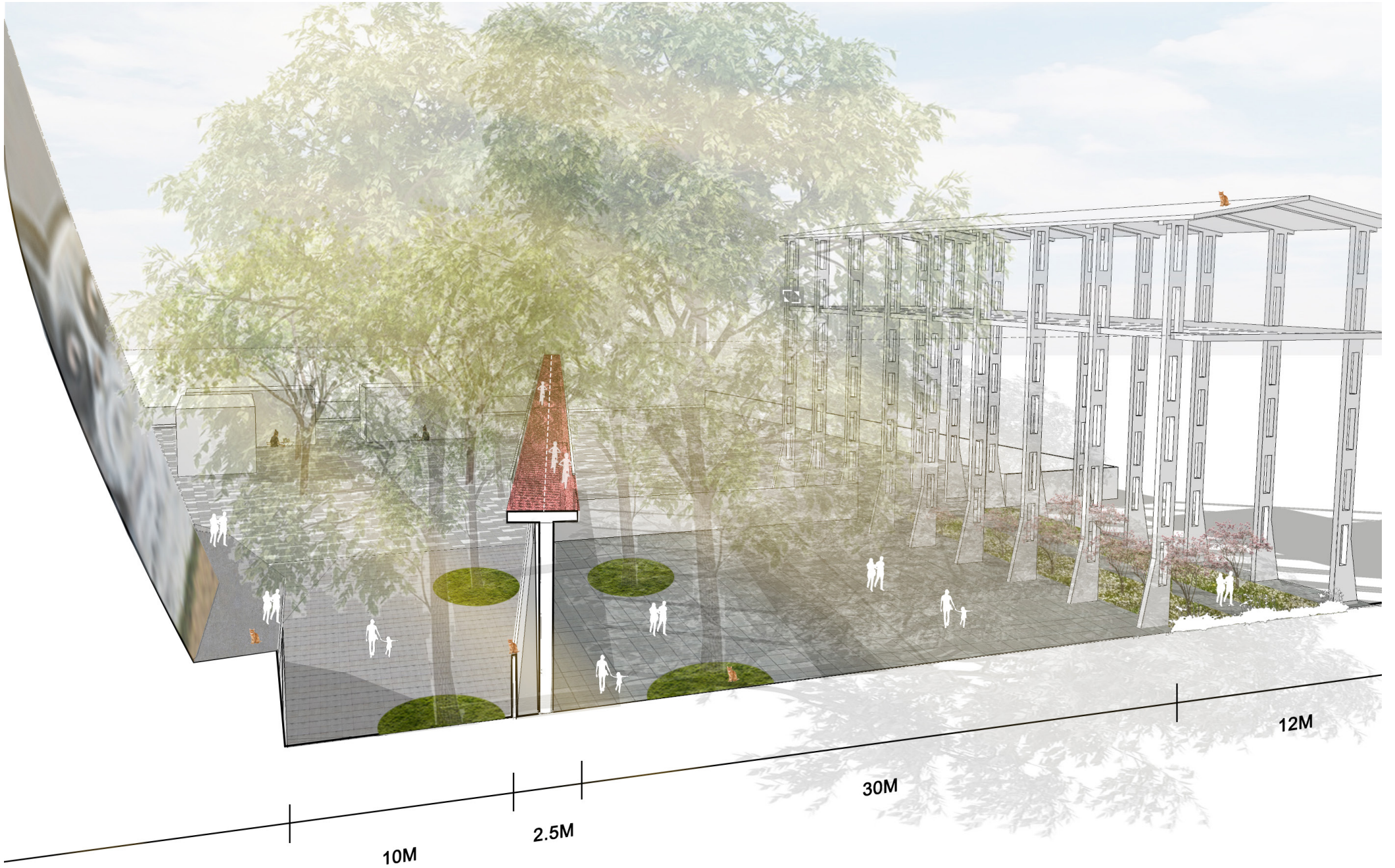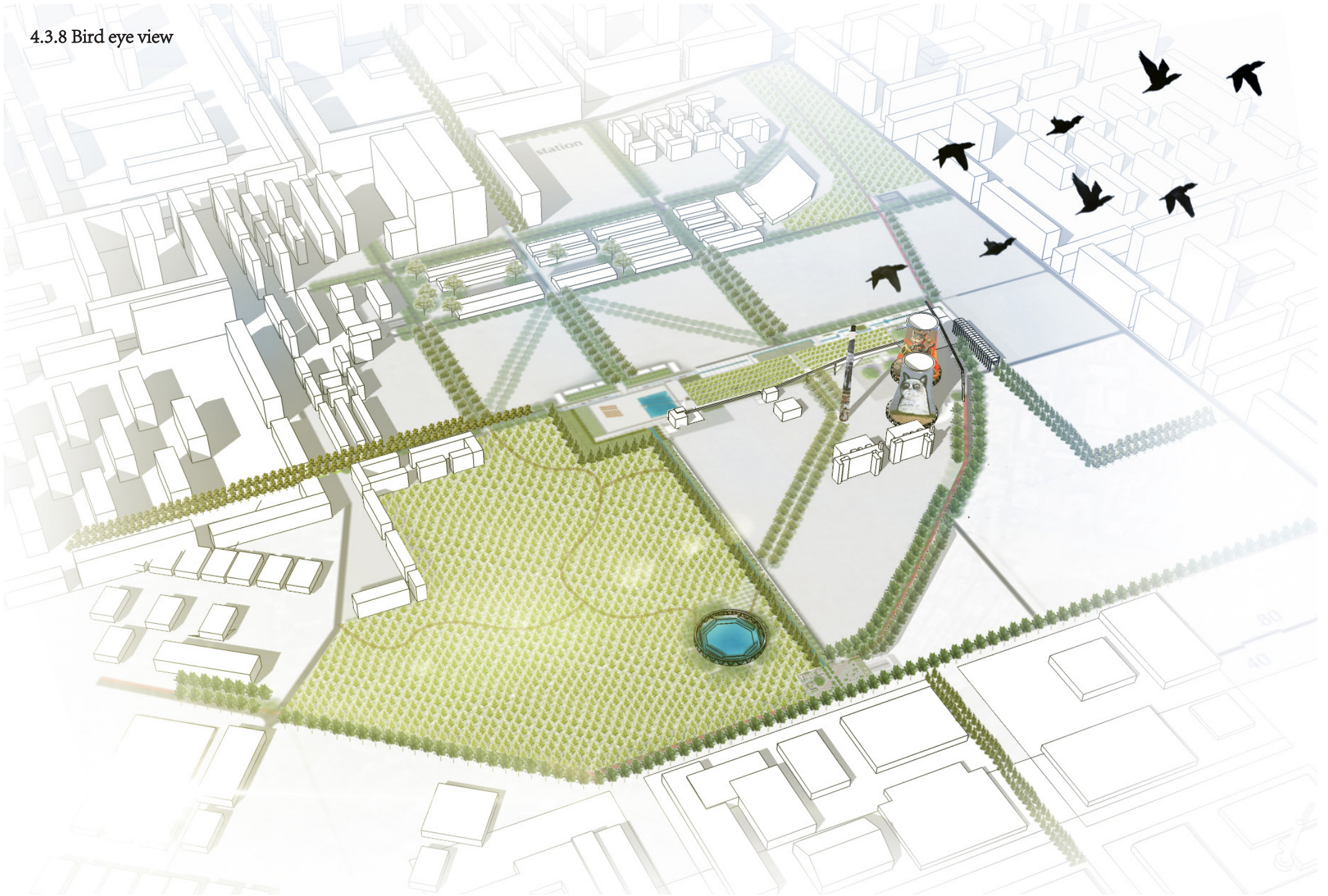
Central Plaza: summer

Central Plaza: winter

4.3.5 Side entrance
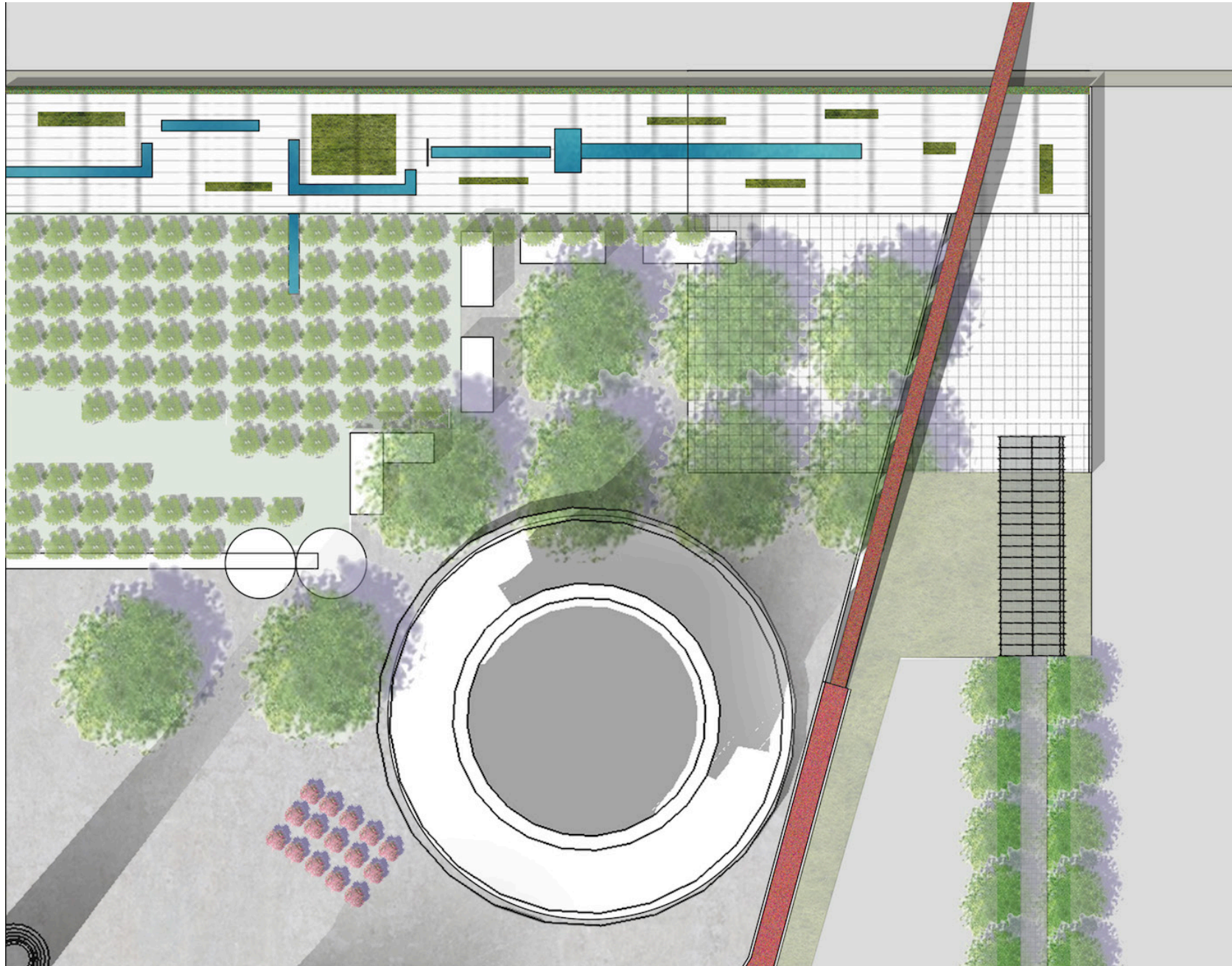
Retention pool summer

Retention pool winter

5. Reflection

5 Reflection

My research goal was to explore the possibilities of post industrial sites to transform them into green infrastructure by multi-scale approach, making them not only benefit the ecology sys- tem in city scale, but also urban environment in local scale, while remaining the industrial beauty of the site.

Through my design, I managed to transformed the abandoned industrial site into the a desirable park: In the first 2 years, all the dangerous leftovers will be removed, and the industrial site will open to public, providing free buildings for many possible uses. Meanwhile, the green backbones will be there, proving green public space and green corridor for nearby residents. In this means, the abandoned dangerous wasteland of the city becomes a open green space that connect to the larger green system as a whole. When the green connection is established, it also provides living habits for many animals. As for the city scale, it provides a potential cultural complex for the city in 15-20 years by attracting people and providing desirable environment. People can enjoy the industrial beauty in the park, and experience the unique spatial quality of the thermal plant. In conclusion, I reached my goals through design, and discovered a general approach of transforming post industrial sites into green infrastructure.

Here I list the general approach of transforming post industrial sites into green infrastructure: Remove the dangers and contamination: The industrial site is dangerous because of sone leftover buildings and contamination. In this part, I deal with this problem to make the place safe for people to visit.
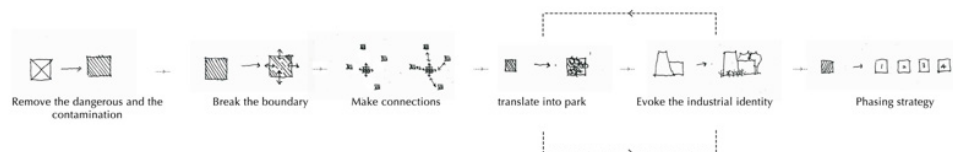
Break the boundary: most industrial parks are inner-oriented. To transform it into green infrastructure, it is important to make connections and break the boundary. Make connections: analyze the current situations of the site. For instance, the traffic system, the water system, the .. and etc to connect the site into the city. Among all the layers, the green infrastructure is a layer that needs to be stressed: the connection is not only the green corridor, but also the backbone of the green infrastructure such as the water system, or walking sequence. 4.Translate it into a park: to translate it into a park, many aspect have to be thought about. For instance, the spatial characters, the rainwater system, the functions of buildings, the movement system... etc.

Evoke the identity of the park: the industrial parks have their own beauty. We can evoke the industrial beauty of the site my multiple approach. For instance, making contrast.

Phasing strategies: the progress of transforming takes a long time, so it is important to consider about the phasing strategy.
When looking back to the background theories, I also found some problems. I looked into literatures and found background theories in two aspects: post-industrial and the green infrastructure. In the post industrial theories, I discussed the ways to deal with the problems. However, the potentials are also very important here: how to discover the industrial beauty of the post industrial landscape? What are the spatial characters of them? What is the unique spatial character or theme of this part of the green infrastructure? Why people are attracted by ruinous industrial landscapes? Somehow the answer of these questions contains the background theory of how to transform it into green infrastructure. The separate of the two theories causes problems to integrate them into one design.

Remove the dangerous and the contamination   Break the boundary   Make connections   translate into park   Evoke the industrial identity   Phasing strategy

In the beginning I planned to first transform the abandoned industrial site into a park, then connect it to larger green system. However, I found it late that is is a process that going back and force, the structure of the larger green system also affect the park design, for instance, where are the entrances? Is the road of green corridor in the park for pedestrians only or also for bicycles functionally?
Basically I finished my goals. However, there are also many things that could be further discussed if I still have more time. For instance, what are the systematic layers of the green infrastructure? How my design benefit the city in quantity? What will happen if I apply my ideas in the design to other sites?

Overall, the design plays an important role in my research: it helps me to dive deeper into the questions. When locate the questions in a certain site, some questions that have not thought about become more clear. For instance, how to deal with the certain contamination of leftover thermal plant? How to make design in extreme weather condition like in Harbin? I discussed these questions through the design, which pushes my research to a deeper level.