THE EMPLOYMENT OF GREEN COMMUNITY DESIGN METHODS IN REDEVELOPING HUASHIYING VILLAGE IN BEIJING, A CHINESE URBAN VILLAGE

by

JUNCHENG LU

(Under the Direction of Sungkyung Lee)

ABSTRACT

Nowadays, a large number of rural villages exist in Chinese major cities such as Beijing and Guangzhou. Called *Chengzhongcun* (urban village), they are regarded as Chinese slums, which has been an obstacle to the urban development in China. The current method—the demolition-redevelopment method that is employed by the government to resolve the issues of Chengzhongcun—is unsustainable. This thesis explores the employment of a kind of new method, green community design methods, in resolving the issues of Chengzhongcun. Based on literature reviews about Chengzhongcun and green community design methods, three case studies, and a site visit, this thesis develops a redevelopment scenario for a typical Chinese Chengzhongcun, Huashiying Village in Beijing, to resolve its issues in the aspect of environment. The results suggest that green community design methods could be an effective way to redevelop Chinese urban villages and are much better than the current redevelopment method that is employed by the government.

INDEX WORDS: Chengzhongcun, Chinese Urban Village, the Redevelopment of Urban Village, Huashiying Village, Chinese Traditional Culture, Green Communities, Green Community Design, Historic Preservation, Stormwater Management

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To my family and friends who give me help and support throughout graduate school.

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TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS v

LIST OF TABLES ix

LIST OF FIGURES x

CHAPTER

1 INTRODUCTION 1

Introduction 1

The Problem 1

Research Question 3

Purpose of Research/Significance 4

Methodology 5

Research Limitations/Delimitations 6

Thesis Structure 7

2 URBAN VILLAGES IN CHINA 8

What Is an Urban Village 8

The Formation and Development of Urban Villages 9

Chinese Dual Land Ownership System 9

Household Registration Systems 9

Rapid Urbanization and Economic Growths 10

The Current Situation of Urban Villages 12

Living Environments in Urban Villages 16
The Social Issues in Chinese Urban Villages 18
Current Redevelopment strategies 18
Summary 21
3 GREEN COMMUNITIES AND DESIGN METHODS 23
What Is a Green Community 23
The History and Development of Green Communities 24
Why Green Communities 25
The Principles of Green Communities 28
The Advantages of Green Communities 29
What a Green Community Should Do 33
The Design Methods of Green Communities 33
4 CASE STUDY 80
Case Study 1: Highlands' Garden Village, Denver, Colorado 80
Case Study 2: Ecolonia, Alphen aan den Rijn, Netherlands 93
Case Study 3: The Broad and Narrow Alley, Chengdu, China 100
5 DEVELOPING A DESIGN PROPOSAL FOR HUASHIYING VILLAGE 106
Site History 106
Site Location 106
Site Area 108
Site Investigation 109
Conclusion 122
Site Analysis 124

Project Design 146
6 CONCLUSION 192
Introduction 192
Findings 193
Implication for Government's Redevelopment Methods 195
Recommendation for Future Research 195
REFERENCES 196

LIST OF TABLES

Page

Table 1: Gender composition of migrants and Beijing's population, 2000-2008.....13

Table 2: Green infrastructure elements.....60

Table 3: The comparison between green community design methods and the current redevelopment method in redeveloping Chinese urban villages 77

Table 4: The connection between the issues of Huashiying Village and methods.....123

Table 5: 2004-2013 Annual rainfall in Beijing.....138

Table 6: 2013 Monthly rainfall in Beijing 138

Table 7: SWOT analysis 141

Table 8: The ratio of the distance between two buildings to the height of the building on the southern side 166

Table 9: The rainfall classification 172

Table 10: Basic information of area 2.....172

LIST OF FIGURES

Page

Figure 1: Urban sprawl and urban villages 8

Figure 2: Distribution of urban villages in the Beijing Metropolitan area 12

Figure 3: The 50 sampled sites in the Beijing Urban Village Survey 13

Figure 4: Age distribution of migrants and Beijing's permanent population 14

Figure 5: Education attainment of migrants and Beijing's permanent population 15

Figure 6: The extreme high density development in Manhattan, NY 40

Figure 7: Manhattan bus map 42

Figure 8: Manhattan subway map 42

Figure 9: Neighborhoods with different connectivity 44

Figure 10: The sidewalk of Michigan Avenue in Chicago, IL 46

Figure 11: 1973 and 2012 fuel shares of total primary energy supply 48

Figure 12: Photovoltaic solar systems 52

Figure 13: Building-mounted wind turbine 53

Figure 14: Highlands' Garden Village 80

Figure 15: Elitch's Zoological Gardens 82

Figure 16: The site plan of Highlands' Garden Village 83

Figure 17: The bird's eye view of Highlands' Garden Village 84

Figure 18: Housing map 85

Figure 19: Normal apartments and senior apartments 85

Figure 20: Land use map....87
Figure 21: Connectivity analysis....87
Figure 22: Historic Elitch Theatre....89
Figure 23: Historic Carousel building....89
Figure 24: The site location of Ecolonia....94
Figure 25: The site plan of Ecolonia....95
Figure 26: Different types of buildings....97
Figure 27: The central pond....98
Figure 28: The site plan of the Broad and Narrow Alley....102
Figure 29: The bird's eye view of the Broad and Narrow Alley....102
Figure 30: Building restored after the project....105
Figure 31: Beijing's location in China....107
Figure 32: Huashiying Village's location in Beijing....107
Figure 33: Huashiying Village and its surroundings....108
Figure 34: The path of site investigation....108
Figure 35: Chinese traditional-style buildings....110
Figure 36: An old house being transformed into a restaurant....111
Figure 37: Illegal houses being built against the wall of a larger building....111
Figure 38: An illegal house built with plastic boards....112
Figure 39: An illegal house built with wooden boards....112
Figure 40: A wall covered with flyers....113
Figure 41: A window heavily stained with kitchen fumes....113
Figure 42: The interior environment of an illegal house....114

Figure 43: Standard residential buildings 114
Figure 44: The main street in Huashiying Village 116
Figure 45: The narrowest streets 116
Figure 46: Wastewater gathered in broken pavement 117
Figure 47: Filthy trash cans 117
Figure 48: Twisted electric wires 118
Figure 49: The boulevard next to Huashiying Village 118
Figure 50: People in Huashiying Village 120
Figure 51: The security station 120
Figure 52: Beijing's central business district 121
Figure 53: Building use map 125
Figure 54: Building type map 126
Figure 55: Accessibility analysis map 128
Figure 56: Places of daily interests detail map 129
Figure 57: Connectivity analysis map 130
Figure 58: Level 1 road plan 131
Figure 59: Level 2 road plan 132
Figure 60: Level 3 and 4 roads 132
Figure 61: The wall that surrounds Huashiying Village 133
Figure 62: The layout of a Beijing's old village 135
Figure 63: The layout patterns of Beijing's old villages 126
Figure 64: The Structure of Siheyuan 136
Figure 65: Beijing's Hutong 136

Figure 66: Villagers' traditional daily activities in Beijing 137
Figure 67: Beijing's traditional businesses 137
Figure 68: Pavement analysis map 139
Figure 69: Existing drainage facilities 140
Figure 70: Pavements in the parking lot 140
Figure 71: The connection between site issues and solutions.....145
Figure 72: Site division map 147
Figure 73: Design focus map 148
Figure 74: Three parts of area A 150
Figure 75: Concept development 151
Figure 76: Area 1 plan 152
Figure 77: Building types.....155
Figure 78: The distribution of Hutong and Siheyuan 156
Figure 79: Nolli map 157
Figure 80: The distribution of traditional businesses.....158
Figure 81: Internal connectivity map 160
Figure 82: Chinese traditional drainage facility.....161
Figure 83: Infiltration planters and rain gardens.....162
Figure 84: The distribution of drainage facilities 162
Figure 85: Concept development 163
Figure 86: Area 2 plan 164
Figure 87: Connectivity analysis map.....165

Figure 88: The ratio of the distance between two buildings to the height of the building on the southern side 166
Figure 89: Analysis of distance between buildings 167
Figure 90: The location of three stormwater management systems 169
Figure 91: The green roof and its structure 170
Figure 92: The infiltration planter and its structure 170
Figure 93: The bioretention and its structure 170
Figure 94: Stormwater management process 171
Figure 95: Stormwater absorption area calcultion 172
Figure 96: The operation system of a green building 173
Figure 97: Complete site plan 174
Figure 98: Design comcept 175
Figure 99: Entrance plaza plan 176
Figure 100: Terrain creation process 177
Figure 101: Contour map 178
Figure 102: Stormwater management process and filter layer structure 179
Figure 103: Four Chinese traditional landscape elements 180
Figure 104: Material selection 180
Figure 105: Circulation map 181
Figure 106: Entrance plaza perspective 1 182
Figure 107: Entrance plaza perspective 2 182
Figure 108: Entrance plaza perspective 3 183
Figure 109: The location of the detailed design area 183

Figure 110: Chinese traditional-style commercial streets plan 184
Figure 111: Chinese traditional elements analysis map 185
Figure 112: Pavement selection 186
Figure 113: Stormwater management analysis map 186
Figure 114: Chinese traditional-style commercial streets with rain gardens 187
Figure 115: Small plaza 176
Figure 116: Hutong with infiltration planters 188
Figure 117: Siheyuan with rain gardens 188
Figure 118: The core area of Chinese traditional-style commercial streets 189
Figure 119: Community park and green roof plan 190
Figure 120: Community park perspective 191
Figure 121: Green roofs perspective 191

CHAPTER 1

INTRODUCTION

Introduction

In China, many rural villages have become surrounded by the expansion of cities due to rapid urbanization. Called *Chengzhongcun*, these urban villages are usually located in downtown areas or rural-urban fringe areas of major Chinese cities, such as Beijing and Guangzhou. They are surrounded by high-rise buildings, commercial areas and other modern urban constructions. The emergence and proliferation of urban villages resulted from three factors: Chinese dual urban and rural systems in terms of ownership, household registration, and rapid urbanization and economic growths, which made urban villages become a unique phenomenon in urban China (Z. Zhou 2014).

The Problem

Even though urban villages are located in China's large prosperous cities, their developments are far behind the developments of these cities, and exhibit many serious economic, social, and environmental issues. For example, most residents are low-income people and their living conditions are very poor. The infrastructures in urban villages are inadequate. The environmental pollution is very serious. Streets are dirty and wastes are everywhere. Also, these urban villages suffer from a high crime rate. Now they have been regarded as a source of sanitary issues and crime in cities, and they are often thought of as modern slums in China.

Urban villages are not only a threat to cities' images, but they are also an obstacle to their further development. Therefore it is necessary to redevelop urban villages.

Today, local governments of Beijing, Guangzhou and other major cities that contain a large number of urban villages, want to urgently resolve the issues of urban villages. From the governments' standpoint, redeveloping urban villages contributes to the modernization of Chinese cities and the improvement of low-income people's living conditions. Under the stimulus of local governments' policies, some urban villages have been redeveloped. However, the redevelopment method is highly contentious. The current method is simply to demolish these urban villages completely and build new high-rise buildings instead. This method makes urban villages look modern, but it does not resolve their fundamental issues. For example, the population density is still high in redeveloped urban villages. The living conditions of low-income people have not improved. They are driven away and have to search for other places with cheap rent. Even after redevelopment, many new issues surface. For example, some old buildings with historical value have been demolished. Furthermore, most of the new buildings in redeveloped urban villages are high-rise buildings, which consume a high amount of energy and contribute to the heat island effect. Also, redeveloping urban villages in this way reduces the amount of housings which low-income people can afford. In general, the current method is not sustainable, posing the following question: How can we redevelop Chinese urban villages in the way of sustainability[1]?

[1] Sustainability: "Sustainability is based on a simple principle: everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony that permit fulfilling the social, economic and other requirements of present and future generations." (United States Environmental Protection Agency n.d.)

Research Question

At present, the current development method is still being employed in redeveloping many urban villages. As more and more urban villages are being redeveloped in an unsustainable way, placing more pressure on the natural environment and society, it is particularly urgent to find a way to solve the issue. Nowadays, green communities (sustainable communities) are a popular topic. They are the communities that are developed to meet the "needs of the present without compromising the ability of future generations to meet their own needs (the United Nations 1987)." Green communities are regenerative. They have "processes that restore, renew or revitalize their own sources of energy and materials, creating sustainable systems that integrate the needs of society with the integrity of nature (Institute for Regenerative Learning n.d.)." The design methods of green communities are methods that use a series of planning and design means combined with high-technology to create sustainable communities that are safe, healthy, well-connected, energy-efficient, environmental-friendly, and harmonious. The methods cover various aspects of our living environment. They usually include the following categories: transportation, density, land use, energy, resources, water, natural conservation, and historic preservation. The methods have been widely employed in the communities of the United States and other European countries. Examples in the United States include: Atlantic Station, Atlanta GA; Highlands' Garden Village, Denver CO; Las Ramblas, Barcelona; and Portland OR.

In China, an urban village is also a kind of community. These communities are suffering from many issues: disorderly streets, overcrowded and dirty living environments, inadequate infrastructures, poor housing conditions, poor residents, and frequent crime. The current solution to these issues is unsustainable. If the design methods of green communities can be employed in redeveloping Chinese urban villages, they will give the project more meanings. By redeveloping

urban villages into green communities, we can not only resolve the current issues of urban villages to fulfill local governments' goals, but also create sustainable communities that have well-connected street networks, high-efficiency transportation, safe and healthy environments, and well-preserved historic buildings and landscapes. Besides, they can protect the natural environment, save energy, and conserve natural resources. Moreover, green communities is still an unfamiliar concept in China. Redeveloping urban villages into green communities will help spread knowledge of this concept, which contributes to sustainable development in China. Huashiying Village is a typical urban village in the central business district of Beijing, China. It has existed with many serious issues such as environmental pollution and lack of infrastructures for more than 30 years and has not yet been redeveloped. This thesis uses Huashiying Village as an experimental site to explore the employment of green community design methods in redeveloping Chinese urban villages. The research question is as follows: How can the design methods of green communities be employed to redevelop a problematic community, Huashiying Village in Beijing, and resolve its issues, as well as preserving its original characteristics?

Purpose of Research/Significance

This thesis explores the current issues of Chinese urban villages and the employment of green community design methods in redeveloping Chinese urban villages. Urban villages are problematic communities that are in urgent need of a sustainable method to redevelop them. The design methods of green communities are sustainable methods being employed in designing communities. By employing them to resolve the current issues of a proposed urban village—Huashiying Village—we will prove that the methods could be an effective way to redevelop

Chinese urban villages and are much better than the government's redevelopment methods. Also, we hope this thesis can contribute to the future development of sustainability practices in China.

Methodology

In the thesis, in order to do an in-depth investigation about Chinese urban villages and green communities, we need to collect a great deal of information about them. Descriptive research methods are mainly employed in the thesis. It contains four types of methods: observation, secondary description, descriptive social surveys, and complex description (including case studies). Observation is very necessary to be employed in collecting information about Huashiying Village, because there is no prior research conducted about it. The observation of Huashiying Village contains a site visit, describing the journey, and taking photos and notes. Secondary description is "the use and summarization of observations or information that has been recorded by people other than the investigator (Deming and Swaffield 2011)." Because there is a large number of research and information about Chinese urban villages and western green communities, these methods are employed in collecting information about them from archival documents, maps, diaries, media reports and previous studies. In the process of observation, some questions still cannot be answered. For example, there are many migrants in Huashiying Village. We do not know how many people live there by mere observation. Therefore, a descriptive social survey is needed. A descriptive social surveys is the method that can answer some questions that cannot be addressed by observation or secondary description. This is done by asking what other people experienced.

Nowadays, there are many successful green communities in the world. Some of them are used as case studies and analyzed by employing descriptive case studies. By analyzing three case

studies, Highlands' Garden Village, Denver, CO; Ecolonia, Alphen aan den Rijn, Netherlands; and the Broad and Narrow Alley, Chengdu, China, we can use the design methods of these projects as a reference in redeveloping Huashiying Village.

Then the projective design method "research by design" is employed when redeveloping Huashiying Village. The redevelopment project of Huashiying Village is used as research to explore the employment of green community design methods in Chinese urban villages.

Research Limitations/Delimitations

Limitations

Most research concerns the designing or planning of new green communities. However, renovation plays an important role in redeveloping Huashiying Village. There may be some different processes or methods between renovating an existing community and designing a new green community. For example, preservation plays a more important part in reinvigorating an existing community than designing a new green community. However, there are still many things we can learn from this existing research about designing or planning a new green community. Moreover, there is no research that has been done about Huashiying Village. Therefore the information about it is very limited. Most information has to be collected by site investigation.

Delimitations

This thesis mainly focuses on the comprehensive design of the community. Specific details such as the design of a green building or infrastructure may not be taken into consideration. In the thesis, the issues of Huashiying Village are mainly resolved by employing physical design methods rather than economic methods or political methods. Some economic or

political issues are listed in the thesis, but they may not be resolved. For example, some residents and their local government could not reach an agreement on compensation for the tearing down of old houses, causing the residents to refuse to move from their homes. This thesis is based on the hypothesis that all the residents are comfortable with the compensation and their old houses will be torn down successfully.

Thesis Structure

After the introduction, chapter 2 reviews the history, the development, and the current situation and issues of urban villages in China. Chapter 3 reviews the concept, history, development, principle and design methods of green communities. These methods will be employed in redeveloping Huashiying Village in chapter 5. Chapter 4 details a series of case studies related to green community design and urban village redevelopment. Chapter 5 develops a concept design to redevelop Huashiying Village based on the findings from chapter 3 and chapter 4. Chapter 6 makes a conclusion for the thesis and discusses the further application of its findings.

CHAPTER 2

URBAN VILLAGES IN CHINA

What is an urban village?

Urban villages, known in Chinese as *Chengzhongcun*, are described as "villages within cities (Song and Zenou 2012)." There are also some other descriptions such as "villages in the city" (Stefan 2014) "villages amid the city" (Tian 2008), and "villages encircled by the city (Zhang, Zhao and Tian 2003)." All of these phrases describe rural villages that are surrounded by the expansion of cities due to rapid urbanization, resulting in these rural lands becoming part of urban areas. Figure 1 shows the transformation process.

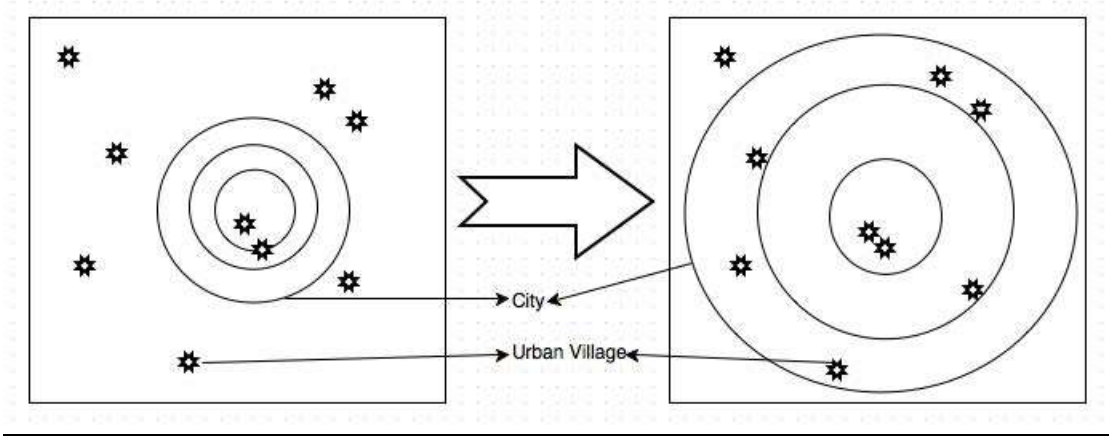


Figure 1. Urban sprawl and urban villages (Verbeelen 2013)

According to a summary of Chinese urban villages' definitions from Catherine Verbeelen (Verbeelen 2013), urban villages are neighborhoods with disadvantaged villagers (landlords) and migrants (tenants) that live in relatively low standards set within the city, and they are "extremely dense developments with poor building safety and quality, inadequate infrastructure,

and insufficient fire protection or lighting, all in all leading to miserable living and safety conditions (Schoon 2013)."

The Formation and Development of Urban Villages

The emergence of Chinese urban villages is not an accidental incident. There are three factors working together to contribute to the emergence of Chinese urban villages: Chinese dual urban and rural systems in terms of land ownership, household registration, and rapid urbanization and economic growths (Z. Zhou 2014).

Chinese Dual Land Ownership System

The Chinese government implements a dual land ownership system. In the system, urban lands are owned by the government, and rural lands are collectively owned by villagers. For urban lands, the government has the right to decide their natures and how these lands are used. For rural lands, the village collective economic organization (VCEO) retains the ownership. Villagers have the user's right of farmland for cultivation and a piece of land for residential use from the VCEO. However, neither VCEO nor villagers can change the nature of rural lands. Only the government has the right to change the ownership and nature of rural lands in the way of expropriation for public interest purpose upon compensation to the VCEO/villagers (Z. Zhou 2014).

Household Registration Systems

Household Registration is known in Chinese as *hukou*. China implements a dual *hukou* system – rural *hukou* and urban *hukou*. According to the policy, people who have a rural *hukou*

cannot enjoy urban welfares. For example, they are not eligible for low-cost affordable housing provided by the government (Zheng, et al. 2009).

Rapid Urbanization and Economic Growths

In late 1970s, since the economic reform and other "open door" policies, China entered a rapid development process. The remarkable economic growth and massive inflow of rural-to-urban migrants have made Chinese cities experience a rapid urbanization. The Chinese urban population increased from 21% in 1982 to 45% in 2007. By 2015, the urban population is expected to exceed 50 % (Zhou and Ma 2005; Y. Zhou 2006; National Bureau of Statistics 2008). In 2007, there were 36 cities in China with two million or more people (National Bureau of Statistics 2008). The Chinese urbanization rate increased from 19.6 % in 1980 to 42.2 % in 2007, and it is planned to reach the same urbanization level as most developed countries (around 70 %) by 2050 (the United Nations 2008).

With the rapid urbanization rate, many Chinese cities expanded very fast, which resulted in high demand for urban lands. Usually there are two ways for the government to increase the amount of urban lands – sprawl and regeneration. The government prefers transforming rural lands into urban lands than regenerating existing urban lands, because the compensation of the former is lower than that of the latter. Moreover, the negotiation with villagers is easier than that with urban citizens who have a higher education and access to broader information resources. In the process of transforming rural lands, the government prefers to acquire farmland and leave the residential areas untouched to avoid a higher cost for villager's resettlements (Zheng, et al. 2009). Without farmlands to make a living, villagers had to find other ways. They built illegal houses or remolded old houses illegally to rent to migrants. There are two factors accelerating

the development of urban villages – migrants and city governments. Firstly, the rapid development of Chinese cities attracted a large number of rural people to these cities hoping to find more opportunities. According to a study, approximately 70 % of the country's urban population growth is from rural-urban migration (Zhang and Song 2003). However, without urban *hukou*, they could not enjoy the preferential policy where city governments provide low-cost affordable housing for low-income groups with urban *hukou*. The rent of the apartments was too high for them, let alone buying small apartments. Thus, the housing with cheap rents in urban villages became the best choice for them. According to a survey (Zheng, et al. 2009), the average monthly rent per urban village unit is 384.1 yuan ($61.5 USD), which is much lower than the average monthly rent (2000 yuan, $320.4 USD) per one-bedroom unit in the formal housing sector. With more and more migrants going into urban villages for housing with cheap rents, a limited number of housing could not meet their requirements. In order to make more profits, villagers divided housing into several small single rooms for different tenants and built many illegal buildings. Secondly, given that renovating urban villages would cost a significant amount of money and governments would like to spend money on building high-rise buildings, which could bring more profits, governments kept a laissez-faire attitude towards these illegal buildings. Moreover, migrants provided a large number of cheap labor for cities' development. Renovating urban villages would evict many migrants. The lack of labor would be detrimental for the development of cities. This is not what the government wanted to see. Under the stimulation of the two factors, many rural-urban migrants went into urban villages. This promoted the development of urban villages.

The Current Situation of Chinese Urban Villages

According to a study (Zheng, et al. 2009), there were 867 urban villages in the Beijing Metropolitan Area (BMA). Most of them are located in the suburban districts (figure 2). The total area of these urban villages was 181 km², accounting for 49.5 % of the total residential land in BMA, which indicated that urban villages played an important role in the provision of housing in Beijing. Moreover, in Guangzhou and Shenzhen, urban villages make up more than 20% to 80% of their planned areas that provide homes to 80% of migrants (Hsing 2010). In this research, the authors drew from a survey of 50 urban villages and 756 migrants in Beijing conducted in September 2008. Then they analyzed demographic and economic characteristics of migrants. In most of the 50 selected urban villages, migrants (individuals who do not have urban or rural *hukou* in Beijing) outnumber natives (individuals who have urban or rural *hukou* in Beijing). Most urban villages have a large migrant-native ratio (figure 3), which indicated that the majority of people living in the urban villages are renters.

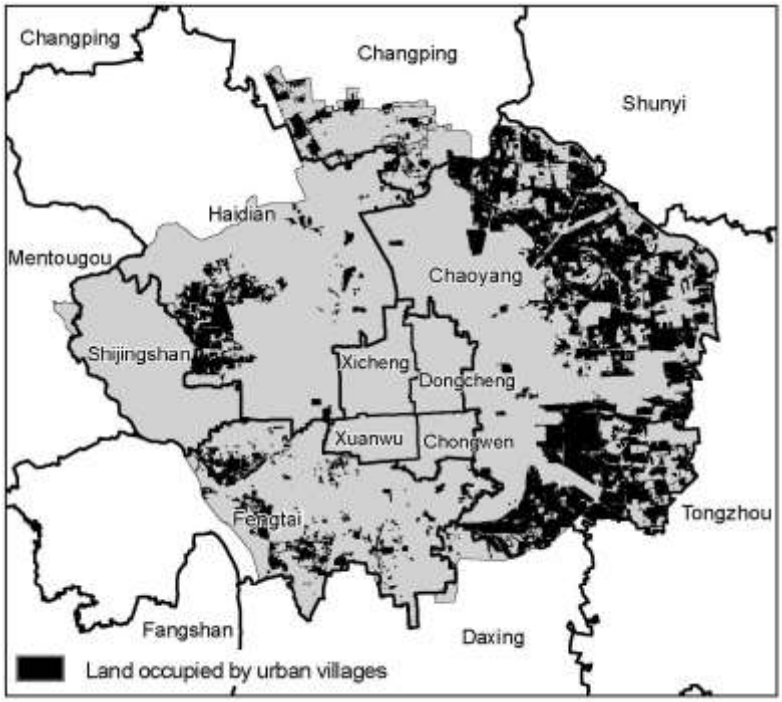


Figure 2. Distribution of urban villages in the Beijing Metropolitan area (Zheng, et al. 2009)

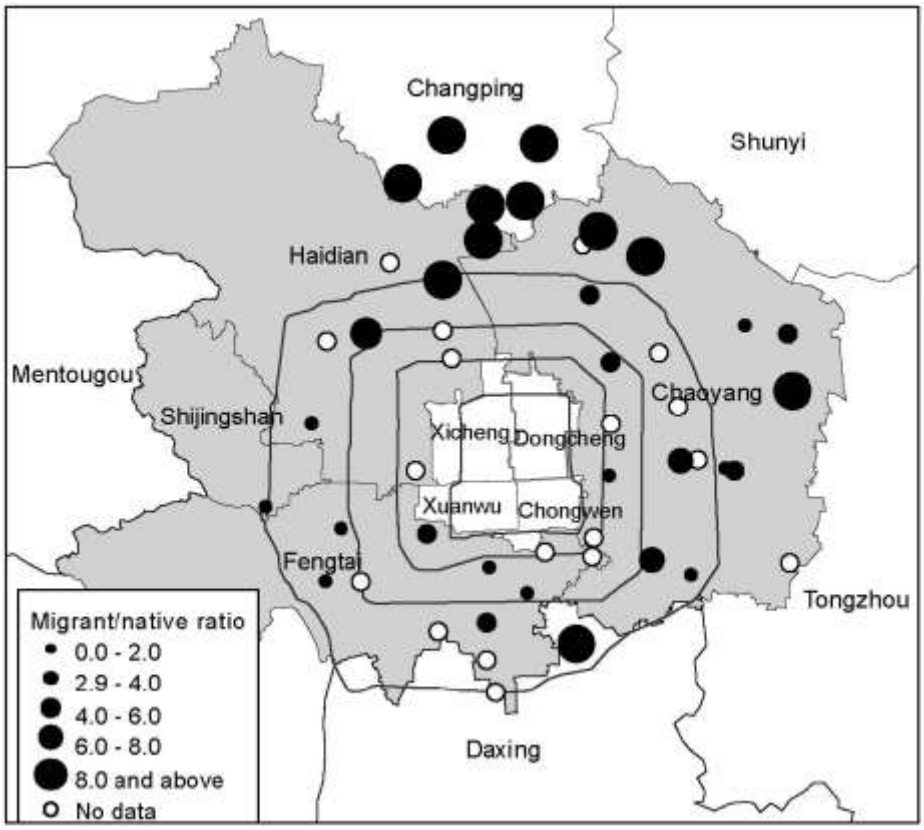


Figure 3. The 50 sampled sites in the Beijing Urban Village Survey (Zheng, et al. 2009). Grey areas refer to the four suburban districts adjacent to Beijing‘s four urban districts. Open (white) circles refer to urban villages in which numbers for migrant and native populations are not available.

Table 1 shows the gender composition of migrants and Beijing’s population. In the survey, they found that the percentage of males in Beijing’s urban villages (66.9%) is much higher than the percentage of males among Beijing’s permanent population (50.8%) and also higher than that in the BMA overall (62.4%).

Table 1. Gender composition of migrants and Beijing’s population, 2000–2008 (percent) (Beijing Bureau of Statistics 2008) (National Bureau of Statistics 2002)

Inhabitants of Beijing	Male	Female
Migrants in 2008 survey	66.9%	33.1%
Migrants in 2000 Census	62.4%	37.6%
Permanent residents in 2007	50.8%	49.2%

Figure 4 shows the age distribution of migrants and Beijing's permanent population. By comparing the age distribution of migrants with that of Beijing's permanent population, they found that around 60 % of migrants were in the age range of 20 to 39. The age distribution of Beijing's permanent population was relatively average. Compared to a mean age of 37.8 among Beijing's permanent population, the mean age of migrants was 34. All of these indicate that most of the migrants living in urban villages are young people.

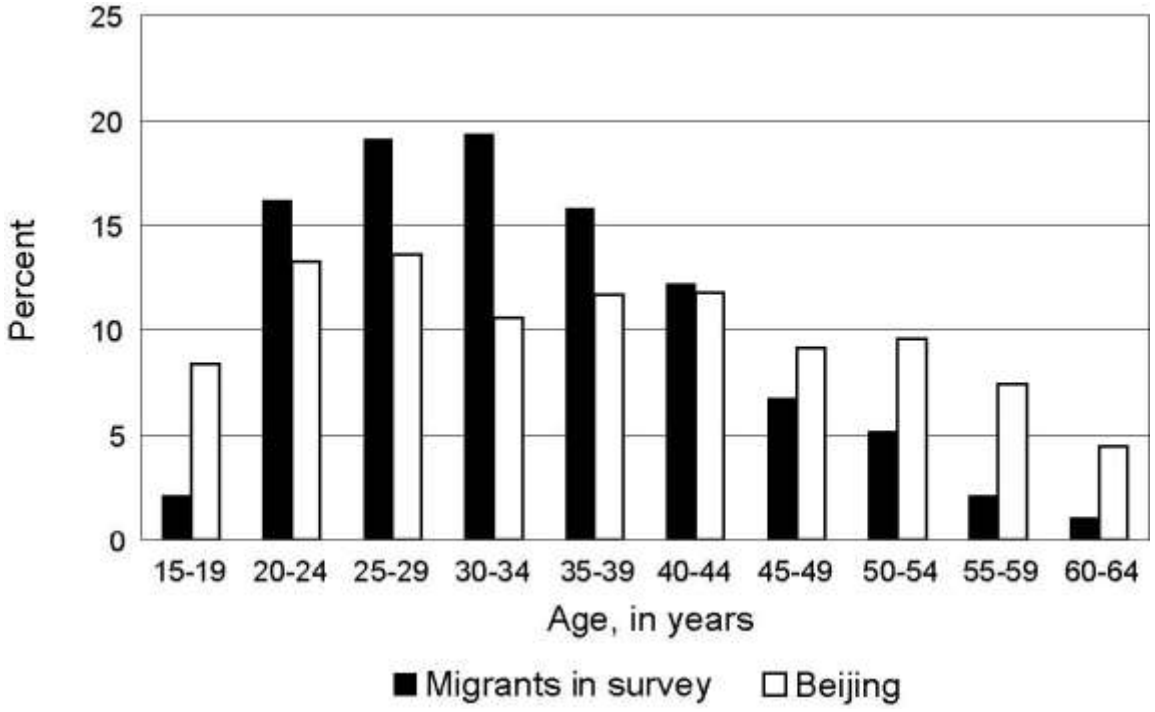


Figure 4. Age distribution of migrants and Beijing's permanent population (Beijing Bureau of Statistics 2008)

Figure 5 compares the educational attainment of migrants with the educational attainment of Beijing's permanent population. Forth-six point nine percent of Beijing's permanent population has junior high school or lower levels of educational attainment. However, there are 73.6 % of migrants with junior high school or lower levels of educational attainment. This

indicates that most of the migrants living in urban villages have a low level of educational attainment.

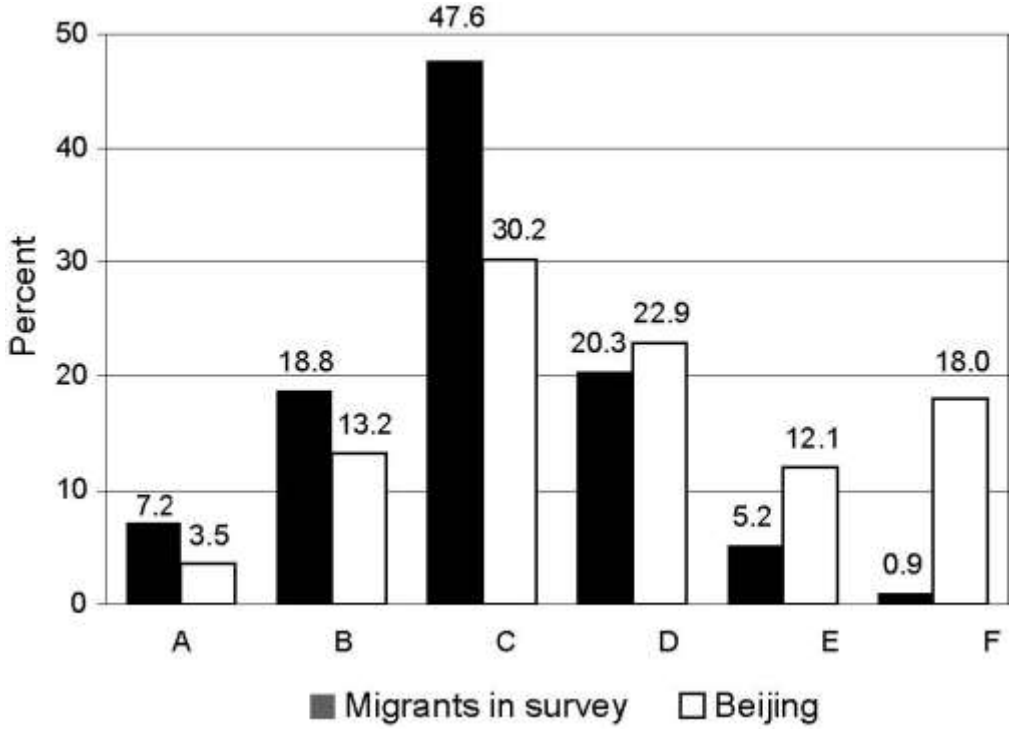


Figure 5. Educational attainment of migrants and Beijing's permanent population. Level of educational attainment: A= no formal education; B= elementary school; C= junior high school; D= senior high school/technical school; E= college; F= university and above (Beijing Bureau of Statistics 2006)

According to a survey (Beijing Bureau of Statistics 2008), the mean income of the labor force in Beijing is 3876 yuan ($615 USD) per month. In this research, the mean income of the 867 migrants is 1984 yuan ($315 USD) per month, which is only about half of that of the labor force in Beijing. This means most of the migrants in urban villages have very low incomes.

Based on the research, we can make a summary of the current situation of Chinese urban villages:

- The amount of Chinese urban village is enormous;
- Most Chinese urban villages are located in suburban districts;
- Chinese urban villages play an important role in the provision of housing;

- Migrants contribute to the main population living in Chinese urban villages;
- Most migrants living in Chinese urban villages are males with low level of educational attainments and low incomes.

The Living Environment in Chinese Urban Villages

In China, urban villages are famous for their poor living environment. According to a series of studies (Zheng, et al. 2009) (Yin 2014) (Jiang 2013), Chinese urban villages mainly have the following environmental issues:

1. Extremely High Building Density

Villagers do not have the knowledge of architecture and planning. They built as many buildings as possible to acquire the most benefit. This led to extremely high building density in Chinese urban villages. Moreover, distances between buildings are very small and below fire-control standards.

2. Extremely Disorderly Building Layout

Without the knowledge of architecture and planning, villagers built buildings disorderly. This led to extremely disorderly building layout.

3. Poor Building Safety and Quality

Villagers built buildings without the government's safety supervision. They used poor materials and did not accommodate these buildings with fire equipment. This led to poor building safety and quality.

4. Poor Indoor Environment

Buildings in Chinese urban villages have insufficient lighting, ventilation and fire protection because of extremely high building density, disorderly building layout and poor building quality.

5. Inadequate and Poorly Maintained Infrastructure

Chinese urban villages suffer from a serious shortage of infrastructure in transportation, electricity, telecommunication, sports, sanitation, stormwater management and education. Moreover, a portion of infrastructure are in disrepair.

6. Poor Street Systems

The streets in Chinese urban villages are narrow, disorderly, filthy, and in disrepair. This leads to the streets below fire-control standards. Moreover, they are very crowded during the rush hour.

7. Serious Environmental Pollution

In Chinese urban villages, environmental pollution mainly includes air pollution and waste pollution. Because of the shortage of infrastructure, villagers are still using coal as main energy supply. Even worse, some villagers burn plastic and plywood that are serious pollutants. These lead to serious air pollution in Chinese urban villages. Moreover, there are not enough waste treatment facilities. Waste is everywhere, which leads to serious waste pollution.

8. Stormwater Runoff Issue

Chinese urban villages suffer from a serious stormwater runoff issue because of the shortage of drainage facilities. The stormwater runoff that is polluted by the waste on streets will lead to serious ground water pollution.

9. Inadequate Green Lands

Green lands can purify air, create open spaces and habitats. However, because of the extremely high building density, there are inadequate green lands in Chinese urban villages.

The Social Issues in Chinese Urban Villages

According to a study (Zheng, et al. 2009), Chinese urban villages mainly have the following social issues:

- High crime rate including robbery, fighting, steal, gamble and drug taking
- Labor market discrimination
- Social segregation
- Inferiority

These issues lead to the lack of a sense of belonging among migrants. They consider the city as merely a place to work but not to live.

Current Redevelopment Method

Even though urban villages contribute to providing housing to migrants, their issues cannot be ignored. It is inevitable to redevelop these urban villages. However, the current redevelopment method that is employed by the government is not a sustainable solution. For example, Guangzhou is a representative metropolis that contains many urban villages. Also, Guangzhou plays the role of a leader in redeveloping urban villages in China. However, the "successful" redevelopment approach in Guangzhou is simply to tear down all existing buildings and build high-rise apartments instead. In the process of redevelopment, there are constant negotiations over compensation between developers and local residents. Usually some of the new apartments are distributed to local residents for compensation and the rest is sold on the

market for a profit. However, no matter what the compensation is, migrants are always the victims of the redevelopment. They are simply forced out by developers in the name of redevelopment (Ren 2014). Liede Village is a so-called successfully redeveloped urban village. The redevelopment projects greatly changed the neighborhood environment and villagers' economic status. According to official data, the ratio of green space in the village increased from 5% to 30 % and the building density decreased from 60% to 28 % (Z. Zhou 2014). The indigenous villagers benefited greatly from the project. They were compensated with new apartments that have the same space as their old apartments. The values of new apartments increased significantly. The average flat value increased roughly from 4,000 ($625 USD) to 30,000 ($4687.5 USD) yuan/m², and the rental income per unit increased from 800 ($125 USD) to 4,000 ($625 USD) yuan/month (Guangzhou Urban Redevelopment Office 2012). Moreover, the housing estate office offered over 200 jobs to indigenous villagers and more employment opportunities would be available for them. However, the vice-mayor of Guangzhou in June 2012 stated "the Liede model is successful but not sustainable. Its experience is good, but is not applicable to other villages (Lai 2012)." The reasons why the redevelopment of Liede is not sustainable can be summarized as followings:

Liede Village is located on the north bank of the Pearl River. Generally, it is inappropriate to build high-rise buildings along the river. However, to ensure the developers' profits and meet villagers' compensation demand, the new Liede Village was built with an extremely high Floor Area Ratio (FAR) of 5.2, compared to the average FAR of 3.0 in Central Guangzhou. This leads to the government having to invest greatly in the infrastructure and facilities for neighborhoods in the near future (Z. Zhou 2014). Moreover, the high-rise residential

buildings contribute to the heat island effect and more energy consumption, and leads to receiving a poor sunshine.

This project provided many benefits to developers and indigenous villagers, but little to migrants. These migrants greatly contributed to the city's development and some of them had lived in the village for more than 20 years. However, they did not benefit from the project at all. Most of them were even forced out of the village and had to find other places to live without any assistances from the government. In this project, the issues of migrants' housing affordability and social exclusion were not resolved at all. Moreover, this aggravates the social inequity and lack of housing among migrants (Z. Zhou 2014).

The current redevelopment method also leads to some issues in the aspect of historic preservation. There are many historic items in Chinese urban villages. According to a study, in Guangzhou, one fifth of historic items are distributed in urban villages, including temples, houses, stores, landscape architectures, arches and bridges (Chen and Zheng 2007). However, during the redevelopment process, the government do not implement a comprehensive historic preservation method on these historic items. Moreover, there is a conflict of interest between building new high-rise buildings and preserving historic items. Developers pay attention to interest and ignore historic preservation. These lead to the destruction of historic items.

Overall, the unsustainability of the current redevelopment method is reflected in the aspects of environmental pollution, social inequity and historic preservation. Political and economic outputs override social, historic and environmental concerns. "Urban regeneration is a multi-dimensional issue and should be progressed in a balanced development of built environment, economic growth, political concerns and social harmony to suit different actors' needs and to deliver inhabitant- and environment-friendly neighborhoods (Z. Zhou 2014)."

Summary

According to the research on Chinese urban villages above, we can make a summary that Chinese urban villages have the following issues:

Environmental Issues

- Extremely high building density
- Extremely disorderly building layout
- Poor building safety and quality
- Poor indoor environment
- Inadequate and poorly maintained infrastructure
- Poor street systems
- Serious environmental pollution
- Stormwater runoff issue
- Inadequate green lands

Social Issues

- High crime rate
- Labor market discrimination
- Social segregation
- Inferiority
- Lack of housing among migrants

The current redevelopment method that is employed by the government is to demolish all of the existing buildings and build new high-rise buildings. Although the method can resolve some environmental issues by demolishing an urban village and creating a new community, most serious issues still exist. Moreover, the current redevelopment method leads to new issues:

- Heat island effect
- More energy consumption
- The destruction of historic items

Overall, the current redevelopment method is unsustainable. We need to explore a new method that can better redevelop Chinese urban villages.

CHAPTER 3

GREEN COMMUNITIES AND DESIGN METHODS

What is a green community?

In the book "*Green Community*", Earl Blumenauer, the U.S. Representative for Oregon's third congressional district, gave a definition about green communities: "the places where we can live in safety and good health, with a wide range of housing and transportation choices, based on economies that rely on sustainable processes and products, in a manner that enhances rather than destroys the natural world on which we depend on (Blumenauer 2009)." According to Susan Piedmont-Palladino (Piedmont-Palladino 2009), a green community can be a place as small as a neighborhood or as large as a megapolitan region, and must include the following functions and more: a place where people live, work, socialize, and participate in public life. Besides these functions, it conserves land, offers people multiple transportation choices, provides open spaces for recreation and cultivation, and wisely manages its natural and cultural resources. Also, people who live in a green community are committed to sustainable living.

A green community is a sustainable community. It follows the principle of sustainable development: "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (the United Nations 1987)." It is regenerative and has "processes that restore, renew or revitalize their own sources of energy and materials, creating sustainable systems that integrate the needs of society with the integrity of nature (Institute for Regenerative Learning n.d.)."

Although different people or organizations give different definitions about green communities, these definitions are similar and clarify the main characteristics of green communities:

- Safe and healthy;
- Well-connected;
- Energy-efficient;
- Little to no impact on natural resources;
- Economic health;
- Harmonious neighborhood social environment.

The History and Development of Green Communities

Developing sustainable communities is part of sustainable development. Between 1972 and 1992, a series of international conferences and initiatives contributed to the theoretical framework of sustainable development. In 1972, the UN Conference on the Human Environment was the first international conference to discuss sustainability on a global scale. Then in 1980, the World Conservation Strategy promoted sustainable development by identifying priority conservation issues and key policy options. Three years later, the UN convened the World Commission on Environment and Development, which aimed to address growing concern over the "accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development (the United Nations 1987)." In 1987, the most commonly used definition of sustainable development was popularized by the landmark publication *Our Common Future*, also known as the Brundtland report. After that, in 1992, the Rio Summit laid the foundation for the global institutionalization of sustainable

development. Then a series of important international conferences on sustainable development followed, including the 1997 Earth Summit+5 in New York and the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg. In this 20-year period (1972-1992), sustainable development has transformed from a controversial idea to a popular concept that is widely endorsed by international institutions, governments, businesses, and civil society. (Drexhage and Murphy 2010)

Although the concept of green communities has become popular in recent years, in fact, its conception began over 100 years ago. In 1902, the concept of the social city was put forward in Ebnezer Howard's book *Garden Cities of To-morrow*. If the social city is understood with updated terminology and placed in a modern context, it is indistinguishable from the concept of the green community. After that, the concept was employed in many city and community plans. We can see the concept in the General Plan of 1952 in Sweden; the Cites Nouvelles built around Paris in France; the layout of Radburn, New Jersey; Chatham Village, Pittsburgh; Baldwin Hills Village, Los Angeles; and Greenbelt, Maryland. (Hall 2009)

Why green communities?

In 1886, the first modern car was invented by German inventor Karl Benz. After that, with the rapid development of automobile industry, the automobile has become an indispensable vehicle in our daily lives. Our society's infrastructure depends immensely on the convenience that automobiles bring to us. However, they also bring serious damage to our living environment at the same time. Every year, automobiles consume a huge amount of non-renewable energy resources, which makes the energy crisis more serious. And their exhaust has caused serious air pollution, resulting in human disease. Moreover, the development of automobiles has led to

urban sprawl. In America, many cities are models of urban sprawl such as Atlanta, GA and Los Angeles, CA. Urban sprawl makes people rely more on automobiles, which leads to more non-renewable energy consumption and exhaust, damage to wildlife habitats, obesity, and other negative effects.

The modern building is another killer to our living environment. Although we enjoy the comfort and safety they bring to us, and appreciate the magnificence of skyscrapers, most buildings are huge unsustainable objects that have negative effects on the natural environment and our health. The HVAC (heating, ventilating, and air conditioning) systems of buildings consumes a huge amount of energy resources and emit many tons of greenhouse gases each year. According to one study (Fettig 2006), buildings account for 40 % of world energy consumption and 50 % of greenhouse gas emissions. They are a major factor leading to greenhouse effect. Moreover, the construction of a building consumes large amounts of raw materials that are robbed from the natural environment, and produces many pollutants. The concentration of many high-rise buildings also leads to the heat island effect.

Besides the two major factors, automobiles and buildings, there are many other factors leading to the unsustainability of our living environment, such as the over-exploitation of nature, stormwater runoff issues, and lack of awareness of environmental protection. Although environmental issues have been brought to the forefront since more than 40 years ago, the current environmental issues are still very serious. More effective solutions need to be explored to resolve environmental issues.

Since the 1987 Brundtland report, sustainable development has been a major goal in the world, but very little progress has been made in the practice of sustainable development. In 2002, the UN Secretary-General Kofi Annan said in his report that “progress towards reaching the

goals set at Rio has been slower than anticipated" and "there is undoubtedly a gap in implementation (The United Nations Commission on Sustainable Development 2002)." Nowadays, even though the term "sustainable development" is very popular around the world, most people actually do not know what they can do to contribute to sustainable development, especially in developing countries. This concept has been emphasized more on the theoretical stage rather than the practical stage. The practice of sustainable development has been mainly implemented by governments and professional organizations or individuals. For example, governments issue some acts about promoting sustainable development such as Clean Water Act. Motor corporations like Tesla Motors research and develop new energy vehicles to replace traditional vehicles. Landscape architecture companies use their designs to preserve and renovate the natural environment. Although the work of governments and professional organizations or individuals has contributed to sustainable development, the fact is that only a small number of people do this job and their work cannot offset the negative impact of unsustainable activities that are performed by a large number of other people. The work of sustainable development should be implemented at the level of common people.

One way to do this is at the community level. According to PCSD (President's Council on Sustainable Development), "whether the United States and other nations will achieve a sustainable future largely depends on how well the concepts and principles of sustainable development are integrated into decision-making at the community level (the President's Council On Sustainable Development 1997)." Communities are the places where people live, work and get together. They are closely related to people's daily lives. When people consider sustainable development at the community level, it becomes clearer because it is related to their daily lives and fundamental needs such as health care, clean air and water, green lands, and

convenient transportation. The impact of sustainable development on people's daily lives will promote people to pay more attention to this concept and put it into practice. At present, many communities around the world – such as Atlantic Station in Atlanta, GA; the Pearl District in Portland, OR; and Zurich, Switzerland – have used sustainable development as a framework for planning their future

The Principles of Green Communities

Developing green communities is part of the work of sustainable development. So a green community must follow the principles of sustainable development. According to one study (Harris 2000), the principles of sustainable development generally have three aspects:

> "**Economic:** An economically sustainable system must be able to produce goods and services on a continuing basis, to maintain manageable levels of government and external debt, and to avoid extreme sectoral imbalances which damage agricultural or industrial production.
>
> **Environmental:** An environmentally sustainable system must maintain a stable resource base, avoiding over-exploitation of renewable resource systems or environmental sink functions, and depleting non-renewable resources only to the extent that investment is made in adequate substitutes. This includes maintenance of biodiversity, atmospheric stability, and other ecosystem functions not ordinarily classed as economic resources.
>
> **Social:** A socially sustainable system must achieve distributional equity, adequate provision of social services including health and education, gender equity, and political accountability and participation."

Based on these three principles of sustainable development, there are some specific principles that have been established for green communities. Although different organizations or individuals give us different principles, they are similar and for the same goal. Synthesizing the work of Sir Peter Hall (Hall 2009), Earl Blumenauer (Blumenauer 2009), the Foundation for Community Association Research (the Foundation for Community Association Research 2014), and the President's Council On Sustainable Development (the President's Council On Sustainable Development 1997), the principles of green communities include:

- High standard of living;
- Community-wide participation in sustainable practices;
- Well-planned transportation network;
- High energy-efficiency;
- Conservation of energy and resources;
- Diversity (land use, biodiversity and job types);
- Self-sufficiency.

The Advantages of Green Communities

Compared with a traditional community, a green community has many advantages in several aspects.

1. **Saving Costs**

By developing green buildings[2] or using energy-saving devices in existing buildings, a green community can greatly improve energy efficiency in buildings and reduce the costs of building operations compared with a traditional community. Generally, the buildings in a green

[2] A "green building" is a building that is designed to conserve resources and reduce negative impacts on the environment, whether it is energy, water, building materials or land. (Lifestyles of Health and Sustainability n.d.)

community have better ventilation, lighting, heat preservation and insulation, which can reduce the use of HVAC (heating, ventilation, and air conditioning) systems and lights. Moreover, these buildings usually use energy-saving devices such as energy-saving light bulbs and water-saving fixtures. These devices use less energy or resources, and have longer lives. For example, compact fluorescent lamps (CFL) use less energy, have a longer lamp life, and produce less heat. Five of this kind of bulb could save $100 per year (the Foundation for Community Association Research 2014). A green community also has many other measures to save money on operation costs such as using solar energy or other renewable energy that is cheaper than fossil energy, as well as using recycling water. Although the preliminary cost of a green building is higher than that of a traditional building, considering the lifecycle cost, a green community costs much less than a traditional building. The State of California's 2003 report showed that minimal increases in preliminary costs of about 2 % on green design would result in lifecycle savings of about 20 % of the total construction costs (Kats, et al. 2003).

Besides saving costs on buildings, a green community also saves vast amounts of money on transportation. In general, a green community has a convenient transportation system that could provide residents with multiple choices of public transportation such as buses, subways, and light rails. For example, Portland is a city where public transportation plays a very important role. Then, a green community has a well-planned transportation network and mixed-use commercial areas with high density. This makes houses, shops, work places, schools, parks, and other places that are essential to daily life more accessible to residents. Moreover, because of the high density-development in a green community, the places that are essential to residents' daily lives are within easy walking distance. This encourages residents to go to these places by foot or bicycle. There are many other measures such as encouraging carpoolings by designating specific

parking areas or lanes. These measures can reduce residents' dependence on private cars, shorten the time on transportation, and provide them with cheaper choices of transportation, which can finally reduce their costs on transportation.

2. Protecting the Natural Environment

A green community is an environment-friendly community. Compared with a traditional community, a green community has much less of an effect on the natural environment. By developing green buildings, using energy-saving devices, and replacing fossil energy with renewable energy, a green community can not only reduce the costs on building operation, but also reduce buildings' consumption of fossil energy. Thereby, buildings could consume less energy and resources, produce less pollutants and carbon emissions. By employing the above series of measures on transportation to reduce residents' use of automobiles, a green community can reduce the consumption of gasoline, which decreases energy consumption, pollutants, and carbon emissions. Moreover, the intensive development of a green community could prevent urban sprawl, which could reduce the damage to the natural environment and habitat. Other measures are also employed to protect the natural environment such as recycling garbage and planting trees.

3. Health and safety

By encouraging the use of public transportation and non-motorized modes of transport, a green community can efficiently reduce the use of private automobiles, which results in the reduction of traffic accidents. Also, encouraging walking and bicycling could effectively prevent obesity. Compared with a traditional community, a green community achieves a better air quality by creating a transit-oriented neighborhood to reduce the dependence on private automobiles, and developing green buildings or highly energy-efficient buildings. Also, the parks or green

spaces help to promote residents' mental health. A study of parks in Copenhagen showed that people who live near parks not only use the parks more frequently than those at a distance, but they have lower stress levels and are less overweighted (Nielsen and Hansen 2007). Moreover, residents can enjoy healthy local food in a green community. By transporting local food from nearby farms, we can reduce the transit time and keep food fresh. Also, the organic farms near a green community use less pesticides and fertilizers than traditional farms.

4. **Harmonious Neighborhood Relationships**

By encouraging walking and public transportation, a green community creates more opportunities for communication among residents, which promotes the development of harmonious neighborhood relationships. One study showed that people in more walkable neighborhoods were more likely to know their neighbors, participate politically, trust other people, and be engaged in social interactions (Leyden 2003). Moreover, the intensive development of a green community shortens the distances between residents. Additionally, open spaces such as parks and plazas provide residents with places for communication. These measures all help promote harmonious neighborhood relationships and give residents a sense of community.

5. **Uniqueness and Identity**

The "Green Community" label can distinguish a green community from other traditional communities. When people think of a green community, they can think of health, safety, environmental-friendliness, and harmony. For a community that has a historically significant building or landscape, by historic preservation, the building or landscape can add uniqueness and a sense of identity to the community. Moreover, a historic community can attract tourists and investments, promote economic development, and preserve workmanship.

What a green community should do?

In order to create a green community, the first step is to establish a series of green missions. *Best Practices Report #9: Green Communities* (the Foundation for Community Association Research 2014) provides a list of green missions and presents what a green community does:

- picks up litter
- recycles and reuses
- saves or stores water
- maintains energy efficient buildings
- manages land and lakes for environmental preservation, conservation, and the benefit of wildlife
- makes its membership aware of green products and services available to them
- uses energy efficient transportation

The Design Methods of Green Communities

The design methods of green communities involve a wide range of aspects including transportation, density, land use, natural conservation, historic preservation, buildings, energy, stormwater management, resources, waste, food, and health. In the thesis, the design methods of green communities are divided into the following categories:

- Density and transportation;
- Energy;
- Resources;
- Water;

- Natural conservation;
- Historic preservation.

Density and Transportation

In the past, the automobile was invented to help people reach their destinations more quickly. However, with the dramatic growth in the number of automobiles in recent years, the benefits of automobiles have almost disappeared. As a result, traffic congestion has become an everyday phenomenon in every big city in the world. In America, the average automobile commuter will spend two and a half years of his or her life stuck in traffic (the President's Council On Sustainable Development 1997). And in Beijing, China, the average duration of weekday traffic congestion is 1 hour 55 minutes per day (Beijing Daily 2014). Automobiles do not make our daily lives more convenient. Even worse, traffic congestion that is led by a large number of automobiles has brought a series of negative effects. First, traffic congestion causes great economic losses. A report from Texas A&M University (Schrank, Eisele and Lomax 2012) shows that, in 2011, traffic congestion cost the U.S. economy $121 billion in the form of 5.5 billion hours of extra time and 2.9 billion gallons of wasted fuel (the negative effect of uncertain or longer delivery times, missed meetings, business relocations and other congestion-related effects are not included). The cost equals the lost productivity and direct medical expenses of 12 average flu seasons. And the cost to the average commuter was $818 in 2011 compared to an inflation-adjusted $342 in 1982. Second, traffic congestion exacerbates environmental pollution. According to the report, 56 billion pounds of additional carbon dioxide are released into the atmosphere during congested conditions, which is equivalent to the liftoff weight of over 12,400 space shuttles with all fuel tanks full (it does not include carbon dioxide production from auto

commuters traveling when roadways are uncongested). Moreover, traffic congestion causes health issues. According to one study (Zhang and Batterman 2013), traffic congestion increases pollutant emissions and degrades air quality, which contributes to risks of morbidity and mortality for drivers, commuters and individuals living near roadways. Another study shows that children in areas with high-levels of emissions on average did worse on intelligence tests and were more prone to depression, anxiety and attention problems than those in areas with cleaner air. Additional research shows that older people who were exposed to higher levels of traffic-related particles and ozone for a long period had memory and reasoning problems (Hotz 2011). With the development of the automobile, our lives have gone through a cycle of "slow to fast, then to slow." In the past, we had much time to do what we wanted to do. However, nowadays, such opportunities have disappeared in the endless traffic congestion.

As automobiles allowed people to extend their footprints far beyond traditional downtowns, this situation resulted in the occurrence of urban sprawl. According to the PSCD (the President's Council On Sustainable Development 1997), sprawl is defined as

> low-density development that spreads out from the edges of cities and towns. It is poorly planned, and often situated without regard to the overall design of a community or a region. It often results in types of development - such as rambling, cookie-cutter subdivisions and strip malls - that perpetuate homogeneity, make inefficient use of land, and rely almost exclusively on automobiles for transportation.

Excessive driving led to urban sprawl, and urban sprawl required more driving in turn. This has become a vicious circle. In the United States, urban sprawl has become a typical phenomenon, which led to a tremendous increase in driving. In 2007, the number of miles driven annually by passenger cars reached a peak of over three trillion, tripling since the 1960s (U.S.

Department of Transportation, Federal Highway Administration 2008). Like traffic congestion, the increasing miles driven also makes people spend more time in traffic and leads on the same negative impacts on the natural environment and people's health. Moreover, urban sprawl leads to the segregation of land use. This phenomenon is especially common in medium and small cities in the United States,. People tend to live far away from commercial areas. They usually drive long distances to buy commodities at Walmart or have a coffee with friends. Also, the segregation of land use is exacerbated because most communities have been designed with only one method of transportation—the automobile. The single transportation option restricts the mobility of people who do not have a car, or are too young or too old to drive. Urban sprawl also leads to the increase in economic investment. For example, the United States has invested billions of dollars in building infrastructures in numerous scattered communities. However, because of the low density of development, such infrastructure is usually abandoned or underutilized. And governments are still spending additional money on new infrastructure for low-density sprawl. This leads to the waste of vast amounts of money (the President's Council On Sustainable Development 1997). Individual costs on transportation are also increased because of urban sprawl. According to one study (Center for Neighborhood Technology n.d.), when we locate housing in walkable, transit-served communities, the percentage of household income spent on transportation drops from approximately 30% to approximately 9%. This situation is particularly obvious in poor families. In order to find houses with cheap rent, they usually live in the most inefficient, poorly-built homes in distant suburban neighborhoods. Although the rent is cheaper than those of better houses, the far distance and inefficient household equipment cause them to spend more money on energy. Low income households spend almost three times the

amount on utilities and fuel than the average American households (the President's Council On Sustainable Development 1997).

Design Methods

In the area of density and transportation, the goal of all design methods is to minimize the use of automobiles and maximize access to various destinations, such as work places, schools, shops, and recreational spaces, without automobiles. And these design methods will ensure that people could reach their destinations safely, easily, and quickly. In order to realize a sustainable transportation system, we need a combination of design methods and policy stimulus. This section will discuss a series of design methods concerning transportation and land use, and the related policies in detail.

When people talk about New York, a similar scene will emerge in the minds of most people: crowded and narrow streets, clustered skyscrapers, serious traffic jams, and dirty living conditions. Most people including New Yorkers, think of this city as an ecological nightmare. But in fact, New York is the greenest community in the United States. The average resident in New York state uses less gasoline than the average resident in any other state. Eighty-two percent of employed Manhattan residents go to work by public transportation, by bicycle, or on foot, which is ten times the rate for Americans in general (Ginsburg and Strauss 2003). If New York City were granted statehood, it would rank fifty-first in per-capita energy use (Owen, More Like Manhattan 2009). And the average resident in New York annually generates 7.1 metric tons of greenhouse gases, lower than the residents of any other American city (Mayor's Office of Long-Term Planning and Sustainability 2007). The ecological health of New York is the result of a combination of several factors: high regional accessibility, high-density development, mixed-uses, transit-oriented development, and connected streets.

1. High Regional Accessibility

New York is a city with high regional accessibility. The extreme compactness of New York allows people to reach their destinations in a short time so that people can choose multiple transportation methods such as buses, subways, bicycles or walking instead of automobiles. According to one study (F. K. Benfield 2009), "even the most sustainably designed and constructed development cannot overcome the environmental shortcomings of a poor location." He puts location as the first step towards a green community and puts forward the principle of "regional accessibility": the proximity of the development site to other major destinations in the region such as work places, services, and other neighborhoods. In general, a major approach to creating high regional accessibility is to locate a development site as near to the center of the region as possible. This will bring the development site closer to more work places and services than other sites that are further from the center. In addition, this will provide people with more transportation choices. Some research shows that the closer a community moves to the center of the region, the less the residents drive. For example, one study compared two automobile-dependent neighborhoods in metropolitan Nashville and found that households in the neighborhood closer to the center of the region drove 25% fewer miles per capita annually, and emit much less carbon dioxide than those in an new outlying suburb (F. K. Benfield 2009). Also, in Atlantic Station, a new exemplary neighborhood in central Atlanta, the residents drive only 8.6 miles per day, compared to 34 miles of driving per day for that vast region's residents (Center for Transportation and the Environment and Lanier Parking Solutions 2008). According to the transportation consulting firm Fehr & Peers, regional accessibility is the most important determinant of the amount of overall driving (measured by average vehicle miles traveled per household) among all the factors including neighborhood density, diversity of uses, and walkable

environment (Fehr & Peers n.d.). This research is based on an exhaustive review of published studies.

2. High Density Development

The extreme high density in New York (figure 6) makes public transportation possible. And the serious traffic jams leaded by this high density encourage people to choose other convenient transportation rather than automobiles. This helps to reduce the use of automobiles. Extensive research shows that there are low driving rates in the metropolitan regions with the densest development (Holtzclaw, et al. 2002). Research from Fehr & Peers shows that, independent of other factors, a doubling of households or work places per acre would reduce driving mileage by 5% and vehicle trips by 4% per household, compared to a base case (F. K. Benfield 2009). In addition, high density creates compact space, which forces residents to live in smaller rooms. This improves the efficiency of buildings, resulting in a lower energy consumption per household. Moreover, compact space encourages walking and strengthens people's interaction, which contributes to a healthy and vibrant lifestyle. According to research, a typical white male who lives in a compact community close to shops and services is likely to weigh 10 pounds less than a similar white male who lives in a residential-only cul-de-sac subdivision with low density (Goldberg, et al. 2007). In the book *The Death and Life of Great American Cities*, author Jane Jacobs, presented the central idea that density and diversity are the engines that make human communities work. She thought moving people closer would bring many benefits: their neighborhood would grow safer, they would become more attuned to another's needs, and they would have more choices for recreation (Owen, More Like Manhattan 2009). Overall, creating high-density development not only reduces the impact on the natural environment, but also provides people a colorful life.

Figure 6. The extreme high density development in Manhattan, NY (The image is a printscreen from Google Earth)

3. Mixed-used Development

Another factor contributing to the prosperity of New York is the highly mixed use of residential and commercial developments. Mixed land use could provide residents with more choices for services in a short distance, shorten the distance between housing and work places, and double the ratio of work places to housing. This will contribute to the increase in walking and population density, the reduction of driving and carbon dioxide emissions, and improve people's health. The research from Fehr & Peers found that, independent of other factors, mixing commercial and residential buildings would result in a 5% reduction in miles driven and a 6% reduction in vehicle trips. Also, the effect of mixed-use could be added to the effects of high density that have been shown above. That means the combination of doubling households or work places per acre and mixing commercial and residential buildings would result in a 10% reduction in miles driven and vehicle trips (F. K. Benfield 2009). The mixed-used development

strengthens the walkability in a community, which brings health benefits. The SMARTRAQ (Strategies for Metropolitan Atlanta's Regional Transportation and Air Quality) study found that people living in mixed-used neighborhoods within easy walking distance are 7% less likely to be obese than those living where there is a lower mix (F. K. Benfield 2009).

4. Transit Oriented Development

New York has a well-developed public transportation system. The subway and bus lines almost cover the entire city (figures 7 and 8). People can easily find a bus station or subway station within walking distance. The well-developed public transportation contributes to an extremely low use of automobiles in New York, which results in very low carbon dioxide emissions. There are many design methods related to transit. Nowadays, TOD (Transited Oriented Development) is a popular trend in creating green communities. TOD is "the creation of compact, walkable communities centered around high quality train systems (Transit Oriented Development Institue n.d.)." Transit Oriented Development provides a major solution to the issues of climate change and energy shortage by creating dense and walkable communities that greatly reduce the need for driving (Transit Oriented Development Institue n.d.). According to a painstaking empirical study of 17 locations, on average, TOD around rail transit stations reduces car trips by 49% in the morning peak hours and by 48% in the evening peak hours (Arrington and Cervero 2008). Nowadays, many cities in the world employ TOD. For example, in Swedens, the concept of satellite towns linked by a metro system was developed around Stockholm. High-density apartments were built to surround a metro station, with a pyramid of density cascading away toward the edge (Hall 2009). Aside from TOD, there are many other methods related to transportation. For example, in Amsterdam, there is a method called traffic calming. Pedestrians share the road with automobiles so that people have to drive at a walking pace and be very

careful. And in Grenoble, France, people use park-and-ride garages to park their automobiles and then board the streetcar in the same structure. The ticket for parking can also be used for the streetcar. In Singapore, the concept of congestion pricing is employed to reduce traffic. And these methods have been widely used in other cities such as London and Oslo. (Hall 2009)

Figure 7. Manhattan bus map (Metropolitan Transportation Authority 2010)

Figure 8. Manhattan subway map (iTapinfo n.d.)

5. Streets

The well-designed street system in New York is another factor that contributes to sustainability. New York has a well-connected street grid with complete sidewalks. This shortens the distances to destinations and encourages walking, which reduces the use of automobiles,

energy consumption, and carbon dioxide emissions. Street connectivity is a key factor that contributes to sustainability in New York. A street lacking connectivity will lead to a series of issues. According to the Federal Highway Administration in the U.S. Department of Transportation (U.S. Department of Transportation, Federal Highway Administration 2008), "streets that are not well connected can limit people's abilities to travel in the most direct path, increase distances to destinations, require larger intersections to move vehicular traffic, increase a pedestrian's exposure to vehicles (which increases the risk of being hit), and discourage walking." According to F. Kaid Benfield (F. K. Benfield 2009), street connectivity is the marker of a streetscape's efficiency. It is measured by the number of a neighborhood's external and internal street connections (figure 9). In general, the more connections a community has, the better. There are two effective objective ways to measure the connectivity of a green community. One is to measure the distances along a project's boundary between intersections with external through streets (the shorter the distances, the better). The other is to measure the number of internal intersections per square mile (the more, the better). The LEED (Leadership in Energy and Environmental Design) for Neighborhood Development rating system sets a quantitative standard to evaluate a community. Any development lacking external connections at least every 800 feet along the boundary or failing to achieve at least 150 intersections per square mile will be disqualified from green certification. And a development that has external connections at least every 400 feet and at least 300 intersections per square mile could earn credit for green certification by having connected streets (U.S. Green Building Council 2008). Highlands' Garden Village in Denver, CO is a community that measures 792 intersections per square mile, which is a great example of connectivity (Alan 2009). A well-connected community could not only improve efficiency in travel, but also create a safer street environment. According to

research based on 24 cities over a nine-year period, the cities with the fewest per capita traffic fatalities (averaging 3.2 traffic deaths per 100,000 people per year, compared to 10.5) had twice the population and one and a half times the number of intersections per square mile as those with the most fatalities (Garrick and Marshall 2008).

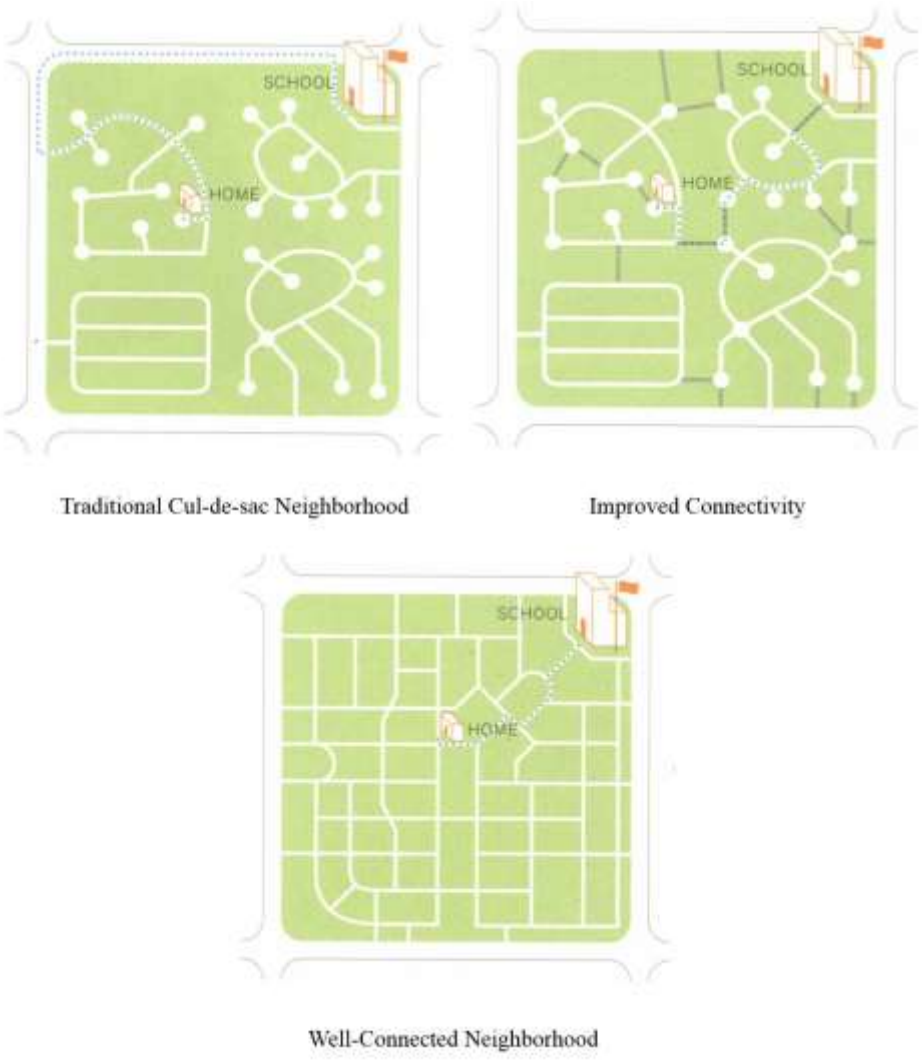


Figure 9. Neighborhoods with different connectivity

Except for connectivity, there are many other factors related to the important role streets play in realizing the sustainability of transportation. For example, sidewalk design is an important factor. A wide and continuous sidewalk with shade trees, street furniture, appropriate building heights and gorgeous facades could encourage more walking and help reduce the use of

automobiles (figure 10). According to the research from Fehr & Peers (Fehr & Peers n.d.), a combination of good connectivity and good sidewalks has a significant effect on reducing the use of automobiles. Doubling these design measures, including street connectivity, density of street and pedestrian networks, and completeness of sidewalks, would reduce miles of driven by 4% and vehicle trips by 2%. And LEED-ND presents a series of quantitative standards for sidewalk design such as width and building-height-to-street-width ratio. Trees also play an important role in sidewalks. They not only have ecological benefits, but also have social and economic benefits. According to one study (Burden 2006), street trees' benefits include slowing traffic speeds, providing safer environments, improving business returns and property values, and reducing temperatures. A single street tree that costs $250-600 will bring over $90,000 in lifetime returns. According to one study (Owen, More Like Manhattan 2009), "Trees are ecologically important in dense urban areas not because they provide temporary repositories for atmospheric carbon, but because their presence along sidewalks makes city dwellers more cheerful about dwelling in cities."

Summary

With a common goal that minimizes the use of automobiles and maximizes regional accessibility, the five categories of methods greatly contribute to the sustainability of transportation. In order to maximize the efficiency of these methods, the best way is to combine these methods. According to Fehr & Peers' estimates, a doubling of these categories, including regional accessibility, density, mixed use, and a walkable environment, would reduce miles driven per household by 34% and the number of vehicle trips by 15% compared to a base case. This could contribute to great reduction in greenhouse gas emissions and other pollutants.

Figure 10. The sidewalk of Michigan Avenue in Chicago, IL (National Real Estate Investor 2015) (Everyday Tourist n.d.)

Energy

Nowadays, we are living in a world driven by energy. Modern essentials, including transportation, HVAC (heating, ventilating, and air conditioning) systems, electronic products, and city infrastructures, all rely on energy. We really appreciate the convenience that energy brings to us. However, we cannot ignore the negative impact that energy brings to the natural environment and people's health. According to the International Energy Agency (Internation Energy Agency 2014), even though the percentage of fossil fuels (oil, coal, and natural gas) in world total primary energy supply decreased from 86.7% in 1973 to 81.7% in 2012 (figure 11), fossil fuels are still the major sources of energy in the world. The consumption of fossil fuels is the main cause of climate change and environmental pollution. According to U.S. Environmental Protection Agency (U.S. Environmental Protection Agency 2010), the burning of fossil fuels causes smog, ozone, and acid rain, and contributes more than 80% of total annual greenhouse gases in America. Although the percentage of nuclear increased from 0.9% in 1973 to 4.8% in 2012, the issues of it are that it is difficult to dispose nuclear waste and building nuclear power plants costs a huge amount of money. Hydropower is a relatively clean energy source, but constructing a new dam is not that clean (Daniels 2009). At present, climate change has been an issue of global concern. However, people do not personally experience climate change impacts because other social issues are more obvious such as traffic congestion and high medical expenses. Once the impacts of climate become tangible, it will be too late to solve the issue (Heller and Heller 2009).

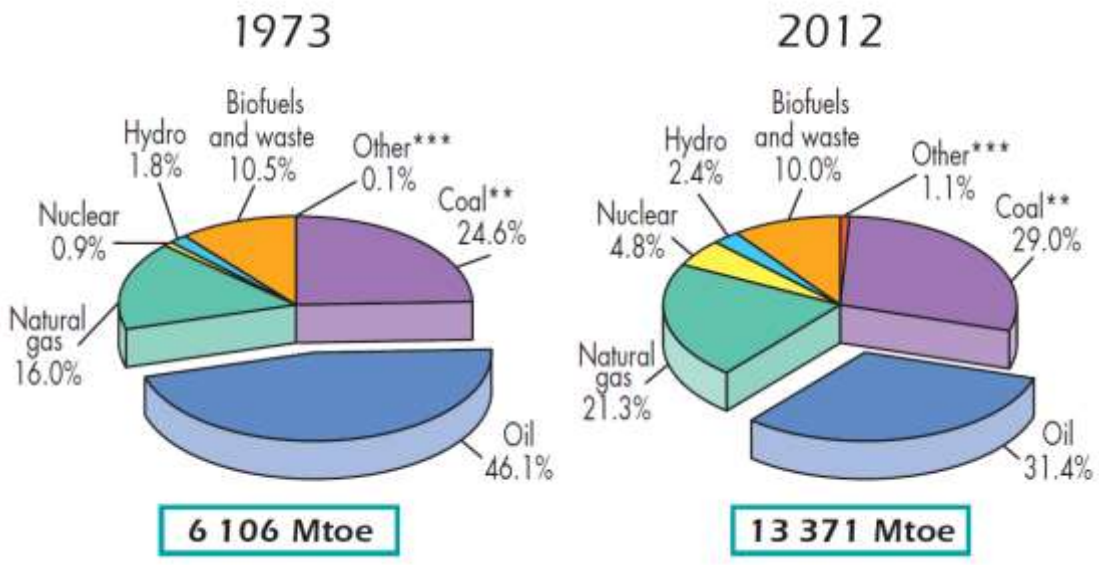


Figure 11. 1973 and 2012 fuel shares of total primary energy supply (U.S. Environmental Protection Agency 2010)
**In these graphs, peat and oil shale are aggregated with coal.
***Includes geothermal, solar, wind, heat, etc.

Design Methods

In the aspect of energy, the goal of all the design methods is to minimize the consumption of fossil fuels and replace fossil fuels with renewable energy. At present, improving energy efficiency and employing renewable energy sources are two main methods in reducing air pollution and the emissions of greenhouse gases. By employing these methods, a community can greatly reduce its negative impact on the natural environment, which contributes to sustainable development.

1. **Reducing Energy Demand**

Reducing energy demand is beginning to save energy. According to LEED (Leadership in Energy and Environmental Design) (The U.S. Green Building Council n.d.), strategies for reducing energy demand include:

Establish design and energy goals. At the beginning of a project, work with the design team to set targets and establish performance indicators, and periodically verify their achievement.

Size the building appropriately. A building should be designed to meet the needs of future occupants but not to exceed those needs.

Use free energy. The approximate orientation of a building can help the building take advantage of natural energy such as solar energy and daylighting. This can reduce the demand of conventional energy.

Insulate. Design high-performance building envelopes can help the building efficiently insulate against heating and cooling losses.

Monitor consumption. Establish energy monitoring and feedback systems to alert building occupants to the use of energy and encourage them to reduce energy demand.

2. Improving Energy Efficiency

According to Erica Heller and Mark Heller, improving energy efficiency is currently the most cost-effective methods to reduce emissions of carbon dioxide and other greenhouse gases (Heller and Heller 2009). Transportation and buildings are major sources of emissions of greenhouse gases. In America, transportation accounted for 27% of greenhouse gas emissions in 2013 (United States Environmental Protection Agency 2014). And the buildings accounted for 48% of the country's greenhouse gas emissions (Mazria n.d.). For transportation, developing technologies to improve the efficiency of engines is a good strategy to promote energy efficiency. However, this strategy is limited to the people who are in the field. There are some other strategies for common people. For example, we can choose fuel efficient cars. There are many cars with low MPG (miles per gallon) such as Honda CR-Z, Audi A3 Diesel and Toyota

Prius. And compared with cars using gasoline or diesel, electric vehicles has higher fuel efficiency and lower impact on the natural environment. For example, Tesla, BMW i3, and Nissan Leaf are all good choices (U.S. Department of Energy 2015). We can also do some easy work to improve the fuel efficiency of our cars. For example, keeping tires properly inflated and replace dirty air filters can improve gas mileage (U.S. Department of Energy n.d.). Keeping speed under 60 mph and avoiding aggressive driving (speeding, rapid acceleration and braking) can save gas (West, McGill and Sluder 1999). For buildings, LEED (The U.S. Green Building Council n.d.) gives a series of strategies to improve building's energy efficiency:

Identify passive design opportunities. Make the best of natural resources such as sun and wind to illuminate, cool, and heat a building. By designing the orientation of a building, choosing proper materials, and arranging the location of windows, a building can capture sunlight, stay cool in summer, and stay warm in winter.

Address the envelope. By using insulation properly in walls and roofs and installing high-performance glazing, buildings can minimize unwanted heat gain or loss, and are properly weatherized.

Install high-performance mechanical systems. High-performance mechanical systems usually need more investments at an early stage but use less energy than conventional systems. If we consider the life-cycle period of high-performance mechanical systems, they costs much less than conventional systems.

Specify high-efficiency appliances. Use computers, monitors, and other equipment that meet or exceed ENERGY STAR requirements. The equipment with ENERGY START uses less energy than conventional equipment.

Use high-efficiency infrastructure. Infrastructure such as high-efficiency street lighting and LED-based traffic signals can help reduce energy demands.

Capture efficiencies of scale. Use a district system (a system that provides thermal conditioning to multiple buildings) to heat or cool multiple buildings

Use thermal energy storage. By capturing heat during the day for use at night, and rejecting heat at night to provide cooling during the day, a building can reduce energy use.

Use energy simulation. By using computer modeling, the building performance can be predicted before construction. And the team can choose the best plan to design and construct the building in order to maximize the energy efficiency.

Monitor and verify performance. Make sure the building systems are functioning as designed and meet the project requirements through the building control systems.

3. Renewable Energy

Although energy efficiency improvements are currently the most cost-effective methods to reduce greenhouse gases emissions, they cannot address the bulk of the carbon dioxide problem (Heller and Heller 2009). At present, fossil fuels are still the major sources of energy in the world. While renewable energy sources account for only 13.5% of total energy sources (figure 11), and they cost more and are less efficient than fossil fuels, considering that the technologies evolve, the cost and scarcity of fossil fuels rise, and the requirement of rapid reduction of greenhouse gas emissions become urgent, renewable energy sources will become more viable. Generally, renewable energy includes solar, wind, wave, biomass, geothermal power, and certain forms of hydropower. For buildings in a community, there are two strategies for meeting energy demand with renewable (The U.S. Green Building Council n.d.):

Generate onsite renewable energy. This strategy is suitable for the renewable energy sources with little land consumption or no land consumption such as solar energy and wind energy. For example, install photovoltaic cells, solar hot water heaters, and building-mounted wind turbines (figures 12 and 13). Currently, solar energy systems and wind energy systems have been widely used in the world. Soldier's Grove is a community that embrace modern solar design at the core of its town planning. It has local ordinances requiring solar access protections and 50% solar heating for commercial buildings. Soldier's Grove is the first solar village and has one of the highest concentrations of solar buildings in America (Becker 1980). And in Denmark, by 2001, more than 100,000 families belonged to wind turbine cooperative, which had installed 86% of all the wind turbines in Denmark (Copenhagen Environment and Energy Office 2001).

Figure 12. Photovoltaic solar systems (Berkeley Lab 2011)

Figure 13. Building-mounted wind turbine (Front Generator Wind Turbine n.d.)

Purchase offsite renewable energy. This strategy is suitable for the renewable energy sources that need large land consumption or are generated in specific sites. For example, a hydro power plant must be built near fast-moving water or an artificial reservoir. And a biomass power plant are usually built in agricultural and forestry areas. Communities that cannot generate onsite renewable energy can buy green power or renewable energy certificates to reduce the impact of purchased electricity, and promote renewable energy generation.

4. Ongoing Energy Performance

After the construction of an energy-efficient building or neighborhood, it is still important to make sure that the project functions as designed, and sustains and improve this

performance over time. LEED gives a series of strategies for maintaining energy efficiency (The U.S. Green Building Council n.d.):

Adhere to owner's project requirement. The owner's project requirement are prepared at the beginning of design. Then the requirement should be used as a benchmark to conduct the commissioning throughout the life cycle of the project and ensure the project functions as designed.

Provide staff training. Training staff ensures that they understand how to maintain and improve the performance of a project.

Conduct preventive maintenance. Develop a periodic maintenance to ensure the project always functions effectively and efficiently.

Create incentives for occupants and tenants. Use incentives to encourage building occupants to reduce energy use. For example, educate occupants about turning off lights and equipment before they leave, and give them regular feedback on energy performance.

Summary

Our communities are intimately tied to energy. Energy is an important factor that promotes the development of modern communities. There are four main strategies related to energy: reducing energy demand, improving energy efficiency, using renewable energy, and maintaining high-efficient performance. Although improving energy efficiency is currently the major strategy, considering the serious impacts and rapidly diminishing stock of fossil fuels, plus the constantly evolving technologies of renewable energy, renewable energy will gradually replace fossil fuels and become the major strategy.

Resources

"A resource is a source or supply from which benefit is produced (Wikipedia n.d.)." Since ancient times, human survival and development have been dependent on natural resources. Almost everything in our lives are made from natural resources such as lumber, stone, and metal. Although nature provides a large amount of resources for us, these resources are limited and it takes a long time for nature to produce them. However, most people do not realize the crisis of resource shortage and waste many resources. Moreover, after an item loses its value, people do not dispose it well or directly throw it into the natural environment, which leads to serious environmental pollution and damage to wildlife habitats. If people do not change their way to deal with resources, resources will be used up and the natural environment will be seriously damaged.

Currently, there are three main methods of disposing waste: landfill, incineration, and composting. And landfill is the main method of disposing waste in China. However, landfill has many disadvantages. As populations increase, more landfills need to be built to increase capacity. But the lack of space makes it difficult to build new facilities. Building facilities in far places will incur the added cost of transporting waste (U.S. Environmental Protection Agency 2010). Moreover, the presence of methane and other landfill gases can cause numerous contamination problems (Conserve Energy Future n.d.). Incineration is a good method that can greatly reduce the volume of solid waste. But this method is expensive and produces dioxins that is a cancer forming chemical. Also, the method requires skilled personnel and continuous maintenance (Row 2010).Composting is an easy and natural bio-degradation process that can turn organic wastes into nutrient rich food. But it has disadvantages of slow disposing process, high costs, and taking much space (Conserve Energy Future n.d.). At present, there is no perfect

method of disposing waste without any negative effect. The best way to reduce negative effects is to reduce the generation of waste.

Design Methods

In a green community, the goal of all the sustainable methods related to resources is to reduce the amount of trash that enters the waste stream. These methods include 3 R's (reduce, reuse and recycle):

1. **Reduce**

Reduce the amount and toxicity of trash you discard (the Foundation for Community Association Research 2014). According to U.S. Environmental Protection Agency (U.S. Environmental Protection Agency 2010), the methods of reducing waste include:

Implement a "Pay as you Throw" system. This system charges residents what they throw out in order to encourage them to discard less to save money.

Use full cost accounting. By identifying and assessing the costs associated with managing a solid waste facility, we can know the real costs of solid waste management. This method can also help local policy makers to identify opportunities to streamline and improve operations in short and long-term planning.

Implement or expand a compost program. This method includes organizing short-term seasonal events specifically for grass clippings, fallen leaves or Christmas trees, and long-term food waste program for residents, farmer's markets, local restaurants/businesses or schools and hospitals.

Make better purchases. Buying long-lasting or recyclable products, or products that contain less packaging materials and are less harmful to the environment.

2. **Reuse**

Before an item go into waste stream, consider if it has value left. This method includes reusing products, repairing broken items, and donating items to someone who can use them. For example, we can reuse mail boxes for storage, turn empty jars into containers, buying refillable pencils, donating old clothes or equipment. (the Foundation for Community Association Research 2014)

3. **Recycle**

According to one study conducted by the Technical University of Denmark, in 83% of cases, recycling is the most efficient method to dispose of household waste (Murphy, Mueller and Gowda 1993). By recycling, we can turn materials that will become waste into valuable resources. The method includes improving information on how to recycle properly and creating incentives for recycling programs in communities (U.S. Environmental Protection Agency 2010).

Except for 3 R's, there are some other methods for specific waste, which include:

4. **Safe Disposal of Hazardous Waste**

A program should be implemented to dispose commercial and residential hazardous wastes in the appropriate manner in order to prevent their harm to the natural environment. (U.S. Environmental Protection Agency 2010)

5. **Building Waste Management**

Buildings generate a huge amount of waste throughout their life cycles, from construction and building operations to demolition. LEED gives some strategies for reducing building waste (The U.S. Green Building Council n.d.):

Size the building appropriately. Consider the size of a building carefully in order to meet the needs of occupants, and at the same time to use little energy as much as possible. A smaller building that meets the needs of occupants can consume less energy than a big building that meets the same needs.

Develop a construction waste management policy. Before construction, outline procedures and goals for construction waste diversion. And a target diversion rate should be specified for general contractor.

Encourage recycling. Establish a waste reduction policy for operations and maintenance. And provide occupants with easy ways to recycle items such as easily accessible collectors for recyclables, and give them directions about what goes where.

Compost. Establish an on-site composting program to transform food and landscaping waste into mulch for garden beds.

Summary

At present, there is no method of disposing waste without any negative effect. The core concept of resource management in green communities is to minimize the generation of waste. By employing the methods listed above, a community can extend the life-cycle of existing resources and materials, and reduce the import of new resources and materials. This can help reduce the consumption of raw materials and natural resources. Moreover, by disposing hazardous waste safely and employing appropriate building waste management, a community can minimize the negative effects of hazardous waste and building construction.

Water

Water is one of the most important resources in earth. Human survival and development is inseparable from water. Almost every activity in our communities relies on continuous access to clean water, from drinking water supplies to clean water that supports commercial, recreation, and industries. However, as population increases, daily water consumption increases a lot. Surface water and aquifers are drained faster than nature can recharge them. Moreover, with the rapid development of cities, especially in developing countries, the issue of water pollution becomes more and more serious. Water quality is threatened by point source pollution such as discharges from factories, and non-point pollution such as stormwater runoff from roadways and parking lots. With water consumption increasing and water pollution becoming serious, people do not solve these issues fundamentally. Additional water supply and treatment facilities are built, which cost vast amounts money. According to Mary Rickel Pelletier (Pelletier 2009), "we are neither developing and maintaining our existing systems, nor preserving the natural resources that they are meant to process, treat, and convey. These systems are at the basis of what we think of as civilization: clean, safe, disease-free, low-cost, dependable, and accessible essential resources."

Design Methods

In a green community, the goal of all the methods is to improve water use efficiency and protect water resources. These methods include: predevelopment water budgets; efficient use of municipal supplies; on-site collection, water recycling and treatment; the reduction of non-point and point source pollution of local watersheds and aquifers; development of green infrastructures.

1. **Predevelopment Water Budgets**

Predevelopment water budgets is to establish the quantity of water absorbed by the landscape before the development of a project. This method provides a measurable benchmark for the design of on-site stormwater management, which enhances new development or renovation projects, and reduces energy costs and maintenance of mechanical pumps that move stormwater through conventional underground storage systems. (Pelletier 2009)

2. **Efficient Use of Municipal Water Supplies**

According to U.S. Environmental Protection Agency (U.S. Environmental Protection Agency 2010), efficient use of water is the key to promoting water conservation and saving money. Also, conserving water reduces energy use, which translates into additional savings. LEED divides water usage into three categories: indoor water for restrooms; outdoor water for landscaping; process water for industrial purposes and building systems. And it gives a series of methods about these categories (The U.S. Green Building Council n.d.).

3. **Indoor Water**

Indoor water is the water that is used for buildings' daily operation, which includes water for water closets, urinals, lavatories, showers, and kitchen or break room sinks. Three methods are employed to reduce indoor water usage:

Install efficient plumbing fixtures. Replace water-intensive fixtures with new low-flow fixtures that use significantly less water. These include low-flow toilets, faucets, and showerheads.

Use nonpotable water. Not all equipment and activities need potable water. Use nonpotable water, including captured rainwater, graywater, or municipal reclaimed water for flush fixtures.

Install submeters. Meters can track consumption trends and pinpoint leaks or other issues.

4. Outdoor Water

Outdoor water is generally the water that is used for landscape irrigation, which is a significant component of many commercial buildings' water use. Five methods are employed to reduce outdoor water usage:

Choose locally adapted plants. Native and adapted plants require less water and maintenance.

Use xeriscaping. Xeriscaping requires less water. In addition, xeriscaping emphasizes soil improvement, mulching, and efficient irrigation to maximize water usage (U.S. Green Building Council 2009).

Select efficient irrigation technologies. Efficient irrigation technologies include drip and bubbler systems, weather-based controllers, and systems that can directly supply water to plants' roots.

Use nonpotable water. Use nonpotable water, including captured rainwater, graywater, or municipal reclaimed water for irrigation.

Install submeters. Meters can track consumption trends and pinpoint leaks or other issues.

5. Process Water

Process water is used for industrial process and building systems, such as cooling towers, boilers, chillers, dishwashers, clothes washers, and ice machines. The methods include:

Use nonpotable water. Use nonpotable water, including captured rainwater, graywater, or municipal reclaimed water for industrial process or in building systems.

Install submeters. Meters can track consumption trends and pinpoint leaks or other issues.

6. Protect Local Watersheds from Point and Non-point Source Pollution

"A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place (United States Environmental Protection Agency n.d.)." Watersheds mainly suffer from point and non-point source pollution. Point source water pollution is pollution that is from a specific discharge source such as factory or wastewater treatment plant. Point sources are usually controlled by governments to prevent water pollution, such as set limits on the amount of discharges that are released into the environment (U.S. Environmental Protection Agency 2010).

Non-point source pollution is pollution that is from urban stormwater run-off and unregulated non-industrial or agricultural sources (U.S. Environmental Protection Agency 2010). It is now a more pressing threat to water quality than industrial pollution (Pelletier 2009). U.S. Environmental Protection Agency gives a series of methods to prevent non-point source pollution: (U.S. Environmental Protection Agency 2010)

- Collect and treat stormwater runoff before it enter into waterways;
- Preserve and construct local wetlands as buffers for aquatic natural systems;
- Build on-site runoff retention and use pervious pavements;
- Establish partnerships with local industry for effluent reductions through green industrial practices and water conservation measures;
- Educate general public about the specific non-point sources and the options for minimizing impacts;
- Monitor watersheds with local-non-profits, schools and other community groups to identify problem areas.

LEED gives three methods for controlling and reducing stormwater runoff: (The U.S. Green Building Council n.d.)

Minimize impervious areas. Use permeable materials, such as vegetated roofs, porous pavement, and grid pavers, to increases the area of permeable surfaces;

Control stormwater. Build dry ponds, rain gardens, bioswales, and similar landscaping features to hold water and slow runoff;

Harvest rainwater. Build rain gardens, green roofs, and cisterns to collect rainwater and use it in building systems such as toilets or irrigation.

7. Developing Green Infrastructures

According to United States Environmental Protection Agency (United States Environmental Protection n.d.), green infrastructure manages water and creates healthier urban environments by using vegetation, soils, and natural processes. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas. It provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems. It mimic nature by soaking up and storing water. Table 2 shows different kinds of green infrastructure elements.

Table 2. Green infrastructure elements (United States Environmental Protection n.d.)

	**Downspout Disconnection** Downspout disconnection separates roof downspouts from the sewer system and redirect rainwater to rain barrels, cisterns, or permeable areas. Downspout disconnection can stores stormwater and allows it to infiltrate into the soil.

	**Rainwater Harvesting** Rainwater harvesting systems collect and store rainwater for later use. They can help reduce and slow stormwater runoff and provide water sources. The systems are particularly attractive in arid places.
	**Rain Gardens** A rain garden is a shallow depression that is planted with native plants. It can absorb and collect stormwater runoff, and mimic natural hydrology by infiltrating and evapotranspiring runoff. Rain gardens are versatile. They can be installed in almost any unpaved space.
	**Planter Boxes** Planter boxes are urban rain gardens that have the same functions as rain gardens. They have vertical walls and open or closed bottoms. Planter boxes are ideal green infrastructures in urban dense areas because they take a little space.
	**Bioswales** Bioswales are channels that are planted with plants or xeriscapes. They can provide treatment and retention when stormwater moves through them. And they slow, infiltrate, and filter stormwater runoff. Bioswales are good choices for streets and parking lots because of their linear features.

	**Permeable Pavements** Permeable pavements allow stormwater move through the surface. They can infiltrate, treat, and/or store stormwater. Their materials are made from pervious concrete, porous asphalt, permeable interlocking pavers, and others. They are cost effective in lands with high values and flooding or icing problems.
	**Green Streets and Alleys** Green streets and alleys integrate green infrastructure elements such as permeable pavements, bioswales, and planter boxes. They are designed to store, infiltrate, and evapotranspire stormwater.
	**Green Parking** Green parking integrates green infrastructure elements such as permeable pavements, bioswales, and rain gardens. It has the benefits of urban heat island mitigation and a more walkable built environment.
	**Green Roofs** Green roofs are roofs with growing media and vegetation. They can infiltrate, store, and evapotranspirating stormwater. Green roofs are cost effective in urban dense areas and large industrial or office buildings where land values and stormwater management costs are high.

	**Urban Tree Canopy** Leaves and branches of trees can intercept precipitation to reduce and slow stormwater. Homeowners, buisnesses, and cities can all participate in the planting and maintenance of trees.
	**Land Conservation** Land conservation is about protecting open spaces and sensitive natural areas. Natural areas such as riparian areas, wetlands, and steep hillsides, are very important in addressing water quality and flooding. Land conservation can mitigate the water quality and flooding impacts of urban stormwater, and provide city residents with recreational opportunities.

Compared with single-purpose gray stormwater infrastructure, green infrastructure reduces and treat stormwater at its source. At the same time, it brings many other environmental, social, and economic benefits. For example, green infrastructure improves water quality, mitigate flooding, increase the efficiency of water supply systems, and saves costs. Besides, the plants in green infrastructure help improve air quality, reduce air pollution, and mitigate urban heat island effect. Moreover, green infrastructure provides habitats for wildlife and recreation spaces for human beings (United States Environmental Protection Agency n.d.).

Summary

In green communities, the final goal is to conserve water resources by efficient use of water, and to protect water resources at the source. As water resources crisis and water pollution become more and more serious in the world, it is urgent to promote sustainable methods to conserve and protect water resources. The achievement of these methods not only needs invests and promotion of governments, but also needs participation by all people.

Natural Conservation

Nowadays, many people measure wealth by tangible assets such as deposits, house properties, and stock portfolios. However, on the background of economic crunch, these assets become illusory. According to Timothy Beatley (Beatley 2009), market systems allocate the value of things based on consumers' and investors' willingness to pay. Highest and best economic use are always subject to the vagaries. However, when the value of these tangible assets precipitously drops, this shocks us to the core. Moreover, these assets become insignificant when natural disasters happens such as flooding, storm, and drought. We should explore a different kind of assets that are less illusory, less volatile, and more resilient. Their values are lasting and enduring, and are not affected by the market economy. Natural systems could be this kind of assets.

Natural systems have many benefits in the aspects of economy, ecology, and health. For example, natural breezes and the shading of trees can help reduce the temperature of neighborhoods, which can reduce the costs on air conditioning. And wetlands or urban streams can prevent flooding, which can reduce the costs on expensive engineering-based solutions. In the aspect of ecology, they can prevent many natural disasters, improve air quality, prevent pollution, and provide habitats for wildlife. And they have the potential to reconnect us to larger systems of life, and bring us together to cherish and celebrate them. In the aspect of health, natural systems have therapeutic and restorative functions. They can improve work productivity, enhance physical and psychological health. (Beatley 2009)

As population grows and urban development expands, many natural areas are seriously damaged. It is important to conserve natural areas. U.S. Environmental Protection Agency gives

a series of strategies about community-based environmental protection [3] : (United States Environmental Protection Agency 1997)

1. **Low Cost, Immediate-Result Voluntary Strategies**

Tree, Grassland, or Wetland Planting or Reforestation. This strategy contains many activities such as planting trees, shrubs, or flowers in urban areas to improve aesthetics. And implementing a reforestation or wetland planting program to improve forests or restore wetlands.

Stream, Beach, or River Cleanups. Communities organize residents to pick up trash and debris from rivers, beaches, or streams.

Storm Drain Stenciling. Stenciling "Do Not Dump" or other instructions on storm drains to alert people that storm drains cannot be used for disposing used oil or other hazardous liquids.

Pollution Prevention. Preventing pollution at source such as implementing recycling programs, using renewable energy, and taking public transportation.

Education. Educating community members to conserve the natural environment such as opening related courses in school and giving out pamphlets about natural conservation.

Amending Covenants Governing Condominium and Homeowners' Associations. Some items in covenants governing condominium and homeowner's associations can help protect the natural environment such as reducing the use of fertilizer and pesticides on lawns or prohibiting the removal of native vegetation.

Instituting Integrated Pest Management (IPM) on Farms and in Gardens. IPM minimizes pesticide use and encourage natural forms of pest control. Strategies include introducing natural enemies of pests, and planting more crops (making it harder for pests to find their targets).

[3] "Community-based environmental protection is action that local individuals and groups take to address their own environmental concerns." (United States Environmental Protection Agency 1997)

Encouraging and Assisting Businesses to Conduct Environmental Audits. Environmental audits involve examining businesses about if their activities are environmentally friendly.

2. **Land Acquisition**

This strategy includes purchase of land or a land easement. Local government can purchase land or easement for conservation purposes. This is one of the most effective ways to preserve an ecosystem.

3. **Zoning Ordinances**

Using zoning techniques to protect the natural environment. For example, controlling the boundaries of urban areas or creating high-density urban areas to prevent urban sprawl, establishing buffer zones to restrict activities that can affect the natural environment, and setting flooding protection districts near rivers to prohibit development.

According to Foundation for Community Association Research (Foundation for Community Association Research n.d.), there are many other methods about protecting the natural environment:

4. **Creating Abundant Plant Communities**

A diversity of plants species can attract more wildlife to the area.

5. **Transforming Lawns into Natural Areas**

Considering the long term, natural areas costs much less than lawns because they will ultimately minimize maintenance and replacement costs. For lawns, they cost a lot annually on irrigation, aeration, mowing, and replacement.

6. **Hiring Professionals**

Hiring professionals or finding professional volunteers to help a community **to** analyze the current situation and draw up a plan.

Summary

In this part, the methods about protecting the natural environment are mainly in the aspect of protecting natural areas such as forests and open spaces. And many methods are on the planning level. In order to protect the natural environment well, these methods must be combined with more specific methods that are in other parts.

Historic Preservation

Historic preservation means protecting the existence and appearance of historic elements of the community (Work Group for Community Health and Development at the University of Kansas n.d.). These elements include neighborhoods, landscapes, buildings or landscape features. Compared with environmental pollution, traffic congestion, and other mainstreaming issues in the world, historic preservation seems to be insignificant. People generally see historic preservation from the perspective of culture and history. However, historic preservation not only brings us cultural benefits, but also brings us economic and environmental benefits. According to Richard Moe and Patrice Frey, and (Moe and Frey 2009), and the Work Group for Community Health and Development at the University of Kansas (Work Group for Community Health and Development at the University of Kansas n.d.), the benefits include:

1. **Use Resources Efficiently**

Constructing buildings consumes a huge amount of energy and natural resources. In addition, it produces a large number of waste. One study from the United Kingdom found that it takes 35 to 50 years for an energy-efficient new home to offset the carbon expended in constructing it (The Building and Social Housing Foundation; The Empty Homes Agency 2008). Historic preservation reduces energy and natural resource consumption, demolition and construction waste, and saves money by repairing and reusing existing buildings instead of demolishing them and building new ones.

2. **Energy Efficiency**

Some old buildings are as energy efficient as many modern buildings. According to one study, U.S. General Services Administration found that the utility costs of historic buildings in their nationwide building inventory were 27% less than that for more modern buildings (U.S.

General Services Administration 1999). Although there are also many buildings that are not energy efficient, an increasing number of green rehabilitation projects demonstrate that older and historic buildings can go green.

3. **Prevent Urban Sprawl**

Many historic buildings and neighborhoods are located in the central area of a city. In the background of transit-oriented development, rehabilitating historic buildings and neighborhoods in urban areas takes advantage of existing and inherently sustainable features, and reduces pressure for urban sprawl.

4. **Preserves Old Methods of Workmanship**

Modern buildings are generally considered to last for a relatively short time compared with historic buildings. The workmanship and building methods of modern buildings are not as durable as methods used in the past. By historic preservation, modern architects and engineers can learn techniques to improve modern buildings.

5. **Add Character and Uniqueness to a Community**

A historically significant building, neighborhood, or landscape can add character and uniqueness to a community, attract tourists, and lead to other improvements.

6. **Attract Investment and Reinvigorate a Deteriorating Neighborhood**

A historically significant building, neighborhood, or landscape can attract tourists, promote residential or commercial development, and create jobs. In western Massachusetts, by rehabilitating an old mill complex and turning it into the world's largest modern art museum, the town of North Adams has been reinvigorated.

7. **Creatively Reuse An Historic Building That Has Stood Empty**

A historic building can be used for other creative purposes, which may bring development and solve community problems. For example, an empty industrial building can be turned into an affordable or mixed-income residential development. This both rescues the building and provides housing for the community.

8. **Good Investment**

Tax incentives, grants, and other support make historic buildings, neighborhoods, or landscape relatively cheap for businesses to rehabilitate.

According to the Work Group for Community Health and Development at the University Kansas (Work Group for Community Health and Development at the University of Kansas n.d.), historic preservation includes four different methods:

1. **Preservation**

"Preservation is preserving a place as it is in the present." By preserving a building, all of its historic materials will be kept where it is possible for people to restore or repair them. And they will be maintained as they are in the future.

2. **Rehabilitation**

"Rehabilitation fixes up a deteriorated historic property, often for a use other than its original one." Rehabilitation is like preservation. But for features or materials that have been severely damaged by time, it allows more leeway to repair and replace them.

3. **Restoration**

Restoration is transforming a building or landscape into its original condition or the condition at a historically significant time. This will eliminate any repairs or alternations that is later than a specific period, and bring back historic features and materials of that period.

4. Reconstruction

Reconstruction is creating an accurate copy of a historic property that no longer exists or an example of a chosen historical period. The process may use traditional techniques and materials, but the materials will be new.

When we decide if a building, neighborhood, or landscape need to be preserved, we need to consider the following factors (Work Group for Community Health and Development at the University of Kansas n.d.):

- The uniqueness of the building or landscape;
- Community significance;
- Current use;
- The state of repair;
- The cost of preservation vs. that of restoration;
- Community's wishes;
- Restrictions from tax incentives or other funding;
- The availability of the expertise to implement careful preservation or restoration.

Chapter Summary

Chapter 3 mainly discusses 6 categories of design methods of green communities, which include: transportation and density, energy, resources, water, natural conservation, and historic preservation. At the community level, the goal of green communities is to create a living environment that is healthier, safer, more economical, more convenient, and more environmentally friendly than that of traditional communities. At the world level, green communities contribute to solving the issues of climate change, energy crisis, environmental pollution, and global health. A green community not only benefits people who live in it, but also benefits a broader environment. When we are implementing these methods in a community, we must choose appropriate methods based on the practical situation of the community. And the key to create a successful green community is the synergy of different categories of methods. Only by the synergy of these methods, a green community can function best.

Conclusion

Based on the research on green community design methods, we use a table to compare green community design methods with the current redevelopment method that is employed by the government in redeveloping Chinese urban villages (table 3).

Table 3. The comparison between green community design methods and the current redevelopment method in redeveloping Chinese urban villages ("√" means an issue of Chinese urban villages can be resolved by a method).

The Issues of Chinese Urban Villages	The Government's Redevelopment Method	Green Community Design Methods
Extremely high building density	√	√
Extremely disorderly building layout	√	√
Poor building safety and quality	√	√
Poor indoor environment	√	√
Inadequate and poorly maintained infrastructure	√	√
Poor street systems	√	√
Serious environmental pollution	not fundamentally resolved	√
Stormwater runoff issue	not fundamentally resolved	√
Inadequate green lands	√	√
High crime rate	aggravate	partly
Labor market discrimination	aggravate	partly
Social segregation	aggravate	partly
Inferiority	aggravate	partly

By comparing the two kinds of methods, we found that although the government's redevelopment method can resolve some issues of Chinese urban villages, it cannot resolve the environmental pollution issue and the stormwater runoff issue fundamentally. By employing the government's redevelopment method, we can improve the outdoor environment and reduce the consumption of fossil energy, which can reduce the environmental pollution of Chinese urban villages. However, a large number of high-rise buildings in redeveloped urban villages contribute to tremendous energy consumption and the heat island effect, leading to new environmental pollution. Moreover, redeveloped Chinese urban villages still have a large area of impervious pavement, because most areas are used to build buildings and streets. This leads to huge stormwater runoff. In addition to producing new environmental issues, the government's

redevelopment method also produces the issue of historic preservation. There are many historic items distributing in Chinese urban villages. However, during the redevelopment process, developers pay attention to interest and ignore historic preservation, which leads to the destruction of these historic items. Moreover, the government's redevelopment method aggravates some social issues of Chinese urban villages, including high crime rate, labor market discrimination, social segregation and inferiority. After redeveloping a Chinese urban village, most migrants are forced out of the village and have to move to other Chinese urban villages. Without any assistances from the government, these migrants feel helpless and hopeless, which aggravates the issues of social segregation and inferiority. Moreover, with these migrants and transients moving to other Chinese urban villages, there will be more crime and worse living environment in those Chinese urban villages, which will lead to higher crime rate and more serious labor market discrimination.

Compared with the government's redevelopment method, green community design methods can resolve more issues and can resolve environmental issues fundamentally. Even though the methods can only partly resolve these social issues because fundamentally resolving these social issues needs the combination of physical design methods and political methods to change some policies, green community design methods do not aggravate some existing issues and do not generate new issues. Moreover, green community design methods can bring many new benefits that are related to sustainability:

- Saving energy and resources;
- Preserving natural resources;
- Preserving historic items;
- Creating high connectivity and accessibility;

- Removing the “Chinese Slum” label.

Furthermore, Chinese government is advocating sustainable development. Redeveloping Chinese urban villages into green communities contributes to the sustainable development in China. Overall, green community design methods are effective methods to resolve the issues of Chinese urban villages and are better than the government’s redevelopment methods.

CHAPTER 4

CASE STUDY

Chapter 3 discussed a series of design methods of green communities. Chapter 4 will mainly focus on the practical use of these methods. In this chapter, two case studies will present how the design methods of green communities are employed and integrated in successful communities, and one case study will present a successful historic preservation project in China. Moreover, some useful information that can be used in the redevelopment of Huashiying Village will be extracted from these case studies.

Case Study 1: Highlands' Garden Village, Denver, Colorado

Figure 14. Highlands' Garden Village

Project Summary

Project Name: Highlands' Garden Village

Location: Denver, Colorado

Project Type: mixed-use and mixed-income community

Land Use: mixed-income housing, senior housing, open space, school, performing arts facility, retail, restaurant

Project Size: 27 acres, 306 housing unites

Cost: $108.2 million

Completion: residential, 2002; commercial, 2007

Project Team:

Developers: Perry Rose LLC, Jonathan Rose Companies

Urban Planner: Calthorpe Associates, Civitas

Contractor: Palace Construction

Civil Engineer: Martin/Martin

Architects:

Residential: Wolff Lyon, OZ Architecture, Harry Teague Architects, Co-Housing Company

Commercial: Klipp Architecture

Landscape: Lee Weintraub & The Denver Botanic Gardens

Awards:

Urban Land Institute Award for Excellence: The Americas, 2007;

International Economic Development Council Excellence in Economic Development Award, 2006;

US Environmental Protection Agency, Smart Growth Achievement Award, 2005;

US Environmental Protection Agency, Clean Air Excellence Award, 2003.

Site History

Before 1994, the site of Highlands' Garden Village was Elitch's Zoological Gardens (figure 15), a theme park that opened in 1890. It had zoo animals, amusement rides, big-band dances, a theatre, a roller-coaster, and gatherings that hosted the likes of cowboy movie hero Hopalong Cassidy. In late 1994, the amusement park relocated to downtown Denver, which left the former site abandoned (K. Benfield 2010). In 1999, developers Chuck Perry and Jonathan F.P. Rose decided to redevelop the abandoned amusement park into a mixed-use, mixed-income, and pedestrian-friendly community (Urban Land Institute 2008).

Figure 15. Elitch's Zoological Gardens (K. Benfield 2010)

Project Overview

Highlands' Garden Village is an urban community that is located in the northwest of downtown Denver. It takes only 10 minutes to drive from the community to downtown Denver. Highlands' Garden Village is a comprehensive community that includes diverse housing, open spaces, gardens, commercial areas, and cultural amenities (Calthorpe Associates n.d.). It has many green features including mixed land use, transit-oriented development, high accessibility and connectivity, energy-efficient buildings, conservation of natural resources, and preservation of historic buildings. Highlands' Garden Village is a community that connects a diverse group of people, both physically and socially.

Figure 16. The site plan of Highlands' Garden Village (CIVITAS n.d.)

Figure 17. The bird's eye view of Highlands' Garden Village (K. Benfield 2010)

Project Features

1. **Diverse Housing**

Highlands' Garden Village has 306 housing units, which includes 52 single family homes, 20 carriage homes above garages, 38 townhomes and condos, 63 apartments for seniors, 74 rental apartments, 33 homes in a co-housing configuration, and 26 live/work lofts. In order to accommodate residents who are in different income groups, 20% of the homes are designated to be affordable to residents earning 50% or less of the area median incosme. The other homes are market-priced. Highlands' Garden Village not only includes residents of different incomes, but also includes residents of different ages (K. Benfield 2010). The diverse housing fosters increased socio-economic integration and yields a realistic balance of housing types for the

balance of nearby jobs (Calthorpe Associates n.d.). It demonstrates that a small infill site can also accommodate diversity and enhance economic and social viability (Jonathan Rose Companies n.d.).

Figure 18. Housing map

Figure 19. Normal apartments and senior apartments (Highlands' Garden Village n.d.)

2. Land Use, Transportation, and Density

Except for the mixed housing types, Highlands' Garden Village also has mixed land uses including residential, commercial, open space/parks, school, and offices. Moreover, the community has high connectivity and accessibility. The commercial street including retails and offices are within walking distance. The pedestrian-friendly streets provide safe and convenient walking paths, which creates high internal connectivity to primary areas of interest (Calthorpe Associates n.d.). There is a bus line along the north border of the community. It takes only 10 minutes for passengers to get to downtown Denver. Also, there are two other bus lines within half a mile from the community center. Moreover, various external places of interest are within walking distance. Measuring from the center, the area within a half-mile radius includes: four food markets, six restaurants, three coffee shops, six bars, three schools, one city park, four bookstores, five fitness, yoga, and dance facilities, one pharmacy, one hardware store, and eight clothing and music shops (K. Benfield 2010). The housing densities are also varied. The densities range from 54 units per acre at the center to 13 units per acre on the edges to match the density of adjacent neighborhoods (Urban Land Institute 2008).

Figure 20. Land use map

Figure 21. Connectivity analysis

3. Energy, Resources, and Natural Conservation

Highlands' Garden Village is an energy-efficient community and resource-conserving community, and it conserves the natural environment. The features are mainly embodied in the following aspects (K. Benfield 2010):

- 30 tons of concrete from the demolition of the amusement park were recycled into the Highlands' Garden Village street network;
- The Sunflower Market building is certified as the first LEED core and shell Gold Supermarket in the United States;
- All single family homes exceed the Colorado's Built Green and Energy Star requirements;
- All of the buildings incorporate recycled materials, energy-efficient conditioning and windows, and low-VOC products;
- All public buildings and infrastructures are using solar or (purchased) wind energy;
- Xeriscapes are employed in sidewalk plantings and native buffalo grass is employed in lawns to reduce water demand;
- Mature trees from the amusement park were kept.

4. Historic Preservation

The historic Elitch Theatre is in the center of Highlands' Garden Village. It was built in 1890, and has been described as "one of the cradles of American drama." The theatre was listed on the National Register of Historic Places in 1978 and became a landmark in the city of Denver in 1995 (Highlands' Garden Village n.d.). A historic carousel is near the historic Elitch Theatre. In the project of Highlands' Garden Village, the historic Elitch Theatre and carousel building

have been preserved and restored. The historic Elitch Theatre is being renovated by a non-profit organization as a community resource and a center for performing arts. The carousel building has been converted to an outdoor pavilion that features a contemplative labyrinth. It has become a site of various events such as weddings, concerts, and quiet relaxation (Jonathan Rose Companies n.d.). The renovation of the historic Elitch Theatre and carousel building preserves the area's distinctive cultural heritage and attracts people nearby to the community (United States Environmental Protection Agency n.d.).

Figure 22. Historic Elitch Theatre (K. Benfield 2010)

Figure 23. Historic Carousel building (CIVITAS n.d.)

Summary

In 2005, Highlands' Garden Village won the Smart Growth Achievement Award from the US Environmental Protection Agency. According to the US Environmental Protection Agency, the project illustrated the following Smart Growth Principles (United States Environmental Protection Agency n.d.):

- Mixed Land Uses
- Compact Building Design
- Range of Housing Choices
- Walkable Neighborhoods
- Distinctive and Attractive Places
- Preserve Open Spaces and Farmland
- Development in Existing Communities
- Transportation Choices
- Community and Stakeholder Participation

Highlands' Garden Village is a good case about integrating different design methods to create a green community. These methods include:

- Designating diverse housing for residents who are in different income groups to meet their needs;
- Creating mixed land use, appropriate building density and multiple transportation choices to improve the connectivity and accessibility in the community;
- Employing energy-efficient methods and resource-conserving methods to conserve the natural environment;
- Preserving and restoring old building.

Moreover, the size (27 acres vs. 15.9 acres of Huashiying Village), location (both of Highland's Garden Village and Huashiying Village are urban community), and target groups (various income groups) of the project are fairly similar to those of Huashiying Village. Considering the similarity of the two projects, some design methods of Highlands' Garden Village can be employed as references in the project of Huashiying Village. There are four main points that can be extracted from the case study to help the development of Huashiying Village:

1. Diverse Housing

There are different income groups and age groups in Huashiying Village. Creating diverse housing can not only meet the needs of different groups, but also create a diverse population. Moreover, the idea of affordable housing in this case also can be used in Huashiying Village to provide housing for migrants with low incomes;

2. Mixed Land Use

Creating a combination of commercial and residential development not only creates a walkable environment but also provides local people with job opportunities. This idea also can be used in the central area of Huashiying Village. By creating a combination of Chinese traditional-style commercial streets and residential development, we can provide local villagers and migrants with walkable environment and job opportunities;

3. Historic Preservation

In this case, the Historic Elitch Theatre and Historic Carousel building are well preserved. In Huashying Village, there are also many old traditional-style buildings with historical value. By developing a historic preservation strategy for these buildings, the traditional culture of Chinese old villages can be preserved and the building group can become a landmark;

4. The Combination of Tradition and Innovation

The Highlands' Garden Village project not only preserved its traditional elements—the theater and carousel—but also introduced innovative elements—green buildings. This idea can be used in Huashiying Village to create a combination of traditional elements—old traditional-style buildings—and innovative elements—new green buildings.

Case Study 2: Ecolonia, Alphen aan den Rijn, Netherlands

Project Summary

Project Name: Ecolonia

Location: Alphen aan den Rijn, Netherlands

Project Type: mixed-use community

Project Size: 22 acres, 101 housing unites

Completion: 1993

Project Team

Client: Bouwfonds Woningbouw

Town Plan: Lucien Kroll, Brussels

Architects

1. Bakker Boots Van Harren Van Der Donk architectenbureau bv, Schagen
2. Architectenburo — J.P. Moerhlein, Groningen
3. Architectenbureau Hopman bv, Delft
4. BEAR architecten, Architectural and Renovation Consultants, Gouda
5. Architectenbureau Alberts & Van Huut, Amsterdamv
6. Lindeman c.s., Architects and Engineers and Cuyk, Energy Management Consultants
7. Vakgroep FAGO, Faculty of Building Technology, Eindhoven University of Technology
8. Peter van Gerwen — Amersfoort
9. Architectenbureau Archi Service, 's-Hertogenbosch

Project History

The project was initiated in 1991 and was part of an expansion plan in the town of Alphen aan der Rijn. Alphen aan der Rijn is located between the cities of Amesterdam, Hague, Rotterdam, and Utrecht. It is known as Netherland's 'green heart.' The development of Ecolonia was mainly influenced by the National Environmental Policy Plan (NMP) that was introduced in 1989 by the Dutch government. The plan identified three major themes: Energy Conservation, Life Cycle Management, and Quality Improvement. The three themes and their further detailing became the guiding principles in the development of Ecolonia (Vliet and Jones n.d.).

Project Overview

Ecolonia is an urban community that consists of 101 semi-detached and terrace homes. The objectives of the project are to demonstrate and advance sustainable building practices, energy conservation techniques, and more sustainable living practices (Vliet and Jones n.d.). The project includes nine different types of buildings that showcase different energy conservation strategies. Also, it includes a central pond for stormwater management. The other green features include public transport-orientated designs, compact living, mixed land use, natural expansion, pedestrian-friendly streets, and developments based on walking and cycling distances.

Figure 24. The site location of Ecolonia (Med ECO-QUARTIERS n.d.)

Figure 25. The site plan of Ecolonia (Alphen aan der Rijn n.d.)

Project Features

1. **Land Use and Transportation**

Before construction, the site was a moorland with a waterway running along the eastern side and a pond in the center. The design creates main green space and buildings around the central pond. There are many smaller open spaces between groups of buildings and along circulation corridors. Moreover, the design incorporates many local squares that provide identity and opportunities for social interaction.

An objective of transportation in Ecolonia was to reduce the dependence on automobiles. The local center on the northern side is within a 10-minute walk to the regional rail station, and the town center of Alphen aan den Rijn is about a 15-minute walking distance past the station. Cycling and walking are the main modes of transportation. Vehicular routes are designed for

slow speed. In the traffic system, there is no clear separation between different types of traffic. Moreover, Ecolonia has low noise levels and improved safety, because it is away from any thoroughfare (Vliet and Jones n.d.).

2. Energy

An important objective of the project was to employ a number of techniques to effectively demonstrate energy conservation strategies. These techniques are mainly employed in buildings. There are nine types of buildings (figure 26) that are considered within the three NMP themes: Energy Conservation, Life Cycle Management, and Quality Improvement. Each type of building focuses on one of the themes. The diversity of housing typologies demonstrated effective energy conservation techniques ranging from solar water heater to maximizing heat storage. Except for these techniques, the more general energy conservation strategies include (Vliet and Jones n.d.):

- Orientation of buildings are designed for maximizing solar collection;
- Using better building envelope design to improve insulation;
- Implementing space-heating systems that have a low environmental load and high efficiency;
- Using efficient appliances to reduce the consumption of gas and electricity;
- 61 dwellings use controlled ventilation with heat recovery, 32 dwellings use controlled ventilation without heat recovery, and 8 dwellings use natural ventilation;
- Approximately 80 dwellings use solar collectors for water heating;
- Energy-efficient lighting is used both indoors and outdoors;
- Adding an insulating layer in concrete flooring sections;

- Using recycled wood cellulose as insulation for cavity and roof insulation.

Figure 26. Different types of buildings (Vliet and Jones n.d.)

3. Water

The central pond is designed as a wetland habitat and a retention pond for stormwater management and maintaining the subsoil conditions (figure 27). Stormwater is conducted into the pond and a variety of wetland plants filter pollutants to reduce non-point source pollution. Other features related to water include (Vliet and Jones n.d.):

- Using water saving fixtures in buildings;
- Using water flow meters;
- Using cisterns to collect rainwater for flushing toilets, watering grass, and washing automobiles;
- Replacing bitumen-based surfaces with concrete pavers;

- Using vitrified clay drains and sewer pipes rather than plastic or iron drains and sewer pipes.

Figure 27. The central pond (MartinBondPhotos n.d.)

4. Waste Management

Another objective of the project was to minimize waste. The choices of types and quantities of construction materials and construction techniques were considered in the design process. The systems that are used by residents in the post-construction phase and future were also taken into consideration to minimize the amount of waste and the impact on the natural environment. The design includes an environment station that is used for collection plastics, textiles, paper, and oil; it also includes a bay for car washing to drain special waste water. More general examples of recycling and materials selection include (Vliet and Jones n.d.):

- All structures use concrete “ecopiles” that contain 20% concrete rubble granulate rather than gravel aggregate;

- Non-load bearing walls and roof panels are insulated with cellulose (recycled wood fiber);
- PPC piping is used for internal drains rather than PVC piping.

5. Economy

In the early stages, the costs of building Ecolonia were higher than the costs of a traditional community. However, the operation costs of Ecolonia are significantly lower than the surrounding communities (Vliet and Jones n.d.). In the long term, the life cycle costs of Ecolonia will be much lower.

Summary

Ecolonia is another good case of integration of different green design strategies. Its green strategies that are helpful for the redevelopment of Huashiying Village include:

1. Green buildings

The energy conservation strategies and water saving strategies can be used in the new buildings in Huashiying Village to maximize the consumption of energy and natural resources;

2. The central pond for stormwater management and as a focal point

Considering the limited space of Huashiying Village, creating a central landscape with a stormwater management function can use the land efficiently. The landscape can not only be a recreational space but also an effective stormwater management facility.

3. Small open spaces

In Huashiying Village, because of the high density of old buildings, there is no big, open space. Creating some small green open spaces in existing building layout and along circulation corridors is a good idea to make full use of these spaces and improve the greening rate.

Case Study 3: The Broad and Narrow Alley, Chengdu, China

Project Summary

Project Name: The Broad and Narrow Alley

Location: Chengdu, China

Project Type: historical and cultural protection district, commercial district

Land Use: residential, commercial, open space

Project Size: 16.3 acres (building area: 10.9 acres)

Cost: $100 million

Completion: 2006

Developer: Chengdu Wenlü Group

Project History

In 310 BC, the first master of Sichuan Province, Zhang Ruo, imitated the model of Xianyang City and built "the new town of wesyernChengdu." The eastern side of the new town was named "Dacheng" and the western side was named "Shaocheng." In 1718, the government sent 3000 soldiers to Tibet to suppress the rebellion. After the rebellion, the government left a thousand soldiers to guard Chengdu and built the city which is Shaocheng today. During the Xuantong period of the Qing dynasty, the Broad Alley was called Xingren Alley, and the Narrow Alley was called Taiping Alley. Also, the Jing Alley was called Ruyi Alley (Baidu Baike n.d.). The Broad and Narrow Alley has a history of more than 2,300 years. Thus, it deserves to be called "the soul of the Chengdu soul (Lv, Su and Qu 2012)." Before developing the area, it was a residential area with some traditional businesses. The local residents ran teahouses, stores and inns in their own houses.

Project Overview

The Broad and Narrow Alley is one of the three major historical and cultural protection districts in Chengdu, Sichuan Province, China. It is composed of three old-fashioned city streets (Broad Alley, Narrow Alley and Jing Alley) and the traditional courtyards among them. In June 2008, the renovation project of the Broad and Narrow Alley, which had lasted for 3 years, was finished. Based on deep research-based planning, the developer, Chengdu Wenlü Group, turned the district into a tourist and business district with historical and cultural characteristics. The new Broad and Narrow Alley includes 45 late Qing Dynasty-style courtyards, the Western-style gardens, the new boutique hotels, and other distinctive buildings.

The goal of the project was to implement a protective renovation for the district and transform it into a tourist and business district with historical and cultural characteristics. By repairing old buildings and streets and establishing new buildings with traditional style, the developer wanted to preserve the history and culture of the Broad and Narrow Alley. Also, they wanted tourists to understand the history and culture and experience the local residents' lives. They also wanted to stimulate consumption and promote the local economic development by transforming most residential buildings into commercial buildings. Finally, the developer wanted this district to become a representative place of Chengdu.

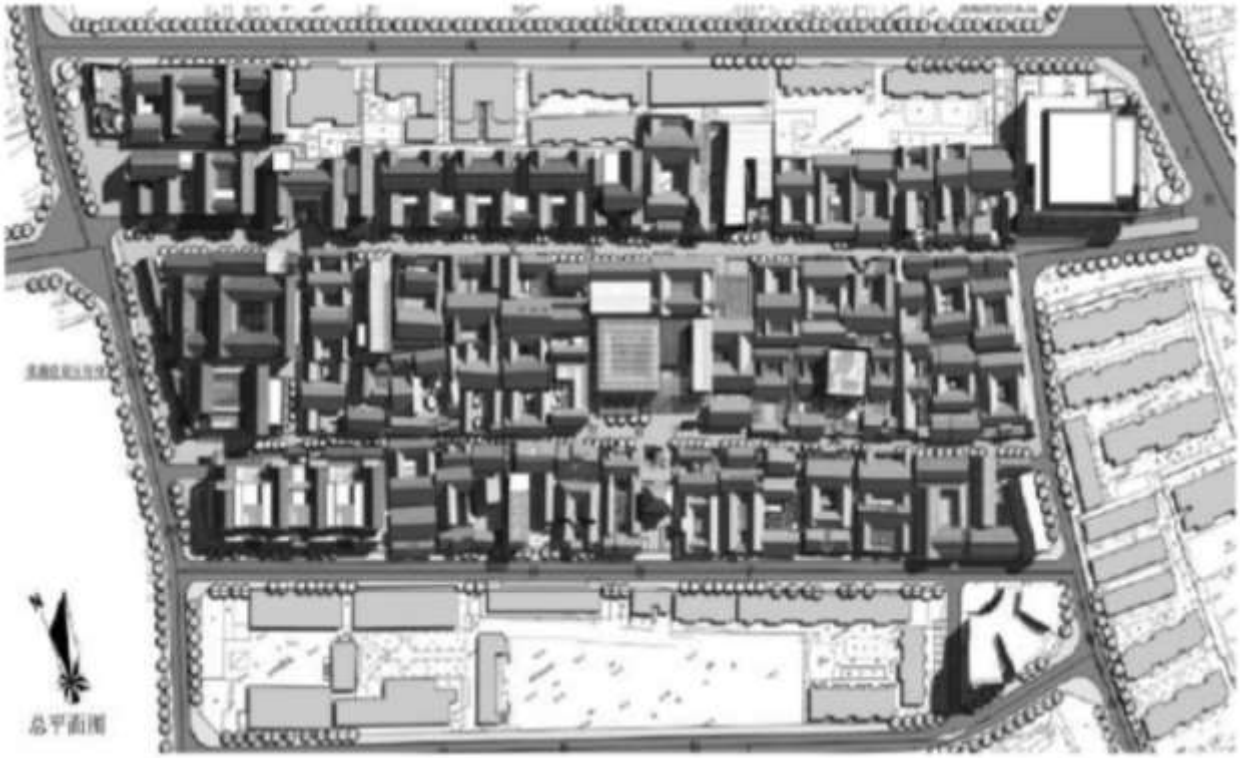


Figure 28. The site plan of the Broad and Narrow Alley (Baidu n.d.)

Figure 29. The bird's eye view of the Broad and Narrow Alley (Chengdu Culture & Tourism Assets Operation Management Co., Ltd n.d.)

Historic Preservation Strategies

According to Long (She 2006), there are six preservation principles of the Broad and Narrow Alley:

- Integrality: Protect the integral form of the Broad and Narrow Alley including humanity and nature that constitute the integrality;
- Authenticity: A certain proportion of original buildings and environments must be preserved to create a real historical environment;
- Diversity: Buildings in different periods should be preserved to create diversity;
- Urban Ecological Protection: Protect the ecosystem in the area;
- Interest Protection: Protect the interests of existing residents;
- People must understand that protection is a kind of development.

In the Broad and Narrow Alley, buildings were classified into six categories for preservation, including (She 2006):

First Class: historical buildings that are well preserved or reconstructed;

Second Class:

1. Original architectural patterns are preserved with a part of building components that are damaged;
2. Original architectural patterns are vague, but building components are undamaged;

Third Class: original architectural patterns and building components are both damaged;

Fourth Class: modern buildings with traditional style;

Fifth Class: modern buildings that have negative effects on traditional style;

Sixth Class: illegal buildings and historical buildings that have lost style and features.

According to the preservation principles, there are six strategies for different categories of buildings:

Preservation: Preserve intact historical buildings or repair a small number of building components. This strategy is suitable for first class buildings and second class buildings with intact important building components;

Rehabilitation: Keep original architectural patterns, style, and external environments, and focus on the interior renovation of buildings. This strategy is suitable for most of the second-class buildings;

Restoration: Restore a building according to its original style and features. This strategy is suitable for third-class buildings;

Renovation: Renovate a modern building with bad style and features. Replace existing style and features with traditional ones. This strategy is suitable for fourth-class buildings;

Reconstruction: Demolish buildings with bad quality, style, and features and reconstruct new buildings with traditional style and features. This strategy is suitable for fifth- and sixth-class buildings;

Removal: Move surrounding traditional dwellings in good conditions into the project site.

Figure 30. Building restored after the project (An-design Architects n.d.)

Summary

Nowadays, in the city of Chengdu, the new Broad and Narrow Alley has become one of the most famous scenic spots and a successful commercial district with the preservation of its culture and history. This is a good case about historical building preservation and developing business to improve the district. These strategies can be used as references in the redevelopment of Huashiying Village. By developing traditional-style commercial streets in Huashiying Village, we can not only preserve the old traditional-style buildings but also create job opportunities for local people.

CHAPTER 5

DEVELOPING A DESIGN PROPOSAL FOR HUASHIYING VILLAGE

Site History

Huashiying Village was established in 1949 and the buildings were used as employee dormitories at first. There are still some original residents who have been living there for more than 60 years. After the 1970s, with the rapid economic development in China, Beijing, the capital, became one of the first cities to undergo rapid development. Many new buildings were built around Huashiying Village. Original residents gradually moved out as many migrants moved into the village. Finally, Huashiying Village became an urban village in Beijing (Du 2014).

Site Location

Huashiying Village is one of Beijing's sixty-five urban villages waiting to be demolished and then redeveloped within 5 years. It is located in the south of Beijing's Chaoyang District (figures 31 and 32), which is one of the most prosperous districts in Beijing. According to one study from the Bureau of Chaoyang District Investment (Beijing Chaoyang District Government 2011), in 2010, the GDP (Gross Domestic Product) of the Chaoyang District was 266.65 billion yuan (42.9 billion dollars), which ranked second among Beijing's six major districts. Huashiying Village is in a small, trapezoidal block that is surrounded by three major roads (figure 33). In this area, in addition to the village, there is a large parking lot, as well as some residential and commercial buildings that surround Huashiying Village. This area also adjoins Beijing's central

business district, where most famous multinational and Chinese enterprises have established their headquarters, such as Motorola, HP, Samsung, Deutsche Bank and China Central Television. So many magnificent skyscrapers and some high-value urban parks surround Huashiying Village, which results in a striking contrast between the village's environment and its surroundings.

Figure 31. Beijing's location in China

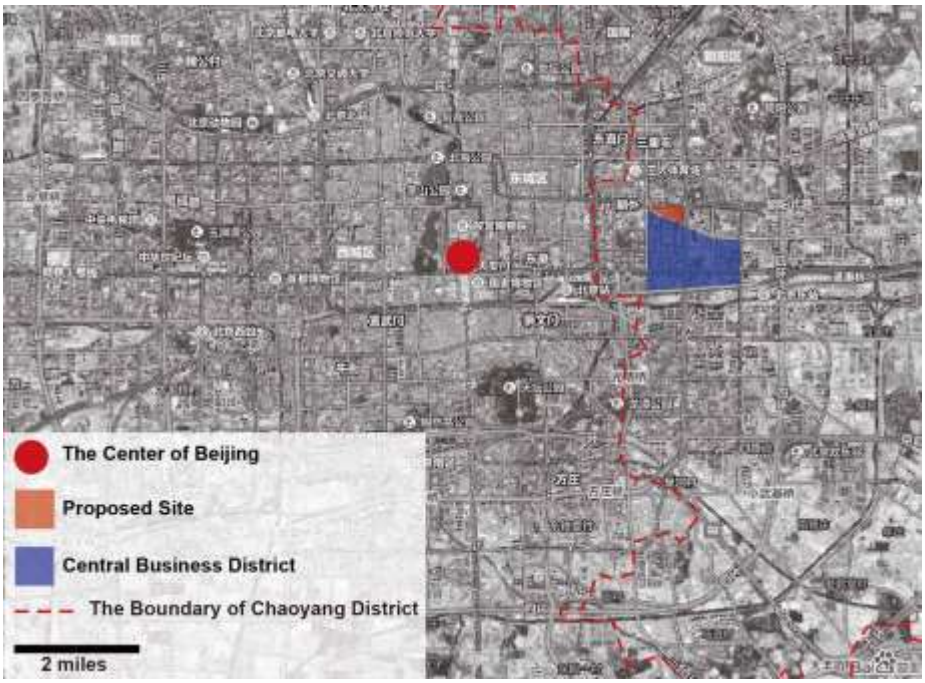


Figure 32. Huashiying Village's location in Beijing

Site Area

The total area of the block is 38.2 acres. The area of the proposed site is 15.9 acres, including Huashiying Village (9.6 acres), a parking lot (5.3 acres), and an abandoned road (1 acre) (figure 33).

Figure 33. Huashiying Village and its surroundings

Figure 34. The path of the site investigation

Site Investigation

In February 2015, we conducted a site investigation in Beijing. Figure 34 shows the path of the site investigation. The investigation mainly focused on the following aspects:

Building

According to the investigation, there are legal and illegal buildings in Huashiying Village. The legal buildings include all of the old houses that were built in 1949 and several buildings that were built after the 1970s. The old houses are Chinese traditional-style buildings with brick structure and pitched roofs (figure 35). These buildings are mainly occupied by local villagers. Villagers live in these houses while, at the same time, transforming them into restaurants, stores or rental housing (figure 36) to make a profit. However, these legal buildings are only in a minority. Most buildings are illegal. These buildings are built by local villagers after the 1970s when a large number of migrants came to Beijing for development opportunities. Local villagers seized the opportunity to build many houses illegally with the intent to lease them for profit. Because there was no formal building plan for these houses, they were built casually and without order. This led to extremely disorderly building layout. Most of the illegal buildings are simply built up against the walls of larger buildings (figure 37). These houses seriously block the streets in Huashiying Village, which makes the street network narrow and disorderly. In addition, these houses have poor structural integrity, which may lead to safety issues. Only a small portion of these houses are built with brick. Most of them are built with thin plastic or wooden boards (figures 38 and 39). The poor structure leads to poor thermal insulation. Considering the cold weather in Beijing during winter, it would be very hard to live in these houses for the winter. Many houses do not have windows. Even though some of them have small windows, tenants always close the windows or use plastic boards to cover them because of

security issues. This leads to poor lighting and ventilation conditions. Also, building too many illegal buildings leads to very high housing density, which leads to the lighting and ventilation conditions becoming even worse. Because the lighting conditions are poor, many residents have to turn on the lights during the day, which wastes energy and money. Moreover, because of the shortage of infrastructure in energy, most people have to use coal as a main energy supply. This leads to serious air pollution in Huashiying Village, which is harmful to the people living there. Furthermore, these houses are unsightly and dirty. Their walls are covered with flyers. Many eaves and windows are stained with kitchen fumes (figures 40 and 41). In many houses, the interior environments are also dirty and shabby (figure 42). Next to Huashiying Village, there are standard residential buildings with good conditions (figure 43).

Figure 35. Chinese traditional-style buildings (nipic n.d.)

Figure 36. An old house being transformed into a restaurant

Figure 37. Illegal houses being built against the wall of a larger building

Figure 38. An illegal house built with plastic boards

Figure 39. An illegal house built with wooden boards

Figure 40. A wall covered with flyers

Figure 41. A window heavily stained with kitchen fumes

Figure 42. The interior environment of an illegal house

Figure 43. Standard residential buildings

Outdoor Environment

The illegal buildings and high housing density lead to Huashiying Village's streets becoming disorderly and narrow. The main street starting from the entrance is the only relatively wide street (figure 44). The width of it is around 16 feet. Along the street, there are waste recycling stations, grocery stores, hardware stores and restaurants that are operated by local villagers or migrants. This street is the busiest street in Huashiying Village. However, the other streets are very lifeless and narrow. Most streets are three to four feet wide. The narrowest point is only two feet wide (figure 45). Due to the narrow and chaotic street system, Huashiying Village is like a maze for people unfamiliar with it. In addition to this, many streets have been badly damaged, which is in convenient for pedestrains. On the periphery of Huashiying Village, because of the poor environment and crime issues in the village, walls are built to separate the village from its surroundings. This reduces its contact with the outside world and makes it a relatively independent region. The sanitation conditions are also very bad. Trash is everywhere and wastewater is poured out on the ground (figures 46 and 47). Sundries are casually placed outdoors, and clothes are hung out on clotheslines. Local residents have grown accustomed to the situation. The infrastructure is inadequate and outdated. There is a limited number of trash cans that are used by more than one thousand residents. These trash cans are exceptionally filthy. The utility poles are old and in a state of disrepair, various pipelines have been installed in a disorganized fashion, and electric wires are twisted (figure 48). The shortage of streetlights makes the village very dark at night. However, just outside Huashiying village, the environment is totally different. Next to the village, there is boulevard that is wide and clean, with adequate surrounding infrastructure (figure 49). This highlights the poor living conditions in Huashiying Village.

Figure 44. The main street in Huashiying Village

Figure 45. The narrowest streets

Figure 46. Wastewater gathered in broken pavement

Figure 47. Filthy trash cans

Figure 48. Twisted electric wires

Figure 49. The boulevard next to Huashiying Village

The People in Huashiying Village

According to the investigation, there are about 1,000 people living in Huashiying Village. More than half of them are migrants. These migrants are called Beijing drifters[4]. They are the main sources of Beijing's cheap labor market. Their education levels are low and they are performing low-income jobs such as workers, scrap collectors, and waiters. Because of their low incomes, they have to rent cheap rooms in the village. Their rooms are usually 30-45 square feet, which can only accommodate a bed. They have to share a public toilet and a limited number of sinks and trash cans. Beijing drifters' lives are difficult. For local villagers, their lives are a little bit better. They live in their own houses without the pressure to pay for rent. They make a living mainly by leasing parts of their houses to migrants and some of them are running small businesses in Huashiying Village, such as operating small stores and restaurants (figure 50). There are also many transients with low incomes or without work in Huashiying Village every day. These people have become the majority contributors to the ranks of local criminal groups. In 2013, a serious fight happened there which lead to one casualty and two people seriously injured. In order to prevent crimes, a security station has been built at the entrance of the village (figure 51). Despite the poor living conditions and security issues, Beijing drifters still prefer to rent a living place in this village, where it is much cheaper than in surrounding areas. They dwell in these shabby and small homes, dreaming of their idealcity life.

[4] Beijing drifters are hundreds of thousands of young people who are drawn to live in the capital, Beijing, where they believe they will have more economic and cultural opportunities (People's Daily Online 2013).

Figure 50. People in Huashiying Village

Figure 51. The security station

Surroundings

There is a strong contrast between Huashiying Village's environment and its surroundings. In this block, there are many residential and commercial buildings forming the outer perimeter of Huashiying Village. These buildings were built after the 1970s and are in good conditions. Beijing's central business district (CBD) is located to the south of the village (figure 52). It is one of the most prosperous areas in Beijing where there are many big companies, luxurious apartments and high-value urban parks. It is the gathering place of high-income groups. Just separated by a road, people's lives in Beijing's CBD and Huashiying Village are totally different.

Figure 52. Beijing's central business district (Baidu Tupian n.d.)

Conclusion

After the research and site investigation on Huashiying Village, we found that this village has all of the typical environmental and social issues that an urban village has, including:

- Extremely high building density
- Extremely disorderly building layout
- Poor building safety and quality
- Poor indoor environment
- Inadequate and poorly maintained infrastructure
- Poor street systems
- Serious environmental pollution
- Stormwater runoff issue
- Inadequate green lands, open spaces and vegetation;
- High crime rate
- Labor market discrimination
- Social segregation
- Inferiority
- Lack of housing among migrants

These issues can be resolved by green community design methods and the methods that are used in the three cases. Table 4 shows the connection between these issues and methods.

Table 4. The connection between the issues of Huashiying Village and methods (the category of green community design methods and case studies to which each method is relevant is indicated after each method)

Issues	Methods
Extremely high building density	Demolish illegal buildings. Arrange new buildings with appropriate density and clear building layout (Density and Transportation)
Extremely disorderly building layout	
Poor building safety and quality	Use affordable housing with better safety, quality and indoor environment to replace illegal buildings and damaged buildings (Highlands' Garden Village)
Poor indoor environment	
Inadequate and poorly maintained infrastructure	Promote the construction of infrastructure in transportation, electricity, telecommunication, sports, sanitation, stormwater management and education (Density and Transportation) (Water) (Energy)
Poor street systems	Develop a new street network to improve internal connectivity and strengthen the connection between Huashiying Village and its external environment. Design new street landscapes to improve the street environment in Huashiying Village (Density and Transportation)
Serious environmental pollution	Build green buildings as affordable housing and employ new stormwater management (Energy) (Water)
Stormwater runoff	Employ new stormwater management (Water) (Ecolonia)
Inadequate green lands, open spaces and vegetation	Create open spaces and green lands (Ecolonia)
Lack of housing among migrants	Building affordable housing for migrants (Highlands' Garden Village)

By employing physical design methods to resolve the environmental issues of Huashiying Village, we can provide migrants with better living environment. This can also help resolve some social issues: high crime rate, labor market discrimination, social segregation and inferiority. Moreover, the government pays close attention to this village because of its central location. It has put the redevelopment of Huashiying Village on the schedule. Considering the representativeness and importance of Huashiying Village, we will use this Village as an experimental site to explore the employment of green community design methods in redeveloping Chinese urban villages.

Site Analysis

According to the research on green communities detailed in chapter 3, a site analysis that is based on the aspects of green communities has been conducted in Huashiying Village and its surrounding areas.

Existing Building Use

By analyzing building use in this block, we found that the block has mixed-use development that includes residential, commercial, and institutional building use. Figure 53 shows the building use in this block. In the block, most buildings are residential buildings, and some of them include commercial use of the first floor. Residential buildings are mainly concentrated on the center and northern side of the block. Commercial buildings are mainly concentrated at the center and northern side of the block, and are surrounded by commercial buildings along the periphery of the western and southeastern sides. Although there are only four institutional buildings, they are important buildings that include a hospital, a community service center, a police station, and a security office. The block has high building density because of its central location in Beijing. The combination of high building density and mixed building use provides people with more choices for services in a short distance. This contributes to a high walking rate and a low driving rate, which could reduce automobile exhaust and promote people's health. Although high building density brings many benefits, extremely high building density may lead to a shortage of open space, which can hinder people's communications and health. Huashiying Village is an example of overcrowding, with very little open space.

Existing Building Types

In the block, there are three types of buildings (figure 54): Chinese traditional-style buildings built in 1949, modern buildings and illegal buildings built after the 1970s. All of the

illegal buildings are concentrated in Huashiying Village. The large number of these buildings causes extremely high building and population density in the village. Moreover, these buildings were built on top of former streets, which blocks the streets and makes the roadway disorderly.

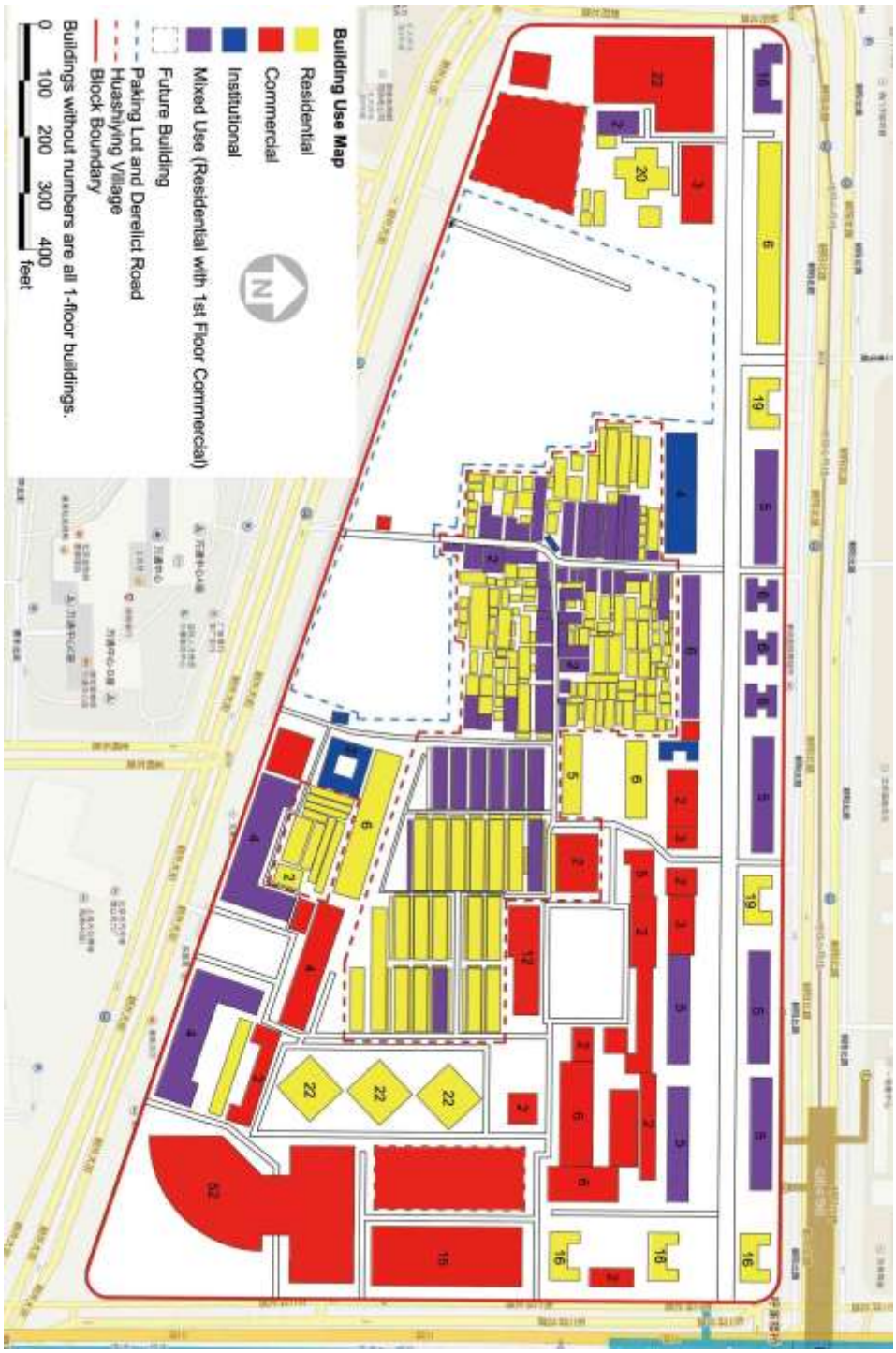


Figure 53. Building use map

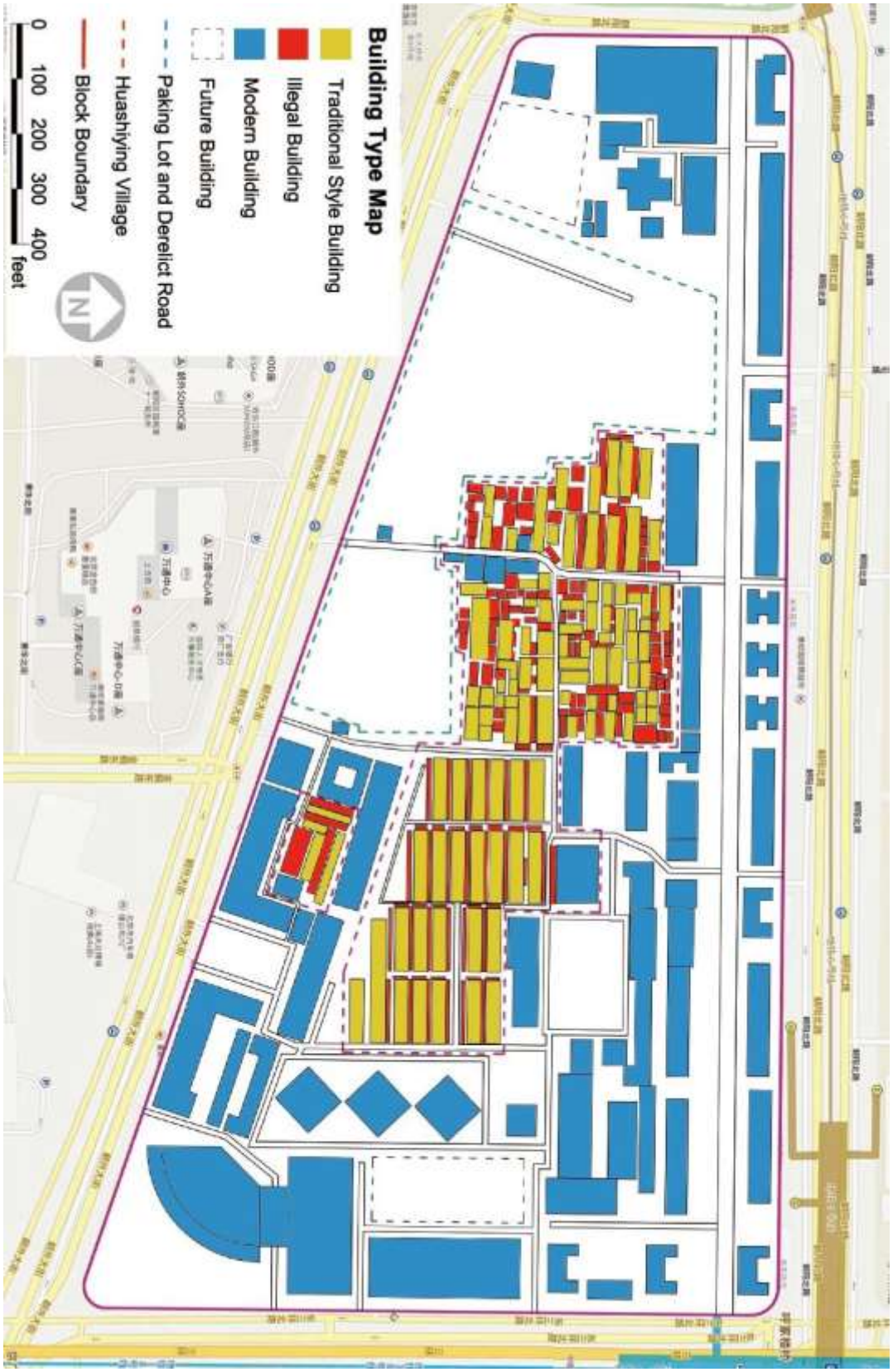


Figure 54. Building type map

Accessibility Analysis

Accessibility analysis, analyzing the accessibility of places of daily interests, has been conducted as a part of this study, starting from the center of Huashiying Village and moving outward towards the surrounding roads. Figure 55 shows the distribution of the places of daily interests near Huashiying Village. Figure 56 shows the category of places of daily interests. Measuring from the center of Huashiying Village, places of daily interests within a 0.3-mile radius include: bus station, subway station, bank, restaurant, retail store, gas station, hospital, entertainment, supermarket, car repair and service, mobile store, pharmacy, community service center, photo shop, massage, salon, print shop, bar, laundry, weight-loss center, coffee, express delivery services, post office, police station, and security office. Various places of daily interests are within walking distance and they provide people with multiple choices. The analysis demonstrates that there is high accessibility in this block.

Connectivity Analysis

Connectivity analysis analyzes Huashiying Village's connectivity to main roads and surrounding areas based on the existing road circulation (figure 57). In the block, there are four levels of roads. Analyzing the road system has revealed some connectivity issues. Firstly, there are four roads connecting Huashiying Village to its surroundings: two roads connect Huashiying Village to the northern side of the block, and two other roads connect Huashiying Village to the southern side of the block. However, there is no direct connection between Huashiying Village and the western side of the block. Moreover, the roadways in the eastern part of the block are too disorderly to directly connect Huashiying Village to the main road at the eastern perimeter. Secondly, there is no road that connects the western perimeter to the eastern perimeter through the center of the block. Thirdly, there is no road mainly for automobiles to connect the northern

perimeter to the southern perimeter. Fourthly, the chaotic arrangement of the roads lowers people's sense of direction and makes it difficult for people to reach their destinations. Additionally, there are many dead ends in the block that lower the connectivity of the roads.

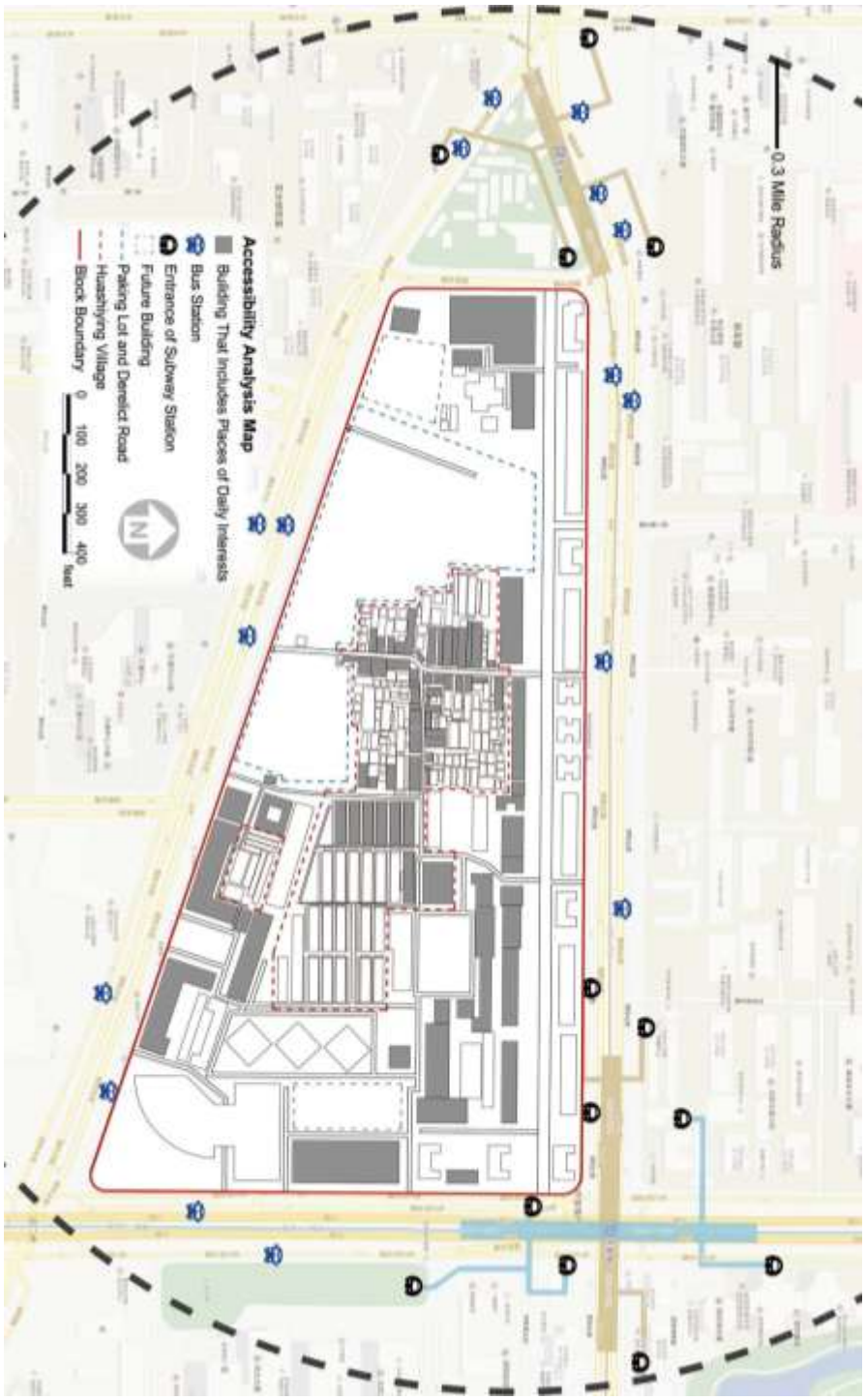


Figure 55. Accessibility analysis map

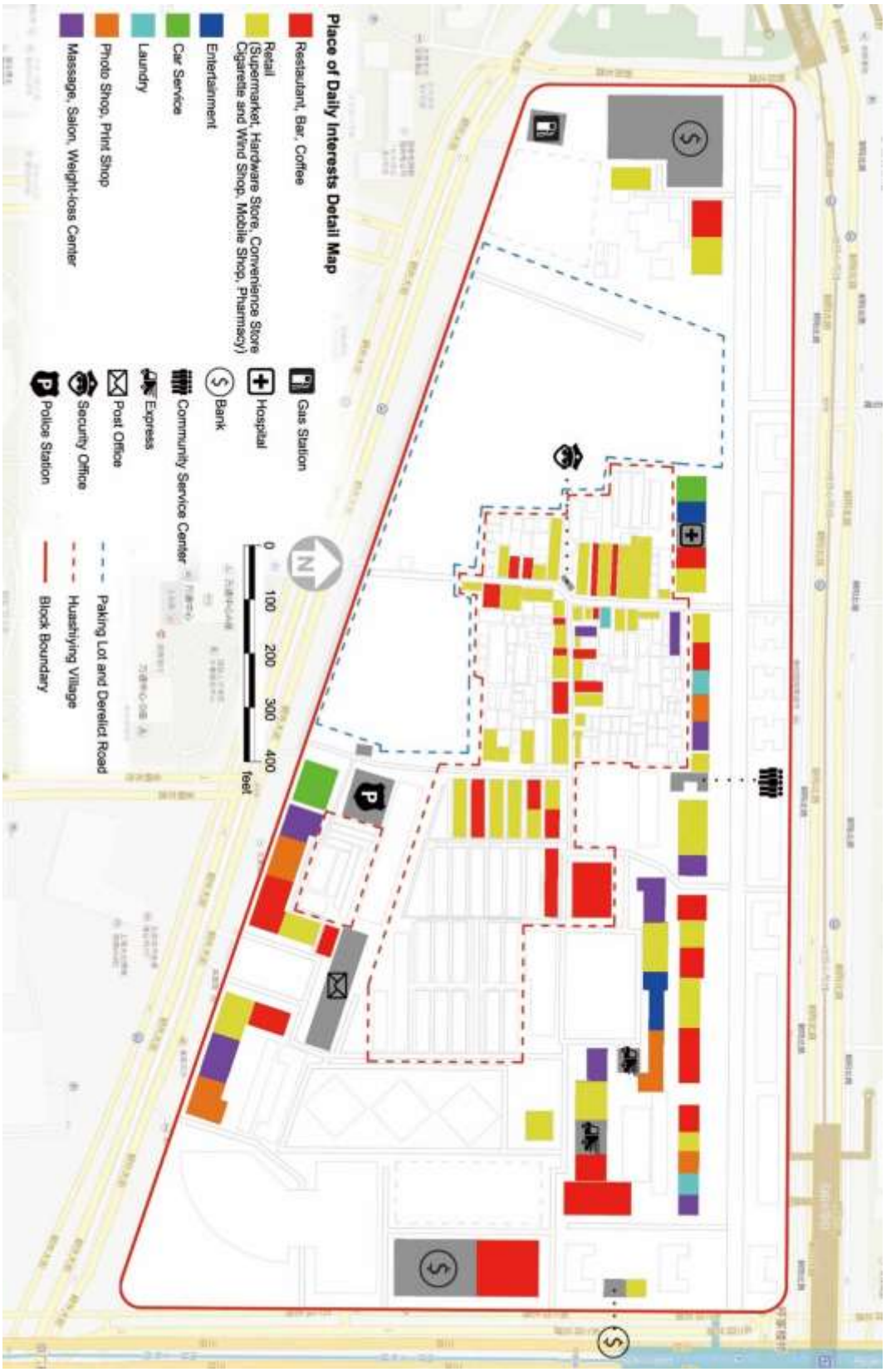


Figure 56. Places of daily interests detail map

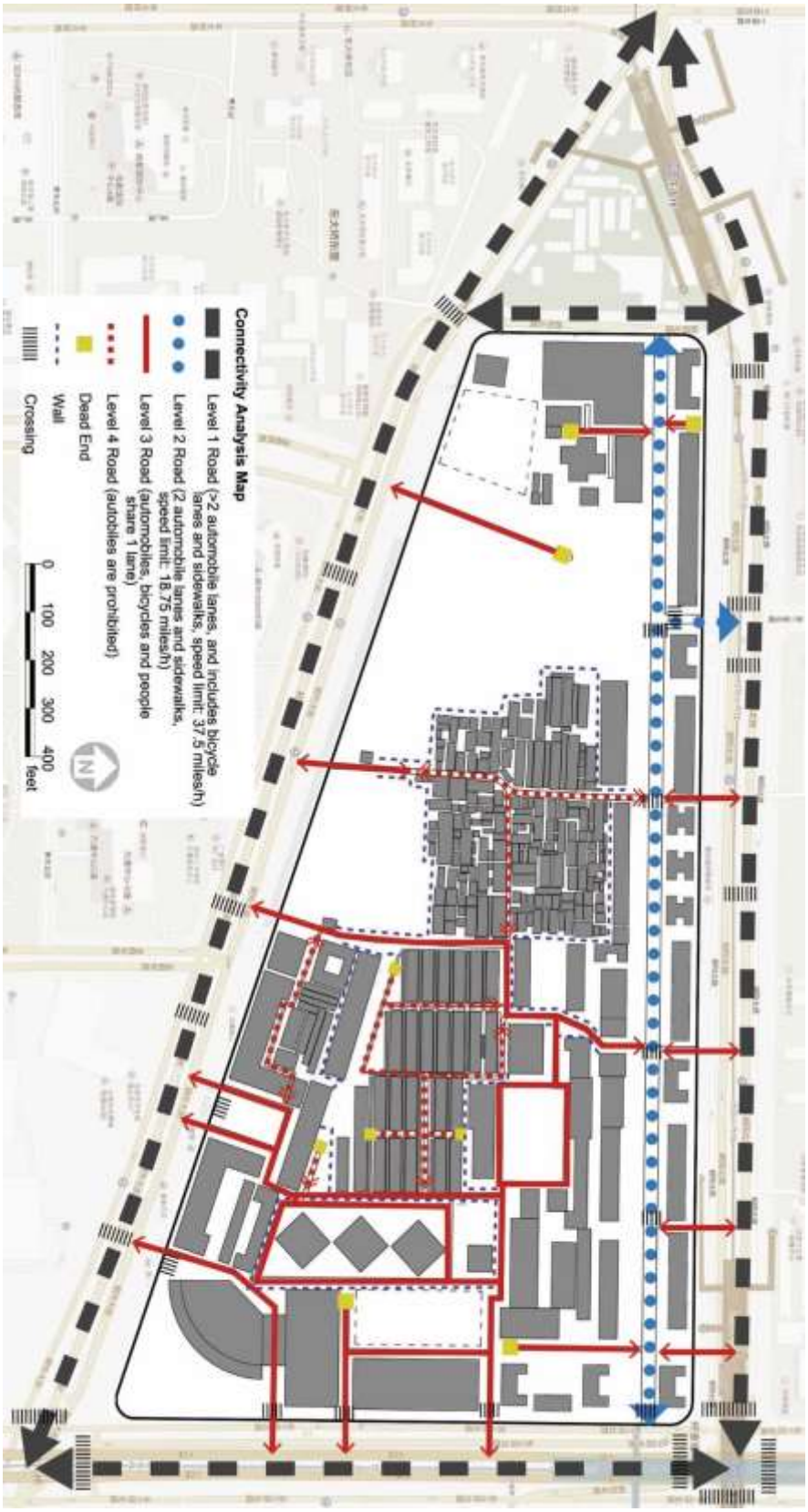


Figure 57. Connectivity analysis map

Road Detail Analysis

There are four levels of road. The level 1 road (figure 58) has a complete structure that includes traffic lanes, bicycle lanes, median strips with planters, and sidewalks with trees. The speed limit of a level 1 road is 60 km/h (37.5 mph). The level 2 road (figure 59) includes two-way traffic lanes that are shared among automobiles, bicycles, street parking, and sidewalks with trees. The speed limit is 30 km/h (18.75 mph). Level 3 roads and level 4 roads (figure 60) have poor structure and conditions, and they are very narrow. Additionally, they lack street landscaping such as trees and shrubs, which makes the streets appear relatively dull. Also, level 3 roads are shared among automobiles, bicycles, and pedestrians, which may cause safety issues.

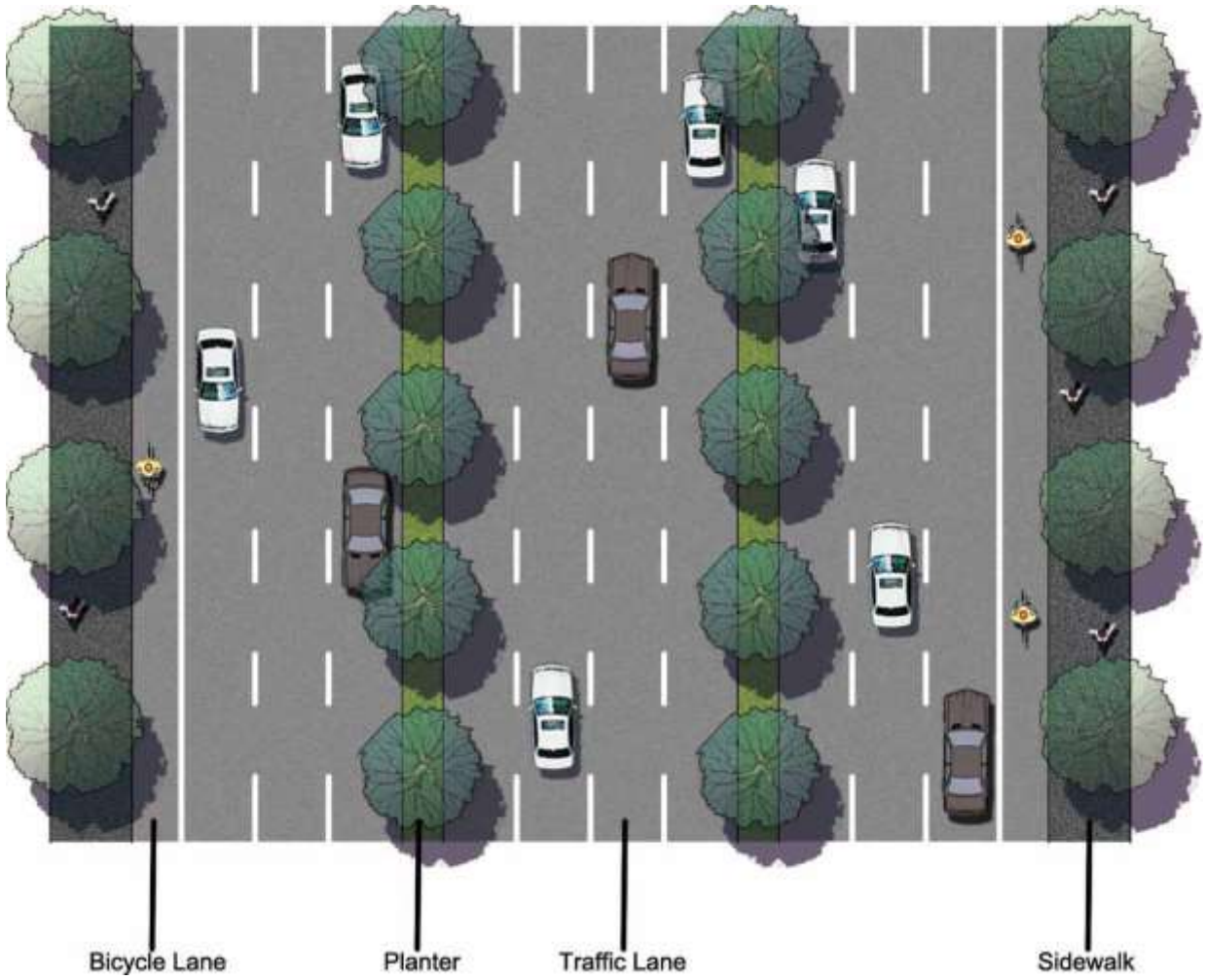


Figure 58. Level 1 road plan

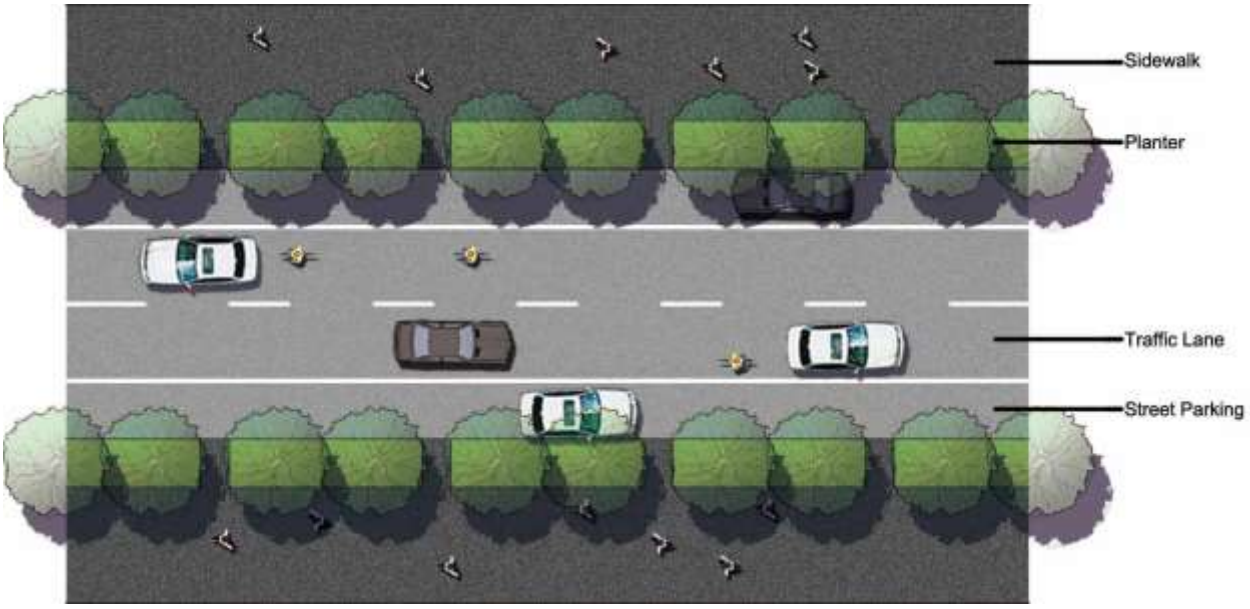


Figure 59. Level 2 road plan

Figure 60. Level 3 and 4 roads

Wall Analysis

The wall surrounding Huashiying Village (figure 61) is an important factor that reduces the connection between Huashiying Village and its external environments. The wall is around 8 feet high and made of concrete brick. It is hard and impervious. The wall completely separates Huashiying Village from the surrounding buildings and creates an enclosed space within the village. These walls have become a label of Huashiying Village, warning people that it is a poor and unsafe place.

Figure 61. The wall that surrounds Huashiying Village

Traditional Elements Analysis

As for old villages in Beijing, their traditional elements generally include: Chinese traditional-style buildings, the traditional layout pattern of Beijing's old villages (figures 62 and 63), villagers' traditional daily activities, and traditional businesses. Chinese traditional-style buildings have brick structure and pitched roofs. In Beijing, the traditional layouts of old villages were formed naturally as time progressed. They include groups of four buildings with an enclosed space in the center, called *Siheyuan* in China (figure 64), or many buildings that are built side by side with narrow lanes between them, called *Hutong* in China (figure 65). In Beijing, villagers' traditional daily activities include playing Chinese chess, tea-tasting, bird watching, and singing Beijing Opera (figure 66). These activities usually happen in courtyards that are enclosed by buildings. Traditional businesses include restaurants with traditional Beijing foods, traditional snack shops, traditional handiwork stores, and teahouses (figure 67). However, except for Chinese traditional-style buildings, the other traditional elements have disappeared in Huashiying Village. If the government's redevelopment method is implemented in Huashiying Village, the Chinese traditional-style buildings will also disappear.

Figure 62. The layout of a Beijing's old village

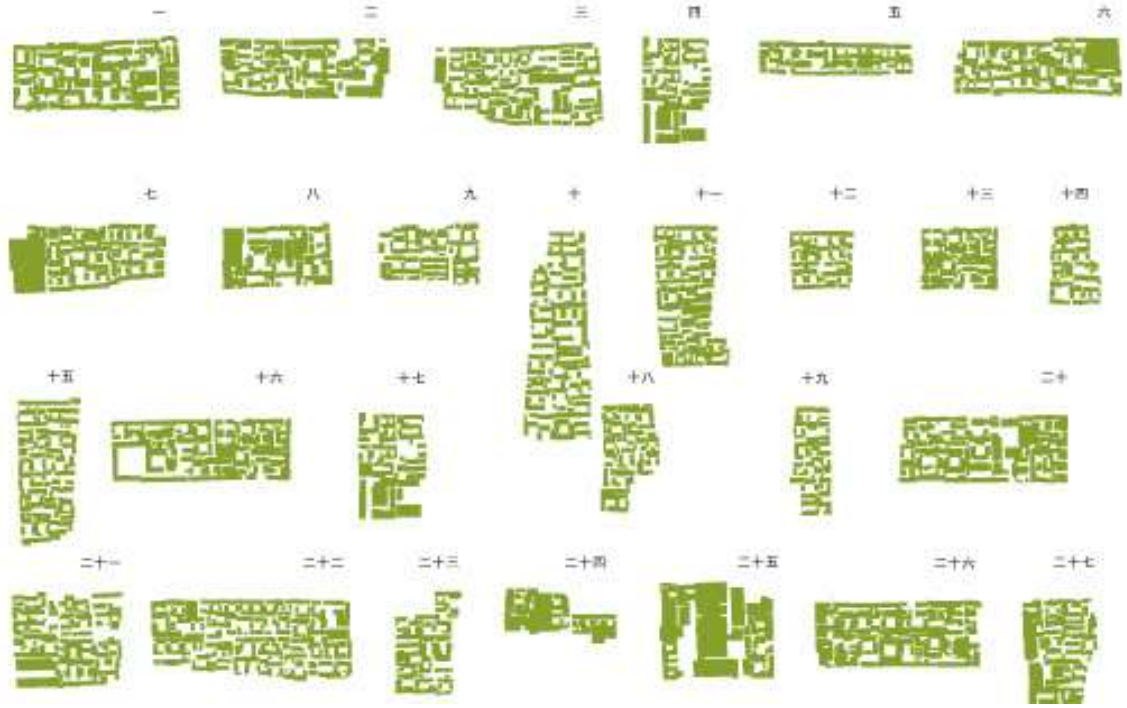


Figure 63. The layout patterns of Beijing's old villages (Hutong 2009)

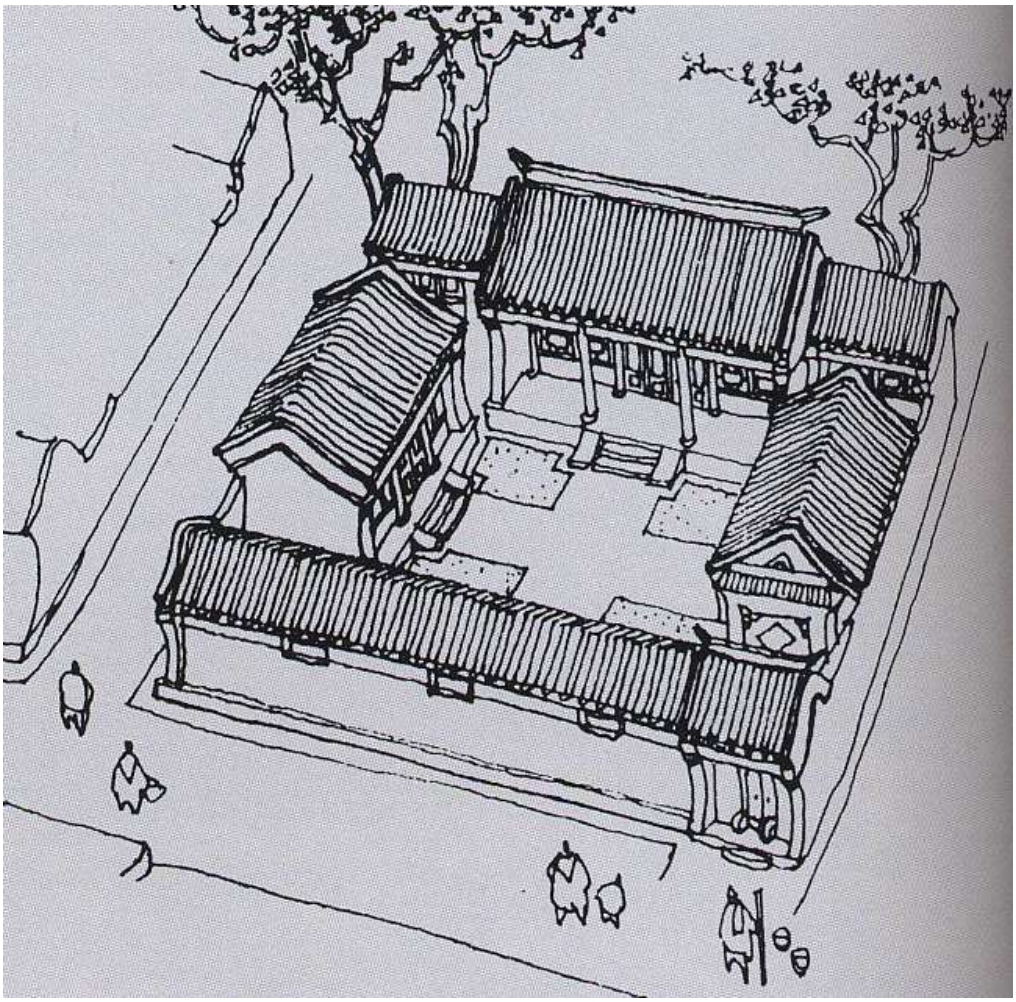


Figure 64. The Structure of Siheyuan (Sina 2011)

Figure 65. Beijing's Hutong (edwin 2013)

Figure 66. Villagers' traditional daily activities in Beijing

Figure 67. Beijing's traditional businesses

Stormwater Analysis

Table 5 shows the average annual rainfall in Beijing from 2004 to 2013. The average annual rainfall during this ten-year period was 21.10 inches, which makes it one of the lowest-ranked locations in rainfall among Chinese provinces (Baidu Wenku 2014). However, Beijing's annual rainfall is mainly concentrated in a four-month period (June to September). Table 6 shows the monthly rainfall in Beijing in 2013. Every year, huge amounts of rainfall from June to September lead to serious stormwater runoff in Beijing, especially in central areas with a lot of impermeable pavement. The block where Huashiying Village is located is this kind of area. Figure 68 analyzes the pavement in the block. Except for some planters with soil, all of the types of pavement are impermeable. Moreover, the existing drainage facilities are inadequate and inefficient. The drainage facilities are mainly installed on level 1 and level 2 roads, and most of them have been blocked by waste (figure 69). Much of the pavement is damaged and uneven, which leads to serious ponding when it is raining (figure 70). A new stormwater management method should be implemented in the area.

Table 5. 2004 – 2013 Annual rainfall in Beijing (Shengcai Xuexiwang 2014)

Year	rainfall (inch)
2004	19.04
2005	16.17
2006	12.52
2007	19.05
2008	24.66
2009	18.92
2010	20.57
2011	28.37
2012	28.87
2013	22.79

Table 6. 2013 Monthly rainfall in Beijing (Baidu 2014)

Month	Rainfall (inch)
January	0.13
February	0.14
March	0.54
April	0.39
May	0.28
June	4.50
July	6.88
August	3.77
September	2.87
October	0.50
November	0.02
December	0

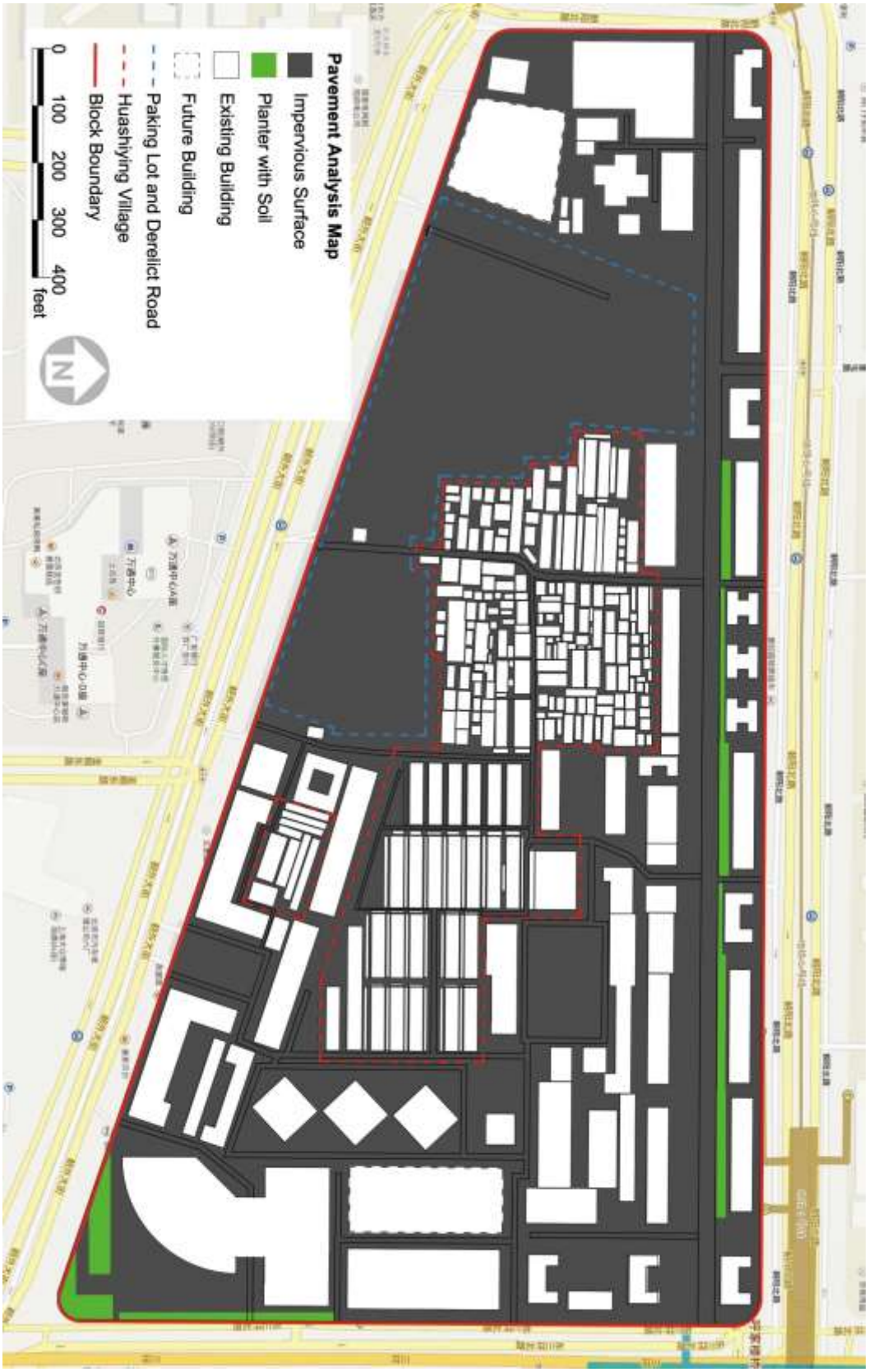


Figure 68. Pavement analysis map

Figure 69. Existing drainage facilities

Figure 70. Pavement in the parking lot

SWOT Analysis

According to the series of analyses above, the following SWOT analysis can be used to illustrate the site's strengths, weaknesses, opportunities, and threats (table 7).

Table 7. SWOT analysis

Strengths	**Weaknesses**
• Central location • High accessibility to places of daily interests • Mixed-use development • Walkable environment • Multiple transportation choices • Level 1 and 2 roads are well-equipped for multiple uses	• Poor environment and living conditions • Inadequate and poorly maintained infrastructure • Poor connection between Huashiying Village and its external environment • Poor connectivity of internal circulation • Disorderly and narrow streets • Extremely high building density and disorderly building layout • Bad waste and stormwater management • Inadequate open spaces and green lands • Poor structure and conditions of level 3 and 4 roads • No direct connection between the western and eastern perimeters through the center of the site • Lack of connection between the northern and southern perimeter for automobiles • Old buildings are not preserved well
Opportunities	**Threats**
• The parking lot is good for new development • Huashiying Village can be redeveloped into a Chinese traditional-style commercial streets to preserve old houses, revive traditional elements, and create income for villagers • Provides affordable housing for low-income tenants • Promotes the development of green communities	• Poor safety and quality of illegal buildings and damaged buildings • Enclosed spaces lead to crime issues • Stormwater runoff issues • Serious environmental pollution

Issues

Bases on the site investigation and analysis, we make a list of site issues. The issues can be divides into three categories:

1. Historic Preservation
    - Old buildings are not preserved well;
    - The loss of Chinese traditional elements: the traditional layout of Beijing's old villages, traditional activities and businesses;
2. Connectivity
    - Poor connection between Huashiying Village and external environment;
    - Poor connectivity of internal circulation in Huashiying Village;
    - Poor north-south connections and east-west connections in the site;
3. Huashiying Village's Living Environment
    - Illegal buildings and damaged buildings with poor building safety and quality;
    - Poor indoor environment;
    - Excessively high building density;
    - Extremely disorderly building layout;
    - Poor structure and conditions of streets;
    - Lack of green lands, open spaces, and vegetation;
    - Inadequate and poorly maintained infrastructure;
    - Stormwater runoff issues;
    - Serious environmental pollution.

Solutions

Among the categories of green community design methods, four categories—Density and Transportation, Water, Energy, and Historic Preservation—are relevant to these issues. The design methods of these categories can be used to innovatively resolve these issues, with greater concern for the environment and cultural sensitivity than the traditional solution of the local government: demolishing all the buildings and constructing new high-rise residential buildings. Moreover, the ideas in three cases also will be used in redeveloping Huashiying Village. Based on the categories of site issues, green community design methods and case studies, three themes are developed. Each theme includes a series of solutions that focus on one aspect of the site's issues and fully take advantage of opportunities. Also, the category of green community design methods to which each solution is relevant is indicated after each solution. The three themes include:

1. **Better Community**: employ green community design methods to create a better living environment and living conditions for villagers and migrants;
    - Use affordable housing to replace illegal buildings and damaged buildings;
    - Develop a new street network to improve internal connectivity and strengthen the connection between Huashiying Village and its external environment (Density and Transportation);
    - Develop an east-west axis and south-north axis to strengthen east-west connections and south-north connections (Density and Transportation);
    - Design new street landscapes to improve the street environment in Huashiying Village (Density and Transportation);
    - Create open spaces and green lands;

- Promote the construction of infrastructure in transportation, electricity, telecommunication, sports, sanitation, stormwater management and education.

2. **Tradition**: preserve and revive Beijing villages' traditional culture and businesses;
    - Preserve existing old buildings by employing historic preservation methods (Historic Preservation);
    - Arrange and build new buildings in Chinese traditional style among old buildings to reflect the Chinese traditional layout (Density and Transportation, Historic Preservation);
    - Develop traditional-style commercial streets in Huashiying Village to revive Chinese traditional businesses;
3. **Innovation**: employ new green technologies and promote their development in China;
    - New stormwater management (Water);
    - Build green buildings as affordable housing (Energy).

By employing physical design methods to resolve the environmental issues of Huashiying Village, we can also partly resolve some social issues: high crime rate, labor market discrimination, social segregation, and inferiority. By improving the connection between Huashiying Village and its surroundings, and creating a better street environment, we can reduce the social segregation of migrants. Moreover, this can reduce the amount of transients who are the majority contributors to the ranks of local criminal groups, which creates a safer environment. By creating a green community, we can improve migrants' living environment and conditions, and remove the label "Chinese slum". This can help to reduce social discrimination on migrants and give them confidence.

Figure 71 illustrates the connection between site issues and solutions:

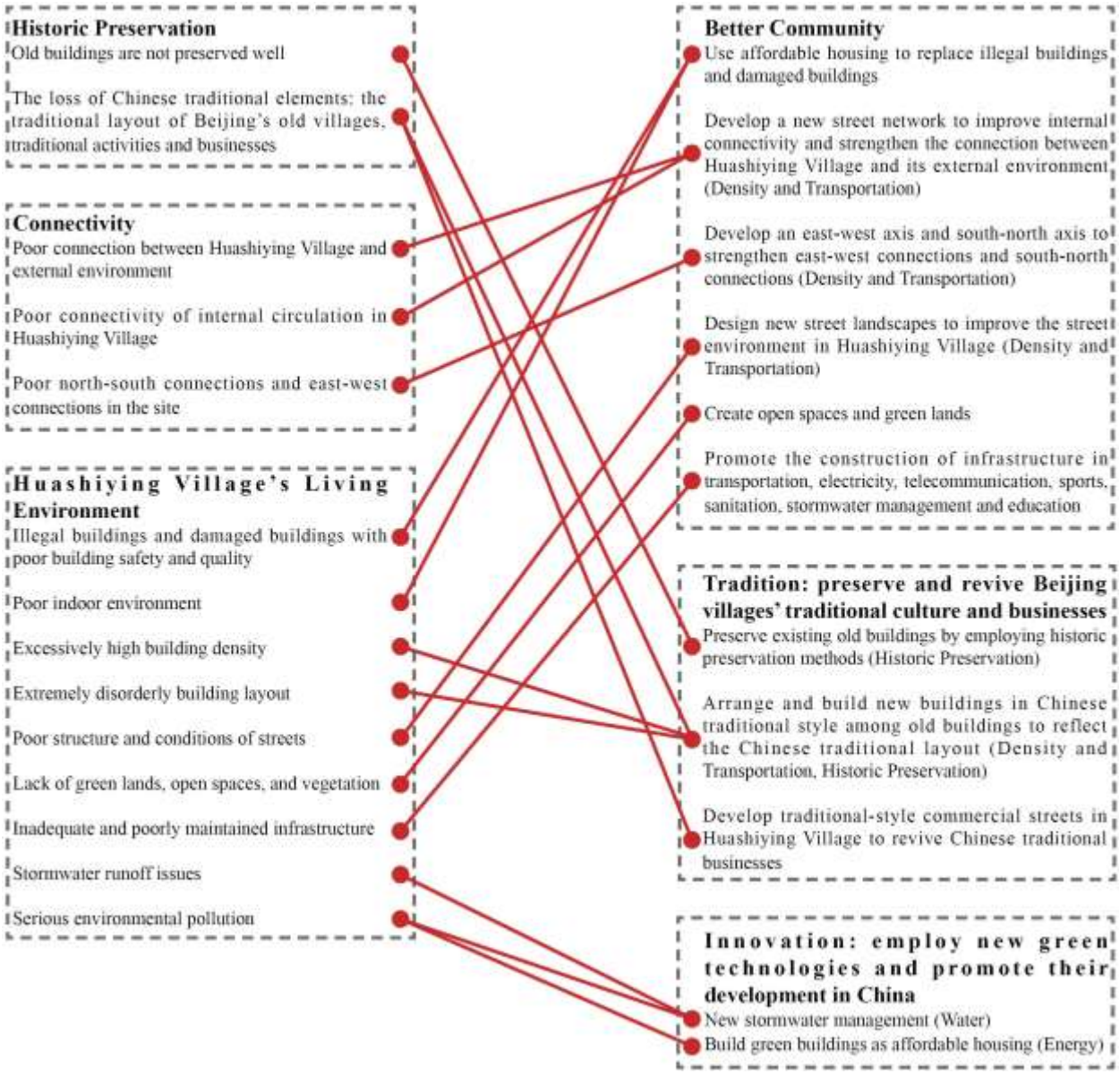


Figure 71. The connection between site issues and solutions

Project Design

Based on the literature review, case studies, site investigation and analysis, a concept design is developed to resolve the issues of the site. In the design, the three themes: better community, tradition, and innovation, are separately reflected in different areas. Figure 72 shows the two areas that reflect the different themes. The design of area 1 focuses on tradition, and the design of area 2 focuses on innovation. Moreover, the combination of the two areas illustrates the theme of better community. Figure 73 shows the design focus of each area and the major axes that are used as major connections in the site. The design focus of area 1 (tradition) includes: Chinese traditional-style commercial streets, Chinese traditional-style buildings, and traditional elements that include the layout pattern of Beijing's old villages, local villagers' traditional activities and businesses. The design focus of area 2 includes: stormwater management, affordable apartments, green buildings, and a community park. Moreover, the design of the whole site will consider open spaces, internal connectivity, internal-external connections, north-south connections, east-west connections, and stormwater management.

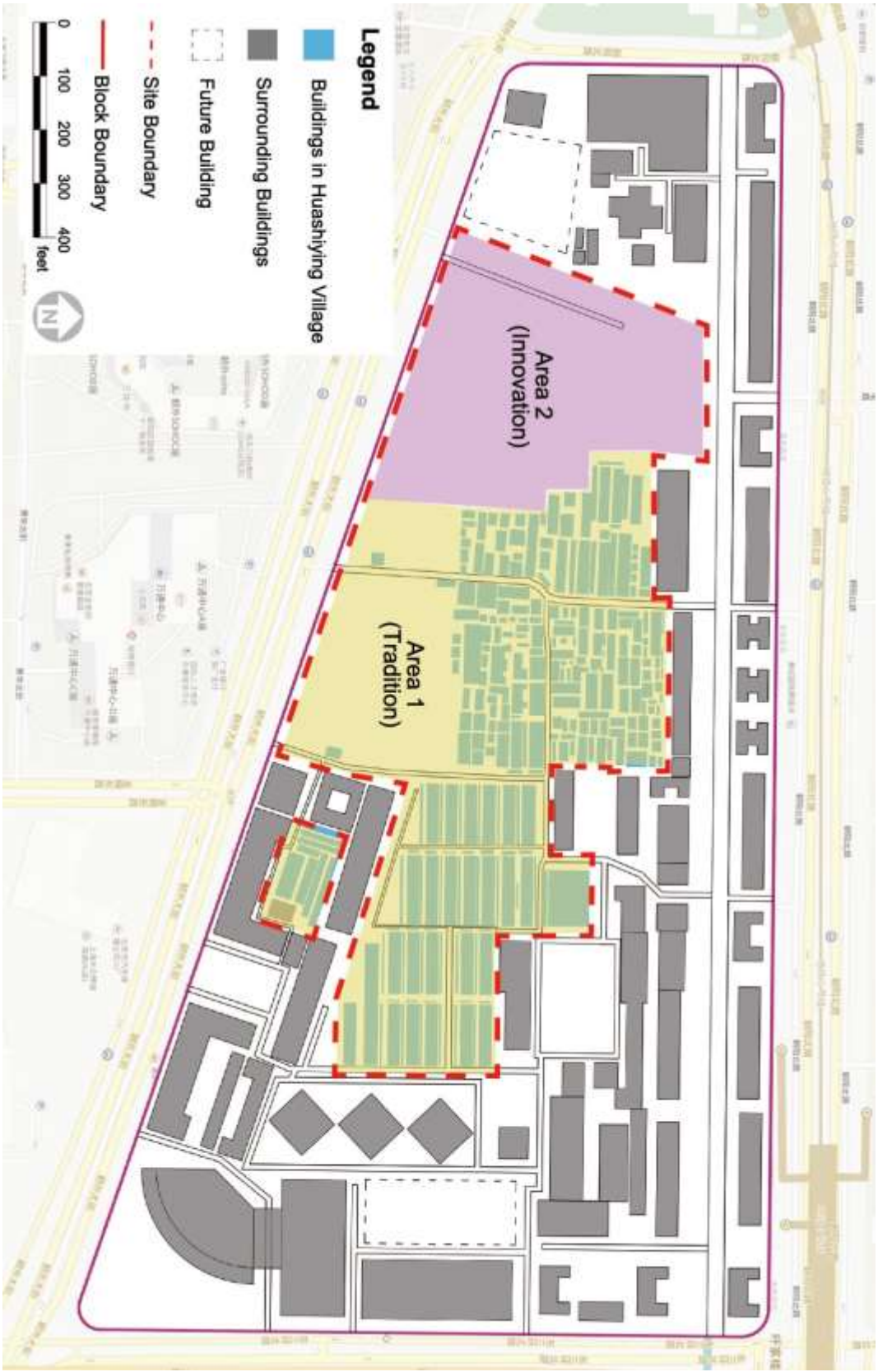


Figure 72. Site division map

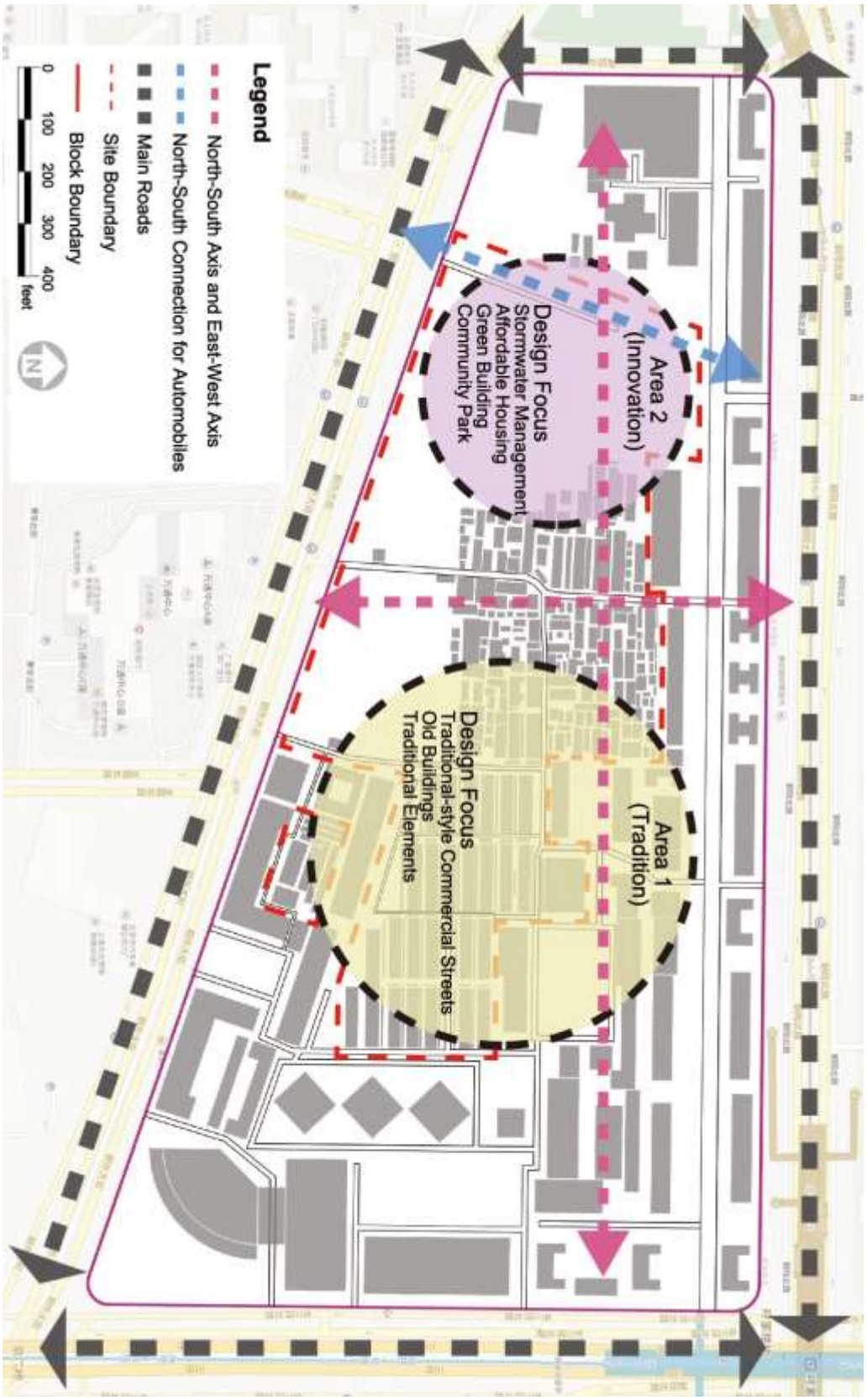


Figure 73. Design focus map

The Design of Area 1

The first step in designing area 1 is to demolish all illegal buildings. Then, there are six modern buildings that are used as restrooms and security offices in the area. Because area 1 will be developed into Chinese traditional-style commercial streets, the modern buildings will be incompatible with the traditional-style buildings. Moreover, the modern buildings do not have cultural significance and historic preservation value. Thus, they will also be demolished. Figure 74 shows the site plan after demolishing illegal buildings and modern buildings. Based on the different conditions of existing traditional-style buildings, area 1 is divided into three parts. Part A has the most traditional-style buildings with different sizes. It still retains the layout pattern of Beijing's old villages. Thus, this part will be the core area of the commercial streets. Moreover, new buildings in the traditional style will be built in this part to extend the layout pattern of Beijing's old villages. In part B, the buildings have a clear layout and are in the best condition. Thus, all of them will be preserved. In part C, the traditional-style buildings are in the worst condition. They are enclosed by modern buildings. They are in the shadow of surrounding buildings all year and block the circulation to surrounding buildings. Considering the very poor inhabitability of part C, these buildings will be demolished. Then a new courtyard will be created to provide open spaces for residents who live in the surrounding buildings.

Concept Development

The concept of designing area 1 is based on three Chinese traditional design elements: the layout pattern of Beijing's old villages, Siheyuan, and Hutong (figure 75). In addition, open spaces, connectivity, and stormwater management will also be taken into consideration.

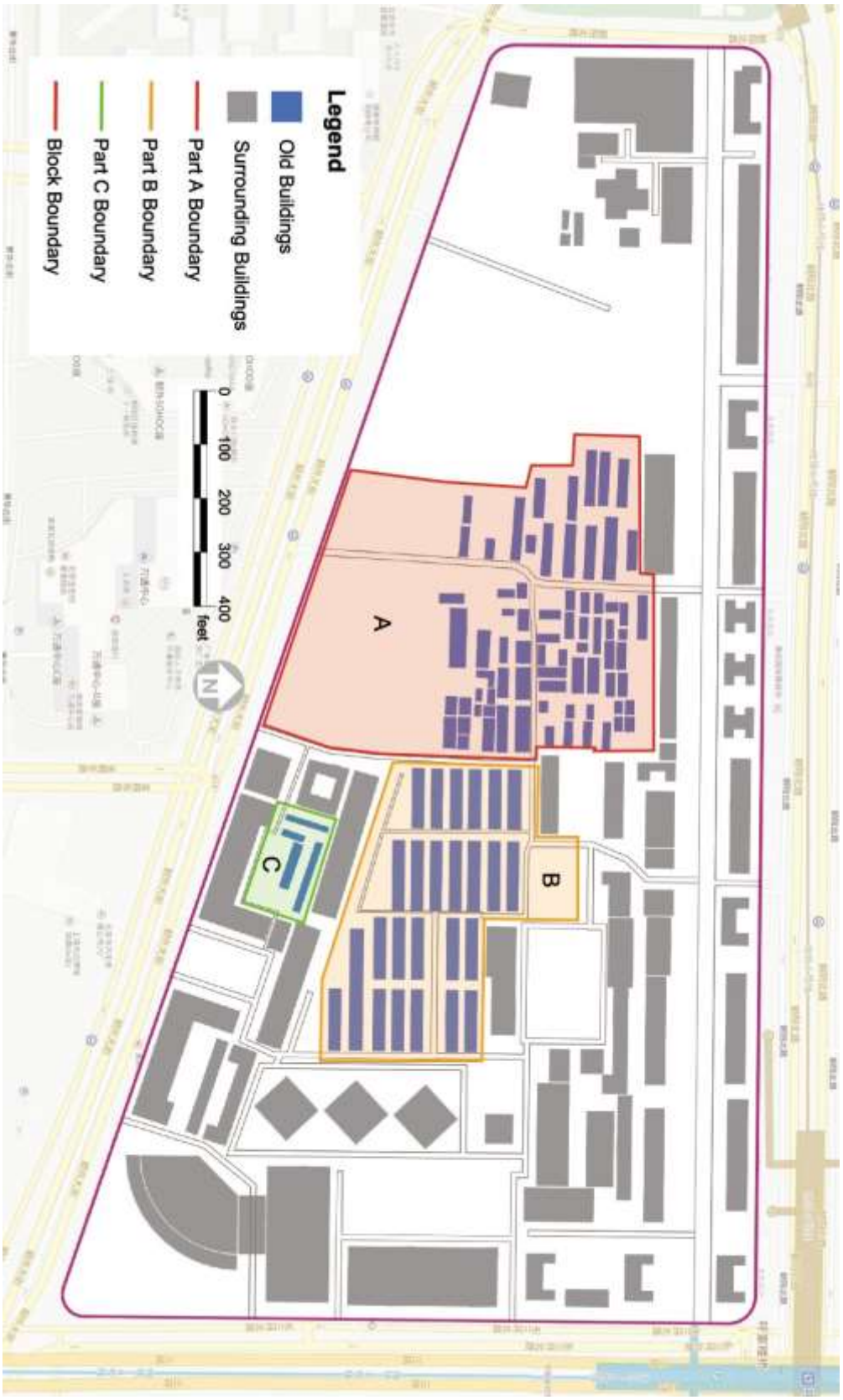


Figure 74. Three parts of area A

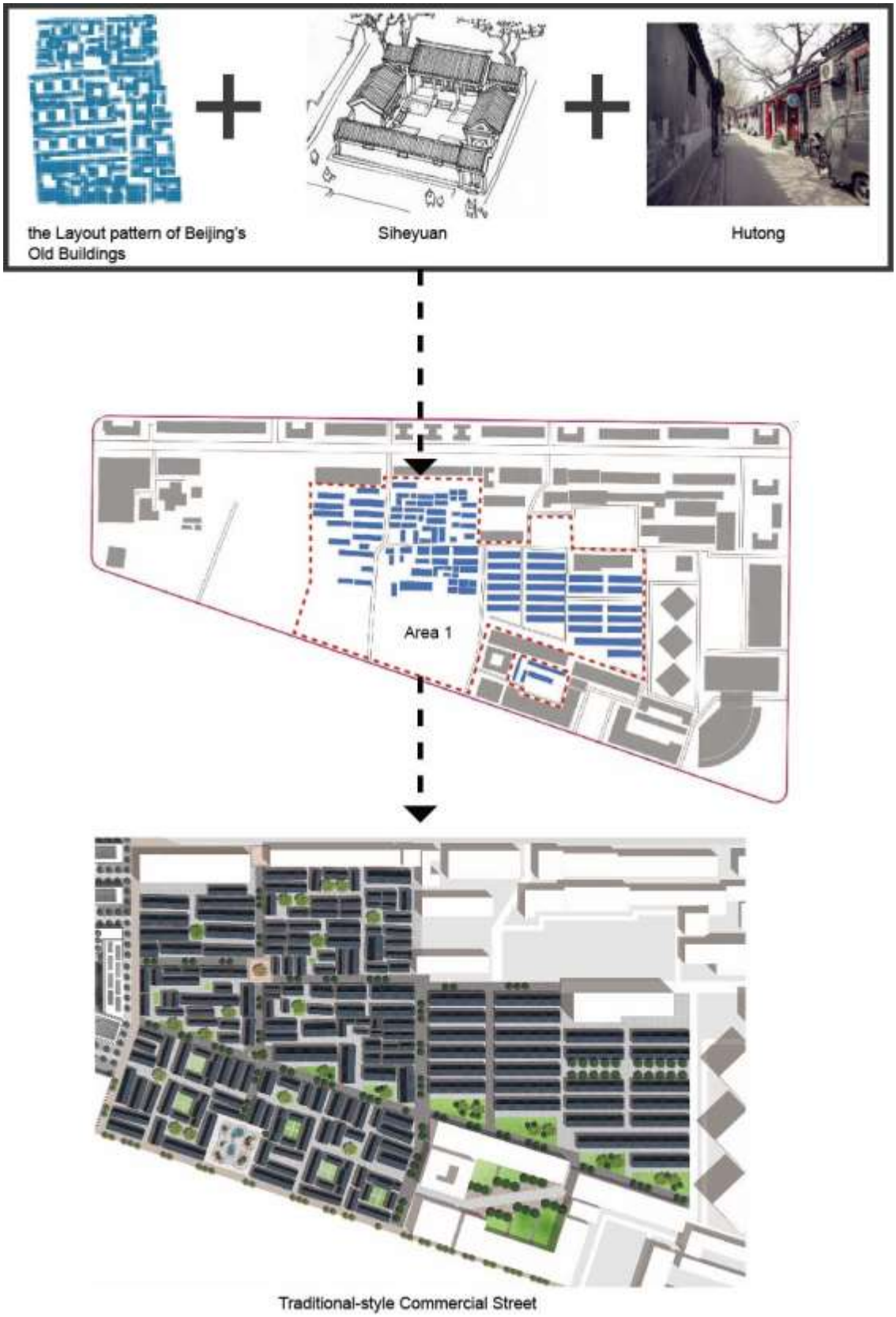


Figure 75. Concept development

Figure 76. Area 1 plan

Traditional Elements Analysis

In area 1, four Chinese traditional elements are integrated into the design, including traditional-style buildings, the layout pattern of Beijing's old villages (Hutong and Siheyuan), small courtyards for villagers' traditional daily activities, and traditional-style commercial streets with all kinds of traditional Beijing businesses.

Based on the historic preservation methods that are discussed in Chapter 3, three methods are used for the buildings of area 1: preservation, restoration, and reconstruction. Figure 77 shows the distribution of different kinds of buildings and different historic preservation methods that are used for these buildings. In area 1, the building group is composed of two kinds of buildings: existing Chinese traditional-style buildings and new-built buildings in a traditional style. For existing traditional-style buildings, a portion of them are well preserved by residents. These buildings still keep their original conditions, structure, and materials. Thus, the preservation method is used in these buildings. However, the other portion of existing traditional-style buildings have been changed. For example, modern paint was used on the wall, which covered the texture of the traditional brick wall. Modern iron doors replaced traditional wood doors. These modern elements are extremely in compatible with the traditional style of Huashiying Village. Thus, the restoration method is used in these buildings to return them to their original conditions. For new-built buildings in a traditional style, the reconstruction method is used to create an accurate copy of traditional-style buildings. The construction process uses Chinese traditional building techniques and materials, but the materials will be new. By using this building technique—build as old—the new-built buildings with traditional style looks like having been existing for a long time.

Figure 78 shows the distribution of the elements of Hutong and Siheyuan. In area 1, because part A retains the traditional layout pattern of Beijing's old villages, as an extension of the layout, Hutong and Siheyuan are distributed in Part A. All of the Siheyuans are located on the southern side of part A, because there is not enough space to build a Siheyuan on the northern side. Hutong and Siheyuan not only display Beijing's traditional culture, but also improve internal connectivity and create open spaces in the area. A series of small open spaces provide places for villagers' traditional daily activities. In the area, traditional-style buildings, Hutong, Siheyuan, and small open spaces, constitute the traditional layout of Beijing's old villages (figure 79).

In area 1, traditional businesses are mainly concentrated on both sides of commercial streets, including restaurants selling traditional Beijing foods, traditional snack shops, traditional handiwork stores, teahouses and other traditional shops (figure 80).

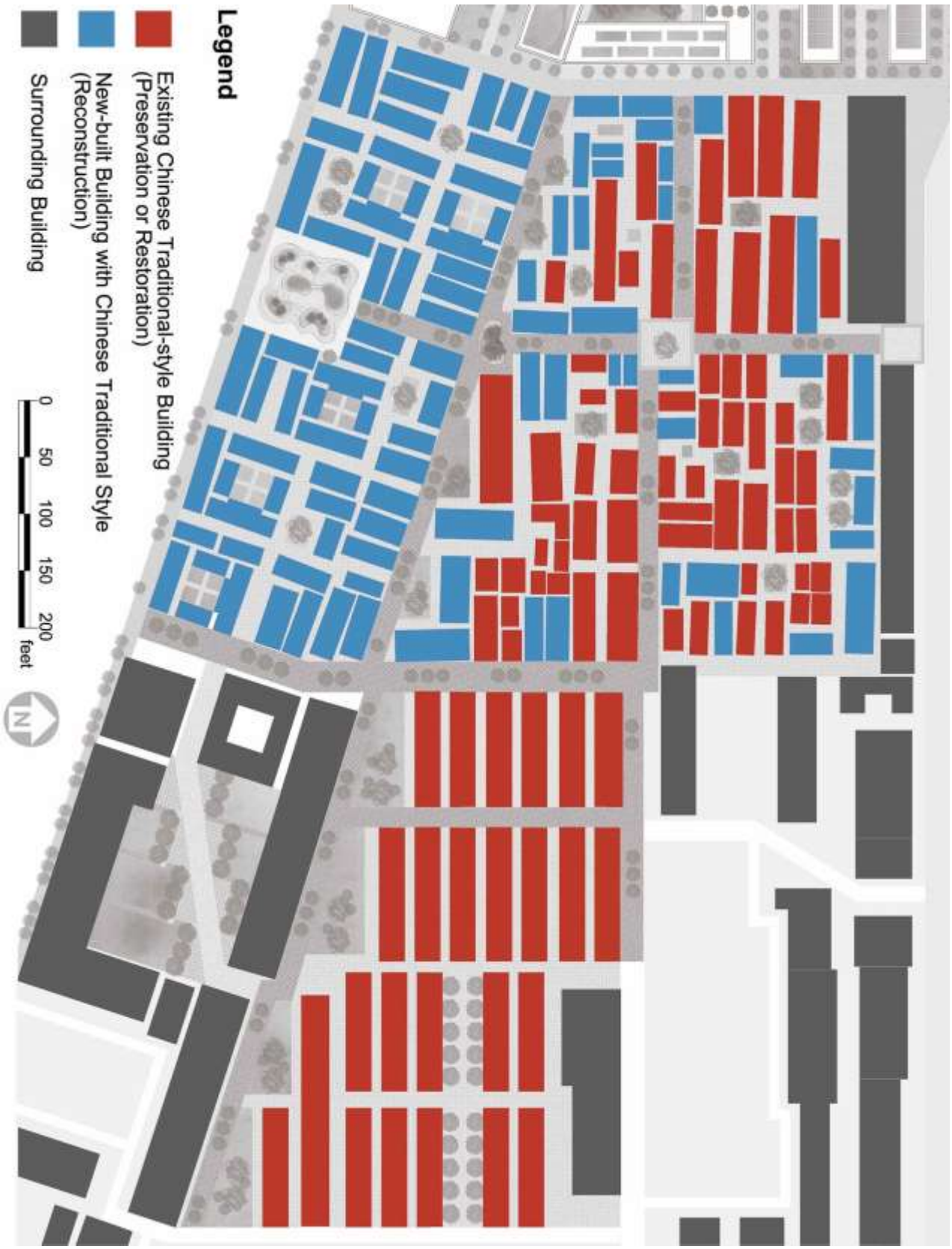


Figure 77. Building types

Figure 78. The distribution of Hutong and Siheyuan

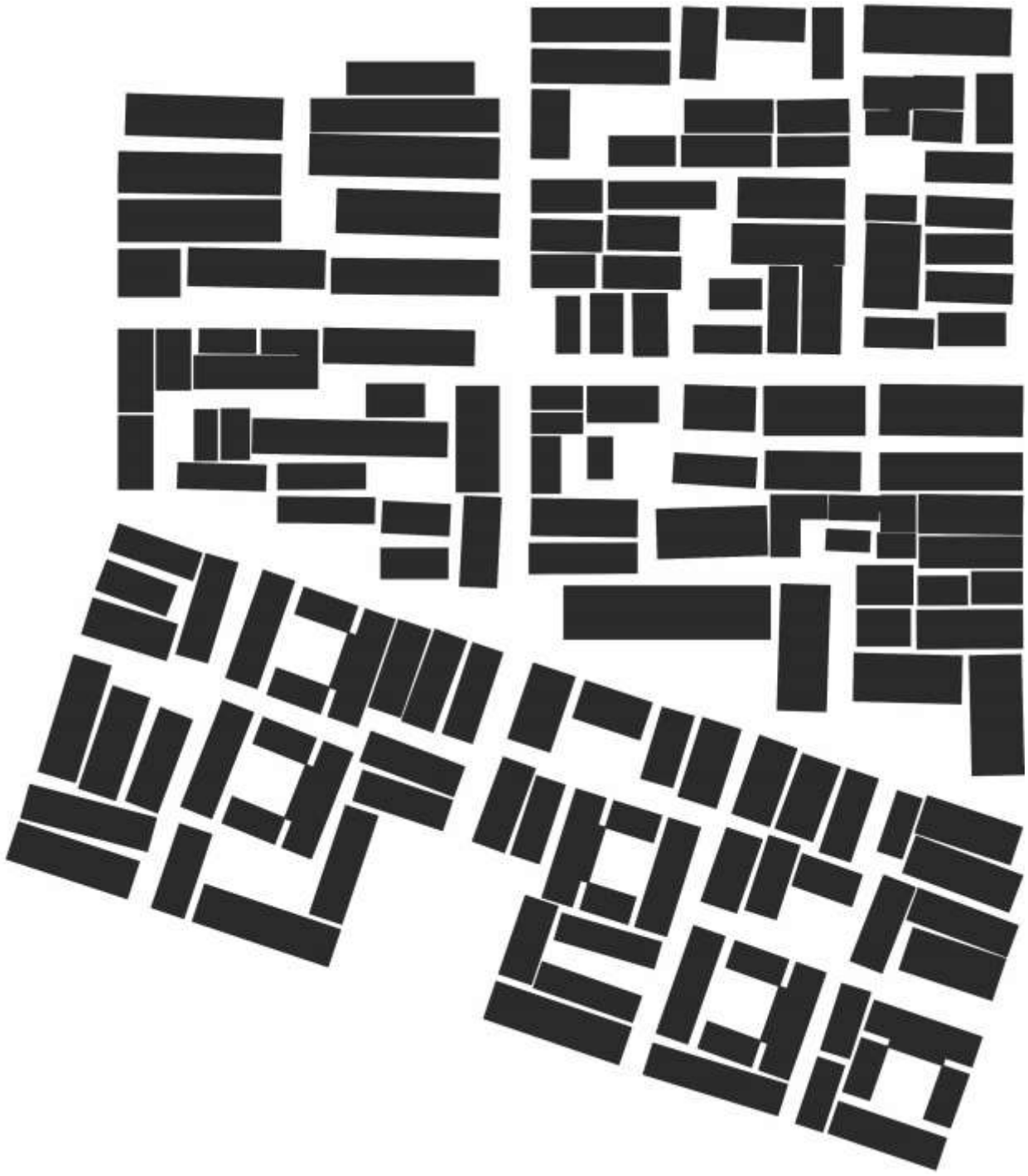


Figure 79. Nolli map

Figure 80. The distribution of traditional businesses

Internal Connectivity Analysis

Area 1 includes seven small districts (figure 81). These districts are connected by five main pedestrian streets. These streets not only connect the seven small districts, but also connect the commercial streets and the surrounding areas. In each district, the internal connectivity is mainly based on secondary streets—Hutong. According to one study (Zhao, Xu and Yin 2005), there is a specific relationship between the width of Hutong and the height of its surrounding buildings. The ratio of Hutong's width to the surrounding buildings' height is 1:0.8 to 1: 1.1. The ratio will bring the benefits of a broad view, comfort, and walkability. In area 1, the height of traditional-style buildings is around 15 feet. By calculation, the width of Hutong should be 12 feet to 16.5 feet. In this area, except for some existing narrow Hutongs, the width of most Hutongs is between 12 feet and 16.5 feet. These Hutongs will be the major means of connection in each small district.

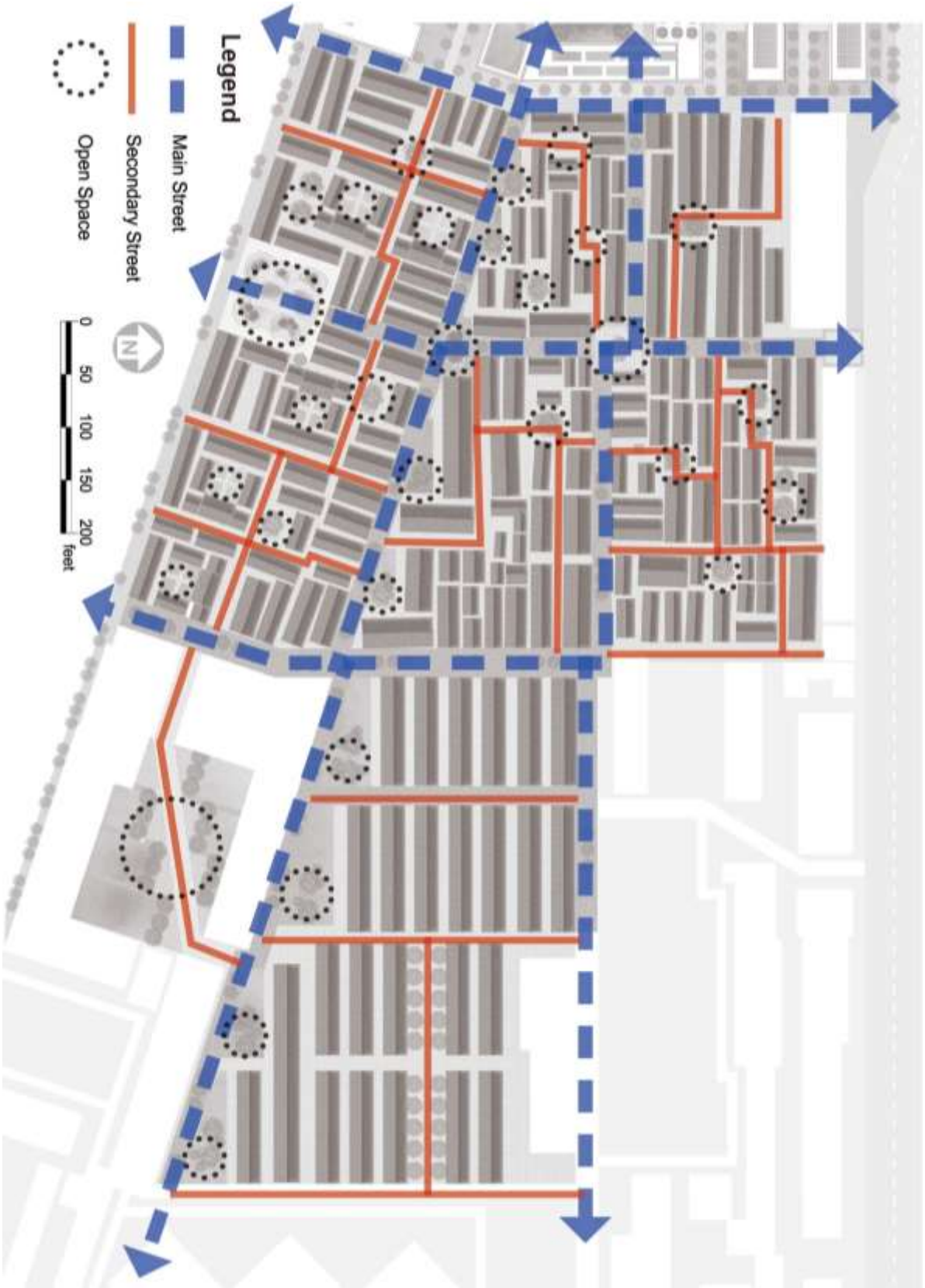


Figure 81. Internal connectivity map

Stormwater Management

In area 1, the stormwater management methods include both traditional and innovative methods. The traditional method is the Chinese traditional drainage facility (figure 82). It is not only a drainage facility, but also a ground decoration. The innovative methods include infiltration planters and rain gardens (figure 83). They can not only absorb stormwater, but also filter it. Moreover, they can be landscapes. Figure 84 shows the distribution of different stormwater management facilities. In a Siheyuan, the stormwater management facilities include four small rain gardens and a Chinese traditional-style drain in the center. When the rain is light or moderate, stormwater can be absorbed and filtered by the rain gardens. When it is raining heavily, redundant stormwater will flow into the drain. In the seven small districts, the stormwater management facilities include rain gardens and infiltration planters. Infiltration planters have the same functions as rain gardens. They have vertical walls and open or closed bottoms. Infiltration planters are ideal green infrastructures in dense urban areas because they occupy little space. Thus, they will be used in Hutongs. Rain gardens will be used in the courtyards of each district. When there is heavy rain, redundant stormwater will flow into the main streets. The stormwater management facilities of main streets include bigger rain gardens and Chinese traditional-style drains. They have the greatest capacity to absorb stormwater from the main streets and surrounding districts.

Figure 82. Chinese traditional drainage facility

Figure 83. Infiltration planters and rain gardens

Figure 84. The distribution of drainage facilities

The Design of Area 2

Concept Development

The core concept of area 2 is innovation. By using a series of innovative methods and technologies, the design will resolve the issues of the area, create a sustainable modern residential area for mixed income people, and provide low income people with a better living environment. The concept is based on four elements: affordable housing, green building, stormwater management, and a community park (figure 85).

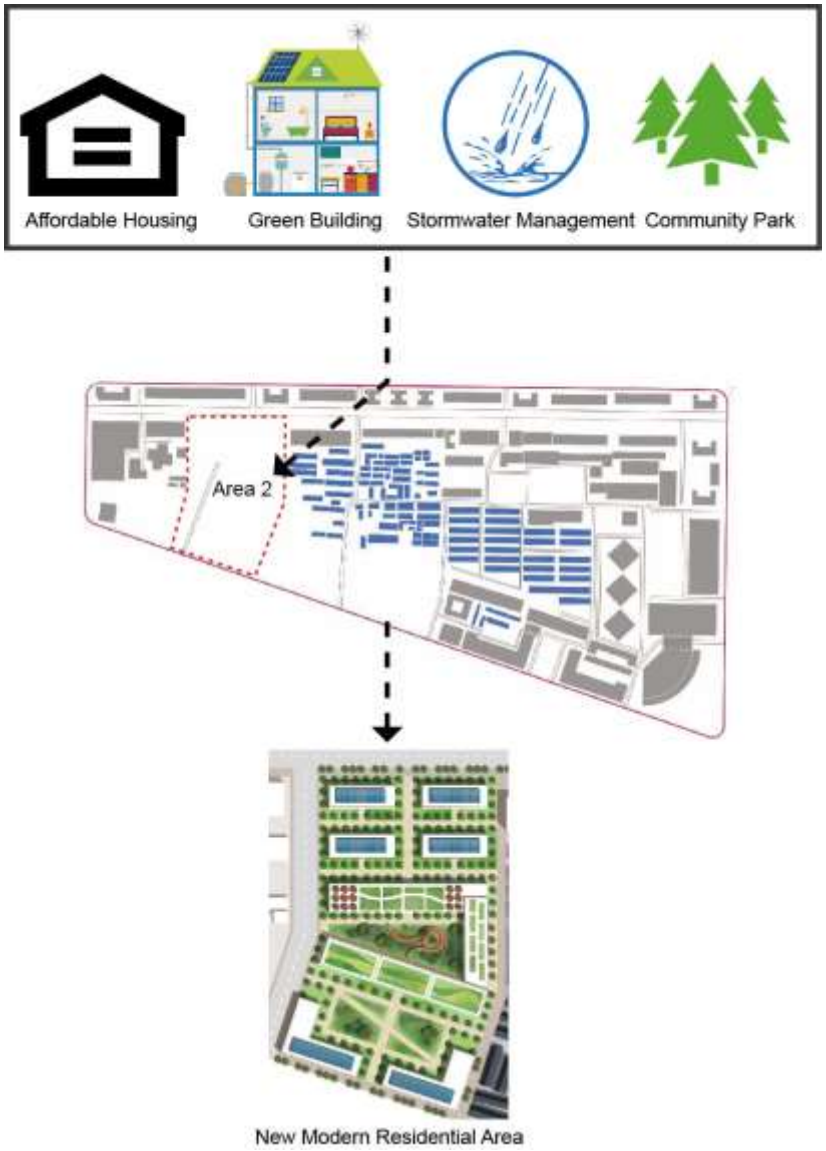


Figure 85. Concept development

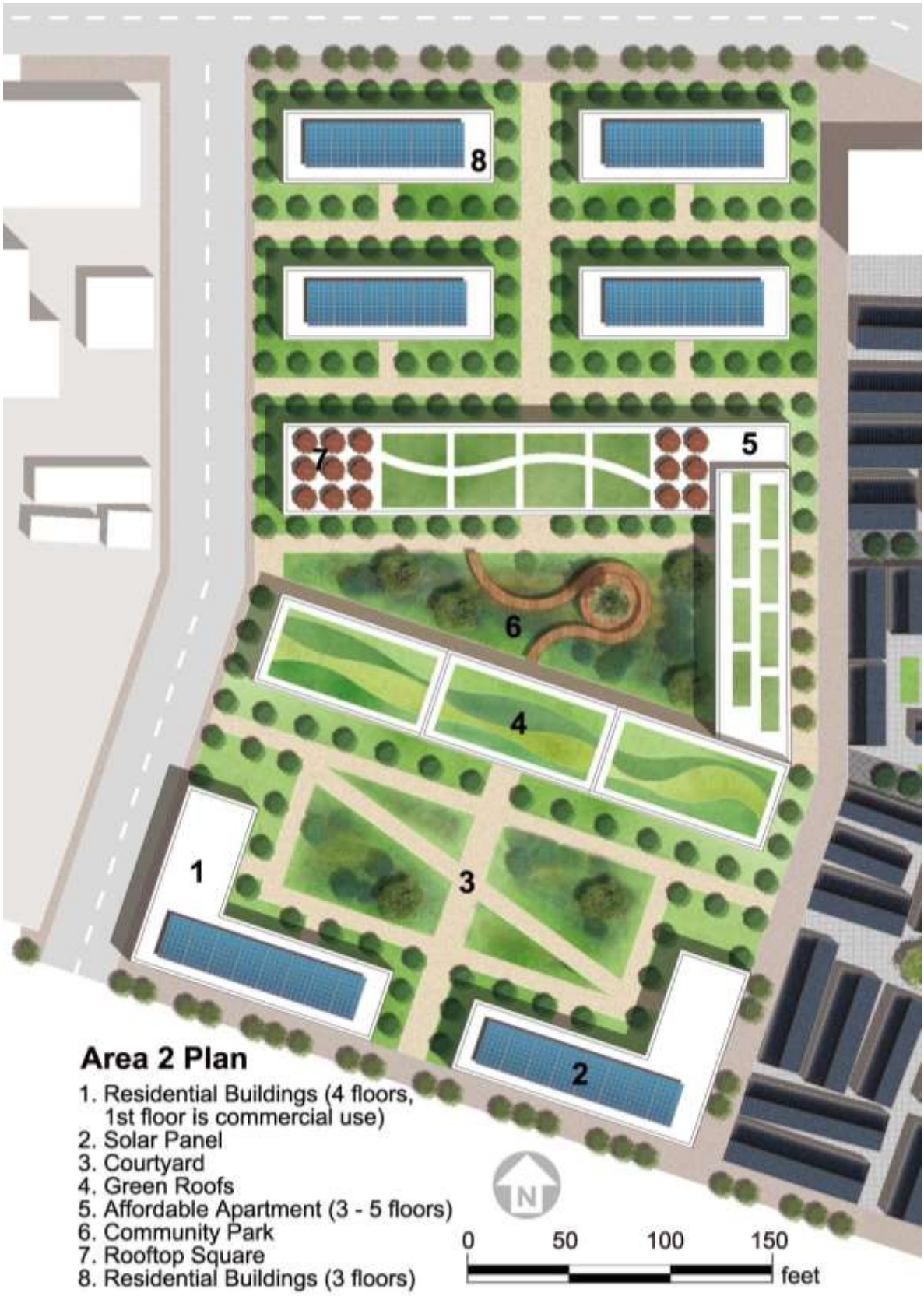


Figure 86. Area 2 plan

Connectivity Analysis

Area 2 plays an important role in connecting Huashiying Village and the west side of the block. In area 2, there are five east-west secondary streets connecting the two areas (figure 87). Also, on the west side of area 2, a new north-south main road is created for automobiles.

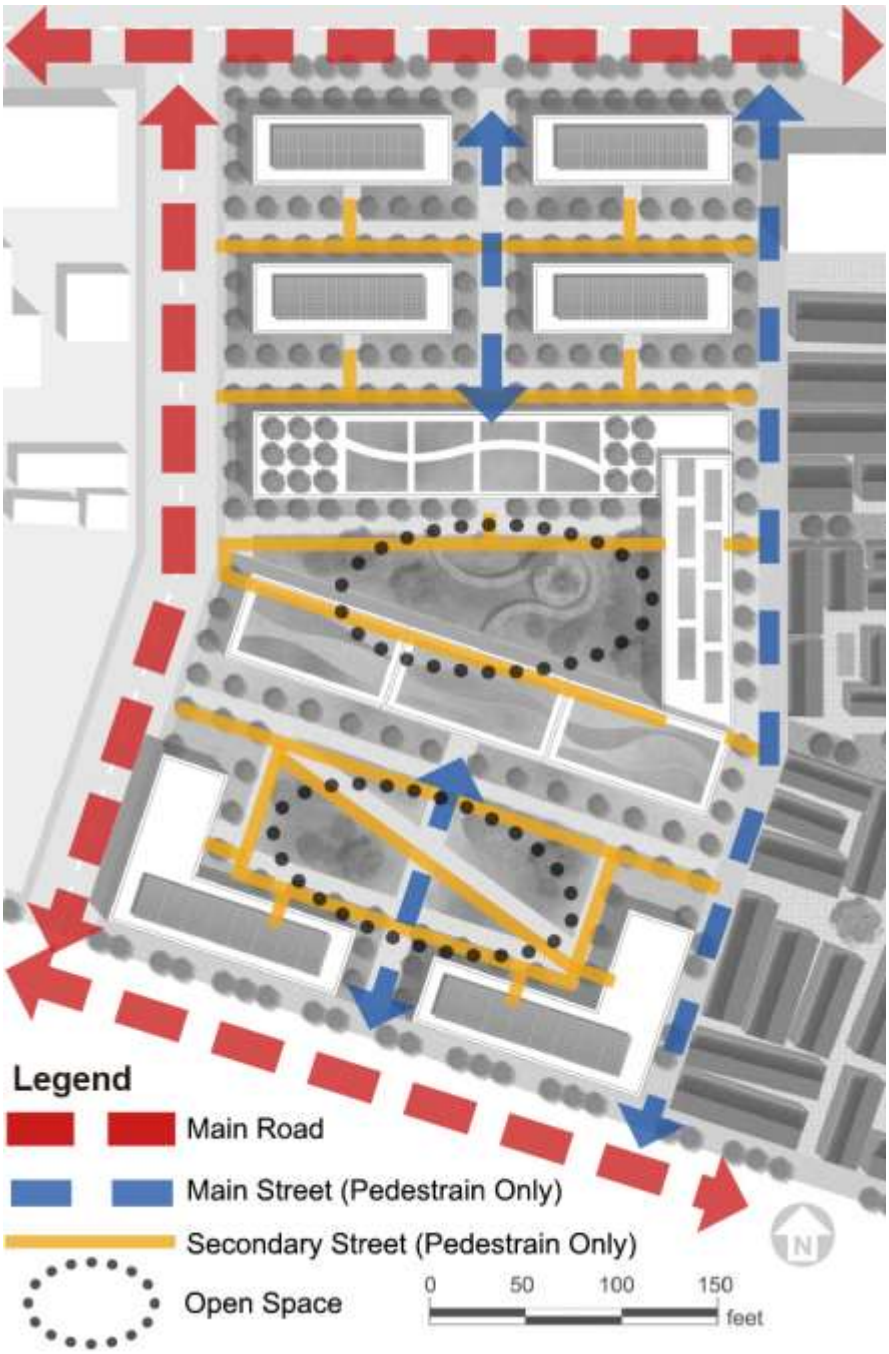


Figure 87. Connectivity analysis map

Analysis of Distance between Buildings

For buildings that are arranged in parallel, there should be a minimum distance between a pair in order to guarantee those that are sheltered by their southern buildings are getting enough sunlight. According to Beijing's construction codes (Beijing Municipal Construction Committee 2012) concerning the distance between two buildings, for plank-type buildings[5], there is a specific relationship between the distance between two buildings and the height of the building on the southern side (table 8 and figure 88). Figure 89 shows the distance between buildings and the heights of those structures in area 2. In the area, all of the distances between buildings are above the minimum requirement.

Table 8. The ratio of the distance between two buildings to the height of the building on the southern side

The Angle between Building Orientation and South	0 – 20 degree	20 – 60 degree	> 60 degree
New Buildings	1.7	1.4	1.5
Renovated Buildings	1.6	1.4	1.5

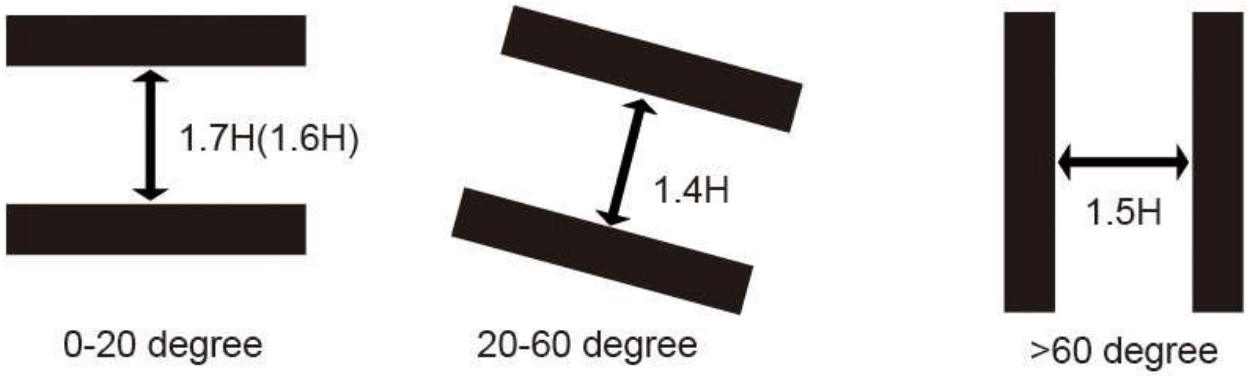


Figure 88. The ratio of the distance between two buildings to the height of the building on the southern side

[5] Plank-type buildings: A plank-type building is a rectangular building. Its length to width ratio should be greater than or equal to 2. And the width should be less than or equal to 16 meters (52.5 feet) (Baidu Baike n.d.).

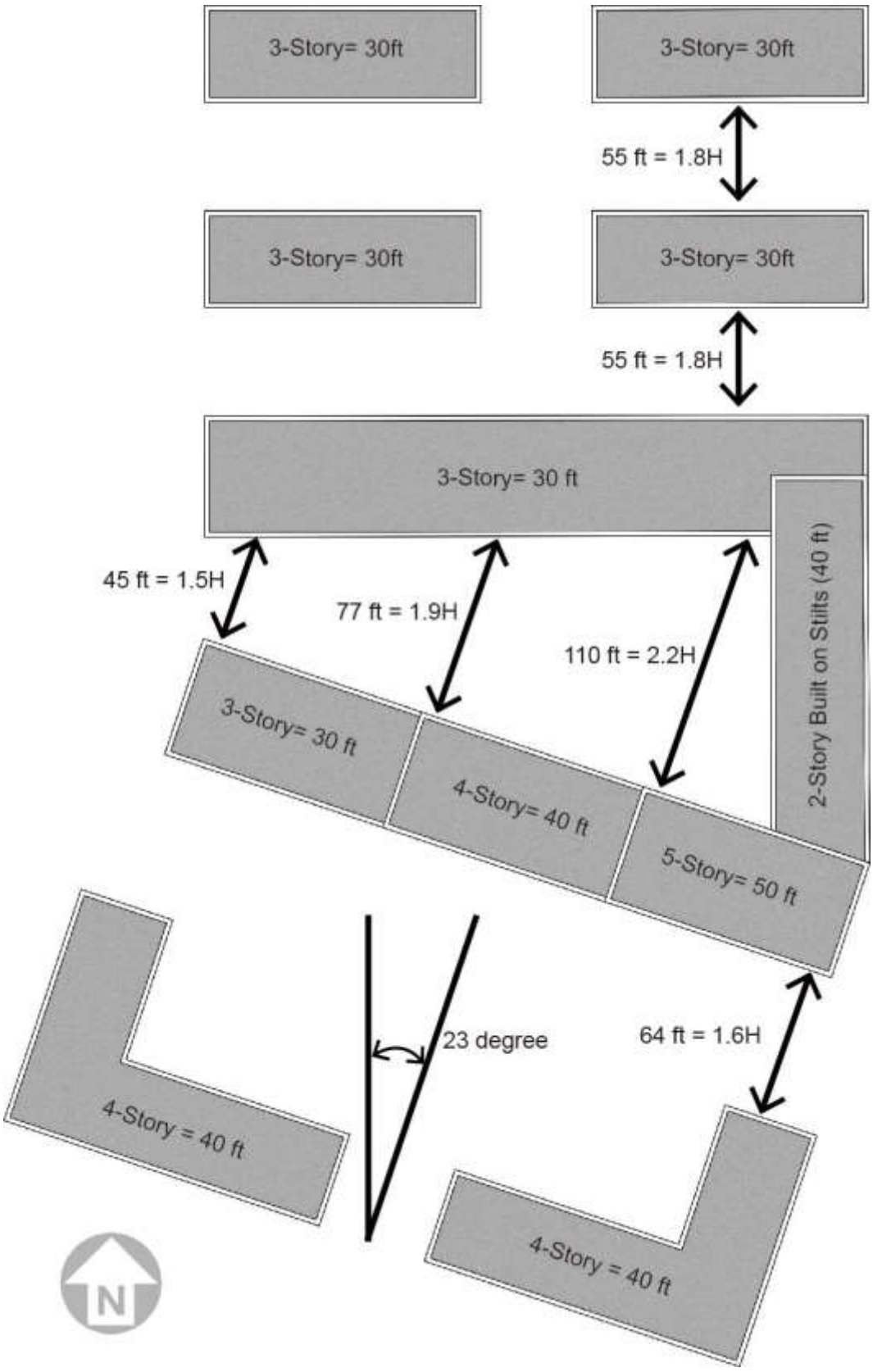


Figure 89. Analysis of distance between buildings

Stormwater Management Analysis

Because of the tremendous amount of rainfall from June to September that may lead to serious stormwater runoff issues, stormwater management will be one of the most important aspects of the design of area 2. In area 2, the stormwater management system includes: green roofs, infiltration planters, and bioretentions (figure 90 to 93). When it is raining, a small portion of stormwater is absorbed and filtered by green roofs and most stormwater is absorbed and filtered by infiltration planters and bioretentions. After infiltration, the stormwater will be clean and then reused in the buildings' toilets and cooling towers. If the rainfall exceeds the maximum volume that the stormwater management system can absorb, the overflow will be sent to a pre-treatment cistern prior to bio-filtration treatment in bioretentions. Figure 94 shows the process of stormwater management in area 2. Table 9 shows the rainfall classification in China. In 2015, the maximum rainfall per rain event in Beijing is 49.1mm (1.93 inch) (Sohu 2015). The stormwater management system in area 2 is designed to completely absorb a volume of rainfall under 50mm (1.97 inch). Table 10 includes information about the area that is needed to calculate the total area of infiltration planters and bioretentions (the stormwater absorption of green roofs will be ignored in the calculation). According to the online calculator (Rain Garden Alliance n.d.), without considering the stormwater absorption of green roofs, the total area of infiltration planters and bioretentions should be at least 71656 square feet (figure 95). And total area of the design is 71932 square feet, which should fulfil the requirement.

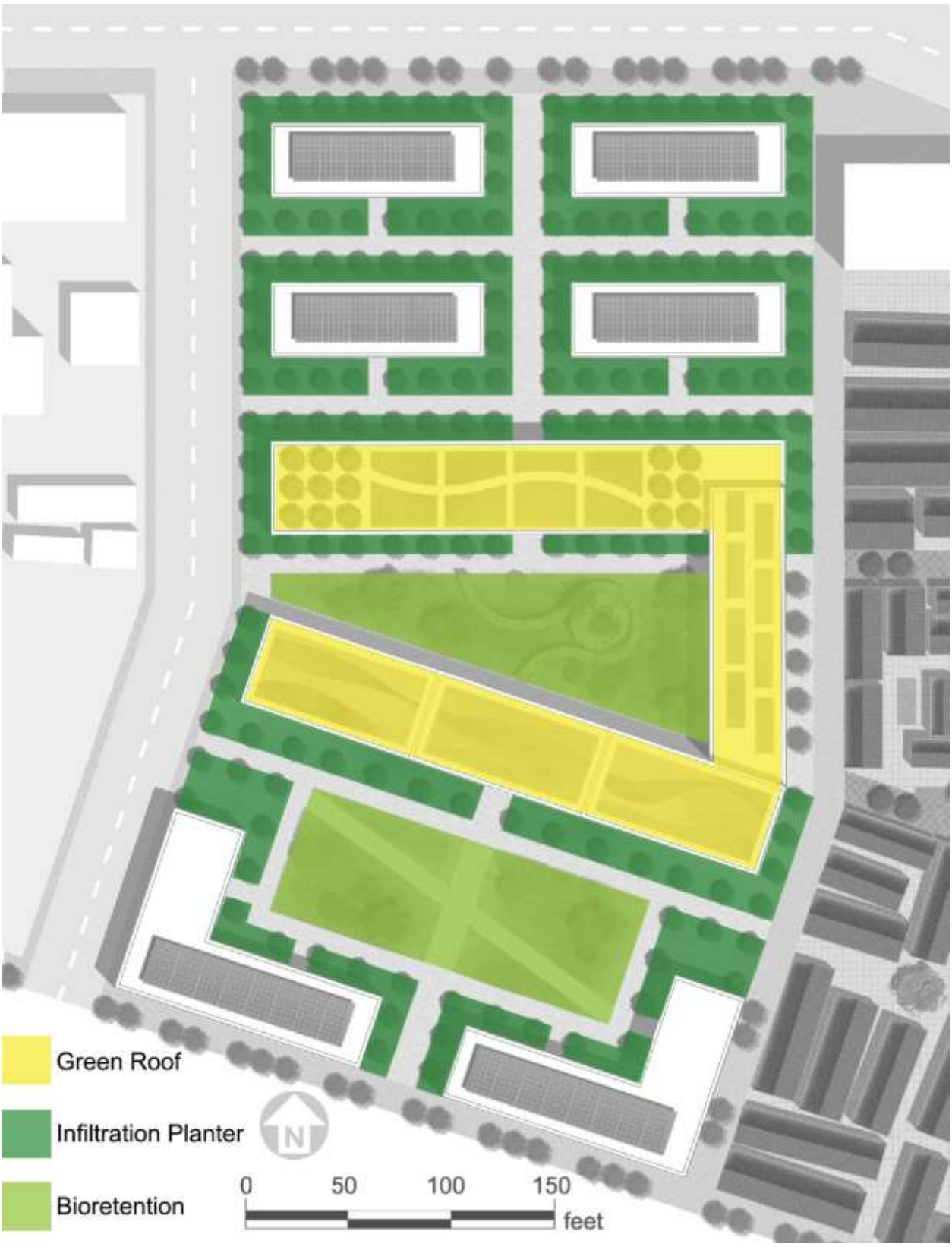


Figure 90. The location of three stormwater management systems

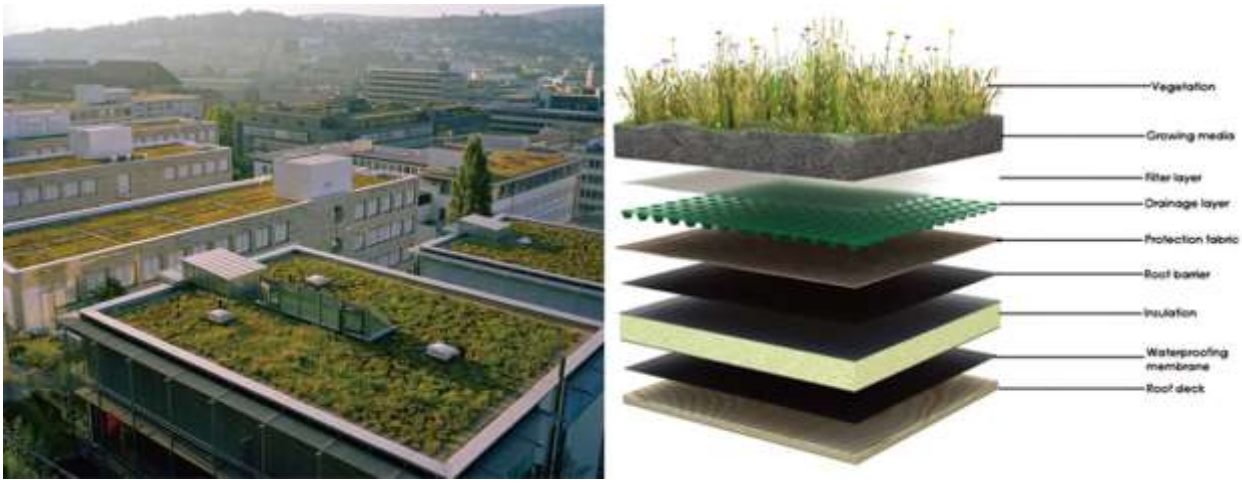


Figure 91. The green roof (Diane Cook & Len Jenshel Photography n.d.) and its structure (dc greenworks n.d.)

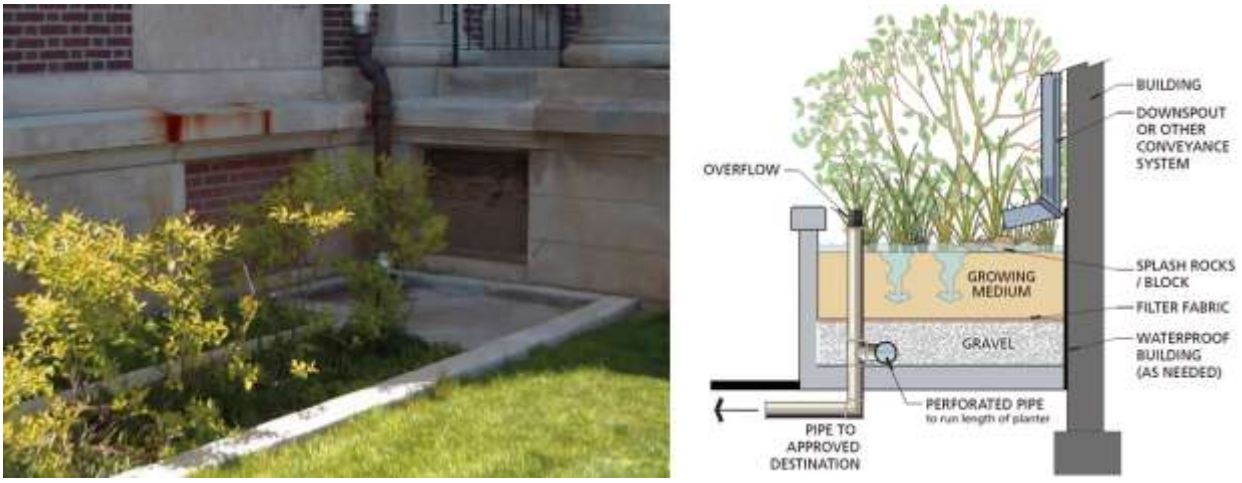


Figure 92. The infiltration planter (Meliora Design n.d.) and its structure (City of Portland n.d.)

Figure 93. The bioretention (Omaha By Design n.d.) and its structure (Douglas County's Environmental Information Center n.d.)

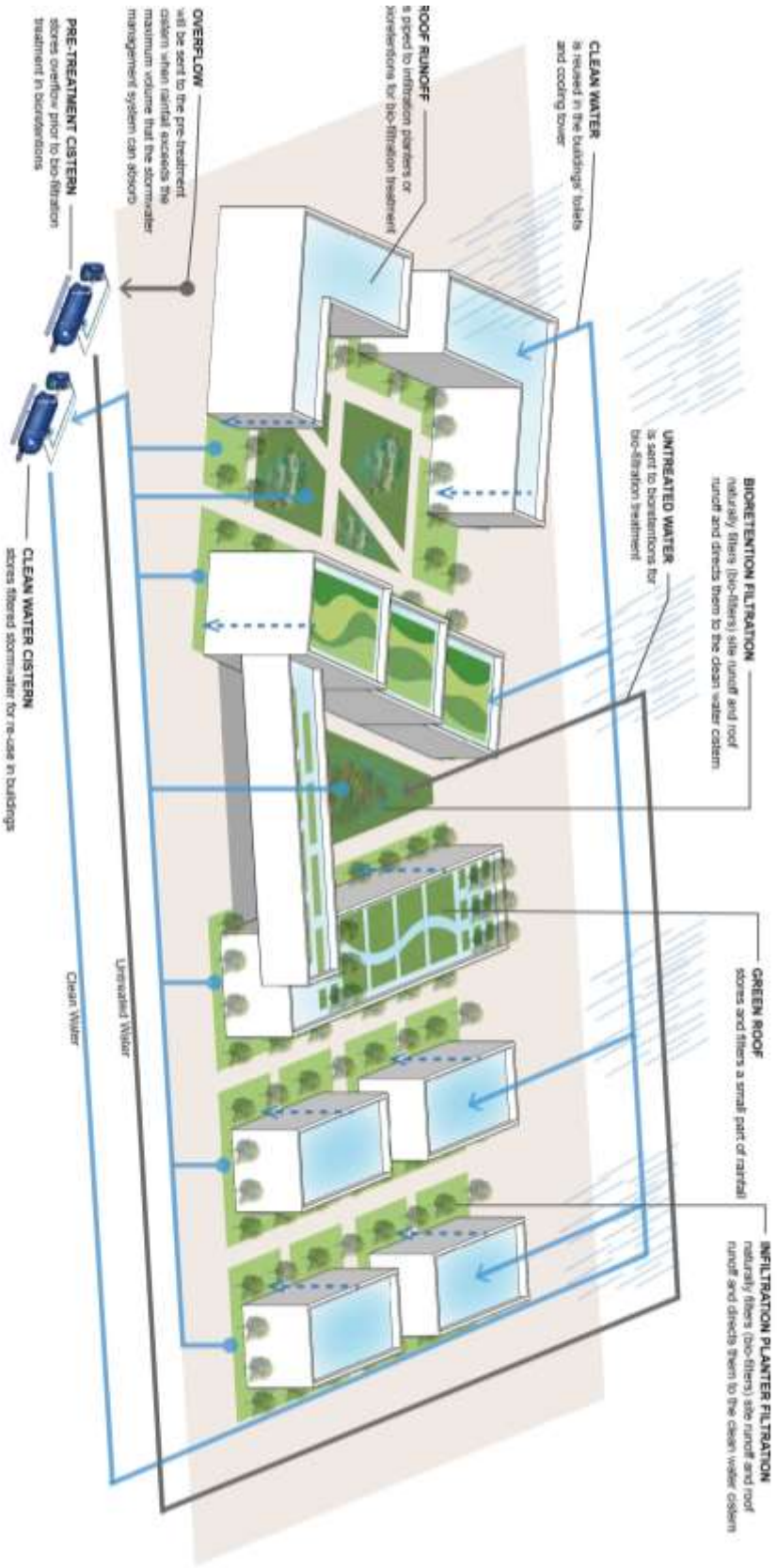


Figure 94. Stormwater management process

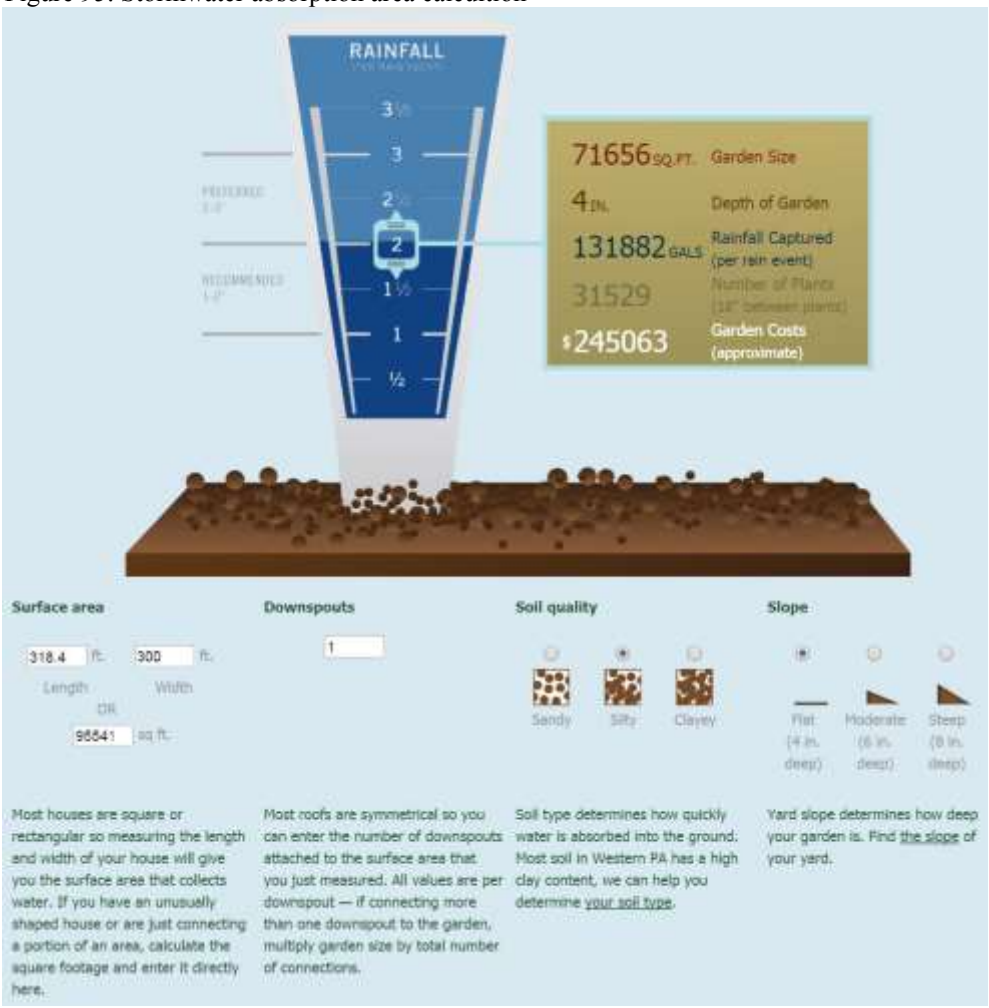
Table 9. The rainfall classification (Baidu Baike n.d.)

Rainfall Types	Rainfall Intensity mm (inch)/day
Light	<10 (0.39)
Moderate	10 – 25 (0.39 – 0.98)
Heavy	25 – 50 (0.98 – 1.97)
Intense	50 – 100 (1.97 – 3.94)
Torrential	100 – 200 (3.94 – 7.87)
Extremely Torrential	>200 (7.87)

Table 10. Basic information of area 2

Impervious Surface Area	95541 squarea feet
Stormwater Absorption Area	71656 squarea feet
Soil Quality	Silty
Slope	Flat
Maximum Stormwater Absorption Volume	50mm (1.97 inch) per event

Figure 95. Stormwater absorption area calcultion



Green Building Analysis

In area 2, all of the buildings are green buildings. Aside from green roofs and solar panels, these buildings include extensive indoor energy-efficient equipment and water-saving fixtures, which can minimize the consumption of energy and resources. Figure 96 shows the operation system of a green building.

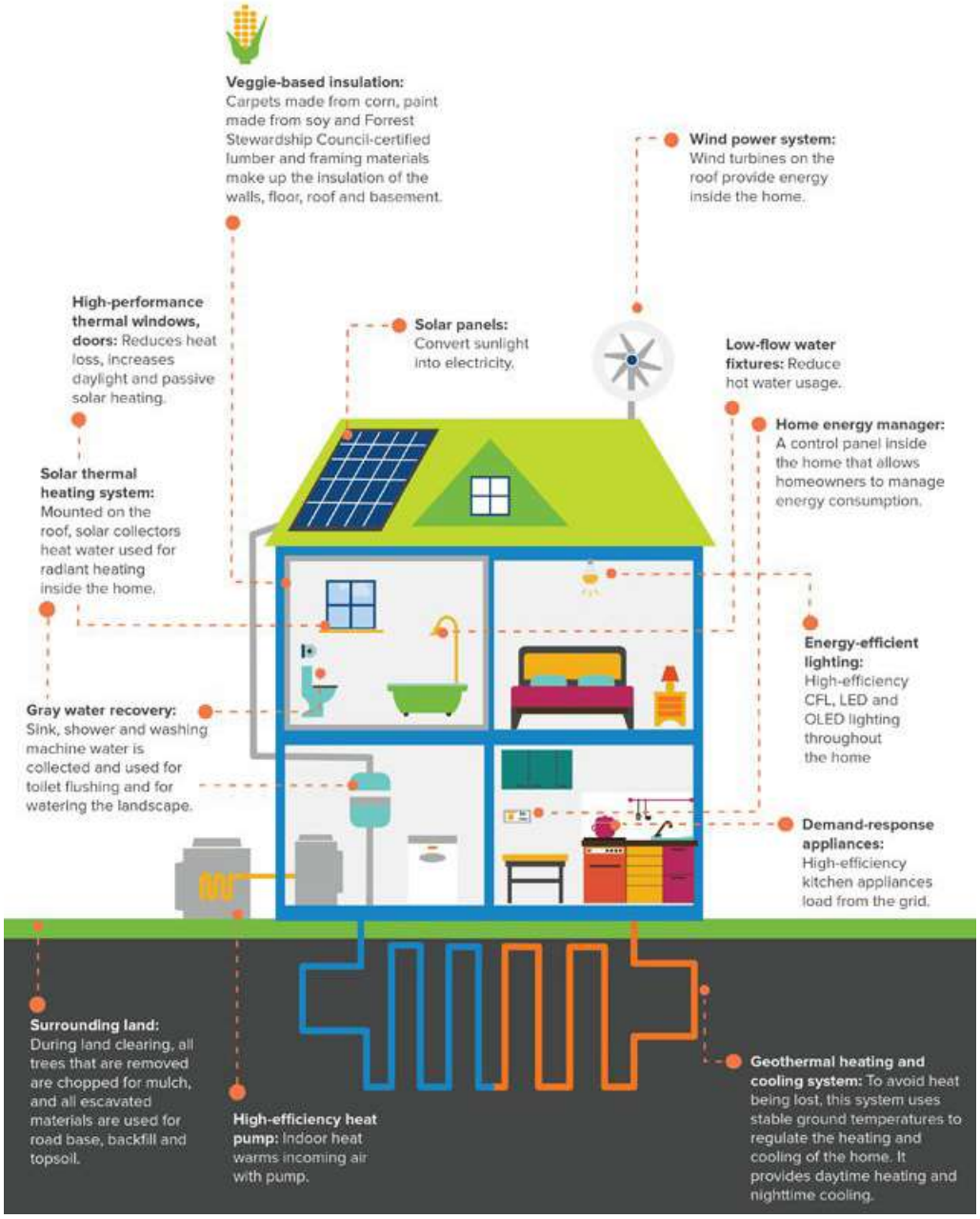


Figure 96. The operation system of a green building (Inhabitat n.d.)

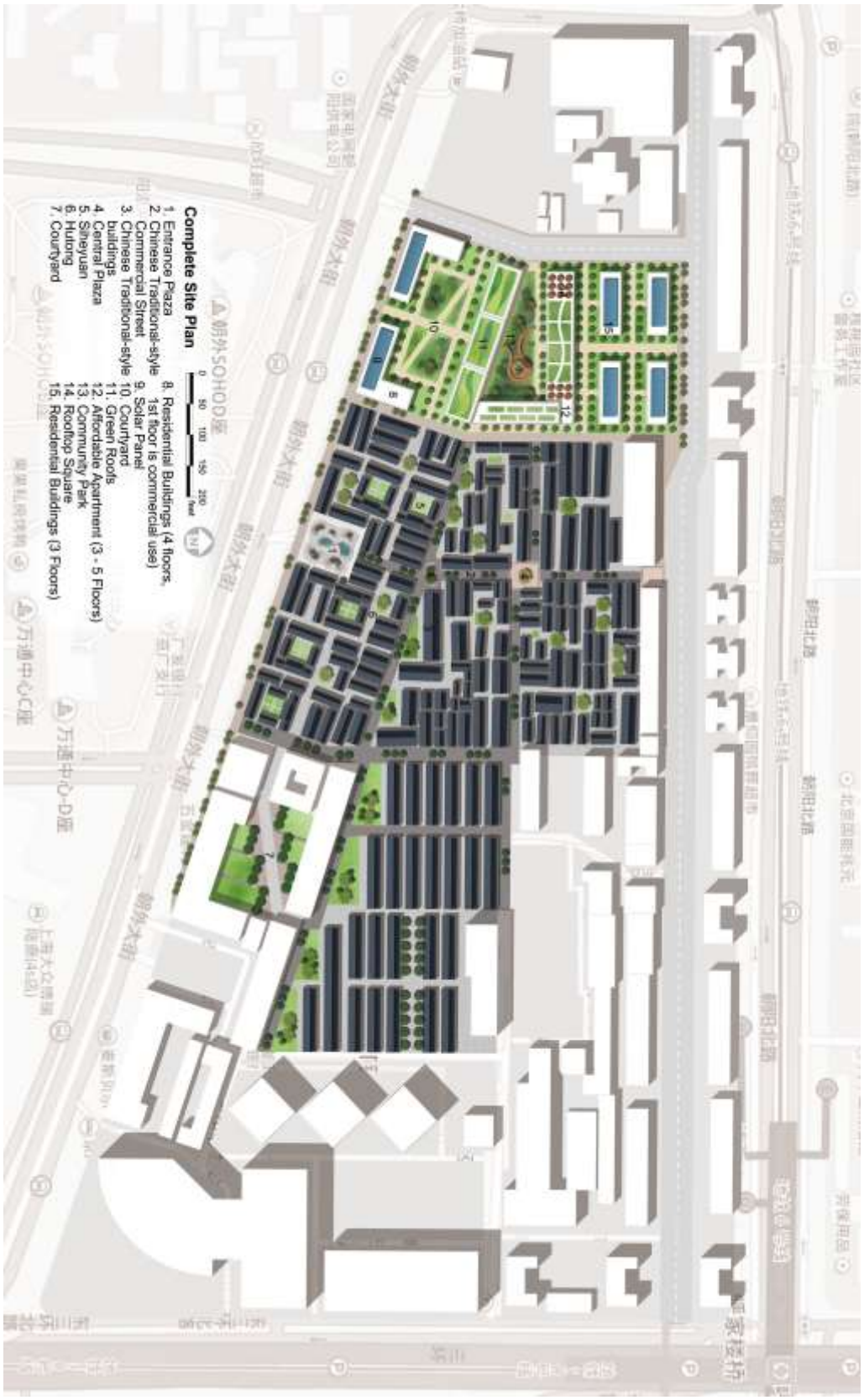


Figure 97. Complete site plan

Core Design

Entrance Plaza

Design Concept

The entrance plaza is the main entrance of the new Huashiying Village. As a major landscape node, the entrance plaza also reflects the design themes—tradition and innovation. The design concept is based on the unchangeable principle of Chinese traditional landscape architecture: “adore nature, imitate nature (Chen 2010).” Chinese ancient landscape architects were good at creating natural landscapes by designing variable terrains, and by using water, natural stones and other elements from the environment (figure 98). In this design, by using the abstract approach to create a variable terrain as well as using Chinese traditional landscape elements, we present Chinese-style landscape architecture in a modern way. Innovation is reflected in the stormwater management function of the plaza. When it is raining, the variable terrain can guide stormwater runoff into several low points. Then the stormwater will be stored and filtered before it enters underground.

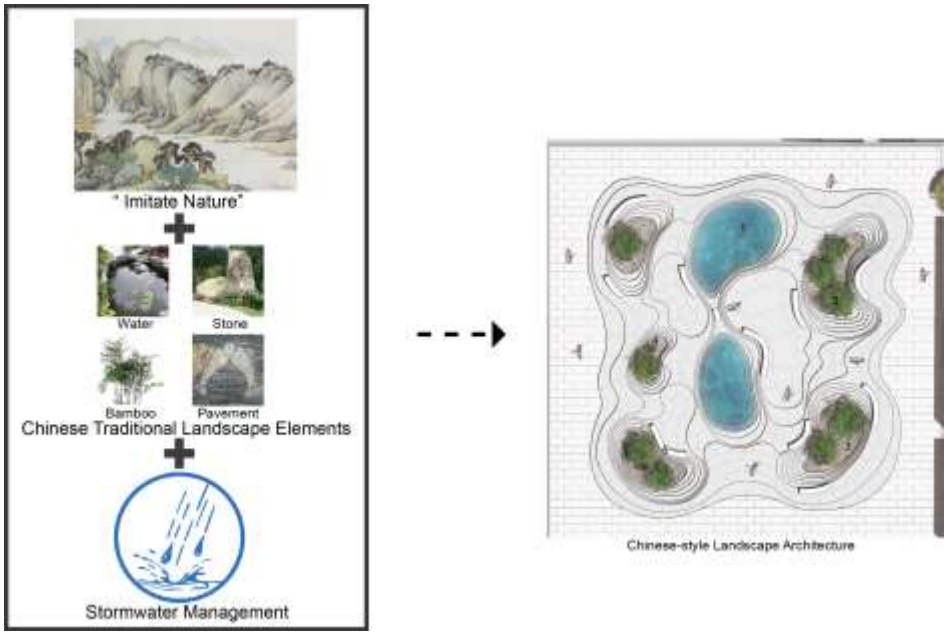


Figure 98. Design concept

Figure 99. Entrance plaza plan

Terrain and Stormwater Management

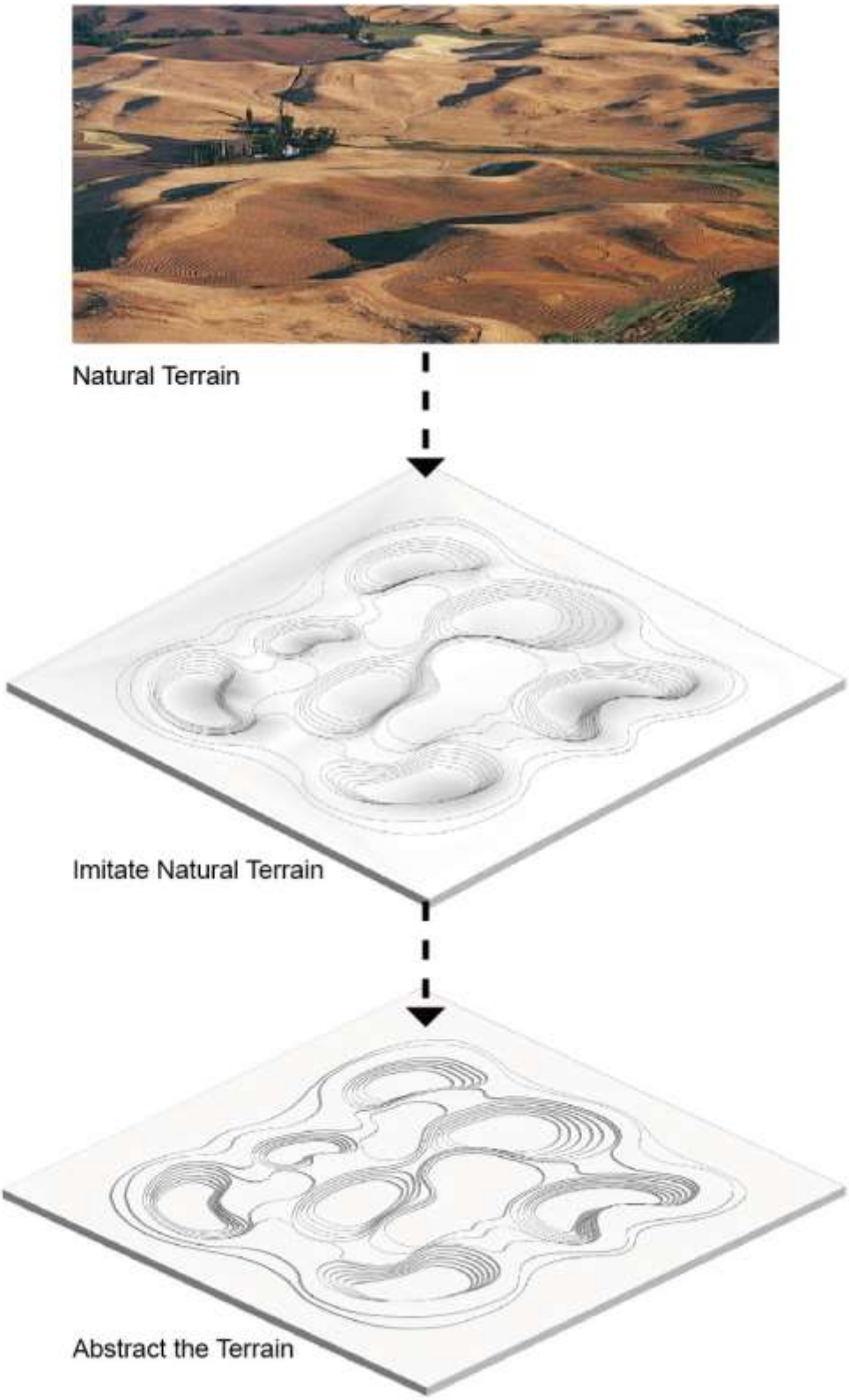


Figure 100. Terrain creation process

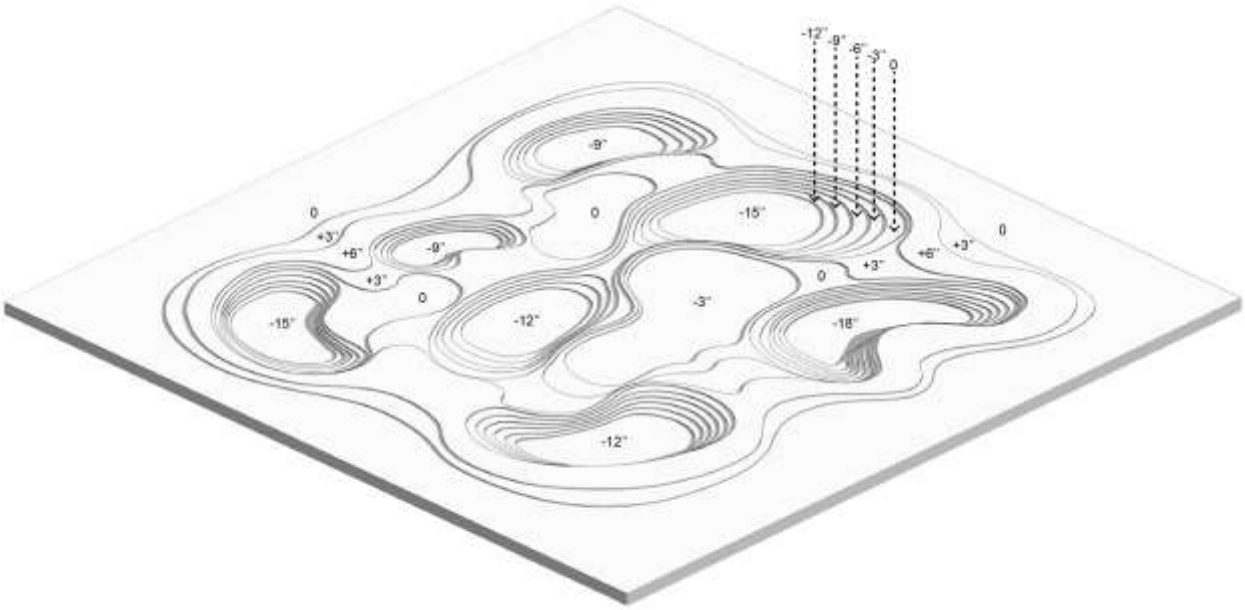


Figure 101. Contour map

In the plaza, there are seven low points. Two of them are water ponds and five of them are pebble pavement. When it is raining, some of the stormwater runoff will be guided into the water ponds by the terrain. The rest of the stormwater runoff will be guided into the five low points with pebble pavement. The pebble pavement will be the first filter layer to remove large particles in stormwater ruoff. Then the stormwater runoff will be deeply filtered by the second filter layer under pebble pavement before it enters the underground. Because some stormwater runoff cannot be guided by the terrain, it will be piped into these low points for filtration. Figure 102 shows the stormwater management process and the filter layer structure.

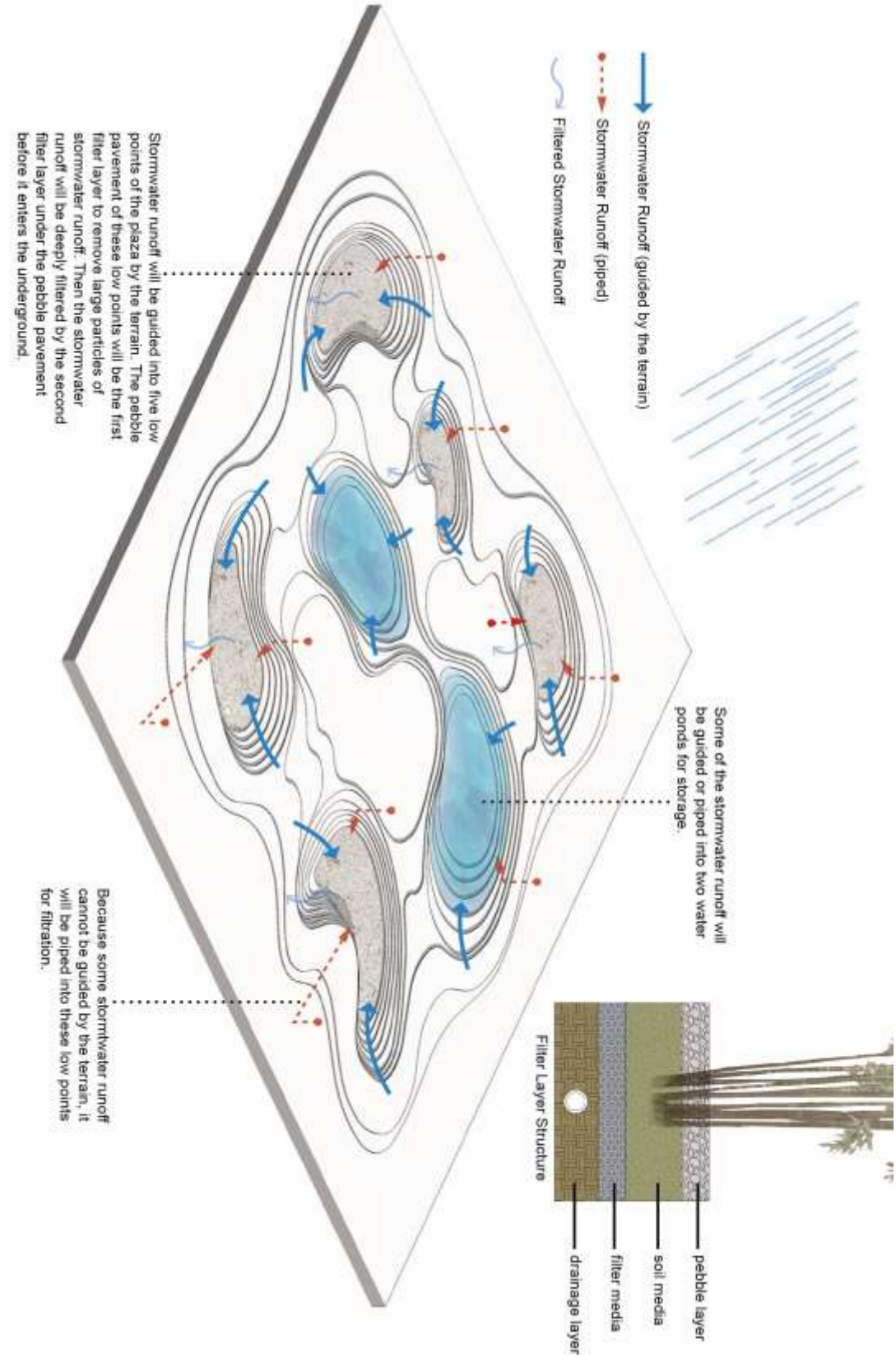


Figure 102. Stormwater management process and filter layer structure

Chinese Traditional Landscape Elements

In the design, four popular Chinese traditional landscape elements are used to represent the Chinese style: bamboo, stone, water, and Chinese traditional-style pavement (figure 103).

Figure 103. Four Chinese traditional landscape elements

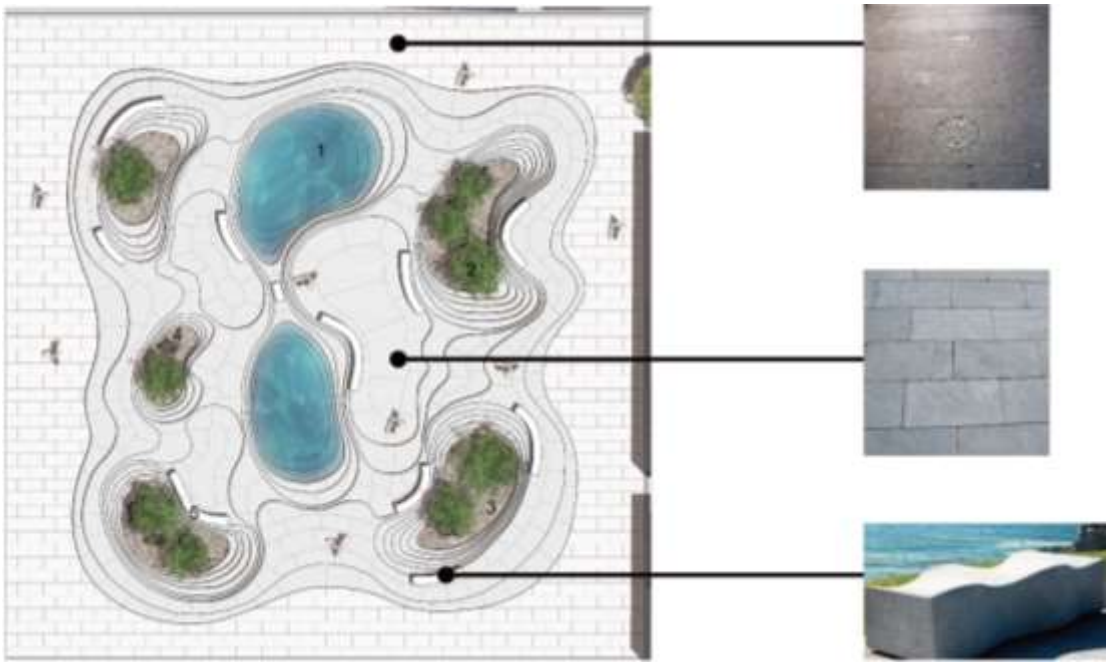


Figure 104. Material selection

Circulation

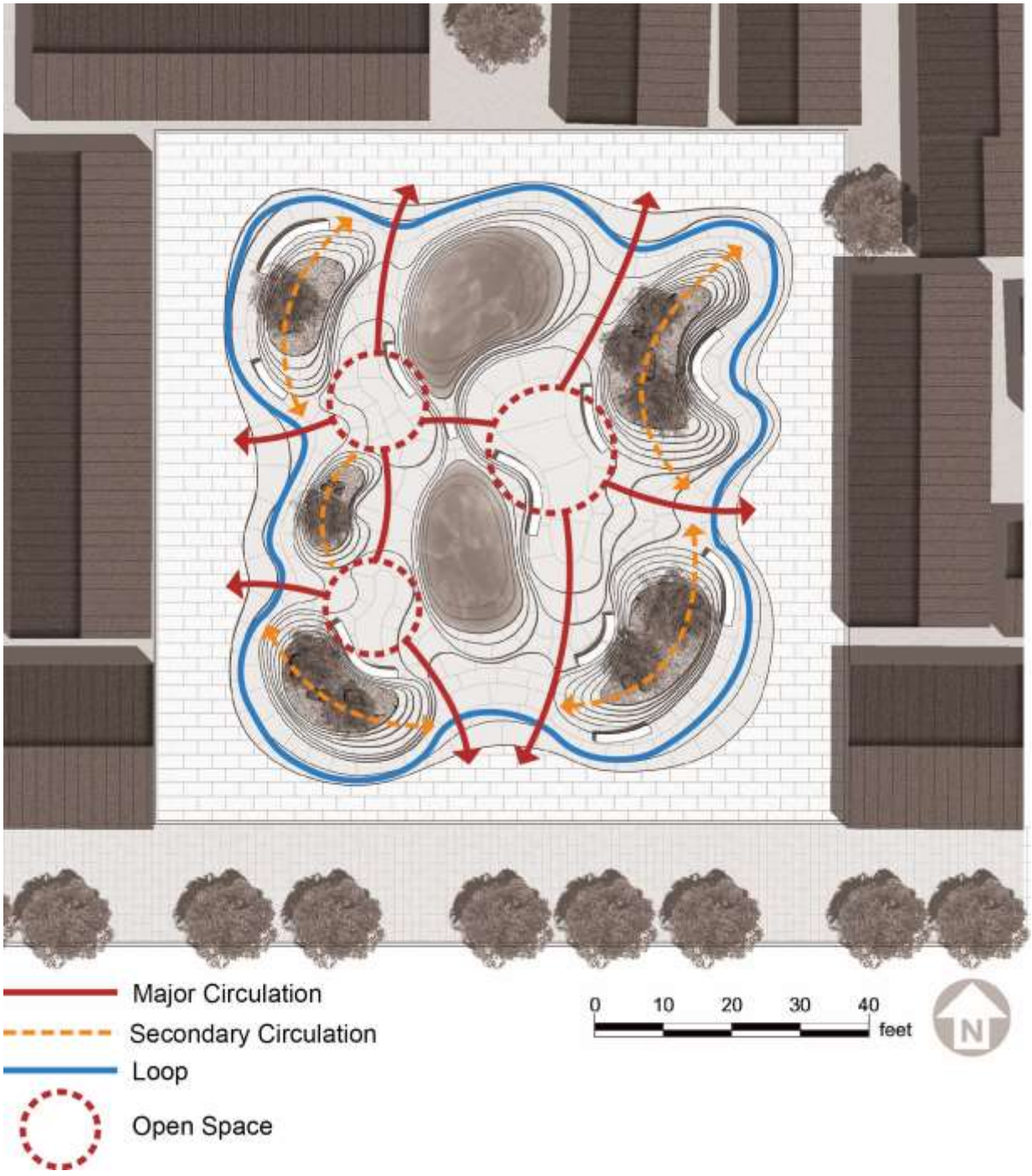


Figure 105. Circulation map

Perspectives

Figure 106. Entrance plaza perspective 1

Figure 107. Entrance plaza perspective 2

Figure 108. Entrance plaza perspective 3

Chinese Traditional-style Commercial Streets

Figure 110 shows the detailed design of the Chinese traditional-style commercial streets' core area. As discussed in the Design of Area 1 section, the design of Chinese traditional-style commercial streets focuses on tradition. The commercial streets include four important Chinese traditional elements: Chinese traditional-style buildings, the layout pattern of Beijing's old villages (Hutong and Siheyuan), small courtyards for villagers' traditional daily activities, and all kinds of traditional businesses along the streets. Also, some Chinese traditional design elements are integrated into the design, including Chinese traditional-style pavements and street lights, and bamboo.

Figure 109. The location of the detailed design area

Figure 110. Chinese traditional-style commercial streets plan

Chinese Traditional Elements Analysis

In the design, seven Chinese traditional elements represent the Chinese style: bamboo, Siheyuan, Hutong, and Chinese traditional-style street lights, buildings, pavement and drains (figure 111).

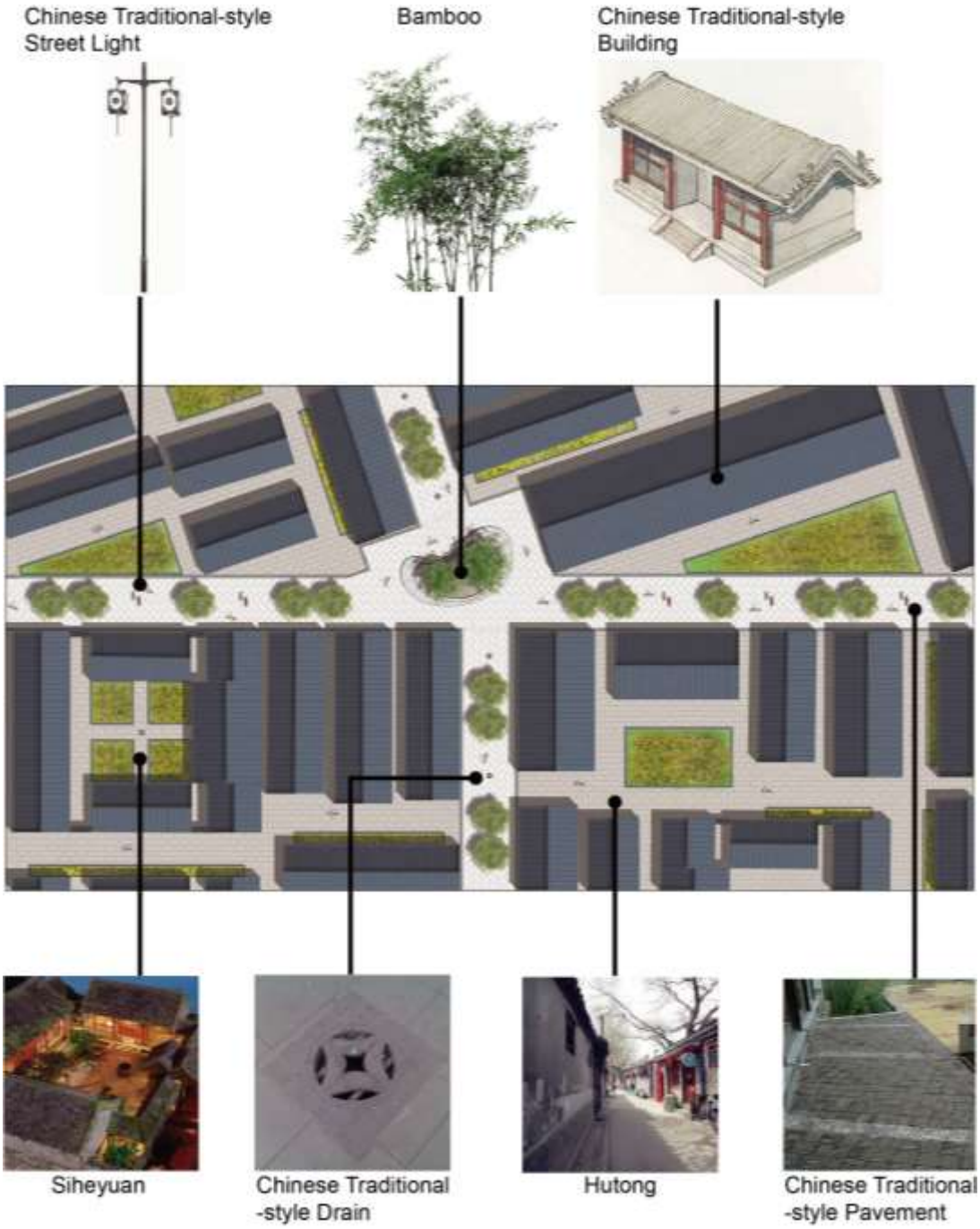


Figure 111. Chinese traditional elements analysis map

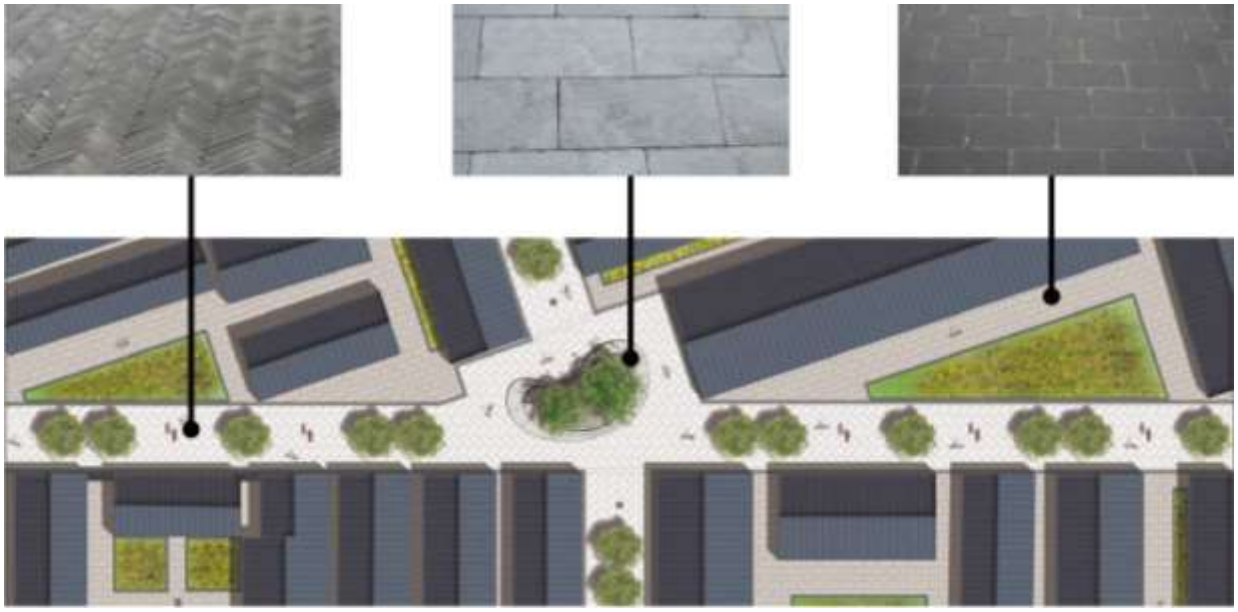


Figure 112. Pavement selection

Stormwater Management Analysis

As discussed in the Design of Area 1 section, traditional and innovative stormwater management methods are employed in commercial streets, including Chinese traditional drains, rain gardens, and infiltration planters (figure 113).

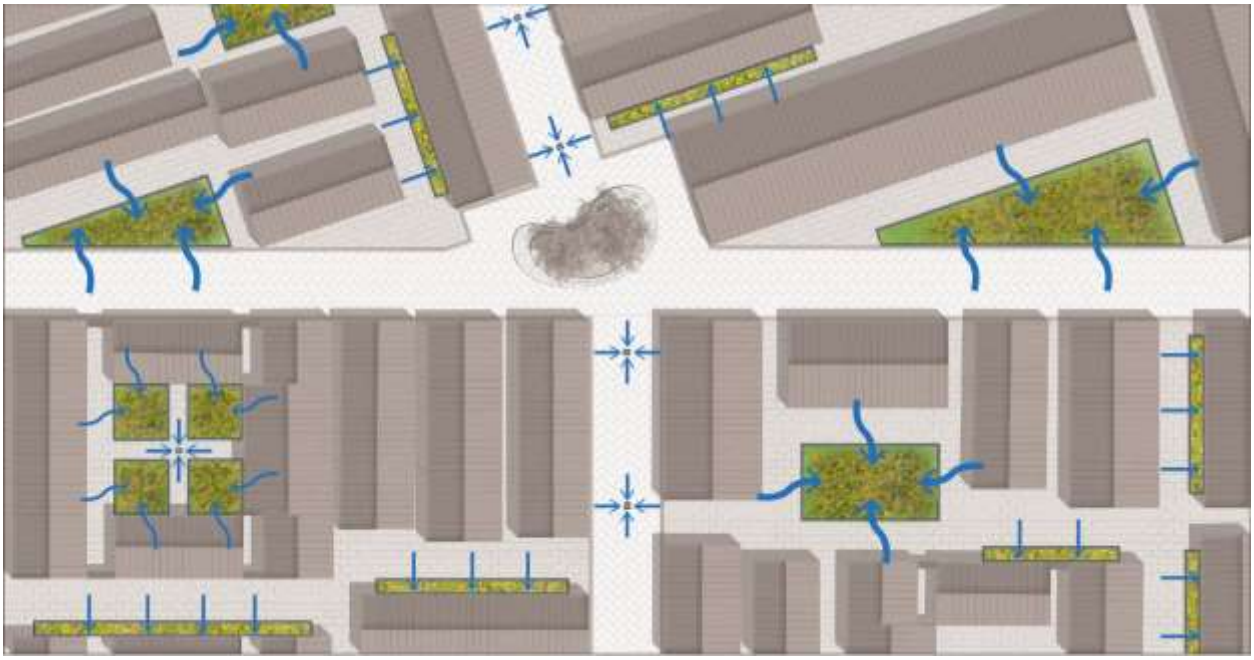


Figure 113. Stormwater management analysis map

Perspectives

Figure 114. Chinese traditional-style commercial streets with rain gardens

Figure 115. Small plaza

Figure 116. Hutong with infiltration planters

Figure 117. Siheyuan with rain gardens

Figure 118. The core area of Chinese traditional-style commercial streets

Community Park and Green Roofs

The community park and green roofs reflect the theme of innovation. They not only provide open spaces for people, but they also have the stormwater management function. The community park includes a large bioretention that can absorb and filter a huge amount of stormwater from surrounding areas. Moreover, a boardwalk is constructed on the bioretention to provide people with space for walking and viewing the landscape. Green roofs can absorb and filter stormwater, and keep buildings warm in the winter and cool in the summer. The affordable apartment's roof includes a roof garden, a roof plaza, a pergola, and plantscapes. These elements provide residents with different recreational spaces.

Figure 119. Community park and green roof plan

Perspectives

Figure 120. Community park perspective

Figure 121. Green roofs perspective

CHAPTER 6

CONCLUSION

Introduction

The research explored the employment of green community design methods in Chinese urban village redevelopment projects. Because the current method of redeveloping Chinese urban villages is unsustainable, and cannot resolve many fundamental issues and produces numerous new ones, it is urgent to find a new method of redeveloping Chinese urban villages in the sustainable ways. The research explored the issues of Chinese urban villages and kinds of sustainable design methods—green community design methods. Then it used a typical urban village in Beijing (Huashiying Village) as an experimental site to explore the employment of green community design methods in redeveloping Chinese urban villages. Through the research, we proved that the green community design methods can be an effective way to redevelop Chinese urban villages and are much better than the government's redevelopment methods. The research sought to answer two of the following questions:

1. How can the design methods of green communities be employed to redevelop a problematic urban village (community), Huashiying Village in Beijing, and resolve its issues, as well as preserving its original characteristics?
2. Are green community design methods an effective way to redevelop Chinese urban villages and an improvement upon the government's redevelopment methods?

Findings

The findings of the research are chapter specific. Their synthesis is to answer the research questions. This section will synthesize these findings to answer the two research questions:

1. How can the design methods of green communities be employed to redevelop a problematic urban village (community), Huashiying Village in Beijing, and resolve its issues, as well as preserving its original characteristics?

Green Communities and Design Methods

Green communities design methods include six categories: density and transportation, energy, resources, water, natural conservation, and historic preservation. The synthesis of these design methods is employed to create a green community with the benefits of safety and health, integration, energy-efficiency, little to no impact on natural resources, economic health, and harmonious neighborhood social environment.

Developing a Design Proposal for Huashiying Village

According to the site investigation of Huashiying Village and its surrounding areas, a site analysis that is based on aspects of green communities is conducted. Then a series of issues pointing to the unsustainability of the site are identified. These issues mainly involve four categories of green communities: density and transportation, water, energy, and historic preservation. For these issues, by combining the design methods in these categories with the practical situation of the site, we developed a design proposal for the site to resolve its issues from three perspectives: tradition, innovation, and better community, and develop it into a green community. At the same time, the original characteristics of Huashiyng Village are preserved. Moreover, the design methods of other two categories (energy and resources) are introduced in

the site as innovations to improve its sustainability and promote the employment of green community design methods in China.

2. Are green community design methods an effective way to redevelop Chinese urban villages and an improvement upon the government's redevelopment methods?

Urban Villages in China

The government's redevelopment strategy is simply to demolish these urban villages completely and build new high-rise buildings instead. This method makes urban villages look modern, but does not resolve their fundamental issues. It is in developers' best interests and brings some profits to local villagers. However, low-income migrants are often the victims of redevelopment. They are driven away and compelled move to another urban village that has not yet been redeveloped. Their living conditions have not improved. Nevertheless, the population density is still high in redeveloped urban villages. Even after redevelopment, many new issues emerge. Some old buildings with historical value have been demolished. The traditional elements of old villages are lost after redevelopment. And most of the new buildings in redeveloped urban villages are high-rise buildings, which consume a large amount of energy and contribute to the heat island effect. Also, redeveloping urban villages in this way reduces the amount of housing which low-income people can afford. In general, the current method is unsustainable.

Developing a Design Proposal for Huashiying Village

The design methods of green communities not only resolve the environmental issues in Huashiying Village, but also improve the living conditions of low-income migrants and preserve the traditional elements of the space. Besides, they bring many additional benefits. The traditional-style commercial street provides local villagers with new job opportunities. The green buildings reduce the consumption of energy and natural resources, which contributes to

environmental protection. Also, these methods can promote the employment of green community design methods in China.

Implication for Government's Redevelopment Methods

Currently, the government is still employing traditional methods to redevelop Chinese urban villages. This research has used findings to show that the government's redevelopment method is not sustainable. Moreover, it suggests the need for exploring new sustainable approaches, such as green community design methods, to replace the government's strategies.

Recommendation for Future Research

There are more than eight hundred urban villages in Beijing. In order to come up with a set of redevelopment methods that can be widely employed in these urban villages, more research should be done on different urban villages to assess their commonalities. On the other hand, green community design methods originated in western countries and have been widely used in these countries. A direct imitation of these methods may not produce the desired results in China. More research should be done on the combination of western design theories and Chinese practical situations.

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