A Vision for Future Development in Historic District: greenway planning, green infrastructure adaptation and landscape design in historic districts of US and China

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1. Introduction

This paper is trying to explore the future development for historic district. “Historic districts” talked in this paper are mostly part of modern cities and have valuable architectures and profuse cultural backgrounds. These historic districts now are legally protected by policies and also by the government, and most of those are involving supremely significant green spaces or greenway systems which can also date hundreds of years ago. However, some of them are still facing serious problem of losing the green patterns of the city and therefore become a scattered puzzle of urban open space system; and some others facing the problem of building facilities decomposed and keep distant to fulfill urban sustainable development. So whether, greenway planning can be adapted to the future development of these historic districts, and can green infrastructure adaptation make their functions to turn the communities green and sustainable? These are the research questions this paper will discuss.

The two study sites that the paper will discuss are Back Bay historic district in Boston, Massachusetts in US and former Concession in Wuhan, China.

2. Background and Literature reviews

2.1 Case studies in development of historic districts
The first law of preserving historic district is passed in France in 1840. And later in 1887, another law called “Monument Protection Act” also came into being and raises the idea of preserving all the valuable historic buildings and relics. After that, England, United States and other countries all around the world start to publish laws about protecting historic buildings.
There are several stages of historic preservation in history. The first stage is to restore the buildings and structures. And the second stage is to take into the considerations of landscape preservation and atmosphere recreation. French Quarter in New Orleans is a good example that government restored most of the buildings after the area had suffered from the Great New Orleans Fire in 1788. There were some adaptive ideas of the buildings such as the design of fire wall and replace the peaked roofs of old French style to flat tiled roofs.

Another great example for adaptive reuse of historic buildings is the New Earth and Heaven in Shanghai, China. The unique architectural style is called Shikumen Architectural style (or "Stone Warehouse Gate"). Shikumens are two or three-story buildings resembling Anglo-American terrace houses or townhouses. The high brick walls enclosing a narrow front yard distinguish them. It is a kind of buildings has strong gateways and made for people of mid-level income. After the World War II, the architectures were heavily subdivided and turned into a messy condition. With the development of the cities, Shikumen cannot survive in the city of Shanghai because of its bad maintain and unsafe environment. Until some buildings have already been torn

down, people started to realize that the unique building style should be a part of the cultural resource that we kept.
In 1997, many architects around the world including Benjamin Wood turned the messy buildings into new markets and shops. It becomes a modern community including all the facilities and entertainments. Now this area becomes the new center for the city and a new landmark for tourists. It is an example of both building restoration and atmosphere recreation.

2.2 Definition and adaptation of Greenway and Green Infrastructure

Julius Gy. Fabos defines greenways as "corridors of various widths, linked together in a network in much the same way as our networks of highways and railroads have been connected. The major difference is that nature's super infrastructure - the greenway corridor networks - is pre-existent. The river valleys have been carved out over many thousands of years. Our linear coastal system with thousands of miles of barrier beaches, rugged cliffs, or extensive Coastal wetland and floodplain systems have been formed by nature. This 'giant circulating system' identified by the US President's Commission (1987) is our greenway corridor network which needs to be treated with special care." (1995)

Fabos also points out in *Greenways--the beginning of an international movement* that majority of greenways fall into one of three major categories, and that the three types are increasingly overlapping in comprehensive greenway systems or networks:
1. Greenways of ecologically significant corridors and natural systems...
2. Recreational greenways...
3. Greenways with historical heritage and cultural values: to attract tourists and to provide recreational educational, scenic and economic benefits; to provide high-quality housing environments at greenway edges for permanents and seasonal housing; to accommodate water resources and flood prevention and sensitively located alternative infrastructure for commuting; to offer vehicles of expression among many other possibilities. (Fabos, 1995)
Jack Ahern concluded five key ideas of greenway definition, which are:

The spatial configuration is linear; Linkage is the key; Multifunctional; The greenway strategy is consistent with the concept of sustainable development and finally, greenway should be considered as a complement to comprehensive landscape and physical planning, not a replacement. (Ahern, 1995) In recent literature there are some new ideas about greenway, such as ecological network, ecological infrastructure, extensive open space systems, multiple use modules, wildlife corridors, and landscape restoration framework. (Ahern, 2002)

Green Infrastructure is a concept originating in the United States in the mid-1990s that highlights the importance of the natural environment in decisions about land use planning. Green infrastructure has its origin in two important concepts: (1) linking parks and other green spaces for the benefit of people, and (2) preserving and linking natural areas to benefit biodiversity and counter habitat fragmentation (Benedict and McMahon 2006). In Jack Ahern's point of view, green infrastructure is defined as "spatially and functionally integrated systems and networks of protected landscapes supported with protected, artificial and hybrid infrastructures of built landscapes that provide multiple, complementary ecosystem and landscape functions to a broad public, in support of sustainability" .(Ahern, 2003)

The main benefits of Green Infrastructure are about hydrology include rainfall interception, water storage, increased soil infiltration, decreasing peak flows and so on. The most Successful and famous examples are: Street Edge Alternatives (SEA Streets) Project in northwest Seattle and the Staten Island Blue Belt in New York. They vary at scale but both use green infrastructure instead of sewer construction to manage storm water.

2.2 History of study areas

History of Back Bay Neighborhood in Boston, Massachusetts

Back Bay neighborhood got its name because it was literally the back by for Boston before it was filled in in 1800s. In 1814, a mill dam was constructed to serve as a toll road connecting Boston to Watertown, and later was buried under the present day Beacon Street.

Nancy Seasholes discuss in the Book *Gaining ground that: O*ne *of the major projects that affected landmaking in Back Bay was called the Mill Dam between 1818 and 1821. This project did not actually create much land but did produce a structure that ultimately led to the filling of the whole Back Bay.(Seasholes, 2003)* Soon after the Mill Dam was finished, more land was made on the south of the dam. The landmaking of now called public garden was happening in 1830s. Then in 1849, there had been a great problem in Back Bay that all the sewage drained into the receiving basin. Far more serious, the city committee reported that: *Back Bay at this hour is nothing less than a great cesspool, into which is daily deposited all the filth of a large and constantly increasing population.(Seasholes, 2003)* Later on, two solutions were adopted to work with this problem, and the second one had been selected at last which is to fill in Back Bay, covering the sewage on the flats. After that, the Back Bay was created by filling the tidewater flats of Charles River. The massive project was begun in 1857, and the filling was completed by 1880. The project reached Kenmore Square in 1890, and got to the Back Bay Fens in 1900. This project was the largest number of land reclamation and would have been impossible to achieve under modern regulations.

Early between 1879 and 1895, Olmsted and Eliot integrated parkways and stream valley parks named Emerald Necklace. Anthony Walmsley talked emerald necklace in his paper Greenways and the making of urban form.: *It is based on the distinctive regional ecologies with the join of historic public grounds of the old city--Boston Common and Public Garden, by way of Commonwealth Avenue and the development of Back Bay, to the Necklace's outward continuation to the country by way of the Arborway, Arnold Arboretum and West Roxbury Park(now Franklin Park).(2003)* This park system had become one of the largest in the country by 1902. (See Figure 1)

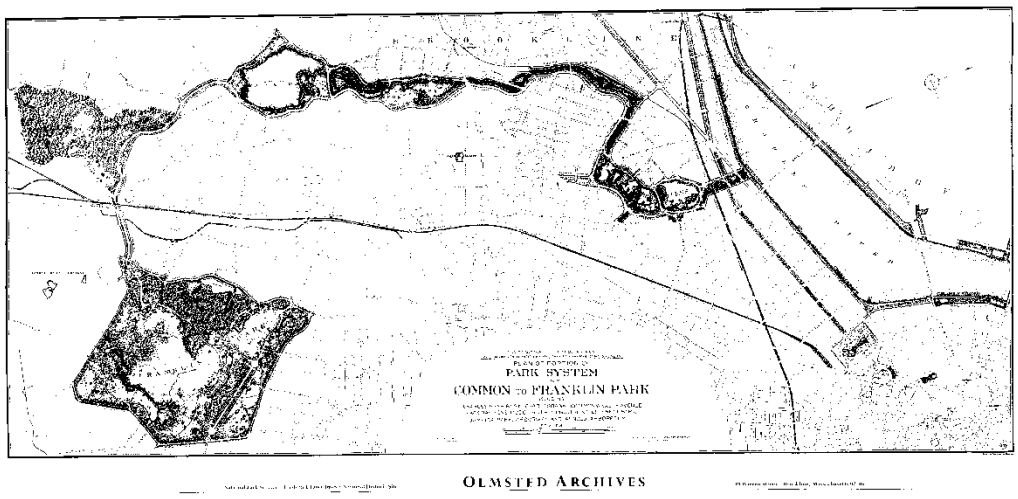

Fig. 1. Plan of Portion of Park System from Common to Franklin Park, 1894(highlight the greenway section as green, and delineate the location of Back Bay)

The Commonwealth Avenue Mall was designed by the famous architect at that time-- Arthur Delevan Gilman. Frederick Law Olmsted designed the Newton portion of Commonwealth Ave and included the parkway as part of the Emerald Necklace park system. The first statue on the Commonwealth Avenue Mall was erected in 1865 at Arlington Street.
The middle park then officially named Commonwealth Avenue Mall, and become a significant part of the whole greenway system of Emerald Necklace.

History of Concession in Wuhan, China

Concessions in China were a group of concession territories within China that were governed and occupied by foreign powers. They are frequently associated with colonialism. Most had extraterritoriality and were enclaves inside key cities that were treaty ports. Other than other minor extraterritorial regions, these concessions no longer exist.

Wuhan is a harbor city along Yangtze River. It is famous for its connectivity to other main nine cities, so it also became one of the dominant areas for foreign powers. Hankow, the district in Wuhan with the longest history is the concession area that foreign countries picked. The first two countries--England and France, started their landing in 1861 after the Second Opium War. The concession area take 246 square kilometers of the land, and divided into five pieces for five different countries.

Concessions in many ways are the shame of the history and the un-healing scars of many Chinese people. But on the cultural viewpoint, this area contains many outstanding architects and extraordinary landscape that will never appear again. So the Wuhan Government started to preserve this area in 1980s and publish laws to preserve buildings and structures.

2.3 Greening historic districts
With the time passed by, there appears the rising concern of people that sustainable becomes a main theme of the urban growth and landscape planning. In the meantime, EPA rises up the idea that we need to find a way to think "Smart Growth and Sustainable Preservation of Existing and

Historic Buildings". However, *the existing problems in historic street blocks are: incorrect preservation ideas, incorrect preservation modes and destroyed habitation and life network.* (Li, Ding. 2003) In this way, there is a gap come into format, which indicates the importance of making historic communities/districts more sustainable.

Then on June 15th, 2011, the U.S. Environmental Protection Agency convened a Symposium on "Greening Historic Communities". The theme of the symposium is "What Works, What Doesn't, and What Should Change?" at the Hotel du Pont in Wilmington, Delaware. Apparently, this symposium is aiming at the future development of historic communities.

Throughout the symposium, participants were encouraged to reflect on what's working, what's not, and what needs to change. The following are key themes that emerged from the presentations and discussions:

• *There is an urgency to these issues that wasn't there 20 years ago. Cities and regions are taking an increasingly proactive and innovative approach to promoting more sustainable development patterns that encourage higher densities, mixed-use development, and increased walkability.*

• *There needs to be a culture-shift towards a culture of re-use, stewardship, and a focus on future generations. Efforts need to look beyond buildings to the communities, recognizing their context and acknowledging their role in maintaining a sense of place.*

• *Standards and policies, both local and federal, need to reflect stronger values around sustainability and preservation, particularly in the face of climate change. Our standards and policies should prevent or disincentive tearing down older buildings to build new LEED certified buildings.*[4]

3. Research Objectives

The goals of this project is to make an evaluation of the ecological patterns of the site, find out the existing condition and problems these sites are facing, and make suggestions to the future development. The best future vision includes creating adaptive ecological habitat, reasonable space arrangement and comfortable living spaces satisfying both the residents' needs and social requirement. By achieve the objectives, the research needs:

-To understand the definition the green way, green infrastructures and sustainable neighborhood, raising possible solutions that may be adopted in historic districts;
-To use certain software to analysis the ecological patterns of the historic districts, invest historic maps and GIS data, including historic records of buildings and surrounding landscape;
-To compare the two study areas, conclude both the merit and deficiency, conclude the problems that historic districts are facing and make recommendations of the process to improve existing conditions and also the future trends.

4. Research Questions

[4] Greening Historic Communities Meeting Synopsis, June, 2011

● Can cultural greenway be included in these historic districts and connected to the existing regional greenway system?
●How can we include green infrastructure to help improve the existing problems of water management?

FIG 2. GIS OVERLAY ANALYSIS
(PHOTO CREDIT: YIWEI HUANG)

5. Methodology

Since different historic districts have different form patterns and different green space type, various methods will be adopted to research these areas. (1) In Wuhan's part, remote sensing, Fragstats and ArcGIS analysis will be used to investigate the ecological spatial patterns and connectivity of Hankow Historic District; (2) In Back Bay's part, the paper will use detailed inventory and analysis (including GIS analysis and measurements) of existing conditions to develop through the understanding of both greenway scale and landscape pattern; (3) The paper will make a conclusion and assessment of whether greenway planning and green infrastructure can be an answer which satisfy the future development of historic district.

6. Research analysis and results

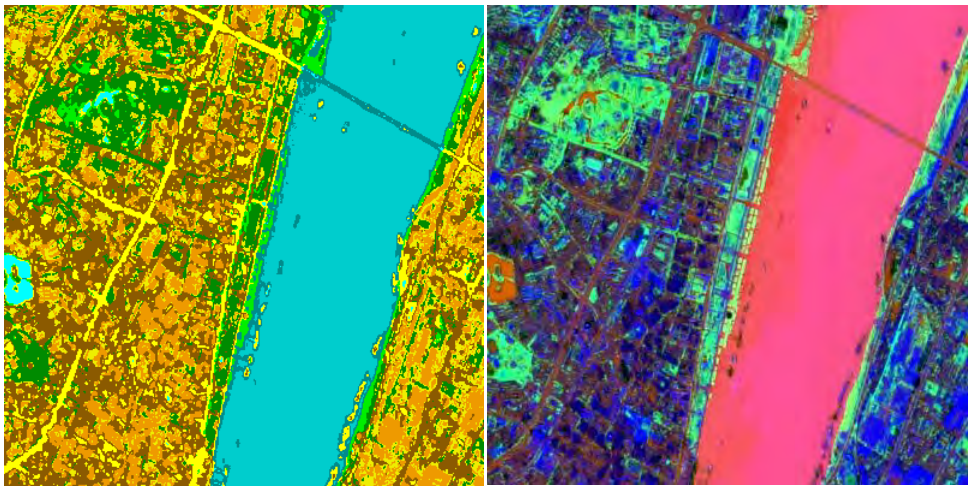

FIGURE 3. REMOTE SENSING PICTURE OF HANKOW CONCESSION IN WUHAN, CHINA
Photo credit: Yiwei Huang

In this project, five categories are divided in terms of the green space. They are vacant space, building surrounding space, green plaza, street trees or tree alley and affiliate space of institution.

The remote sensing picture was first used to get the overall picture of the concession. After that, GIS grids of 2.5cm*2.5 cm squares were drawn on the map. The project also uses CAD to revise some of the remote data that is not correct comparing to the current situations. After all these pictures prepared, Fragstats software was used to calculate the spatial landscape pattern on site.

Table Data result of Landscape Metrics

ID	LID	CA	NP	PD	LSI	AREA_MN	PLADJ	COHESION	AI
1	Vacant Space	0.29	3.00	1038.96	1.93	0.10	91.02	99.75	95.46
2	Building surrounding space	1.25	51.00	4077.96	9.47	0.02	78.71	95.25	80.52
3	Green plaza	0.11	5.00	4733.73	2.35	0.02	81.95	94.88	88.78
4	Tree Alley	1.23	135.00	10942.25	14.47	0.01	67.38	84.59	68.93
5	Affiliate space of institution	0.37	3.00	802.68	2.41	0.12	90.13	97.45	93.98

The table above shows the number the project get from Russian Concession. Each number can find scientific meaning by comparison to other numbers and the definition of the metric configuration.

Here are some definitions of the configurations:

Core Area (CA)--Core area represents the interior area of patches after a user-specified edge buffer is eliminated. All other things equal, smaller patches with greater shape complexity have less core area.

Isolation/Proximity (PD)--Isolation/proximity refers to the tendency for patches to be relatively isolated in space (i.e., distant) from other patches of the same or similar (ecologically friendly) class.

Number of Patches (NP) --The higher degree of fragmentation, the higher NP the area has.

So after all these calculations and comparisons, it is easy to get that the vacant spaces, urban green plazas and affiliate spaces of institution has very limited biodiversity comparing to building surrounding spaces or tree alleys; On the other hand, the PD and NP of Tree alleys is much higher than other green spaces, which means the degree of fragmentation of street trees is much higher than others.

After this project, we can draw some conclusions that the biodiversity of historic districts is limited, and especially in urban plazas and affiliate spaces of institutions; and the street trees lack connection to each other so that they will become scattered point of green space but not providing any benefit to ecosystem service. The whole green space inside the historic district lacks connection to the green space in the city outside the historic district.

In Back Bay historic district, although Emerald necklace is one the most famous cultural greenway system in the country, the Back Bay neighborhood can be still improved in some way. The most severe problem that Back Bay neighborhood is facing is the decrease of ground water level. It is mentioned in the report *Back Bay Boston, Part II: Groundwater Levels:* With construction of sewers, drains, subways and the basements of buildings below the water table, some of which leak, the groundwater level has dropped in Back Bay. Where wood piles have been exposed to air for some time, the piles have rotted when attacked by fungi, borers and other organisms. A few buildings have settled and cracked, requiring owners to underpin their structures at great cost in order to restore the foundations. (Aldrich, Lambrechts.1986)

And in the MBTA Groundwater Action Plan in 2006 also mentions that: the current causes of groundwater removal are Construction dewatering, Leakage into deep sewer pipes, Sump pumping from residences, deep basements and transportation corridors and Loss of infiltration due to surface cover and so on.

Based on the analysis result from the GIS map, the emerald necklace greenway system is only connected through the commonwealth avenue within the Back Bay historic district. Besides, the land cover on both sides of the avenue is a impervious pavement. (Fig 5) The bike trail system, although connecting the way from Arlington Street to Massachusetts Avenue, the on-street parking is big obstacle to prevent people from engaging with the Commonwealth Avenue Mall.

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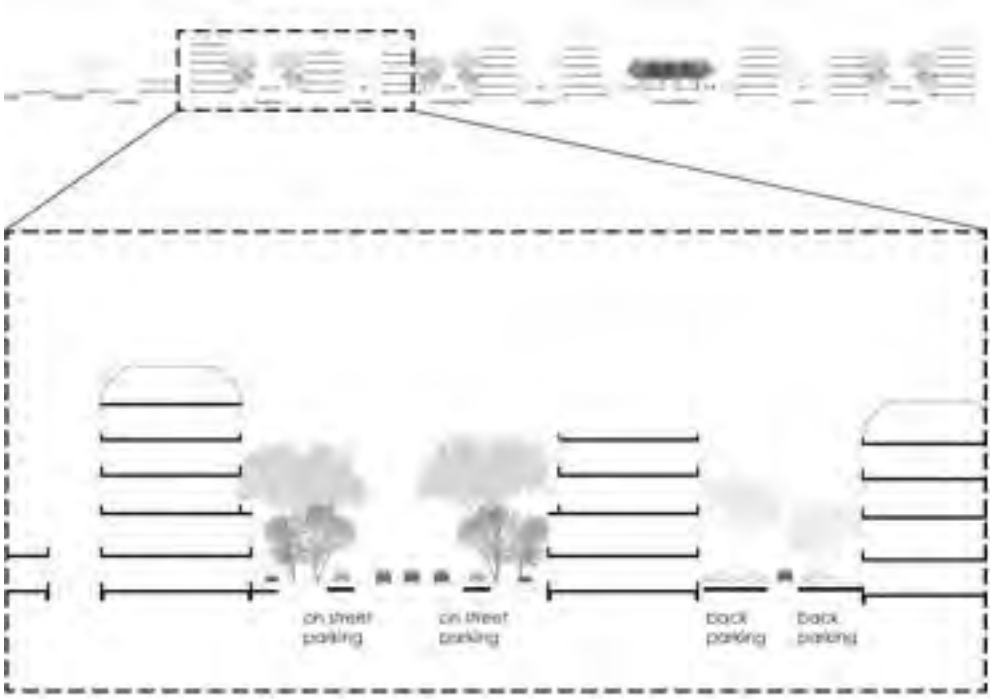

FIGURE 7 EXISTING CONDITION CUTTING PERPENDICULAR TO COMMONWEALTH AVENUE, PHOTO CREDIT: YIWEI HUANG

It can be concluded from the above that impervious pavement has been the problem of this site. Despite other fact, replace impervious pavement with permeable pavers can maintain the amount of groundwater. So green infrastructures, such as bio swales, permeable pavement, and LID projects such as green-parking spaces can be the solution to the site. (Figure 8)

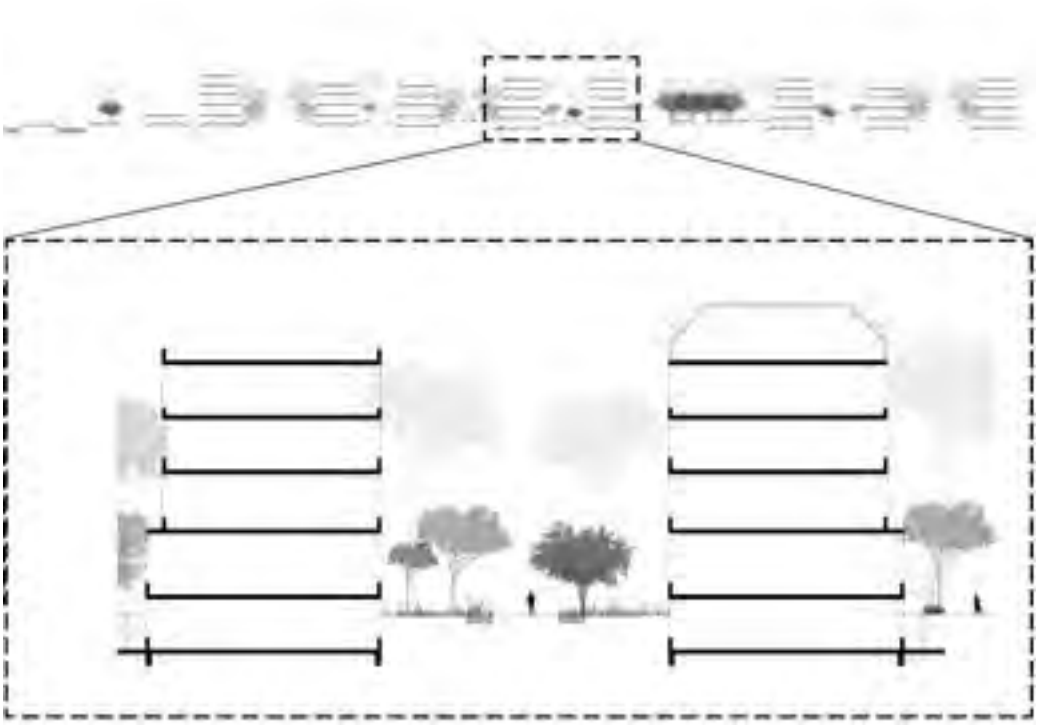

FIGURE 8 PROPOSED SECTION CUTTING PERPENDICULAR TO COMMONWEALTH AVENUE, PHOTO CREDIT: YIWEI HUANG

And also, in terms of the whole communities, green infrastructures can be adapted to become a branch for the historic greenway on Commonwealth Avenue.

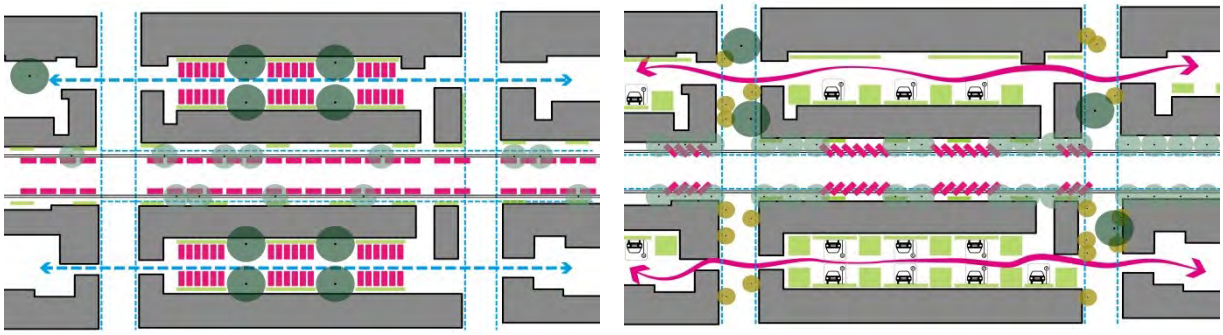

FIGURE 9 EXISTING AND PROPOSED CONDITION OF ONE BLOCK, PHOTO CREDIT: YIWEI HUANG

The figure above shows one possible way to adapt green infrastructure on the site. By not change the building but change some part of the road such as add bio-swales, rain garden, and even small green backyard, we can achieve the goal of water management. Other possible solutions can be green roof, vertical gardens and small rain gardens. Those green infrastructures take little space but do function well to control the water. So green infrastructure can be one way to improve the condition of water problem. But in terms of keep the French style feature, bio-

swales; underground water tunnels, permeable pavement and green parking lots can be suitable answer to the question.

7. Conclusions:

Cultural greenway system is a significantly powerful axis that the urban buildings should follow. At the same time, historic buildings can be powerful edges on both sides of the greenway system. And with the time pass by, the greenway system or green infrastructure nowadays should not just provide the function of connecting the two green spaces or provide recreation space for humans, it also require the function of prevent hazards, maintain groundwater and connect the fragmented patches for ecosystem.

Specifically in historic districts, large scale planning combined with human scale green infrastructure can be an answer to the future development in terms of the continuity and stability of ecosystem. At the same time, since the historic features are still preserved in many places, these green elements should be carefully designed to keep the origin features of the historic districts by following the grids and the edge of the buildings. The historic greenway, at this point, is also a central park space for both local residents and tourists. In sum, the way searching future for historic districts has various answers, and there is always a long way to go.

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http://www.dainet.org/water/index.htm
USGS Seamless data warehouse – Orthophoto, Land Cover, and Impervious Surface Map, 2012
http://seamless.usgs.gov/