ID 1339 | GREEN SPACE SYSTEM PLANNING BASED ON THE GREEN INFRASTRUCTURE - A CASE STUDY OF JI´AN, CHINA

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1 LIMITATIONS OF CURRENT GREEN SPACE SYSTEM PLANNING IN CHINA

With the rapid promotion of China's urbanization, problems of rapid urbanization gradually threaten the healthy and sustainable development of the city. The theory and method of the traditional green space system planning is difficult to meet the basic requirement for modern cities, which embodies in: 1) Evaluates urban green space system planning and construction of urban green space by the green index, resulting in result in low benefit of many urban green space system planning; 2) Planning is mainly confined to the built-up area, and lack of consideration on the regional ecological integrity and the relationship between green spaces inside and outside the city. The green space system planning within the region is difficult to implement; 3) Lacks of mechanism to promote the effective participation of multi-subject. Planning Text often one-sided emphasizes on the harmony between human and nature, but lacks of the powerful means of space construction; 4) Green spaces and other construction sites are placed together and isolated in the city, and the result is that green spaces have been eroded by construction sites.

Therefore, the green space system planning in the new period must break through the limitations of the traditional green space system planning. The layout of the green space system must be based on the principles of Urban and Rural planning and ecological construction, and consider the green spaces within and outside the city integrated, systematic and ecological. This requires planning workers not only to consider problems with macroscopic spatial and temporal scale, but also implement specific work of meso and micro level. We should fully grasp the structure and function, form and elements of green space in a specific urban and rural environment, to make the artificial environment and the natural environment to form a coordinated system.

2 THE CONCEPT AND PLANNING METHOD OF GREEN INFRASTRUCTURE

2.1 CONCEPT

The concept of Green Infrastructure was proposed against the background of ecological destruction, environmental control and improvement brought by the industrial revolutions in western countries, as the requirement of modern ecological civilization and sustainable social development. Green Infrastructure (GI) was first defined in the U.S. in 1999, "Green Infrastructure is a national natural life support system, and a correlated natural ecological network (Williamson, 2003)". It was defined as one of the key strategies for achieving sustainable development objectives in the U.S., and its significance was promoted to the national natural life support system—a land and water protection network supports local species, maintains natural ecological processes, preserves air and water resources, and devotes to improvement of community, residents' health and life quality (Benedict and Mcmahon, 2001). In the past decade, concept and relevant practices of Green Infrastructure have gained popularity fast in the United States and Europe[1].

The ultimate goal of GI is to achieve the true integration of urban and rural green network, to integrate the city into nature, which coincides with the requirements of urban and rural planning and ecological civilization construction in China. Therefore, the construction of GI is an effective means to improve the living environment and improve the ecological quality of the city. Through the construction of the GI network, the green spaces can be promoted to the level of the urban infrastructure, to ensure the flexibility and priority of the green land boundary. On this basis, it can form a green space systemwith complete function (Tab.1).

Classification	Sub-classification	Type
Green infrastructure	Natural Semi-natural Artificial	Forest, marsh, water such as river and reservoir Orchard and cropland Landscape garden such as park, roadside garden
Gray infrastructure		Built-up land, involving residential, industrial, commercial and public facilities land Unused land, where all land covers have been cleared for development

Table 1 - Classification system of urban infrastructures

2.2 CONSTITUTION

Green infrastructure's components include a variety of natural and restored ecosystem and landscapes features that lead to a system known as "Hubs" and "Links"(Fig.1). Hubs anchor Green Infrastructure networks, providing origins and destination for the wildlife and ecological processes moving to or through them. Meanwhile, links are the connecting tying the system together and enabling green infrastructure network to work. Sites are also a type of green infrastructure network. Although the scale of sites are much smaller than hubs, and they are not necessarily connected with the regional protection system or the whole network, but are also important parts of green infrastructure.

On this basis, green infrastructure can develop into a more integrated network, including open space, low impact traffic, water, biological habitat and metabolism and so on. At the same time, GI can be extended to a social network which composed of residents, social organizations, green activities and practical projects.

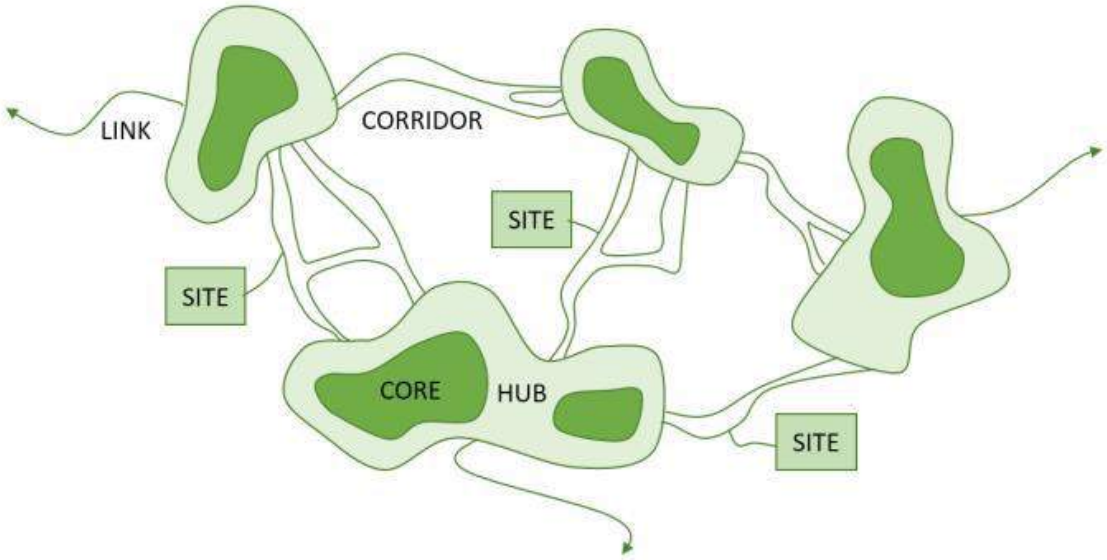


Figure 1 - Composition of GI System

2.3 PLANNING METHOD OF GREEN INFRASTRUCTURE NETWORK

2.3.1 PLANNING PROCESS

Up to now, a lot of research and practice on GI have been done in many areas, through summarizing the existing outstanding cases, the planning step green infrastructure is divided into the following phases: 1) Set goals: determine the specific objectives on the basis of the existing planning, the interests of the main views, urban positioning and protection objectives; 2) Collect data: collect the basic information of the research area, especially the land use data, which is the most important data source of GI; 3) Analysis and evaluation: analysis and evaluation of land use types that may be used as a component of green infrastructure by overlay analysis or other methods. It's a key step to construct the GI system; 4) Determine factors: according to the characteristics of each factor, the hubs, links and sites of the green infrastructure in the research area are determined on the basis of analysis and evaluation, and then

determine the overall spatial pattern of GI; 5) Construct GI priority protection system: take the green infrastructure priority protection system as the basis, and then comprehensive factors such as urban and rural layout, strategic focus, the status quo of land use, historical landscape, per capita green space and green space accessibility and so on to modified the GI priority protection system(Fig.2).

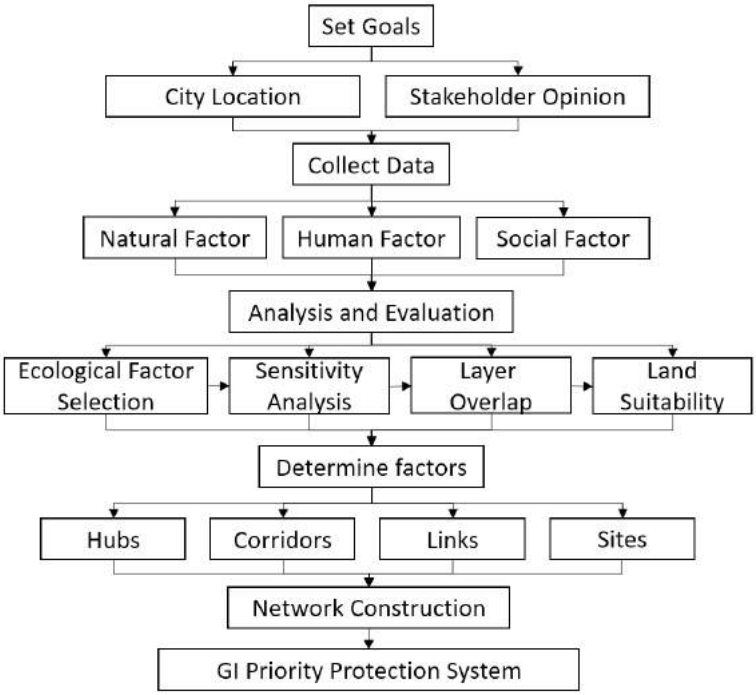


Figure 2 - The General Process of Green Infrastructure Planning

2.3.2 TECHNICAL MEANS

Superposition analysis method based on vertical ecological process[2]: process the basic data by using GIS and RS technology, and evaluate of ecological sensitivity in the study area by using the superposition method of vertical ecological process of McHarg. After the superposition of the influencing factors, the sensitivity level of each unit is divided, and the most sensitive landscape unit is the hubs or the source patches.

Spatial analysis method is based on horizontal ecological process: the minimum cost model is used to determine the location and pattern of the corridors. The minimum cost path does not necessarily mean that the species will use the corridor when moving between habitats, but should be considered as a potential path to reduce the cost of liquidity. Its meaning mainly refers to the potential ecological corridor is the lowest cost path. Through the resistance of the various factors on the horizontal movement of animals and plants, it's mainly to establish the resistance surface, using the minimum cost model to calculate the minimum cost path from the "centers" to the "hubs".

In addition, there are two kinds of methods, which are based on the graph theory and the analysis of morphological spatial pattern. But in this paper, we mainly use two methods: ecological superposition method and minimum cost model.

3 CASE STUDY OF JI'AN

3.1 REGIONAL OVERVIEW

The planning area is located on the west side of downtown Ji'an, Jiangxi, with a total area of 5.19 square kilometers. Planning area has obvious traffic advantage. After the completion of the Ji'an high-speed railway station, will further strengthen the central city of Ji'an in the central position of Jitai town group (Fig.3).

The planning area has the high terrain in north and south, and is low in the middle. Water runoff is from east to west, and the highest point of the terrain reaches 95.9m, to show a form of low hill crowded (Fig.4). The destruction of ecological environment is small, and the natural vegetation protection is good. In recent years, around the orientation of "Luling excelllent in culture, Ji'an famous for landscape", Ji'an vigorously promotes the construction of theme parks, ecological corridors and country parkswhich possess high quality. In the past few years, Ji'an has been named the China Excellent Tourism City, the National Garden City, the China Characteristic Charm City 200, the China Habitat Environment Award, and has laid a good foundation for the green space system planning.

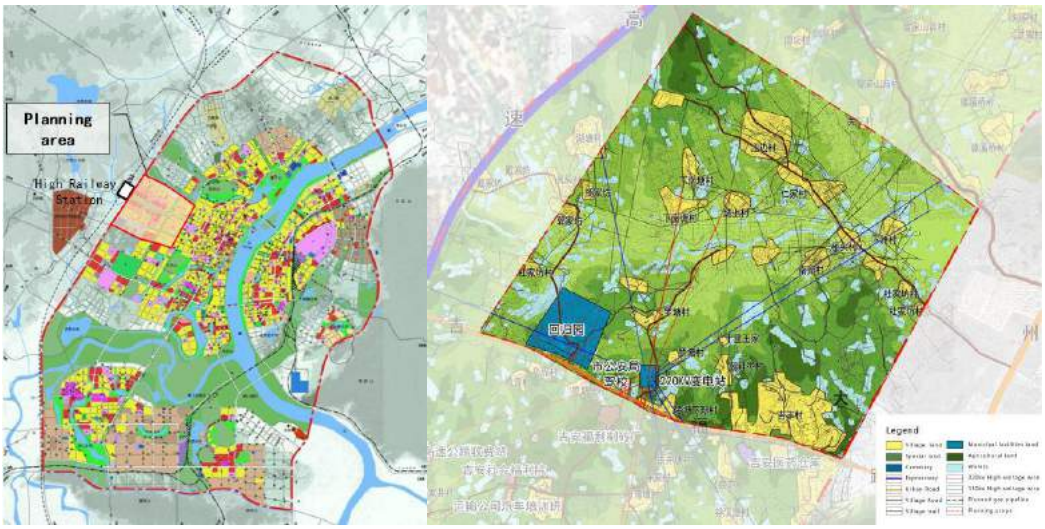


Figure 3 – Location Figure 4 - Planning area status

3.2 PLANNING OBJECTIVES

GI can effectively connect the artificial environment, semi-natural semi-artificial environment and natural environment, committed to improving the environment, enhancing the ability of sustainable development of the environment. GI planning emphasizes respect on the natural ecological environment and function, highlights the natural background, focuses on biodiversity conservation planning, stormwater management practices and climate change efficiency in planning and construction, which has strong ecological benefits; at the same time, GI has multiple functions of air purification, to alleviate the psychological pressure, and the protection of historic resources. It can bring the potential economic value of real estate appreciation, and the visit of GI to exercise or enjoy the ecological function can benefit residents' health. The social benefit can't be overlooked.

Planning area is located opposite the Ji'an high-speed railway station, which is the city's gateway, and has an important role in landscape display. Based on the construction of GI system with multiple complex functions, the green space system planning can be batter. On the basis of retaining the original natural ecological texture, we construct the urban green space network in planning, and carry a variety of urban activities, to create a natural and dynamic new area with culture and ecological experience.

3.3 SINGLE FUNCTION QUANTITATIVE EVALUATION

3.3.1 ECOLOGICAL PROTECTION FUNCTION

Three-dimensional space analysis technology of GIS can be used to visualize the environment of the region and its surroundings, in order to better study the regional elevation, slope and other indicators, while understanding the vegetation coverage of the planning area, finally provide more intuitive basic data for the green infrastructure construction(Fig.5).

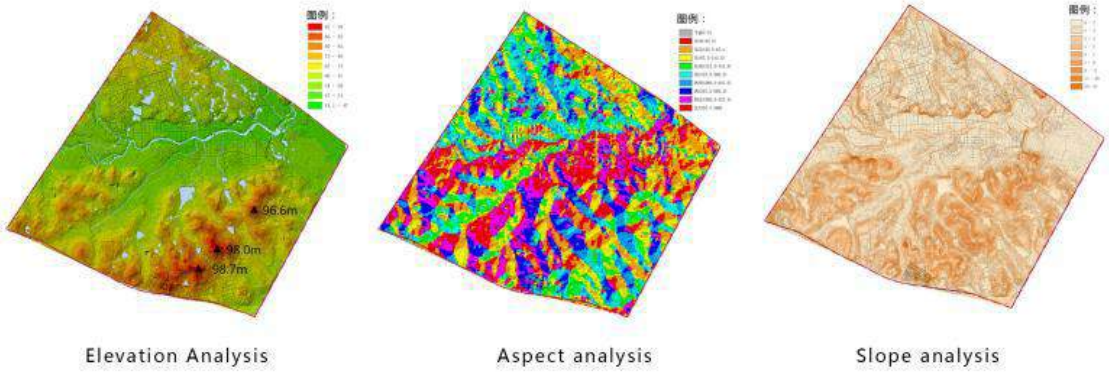


Figure 5 - Topography analysis

3.3.2 STORMWATER MANAGEMENT FUNCTION

GI construction is an effective way to reduce urban stormwater runoff.Countries and regions have gradually attached importance to the construction of GI, and rapid urbanization areas have upgraded attention to GI. The stomwater GI includes large reservoirs, wetlands, waterfront landscape, green street, rain gardens, detention ponds, ecological ditches and green roofs, reasonable planning and layout of the Rain GI has a significant impact on the hydrological characteristics, nutrient transfertation and combined sewer overflowing. Through the GIS analysis, we can get the main flow direction of the river and rain in the region, and control it through the GI (Fig.6).

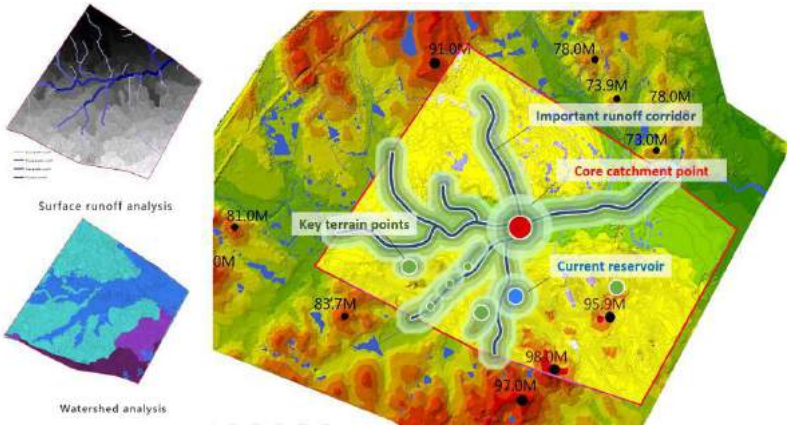


Figure 6 - Stormwater runoff analysis

3.3.3 ENTERTAINMENT AND LEISURE FUNCTION

The protection of green space system planning should not only pay attention to the natural environment, but also to provide a comfortable living environment for the city residents. It should provide leisure and entertainment places for residents, increase the “green” contact. The quantitative evaluation of entertainment and leisure function is to collect and screen the land use class diagram spot, and then extract the high representative recreation resources and active points.

3.4 GREEN SPACE SYSTEM PLANNING STRUCTURE OF JIAN

3.4.1 GI NETWORK

According to the above analysis, green infrastructure is a natural and artificial green space network system composed of hubs and links. Hubs and links contain various scales of natural and artificial landscape and ecological factors, such as green road, wetland, forest, park, shoreline and so on. The hubs are the

starting points and end points of GI, which provide habitat for wildlife growth or passage; Hubs and links connect to each other to ensure the ecological function of landscape connectivity, and to make the system to be a network; Sites are smaller than hubs, and may not be connected with the green network, but have an important contribution to the ecological and social value, such as the small open spaces and community parks.

(1) Building hubs relying on ecological background

The hubs of the green infrastructure of planning area consists of large areas of public parks (regional park, town park, local park and neighborhood park), existing private land (agriculture land, forest reserves and residential, institutional, etc.), cemeteries and undeveloped land (undeveloped open space and undeveloped committed future development). The hubs become the environmentally significant area to maintain the essential ecological processes, preserve the diversity of species, safeguard habitats, critical for the sustainable use of species and maintain the productive capacities of the ecosystem.

(2) Establishing links by rivers and roads

Links often follow natural or existing land or water features such as ridgelines, stream valleys, rivers, canals, utility corridors, and others. Although each link is unique, most connect recreational, natural, and cultural areas. Some links are designed for people to use for recreation and nonmotorized transportation, while others are designed for wildlife, biodiversity, and scenic beauty. The width and functions of links in planning area is shown in Table 2.The main corridor along the main layout of the planning, the main corridor along the rain runoff, high pressure corridors, community center green belt layout[3]. At the same time, in order to ensure the connectivity and accessibility of the corridor, three corridors are arranged along the road.

Grade of the links	Width	Function
Main links	90m-120m	Can be capable of absorbing and retention of runoff from the entire region in strong precipitation, while provide habitat for egrets and other birds and frogs, finally realize the symbiosis of man and nature. Can also be combined with community garden and leisure agriculture.
Secondary links	30m-90m	Can be able to absorb runoff in the middle intensity precipitation.
Three level links	20m-30m	Can absorb runoff in the low intensity precipitation.

Table 2–Grade of the links

(3) Using small sites to form ecological nodes

Sitesare small natural habitat and recreation site that is independent of a large natural area. It is a supplement to the hubs and acts as a stepping stone.Sites in this planningare the center green of the community, small gardens by the street, the landscape squaresand so on. They are evenly distributed in various communities, combined with the community center service facilities, to improve the living environment of the community, at the same time, provide leisure and entertainment venuesfor community residents.

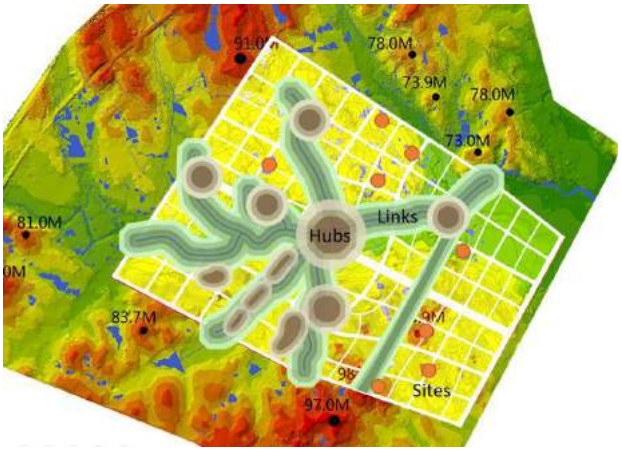


Figure 7 –Structure of GI

3.4.2 GI PRIORITY PROTECTION SYSTEM

According to the hubs, links and sites that have been identified, we determine the different evaluation factors, and give all kinds of evaluation factor to a certain weight value, then score them(Tab.3). On this basis we can get grading system of the hubs,links and sites. Based on these results, all kinds of elements with high scores can be extracted, then obtain the GI priority protection system, with strict protection all of the elements; various elements of low scores can be implemented within the appropriate development and construction.

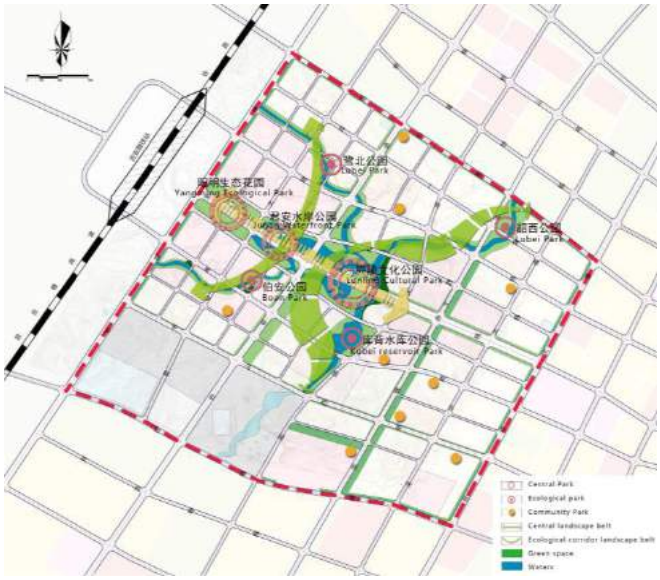
Element	Evaluation factor	Weight
Hubs	Proportion of internal natural areas	6
	Flow length	4
	Vegetation coverage , Number of vegetation types	3
	Distance to main road, Distance to nearest hub, Wetland, Abandoned land	2
	Bio-diversity, Terrain, Soil type number, River connection	1
Links	Connect to the high level hubs.	8
	The average value of Mountain Block and Water Block, The number of connection breaks	4
	The grade of the road, the total number of species, Peripheral buffer suitability	2
	Total area,Stream length, Distance from the nearest main road and secondary road, Biological integrity,Wetland	1
Sites	Peripheral buffer suitability	8
	Distance to the hubs	6
	Part of the area of mature and natural vegetation	4
	The total number of species	3
	Total area,Stream length, Distance from the nearest main road and secondary road, Biological integrity,Wetland	1

Table 3 –Evaluation factor and weight[4]

3.4.3 GREEN SPACE SYSTEM PLANNING STRUCTURE

The green space system planning of this district is based on the GI priority system, taking the per capita green space index and all kinds of green spaces accessibility as the condition. It empahsizes on the accessibility and closeness to nature, and pays attention to the integrity, systematicness and ecological of urban green spaces, so as to improve the urban living environment quality and create green leisure spaces. According to the Ji'an city overall planning layout and planning objectives, we determine the green space system structure of the planning area as "one axis, seven hearts, four corridors, multiple points"(Fig.8).

One axis: that is the central green landscape axis from east to west, and has important position in building the green space pattern of high speed rail portal area.



Seven hearts: include Yangming Ecological Park, Junan Waterfront Park, Luling Cultural Park, Lubei Park, Shaoxi Park, Boan Park, and Kubei Reservoir Park that are located in the green landscape belt.

Four Corridors: combined with water systems, wedge shaped infiltration, to ensure the integration of urban land and the surrounding ecological green spaces.

Figure 8 - Green space system planning structure

Multi- points: they are the public space nodes on the main entrance, node location, important terrain points, as well as the community and neighborhood parks.

3.5 GREEN INFRASTRUCTURE PLANNING OF MULTI SCALE

Green infrastructure is a multi-level system. In the regional and district level, GI supports critical ecosystem functions. The main elements include the National Park, the shoreline, the main river corridor and long distance trails; in the city or community level, GI formed an open space network by city parks, leisure, farmland, community gardens, street landscape and private garden, small water and streams, and roof gardens(Fig.9). Planning should take into account the connection and coordination of different scales, and make them to be a multi-scale green space system.

Figure 9 - Topography analysis

3.5.1 MACRO NETWORK

Analysis of the all kinds of green spaces and road system in the entire city of Ji'an, and the green space within the planning area is connected with the whole urban green space system, to achieve a wider range of GI connection, ensure the integrity of ecosystem (Fig.10).

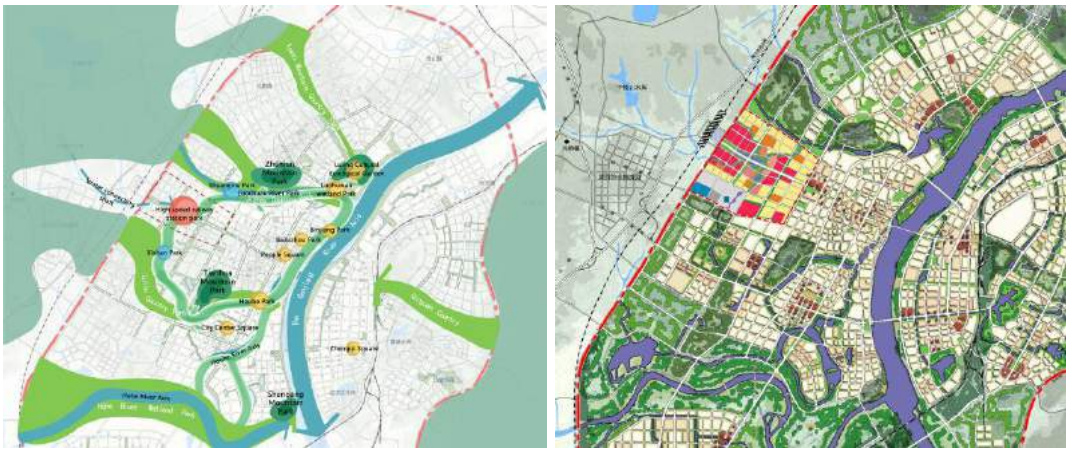


Figure 10 - The Connection of Regional Green Space System

3.5.2 MESOSCOPIC NETWORK

Green Street planted a variety of plantsin the green area of the street, to form a ecological treatment system of rainwater collection, retention, purification, infiltration and other functions. Itcan solve the city stormwater disaster problem under rainstorm events and protectthe plants; build the underground pipe gallery, to improve existing grey infrastructure, and create a beautiful natural scenery of the street (Fig.11). The purpose of the green street design is to reduce stormwater runoff and reduce surface source pollution; to alleviate the air

pollution caused by vehicle exhaust; to bring natural elements into the streets; to provide opportunities for the low impact traffic systems.

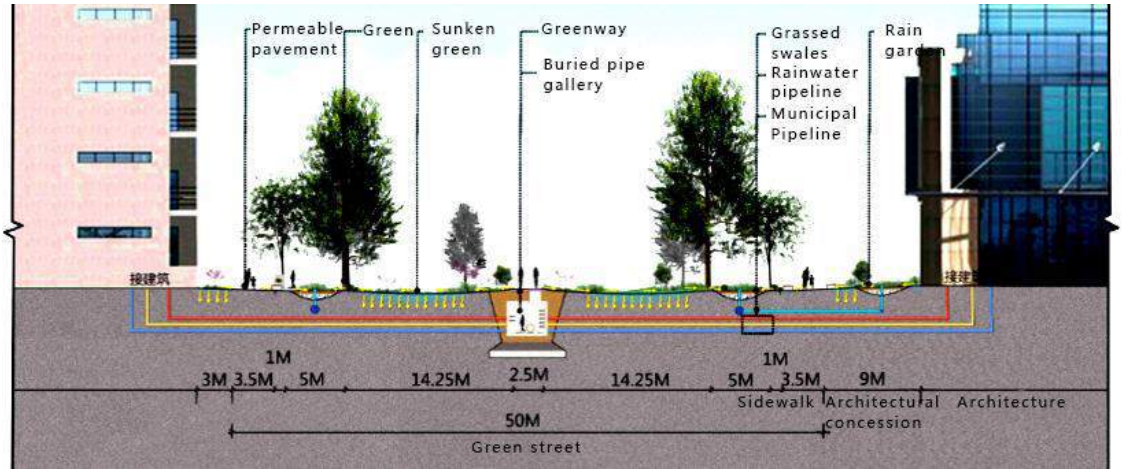


Figure 11 - The Connection of Regional Green Space System

The artificial wetland is an artificial design and manufacture.As a green infrastructure, it can bring a variety of benefits such as natural wetlands like. They can be used as economic and efficient measures for flood control and city stormwater management, also as a wild animal habitat, and can enhance the landscape aesthetic taste, provide recreational facilities. The planning makes a number of stormwater runoff planning to be the adjustable artificial wetlands. In the water season they can be used to store rainwater, and in the dry season they can be used asgreen spaces for the residents to play(Fig.12).

Figure 12 - Seasonal rainfall water level and green space

4 CONCLUSIONS

Green infrastructure has functions with complex characteristics, includes two aspects in summary: one is to serve people, by protecting and connecting the scattered green space to provide social services such as leisure, health and aesthetic; one is the service to the system of nature, through biological and habitat protection, keeping the connection of natural areas to maintain biodiversity, and avoid habitat fragmentation.

The function of green space, the structure of green space and the actual effect of planning are the key points of urban green space system planning. In the background of Rapid City, strengthen the concept that city green space is the city infrastructure, by GIS and other scientific analysis methods, identify elements that constitute the network of green infrastructure. On the basis, further improving the urban green space system planning, can provide a powerful guarantee for the scientificalness of green space function, the rationality of the structure arrangement and the effectiveness of the planning, to further promote the construction of the the smart city and spong city.

Because of the limited space, the author believes that the following two aspects can be discussed: first, the construction of citizen participation mechanism. GI involves a wide range of aspects, and involves a lot of the general public interest, but the current public participation mechanism is not perfect. We can further

discuss in the follow-up study; two is the limitations of the scale. About green infrastructure of district scale, the main contradiction is not the connectivity, but should consider the fairness of GI elements (such as city park) in space. On this basis, further optimize the research results.

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ID 1353 | GREEN INFRASTRUCTURE IN LIMINAL STREETSIDE SPACES: CASES FROM EUROPEAN CITY CORES

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1 INTRODUCTION

Human interactions ranging from everyday socialization to celebratory gathering and insurgency are all more or less accommodated along the streets of contemporary Western cities. In the denser quarters of European cities, in particular, the street is the setting along which much of the civic life of urban dwellers is played out. As the pedestrian moves laterally from the roadway curb outwards, a narrow ribbon of quasipublic/private space that emerges from adjacent buildings is usually encountered. In the city core and inner ring suburbs, this transition zone harbours stoops, landings, areaways, pavement gaps at foundation walls, facades, sills and lintels, handrails, stairwells, and other niches that present urban dwellers with tight-butsufficient opportunity for streetside horticulture and related accoutrements. It is this underappreciated transition zone, and the recreational and expressive activities associated with growing plants in it, that is addressed below. I use the term convivial greenstreet to convey an assemblage of features and patterns in a supportive context (street, built form). This setting is enacted by gardeners (residents, merchants, employees) who cultivate plants to a degree sufficient to elicit some sensory appreciation on the part of passers-by and, now and then, to prompt social engagement between cultivators, neighbours, and passers-by who share the street's frontage.

"Convivial greenstreet" as used here is a conceptual umbrella term for a range of greenstreet types that all have in common an emphasis on informal private and quasi-public installations. The ideal convivial greenstreet (hereinafter: CG) accommodates processes and patterns of socially inclusive, uncommodified, and culturally diverse horticulture that is situated in physically interstitial and socially liminal streetside niches in the tight quarters of contemporary cities (Steven, 2007). A proposed—and still evolving—typology with a focus on residential types is provided in Section 3, below.

The convivial greenstreet may be framed within the generally analogous rubric posed by critical urbanists, including Dovey (2008) and Miles (2000). Both scholars trace various kinds of citizen ornamentation and place-making as ways to reclaim urban space and ascertain local identities. Miles (2000, p.203) writes, "An understanding of the architectural everyday contributes to sustainability by emphasizing the specifics of locality…sustainable solutions to urban problems will be found outside the dominant structures of development." And Dovey (2008, p. 175) seems to anticipate a role for CGs in his call for "new ways of