# SUSTAINABLE URBAN FORM FOR MODERN GUANGZHOU IN SOUTHERN CHINA: A CULTURALLY ROOTED PROPOSAL

by

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# ABSTRACT

*"As planners and designers, we face the challenge of creating and maintaining communities which are affordable, efficient, scaled to human proportions, and environmentally sound. When searching for design solutions within these constraints, it is important to consider and learn from the past, from its successes and its failures. The past can reveal suggestions and alternatives for the future."* (Nelessen, 1994, p43)

Owing to over 2100 years of history and a distinct geographical location, the traditional city of Guangzhou is characterized by the Ling-nan culture and a unique subtropical climate. Since the mid-1980s, the city has witnessed rapid economic growth and a booming population, placing considerable strain on its infrastructure, environment, and culture. It has been an urgent need for an appropriate urban spatial form to develop the city toward sustainability. This thesis takes on this challenge and tries to draw inspiration from the city's old-traditional districts to make recommendations for the city's development in the future.

In this research, 25 indicators are proposed with regard to urban design components at both site and city region scales. These indicators are developed with regard to the principle of sustainable development in the environmental and human dimensions. They are used to evaluate and analyze both Guangzhou's old and current city forms, generating 57 recommendations for the development of a more sustainable urban form for the City of Guangzhou.

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*I dedicate this work to my parents who always encourage me to challenge my limit.*

*I also dedicate this work to my son, Da Ke and my daughter, Ingrid Yan Ke. I hope they can do a better job than I did in the future.*

# Chapter One

## 1. Introduction

> *Sustainable landscapes are likely to express a unique sense of visual and spatial pluralism....Because of the infinite relationships possible between humans, ecosystems, and natural resources, no two sustainable landscapes are apt to look alike, particularly if they occur in different regions or evolve with different baseline ecosystems or cultures. (Thayer, 1994, p316)*

The major purpose of my thesis is to explore a more sustainable urban form for the ancient city of Guangzhou in Southern China. These patterns draw inspiration from the city's old districts and are unique to maintaining local identity.

### 1.1 The Environmental and Identity Crisis of Contemporary Chinese Cities

Professor Liangyong Wu, former chairman of the International Union of Architects' Scientific Committee and the president of the World Society of Ekistics (1993-1995), once stated that environmental and identity crises are the two major obstacles to a sustainable future for human settlement (Wu, 2000).

This is especially true in China. In last 10 years alone, China has doubled its per capita GDP. It is expected to double again within the next five years. The urban population of China has increased by 250 million in the past 25 years, while another 150 million people are predicted to be added to the urban population by 2010 (Liu, 2003). Urbanization and

improved living standards are progressing at such a brisk rate that the government is planning entire cities in anticipation of large new urban populations.

Despite its huge population, China is seriously deficient in natural resources, especially cultivated land and fresh water (BJDX, 1996). Urban construction in the past two decades has greatly polluted the air and water. Meanwhile, the urban landscapes of Chinese cities have been changing dramatically. Forests of high-rise apartment buildings have become a common feature in big cities. In order to attract clients, developers are making an effort to create landscapes and architecture that are visually pleasing. However, China's striking contemporary urban landscapes have been called a "poor collection of attempted modern-style structures" (Chen, 2003) and the "celebration of superficiality" (Li, 2000). As the result, while all cities claim to be in pursuit of uniqueness, they all look alike, favouring a globalized style (Yu, 2001; Wu, 2003).

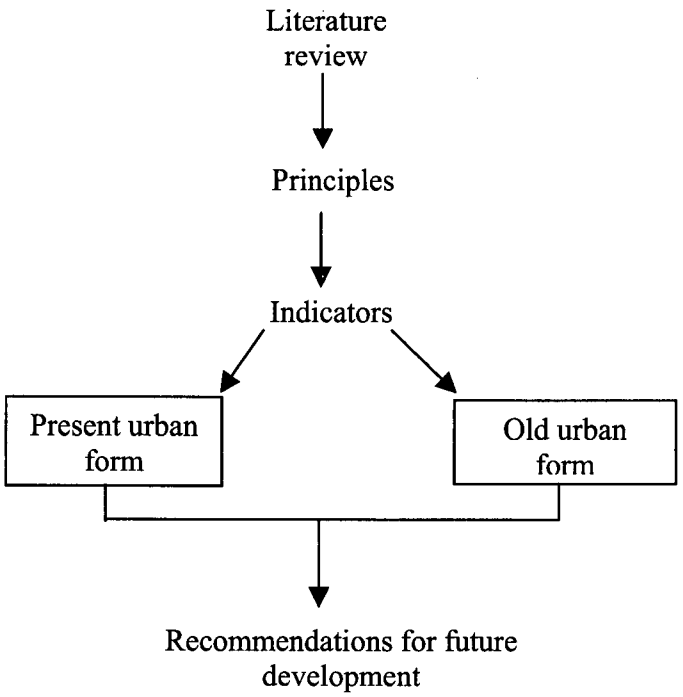
### 1.2 Learning from the past

Traditional vernacular landscapes were shaped within limitations of the natural environment, climate, building materials, and economic and social traditions (Jackson, 1984). For these reasons, vernacular landscapes present diversity. The differences that are thus created in these landscapes have been viewed negatively by contemporary planners and designers, but are essentially and fundamentally connected to the sustainability of the land (Hough, 1990). Carefully studying both the successes and failures of the past is an important way to find viable solutions for the future.

### 1.3 Research methodology

Sustainable development was a concept invented on a global scale, and ultimately, it will only be truly achievable on that scale. However, as the elements and decisions defining the systems and activities which make up global systems need to be addressed on a local scale, local actions must "share certain general features and must flow from a consensus on the basic concept of sustainable development and on a broad strategic framework for achieving it." (WCED, 1987, p43).

Therefore, by conducting a literature review, my thesis will develop a set of general principles and indicators that are imbedded in the basic concept of "sustainable development" and applicable to a sustainable urban environment. By using indicators to evaluate and analyze the present and old city form, recommendations will be made for the city's development in the future.



1.4 **Scope of Investigation** (Southern China and residential areas)

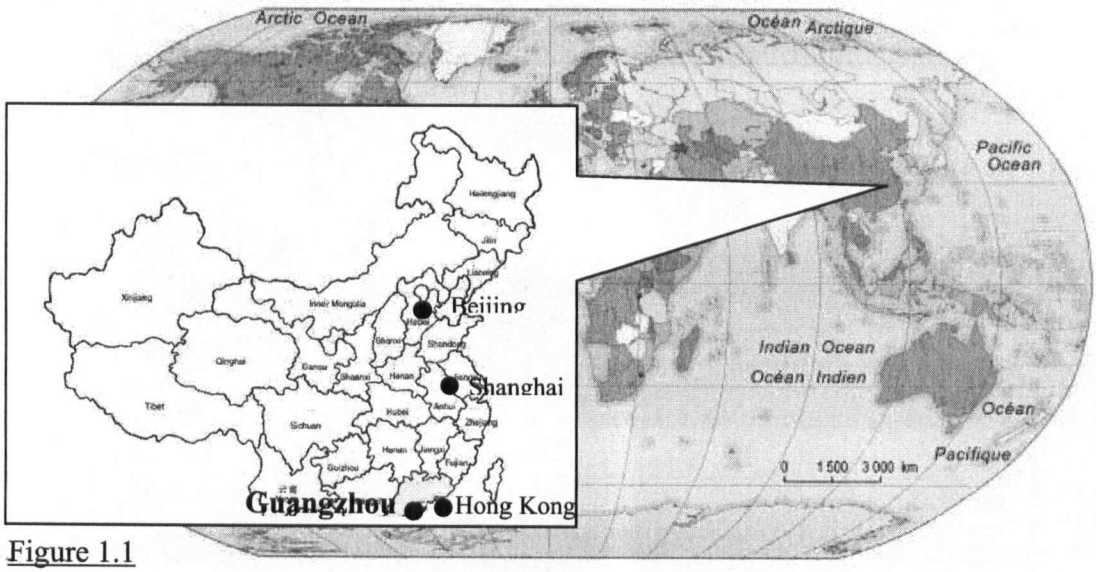



Figure 1.1

Guangzhou (formerly known as Canton) (Figure 1-3), as the largest city in the south of China, is the current frontier of economic development in the country. Due to over 2100 years of history and a distinct geographical location, the city of Guangzhou is characteristic of the traditional Ling-nan culture and has a unique subtropical climate. The significance of traditional culture as well as geographic and economic conditions of the region deserves special attention from researchers of sustainable human settlement.

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# Chapter Two

## 2. Literature review of sustainable design and planning

### 2.1 The concept of sustainable development

#### 2.1.1 Background to sustainable development

It was estimated in 1991 that the global economic product for a 17 day period was equal to that of the whole year in 1900 (Reid, 1995). If this production value is the only factor taken into account, it is possible to conclude that the economic growth has had unprecedented success in the past century. However, numerous environmental and social statistical studies compiled conducted over the past 40 years paint a less optimistic picture. The number of poverty-stricken and uneducated people is increasing instead of shrinking (WCED, 1987), and human diversity is declining in many areas (Reid, 1995, p5). The loss of natural resources, as well as global pollution problems are destroying our natural environment. The reserves of petroleum will run out by 2032, of gas by 2053, and of coal by 2308 if used at the 1989 rate of consumption (Sheltair, 1998). Every year 48 million tons of nitrous oxide, sulphur dioxide, and particulates are emitted into the atmosphere by American companies alone (Thayer, 1994, 49). Every day 100 species become extinct in the biosphere (Reid, 1995). Furthermore, these figures are increasing at an amazing rate as a result of world population growth. The global population is projected to reach between 8 and 14 billion by 2040, as compared to the present figure of 6 billion (Reid, 1995, 9). When we focus on the above statistics, it becomes clear that human development will not be able to sustain itself for future generations at these levels and that we even run a true risk of self-annihilation.

### 2.1.2 The evolution of the concept of sustainable development

The origin of "sustainable development" is rooted in the gradual awareness of the global environmental crisis that has been unfolding since the 1970s[1]. This term first received pubic attention in 1980, when the World Conservation Union (IUCN) published the *World Conservation Strategy* (WCS), which warned that what we have until now called "development" is in fact jeopardizing our future (IUCN, 1980). In 1987, the Brundtland Commission authored the book *Our Common Future*, which defined the concept of "sustainable development" as meeting " the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p43). Although this definition was criticized by some researchers as being vague and emphasizing on the priority of human-needs (Daly and Goodland, 1992; Pearce, et. al., 1989), it got a widespread support in the world.

In 1992, over 100 state leaders assembled in the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, and adopted Agenda 21, a 300-page plan for the achievement of sustainable development in the 21st century. In the same year, the United Nations Commission on Sustainable Development (CSD) was created in order to monitor and report on implementation of the Earth Summit agreement. The CSD was charged with creating a progress report every five years. The first five-year review of the progress of the Earth Summit recommendations took place in 1997.

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[1] In 1970, some of the major environmental problems were perceived to be local: smog, DDT, oil spills, jet exhaust and mercury. By 1990 the list and scale of environmental problems had grown to global proportions and came to include desertification, rising sea levels, temperate instability etc. (Roseland, 1992, p5). In addition, the first space shots portraying the Earth as a single, precious and rather vulnerable entity initiated discussions of the planet's capability to absorb the growing material demands from the human race (Reid, 1995, p3; WCED, 1987, p1-2). It was in 1980 that the term "sustainable development" first came to prominent usage in the World Conservation Strategy (WCS) that was published by the World Conservation Union (Reid, 1995, Introduction).

In 2002, the World Summit on Sustainable Development (WSSD) was held in Johannesburg, South Africa. Over 22,000 people attended the Summit, including 100 heads of State and Government. Around 10,000 delegates, 8,000 representatives of Major Groups and 4,000 media attended the Summit in Johannesburg. The Summit reiterated the initial mandate and functions of the CSD as a high level forum on sustainable development, and deliberated in order to enhance its role so that it could respond effectively to the new demands that emerged from the WSSD Plan of Implementation.

**2.2 Sustainability indicators**

Despite the good intentions behind the creation of its definition, the concept of sustainable development is not easily integrated into existing practices. While it sounds so universally positive that everyone can agree with it, individuals tend to project their own interpretation onto it (Pearce, et. al., 1989; O'Riordan, 1993). In order to take meaningful action in the pursuit of sustainable development, local action must "share certain general features and must flow from a consensus on the basic concept of sustainable development and on a broad strategic framework for achieving it." (WCED, 1987, p43).

> *Indicators of sustainable development need to be developed to provide a solid basis for decision-making at all levels and to contribute to the self-regulating sustainability of integrated environmental and development systems.* (Agenda 21, chapter 40, cited by IIUE, 1998); *Indicators can provide crucial guidance for decision-making in a variety of ways. They can translate physical and social science knowledge into manageable units of information that can facilitate the decision-making process* (United Nations, 2001, p3).

For a very long time, indicators have been used by policy makers, researchers and investors in order to identify conditions and to provide a basis for decision making. As early as the19$^{th}$ century, social reformers in Europe and the United States began to look into social

statistics such as crime, poverty and alcohol consumption. They attempted to link this data to analyze social conditions (Cobb, 1998). Just before the end of the 20th century, economic, social and environmental indicators came to be used to aid policy-making in each of the three realms (Flynn, 2002). Due to growing concerns about social and environmental problems, researchers concluded that broader measures including economic, social and environmental factors was needed. During the late 1980s and early 1990s, the popularity of current community indicator projects was established (Gahin, 2001). In these projects, indicators serving as a dialogue tool, with which to measure human activities, and to make changes to achieve a more satisfactory situation, were constructed within a framework of sustainability, community health, quality of life, and similar features (e.g. Sustainable Seattle; Calvert-Henderson Quality of Life Indicators).

In order to input sustainability concerns and priorities into physical urban designs, a set of sustainability indicators will be developed to guide the further exploration for a more sustainable urban spatial form.

## 2.3 Sustainability in urban context

### 2.3.1 The ecological and human dimensions of sustainability

By definition, sustainable development emphasizes equally the human and environmental dimensions. Forman (1990) indicates, "People attempt to improve their well-being. The environment provides materials, but also constrains the effort. This interplay between human aspiration and ecological integrity is an underlying theme of sustainable development ..." (Forman, 1990, p261).

In the urban context, the rate of global urbanization is presently accelerating faster than ever before. By 2000, almost 50% of all people in the world were living in urban areas (WCED, 1987, p235). In Europe, this figure reached 80% (IIUE, 1997, p13). Incremental improvements in fields such as housing, employment or transport are often achieved in a sequence, often inadvertently affecting the environmental conditions in cities and well-being of citizens in a negative way. Already, 75% of all pollution arises from urban environments, roughly 45% from buildings and 30% from transport (UTF, 1999, p28).

Theories of sustainable development stress the need to adopt a 'whole systems' approach that appreciates both the complexity and interactions that are involved (Hardi and Zdan, 1997). Therefore the 'interplay' between humans and ecology should be based on a compatible outlook (for example appreciating that renewable energy can benefit both the environment and human well being). This type of attitude is superior and more effective than one which focuses rather on the theoretical justification for trade-offs between such features as the depletion of fossil fuel and the GDP growth in the economy (Forman, 1995; Gidding, et. al., 2002).

### 2.3.2 Roles of design and planning

Arguments have been made regarding the incremental nature of urban development. The driving forces cited include the technology of movement, communication and the economic value of land (Venturi et al., 1972). Urban planning and urban design have had very little positive influence on the process of urban development and change. Looking back through history, many towns and cities have developed incrementally and without a master plan but with very good results. In contrast, many grand-scale master plans that were

developed in the 1950s and 1960s have resulted in loss of much of the historical fabric and traditional development pattern (Taylor, 1998).

Tibbalds (1992), explained that historic incremental speculative development was based on a commonly accepted set of development rules and patterns and generated a strongly ordered urban environment; current incremental speculative development adopts a free-for-all approach and generates 'opportunistic chaos'. Although the situation today is similar to that of the past, current economic forces are no longer only local but international or global in scale.

> *"Any physical part of the city has a form, and the orchestration of such parts generates a specific urban form and structure. Any physical part of the city is accordingly designable, and so is the orchestration of these parts to form streets, squares, urban fabric, monuments, a sky-line. Though the form and structure of the traditional city may have evolved in a slow and incremental process without formal planning and design, it evolved on the basis of commonly understood and accepted development patterns. Today, so many non-local forces are shaping the city –forces that frequently do not even know the specific cities in which they are at work – that rules and patterns need to be introduced in the form of development and design frameworks which must be based on the city's particular history, culture, location and topography in order to safeguard its identity. ...There are other and even more significant reasons why planning and designing the city is so important today. The most crucial one is that current urban development and urban living are today regarded by many as ultimately unsustainable because of the destructive burden they place on the environment. One of the causes for this destructive influence is believed to be the city's very form and structure, which urgently require improvement. This in turn highlights the vital role urban planning and design have to play in a process that attempts to rescue the global environment and with it the hinterland upon which the city utterly depends. It is therefore essential to spell out the significant contribution urban planning and design can and should make towards sustainable urban development and living by improving the city's form and structure and, as a consequence, making the city a more people-friendly place and reducing its destructive environmental impact."* (Frey, 1999, p15-16)

According to Frey (1999), it is undeniable that economic forces still play an important role in the shaping of modern cities. In order for development to be considered sustainable, it is crucial that 'good' urban design and planning should guide the economic forces to operate the city. That guidance must be based upon a city's particular history, culture, location and topography, so that each city can maintain its identity.

### 2.3.3 The importance of scales for urban design and planning

After World War II, cookie-cutter houses and suburban sprawl were dominant features of the land development pattern in North America. The development of these patterns was facilitated by zoning laws and the mass production of automobiles. Over the past twenty years, this pattern has continued and urban growth has become more and more dysfunctional. Zoning laws have resulted in people being progressively more dependent on automobiles for commuting to work and even for basic living necessities. Urban sprawl increases pollution and the demand for natural resources, and isolates "people and activities in an inefficient network" (Calthorpe, 1993, p16; Maser, 1997).

In light of these problems, many sustainable community planning and design professionals have been making an effort to provide alternatives to urban sprawl. These plans are characterized by more dense and mixed land uses, pedestrian friendly streets, public transport, etc (Van der Ryn, 1986; Calthorpe, 1993; Duany and Pater-Zyberk, 1991). In terms of dealing with the parts of complex city structures, their initiatives have been considered successful. However a city is an entity containing a complex structure of land and people. Its functional, socio-economic and environmental qualities cannot be solely

judged by residential use dominated suburbs. In other words, a city's form and structure have large impacts on the claimed values of sustainable communities. For example, the performance of Calthorpe's TOD model (Transit Oriented Design) is largely dependent on the viability of the city's public transit system. Without the creation of an efficient city structure, a degree of population density and service provision, the automobile will continue to be a necessity of livelihood (Thomas and Cousin, 1996).

The concept of 'sustainable development' has raised much debate on the nature of sustainable urban form (Jenks, et. al., 1996; Jenk and Burgess, 2000). Some argue for a compact city form that preserves country land, makes efficient use of public transportation and saves energy, hence contributing lower levels of pollution, a high quality of life, and urban viability. Others promote a dispersed urban form that resolves congestion, integrates more open spaces, and is more easily accessible for solar energy use (Jenks, et. al., 1996; Jenk and Burgess, 2000). Frey (1999, p3) argues that much of the discussion regarding a compact city form is confused and inconclusive because it commonly lacks a recognition that "many of the problems of the city are actually the result of its inadequate structure and form, its distribution of population, its patterns of land use and its systems of transport, all of which are interdependent." Lynch (1981) also deems that the physical form of built environment on a city or a regional scale is critical in affecting the environment and residents' quality of life.

In summary of the above discussion, it is crucial that when considering a more sustainable spatial form for a city, that the two crucial factors of site and city scale are given priority consideration.

## 2.4 Principles, planning goals, and indicators for sustainable urban design

In order for consensus to be reached on a philosophy of sustainable development for urban design and planning, a hierarchical structure of principles, planning goals, and indicators are developed. Principles are created under the two dimensions: environment and human.

### 2.4.1 Environmental dimension

**Principle I: to maintain or enhance the current environmental carrying capacities for future generations**

All human activities by their very nature, must take place within the context of the environment. Our material needs such as heat, light, food, medicines, clothing, as well as modern consumer goods are made with materials and energy that come from the environment. Man-made products eventually end up returning to the environment. The environment also provides the source of much of culture and leisure enjoyment for human beings.

Maintaining or enhancing the ability of ecological systems to provide materials and assimilate wastes should be a priority for human development (Grant, et. al. 1996; Giddings, et. al., 2002; Lyle, 1994). It requires maintaining or improving the landscape productivity, and the consumption of energy, water, food, and other resources at the rates which can be renewed or regenerated. Material outputs from one system should be used as input material for other constructive processes and not be deposited as waste (Lyle, 1994).

### 2.4.2 Human dimension

**Principle II: enhancing social cohesion and popularizing a common value of sustainability**

The conflict between environmental constraints and human aspirations is incompatible with sustainability. Instead, sustainable development requires a common intellectual aesthetic and moral traditions linking people to cooperate with each other so that competition for space and resources is not compromised by the necessity for a sustainable environment (WCED, 1987, Thayer, 1994, Forman, 1995).

The question, however, is how does one encourage individuals to act in the common interest of sustainable development? Although education, institutional development, and law enforcement are some effective means, the critical answer lies in fostering a stable and cohesive society in which people have equal access to environmental goods (heating, housing, transport, and green space), or public services, and a fair distribution of environmental hazards (e.g. pollution, risks) (WCED, 1987). In this way, the health of the landscape becomes a common concern of the entirety of its citizens (Thayer, 1994; Forman, 1995).

### 2.4.3 Planning goals and indicators

Under each principle, planning goals are assigned to each design component at both site and city region scale respectively. At the lowest level, indicators are judged for measuring the achievement of each planning goal. The indicators are considered as evaluation criteria for any proposed urban form.

### Linking the two dimensions

According to Forman (1990), it is the quality and level of the set of slowly changing foundation variables that determines whether an environment is sustainable or not. These foundation variables include: soil, biological productivity, biodiversity, fresh water, ocean, atmosphere, basic human needs of food, water, health, and housing, fuel, and cultural cohesion and diversity. Making connections between the indicator and its positive influence on foundation variables can help one to avoid missing some aspects of creating a sustainable environment and also make a compatible interplay between the environmental and human dimensions.

## Section One: Environmental dimension: response to principle 1

■ indicates direct benefit to the variable

□ indicates indirect benefit to the variable

| City and city region / Environmental dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land use | The goal of **land use** planning | To ensure that urban land uses conserve land resources | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | Urban land use often consumes farmland and wildlife habitat. For example, between 1987 and 1992, China lost close to one million hectares of farmland each year to urbanization and the expansion of roads and industries. In the US, urban sprawl takes over nearly 400,000 hectares of farmland each year[2]. As a result of population growth, the reduction of farmland may threaten food provision and the survival of the human beings.<br>Urban areas are often expanded by destroying natural habitat such as woodlands, wetlands, prairies, etc. In the process, the capacity of the environment for providing oxygen, filtering pollutants out of air and water, reducing global warming, and enriching biodiversity is compromised. | | | | | | | | | | | | |
| | Indicator for measuring planning goal | 1. Policy and legal structures encourage compact development and limit outward sprawl | | | | | | | | | | | | |
| | √ | √ | √ | √ | ■ | ■ | ■ | ■ | □ | ■ | ■ | □ | □ | |
| | Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Calthorpe, 1993 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

2 http://66.102.7.104/search?q=cache:agcbN6Hk4pIJ:www.infoforhealth.org/pr/m13/m13chap3_3.shtml+urban+sprawl+farmland+food+production&hl=fr

| City and city region / Environmental dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Circulation | The goal of **circulation** planning | To ensure that urban transportation systems are planned with the aim of reducing energy consumption, as well as air and water pollutants. | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | Urban transport systems, dominated by automobile uses and highways systems, have become a major source of non-renewable resource consumption, as well as air and water pollution. For example, in North America, transportation accounts for over 60% of all petroleum used, representing about 25% of all energy consumed. Nearly 75% of transportation petroleum is used by road vehicles, with the remainder being consumed by air, water, rail, pipeline and off-road transport. In total, North American road vehicles consume over half of the world's automotive fuel supply[3]. It was estimated that in the industrialized nations, automobiles are responsible for approximately three-quarters of the carbon monoxide, half of the nitrogen oxides, and two-fifths of the hydrocarbons emitted (Lyle, 1994). Automobiles, together with related forms of transportation, are also major contributors to water pollution. The contaminated soil and air seriously decrease landscape productivity and biodiversity.<br>Lowering the levels of vehicle travel miles conserves non-renewable energy resources and reduces air and water pollution. | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **2.** Maximum length of daily journey | | | | | | | | | | | | |
| | √ | √ | √ | √ | ■ | ■ | ■ | ■ | ■ | ■ | □ | ■ | ■ | |
| | Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Calthorpe, 1993 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

[3] http://www.geocities.com/davefergus/Transportation

| City and city region / Environmental dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Open space | The goal of **open space** planning | To enhance or maintain biodiversity in the city region | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | Biodiversity is an important indicator of a healthy ecosystem. All creatures are interconnected in the environment. Ecosystem services such as water purification, nutrient cycling, and productivity depend on an intricate web ranging from microscopic organisms to mega-fauna and every size of organism in between working together in nature.<br>Landscape ecology requires the maintenance of adequate size, configuration, and connectivity between habitat lands in order to accommodate the requirements of species that occur naturally in the landscape (Forman, 1995). Urban development activities should support the composition of indigenous habitat and avoid fragmenting the landscape matrix: habitat patches must not become so small that they exclude interior species, nor so disconnected that species emigration and regional extinctions occur. Open spaces in the city region that are connected as a net of diverse and important habitats, maintaining the existence of very large nodes of habitat, connected by unbroken corridors. | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **3.** The existence of very large nodes of habitat and unbroken corridors | | | | | | | | | | | | |
| | √ | √ | √ | √ | ■ | ■ | ■ | □ | □ | ■ | □ | □ | □ | |
| | Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Calthorpe, 1993 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

| Site planning / Environmental dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land use | The goal of **land use** planning | To maintain the hydrological regime on site | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | Residential land uses turn natural habitats into areas that are dominated by pavement and buildings. These changes alter the drainage patterns in neighborhoods as well as the hydrological regime of the ecosystem. The natural functioning of the ecosystem is therefore altered (Marsh, 1997). In addition, impermeable surfaces generate large amounts of storm water runoff. This runoff in turn creates a host of non-point source pollutants (e.g. pathogens, oxygen-depleting substances, nutrients, sediments, and toxins) that bring about soil erosion, water pollution, as well as an associated decline of bio-productivity and biodiversity.<br>In a natural situation, runoff can be infiltrated and stored by soil and vegetation. The infiltration also has cleansing effects to remove pollutants. | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **4.** Zero stormwater directly discharged through pipes to downstream (OR, zero net increase in stormwater discharge from a site as a result of development) | | | | | | | | | | | | |
| | √ | √ | | √ | ■ | ■ | ■ | ■ | □ | ■ | ■ | □ | □ | |
| | Thayer, 1994 | Lyle, 1994 | Calthorpe, 1993 | Urban Task Force, 1999 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

| Site planning / Environmental dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Circulation | The goal of **circulation** planning | To design streets with minimal adverse environmental impacts | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | It has been estimated that the amount of petroleum residues washed off streets, highways, parking lots, and industrial sites each year exceeds the total worldwide spillage from oil tankers and barges (Marsh, 1998). Roads and parking lots usually occupy a large part of urban areas and have the effect of fragmenting animal and plant habitat. Many species are cut off from potential mates and resources. Streets and parking lots are also major contributors to the urban hot island effect due to high levels of solar radiation, absorption and thermal capacity and conductivity of the hard surfaces (Landsberg, 1981).<br>Many practices have demonstrated that by incorporating surface drainage systems, streets can serve a double function as a system of corridors to capture, transport, and infiltrate storm water (Condon, et. al., 2003; Corbett and Corbett, 2000). Streets and parking areas are also ideal locations for creating a thriving urban forest which is a critical component in urban storm water management and habitat enhancement. Each urban tree with a 50 year life-span provides an almost $275/year (in 1985) cost reduction with regard to air conditioning, erosion control, storm water control, air pollution and wildlife shelter (quoted in Condon, et. al., 2003, p110). Moreover, a variety of research suggests that immediate access to green spaces can enhance property values (Condon and Gonyea, 2001). | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **5.** Streets serve both as a corridor system to capture and to infiltrate storm water (yes / no)<br>**6.** A mature tree canopy coverage to roadways and parking areas (% canopy cover) | | | | | | | | | | | | |
| | √ | √ | √ | √ | ■ | ■ | ■ | □ | □ | ■ | □ | □ | ■ | |
| | Thayer, 1994 | Lyle, 1994 | Calthorpe, 1993 | Urban Task Force, 1999 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

| Site planning / Environmental dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Open space | The goal of **open space** planning | To maximize environmental benefits of urban open space. | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | Appropriately designed open spaces can be natural processors of air and water, taking in carbon monoxide, emitting oxygen, absorbing, storing, cleaning, and discharging rainwater to streams, removing pollutants, and creating microclimate.<br>However, the environmental value claimed by open space depends heavily on the form, density, and species selection of planting. Poor design can turn the landscape into an environment liability.<br>Lawns are one of the major contributors to ground water and stream pollution (Girling, et. al. 2000).<br>Landscaped areas that are convex in shape contribute to stormwater runoff and related pollution.<br>Exotic plantings require inputs in the form of irrigation water, pesticides, fertilizers, and fossil fuels for maintenance that considerably exceed the benefits they provide in the forms of microclimate and drainage control, air filtering, and habitat value. Conversely, plants adapted to the conditions of the local environment tend to do well with the regionally available water and nutrients. If they are species native to the region and have co-evolved with other species there, they will also support the region's wildlife communities. Native plants support up to 50 times more wildlife species than non-native plants (Schaefer, et. al., 2002). The density of the tree canopy determines its effectiveness in ambient cooling and in filtering air pollution (Lyle, 1994). | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **7.** % of open space in turf area<br>**8.** % of the open space covered by native trees and plants<br>**9.** Presence of open spaces for stormwater management | | | | | | | | | | | | |
| | √ | √ | √ | | ■ | ■ | ■ | □ | □ | ■ | □ | □ | ■ | |
| | Thayer, 1994 | Lyle, 1994 | Calthorpe, 1993 | Urban Task Force, 1999 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

| Site planning / Environmental dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Building | The goal of **building** design | To reduce the building demands on energy and other associated pollution | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | Energy use in buildings largely depends on the combustion of fossil fuels, such as natural gas, coal, etc. The building sector accounts for over 80% of electricity consumption (Hui, 2000). The generation of electricity throughout the world accounts for about one-third of all heat-trapping gases entering the atmosphere (Corbett and Corbett, 2000). The combustion of fossil fuel not only depletes non-renewable energy resources, but also produces pollutants such as sulfur oxides, nitrogen oxides, and particulates that further deteriorate landscape productivity and biodiversity. Using air conditioning to achieve thermal comfort has the effect of directly damaging the environment by increasing the urban outdoor temperature and reducing the ozone layer that contributes to the green house effect and acid rain (Schiller and Evans, 2000).<br>Energy use in buildings is related principally to heating, cooling, ventilation, and lighting (Hui, 2000). Therefore, building design at the urban and architectural levels can have a great effect with regard to how energy is used in buildings. Factors such as access to direct winter sun, natural ventilation and daylight, building forms that reduce heat loss, etc., all affect the energy demand of the built environment. For example, in the Village Homes community (Corbett and Corbett, 2000), every lot is south-north oriented, with the majority of south-facing windows shaded with overhangs in summer. Combined with good insulation and ventilation, this measure has allowed for home utility bills to be reduced by almost 50%. | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **10.** Buildings are designed for natural cooling, warming and lighting (yes / no) | | | | | | | | | | | | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |
| | Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Calthorpe, 1993 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | √ | √ | √ | √ | | □ | □ | □ | □ | ■ | ■ | ■ | ■ | |

## Section Two: Human dimension: response to principle 2

■ indicates direct benefit to the variable

□ indicates indirect benefit to the variable

| City and city region / Human dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land use | The goal of **Land use** planning | To promote social integration instead of exclusion through urban land use design | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | It is evident that inequitable access to environmental goods or public services can result in homelessness, poor nutrition, poor health, child neglect, crime, drugs, and racial violence, all of which threaten societal health. For instance, a study in the UK showed that child pedestrians in poor communities were five times more likely to be killed by vehicles than children from affluent areas (Eames, 2002). In China, rising economic inequality contributed to a 212% increase in recorded crime between 1979 and 1998 (Cao & Dai, 2001, p.78; Feng, 2001, pp123-124). This is because economic inequality often results in unequal access to mainstream jobs, education, and social opportunities.<br>Many urban workplaces, services and facilities are concentrated in a single core. Suburban areas are characterized by heavy dependence on separate zones for different uses. People with low income who cannot afford mobility and higher housing prices, or who depend upon the provision of social housing become trapped in disadvantaged areas of the city. | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **11.** Services and employment locations are equally distributed within the built up area, allowing equality of physical access of all residents<br>**12.** Diverse housing types for varying households (income, age, family composition) within neighborhoods | | | | | | | | | | | | |
| | √ | √ | √ | √ | □ | □ | □ | □ | □ | □ | ■ | ■ | ■ | |
| | Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Calthorpe, 1993 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

| City and city region / Human dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Circulation | The goal of **circulation** planning | To plan street networks in a city that facilitate movement | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | At a basic level, a city should be able to provide access to work, services, recreation, and communication for its citizens. Frey (1999) argued that even if future technologies could solve pollution and energy problems, car-dependent transport will still create problems of space consumption and traffic congestion.<br>The conventional way of improving a city's mobility is by increasing the width of major roads and reducing road intersections in order to ensure a smoother movement of the traffic that exists. This approach, however, tends to create a vicious circle because the lower accessibility and connectivity of a road system, the more vehicles end up directed onto fewer streets and thus in turn, there is an increase in traffic volume and congestion. The resulting hostile environment (noise, aggressive driving attitudes etc.) discourages walking, increases the use of private cars and further worsens traffic conditions. Tree-like street networks, based on the use of many cul-de-sacs, and designed to limit through-movement are typical street patterns that are undesirable for both cars and pedestrians. On the other hand, a well-interconnected street network can provide the most direct and short routes for pedestrians to approach destinations while at the same time slowing down traffic. The grid street network is a classic prototype. | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **13.** Well-interconnected vehicle street networks with short intervals (e.g. Condon suggests that street blocks should not bigger than 90 by 180 meters) (Condon, et. al., 2003)<br>**14.** Well-interconnected pedestrian street networks with short intervals less than 100 meters | | | | | | | | | | | | |
| | √ | √ | √ | √ | □ | □ | □ | □ | □ | ■ | ■ | ■ | ■ | |
| | Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Calthorpe, 1993 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

City and city region / Human dimension

Open space

| | |
|---|---|
| The goal of **open space** planning | To increase the accessibility of urbanites to green open spaces |
| The rationale of the goal and the indicator | "The access to some form of nature is a fundamental human need and therefore, a vitally important part of access to open spaces." (Thompson, 2002, p66)<br>An understanding and appreciation of nature is a starting point for people to cherish the sustainable landscape. Understanding nature requires more than biology lessons taught in classrooms, or the occasional trip to a rural nature center. Urban design should provide constant and direct experience assimilated through daily exposure to, and interaction with, the place one lives in (Kaplan, et. al., 1998). |
| Indicator for measuring planning goal | **15.** The distance from urban central areas to the urban natural areas<br>**16.** A park or open space within ¼ to ½ mile of all homes |

| Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Calthorpe, 1993 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity |
| √ | √ | √ | √ | □ | □ | □ | □ | □ | ■ | ■ | □ | ■ |

| Site planning / Human dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land use | The goal of **land use** planning | To facilitate individual participation in decision making | | | | | | | | | | | | |
| | Rationale of the goal and indicator | The social aspect of sustainability requires a stable and cohesive society in which the health of the landscape has become a common concern for all of its citizens. Sustainable site planning often seeks to fulfill people's sense of belonging to a place by creating a more gregarious site plan (Thayer, 1994).<br>Investigations into how people's conception of a city show that the named local community is often an important element of that mental structure (Lynch, 1981). It was found that the perceptual ability of people determined that the scale at which people showed the most interest and concern, the neighborhood, is the most effective means to approach global sustainability. For example, source separation of waste, water retention, solar heating and cooling, is most easily carried out at the neighborhood level. Although the idea that cities are made up of neighborhood units has been the source of many debates, in terms of linking individuals' ideas to the creation of a shared vision, the idea of the neighborhood structure plays an undeniable role (Lynch, 1981).<br>Residential land use structure reflecting and supporting a desired social structure would help to establish a cohesive society and a shared vision (Gehl, 1996; Forman, 1995). | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **17.** Neighborhoods are basic units of residential areas | | | | | | | | | | | | |
| | | | | | □ | □ | □ | □ | □ | □ | ■ | □ | ■ | |
| | Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Calthorpe, 1993 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

| Site planning / Human dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Circulation | The goal of **circulation** planning | To design high quality streets in order to increase street activities | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | The face to face contact that occurs through pedestrian activity is important to human physical and mental health, and also contributes the establishment of strong social ties between neighbors (Freeman, 2001; Leyden, 2003; Jackson, 2003).<br>When streets are of poor quality, only the bare minimum of activity (e.g. going to school or work, shopping, waiting for buses, etc.) occurs. Improvement in the quality of streets (e.g. calming down traffic, thermal comfort, improving street furniture, etc.) not only markedly broadens the range of activity types (e.g. stop, eat, play, etc.) but also lengthens the duration time of all the street activities (Gehl, 1996). A well known study by Appleyard and Lintell (1972) shows that even a relatively limited deterioration of the quality of the street environment can have disproportionately severe negative effects on the extent of outdoor activity (Appleyard and Lintell, 1972).<br>Safety from traffic and crime, as well as thermal comfort against weather conditions are the two biggest factors of concern with regard to the quality of street design (Gehl, 1996). For example, streets designed to block winter winds or protect from the scorching sun are very favorable for people. Factors such as continuous active frontages and the ability to see below from upper storeys are important to the quality of streets because they provide a natural form of self-policing. The continuous presence of passers-by, as well as informal surveillance, combine to create a blend of urban vitality and safety. | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **18.** Protection from weather conditions (yes / no)<br>**19.** Protection from vehicle traffic (yes / no)<br>**20.** Level of social surveillance | | | | | | | | | | | | |
| | √ | √ | √ | √ | ■ | ■ | ■ | ■ | □ | ■ | ■ | | □ | |
| | Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Calthorpe, 1993 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

## Site planning / Human dimension

**Open space**

| | |
|---|---|
| The goal of **open space** planning | To design open spaces for outdoor activities |
| The rationale of the goal and the indicator | Open spaces provide opportunities for people to meet and engage in activities. Public activities, defined as "transitional forms between being alone and being together" serve as a foundation for creating cohesive social networks (Gehl, 2001).<br>"In order for neighbor contacts and various forms of communal activities to develop beyond a superficial level, a meaningful common denominator must exist – common background, common interests, or common problems." (Gehl, 2001, p55) Residential site planning can open up opportunities for such interaction patterns where a hierarchy of communal spaces reflects a desired social structure at various levels.<br>However, no matter what kind of efforts designers make to organize open spaces, the determinate factors for "lengthy outdoor stays" (a critical indicator of lively residential areas and city spaces) continues to be protection against unpleasant weather conditions and a sense of security from crime and vehicular traffic (Gehl, 2001). |
| Indicator for measuring planning goal | **21.** Neighborhood common land (yes / no)<br>**22.** Protection from weather conditions for outdoor social activities<br>**23.** Protection from vehicle traffic<br>**24.** Level of social surveillance |

| Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thayer, 1994 | Lyle, 1994 | Urban Task Force, 1999 | Frey, 1999 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity |
| √ | √ | √ | √ | □ | □ | □ | □ | □ | □ | ■ | □ | ■ |

| Site planning / Human dimension | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Building | The goal of **building** design | To facilitate people and social activities to move from the private to the public environment | | | | | | | | | | | | |
| | The rationale of the goal and the indicator | When people are isolated, they become more defensive, and are less likely to share with others who are unlike themselves. Moving people and activities from the private realm to the public environment is a prerequirement for developing more social interactions among residents.<br><br>Sharply demarcated borders (stairs, elevators, etc.) will render it difficult in many situations to move into the public environment if it is not necessary to do so. On the other hand, if the edge of a public space works, so does the space. Carefully designed edge zones which could include a small terrace, a tiny garden, a bench by the door, or a screen between neighbours will function as connecting links. Well thought out design elements such as these make it easier, both physically and psychologically, for residents and activities to move back and forth between private and public spaces, and between the indoors and the outdoors. Providing attractive opportunities for places to stop and rest on the public side of housing is important. | | | | | | | | | | | | |
| | Indicator for measuring planning goal | **25.** Stopping and resting places at frequent intervals in the public realm and on the public side of buildings | | | | | | | | | | | | |
| | √ | √ | √ | √ | □ | □ | □ | □ | □ | □ | ■ | □ | ■ | |
| | Thayer, 1994 | Lyle, 1994 | Calthorpe, 1993 | Urban Task Force, 1999 | Soil | Bio-productivity | Bio-diversity | Fresh water | Ocean | Atmosphere | Basic human needs of food, water, health, and housing | Fuel | Cultural cohesion and diversity | |
| | Supporting document | | | | Effects on Forman's fundamental variables | | | | | | | | | |

## 2.5 Chapter summary

In summary, 25 indicators have been proposed with regard to urban design components at both site and city region scales. These indicators were developed with regard to the principles of sustainable development in the environmental and human dimensions. The indicators are categories by scale as well as predominant use. They are summarized in the table below.

Table 2-1 The summary of indicators

| Scale | Use | Environment | Human |
|---|---|---|---|
| City Region | Land use | **1.** Policy and legal structures encourage compact development and limit outward sprawl | **11.** Services and employment locations are equally distributed within the built up area, allowing equality of physical access of all residents<br>**12.** Diverse housing types for varying households within neighborhoods |
| | Circulation | **2.** Maximum length of daily journey | **13.** Well-interconnected vehicle street networks with short intervals (e.g. 90 to 180 meters)<br>**14.** Well-interconnected pedestrian street networks with short intervals less than 100 meters |
| | Open space | **3.** The existence of very large nodes of habitat and unbroken corridors | **15.** The distance from urban central areas to urban natural areas<br>**16.** A park or open space within ¼ to ½ mile of all homes |
| Site plan | Land use | **4.** Zero stormwater directly discharged through pipes to downstream (OR, Zero net increase in storm water discharge from a site as a result of development) | **17.** Neighborhoods are basic units of residential areas |
| | Circulation | **5.** Streets serve both as a corridor system to capture and to infiltrate storm water (Y/N)<br>**6.** A mature tree canopy coverage to roadways and parking areas | **18:** Protection from weather conditions (Y/N)<br>**19:** Protection from vehicular traffic (Y/N)<br>**20:** Level of social surveillance |
| | Open space | **7.** % of open space is turf area<br>**8.** % of the open space is covered by native trees and plants<br>**9.** Open space for stormwater management | **21.** Neighbourhood common land (Y/N)<br>**22.** Protection from weather conditions for outdoor social activities<br>**23.** Protection from vehicular traffic<br>**24.** Level of social surveillance |
| | Building | **10.** Buildings are designed for natural cooling, warming and lighting conditions (Y/N) | **25:** Stopping and resting places on the public side of buildings |

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# Chapter Three

### 3. Applying indicators to the old and present urban form

### 3.1 Background information of the Guangzhou City

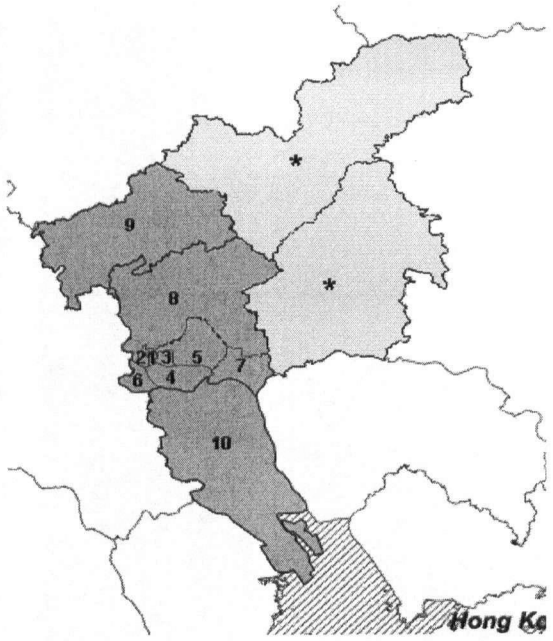
Guangzhou (formerly known as Canton) is situated in southern China at latitude between 22° and 24° North. It lies at the confluence of two navigable rivers of the Pearl River system with several hills to the northeast and the Pearl River Delta (PRD) alluvial plain to the south. (Figure: 3-1; Figure: 3-2) Guangzhou as the largest city in the south of China, is the current frontier of economic development in the country. Meanwhile, due to over 2,100 years of history and a distinct geographical location, the city of Guangzhou is characteristic of the traditional Ling-nan culture and has a unique subtropical climate.

Figure 3-1

Figure 3-2

Since the mid-1980s, the city has witnessed rapid economic growth and a booming population, placing considerable strain on its infrastructure, environment, and culture. By the mid-1990s traffic congestion became commonplace and the natural environment was deteriorating rapidly (Wu, 1999).

Currently, the city of Guangzhou covers an area of 3,718.8 $km^2$ with a 2000 census population of 7.4 million. It is comprised of ten city districts (Yuexiu, Dongshan, Haizhu, Liwan, Tianhe, Baiyun, Whampoa, Fangchun, Huadu and Panyu) (Xu and Yeh, 2003) (Figure 3-3). Of these ten districts, Huadu and Panyu, formerly county-level cities, were amalgamated to Guangzhou as urban districts by the State Council in June 2000, despite strong local resistance. Thus, housing construction has spread over a large area that is even further away from central Guangzhou.




**1** – Yuexiu; **2** – Liwan; **3** – Dongshan;
**4** – Haizhu; **5** – Tianhe; **6** – Fangchun
**7** – Whampoa; **8** – Baiyun; **9** – Huadu;
**10** – Panyu;

* are two present county-level cities, Conghua and Zengceng, although under the administration of Guangzhou Municipality, enjoy considerable fiscal independence.

Figure: 3-3

Table 3-1

| Districts | Population | Administrative area ($KM^2$) | | Districts | Population | Administrative area ($KM^2$) |
|---|---|---|---|---|---|---|
| YueXiu | 430,000 | 8.9 | | Baiyun | 858,000 | 1042 |
| Liwan | 510,000 | 11.8 | | Fangcun | 180,000 | 42.6 |
| Dongshan | 550,000 | 17.2 | | Huangpu | 203,000 | 121.7 |
| Haizhu | 800,000 | 90.4 | | Huadu | 600,000 | 961 |
| Tianhe | 547,000 | 108.3 | | Panyu | 927,000 | 1313 |

Note: About 25% population in the city region are agricultural population

**3.2 The biography of urban development** (Figure 3-4)

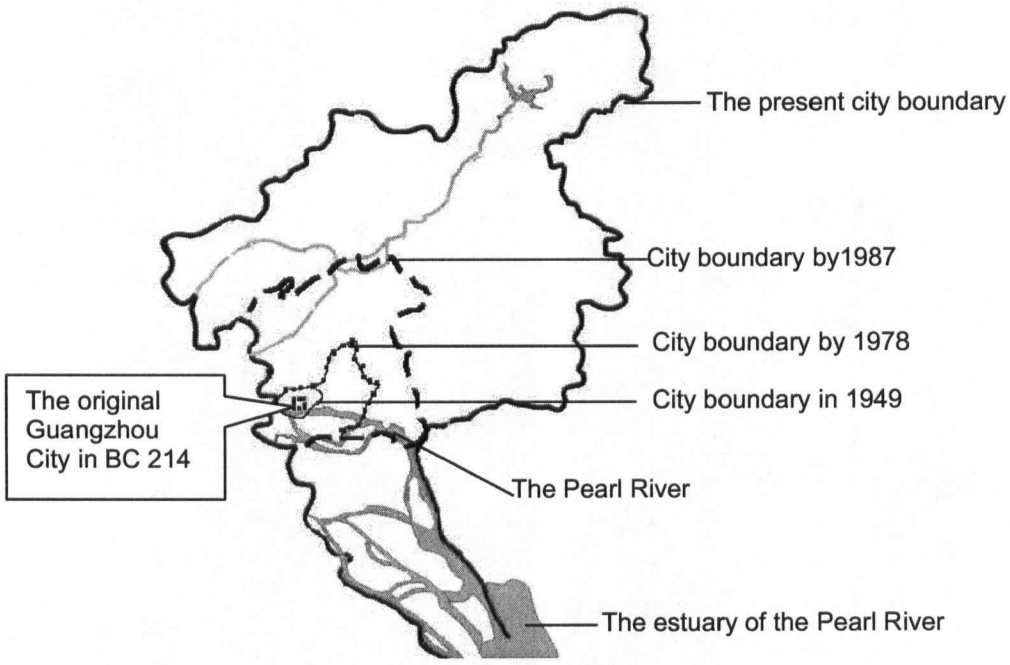



Figure: 3-4

**3.2.1** ***Pre-1949:*** *Guangzhou, as a prominent port city in China was developed incrementally with a compact city form. Spanning 1900 years of its history, Guangzhou was surrounded by city walls. As Guangzhou's social and commercial activities began to flourish, the city began to expand. Eventually city walls were demolished.*

Unlike other capital cities in feudal China (old centres of Beijing, Xian, and Kaifeng had a rigid square shape), Guangzhou as an important port city (Wu, 1986) throughout the Chinese history evolved spontaneously to conform to the developments of the population and social life, as well as the shifting natural environment (Chen, 1996). Already during the

Qin dynasty (AD 214), was built in approximately the same area of today's old city center. River sedimentation has dictated that its physical expansion, before the establishment of communist China, in 1949, followed the movements of the port (Zeng, 1991). As the city evolved, city walls were built continuously, and as needed, in order to include new districts, as well as to meet the needs of defense and administration.

With the improvement of technologies, city walls lost their original functions of defense. The existence of city walls was also a hindrance to free exchange of commodities. By the time of the Qing dynasty (1644-1911 AD), the city walls had stopped expanding and the city's growth broke through the existing city walls.

In 1921, Dr. Sun Yat-sen established the Government of the Republic of China in Guangzhou. At this time, Guangzhou entered a new period of construction (1921-1936). The collapse of the feudal dynasty further lead the city walls to becoming meaningless as a symbol of the reach and dominion of Chinese emperors. At the initiative of city officers and engineers, the city walls were demolished, roads were widened, street facades were updated and infrastructure improvements were made. Public parks also began to be developed within the city limits. The urban reconstruction and renovated cityscapes of this period, though highly influenced by western city planning and architectural theory and techniques, still maintained the traditional spirit of Guangzhou (Cody, 1996).

By 1948, the administrative area of Guangzhou was 36.2 $km^2$ (Chen, 1996). The built up area covered about 15.2 $km^2$ and accommodated 1.4 million inhabitants (Xu and Yeh, 2003) (Figure 3-4).

**3.2.2** ***1949 to 1978:*** *Urban development was very slow and took a form in which work unit compounds dotted the city's periphery, while the old urban districts were barely redeveloped.*

The Communists took over Guangzhou in 1949. The city was subjected to a socialist transformation in which market relations were abolished and an emphasis was placed on the promotion of public ownership and productive relationships (Xu and Yeh, 2003). The government had a centrally-planned economy and made decisions on resource allocation. Land was designated to work units (state enterprises, institutes, non-profit organizations, and to a lesser extent, collective enterprises) on a rent-free basis, according to their requirements of production. Working units, instead of municipalities, were responsible for housing their employees. Housing, amenities and other social facilities were constructed within work-unit compounds as worker's welfare. Urban development came to be based on project registration rather than planning permits. Under this circumstance, Guangzhou, during this period, like all other cities in China, was characterized by a work-unit orientated landscape mixed with small-scale neighbourhood-orientated traditional urban forms that remained from the previous capitalist era (Yeh et. al. 1995).

Residential community design theory in Maoist China was established by drawing lessons from two theories. One was the C. Perry's Neighbourhood Unit Pattern Model proposed in 1929 in the United States (Figure 3-5), and the other was Soviet Russian Planning Theory[4] introduced into China in the 1950s. (Zou and Bian, 2000; Gaubatz, 1995). Both theories emphasized the functionalism of urban spatial structures and were well adapted

[4] Urban planning in the Soviet Union during the 1950's emphasized residential districts as the principle urban units. These were spatially separated from industrial workplaces by a maximum distance of 40 minutes commute by public transit.. Residential districts were made up of residential neighbourhoods. Each of the neighbourhoods were comprised of 2 to 10 hectares within which daycare centers, retail outlets, recreational and athletic facilities were provided.

to serve the socialist centrally planned economy. The socialist principle of equality (Lo, 1987) translated into planning standards whereby a range of services had to be provided in conjunction with the size and population of the community and neighbourhood (ie. the building area of medical services per 1,000 residents) (Kwok, 1981; Phillips and Yeh, 1987).

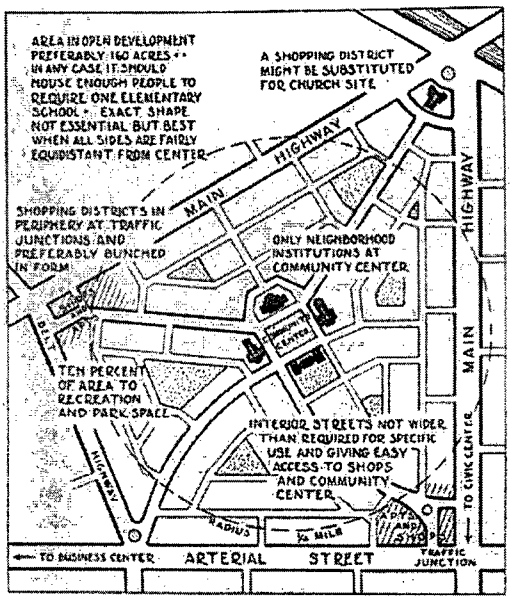



Figure 1: Perry's concept of neighborhood units: neighbourhoods are about 64 hectares in size, and each contains 750 to 1500 families to support one elementary school. Schools and other community services are located at the center of the neighborhood where are within 500 meters distance to every household of the neiborhood.

Figure: 3-5

Until 1978, the city's built up area increased to 50 $km^2$ accommodating a population of 2.3 million people (Chen, 1996) (Figure 3-4).

**3.2.3 *Post 1978:*** *Large scale residential communities have become a major form of suburban sprawl.*

Since 1978, China has adopted a series of reforms and open policies. The municipality of Guangzhou has since formulated plans to stimulate urban growth. Land leasing reform that was instigated between 1982 and 1987, and the housing reform of the 1990's have given market values to land and houses. Housing is no longer developed only as occupational welfare by enterprises. State enterprises and individuals both began to buy housing from property markets. As a result, a sudden boom in real estate investment has taken place.

Residential development has become a major form of suburban sprawl (Wu and Yeh, 1999). Between 1987 and 2001, the city's developed area was enlarged from 176 $km^2$ to 553.5 $km^2$ accommodating a non-agricultural population of 4.7 million (Guangzhou Statistics Bureau, 2001). It is expected to reach 755.24 $km^2$ by 2010 (Yang, 2004). From 1980 to 2000, the floor area of housing in Guangzhou increased by 36 million square meters. This figure is four times as large as the total floor area of housing in Guangzhou was in 1980 (Guangzhou Statistics Bureau, 2001).

Economic reforms also put an end to the ideal of the Maoist city and made Chinese cities look and function very differently from the Maoist vision. However, urban planning and community site design methods still continued as they had during the centrally-planned economic period.

### 3.3 The city's present development trends

#### 3.3.1 The structure of the present city areas (Figure 3-6)

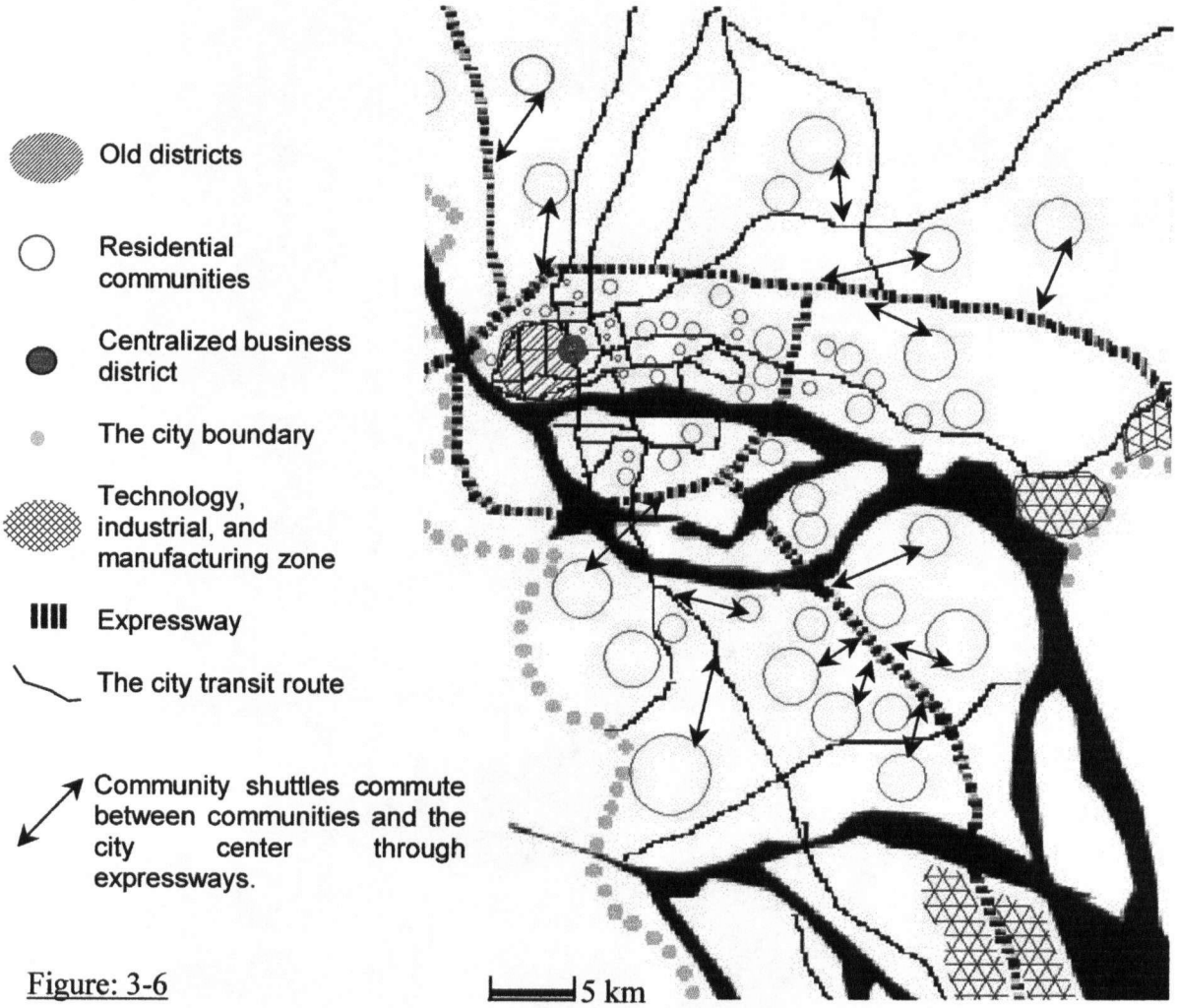



Figure: 3-6

Present day Guangzhou has been marked by the rapid growth of the urban inner centre and leap-frogging urban expansion (Wu and Yeh, 1999; Xu and Yeh, 2003). Many city functions such as commerce, finance, education, etc. are concentrated in the city's old district, which is the place of the present city center. In new districts, residential

communities are randomly distributed along expressways. Industrials zones that used to be located on the fringes of the city have been moved out to suburban areas, away from the city center and other residential areas (Figure 3-6).

Dispersed settlements in suburban areas are poorly served by public transit. Residents in these areas have to drive private cars and those who don't own a car are greatly inconvenienced in daily life. In 2002, there were 220,000 private vehicles in Guangzhou, (about eight vehicles per 100 households). This is 40 times the figure of 10 years ago, and private car ownership continues to increase at the rate of more than 60% per year (Xie, 2002). The daily need to move tens of thousands of peoples from their residential areas to their places of work has burdened the city's transit systems and contributes to surging heavy traffic.

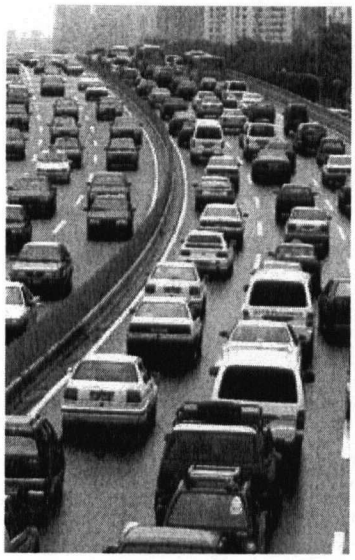


Figure 3-7

Figure 3-8

In order to relieve traffic congestion, elevated roads and flyovers have been added to existing roads (Figure 3-7). Newly constructed city roads are more than 40 meters in width to accommodate more traffic flow (Figure 3-8). The road system has adopted intervals between intersections of 400 meters to 1000, or even 1500 meters in order to reduce the number of intersections, and therefore smooth the movement of traffic flow.

Due to an overall lack of strategy for open space planning, the many scattered residential communities and other specialized districts have turned a great quantity of valuable farmlands over to construction uses[5]. Meanwhile, Guangzhou's forests are heavily fragmented by urbanization. The BaiYuan Mountain and the original hilly forest have been isolated as islands (Li and Wang, 2005).

### 3.3.2 Residential communities in newly developed districts

The urban land use patterns for residential uses in the city's newly developed districts have taken on a similar approach to that which was used during the Maoist period. Once a developer acquires a piece of land, he builds a self-sufficient residential community that provides not only housing, but also a certain degree of living facilities according to the Residential Construction Code [6].

The basic unit of residential planning and development in China is called "sealed residential quarters". They are designed and managed according to a sealed form with an almost standard layout. Along the site property, line walls divide the inside and outside

[5] According to the statistic data, in 2000 alone there is 1,584 hectares of farmlands have been changed to construction uses (Guangzhou Statistics Bureau, 2001).

[6] For example: residential communities with populations of 10,000 to 15,000 are provided with grocery stores, markets, restaurants, etc. with a total building floor area of 2,000 to 3,600 $m^2$; residential communities with populations between 30,000 to 50,000 are provided the same facilities with a total building floor area of 5,000 to 8,200 $m^2$.

environment, forming an enclosed community. For security reasons, entries and exits into communities are minimal and they are as guarded by 'house detectives' (Figure 3-9; 3-10).

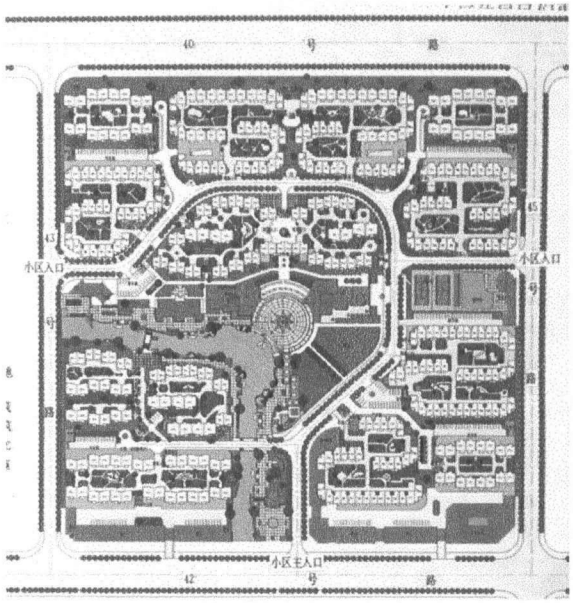
Figure 3-9

Figure 3-10

Some basic civic and commercial facilities have been designed to accommodate the population size (e.g. school, shops, green spaces etc.), according to the established code. The nature of the sealed form decides that community open spaces, safe pedestrian areas, playgrounds, clubhouses and other community-oriented facilities have to be located in the centre of the walled compounds. Meanwhile, to ensure business success and enough sources of students, markets and schools are located at the peripheries of the residential quarters and are open to the city's arterial corridors, which are often 30 to 60 meters in width, with very busy traffic flows (Figure 3-11).

The size of each residential quarter is usually over 15 hectares, as determined by the planned city road system (a grid with over 400 m intervals). In suburban areas, the scale of residential development has been increasing, and sometimes covers a land area of over several hundred hectares which is inhabited by more than 100,000 people (Xu, 2002; Huang and Huang, 2003） (Figure 3-12).

The sealed residential planning form is so influential that reports on Guangdong indicate that in 2000, more than 70% of the residential areas containing over 80% of the population were gated in variety of ways (Miao, 2003).



*A typical residential community in China. In this project there are only three entrances to the community. The dark colors are commercial facilities, daycares, a school and other services. Gray colors are open spaces in the community*

Figure 3-11


*A typical large scale residential community in the sub urban area. The project covers a land area of 200 hectares accommodating 70,000 population. Public faculties are concentrated at the southern end of the property proximate to city highways while the rest of the land areas are walled as quiet living areas.*

Figure 3-12

Within these "sealed residential quarters" are private residential community streets that provide the sole transit function inside the community. Guards restrict any through-traffic. Walls and gates also restrict the connection of pedestrian routes within the community and those in the outside environment. (Figure: 3-13).

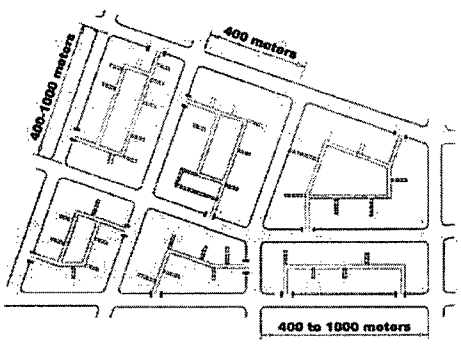



Figure 3-13

In order to attract more residents, the design of open spaces and buildings in the residential communities has been overwhelmingly focused on visual attractiveness. As a result, building forms, colors, orientation, and materials often pursue the current most popular styles in the nation, all the while ignoring their suitability to the local climatic conditions (Huang and Yang, 2003). The open spaces in residential communities play very limited roles in such ecological functions as managing stormwater, microclimatic adjustment, food production, etc. Planting in open spaces is characterized by selecting species of flowering and palm trees that grow quickly but have only small to medium final size and short lifespan. Many inappropriate exotic species are also introduced to newly developed areas (Jim, 2001).

### 3.4 The city's traditional development pattern

*"As planners and designers, we face the challenge of creating and maintaining communities which are affordable, efficient, scaled to human proportions, and environmentally sound. When searching for design solutions within these constraints, it is important to consider and learn from the past, from its successes and its failures. The past can reveal suggestions and alternatives for the future."* (Nelessen, 1994, p43)

#### 3.4.1 The three old districts

Currently, the City of Guangzhou comprises ten city districts (Yuexiu, Dongshan, Haizhu, Liwan, Tianhe, Baiyun, Whampoa, Fangchun, Huadu and Panyu). Of these ten districts, Yuexiou, Liwan, and Dongshan are called inner city core areas and they were the main built-up urban areas before the rapid urbanization process (Figure 3-14; Table 3-1). Unlike residents of most western cities or even some Chinese cities like Beijing, residents of Guangzhou have demonstrated their strong preference for living in these three districts (Wang and Li, 2004). Although the residential movement from the inner core of the city to suburban areas is evident, research has found that the driving force behind this movement has not been voluntary (Li, 2001).

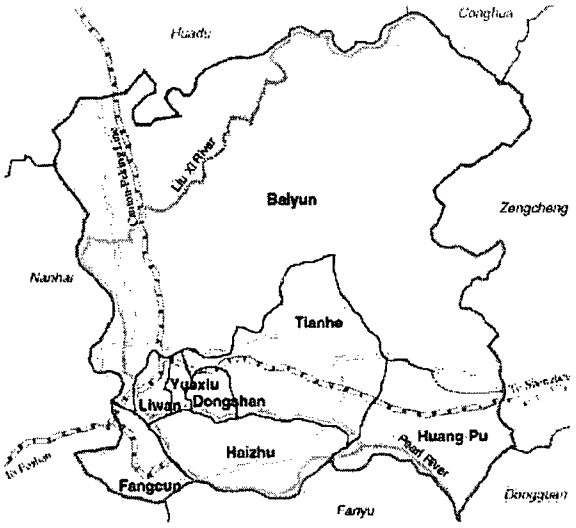



Figure 3-14: *Spatial configuration of districts in Guangzhou*

Table 3-2

| Districts | History | Population | Urban built-up area ($KM^2$) | % of city lands are residential area | Population density (people/$KM^2$) | Gross residential density (units/ hectare) |
|---|---|---|---|---|---|---|
| YueXiu | 2500 | 430,000 | 8.9 | 41.5% | 48314 | 363 |
| Liwan | 1500 | 510,000 | 11.8 | 56.5% | 43220 | 233 |
| Dongshan | 150 | 550,000 | 17.2 | 35.9% | 34883 | 303 |

*The gross residential density includes land uses for neighbourhood's greens, schools, and other neighbourhood level public facilities.*

### 3.4.1-1 The Yuexiu district

The first city of Guangzhou was built in 221 BC. This original city is located within the boundary of today's Yuexiu district. Today, Yuexiu district is still the location of the municipal government. Most of the municipal administrative departments and places of historic interest and scenic beauty are concentrated in this district.

### 3.4.1-2 Liwan district

Old Liwan has been developed since 500 AD and has had a traditional focus on handicrafts, international trade, commerce, and light industrial. The residential areas of Old Liwan were in large part developed to meet the living requirements of local business people. As a result, the famous traditional, long-standing restaurants, handicrafts and shopping stores are concentrated in Liwan district.

### 3.4.1-3 Dongshan District

Dongshan's development dates back 150 years. Provincial and municipal government uses, which have been established since the 1900s take up a sizeable area in today's Dongshan district. A large number of residential areas have also been built since the 1950s. Dongshan is noted for its high quality educational facilities and financial services.

### 3.4.1-4 Accessibility is the key for success

Haizhu district is located on the waterfront facing Yuexiu and Liwan. It has been developed for over 80 years, and has a population of 700,000. It is located geographically across the Pearl River from Yuexiu and Liwan and is administratively considered to be an inner core district. However, due to easy transportation being impeded by the Pearl River, in the mind of the people of Guangzhou, Haizhu remains an inaccessible and backward region (Wang and Li, 2004).

On the contrary, Tianhe district with only 25 years of development history and 500,000 inhabitants is considered by the people of Guangzhou as constituting a part of Guangzhou's urban core after the construction of Guangzhou East Railway Station and Tianhe Stadium, and the completion of the Stage 1 of Guangzhou Metro in 1998 (Wang and Li, 2004). It is the only district outside of the inner core to which Guangzhou people attach strong preference (Wang and Li, 2004).

### 3.4.2 The inner structure of old districts

Taking Yuexiu district as an example, this old district is highly compact and has very mixed city functions (Figure 3-15). These include residential, commercial, financial, business, green spaces, education, medical, recreation, light industry, and government apparatus. Although some city functions such as government and commerce are concentrated in certain areas, these areas are packed closely with transitions of mixed use between them.

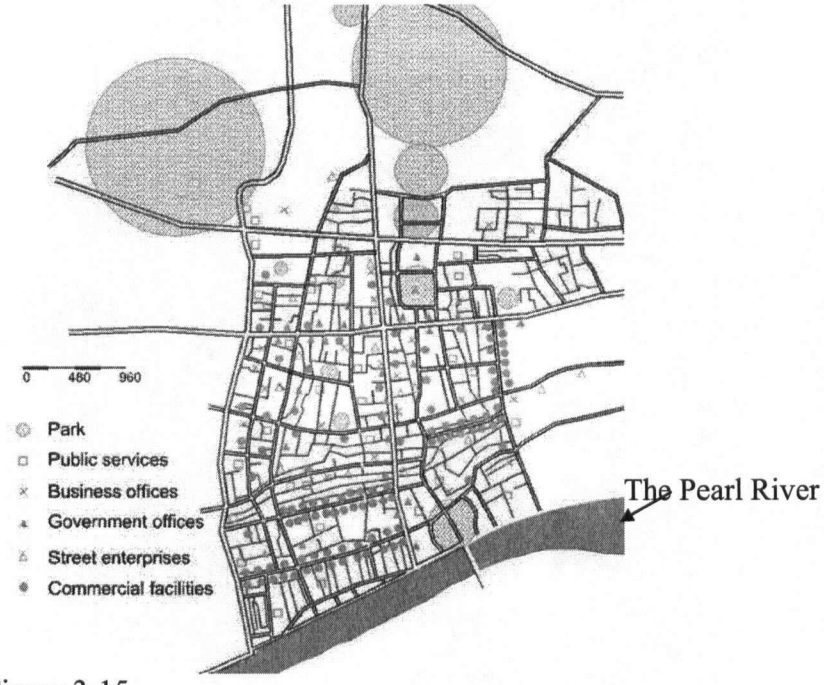



Figure 3-15

The streets and lanes in the city's old district form a dense and modified grid network, which constitutes the framework for the distribution of the city's public facilities. Some streets are less than 100 meters apart, but some reach 1000 meters between intersections. In contrast, pedestrian lanes in housing areas are dense and numerous and are well connected to streets.

There are two large parks at the northern end of the district. They cover a total land area of 1.29 $km^2$, including 38 hectares of artificial lakes and seven hilly natural habitats. The artificial lakes were originally designed to store storm waters that affect the area of Guangzhou every ten years or so. At the present time, they not only play an important role in flood control but have also attracted many wild nesting birds to an island that is located in

the middle of the largest lake (Yang and Tang, 2005). The two parks have become important leisure destinations for residents (Figure 3-16).

Figure 3-16

Figure 3-17

The city is situated in a sub-tropical climatic zone which experiences rich amounts of rainfall and warm weather. As early as 100 BC, some native tree species were domesticated for religious reasons and also for private garden uses in urban Guangzhou (Jim, 2004). Since the 1850s, and as a result of western influences (Cody, 1996), park and roadside greening has been introduced into the city. The warm and humid climate and longstanding urban tree planting tradition has resulted in Guangzhou's urban green coverage and tree species diversity ranking amongst the highest in large cities across China (Zheng, 1995).

Like the other two old districts, Yuexiu district preserves a rich assemblage of plants, especially the champion trees along the roadsides (Jim, 2004a; Figure 3-17). Before urbanization, the district supported a natural rain forest of large trees with broad and dense crowns and long life expectancies (Jim and Liu, 2001). At the present time, these rain forest tree species often form outstanding landmarks for a street or neighborhood (Table 3-2).

Table 3-3 Dominate tree species in the urban forest of Yuexiu district

| Species | Family | Species | Family |
|---|---|---|---|
| Ficus virens | *Moraceae* | *Bauhinia purpurea* | *Caesalpiniaceae* |
| *Ficus microcarpa* | *Moraceae* | *Bombax malabaricum* | *Bombacaceae* |
| *Ficus hispida* | *Moraceae* | *Pinus massoniana* | *Pinaceae* |
| *Broussonetia papyrifera* | *Moraceae* | *Bauhinia variegata* | *Caesalpiniaceae* |
| *Cinnamomum burmanii* | *Lauraceae* | *Bauhinia blakeana* | *Caesalpiniaceae* |
| *Celtis sinensis* | *Ulmaceae* | *Cinnamomum camphora* | *Lauraceae* |

**3.4.3 Qilou** (*three or four storied buildings along streets with a protruding structure, or arcade, stretching above from the second story over the sidewalk*) – the product combined local climatic conditions and cultural characteristics

The origins and history of Qilou buildings date back to ancient Greece some 2,000 years ago. Buildings of this style subsequently became popular in Europe. At the beginning of the twentieth century, this western architectural style was blended with traditional local housing features, thus giving birth to the unique structure of Qilou buildings (Figure 3-18).

Figure 3-18

Most of the Qilou buildings in Guangzhou are three or four storied with shops at the ground level and residences upstairs. Each Qilou building, with its second storey protruding over the sidewalk, was built next to the other along the street, covering the whole sidewalk

with colonnades (Figure 3-18; 3-19; 3-20). For both cultural and climatic reasons, this architectural form gained popularity and reputation in the city of Guangzhou.

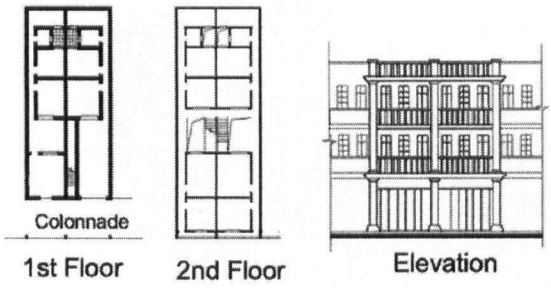



Figure 3-19

Figure 3-20

### 3.4.3-1 Climatic reasons

Guangzhou is in the northern subtropical-humid climatic zone with a mean annual precipitation of 1690 mm and air temperature of 21.8 degrees Celsius. Characterized by subtropical marine monsoon weather, Guangzhou has long summers, short springs and autumns, with no winters at all. The summer, which lasts from mid April until October is very hot and humid with lots of tropical showers and the occasional typhoon and thunderstorm.

Gaining shade and protection from sun and heavy rain is so important that one western traveler wrote that:

*"The streets, by which this ancient city is intersected, are numerous and narrow. There is, if we mistake not, a law to the effect that the streets of Chinese cities shall not be*

*less, in point of width, than seven, or eight Chinese feet. The city of Canton, however, contains several streets, which are so narrow as to lead to the conclusion that the law to which a reference has just been made is more honoured in the breach, than in the observance. But though the majority of the streets, in the city in question, are narrow, they, it ought to be observed, possess, in consequence, during the summer months of the year, the coolness of well shaded glens. This, of course, arises from the fact that so narrow are they as to exclude, in a great measure, from their precincts,*

*"Those blazing suns that dart a downward ray,*
*And fiercely shed intolerable day."*

*Again, in not a few instances, the streets of this city, - more especially those, which are larger, and more frequented than others - are, during the hot season of the year, partially shaded, at the expense of the citizens, who, respectively, inhabit them, by coverings, which consist either of canvass, or matting, or thin boards of pine."* (Gray, 1875, p15)

These coverings are considered to be the embryonic form of the Qilou.

The hot, humid climate and light breezes that come year-round from the south-east create a more comfortable outdoor rather than indoor environment especially in the evening. In addition, unlike the traditional courtyard housing form in the northern China, the vernacular housing in Guangzhou lacks common spaces which could be used for family activities. The living pattern of the people of Guangzhou tends to be outdoor orientated. Children run and play in the lanes and buy their favorite foods in the streets. Women or old people safeguard the children at the doorway, while at the same time selling goods to support the family. During special festivals, streets are also used as places for festivities and related programs such as dragon dances, lion dances, flower markets, etc.

In the first decade of the 20$^{th}$ century, the city was introduced to western style colonnade (or arcade) buildings and advanced construction technologies. The covered sidewalks provide a comfortable outdoor environment for commerce, as well as resident's associations. During the ephemeral capitalist era of the city (1911 to 1937), almost all of the buildings beside streets were constructed in the Qilu form (Li, 1996).

### 3.4.3-2 Cultural reasons

Guangzhou has become famous for its highly developed commercial activities throughout its over 2,500 years history. As early as 581 AD, it became the starting point of the Silk Road on Water, linking the city with Southeast Asia and the Middle East. In the more recent times, from the late 18$^{th}$ century to the early 19$^{th}$ century, it was the only trading port opened by the government. Even during the Maoist regime, though economic marketing relations had been abolished, the tertiary sector of Guangzhou accounted for 30% of its GDP, which was proportionally much higher relative to other large cities like Shanghai, whose tertiary sector only accounted for 18% of its GDP. After economic reform, a free market economy was restored. Guangzhou rapidly became a city with the highest per capital disposable income in China and the share of the tertiary industry in GDP increased to 54.49% in 2001(Yang, 2004).

Moreover, Guangzhou, which is situated at the southern end of China, has been cut off from relations with central inland areas by the Lingnan sierra mountains to the north. Central Chinese culture has far less influence on local people's values and life styles than the ocean-commercial cultures (Tan, 2003). The people of Guangzhou have formed an ideology which emphasizes economic values but with contempt for the contest of power and influence.

The Qilou architectural form effectively uses the spaces above sidewalks and maximizes the economic profit from the land. These buildings are closely packed along streets, forming extremely high-density living environments, but maximizing the contact opportunities between the commodities and urbanites in order to enhance purchasing capabilities. This is probably the major reason that the architectural form was widely accepted (Gong and Liu, 1991).

The high living density found in Guangzhou is not found in other Chinese cities. However, their unique cultural values have given the Cantonese the highest levels of tolerance for congested conditions (Lai, 1993). This highly congested city also gained a reputation for being the city with the highest levels of vitality and freedom (Yi, 1997).

In fact, the spirit of 'freedom' is evident throughout Guangzhou's entire history. In the prosperous times of the Chinese feudal era, when Chinese emperors arrogantly believed that all countries outside of China were barbarian places, Guangzhou became a city in which foreign people lived side by side and in peace with local people. As early as the Tang Dynasty (618-907AD), Guangzhou was home to 300,000 residents, among which 10,000 were foreign traders and travelers (Chen, 1996). In the last stage of the feudal period, Guangzhou was the base of China's democratic revolution and Dr. Sun Yat-sen established the first Government of the Republic of China in Guangzhou. After the 1978 socialist reform in China, Guangzhou was known as a pioneer city in terms of exploiting the new scope offered by the reform policies.

The spirit of 'freedom' manifested itself in handicrafts and urban features which melded western and traditional Chinese cultural features. During the Ming Dynasty (1368-1644 AD), western patterns and features of western people appeared on Guangzhou's handicrafts (Li, 1997). Later, in the early $20^{th}$ century, when flat, wooden buildings dominated most Chinese cities, the Qilou style, which borrowed from western style by using concrete structures and integrating them with Guangzhou's vernacular housing form. This form became widely used in the city of Guangzhou, and Qilou has become the symbol of the city's cultural characters.

## 3.5 Indicator analysis and urban design recommendations based on a comparison of the performances of the present and old city forms on indicators

In light of the 25 indicators, this part of the document is going to evaluate and analysis the failure and success of the both old and present city forms, and then propose recommendations for the city's development. Each of the indicators will be processed within two constant frames. Figure 3-21 and figure 3-22 are two proposed models representing an overall picture of what a sustainable Guangzhou City could look like respectively on the city and site scales.

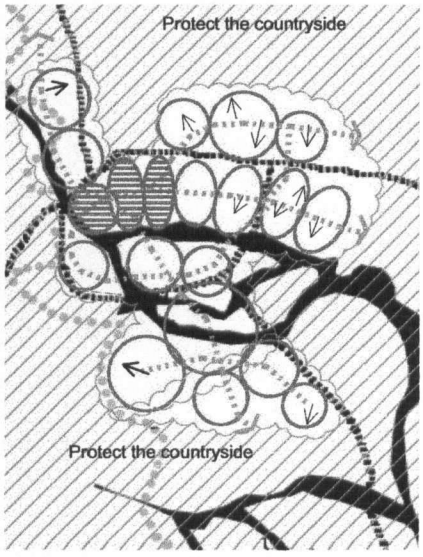



Figure 3-21
*A more sustainable urban spatial structure*
*For more details refer to Figure 4-1.*

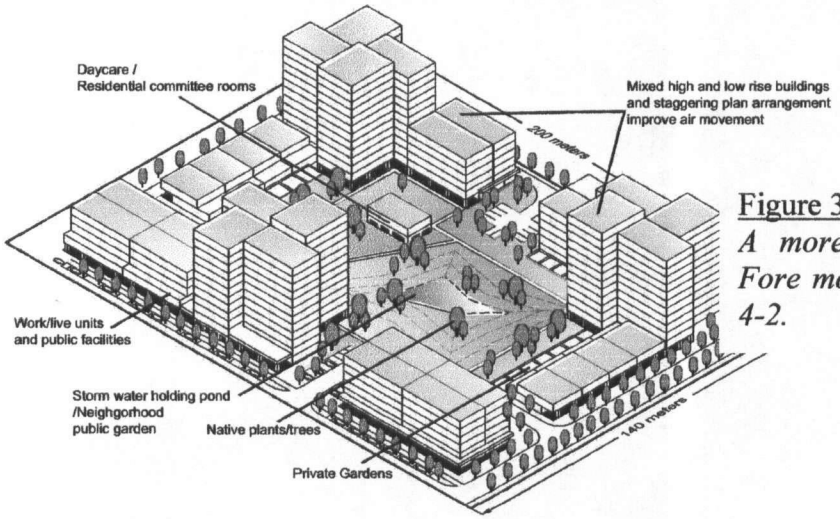



Figure 3-22
*A more sustainable urban cell. Fore more details refer to Figure 4-2.*

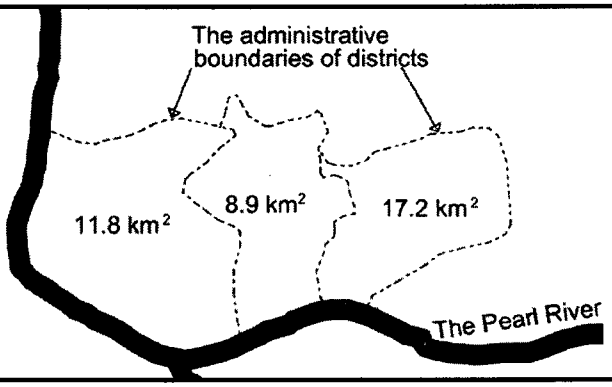
The goal of land use planning:
To ensure that urban land uses conserve land resources

**Indicator 1**:
Policy and legal structures encourage compact development and limit outward sprawl

Environmental dimension

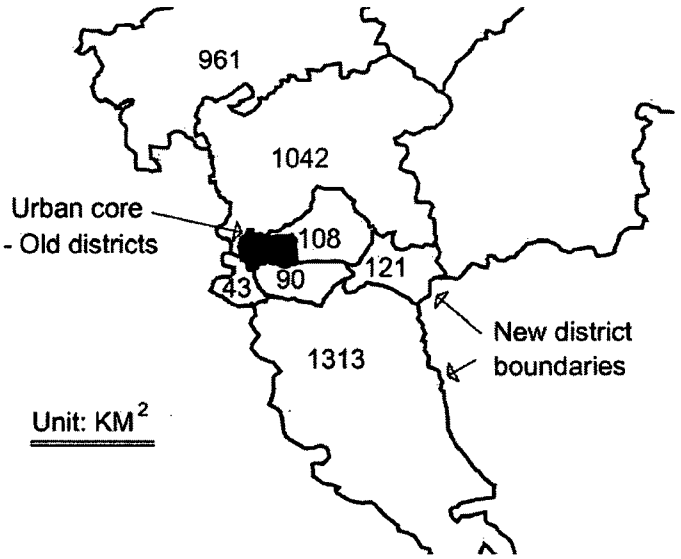
Old district

Small administrative areas of old districts make outward urban sprawl impossible.




New district

New districts have large administrative areas. Urban settlements are scattered through new districts.



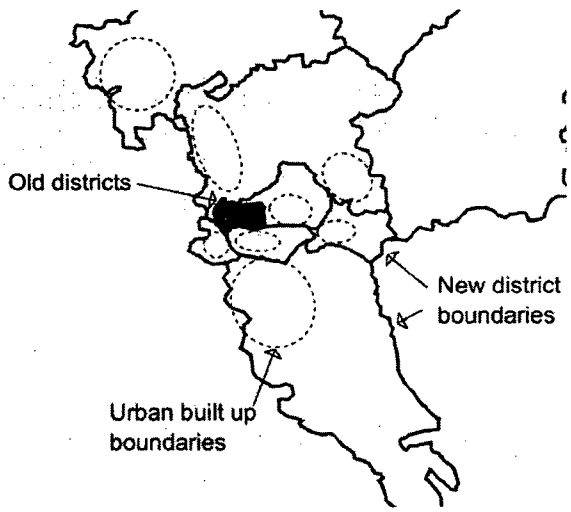
## Recommendations

The goal of land use planning:
To ensure that urban land uses conserve land resources

Indicator 1:
Policy and legal structures encourage compact development and limit outward sprawl

| | |
|---|---|
| Analysis | Setting up urban growth boundaries, such as has been done in Portland, Oregon in the United States, is often an effective means to limiting urban sprawl. In Guangzhou, the conditions are such that the city is divided into districts that carry out administration. New districts with large land areas (some are one hundred times the size of the old districts) (Table 3-1) should not only undertake the responsibility of urban development, but also need to focus on preserving farmlands and natural resources that provide raw materials. |

***Recommendation* 1:** Urban growth boundaries should be set for districts to preserve land resources;




| | |
|---|---|
| ***Related recommendations*** | 7, 9, 10 |

## Circulation / City region

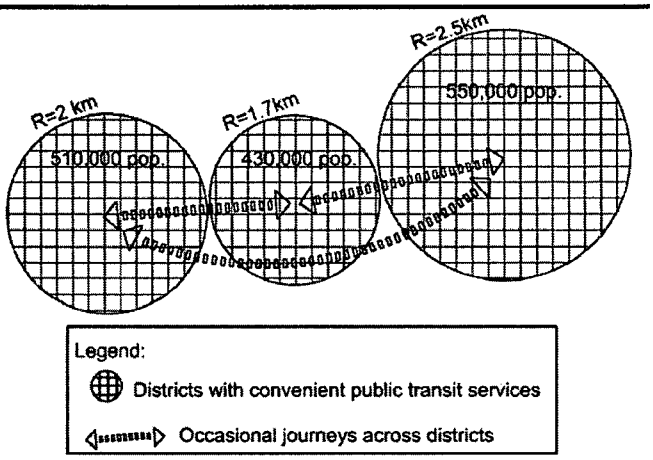
The goal of circulation planning:
To ensure that urban transportation systems are planned with the aim of reducing energy consumption, as well as air and water pollutants

**Indicator 2**:
Maximum length of daily journey

Environmental dimension

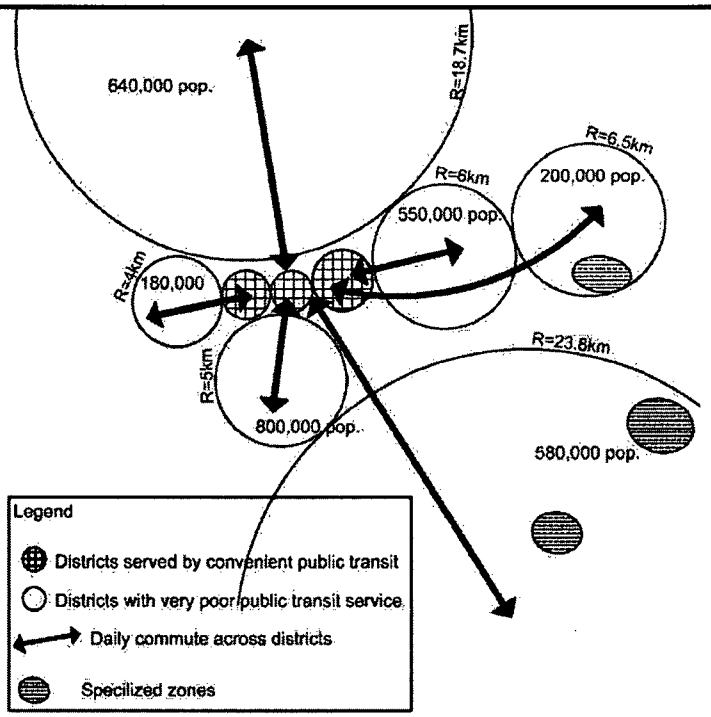
Old districts

The maximum length of the daily journey for most people living in old districts is within 5 km/person.




New districts

The maximum length of the daily journey for most people living in new districts is within a range of 5 to 50 km/person.



## Recommendations

The goal of circulation planning:
To ensure that urban transportation systems are planned with the aim of reducing energy consumption, as well as air and water pollutants

Indicator 2:
The level of vehicle travel miles

| | |
|---|---|
| Analysis | In the City of Guangzhou, the loosely dispersed settlement areas in the new districts have to rely on the old districts to provide services and jobs. Inconvenient public transit in the new districts further encourages the use of private cars.<br>In contrast, the three old districts have compact and mixed urban core areas, each with a well-developed public transit system and a large population enough to support a sophisticated service system[7]. In this way, the need for people who live in the three old districts to commute across district boundaries to seek services are largely reduced.<br>In addition, to maintain the city as a whole, accessibility throughout the city region is the key to success. Looking back historically, the development of Haizhu and Tianhe districts can be used for reference (3.4.1-4). |

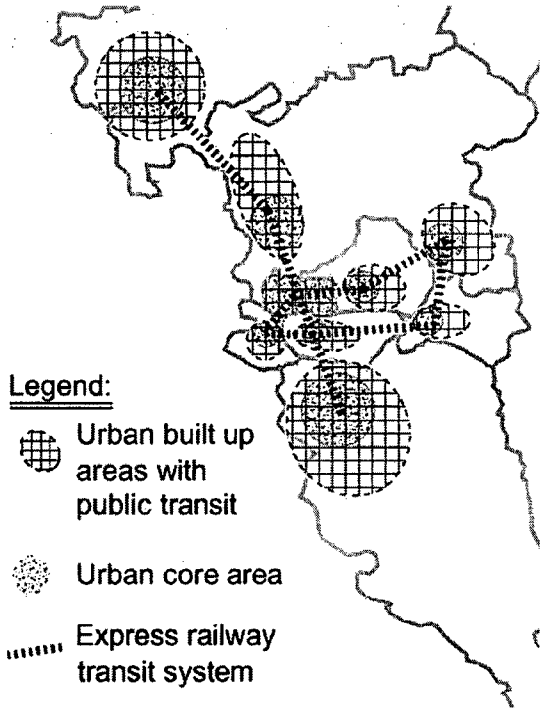
***Recommendation 2***. All the built up urban areas should be transit accessible;

***Recommendation 3***. Each district should develop their own mixed-use urban core areas;

***Recommendation 4***. Each of the urban cores should be planned to contain a minimum population of 300,000;

***Recommendation 5***. The urban clusters of the city should be connected by an express railway system;

***Recommendation 6***. A minimum population density of 100 persons per hectare is highly recommended for developing a valid subway system (Olsen, 2004);




| | |
|---|---|
| ***Related recommendations*** | 28, 29, 35, 37, 45, 47 |

[7] According to Alexander (1977), a minimum of 300,000 people are required to support a sophisticated service system including a variety of retail and professional services, as well as recreational and cultural activities.

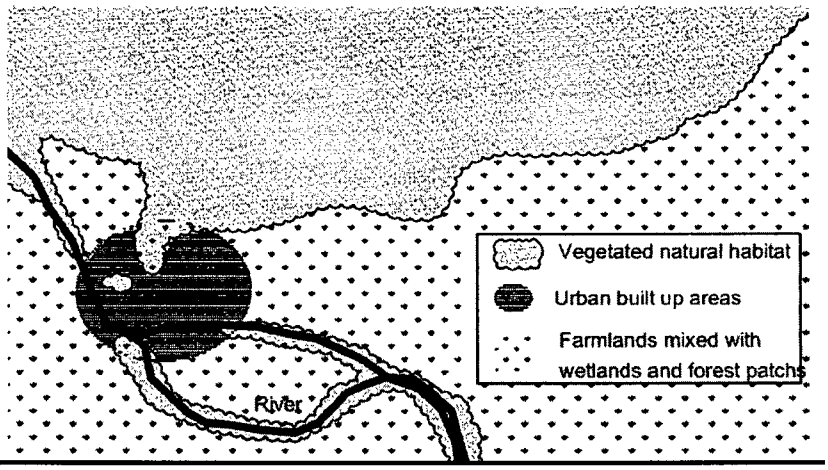
The goal of open space planning:
To enhance or maintain biodiversity in the city region

**Indicator 3**:
The existence of very large nodes of habitat and unbroken corridors

Environmental dimension

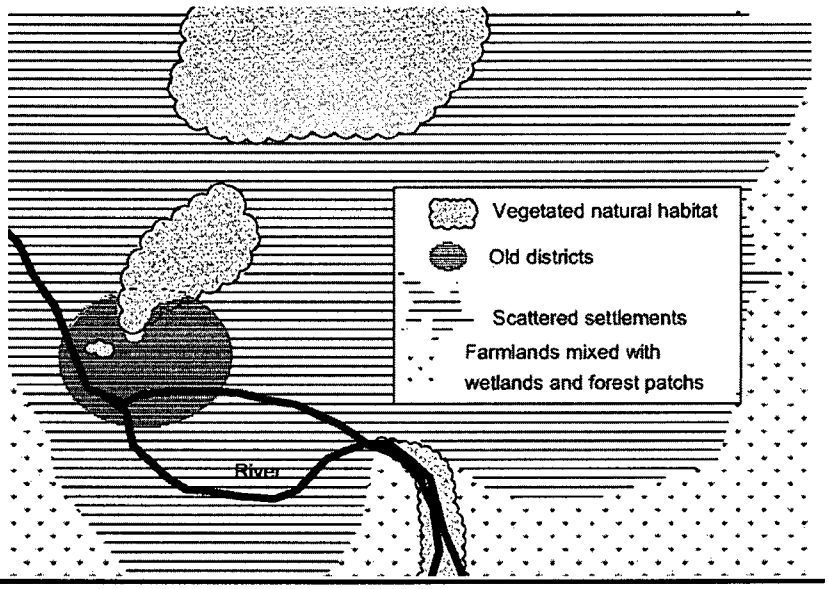
Old district

Continuous high density urban development of the old city cuts off connections between diverse local habitats




New district

Leap-frogging urban sprawl erodes the countryside, destroys the integrity of large natural habitats and further worsens the ecological connectivity of the region



## Recommendations

The goal of open space planning:
To enhance or maintain biodiversity in the city region

Indicator 3:
The open spaces in the city region are connected as a net of diverse and important habitats, maintaining the existence of very large nodes connected by unbroken corridors

| | |
|---|---|
| Analysis | Though neither the old nor the present city form can support the ecological connectivity of the region, some practices that were employed in the past can still help with current urban development.<br><br>In 1910s, the city planed several parks which preserved a hilly forest and adapted natural wetlands to flooding reservoirs. Although the hilly forest is connected to the large mountain area in the north, it was disconnected from the river corridor in the south and from other wetlands.<br><br>In contrast, urban parks in the new districts are not only limited in numbers but also lack in natural habitat value. Many important and diverse local natural habitats have been removed as a result of urban expansion. |

***Recommendation 7.*** Planning urban ecological infrastructure before planning urban land use;

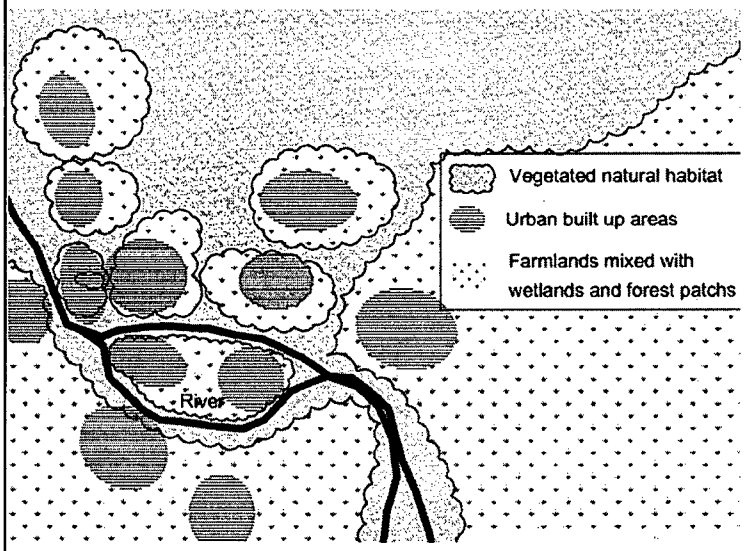
***Recommendation 8.*** Preserving important habitat patches such as urban parks;

***Recommendation 9.*** Protecting the forested area in the north from heavy urban development and safeguarding clean fresh water resources;

***Recommendation 10.*** Protecting the farmlands and stream networks in the south;

***Recommendation 11.*** Establishing, preserving, or restoring urban green corridors to connect natural habitat patches;

***Recommendation 12.*** Restoring riparian habitats along Pearl River watersides;




| | |
|---|---|
| ***Related recommendations*** | 1, 18, 20, 21, 38, 39 |

## Land use / Site planning

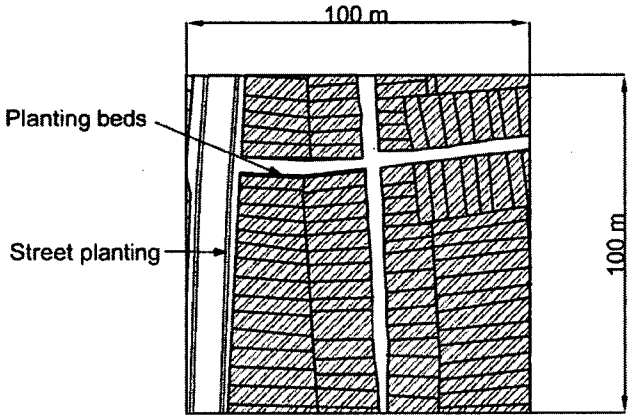
The goal of land use planning:
To maintain the hydrological regime on site

**Indicator 4**:
Zero storm water discharged directly downstream through pipes (OR, Zero net increase in storm water discharge from a site as a result of development)

Environmental dimension

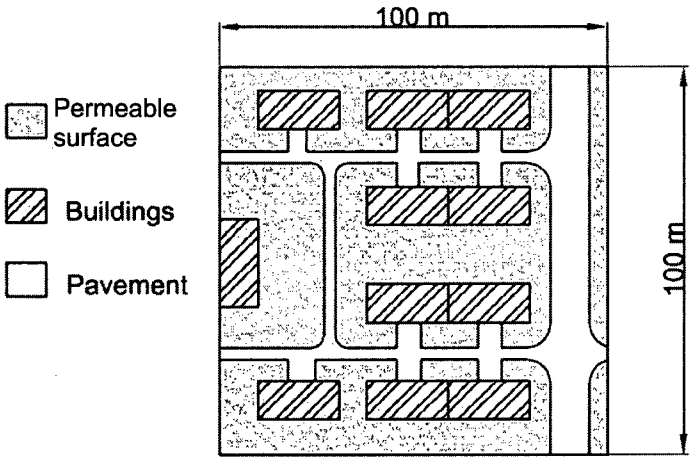
**Old districts**

Indicator 4: In old neighborhoods, almost all the runoff generated from paved areas on site are piped downstream to streams and rivers.




**New district**

Indicator 4:
In present residential communities, about 20% of precipitate can be absorbed by on site soil and the rest is piped downstream into streams and rivers.



## Recommendations

The goal of land use planning:
To maintain the hydrological regime on site

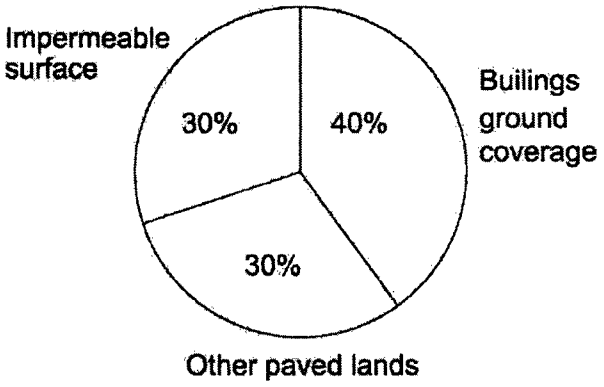
Indicator 4:
Zero stormwater discharged directly downstream through pipes (OR, Zero net increase in stormwater discharge from a site as a result of development

| | |
|---|---|
| Analysis | In old neighborhoods, the site is almost fully occupied by buildings and streets except street planting strips and a few planting beds, resulting in over 90% of rainwater being directly discharged downstream. In new residential communities, restricted by the design and construction code, at least 30% of the site lands have to be dedicated for greening. This results in about 78% of rainwater being directly discharged downstream.<br>To achieve this indicator, rainwater needs to be absorbed as much as possible by vegetation and permeable soils, excess water needs to be stored for further evaporation and infiltration, and pollutants need to be removed as much as possible by effective plants. |

***Recommendation 13***. Minimizing building coverage and impervious pavement on land surface (no more than 70%);

***Recommendation 14***. Maximizing usage of green roofs;

***Recommendation 15***. Maintaining the original topography of the land;




| | |
|---|---|
| ***Related recommendations*** | 7, 16, 17, 20, 21, 22, 23 |

## Circulation / Site planning

The goal of circulation planning:
To design streets with minimal adverse environmental impacts

**Indicator 5**:
Streets serve both as a corridor system to capture and to infiltrate storm water

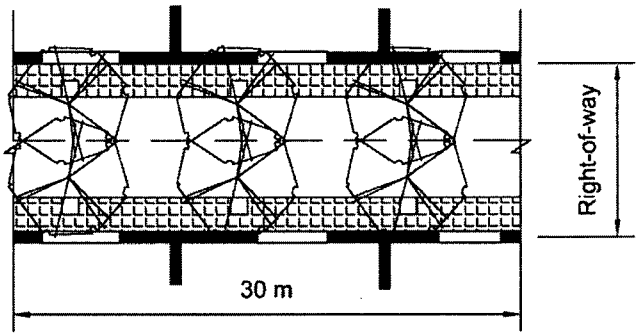
**Indicator 6**:
A mature tree canopy coverage to the roadway and parking area

Environmental dimension

### Old districts

Indicator 5:
Streets in old districts cannot serve as a corridor system to capture and infiltrate storm water.

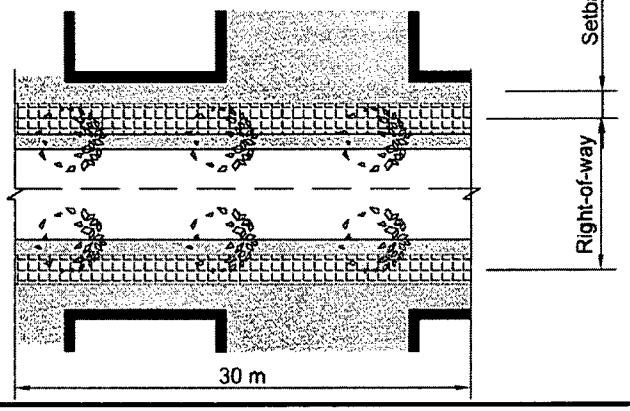
Indicator 6:
Traditional street tree planting emphasizes shading effect and provides high canopy coverage to streets and parking lots.




### New districts

Indicator 5:
Present streets cannot serve as a corridor system to capture and infiltrate storm water.

Indicator 6:
Present tree planting emphasizes the visual effect and provides limited canopy coverage to streets and parking lots.



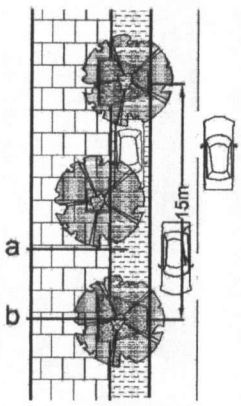
| Recommendations | |
|---|---|
| The goal of circulation planning:<br>To design streets with minimal adverse environmental impacts | |
| Indicator 5:<br>Streets serve both as a corridor system to capture and to infiltrate storm water<br>Indicator 6:<br>A mature tree canopy coverage to the roadway and parking area | |
| Analysis | Streets both in the new and old urban areas use a curb and gutter system to discharge storm water directly downstream.<br>Regarding street tree planting, the city has a long history of tree cultivation, with a tendency to select native species with broad and dense crowns, large final dimensions and long life expectancy (for example, *Ficus virens, Ficus microcarpa,* etc.). These trees are resistant to air pollution (Wen, et. al. 2004), clean the atmosphere, attract wildlife and reduce noise levels (Liu, 2002). They also form outstanding landmarks, especially at roadsides. In contrast, the current trend of tree planting in new urban districts focuses on visual and decorative aspects. The selected species are usually flowering and palm trees which have the habit of quick growth. However, they usually have a small to medium final size and a short lifespan. Many inappropriate exotic species are also often introduced to newly developed areas (Jim, 2001). |

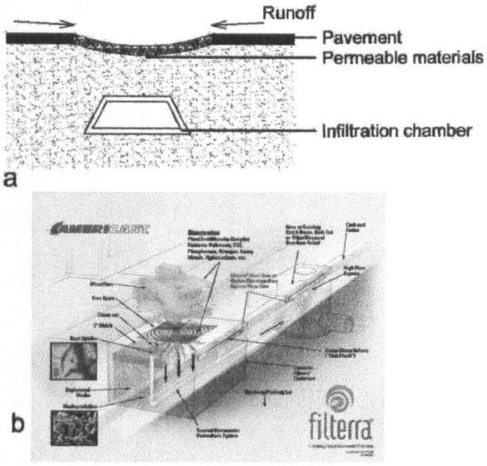
***Recommendation 16.*** Using pervious paving materials for parking areas and street shoulders;

***Recommendation 17.*** Replacing the curb and gutter system by opened channels, grassed swales or infiltration chambers;

***Recommendation 18.*** Planting street trees that are spaced no more than 10 meters apart along each street and in parking areas;

***Recommendation 19.*** Traditional street tree species, such as *Ficus virens, Ficus microcarpa*, etc. should be emphasized to use;




| ***Related recommendations*** | 13, 14, 21, 35 |
|---|---|

## Open space / Site planning

The goal of open space planning:
To maximize environmental benefits and to minimize adverse environmental impacts through open space design

**Indicator 7:**
% of open space is turf area
**Indicator 8**:
% of the open space is covered by native trees and plants
**Indicator 9:**
Open spaces for storm water management

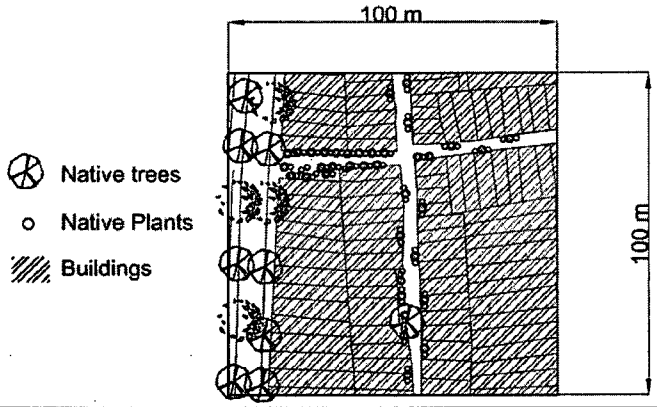
Environmental dimension

**Old districts**

Indicator 7:
Lawns are not planted in the old neighborhoods;

Indicator 8:
Over 50% of urban trees in the old districts are native species

Indicator 9:
Open spaces in the old neighborhoods do not serve in storm water management

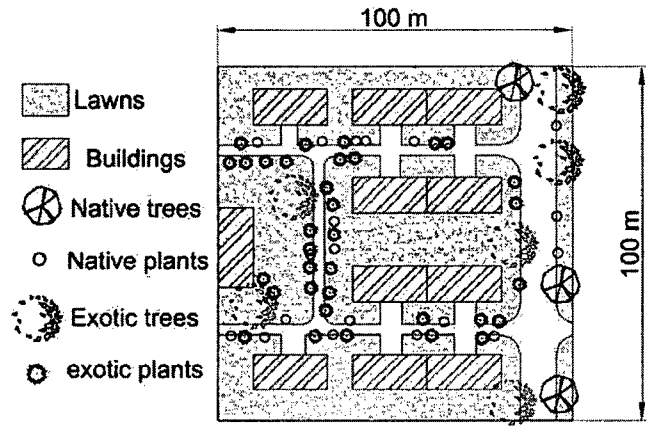



**New districts**

Indicator 7:
Lawns are popularly used in new residential communities

Indicator 8:
The current trend of tree planting in new urban neighborhoods focuses on visual and decorative aspects. Therefore many exotic species are introduced to newly developed areas

Indicator 9:
Open spaces in new urban neighborhoods do not serve in storm water management



## Recommendations

The goal of open space planning:
To maximize environmental benefits and to minimize adverse environmental impacts through open space design

Indicator 7:
% of open space is turf area

Indicator 8:
% of the open space is covered by native trees and plants

Indicator 9:
Open spaces for storm water management

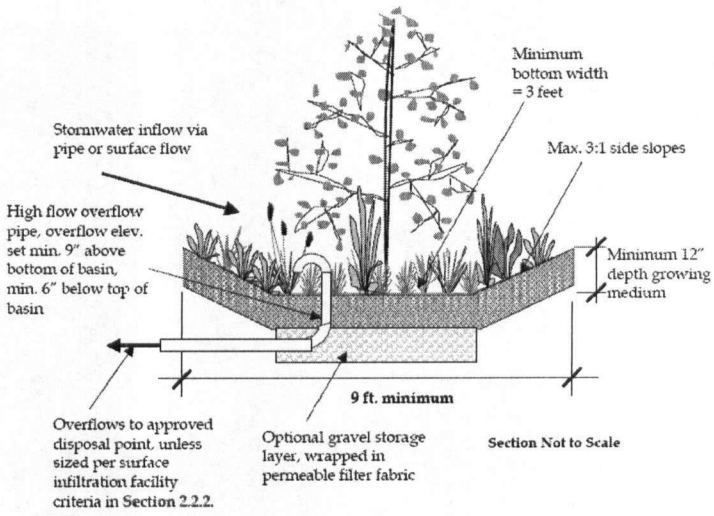
| | |
|---|---|
| Analysis | Open spaces both in old and new urban residential areas are unsuitable for storm water management. However, the planting tradition in the old urban areas tends to be more environmentally beneficial than does the planting in the new urban areas. First of all, lawns are seldom used in the old urban areas whereas in new residential areas, lawn planting is used to meet the construction code for neibourhood greening. Secondly, in the old urban areas, although the high building coverage leaves for little open land, native trees and plants with large canopies cover extensive areas of the site. Contrarily, in new urban areas, exotic flowering trees and plants with small canopies cover only a small portion of the site. |

***Recommendation 20.*** Maximizing using meadows and perennials rather than lawns;

***Recommendation 21.*** Maximizing planting native plants and trees;

***Recommendation 22.*** Designing bioretention-planting areas in neighborhoods to hold, infiltrate, and evaporate runoff;

***Recommendation 23.*** Using cisterns to store excess stormwater;




Vegetated infiltration basin
Source: City of Portland Bureau of Environmental Services. *Stormwater Management Manual.* July 1, 1999; Revised 2004

| | |
|---|---|
| ***Related recommendations*** | 13, 14, 15 |

## Building / Site planning

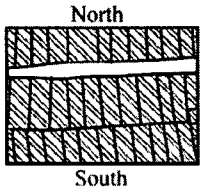
The goal of building design:
To reduce the building demands on energy and other associated pollution

**Indicator 10**:
Buildings are designed for natural cooling, warming and lighting (Y/N)

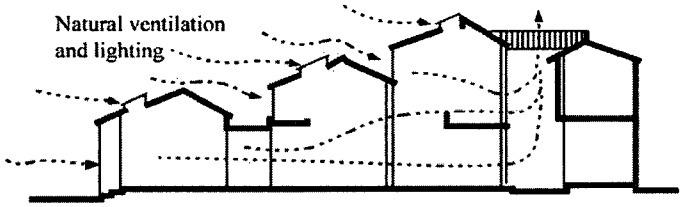
Environmental dimension

**Old district**

Indicator 10:
Natural cooling, warming, and lighting are provided in the traditional housing of Guangzhou.

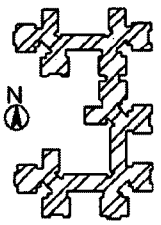


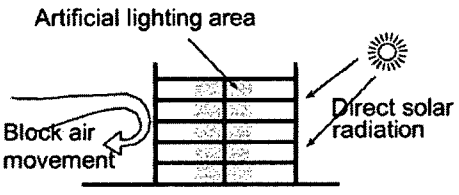

Closely packed buildings reduce the exposed surface areas to the solar radiation




**New districts**

Indicator 10:
Present architectural design largely dependents on artificial means to provide thermal comfort.



## Recommendations

The goal of Building design:
To reduce the building demands on energy and other associated pollution

Indicator 10:
Buildings are designed for natural cooling, warming and lighting

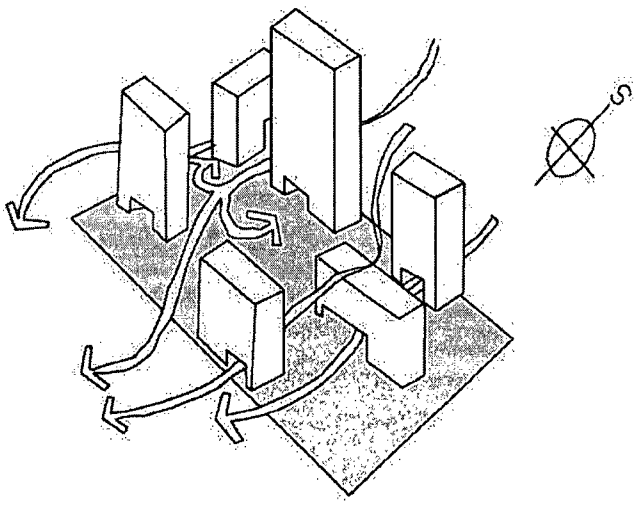
| | |
|---|---|
| Analysis | Guangzhou is located in the equatorial belt. A warm, humid climate dominates for most of the year. However, through appropriate building design and construction,, Guangzhou's traditional housing is able to provide thermal comfort despite external conditions. A closer investigation on the structure of traditional housing reveals several key points in the bioclimatic design of buildings in the Guangzhou region.<br><br>Most traditional houses are south-north orientated. Their west and east walls are closely connected to each other, with no windows. The layouts and openings of walls and roofs are designed to facilitate natural ventilation and natural lighting, and at the same time to prevent direct solar radiation.<br><br>Though contemporary housing is unable to copy this building form, means for attaining shade and air movement should be taken as primary consideration in architectural design. |

***Recommendation 24*** The main facades of buildings should face north and south with a tolerance of 30° to the east or west. Windows in facades should receive sun from the west with a tolerance of 30° and must have complete protection;

***Recommendation 25.*** Buildings should be arranged with variations in height, and staggered forms should be included in plans to channel breezes (Schiller and Evans, 1998);

***Recommendation 26.*** Open passages at ground level would help to direct breeze to the pedestrian level (Schiller and Evans, 1998);

***Recommendation 27.*** Buildings should have a shallow depth and carefully considered layout to allow cross ventilation and natural lighting;




| | |
|---|---|
| ***Related recommendations*** | 14, 16, 52, 53 |

## Land use / City region

The goal of land use planning:
To promote social integration instead of exclusion through urban land use planning

**Indicator 11**:
Services and employment locations are equally distributed within the built up area, allowing equality of physical access of all residents

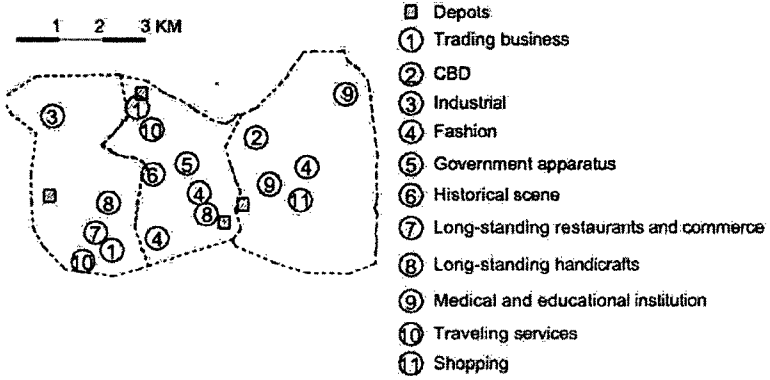
**Indicator 12**:
Diverse housing types for varying households (income, age, family composition) within neighborhood

Human dimension

Old districts

Indicator 11:
The old city has a multinucleate form so that everyone is able to live close to the services and jobs.

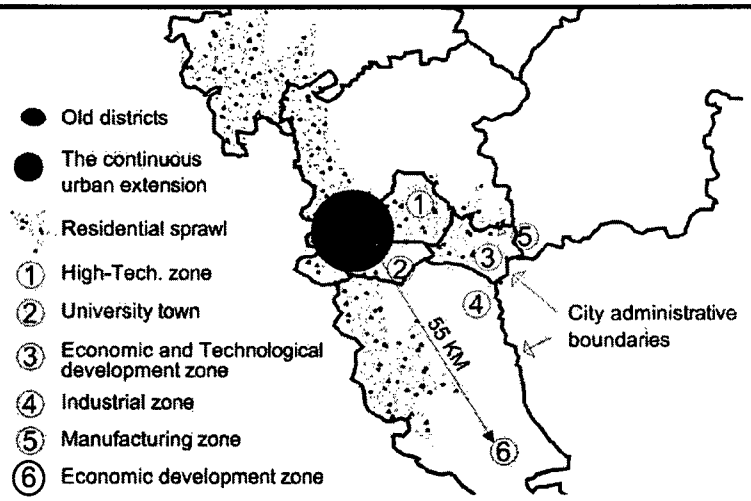
Indicator 12:
Households with different income, age, family composition all co-exist in the city's old districts.




New districts

Indicator 11:
In the present city, a single city function often occupies a large land area, forming different specialized zones. People's accessibility to city services and jobs vary.

Indicator 12:
Young people who can afford private cars are dominate in the new districts.



## Recommendations

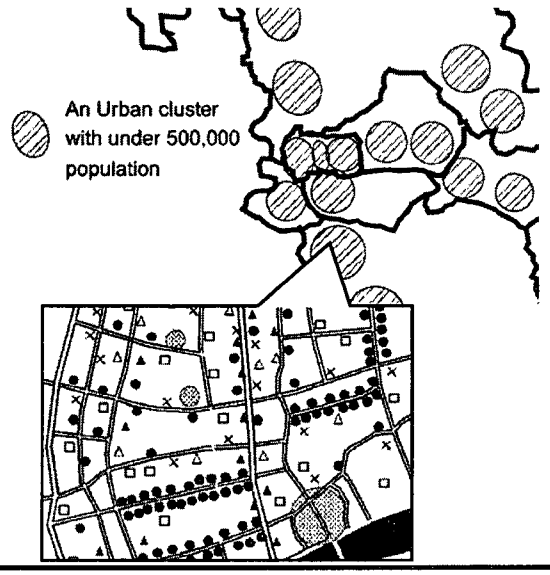
The goal of land use planning:
To promote social integration instead of exclusion through urban land use planning

Indicator 11:
Services and employment locations are equally distributed within the built up area, allowing equality of physical access of all residents

Indicator 12:
Diverse housing types for varying households (income, age, family composition)

| | |
|---|---|
| Analysis | "Land near the core is expensive; few people can live near enough to it to give them genuine access to the city's life; most people live far out from the core. To all intents and purposes, they are in the suburbs and have to more than occasional access to the city's life." (Alexander, et. al., 1977, p59) The above quote is an accurate portrayal of present-day Guangzhou. To best way to solve this problem, according to Alexander is to "decentralize the core to form a multitude of smaller cores, each devoted to some special way of life" i (Alexander, et. al., 1977, p59).<br>Historically, we will see that the old urban form of Guangzhou is in alignment with Alexander's ideas. The districts that make up the old city are thoroughly mixed in use, with high density. Therefore, on the macro scale, the city was made up of several core areas, each with their own unique identity. Internally, these core areas have a balanced land use including residential (40% to 50%), commercial (11% to 17%), institutional (5% to 19%), transport (12% to 22%), parks (7% to 16%), and light industrial (0.4% to 5%) (adapted form Jim and Liu, 2001).<br>The city's public facilities are all distributed along streets. Gradually, some streets have become specialized for serving the region for special purposes, while also serving smaller areas. These specialized areas are close to each other with transitions of mixed uses between them.<br>In addition, over the long term, the old urban districts have been redeveloped in terms of retrofitting or infilling and the government also subsidizes housing for low income families. The diversified housing types and the multinucleate urban form generate many alternative locations for housing, jobs, and services so that everyone is afforded access to urban life. |

***Recommendation 28***. Planning the city region to comprise of a whole series of urban cores;
***Recommendation 29***. Planning a core area with no more than 50% land for a single land use;
***Recommendation 30***. Controlling the population size of clustered urban areas to remain under 500,000 (refer to the population size of the old districts);
***Recommendation 31***. Planning the distribution of city level public facilities along major streets;
***Recommendation 32.*** Buildings along streets should be designed for mixed uses, therefore adaptable to changes;
***Recommendation 33***. The urban residential areas in a district should offer mixed housing types (one-person, couples, families with children and seniors);
***Recommendation 34***. Integrating government subsidized housing into market oriented neighborhoods;




| | |
|---|---|
| ***Related recommendations*** | 1, 2, 6, 39, 45, 47 |

## Circulation / City region

The goal of circulation planning:
To plan street networks in a city that facilitate movement

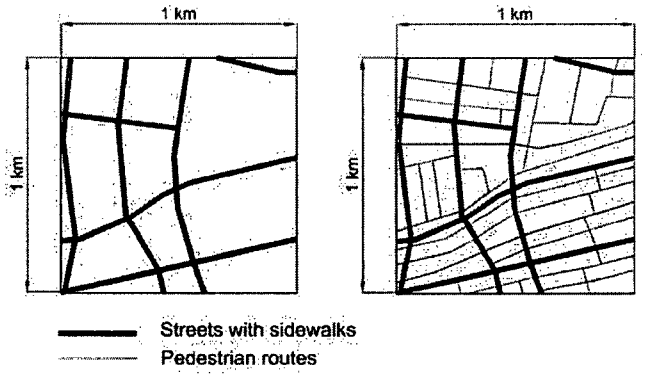
**Indicator 13**:
Well-interconnected vehicle street networks with short intervals (90 to 180 meters)
**Indicator 14**:
Well-interconnected pedestrian street networks with short intervals (less than 100 meters)

Human dimension

### Old districts

Indicator 13:
In the city's old districts, the intervals of street networks are between 200 to 800 meters. Traffic congestion is serious

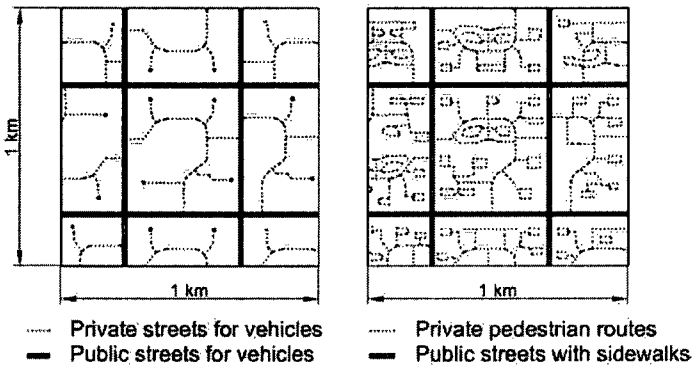
Indicator 14:
Numerous pedestrian paths running through street blocks form a dense pedestrian network overlay to the street network.




### New districts

Indicator 13:
In the city's new districts, the intervals of street networks are over 400 meters. Traffic congestion is serious.

Indicator 14:
Within each street block are private streets and pedestrian paths which are not connected to the streets and paths in other communities



## Recommendations

The goal of **circulation** planning:
To plan street networks in a city that facilitate movement

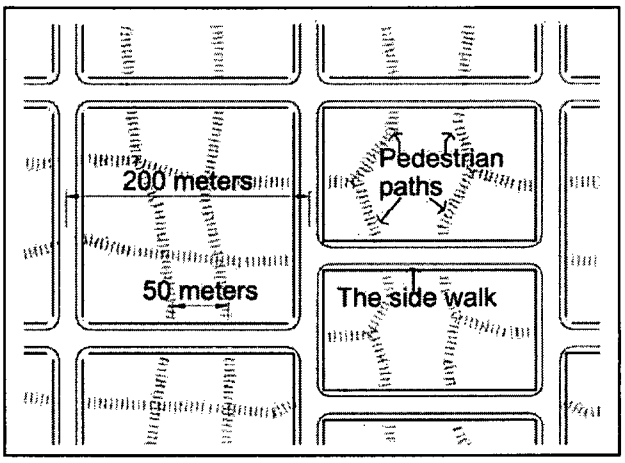
Indicator 13:
Well-interconnected vehicle street networks with short intervals
Indicator 14:
Well-interconnected pedestrian street networks with short intervals

| | |
|---|---|
| Analysis | The vehicle street networks in both the old and new districts are ineffective in evacuating traffic. In terms of pedestrian routes, the old district has pedestrian networks which are more efficient and better than the dendritic forms found in the new district.<br>As pedestrian traffic was the dominant mode of transportation in the past, less street coverage was required in the city's land use than it is in the present era. As automobiles become more important in people's daily lives, an increase in street capacity is therefore needed.<br>Instead of widening the street right-of-way and lengthening the street intervals, the most effective way to plan the street network is to maintain the street width as narrowly as possible but with denser the street intervals. This is because a dense and narrow street network with more intervals will mean that traffic volume will get dispersed among more streets, slowing traffic speed (due to more intersections and narrow street width), and saving travel time (due to the more direct trip distances and reduced traffic signal delays) (Condon, 2001). The grid street network is a popular pattern that was commonly used in ancient China as well as in North America. Generally speaking, in terms of accessibility (both duration of vehicle travel and frequency of transit use), legibility, and land use efficiency, the grid pattern has obvious superior qualities to other types of street networks (Condon, et. al., 2003; Southworth & Ben-Joseph, 1996). |

***Recommendation 35***. Planning a denser public street network with intervals of less than 200 meters to disperse traffic flow;

***Recommendation 36***. Maintaining the right-of-way of commercial and mixed-use streets within 32 meters;

***Recommendation 37***. Overlaying a public pedestrian path network on the street network with intervals of less than 50 meters;




| | |
|---|---|
| ***Related recommendations*** | 15, 16, 17, 18, 44, 45, 52 |

## Open space / City region

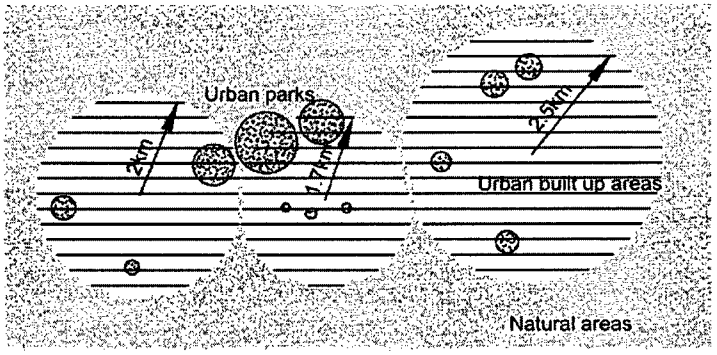
The goal of open space planning:
To increase the accessibility of urbanites to green open spaces

**Indicator 15**:
The distance from urban central areas to the urban natural areas
**Indicator 16**:
A park or open space within ¼ or ½ mile of all homes

Human dimension

### Old districts

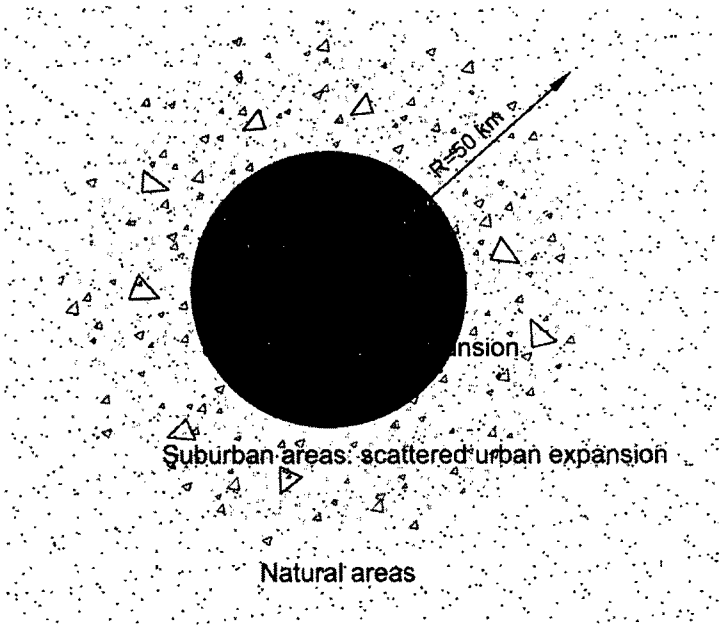
Indicator 15:
The old city form provides reasonable a distance from central urban areas to the access access point of natural areas.
Indicator 16:
The distribution of urban parks in the old districts are from 100 meters to 1,500 meters




### New districts

Indicator 15:
The distance from the central urban areas to the access point of natural areas is great in the present city. However, all the areas in the suburban regions can be considered to have better access to green wedges if well planned;

Indicator 16:
In the city's new districts, though public parks are barely planned, private community greens give residents better access to green open spaces, but they are often underused.



## Recommendations

The goal of open space planning:
To increase the accessibility of urbanites to green open spaces

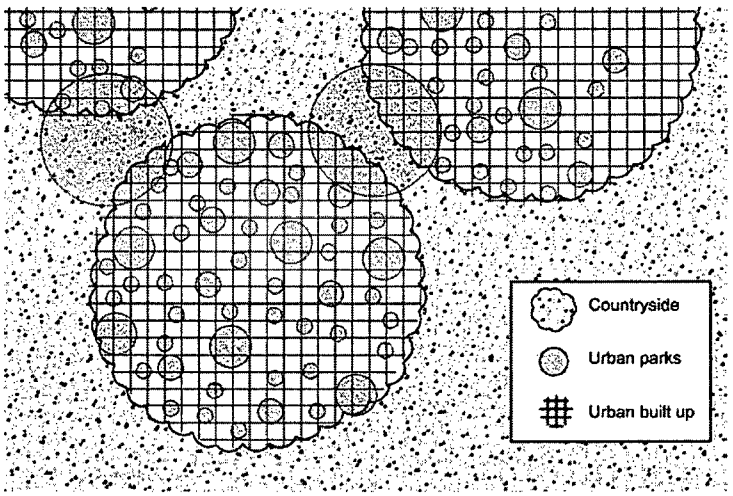
**Indicator 15**:
The distance from urban central areas to the urban natural areas

**Indicator 16**:
A park or open space within ¼ or ½ mile of all homes

| | |
|---|---|
| Analysis | As the city population growth rises , it seems inevitable that the average distance between people's homes and the countryside will continue to increase. However, developments of the past were well thought out. The hilly forest park which is connected to the mountain range to the north of the city, also has a dividing border with two adjancent districts. The natural green wedges in urban areas shorten the distance for urbanites to approach the countryside.<br>Regarding the distributional interval of open public greens, neither the old nor the present city form are well planned of successful. Due to the lack of neighborhood greens, residents in the old districts have to rely on 11 urban parks for providing green open spaces. They are popular spots with a continuous stream of local as well as regional visitors year round. However they are unevenly distributed with intervals that range from 100 meters to 1500 meters, so that many people have poor access to them.<br>There are only 3 public parks in the 7 new districts, but residents in the new districts have good access to private community greens as regulated by design and planning code. However, these community green areas are often underused because of community walls and gates rigidly restricting who has access to them (only residents in the community). This makes it inconvenient for people to arrange activities on these greens. |

***Recommendation 38***. Using preserved natural features such as forested hills, wetlands, river systems, farmlands, etc to divide urban core areas;

***Recommendation 39***. Building at least one small public green within three minutes' walk of every dwelling;




| | |
|---|---|
| ***Related recommendations*** | 1, 7, 8, 9, 10, 12 |

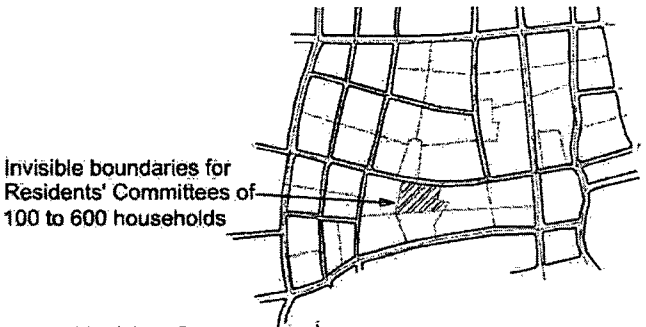
The goal of land use planning:
To facilitate individual participation in decision making

**Indicator 17**:
Neighborhoods are basic units of residential areas

Social dimension

Old districts

The Indicator 17:
Grassroots neighborhood unit of a Residential Committee is a basic unit of residential areas



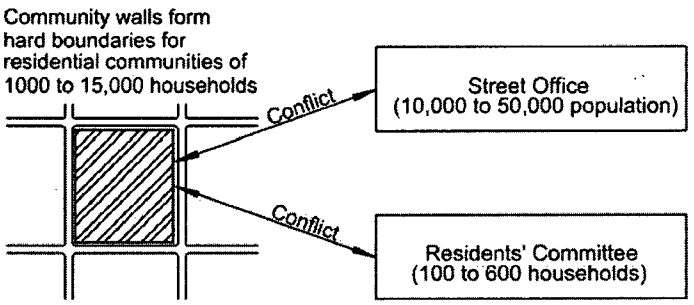

Municipal Government
District Government
Street Office
(10,000 to 50,000 pop.)
Residents' Committee
(100 to 600 hshd.)
Residents' Group
(10 to 15 households)
Individual household

Direct Administrative Structure

Mass organizations and local government dispatches working on principles of informal mutual help

New districts

Indicator 17:
New districts appear as a map of real-estate territories belonging to various companies. This system conflicts with grassroots neighbourhood social structures.



## Recommendations

The goal of land use planning:
To facilitate individual participation in decision making

Indicator 17:
Neighborhoods are basic units of residential areas

Analysis

Throughout China's history, grassroots organizations coordinated household registration, tax collection, local security and regulations, the mobilization of soldiers, and they functioned as essential social control mechanisms for stabilizing society [8]. Both the traditional Chinese and socialist ideological philosophies conceive the individual to be primarily a member of a network of groups (Li, 1979). Based on this tradition, since 1954, neighbourhood Street Offices as local government dispatches, have been set up throughout cities in China. Street Offices organize households into Residential Committees within their administrative areas. These Residential Committees provide community services specifically to promote the various forms of non-profit, mutual-help services such as conflict mediation, political education, grassroots feedback, assistance to families in need, collective cleaning of common areas, and informal care for the needy and the destitute (Chan, 1993). These activities in turn help build interpersonal ties and build a considerable sense of community. In China's context, they are believed to be viable grassroots structures for welfare delivery as well as for crime prevention (Bartlett and Phillips, 1997; Chen, 2002).

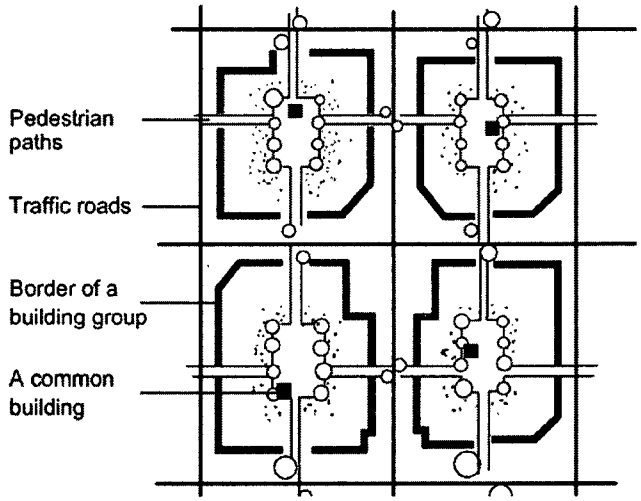
Formerly residents of the city participated in a neighborhood decision making process within their work unit compounds. To facilitate this local cultural tradition, visually identifiable neighbourhoods with communal places need to be developed.

***Recommendation 40***. Arrange buildings to form clusters of 100 to 600 households (a population size of a Residents' Committee);

***Recommendation 41***. Clearly define the border of the clustered buildings but do not block the general access to the land;

***Recommendation 42***. Keep major roads outside these neighborhoods;

***Recommendation 43***. Place a residents' committee office, a day care, or a playground in the center of the neighborhoods;




| ***Related recommendations*** | 15, 44, 45, 49, 50 |
|---|---|

[8] For example, the Ming and Qing Dynasties adopted a neighbourhood and village (*xiang li*) system. A hundred households were formed into a *li*, for whom a leader responsible for civil affairs, education, local security and tax collection was appointed (Chan, 1993)

## Circulation / Site planning

The goal of circulation planning:
To design high quality streets in order to increase street activities

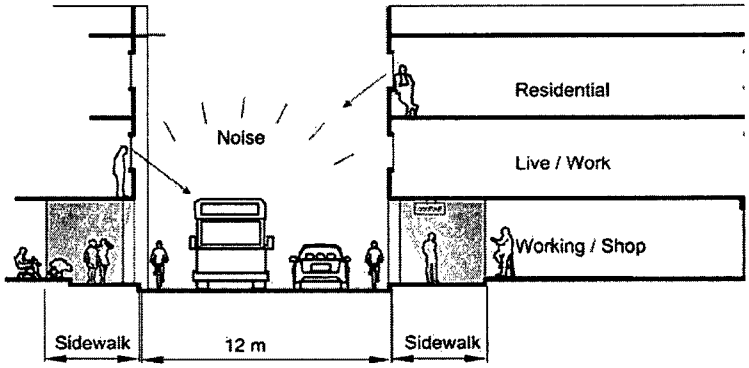
**Indicator 18**:
Protection from weather conditions (Y/N)
**Indicator 19**:
Protection from vehicular traffic (Y/N)
**Indicator 20**:
Safety from crime

Social dimension

### Old districts

Indicator 18:
Streets in old neighbourhoods have full protection from adverse weather conditions;

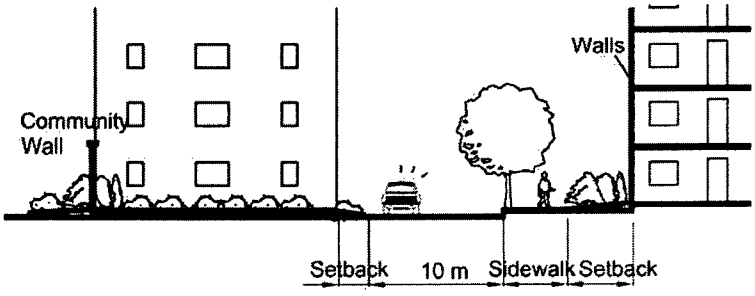
Indicator 19:
Vehicle congested streets in old neighbourhoods;
Indicator 20:
High level of social surveillance in old neighbourhood streets;




### New districts

Indicator 18:
Streets in new urban areas are not protected from adverse weather conditions;

Indicator 19:
Light traffic flow in streets of new residential communities;
Indicator 20:
Low level of social surveillance in new residential community streets;



## Recommendations

The goal of circulation planning:
To design high quality streets in order to increase street activities

Indicator 18:
Protection from weather conditions (Y/N)
Indicator 19:
Protection from vehicular traffic (Y/N)
Indicator 20:
Safety from crime

Analysis

According to indicator 18, the streets in new residential communities do not perform to the level of those in old neighbourhoods. Due to the small size of tree species and large building setbacks, streets in new residential communities are exposed to frequent alternations of scorching sunshine and sudden heavy showers. These types of climatic conditions are distinct weather features in the Guangzhou region. In contrast, streets in the old urban areas are covered by colonnade buildings and dense crown evergreen trees provide full canopy coverage to the streets.

According to indicator 19, the streets in new residential communities have similar performance to those in old urban areas. Although vehicle volumes in the old neighbourhoods are much higher than those in new residential communities (through traffic is not allowed to enter through walls and gates), colonnades provide full protection for pedestrians and the narrow street right-of-way (12 meters) limits the speed of traffic.

According to indicator 20, the streets in old neighbourhoods perform much better than those in new residential communities. Streets in old neighbourhoods are defined by residential and commercial mixed use buildings which have shops and other public facilities on their ground floors. The continuous doorways and windows onto the street level provide for a high level of social surveillance. In contrast, buildings in new residential communities are purposefully designed not to face onto the street, therefore neglecting to provide social77 surveillance. Moreover the community streets are not publicly accessible, making it impossible to integrate other urban activities such as social and commercial encounters and exchanges. As a result, they are often underused. The absence of passers-by further weakens the sense of security from street crime.

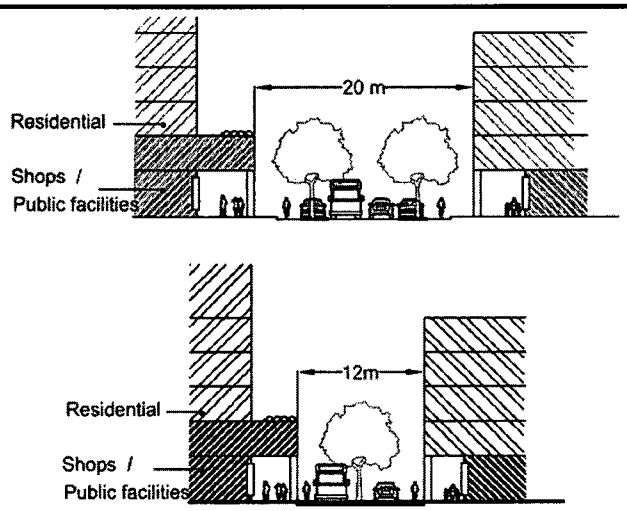
***Recommendation 44***. Maintaining residential streets within 12 to 20 meters;

***Recommendation 45***. Planning residential streets to be publicly accessible;

***Recommendation 46***. Minimizing building setbacks and planning for windows and doors to face directly onto streets;

***Recommendation 47***. Allowing the ground level of residential buildings for commercial and other public uses to create social surveillance;

***Recommendation 48***. Using colonnades to cover streets




| *Related recommendations* | 18, 32, 35, 36, 37, 52, 53, 54, 55, 56, 57 |
|---|---|

## Open space / Site planning

The goal of open space planning:
To design open spaces for outdoor activities

**Indicator 21**:
Neighborhood common land (Y/N)
**Indicator 22**:
Protection from weather conditions for outdoor social activities
**Indicator 23**:
Protection from vehicular traffic
**Indicator 24**:
Level of social surveillance

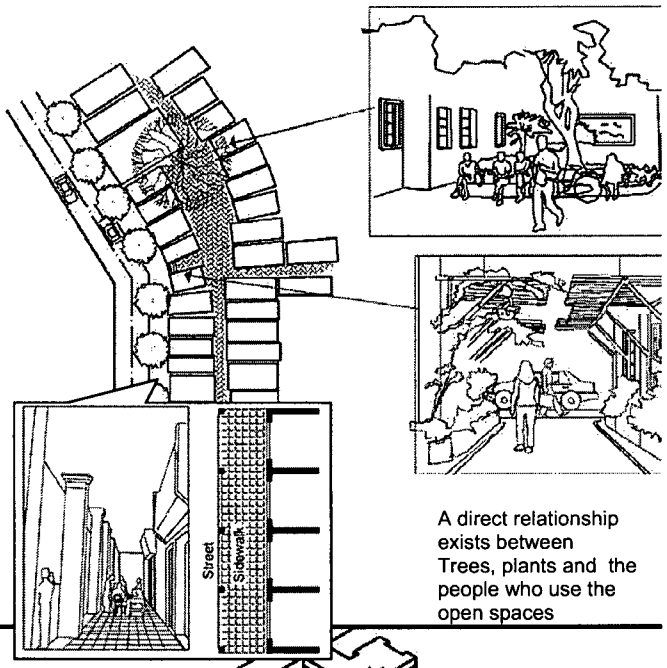
Social dimension

**Old districts**

Indicator 21:
The high building coverage in old neighbourhoods minimizes the potential for neighbourhood communal spaces;

Indicator 22:
Buildings, plants and trees are all means to provide shelter from direct solar radiation and sudden showers;
Indicator 23
Street sidewalks are protected by colonnades. Inside street blocks are pedestrian-only areas;

Indicator 24
Doorways, windows, and frequent passers-by add eyes on streets, providing for a greater degree of social surveillance and collective responsibility;



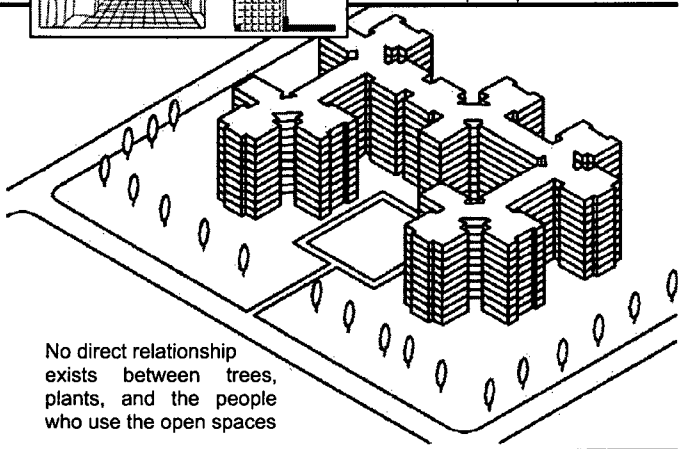

A direct relationship exists between Trees, plants and the people who use the open spaces

**New districts**

Indicator 21:
High-rise apartments standing in open spaces lack clearly defined common areas;

Indicator 22:
Lack of shaded areas for outdoor activities;
Indicator 23:
Light traffic flows passing through open spaces;

Indicator 24:
Under-used open spaces lack social surveillance;



No direct relationship exists between trees, plants, and the people who use the open spaces

## Recommendations

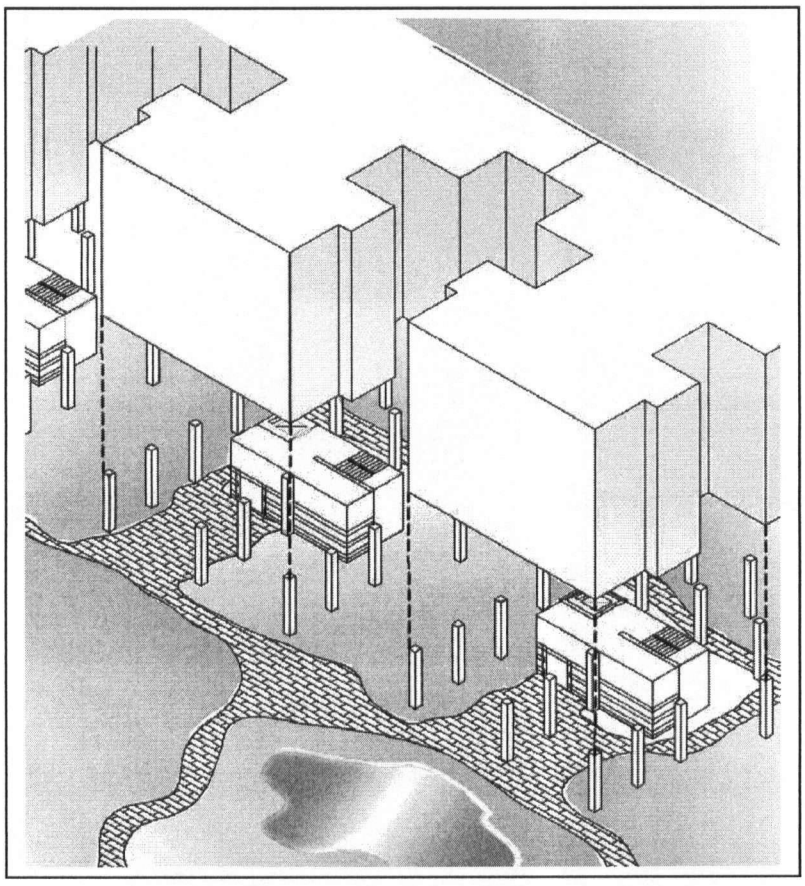
The goal of open space planning:
To design open spaces for outdoor activities

Indicator 21:
Neighborhood common land
Indicator 22:
Protection from weather conditions for outdoor activities
Indicator 23:
Protection from vehicle traffic
Indicator 24:
Level of social surveillance

| | |
|---|---|
| Analysis | In the city's old neighbourhoods, public space is defined by continuous street frontages. Therefore, streets in the old neighbourhoods also serve as open spaces. Their good performance on indicators 22, 23, and 24 have been demonstrated on page 84.<br>In new residential communities, the performance of open spaces as per indicators 22 and 24, yield to the performance of those in the old neighbourhoods. First of all, plants and trees in new communities are planted for visual effect. They are seldom planned in order to provide shade and shelter for people who use the open spaces. Secondly, the spacious distances between high-rises leaves the open space unsupervised by natural surveillance. The gates and walls discourage residents in the community from walking outside and also render it impossible for outsiders to pass through the open spaces. A lack of passers-by further weakens the sense of security.<br>With regard to indicator 23, open spaces in the new districts are comparable to old neighbourhoods. In new communities, pedestrians in open spaces are protected from traffic by walls and gates which exclude through-traffic, while in old neighbourhoods, pedestrians are protected by colonnade buildings.<br>According to indicator 21, both new and old neighbourhoods perform poorly according to this indicator. The high building coverage in old neighbourhoods minimizes the potential for defining neighbourhood communal spaces. Open spaces in new residential communities are characterized by highrise apartments standing in open spaces. This also results in a lack of clearly defined neighbourhood communal land. |

***Recommendation 49***. Arrange buildings around a landscaped open space;
***Recommendation 50.*** Exclude traffic from neighbourhood open spaces;
***Recommendation 51***. Open parts of the buildings at ground level to provide roofed open spaces (Figure on page 90);
***Recommendation 52***. Select trees with large canopies to provide shade;
***Recommendation 53***.Plant trees and shape buildings in response to each other to form enclosures, avenues, groves, and umbrellas so that people can use these places;

| | |
|---|---|
| ***Related recommendations*** | 26, 40, 42, 54, 55, 56, 57 |



## Building / Site planning

The goal of building design:
To encourage people and social activities to move from the private to the public environment

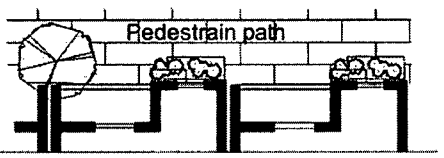
**Indicator 25**:
Stopping and resting places on the public side of buildings

Social dimension

Old districts

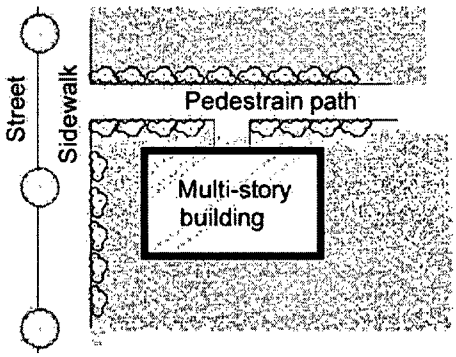
Guangzhou's traditional housing has soft building edges, providing good possibilities for stopping and resting on the public side of houses

A small terrain and flower beds extent the indoor life to the public side of buildings




New districts

Edges of new residential buildings are not designed for stopping or resting.




Contemporary buildings have sharply demarcated borders

| Recommendations | |
|---|---|
| The goal of building design:<br>To encourage people and social activities to move from the private to the public environment | |
| Indicator 25:<br>Stopping and resting places on the public side of buildings | |
| Analysis | Guangzhou's traditional housing provides better opportunities for stopping and resting on the public side of the houses than newly designed residential buildings.<br>Guangzhou's traditional housing was often built directly beside pedestrian alleys. Their doorways were slightly withdrawn to one or two meters from the building walls, forming small terrains. Due to the hot and humid climate, residents often open their doors and the small semi-public terrain serves as a transitional zone between the public and the private. Children run and play in the lanes and buy their favourite foods in the streets. Women safeguard their children through the opened doors. Families have dinner at doorways.<br>In contrast, present residential buildings all have a minimum setback of 2 to 5 meters from the streets and lanes as recommended by the code of urban residential area planning and design. Formal beds of flowers and plants cut off the connection of buildings to the public spaces. |
| ***Recommendation 54***. Allow buildings being built right up to paths (Alexander, 1997; Condon, et. al., 2003);<br>***Recommendation 55***. Provide a yard in front of dwelling entrances on the ground floor;<br>***Recommendation 56***. Each upstairs unit should be provided with a balcony;<br>***Recommendation 57***. Design rest areas in front of each building entrance; | |
| ***Related recommendations*** | 26, 44, 46, 47, 48, 51, 53 |

## 3.6 Chapter summary

In summary, the 25 indicators have been used to evaluate and analyze both Guangzhou's old and current city forms, generating 57 recommendations for the development of a more sustainable urban form for the City of Guangzhou. The recommendations and indicators are summarized below.

Table 3-4: Summary of recommendations

| Related recommen -dations | Recommendations (1 ~ 19) | Indicators (1 ~ 6) |
|---|---|---|
| 7, 9, 10 | ***Recommendation* 1:** Urban growth boundaries should be set for districts to preserve land resources; | **1.** Policy and legal structures encourage compact development and limit outward sprawl |
| 28, 29, 35<br>37, 45, 47 | ***Recommendation* 2.** All the urban built up areas should be transit accessible; | **2.** Maximum length of daily journey |
| | ***Recommendation* 3.** Each district should develop their own mixed-use urban core areas; | |
| | ***Recommendation* 4.** Each of the urban cores should be planned to contain a minimum population of 300,000; | |
| | ***Recommendation* 5.** The urban clusters of the city should be connected by express railway systems; | |
| | ***Recommendation* 6.** A minimum population density of 100 persons per hectare plus employment is highly recommended for developing a valid subway system (Olsen, 2004); | |
| 1, 18, 20,<br>21, 38, 39 | ***Recommendation* 7.** Plan urban ecological infrastructure before urban land use plan; | **3.** The existence of very large nodes of habitat and unbroken corridors |
| | ***Recommendation* 8.** Preserve important habitat patches such as urban parks; | |
| | ***Recommendation* 9.** Protect the forested area in the north from heavy urban development and safeguard clean fresh water resources; | |
| | ***Recommendation* 10.** Protect the farmlands and stream networks in the south; | |
| | ***Recommendation* 11.** Establish, preserve, or restore urban green corridors to connect natural habitat patches; | |
| | ***Recommendation* 12.** Restore riparian habitat along Pearl River watersides; | |
| 7, 16, 17,<br>20, 21, 22,<br>23 | ***Recommendation* 13.** Minimize building coverage and impervious pavement on land surface (no more than 70%); | **4.** Zero stormwater directly discharged through pipes to downstream |
| | ***Recommendation* 14.** Maximize usage of green roofs; | |
| | ***Recommendation* 15.** Maintain the original topography of the land; | |
| 13, 14, 21,<br>35 | ***Recommendation* 16.** Use pervious paving materials for parking areas and street shoulders; | **5.** Streets serve both as a corridor system to capture and to infiltrate storm water<br><br>**6.** A mature tree canopy coverage to roadways and parking areas |
| | ***Recommendation* 17.** Replace the curb and gutter system with open channels, grassed swales or infiltration chambers; | |
| | ***Recommendation* 18.** Plant street trees that are spaced no more than 10 meters apart along each street and in parking areas; | |
| | ***Recommendation* 19.** Traditional street tree species, such as *Ficus virens, Ficus microcarpa*, etc. should be emphasized for use; | |

Table 3-4 (cont.)

| Related Recommen -dations | Recommendations (20 ~ 37) | Indicators (7 ~ 14) |
|---|---|---|
| 13, 14, 15 | ***Recommendation 20.*** Maximize the use of meadows and perennials rather than lawns; | **7.** % of open space is turf area |
| | ***Recommendation 21.*** Maximize planting native plants and trees; | **8.** % of the open space is covered by native trees and plants |
| | ***Recommendation 22.*** Design bio-retention planting areas in neighbourhoods to hold, infiltrate, and evaporate runoff; | **9.** Open space for stormwater management |
| | ***Recommendation 23. Recommendation 23.*** Using cisterns to store excess stormwater; | |
| 14, 16, 52, 53 | ***Recommendation 24.*** Main facades of buildings should face north and south with a tolerance of 30° to the east or west. Windows in facades receiving sun from the west with a tolerance of 30° must have complete protection; | **10.** Buildings are designed for natural cooling, warming and lighting conditions |
| | ***Recommendation 25.*** Buildings should be arranged with variations in height, staggered forms in order to channel breezes (Schiller and Evans, 1998); | |
| | ***Recommendation 26.*** The open passages at ground level will help direct breeze to the pedestrian level (Schiller and Evans, 1998); | |
| | ***Recommendation 27.*** Buildings should have sallow depth and carefully considered layout to allow cross ventilation and natural lighting; | |
| 1, 2, 6, 39, 45, 47 | ***Recommendation 28.*** Plan the city region, which is comprised of a whole series of urban cores; | **11.** Services and employment locations are equally distributed within the built up area, allowing equality of physical access of all, residents<br><br>**12.** Diverse housing types for varying households (income, age, family composition) |
| | ***Recommendation 29.*** Plan a core area with no more than 50% land for a single land use; | |
| | ***Recommendation 30.*** Control the population size of a clustered urban area to be under 500,000 (refer to the population size of the old districts); | |
| | ***Recommendation 31.*** Plan the distribution of city level public facilities along major streets; | |
| | ***Recommendation 32.*** Buildings along streets should be allowed for mixed uses, therefore adaptable to changes; | |
| | ***Recommendation 33.*** The urban residential areas in a district should offer mixed housing types (one-person, couples, families with children and senior people); | |
| | ***Recommendation 34.*** Integrate government subsidized housing into market oriented neighbourhoods; | |
| 44, 45 | ***Recommendation 35.*** Plan a denser public street network with intervals of less than 200 meters to disperse traffic flow; | **13.** Well-interconnected vehicle street networks with short intervals<br><br>**14.** Well-interconnected pedestrian street networks with short intervals |
| | ***Recommendation 36.*** Maintain the right-of-way of commercial and mixed-use street within 32 meters; | |
| | ***Recommendation 37.*** Overlay a public pedestrian path network on the street network with intervals of less than 50 meters; | |

Table 3-4 (cont.)

| Related Recommen -dations | Recommendations (38 ~ 57) | Indicators (15 ~ 14) |
|---|---|---|
| 1, 7, 8, 9, 10, 12 | ***Recommendation 38***. Use preserved natural features such as forested hills, wetlands, river systems, farmlands, etc. to divide urban core areas; | **15.** The distance from urban central areas to the urban natural areas |
| | ***Recommendation 39***. Build at least one small public green within three minutes' walk of every dwelling; | **16.** A park or open space within ¼ to ½ mile of all homes |
| 15, 44, 45, 49, 50 | ***Recommendation 40***. Arrange buildings to form clusters of 100 to 600 households (the population size of a Residents' Committee); | **17.** Neighborhoods are basic units of residential areas |
| | ***Recommendation 41***. Clearly define the border of the clustered buildings but do not block general access to the land; | |
| | ***Recommendation 42***. Keep major roads outside these neighbourhoods; | |
| | ***Recommendation 43***. Place a Residents' Committee office, a day care, or a playground in the center of the neighbourhoods; | |
| 18, 32, 35, 36, 37, 52, 53, 54, 55, 56, 57 | ***Recommendation 44***. Maintain residential streets within 12 to 20 meters; | **18:** Protection from weather conditions<br>**19:** Protection from vehicular traffic<br>**20:** Level of social surveillance |
| | ***Recommendation 45***. Plan residential streets to be publicly accessible; | |
| | ***Recommendation 46***. Minimize building setbacks and planning for directly open windows and doors onto streets; | |
| | ***Recommendation 47***. Allow the ground level of residential buildings for commercial and other public uses; | |
| | ***Recommendation 48***. Use colonnades to cover street sidewalks; | |
| 42, 40, 26, 54, 55, 56 57 | ***Recommendation 49***. Arrange buildings around a landscaped open space; | **21.** Neighbourhood common land<br>**22.** Protection from weather conditions<br>**23.** Protection from vehicular traffic<br>**24.** Level of social surveillance |
| | ***Recommendation 50.*** Exclude traffic from neighbourhood open spaces; | |
| | ***Recommendation 51***. Open parts of buildings ground level to provide roofed open spaces; | |
| | ***Recommendation 52***. Select trees with large canopies to provide shade; | |
| | ***Recommendation 53***.Plant trees and shaping buildings in response to each other to form enclosures, avenues, groves, and umbrella, etc., so that people can use these places; | |
| 26, 44, 46, 47, 48, 51, 53 | ***Recommendation 54***. Minimize building setbacks; | **25:** Stopping and resting places on the public side of buildings |
| | ***Recommendation 55***. Provide a front yard in front of ground floor dwelling entrances; | |
| | ***Recommendation 56***. Each upstairs unit should be provided with a balcony; | |
| | ***Recommendation 57***. Provide a rest area in front of each building entrance; | |

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**4. Conclusion and evaluation**

This chapter will gather the recommendations from the preceding chapter with the purpose of assembling an overall picture of what a sustainable Guangzhou City could look like. The referenced recommendation numbers are indicated in brackets. An overall evaluation of the recommendations by the indicators is also made in this document.

**4.1 The city region** (Figure 4-1)

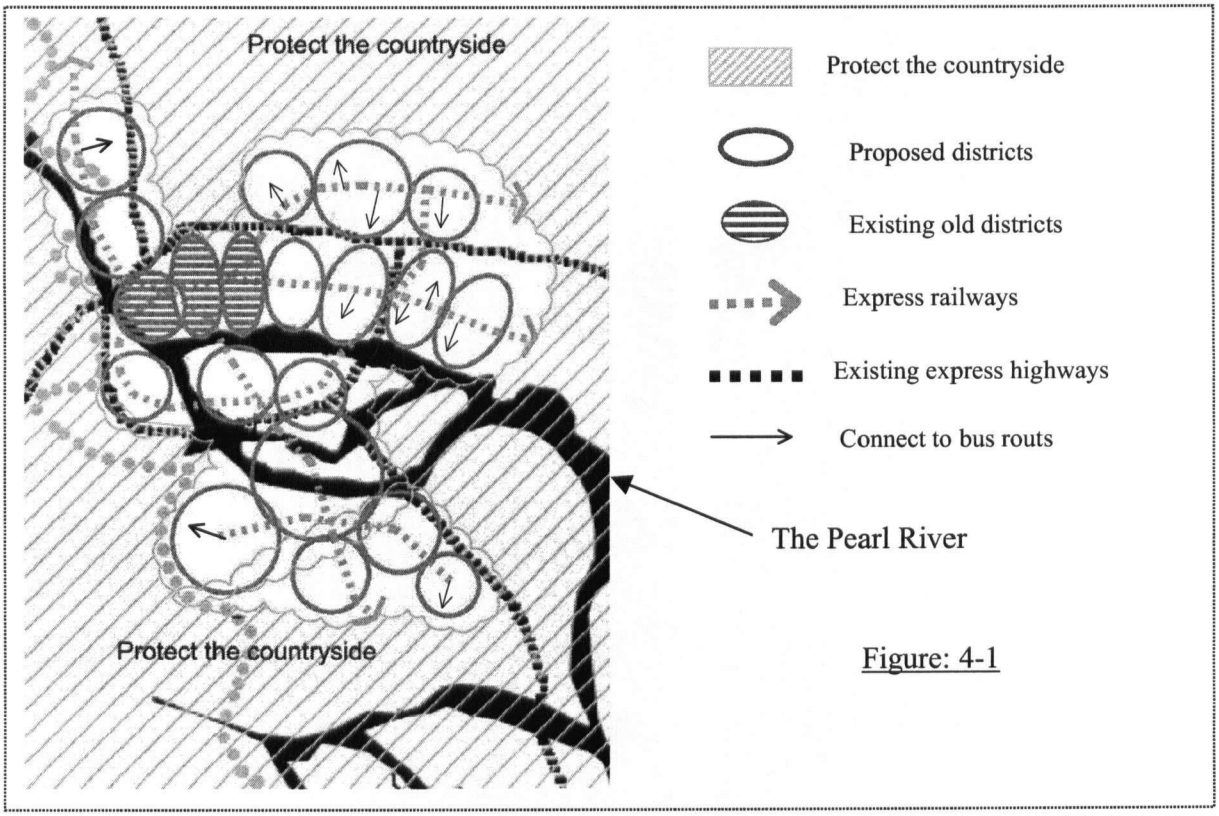


Figure: 4-1

Many famous ancient cities in China have changed their location several times during their long histories. For example, the location of present-day Beijing is no longer where it was in the Yuan dynasty (1271-1368). A similar displacement happened to the ancient city of Xian. Urban development in Guangzhou has changed considerably over its 2800 year history, and new districts have evolved surrounding the original site.

The development of the city of Guangzhou should conform to the traditional urban form that is comprised of a series of urban clusters (3, 28). Each urban cluster is highly compact with mixed land uses to support populations of 300,000 to 500,000 people (4, 6, 29, 30). As the urban population grows, more urban clusters are developed. They are set apart from each other by green fingers such as forests, wetlands, farmlands, and green corridors, etc. (1, 7, 8, 9, 10, 11, 12, 38), but are well connected to each other by a convenient public transportation system (5). In this way, the city maintains its identity as a whole.

Individual urban clusters within the city region follow the urban tradition of Guangzhou by developing multiple centers which are typically comprised of several commercial and mixed use streets (31, 36). These centers may have a general catchment range while also serving the entire city region for special purposes.

Residential areas are composed of small building groups (40) rather than large and standardized residential communities, and are connected by an all-encompassing street network (44, 45, 47). Such small cells facilitate the incremental formation of a development parcel. The flexibility not only allows for projects of various sizes to suit the different capacities of real-estate developers, but also encourages diverse housing types and varied social characters (32, 33, 34). Though these urban areas are developed for high density, traffic congestion will rarely occur (2, 35) and everyone is close the nature (39).

**4.2 Urban cells** (Figure 4-2)

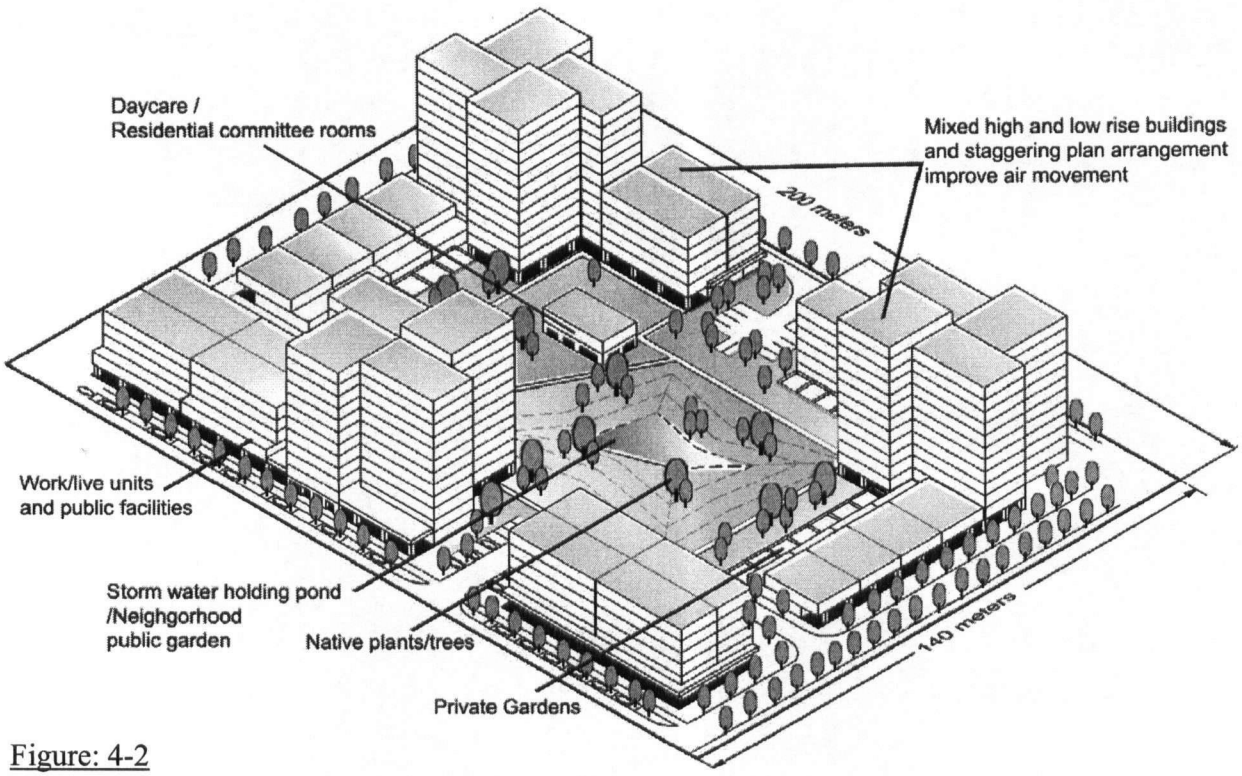


Figure: 4-2

The residential cells in the urban area are less than 4 hectares (35). Public facilities are found on the edges of the residential cells and open onto public streets where colonnades are used to create a continuous frontage and give shelters to the streets (44, 48,). The colonnade buildings also mark the borders of the residential cells, providing a sense of privacy to the group of the buildings while at the same time providing four season public spaces for chance encounters among residents who live in either the same or different residential cells (41, 46, 47).

Although vehicles are not allowed to pass through the residential cells (42) pedestrians have free access (37) (Figure 4-3). Due to the presence of a flexible choice for services, free

social contact across residential cells, and the provision of numerous alternative routes, driving is largely reduced and is replaced by pedestrian activity.

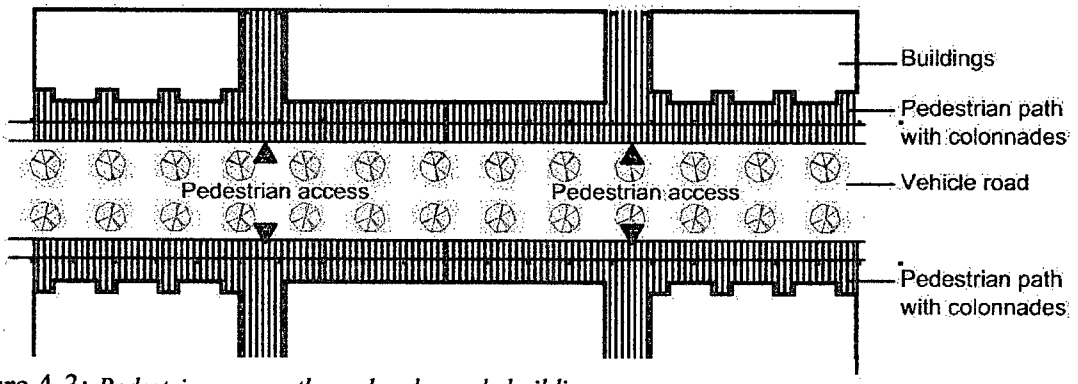


Figure 4-3: *Pedestrian access through colonnade buildings*

Each of the residential cells has a traffic-free common land (49, 50) where neighbours often stop to greet each other and chat (54, 55, 57). Shade and light breezes attract senior residents and small children to spend most of their time outside (25, 26, 52, 53), and collective activities frequently take place despite the weather conditions (43, 51). The experience of outdoor spaces as belonging to a social group results in greater degrees of surveillance and collective responsibility for the public space and its residents.

The residential cells also become learning grounds for residents to gain knowledge about their natural environment. Lush trees and plants which require little maintenance clean the air and stormwater, provide shade, and attract wildlife, which lives harmoniously alongside the human population (18, 19, 20, 21). Buildings are naturally conditioned and their windows are kept open to receive the fresh natural breezes (24, 25, 27). When the rainy season arrives, flooding is unlikely because the bulk of the rainwater is absorbed by soil, plants, and trees (13, 14, 15, 16) and runoff flows through grassed swales (17) then collected in ponds where further filtration, evaporation, and cleaning take place (22). When the ponds gradually fill, cisterns collect excess rainwater for watering plants and trees during the dry season (23).

## 4.3 Evaluating recommendations by indicators

Table 4-1: Evaluating recommendations: (■ indicates a direct benefits to the indicator)

| | Indicator 1 | Indicator 2 | Indicator 3 | Indicator 4 | Indicator 5 | Indicator 6 | Indicator 7 | Indicator 8 | Indicator 9 | Indicator 10 | Indicator 11 | Indicator 12 | Indicator 13 | Indicator 14 | Indicator 15 | Indicator 16 | Indicator 17 | Indicator 18 | Indicator 19 | Indicator 20 | Indicator 21 | Indicator 22 | Indicator 23 | Indicator 24 | Indicator 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Recommendation* 1:** Urban growth boundaries should be set for districts to preserve land resources; | ■ | | ■ | | | | | | | | ■ | | | | ■ | | | | | | | | | | |
| ***Recommendation 2.*** All the urban built up areas should be transit accessible; | | ■ | | | | | | | | | ■ | | | | | | | | | | | | | | |
| ***Recommendation 3.*** Each district should develop their own mixed-use urban core areas; | | ■ | | | | | | | | | | | | | | | | | | | | | | | |
| ***Recommendation 4.*** Each of the urban cores should be planned to contain a minimum population of 300,000; | | ■ | | | | | | | | | | | | | | | | | | | | | | | |
| ***Recommendation 5.*** The urban clusters of the city should be connected by express railway systems; | | ■ | | | | | | | | | | | | | | | | | | | | | | | |
| ***Recommendation 6.*** A minimum population density of 100 persons per hectare plus employment is highly recommended for developing a valid subway system (Olsen, 2004); | | ■ | | | | | | | | | ■ | | | | | | | | | | | | | | |
| ***Recommendation 7.*** Planning urban ecological infrastructure before urban land use planning; | ■ | | ■ | ■ | | | | | | | | | | | ■ | ■ | | | | | | | | | |
| ***Recommendation 8.*** Preserving important habitat patches such as urban parks; | | | ■ | | | | | | | | | | | | ■ | ■ | | | | | | | | | |
| ***Recommendation 9.*** Protecting the forested area in the north from heavy urban development and safeguarding clean fresh water resources; | ■ | | ■ | | | | | | | | | | | | ■ | | | | | | | | | | |
| ***Recommendation 10.*** Protecting the farmlands and stream networks in the south; | ■ | | ■ | | | | | | | | | | | | ■ | | | | | | | | | | |
| ***Recommendation 11.*** Establishing, preserving, or restoring urban green corridors to connect natural habitat patches; | | | ■ | | | | | | | | | | | | | | | | | | | | | | |
| ***Recommendation 12.*** Restoring riparian habitat along Pearl River watersides; | | | ■ | | | | | | | | | | | | ■ | | | | | | | | | | |
| ***Recommendation 13.*** Minimizing building coverage and impervious pavement on land surface (no more than 70%); | | | | ■ | | | ■ | ■ | ■ | | | | | | | | | | | | | | | | |
| ***Recommendation 14.*** Maximizing usage of green roofs; | | | | | | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | |
| ***Recommendation 15.*** Maintaining the original topography of the land; | | | | ■ | | | | | ■ | | | | | | | | ■ | | | | | | | | |

Table 4-1: (cont.)

| | Indicator 1 | Indicator 2 | Indicator 3 | Indicator 4 | Indicator 5 | Indicator 6 | Indicator 7 | Indicator 8 | Indicator 9 | Indicator 10 | Indicator 11 | Indicator 12 | Indicator 13 | Indicator 14 | Indicator 15 | Indicator 16 | Indicator 17 | Indicator 18 | Indicator 19 | Indicator 20 | Indicator 21 | Indicator 22 | Indicator 23 | Indicator 24 | Indicator 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Recommendation 16.*** Using pervious paving materials for parking areas and street shoulders; | | | | ■ | | ■ | | | | ■ | | | | | | | | | | | | | | | |
| ***Recommendation 17.*** Replacing the curb and gutter system with open channels, grassed swales or infiltration chambers; | | | | ■ | | ■ | | | | | | | | | | | | | | | | | | | |
| ***Recommendation 18.*** Planting street trees that are spaced no more than 10 meters apart along each street and in parking areas; | | | ■ | | ■ | ■ | | | | | | | | | | | | ■ | | | | | | | |
| ***Recommendation 19.*** Traditional street tree species, such as *Ficus virens, Ficus microcarpa*, etc. should be emphasized for use; | | | | | ■ | ■ | | | | | | | | | | | | | | | | | | | |
| ***Recommendation 20.*** Maximizing the use of meadows and perennials rather than lawns; | | | ■ | ■ | | | ■ | | ■ | | | | | | | | | | | | | | | | |
| ***Recommendation 21.*** Maximizing planting native plants and trees; | | | ■ | ■ | ■ | | ■ | ■ | ■ | | | | | | | | | | | | | | | | |
| ***Recommendation 22.*** Designing bio-retention planting areas in neighbourhoods to hold, infiltrate, and evaporate runoff; | | | | ■ | | | | | ■ | | | | | | | | | | | | | | | | |
| ***Recommendation 23.*** Using cisterns to store excess stormwater; | | | | ■ | | | | | ■ | | | | | | | | | | | | | | | | |
| ***Recommendation 24.*** Main facades of buildings should face north and south with a tolerance of 30° to the east or west. Windows in facades receiving sun from the west with a tolerance of 30° must have complete protection; | | | | | | | | | | ■ | | | | | | | | | | | | | | | |
| ***Recommendation 25.*** Buildings should be arranged with variations in height, staggered forms in order to channel breezes (Schiller and Evans, 1998); | | | | | | | | | | ■ | | | | | | | | | | | | | | | |
| ***Recommendation 26.*** The open passages at ground level will help direct breeze to the pedestrian level (Schiller and Evans, 1998); | | | | | | | | | | ■ | | | | | | | | | | | | ■ | | | ■ |
| ***Recommendation 27.*** Buildings should have sallow depth and carefully considered layout to allow cross ventilation and natural lighting; | | | | | | | | | | ■ | | | | | | | | | | | | | | | |

Table 4-1: (cont.)

| | Indicator 1 | Indicator 2 | Indicator 3 | Indicator 4 | Indicator 5 | Indicator 6 | Indicator 7 | Indicator 8 | Indicator 9 | Indicator 10 | Indicator 11 | Indicator 12 | Indicator 13 | Indicator 14 | Indicator 15 | Indicator 16 | Indicator 17 | Indicator 18 | Indicator 19 | Indicator 20 | Indicator 21 | Indicator 22 | Indicator 23 | Indicator 24 | Indicator 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Recommendation 28.*** Planning the city region, which is comprised of a whole series of urban cores; | ■ | ■ | | | | | | | | | ■ | | | | | | | | | | | | | | |
| ***Recommendation 29.*** Planning a core area with no more than 50% land for a single land use; | ■ | ■ | | | | | | | | | ■ | ■ | | | | | | | | | | | | | |
| ***Recommendation 30.*** Controlling the population size of a clustered urban area to be under 500,000 (refer to the population size of the old districts); | | | | | | | | | | | ■ | | | | | | | | | | | | | | |
| ***Recommendation 31.*** Planning the distribution of city level public facilities along major streets; | | | | | | | | | | | ■ | | | | | | | | | | | | | | |
| ***Recommendation 32.*** Buildings along streets should be allowed for mixed uses, therefore adaptable to changes; | | | | | | | | | | | ■ | | | | | | | | | ■ | | | | | |
| ***Recommendation 33.*** The urban residential areas in a district should offer mixed housing types (one-person, couples, families with children and senior people); | | | | | | | | | | | | ■ | | | | | | | | | | | | | |
| ***Recommendation 34.*** Integrating government subsidized housing into market oriented neighbourhoods; | | | | | | | | | | | | ■ | | | | | | | | | | | | | |
| ***Recommendation 35.*** Planning a denser public street network with intervals of less than 200 meters to disperse traffic flow; | ■ | ■ | | | | ■ | | | | | | | | | | | | | ■ | | | | | | |
| ***Recommendation 36.*** Maintaining the right-of-way of commercial and mixed-use street within 32 meters; | | | | | | | | | | | | | | | | | | | ■ | ■ | | | | | |
| ***Recommendation 37.*** Overlaying a public pedestrian path network on the street network with intervals of less than 50 meters; | | ■ | | | | | | | | | | | | | | | | | ■ | ■ | | | | | |
| ***Recommendation 38.*** Using preserved natural features such as forested hills, wetlands, river systems, farmlands, etc. to divide urban core areas; | | | ■ | | | | | | | | | | | | ■ | | | | | | | | | | |
| ***Recommendation 39.*** Building at least one small public green within three minutes' walk of every dwelling; | | | ■ | | | | | | | | ■ | | | | | ■ | | | | | | | | | |

Table 4-1: (cont.)

| | Indicator 1 | Indicator 2 | Indicator 3 | Indicator 4 | Indicator 5 | Indicator 6 | Indicator 7 | Indicator 8 | Indicator 9 | Indicator 10 | Indicator 11 | Indicator 12 | Indicator 13 | Indicator 14 | Indicator 15 | Indicator 16 | Indicator 17 | Indicator 18 | Indicator 19 | Indicator 20 | Indicator 21 | Indicator 22 | Indicator 23 | Indicator 24 | Indicator 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Recommendation 40***. Arrange buildings to form clusters of 100 to 600 households (the population size of a Residents' Committee); | | | | | | | | | | | | | | | | | ■ | | | | ■ | | | ■ | |
| ***Recommendation 41***. Clearly define the border of the clustered buildings but do not block general access to the land; | | | | | | | | | | | | | | | | | ■ | | | | | | | | |
| ***Recommendation 42***. Keep major roads outside these neighbourhoods; | | | | | | | | | | | | | | | | | ■ | | | | | | ■ | | |
| ***Recommendation 43***. Placing a Residents' Committee office, a day care, or a playground in the center of the neighbourhoods; | | | | | | | | | | | | | | | | | ■ | | | | | | | | |
| ***Recommendation 44***. Maintaining residential streets within 12 to 20 meters; | | | | | | | | | | | | | ■ | | | | ■ | | ■ | ■ | | | | | ■ |
| ***Recommendation 45***. Planning residential streets to be publicly accessible; | | ■ | | | | | | | | | ■ | | ■ | ■ | | | ■ | | | ■ | | | | | |
| ***Recommendation 46***. Minimizing building setbacks and planning for directly open windows and doors onto streets; | | | | | | | | | | | | | | | | | | | | ■ | | | | | ■ |
| ***Recommendation 47***. Allowing the ground level of residential buildings for commercial and other public uses; | | ■ | | | | | | | | | ■ | | | | | | | | ■ | ■ | | | | | ■ |
| ***Recommendation 48***. Using colonnades to cover street sidewalks; | | | | | | | | | | | | | | | | | | ■ | ■ | | | | | | ■ |
| ***Recommendation 49***. Arranging buildings around a landscaped open space; | | | | | | | | | | | | | | | | | ■ | | | | ■ | | ■ | ■ | |
| ***Recommendation 50***. Excluding traffic from neighbourhood open spaces; | | | | | | | | | | | | | | | | | ■ | | | | ■ | | ■ | | |
| ***Recommendation 51***. Open parts of buildings ground level to provide roofed open spaces; | | | | | | | | | | | | | | | | | | | | | | ■ | | | ■ |
| ***Recommendation 52***. Selecting trees with large canopies to provide shade; | | | | | | | | | | ■ | | | | | | | | | | | | ■ | | | |
| ***Recommendation 53***.Planting trees and shaping buildings in response to each other to form enclosures, avenues, groves, and umbrella, etc., so that people can use these places; | | | | | | | | | | ■ | | | | | | | | | | | | ■ | | | ■ |
| ***Recommendation 54***. Minimizing building setbacks; | | | | | | | | | | | | | | | | | | | | ■ | | | | ■ | ■ |
| ***Recommendation 55***. Providing a front yard in front of ground floor dwelling entrances; | | | | | | | | | | | | | | | | | | | | ■ | | | | ■ | ■ |
| ***Recommendation 56***. Each upstairs unit should be provided with a balcony; | | | | | | | | | | | | | | | | | | | | ■ | | | | ■ | ■ |
| ***Recommendation 57***. Providing a rest area in front of each building entrance. | | | | | | | | | | | | | | | | | | | | ■ | | | | ■ | ■ |

### 4.4 Prioritization of implementing sustainability in China's urban areas

In western countries, low-density residential zoning development is a dominant form of urban growth. The negative environmental and social side-effects that have resulted from this pattern of development have been widely discussed in the literature (Ewing, 1997; Jacobs, 1961; Calthorpe, 1993; Nelessen, 1993).

In China, conditions are different. Gated residential communities that are self-sufficient in terms of daily services are springing up from the urban cores to remote areas. Although they normally have much higher densities and more mixed land use than North American residential areas, their impacts on the environment and social well-being are still not optimistic.

The gated residential communities developed in Chinese cities are intended to create secure, traffic calming, and less automobile dependent urban living environment (Miao, 2003). However, these claimed benefits are more likely to be an illusion. The sealed site planning form ultimately creates the effect that increased traffic volumes are dumped into the larger urban environment outside of the individual communities, and therefore worsen the city's traffic problems. Walls become both physical and psychological barriers against people using the public streets, and therefore actually protect criminals from being detected by people on public streets and in neighbouring buildings. The service provisions that are required by each of these community developments generate similar and continually repeated, minimum-level facilities, rather than colourful urban life created by combining various facilities, even where several communities are located side by side. The result is not only a wasteful use of resources, but also creates a dramatic increase on transit demands between the city center and suburban areas. This is further related to urban problems of pollution, energy consumption, and traffic congestion.

In addition to the unrealistic benefits that have been touted with regard to these developments, when the gated residential community is becoming the sole type of urbanization within Chinese cities like Guangzhou, the possibility of that city's developing sustainability is seriously jeopardised.

Under the pressure of an increasingly large urban population and deficient natural resources, China's urban developments are in an urgent need of efficient spatial structures in which urban growth and natural resource conservation (soil, water, petroleum, etc.) can coexist. However, since the government is highly reliant on community development to provide infrastructure such as roads, green spaces, amenities, etc. for the rapid urban expansion, the city's overall ecological and civic planning has lagged far behind the urban development. The result is an uncontrolled urban spatial structure that has been manifested through leap-frogging and sprawling residential communities all over China. These results have been noted as the dramatic loss of farmlands, the fragmentation of large natural habitats, and increasing vehicle travel demands, with their related pollution levels.

In addition, China is in a process of transition from a planned economic system to a market-oriented one. Traditional shared values such as communism and Confucianism are facing challenges, and at the same time, the rising economic inequality is stratifying, and even tribalizing the previously classless society. Maintaining a cohesive society has therefore become a foremost concern in modern China. However, the residential areas in China's urban districts are not only walled and gated, but also designed in a standard, closed form exclusively for a specific class. This means that the Chinese urban space will become increasingly more fragmented, isolating different groups from each other, and eventually pitting one against the other.

It becomes evident that in order to implement sustainability in China's urban areas, dismantling residential community walls and gates, and giving up the conventional residential design and planning methods should be considered as the first step. This requires that the role of city planning in China's present era has to be bolstered. City planning should recognize the importance of organizing an overall, efficient infrastructure and public facilities for the entire city. Furthermore, there is a need to generate documents that can set detailed regulations for the preparation of site plans for small land parcels.

As the result, even if residential areas in a city are somewhat segregated, due to the sharing character of city's public facilities and spaces, people of different types must negotiate their mutual fate together. In some respects, they learn to value one another more highly, and social networks are expanded. Moreover, the environmental protection of the land parcel level would no longer rely on the self-discipline of land users. Residential sites would be designed according to detailed guidelines which would be generated based on the region's ecological carrying capability.

### 4.5 Feasibility of implementation beyond Guangzhou city

As a pioneer city in China's economic and social reform, Guangzhou's urban spatial structure has changed dramatically from a compact form to a dispersed metropolis. Similar urban spatial changes are occurring other Chinese cities. Thus, an examination of Guangzhou's experience can shed light on urban development issues and problems facing other Chinese cities. However, due to cultural differences, the recommendations may not be applicable to places further afield, such as North American cities.

For example, the residential cell (a cluster of 100 to 600 households surrounding a common land) proposed in this thesis may raise many arguments when applied to cities in

western countries. Based on the traditional spirit of liberty and democracy, the prosperity of western cities depends upon individual citizens' enterprising spirit in economic and political ventures. But throughout China's history, cities in China existed mainly as outposts of the empire to serve the latter's taxation and military needs. The grassroots organizations in Chinese urban areas have always been effective means for China's economic and political development, administration, and the stabilization of the society throughout different historical periods (Chan, 1993).

In a Chinese context, in order to link the individual's interest to the common value of sustainability and stabilize the quickly shifting society in an era of transition, the value of establishing a neighborhood spatial structure corresponding to the traditional social structure is self-evident. But in western countries, it may not applicable.

### 4.6 Future research

#### Other levels of planning

This thesis explores a more sustainable urban spatial form for the City of Guangzhou on two crucial scales, the city region and the site. In fact, between these two scales, there exist many intermediate levels of planning that are important for controlling the day-to-day development toward desirable planning goals. Numerous and well considered plans, regulations and supporting documents need to be formulated to specify land subdivisions, development intensities, layout of infrastructures, allocation of public facilities, etc. However, to limit the scope of this thesis, they have not been addressed, but are worth future exploration.

**Pilot projects**

It is my great regret that due to the unavailability of data from China, this thesis adopts an approach of qualitative analysis, and therefore the conclusions of this thesis represent only highly probable assumptions. In the future, joint sponsorship of pilot projects should be undertaken by government and private interests because virtual laboratories would be most useful in order to obtain additional evidence and empirical data to better support altering mainstream practices and monitor the results. At the same time, they would provide tangible precedents for innovative ideas that people could walk through, touch, evaluate and improve upon.

**Economic evaluations**

Differing from conventional documents, which often explore issues of sustainable city and community based on the three balanced aspects of the environment, society, and the economy (British Columbia Round Table, 1994; Haughton, 1994), this thesis focuses on two dimensions: environment and human aspirations. My perception is that economic activities are only a subset of social activities. The artificial separation of the economy from society would inflate the importance of the market, assume it is autonomous, and would not focus primarily on meeting human needs, whether by the market or other means (Gidding, et. al., 2002).

Nonetheless, the political reality gives primacy to the economy and until that changes economics will continue to play an important role in describing what can and cannot be done. As an interim measure, economic evaluations empowering sustainable design process must be done to help change the status quo.

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