CHAPTER-1
INTRODUCTION

1.1 Introduction
Two major concerns of the 21st century are urbanization and climate change. It has been estimated that by 2030 more than half the world’s population will be living in urban areas. Many researchers have come to this conclusion. Sustainable development of cities and metropolises will be a major challenge for city planners and designers the world over.

Rapid urbanization during the 20th and 21st centuries has exerted a tremendous pressure on the resources like land, water and air due to the high and generally unplanned increase of population in urban areas. This manifests in the form of congestion and overcrowding, water scarcity and environmental pollution ultimately leading to urban sprawl, indiscriminate tapping of ground water by private agencies and deteriorating air quality. This has an adverse impact on human health and happiness, resulting in poor urban livability and is not sustainable any longer. The quality of urban environment thus has become a major societal concern.

Metropolises are a niche of complex interactions of the natural systems and built elements. In order to maintain some degree of balance in the natural systems, human engineered systems are required to produce and transport energy, to remove and process wastes, and to channelize and conserve storm water runoff. This provokes a reflection and rethinking regarding traditional or conventional interventions. Ways to work more closely with natural processes to resolve some of the deficiencies and excesses that are concomitant with urban living have to be worked out. This approach is described by the term “green infrastructure”.

One of the prominent spatial manifestations of the rapid urbanization process is the ‘gated community’. In its modern form, a gated community is a form of residential community or housing estate containing strictly-controlled entrances for pedestrians, bicycles, and automobiles, and often characterized by a closed perimeter of walls and fences. Gated communities usually consist of small residential streets and include various shared amenities.
Technological revolution of the present century embodies fundamental changes regarding how and where people work, live and play. It has created new economies based on the varieties of services provided. Such changes have brought in challenges commonly associated with increased and unanticipated growth, traffic congestion and urban sprawl in existing urban areas. Bangalore has been substantially affected by globalization and rapid urbanization over the last decade and manifests many of these issues in many ways.

A major source of growth in recent times has been the development of Information Technology based industries. The annual population growth rates for Bangalore indicate high trends relative to other cities in the country – at 3 percent for the total population; 6 percent for employment; and 9 percent for the incomes. This has led to the emergence of Bangalore as a leading metropolitan city of India.

Economic, social and population growth has translated into spatial development of the city. Between 1983 and 1990 the urban area of the city increased from 202 sq. km to 284 sq km. In 2003, the city’s area increased to 565 sq. km, indicating a 100 percent increase in 12 years and an average progression of about 2200 ha per year with a growth rate of 5.4 percent. This is considerably significant growth rate and is the highest in the country. In the absence of a defined natural boundary, the city has spread in all directions and along the major roads and highways.

Gated Communities have emerged along all the major roads to cater to the housing needs of the large population that works in the IT related industries. Such communities have largely developed due to private initiative and families with relatively large disposable incomes are the patrons. Gated Communities are generally well planned and designed housing facilities.

1.2 Defining Green Infrastructure and Gated Communities

**Green Infrastructure:** The “green infrastructure” of a city is made up of natural as well as deliberately designed flora systems and elements of the city that decisively contribute to natural processes in managing air, water, microclimate and energy resources. The most essential part of this infrastructure is all places that have water-pervious surfaces and/or soil to support plant material. The most visible elements of
this infrastructure are the trees, shrubs and bowers. The principal parts of this infrastructure include natural areas as well as open to sky spaces. As green infrastructure is patterned after natural systems, it includes waterways and microclimatic systems that vegetation, land and water-bodies together create; that is, those parts of the urban system that are ecologically wholesome.

According to Lynda H. Schneekloth (2001) the green infrastructure of a city consists of those parts that contribute to the natural process of keeping water and air clean and of recycling of waste. It includes the parks and wild lands, stream corridors, utility corridors and vacant regenerating sites. These elements of city property, if considered as a single system similar to transportation or waste treatment, offer opportunities for keeping our cities clean and beautiful and for providing recreational space.

Benedict and McMahon state that –

- “Where-as green space is often viewed as something that is nice to have, the term green infrastructure implies something that we must have. Protecting and restoring our nation’s natural life support system is a necessity, not a mere amenity.

- Where-as green space is often thought of as isolated parks, recreation sites or natural areas, the term green infrastructure emphasizes interconnected systems of natural areas and other open spaces that are protected and managed for the ecological benefits they provide to people and the environment.

- Where-as green space is often viewed as self-sustaining, the term green infrastructure implies something that must be actively maintained and at times restored.”

**Natural Areas:** Natural areas include stream corridors, valleys, ridges, water-bodies, wetlands, mangroves, wild lands, and areas of significant biodiversity and ecological importance.

**Open-to-sky Spaces:** Open-to-sky Spaces include organized spaces open to public like parks, playgrounds, cemeteries, transport networks, utility corridors, private open
spaces of residences, commercial and institutional buildings, campuses including those designed as gardens, vacant regenerating sites.

**Gated Community:** As understood in modern urban design parlance, a gated community is a form of residential community or housing estate containing strictly-controlled entrances for pedestrians, bicycles, and automobiles, and often characterized by a closed perimeter of walls and fences. (http://www.google.co.in/search?q=define%3AGated+communities&btnG=Search&hl=en&rlz=1W1GGLR-en&sa=2) Accessed on 03/11/2010.

Gated communities usually are equipped with small residential streets and include various shared amenities. For smaller communities this may be only a park or other common area. For larger communities, it may be possible for residents to stay within the community for most day-to-day activities. Gated communities are a type of common interest development, but are distinct from intentional communities. (http://en.wikipedia.org/wiki/Gated_community) Accessed on 03/11/2010.

In countries with a low Human Development Index and/or high Gini coefficient, characterized by high inequalities, gated communities attempt to provide security to the upper class as well as expatriates. (ibid)

Some gated communities, usually called guard-gated communities, are staffed by private security guards and are often home to high-value properties, and/or are set up as retirement villages. Some gated communities are secure enough to resemble fortresses and are intended as such. (ibid).

**1.3 The History of Green Infrastructure Planning**

Green Infrastructure is a concept originating in the United States in the mid-1990s that highlights the importance of the natural environment in decisions about land use planning. In particular there is an emphasis on the "life support" functions provided by a network of natural ecosystems, with an emphasis on interconnectivity to support long term sustainability. (http://en.wikipedia.org/wiki/Green_infrastructure). Accessed on 03/11/2010.
Examples include clean water and healthy soils, as well as the more anthropocentric functions such as recreation and providing shade and shelter in and around towns and cities.

Green infrastructure is an emerging paradigm with the potential to forge a more wholesome relationship between the community and the environment. A green infrastructure approach repositions the role of nature in and around the city from an optional amenity and scenic backdrop to valued purveyor of ecosystem services and a platform for more compact, vibrant communities. Green infrastructure is the dynamic complex of interdependent systems that animates our cities, and we must calibrate our capacity to measure and express the performance of these life support systems. Where this is happening, public and private investment flows naturally toward the richly layered and interconnected assets that provide multi-functional benefits of enduring value.

The idea of green infrastructure suggests a new breed of ‘high performance landscapes,’ integrating emerging ecological realities and urban infrastructural needs, which could reflect a contemporary ‘aesthetic of performance.’ The hybrid and assembled nature of ecologically high performing landscapes requires greater physical complexity and a more organized, or operational, approach to practice. Resolution of these complex issues is a priority.

The planning and design framework here is based on 6 interdependent systems - the social, circulatory, metabolic, biologic, hydrologic, and geologic functions of green infrastructure in the city. Each system has its associated resources and criteria of performance.

The physical elements are a community's green infrastructure assets, and these can range in scale from a single tree to an entire watershed with greenery. Most assets perform more than one role, and through planning and design this multi-dimensionality can be enhanced. Assets are most effective when linked to form a mutuality network of green infrastructure.

Green infrastructure embodies a diversity of public and private benefits and values that fulfill both natural and human needs and sustain the environment and the communities.
Green infrastructure systems help protect and upgrade naturally functioning ecosystems and provide a framework or background for future development. In doing so, they provide a diversity of ecological, social, and economic inputs and benefits which include enriched habitat and biodiversity, maintenance of natural landscape processes, cleaner air and water, increased recreational and transportation opportunities, improved health, better connection to nature and an enhanced sense of place.

Well planned green space has also been seen to increase property values and decrease the costs of public infrastructure and public services, including the costs for storm-water management and water treatment systems. A nature provided input for rainwater conservation.

Investing in green infrastructure can often be more cost effective than conventional public works projects. Just as all forms of built up infrastructure are promoted for a wide range of public and private benefits they provide, Green Infrastructure systems need to be actively promoted for their wide range of essential ecological and social functions, values and benefits that accrue to people and nature.

According to Benedict and McMahon (2000) Green infrastructure can be designed to shape urban form and provide a framework for growth. It works best when the framework pre-identifies both ecologically significant lands and suitable development areas. They state that, “Just like our built infrastructure, our green infrastructure should be carefully planned, designed, and invested far in advance for development. Green infrastructure planning should be the first step in the land-use planning and design process. Green infrastructure planning should also be coordinated with planning for gray infrastructure - roads, bike trails, water supply, electricity, telecommunication and other essential community support systems. Integrated planning and design should connect the two in a more effective, economic and sustainable blend.

Green infrastructure initiatives should use approaches similar to those used for the planning, design and financing of built infrastructure. Green infrastructure should be:

**Designed Holistically** - Like our transportation system, green infrastructure should be designed to link diverse green space elements into a system that
functions as a whole, rather than as separate, unrelated parts. Very much like connections between different wildlife sanctuaries.

Planned Comprehensively - Like our electric power and telecommunication systems, our green space systems need to be planned comprehensively to provide ecological, social and economic benefits, functions, and values.

Laid Out Strategically - Like our roads and water systems, our green space systems need to be laid out strategically to cross multiple jurisdictions and incorporate green space elements at each level of government. For example when roads or railways have to pass across green areas or forest sanctuaries, flyovers may be built.

Planned and Implemented Publicly - Like our built infrastructure systems, our green infrastructure systems should be planned and implemented with input from and involvement of the public, including community organizations and private landowners.

Grounded in the Principles and Practices of Diverse Professions - Like the design and planning of our transportation, water, electrical and phone systems, green space systems should be based on sound science and should build on the knowledge of professional disciplines such as landscape ecology, urban and regional planning, and landscape architecture.

Funded Up-Front - Like other infrastructure systems, our green space systems need to be funded as a primary public investment. In other words, green infrastructure should be funded up front with other essential services, rather than with money that is left over after all other services have been provided.

Green infrastructure planning should take place at all levels or scales: from the individual parcel, to the local, regional and statewide scales. At the parcel level this could mean designing homes and businesses around green space. At the community level this could mean creating greenways to link existing parks. And at the wider statewide level this could mean protecting broad wildlife movement corridors to connect state and national forests.

Six guiding principles and strategies have been identified as critical to the success of green infrastructure initiatives. Taken together, these principles provide a strategy or framework for conservation or sustainable use of land while providing an
interconnected system of green spaces that benefit people, promote wildlife and the economy. They are intended to help provide design, planning, acquisition and other decision making guidance for community-based sustainable development. There are seven principles identified:

- Green infrastructure should be the framework for conservation and development.
- Design and plan green infrastructure before development.
- Linkage is the key.
- Green infrastructure functions across multiple jurisdictions and at different scales.
- Green infrastructure is grounded in sound science and land use planning theories and practices.
- Green infrastructure is a critical public investment.
- Green infrastructure involves diverse stakeholders.

1.4 Functions of Green Infrastructure

According to Schneekloth H. Lynda (2001) green infrastructure performs ecological, recreational and aesthetic functions. It improves the quality of the urban environment, provides access to natural habitats, and avoids damage to the built form and in general contributes to keep all healthy. In the context of this study the emphasis will be on the recreational and aesthetic aspects of green infrastructure.

The functions of green infrastructure are:

**Air Quality Improvement**: Vegetation reduces air pollution as it filters dust particles and pollutants attached to them. Through photosynthesis, carbon dioxide is reduced and oxygen liberated.

**Microclimate Modification**: Nonporous urban surfaces absorb and hold heat during warm weather contributing the heat island effect wherein temperatures can be between 8-10% higher than the areas with soil or water pervious surface. According to Lawrence Berkeley Laboratory (2002) the green infrastructure of a city is a natural air conditioner, the greater its coverage and canopy, the greater the
benefits. If strategically planted, trees serve as windbreaks, in part by lifting strong seasonal winds up and over the leeward structures and by breaking down strong wind patterns.

**Storm water management:** One of the most important benefits of the green infrastructure is in naturalizing the hydrological cycles in a city. The hard surfaces of the urban fabric increase the intensity of the run-off and the amount of pollutants in urban waters. Instead of water soaking into the ground, it runs off quickly into storm drainage systems that flow into rivers and streams, causing increased flooding and erosion. The green fabric, on the other hand, absorbs water at the source, recharging groundwater, filtering pollutants, and slowing down the run off of water. This improves water quality, is cost-effective; availability of ground water increases and becomes necessary as water sources become dispersed.

**Biodiversity:** The urban environment is home to even other creatures than human beings, and one might remark that the more we encourage wildlife in the city environs at appropriate places, the more varied and enriched will be the quality of life. A rich variety of birds and animals is an indicator of a healthy environment. Wildlife in the city moves through riparian corridors along rivers and streams and large parks having native vegetation. The health of these habitats, however, depends to a large extent on their size and connectivity—one of the reasons for doing a green inventory of a city is to locate significant areas for wildlife habitat, sanctuaries and corridor links between natural conservation systems.

**Recreational opportunities:** One of the most visible and important functions of the green structure is for recreation, e.g., in addition to using riparian corridors as flood and erosion control and habitat links, these are prime areas for bicycle trails and nature hikes. Major parks, with large and diverse ecological systems, provide parks for active recreation and sports fields, but also for passive recreation, bird watching and school field trips for science classes. Each part of the urban green fabric should be considered as a multi-use structure.(Schneekloth H. Lynda, 2001, pp 7.4.2)
1.5 Background of the Study Area

Bangalore, the capital of Karnataka, is the fifth largest metropolitan city in India. It is well known – nationally and internationally – as a destination of choice for high-technology industries, particularly in the IT/ITES and Biotechnology sectors. It is a city that has transformed itself from a “pensioners’ paradise” to a modern thriving cosmopolitan metropolis. The pleasant climatic conditions and the “garden city” image, as well as the presence of academic institutions and skilled workforce, led to this rapid development. The Bangalore Metropolitan Area covers an area of 1307 sq. km and includes the Bruhat Bangalore Mahanagara Palike, surrounding villages and the Bangalore-Mysore Infrastructure Corridor Project Area (BMICPA).

The Bangalore Metropolitan Area has witnessed a manifold increase in population (presently 9.5 millions) towards the end of the last century as a result of the development of the IT industry. This has spawned waves of haphazard urbanization especially in the outer ring planning districts. A direct spatial manifestation is the proliferation of privately developed gated communities to cater to the housing needs of the IT industry. This has exacerbated many environmental and social problems leading to high costs and difficulties in taking remedial measures. Bangalore is comparatively better placed in the overall Indian context and experience of urban environmental management.

Historically Bangalore is known as the Garden City of India. The green infrastructure assets of the city include the large number of parks as well as private gardens, roadside and avenue trees and the magnificent Lalbagh and Cubbon Park. Bangalore has several parks spread across the city in the form of small and medium sized parks as well as large parks. The parks having been publicly developed and maintained are located mainly in the Core and Intermediate Ring Planning districts. They perform environmental functions as well as cater to the needs of recreation of the people as they are easily accessible.
Bangalore’s Vision for the year 2015 as developed through the City Development Plan (CDP) and adopted by the city’s Local Self Government Institutions (LSGIs) is “to retain its pre-eminent position as a City of the Future through its cosmopolitan character and global presence and to enable and empower its citizens with: growth opportunities to promote innovation and economic prosperity; a clean green environment; high-quality infrastructure for transport and communication; wide-ranging services aimed at improving the quality for all; conservation of its heritage and diverse culture; and responsive and efficient governance.” (Bangalore Development Authority, Vision Document of RMP 2015)

The privately developed gated communities are located mainly in the suburbs and access to the developed parks therein is difficult for the general public. Therefore the onus of developing green infrastructure assets of such communities is entirely on the private developer and once developed its maintenance depends on the Residents Welfare Association. It is obvious that adequate open space for both recreation and rest is a vital element in maintaining and improving the health of the people of the gated communities.

This calls for a review of the planning regulations and design guidelines, financial conditions, institutional and NGO’s role in the formulation of an effective plan for the conservation or creation of green infrastructure by the private developers and the Resident Welfare Associations of the gated communities.

The Bangalore Development Authority has sanctioned 96 residential group housing development plans from July 2000 to March 2011. Since such developments are located in the Third Ring Planning districts which are suburban areas and they are developed as gated communities by the private developers to attract rich buyers as well as for reasons of security. The per sq. ft selling price increases in direct proportion to the amenities provided by the developers. As per the Land use Zonal Regulations of RMP 2015 10% of the total site area has to be developed as park for recreational purpose.
1.6 The Aim and Objectives of the Study

The aim is to study the development and maintenance of green infrastructure in the privately developed gated communities. The objectives are:

- to study the historical background of green infrastructure in gated communities in the Bangalore Metropolitan Area.
- to identify the location, size, green infrastructure assets, housing types and other parameters in gated communities.
- to review the planning regulations and guidelines, financial conditions, institutional and NGO’s role to formulate effective plan for the creation of green infrastructure by the private developers of the gated communities.
- to assess the development of selected gated communities for promoting green infrastructure through contemporary design elements.
- to suggest ways for conservation and development of green infrastructure with respect to the existing gated communities.

1.7 Methodology

The study is primarily with a view to obtaining an environmental planning strategy and guidelines for either the conservation or the creation of green infrastructure in the gated communities which are private developments. For this study the data are mainly from secondary sources. Primary sources consist of personal visits through field survey. Secondary information is obtained from various sources including technical papers, reports, website articles, planning documents and other written and printed materials. Interactions with policy makers, administrators and local officials provide important insight. Similarly opinions of the private developers as well as the gated community members are valuable input. Appropriate policy guidelines, planning strategies, design guidelines and techniques are sought to be formulated.

1.8 Scope and Limitations of the Study

Gated communities are privately developed and are located mainly in the suburbs. The residents of the gated community need breathing space where they can relax and enjoy the bounties of nature. The range of recreational facilities should cater to all age and social groups within the gated community. The green infrastructure of the gated
community should include tracks and trails for jogging and walking which would also serve to link and unify the various areas and activities. It should also include plant species that bear edible berries, fruits and nectar for attracting and providing for the birds and butterflies with suitable habitat which will also add to the biodiversity of the area.

Budgetary and other constraints force the neglect of the development of the green infrastructure by the developers of the gated communities. Therefore there is an urgent need to arrive at a policy for the development of green infrastructure within the gated community. This would provide opportunities for active and passive recreation within the community itself. Tree planting should be encouraged if not made mandatory.

The study is limited to green infrastructure in selected few gated communities and will be carried out in the Bangalore Metropolitan Area. The data for this study will be from both secondary and primary sources. Effort has been made to visit selected gated communities to understand the various issues about green infrastructure. The focus of this research will be to highlight the historical background and assessment of the existing situation of the green infrastructure in the selected gated communities. The study will focus on planning strategies and design guidelines to ensure the aesthetic quality of the built environment through augmentation of green infrastructure in gated communities in the Bangalore Metropolitan Area.

1.9 Organization of the Thesis

The thesis work has been organized in six chapters. The following account is a brief description of each of the chapters.

Chapter-1 Introduction: This chapter sets the background to the thesis work. It includes a brief history of green infrastructure planning and highlights the functions of green infrastructure. The contemporary meaning of gated community has been stated. A brief background of the study area has been given with reference to the emergence of the gated communities as a consequence of the economic changes mainly due to the information technology industry. The aims and objectives of the thesis work have been stated. The methodology, scope and limitations of the thesis work have been briefly described.
Chapter-2 Review of Literature: In this chapter efforts have been made to study the available literature on green infrastructure and gated communities. The literature has been organized and presented based on the main theme, green infrastructure and the sub-theme, gated communities. The attempt has been to access and review literature from sources including available books, statutory documents, journals and websites.

Chapter-3 Background of the Study Area, Bangalore Metropolitan Area: The chapter begins with a brief history followed by an outline of the growth and development of Bangalore. The geographical setting including the location and topographical features has been described. Since climate is an important factor for green infrastructure there is description of climatic factors including temperature, humidity, rainfall, winds and the change in micro climate due to urbanization. Population growth has been discussed as it is a key factor for the emergence of gated communities. Land use pattern, Zoning of Land use and Regulations, Civic Amenities and Community facilities at city-scale have been discussed briefly. Bangalore’s current prominence has been discussed. The emergence of gated communities as result of the impact of the Information Technology industry has been discussed as also the issue of green infrastructure in the privately developed gated communities.

Chapter-4 Development of Green Infrastructure in Gated Communities in the Study Area: This chapter begins with a brief description of the circumstances leading to the emergence of gated communities in the Bangalore Metropolitan Area and their popularity as housing destinations for families with relatively large disposable incomes. There is a comprehensive description of several gated communities with specific references to the green infrastructure issues therein. Interactions with policy makers, administrators and local officials provide important insight for such research work and they have been stated. Similarly opinions of the private developers as well as the gated community members are valuable input and have been stated too. Visual and aesthetic elements identified through visual surveys have been stated. There is a description of six gated communities studied along with their residential development plans sanctioned by the Bangalore Development Authority.
Chapter-5 Considerations for Green Infrastructure in Gated Communities in the Study Area: The focus of this research is the study of green infrastructure with respect to selected gated communities in the Bangalore Metropolitan Area. This chapter begins with a brief discussion relating to the location of the gated communities in the Bangalore Metropolitan Area, provisions in the Land use Zonal Regulations of the RMP – 2015 and the controversy relating to the legality of the perimeter walls. There is an attempt to analyze the relationship between the housing type and green infrastructure as well as design themes and green infrastructure. Issues pertaining to solid waste management, storm water management, rain water harvesting and green infrastructure, water supply and sewerage, waste water recycling and green infrastructure, energy in the gated communities have been discussed. There is also a brief discussion on gated communities as real estate developments as well as how they are perceived as safe havens by their patrons. The six gated communities selected as case-studies have analyzed with respect to density of population, built-up area open space ratio, nature of vegetation, sporting facilities, rain water harvesting, waste management and sewerage system, reduction of heat island effects, role of NGO’s in enhancing green infrastructure, departmental and institutional role for enhancing green infrastructure as well as the funds for the development and maintenance of the green infrastructure assets of the community. It has been inferred that the studied gated communities promoted green infrastructure through contemporary design elements of considerable visual delight and aesthetic value.

Chapter-6 Conclusion, Suggestions and Recommendations: The concluding chapter of this research work highlights the emergence of the gated communities as a result of the impact of the Information Technology industry and their popularity as housing destinations for families with large disposal incomes. There are brief references to the legality of the controversial perimeter walls as well as the provisions of the Land use Zonal Regulations of the RMP – 2015 with respect to the gated communities and their development plans.

Gated Communities are developed by private developers or promoters and cater to the housing needs of families with large disposable income. There are suggestions for the private developers of the gated communities specifically relating to the green infrastructure issues. Gated communities are designed developments and the design teams include professional urban planners, urban designers, architects landscape architects and interior designers. There are suggestions for the professionals involved
in conceptualizing and designing gated communities with the focus being the
development of the green infrastructure assets of the community. The green
infrastructure assets of the gated community are managed and maintained by the
community’s Resident Welfare Association. There are suggestions for the Resident
Welfare Association members specifically responsible for the management and
maintenance of the green infrastructure assets of the community. Last but not the least,
the green infrastructure assets of the community is meant for the benefit and
enjoyment of the community members. There are suggestions for the community
members who are the beneficiaries of the green infrastructure assets.

The developer/promoter of the gated community prepares the development plan in
accordance with the bye-laws and submits it to the Bangalore Development Authority
which is the sanctioning authority. There are recommendations to the Bangalore
Development Authority with the expectation that the same be mandated as bye-law.

The experience of this piece of research work has opened up avenues of exploration
and further research. There is a brief account of the same.