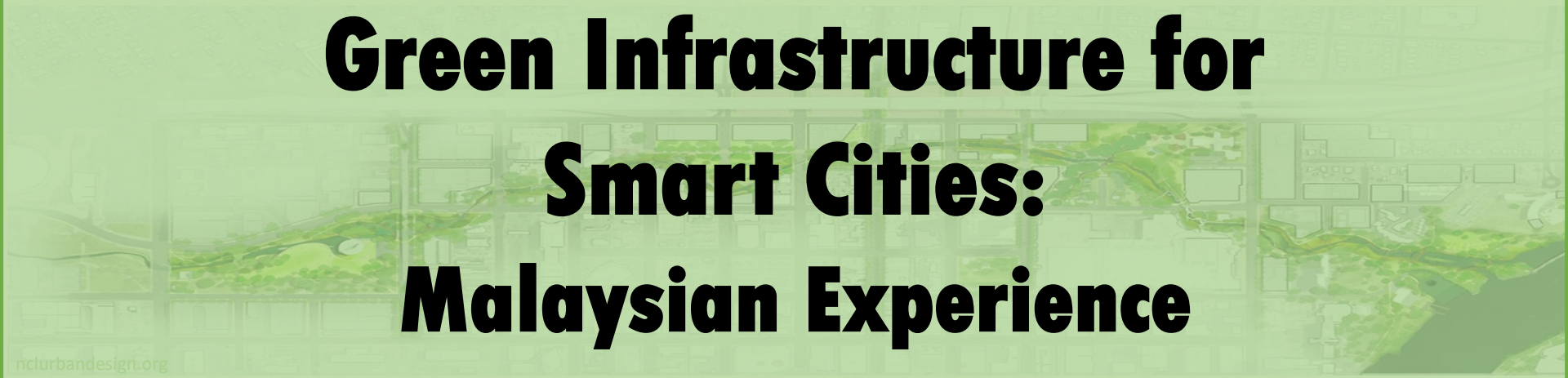
Green Infrastructure for Smart Cities: Malaysian Experience



SAINTIKS 2017
SEMINAR NASIONAL TEKNIK, KOMPUTER DAN REKAYASA
"Inovasi Ipteks Dalam Pengembangan Infrastruktur, *ICT* dan Kesejahteraan Masyarakat"

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Johor Bahru, Johor
9 Nov 2017

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UNIVERSITI TEKNOLOGI MALAYSIA

ABOUT

UTM
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STAFF

5,056 Total

1,794 Total Academic Staff

1,357 PhD

3,262 Total Non- Academic Staff

PG STUDENTS

ENROLMENT

9,331 Enrolment

7,404 Malaysian

1,927 InternaGonal

4,456 PhD

4,875 Masters

UG STUDENTS

ENROLMENT

10,495 Enrolment

10,151 Malaysian

344 InternaGonal

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A. Smart City Overview

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A. What are Smart Cities?

…an urban area that uses different types of electronic data collection sensors to **supply information used to manage assets and resources efficiently** (Hamblen, 2015).

..integrates **information and communication technology (ICT)** to **optimize the efficiency of city operations** and **services and connect to citizens** (Cohen, 2015; Ortiz et al., 2016; Marcus and Forth, 2008).

…..a city that **not only possesses ICT technology** in particular areas, but has **also implemented this technology in a manner that positively impacts the local community** (Daekin, 2013).

Other definitions:

- A city can be defined as 'smart' when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel **sustainable economic development** and a **high quality of life**, with a **wise management of natural resources**, through **participatory action and engagement** (*Caragliu and Nijkamp, 2009)*.
- Frost & Sullivan (2014) identified eight key aspects that define a Smart City: **smart governance, smart energy, smart building, smart mobility, smart infrastructure, smart technology, smart healthcare and smart citizen**.

Elements of Smart Cities

- ✓ **A smart city includes-**

  Data! Data! Data!.... Data collected from citizens, devices, assets processed and analyzed to monitor and manage Traffic and Transportation systems, Information systems, Power plants, Water supply networks, Waste management, Law enforcement, Schools, Libraries, Hospitals, and Other community services (McLaren *et al*., 2015; Musa, n.d.).....real time most of the times.

- ✓ ..Allowing city officials **to interact directly with both community and city infrastructure** and **to monitor what is happening** in the city and how the city is evolving.

- ✓ City applications are developed to **manage urban flows and allow for real-time responses** (Nicos, 2013).

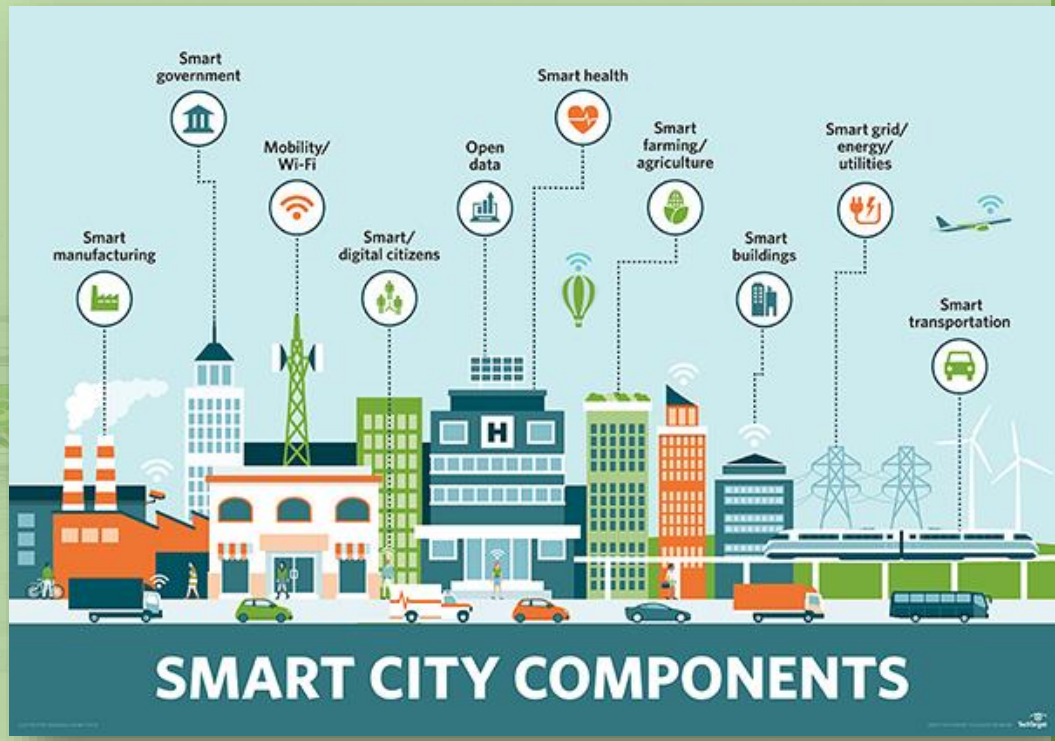


Fig: Smart City Components
Source: Rouse, 2016.
http://internetofthingsagenda.techtarget.com/definition/smart-city

Characteristics of Smart Cities

- ✓ **ICT**.....A smart city uses information technologies for **more efficient use of physical infrastructure through artificial intelligence and data analytics** to support better economic, social, cultural development (Hollands, 2008).

- ✓ **Engagement**....**Engage effectively with local people in local governance and decision by use of open innovation processes and e-participation** (Ballon et al., 2011), **improving the collective intelligence** of the city's institutions through **e-governance** (Nicos, 2013), with emphasis placed on **citizen participation and co-design** (Deakin and Allwinkle, 2007; Daniel et al., 2015).

- ✓ **Intelligence**.....**Learn, adapt and innovate** and thereby respond more effectively and promptly to **changing circumstances by improving the intelligence of the city** (Nicos, 2013; Coe et al., 2001). They evolve towards a **strong integration of all dimensions of human intelligence, collective intelligence, and also artificial intelligence within the city** (Komninos, 2008; Atlee et al., 2006).

Oft-cited Examples of Smart Cities

Dubai, Milton Keynes, Southampton, Amsterdam, Barcelona, Madrid, Stockholm, Singapore, Hong Kong, Seoul etc.

Fig: Amsterdam

- ✓ The Amsterdam Smart City initiative began in **2009**
- ✓ Currently includes **170+ projects** (Mark, 2013)
- ✓ Run on an interconnected platform through wireless devices to enhance the city's **real time decision making abilities.**
- ✓ The purpose of the projects is to **reduce traffic, save energy and improve public safety** (Nicos, 2013).

Fig: Stcokholm

- ✓ First developed in **1994 to provide a universal fibre optic network across Stockholm** (ICT Regulation Toolkit, 2015).
- ✓ Within this framework, Stockholm has created a **Green IT strategy** (Stockholm City Council, 2015).
- ✓ Seeks to reduce the environmental impact of Stockholm through **IT functions such as energy efficient buildings, traffic monitoring and development of e-services.**

Fig: Singapore

- ✓ Has become one of the world's most advanced and liveable countries.
- ✓ It has embarked on its next phase of transformation towards a **Smart Nation,**
- ✓ Endeavors to harness the power of networks, data and information technologies **to improve living, create economic opportunities and build closer communities**.

B. Malaysian Smart City?

KKBPKT: Proposed Smart City Blueprint for Malaysia

Smart City Components

SMART ECONOMY — Competitiveness
- Economic Growth and Value Creation
- Innovative economic growth
- Equitable Wealth Distribution
- Entrepreneurship

SMART ENVIRONMENT — Efficient & Sustainable
- Clean environment
- Environmental protection
- Green development
- Green infrastructure
- Smart Growth
- Green Economy

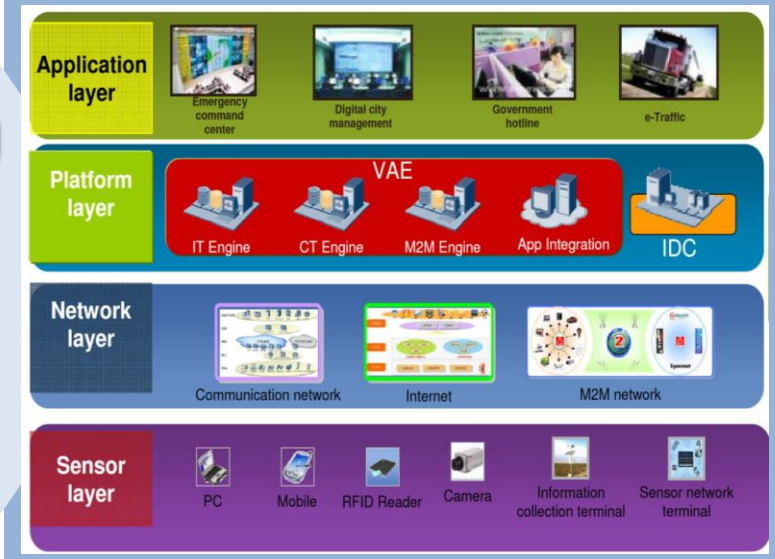
SMART GOVERNANCE — Transparent & Inclusive
- Public Participation
- Efficient Public and social services
- Private Public Partnership
- Transparent governance

SMART PEOPLE — Productive
- Caring community
- Racial Harmony
- Skilled and Talented Human Capital

SMART MOBILITY — Connectivity
- Efficient Road accessibility
- Efficient Public transportation
- Non motorized accessibility
- Availability of ICT infrastructure

SMART LIVING — Quality of Life
- Safety and security
- Low Carbon lifestyle
- Housing quality
- Educational quality
- Health Conditions
- Cultural facilities
- Tourist/recreational attractiveness

Aspects of Smart City (4 Technology Layers)



KKBPKT: Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan
(Ministry of Urban Well-being, Housing and Local Authorities)

Malaysian Smart City? A Malaysian City's Aspiration...of becoming a smart city

ISKANDAR REGIONAL DEVELOPMENT AUTHORITY

ISKANDAR MALAYSIA 2006 – 2016

Smart City Iskandar Malaysia endorsed by Malaysian PM 1st November 2012

Smart Healthy City

Smart City Booklet

IM Smart City Recognition Guideline for Award

2007 — **2012** — **2013** — **2014** — **2015** — **2016** — **2025**

Comprehensive Development Plan 2006-2025

Low Carbon Society Blueprint for Iskandar Malaysia 2025

COP 18, Doha

COP 19, Warsaw

SE4All

COP 20, Peru

Comprehensive Development PlanII 2015-2025

METROPOLIS OF INTERNATIONAL STANDING

SMART CITY ISKANDAR MALAYSIA

Malaysian Smart City? A Malaysian City's Aspiration...of becoming a smart city

ISKANDAR REGIONAL DEVELOPMENT AUTHORITY

ISKANDAR MALAYSIA 10 YEARS 2006 – 2016

6 Dimensions and 28 Characters, defined Smart City Iskandar Malaysia

SMART ECONOMY

Attract economy through smart investment

- Economic Growth and Value Creation
- Innovative economic growth
- Equitable Wealth Distribution
- Entrepreneurship

SMART ENVIRONMENT

Manage environment through smart collaboration

- Clean environment
- Environmental protection
- Green development
- Green infrastructure
- Smart Growth
- Green Economy

SMART GOVERNANCE

Smart governance that focus on 'rakyat' needs

- Public Participation
- Efficient Public and social services
- Private Public Partnership
- Transparent governance

SMART PEOPLE

Produce smart people and mindset

- Caring community
- Racial Harmony
- Skilled and Talented Human Capital

SMART MOBILITY

Provide smart mobility and connectivity

- Efficient Road accessibility
- Efficient Public transportation
- Non motorized accessibility
- Availability of ICT infrastructure

SMART LIVING

Provide smart living quality

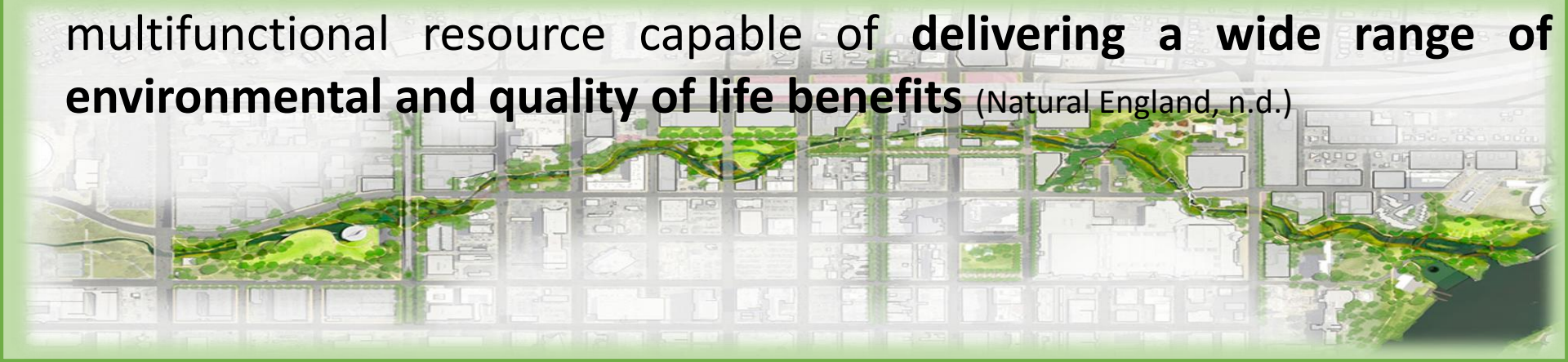
- Safety and security
- Low Carbon lifestyle
- Housing quality
- Educational quality
- Health Conditions
- Cultural facilities
- Tourist/recreational attractiveness

C. GREEN INFRASTRUCTURES

- ✓ An **interconnected network** of green space and other environmental assets that **conserves the functions of the natural ecosystem** and provides associated benefits to people (*McMahon and Benedict, 2000)*

- ✓ A **network of multi-functional** open spaces, including formal parks, gardens, woodlands, green corridors, waterways, street trees and open countryside that **contributes towards sustainable resource management** (Greenport, 2013).

- ✓ Strategically planned and delivered **network of high quality green spaces** and other environmental features designed and managed as a multifunctional resource capable of **delivering a wide range of environmental and quality of life benefits** (Natural England, n.d.)

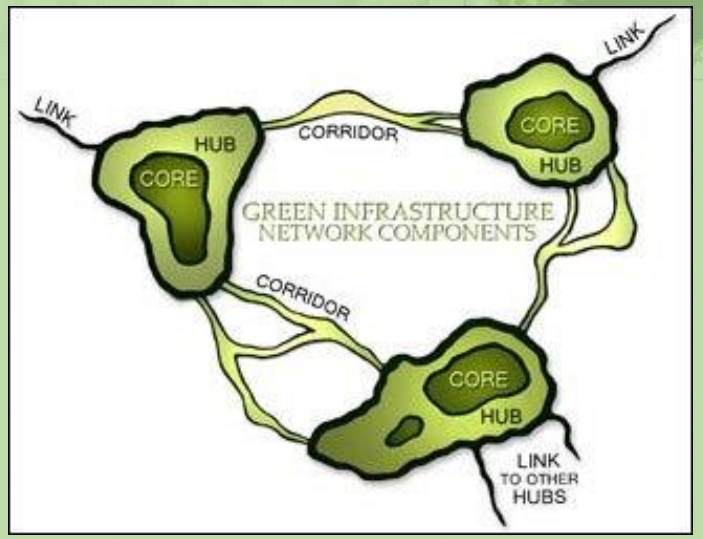


GREEN INFRASTRUCTURES…..characteristics

- Hubs and linkages system
- Shapes urban form and provides framework for network
- Encourages natural systems
- Supports conservation action
- Connectivity important
- Context matters
- Grounded in science and land use theory
- Functions as a framework
- Planned and protected before development

(Source: LeBleu, ASLA AICP)

Fig: Elements of Green Infrastructure



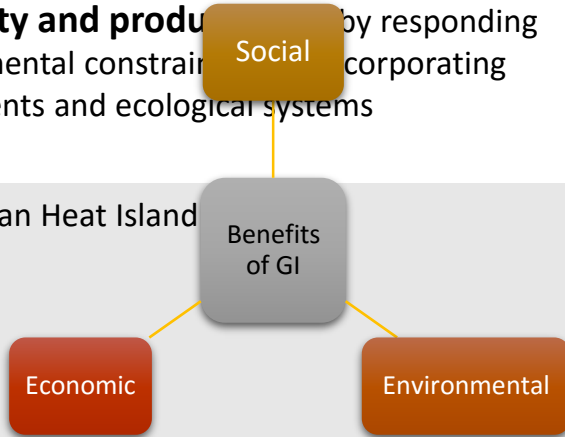
GREEN INFRASTRUCTURES…..components

Green Infrastucture (GI) vs Green Space (GS)

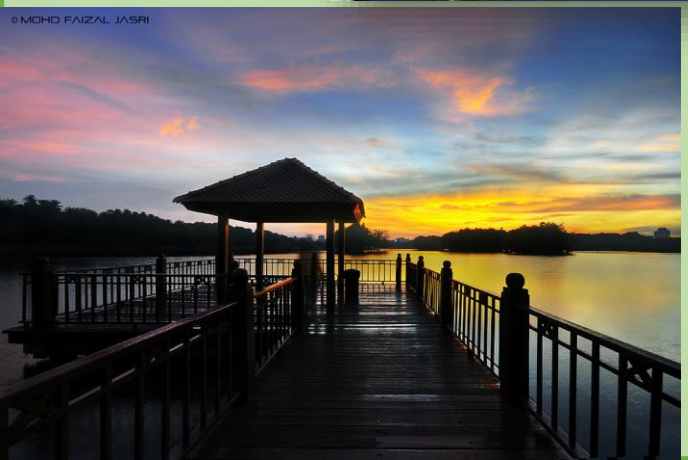
- **GI = GS + environmental components in non-GS land use contexts.**
- **GI = Benefits derived from functionality.**
- **GI = more than a space – it's a natural environmental system.**
- **GS (Resource/Asset) = GI but GI is not necessarily a space.**

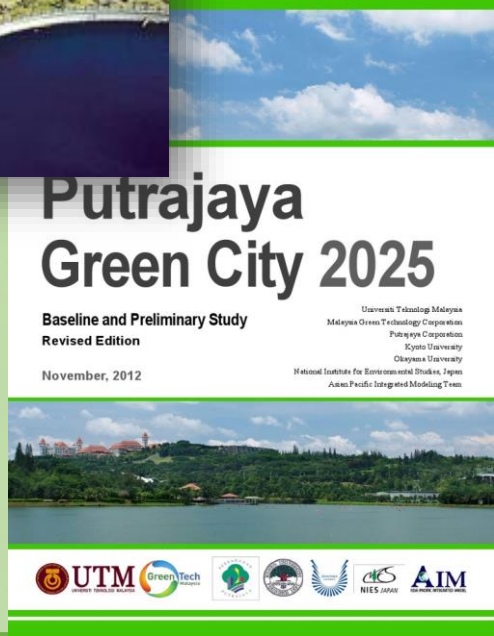
GREEN INFRASTRUCTURES…..Benefits

Social	Economic	Environmental
Amenities - the community benefits from new amenities and recreational opportunities	**Lower costs** – it results in lower lifecycle costs when compared to traditional larger-scale, non-integrated systems.	**Efficiency** - through reductions in the size of the distribution system, reductions in overall capacity, and better matching of resource quality to the user's needs.
Aesthetics & a 'sense of place' - offers new opportunities for beautification of public spaces and creating a 'sense of place'.	**Longer-term Investments by stakeholders** – the stakeholders are likely to see the wisdom of investing in demand side management and lifecycle costing.	**Innovation and upgrading** - using small scale, cluster structure technologies, is a system that is well suited for trying out new technologies, and for integrating technological advances in a rapid, incremental style.
Flexibility - allow cities to more effectively use their land base	**Local job creation** - Green infrastructure creates more employment within the community.	**Restoration** - respect local carrying capacity and adapt to the environmentally sensitive areas.
A greater choice of lifestyles - A diversity of infrastructure systems creates the possibility for greater choice in lifestyle.	**Local procurement** - it boosts business in the community.	**Biodiversity and produ** by responding to environmental constrai corporating living elements and ecological systems
Improved public health, safety, and quality of life	**Increased property values and economic development** - Streetscape improvements have the potential to increase neighbourhoods livability and increase its property values	Reduce Urban Heat Island



D. PUTRAJAYA WETLAND…Example of Green Infrastructure





PUTRAJAYA WETLAND….Example of Green Infrastructure

- **First man-made wetland in Malaysia and the largest constructed freshwater wetlands** in the tropics.
- Part of the Putrajaya Lake system, it covers approximately **200 hectares of lands and water.**

Fig: Putrajaya Wetland (Source: www.google.com)

- Construction began in **1997 and completed in 2002.** Key environmental function is to **treat catchment water before it enters Putrajaya Lake**, thus ensuring that water in the lake remains clean and unpolluted.
- **30%** area of catchment managed by the authority; **70%** is controlled by the private land owners.
- Managed through specific procedures and management guidelines that include the **Putrajaya Lake Use Master Plan and Environmental Management Guidelines** considering the overall lake and wetland management scope.

PUTRAJAYA WETLAND….Example of Green Infrastructure

- To ensure the efficiency of the lake management, **six zones** have been established together with a schedule or permissible and non-permissible land-based and water-based activities applicable to each zone.

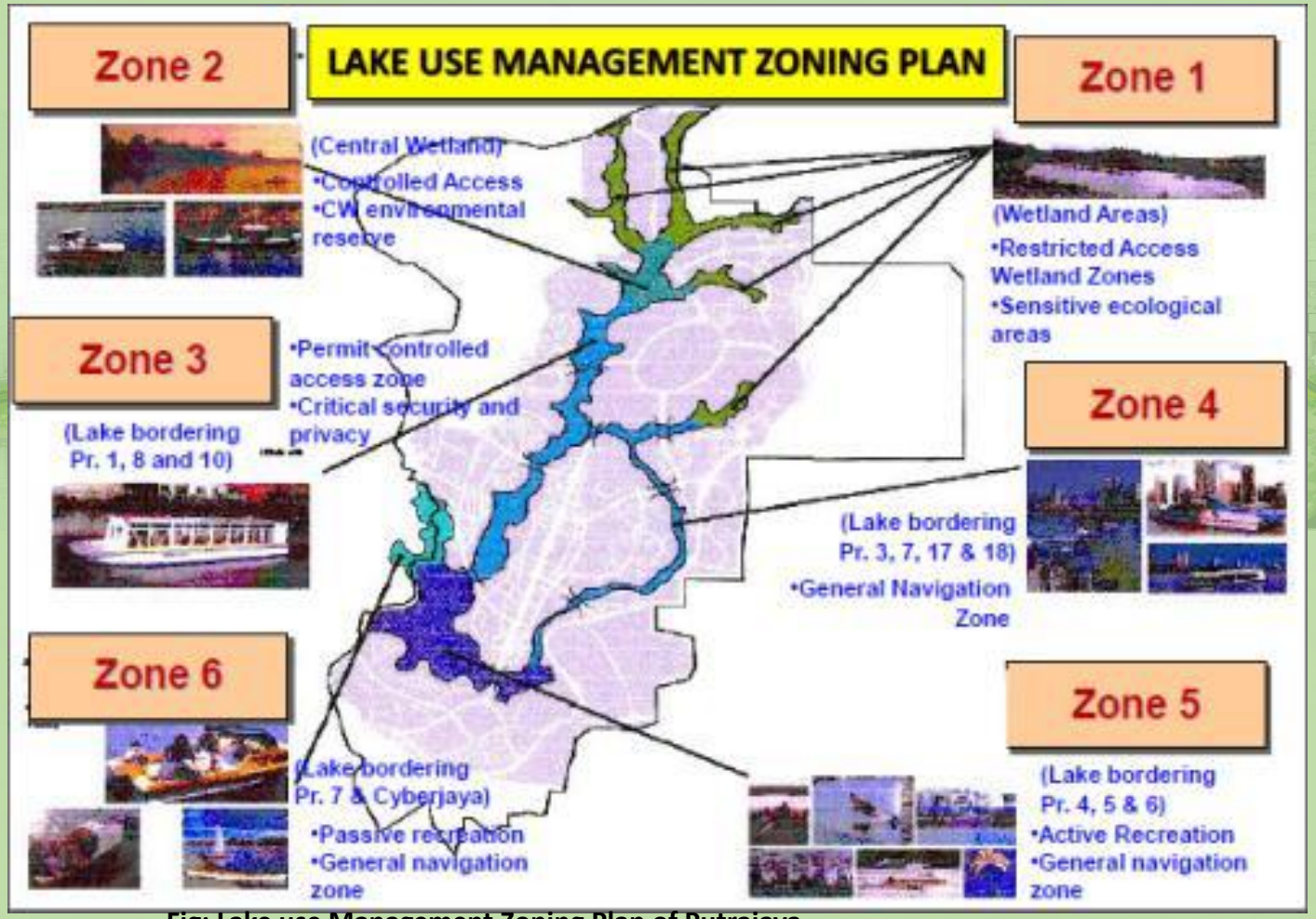


Fig: Lake use Management Zoning Plan of Putrajaya

(Source: Hasnul *et al.,* n.d.)

PUTRAJAYA WETLAND….Example of Green Infrastructure

Putrajaya's Wetland serves various functions such as :

- ✓ **Natural grey water treatment system**
- ✓ **Storm water management - flood retention by multi-cells**
- ✓ **Groundwater recharging system**
- ✓ **Soil stabilization measure**
- ✓ **Erosion control**
- ✓ **Hub for nature and biodiversity in urban fabric**
- ✓ **Recreational hot spots**
- ✓ **Enhance the city's landscape**

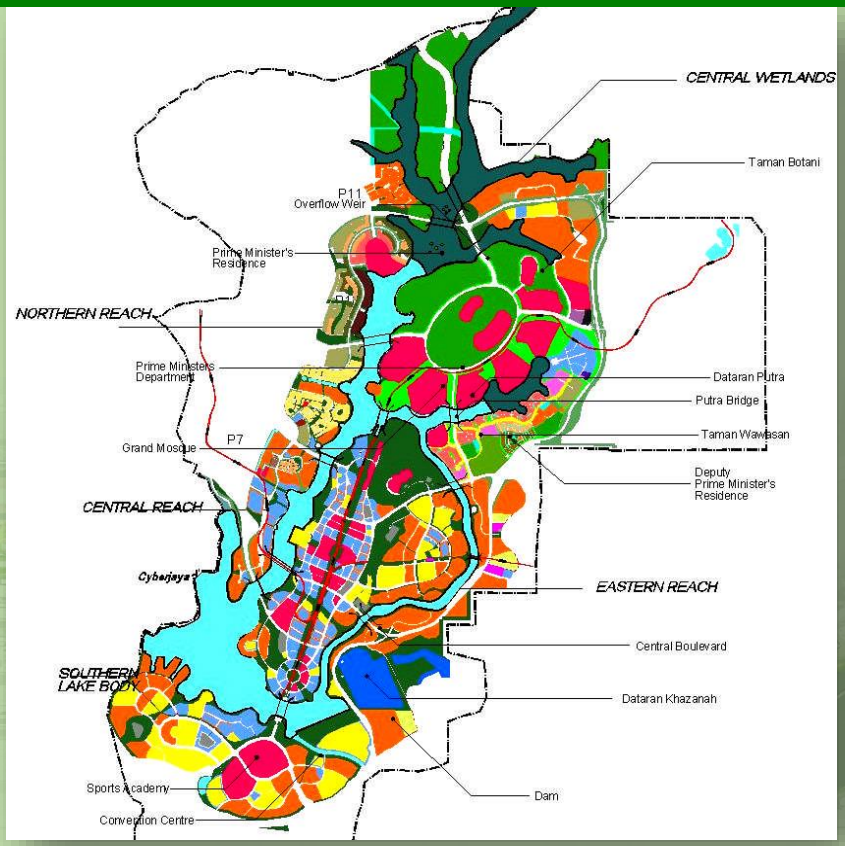


Fig: Putrajaya Masterplan and Wetland System (Siong, 2006)

PUTRAJAYA WETLAND….Example of Green Infrastructure

How it works

- ✓ The system features a **multi-cell multistage system with flood retention capability.**
- ✓ Consists of **24 cells** divided into six arms. All arms except one discharge to the Central Wetland, the 24th cell, before flowing into Putrajaya Lake.
- ✓ A series of **rock filled weirs** was constructed along the six arms of the wetland to divide the 24 cells.
- ✓ Each wetland cell is planted with wetland plants native to Malaysia.
- ✓ The water that flows into all these 24 wetlands cells is cleansed multiples times through natural processes ensuring that only clean water enters Putrajaya Lake (ADB, 2016).

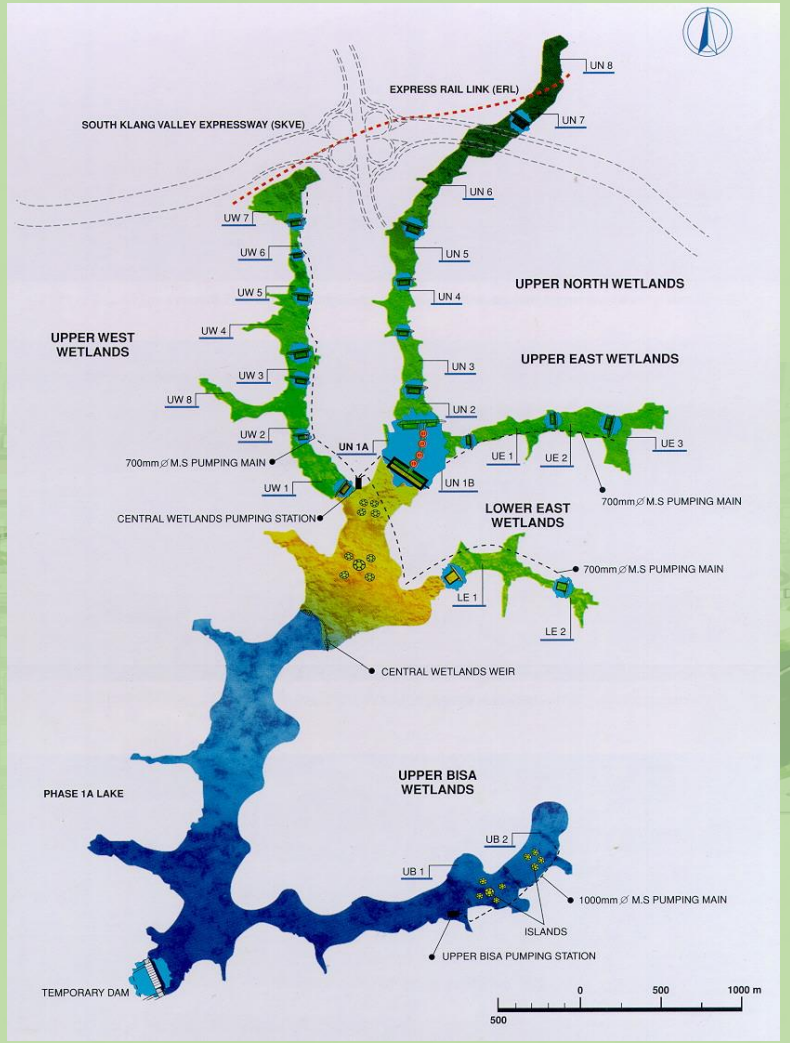


Fig : Illustration of the Regions and Components Supporting the Function of the Putrajaya Wetlands (ADB, 2016).

PUTRAJAYA WETLAND….Example of Green Infrastructure

Benefits:

- ✓ **Natural storm water and flood management system** for Putrajaya.
- ✓ Increased **wildlife habitat** and conservation zones.
- ✓ **Nature education and research area.**
- ✓ **Increased outdoor tourism**
- ✓ Filtration properties of the **wetland trap, break down, and digest pollutants in water before it enters the lake.**

Nutrient removal performance along six cells was

- ✓ **82.11% for total nitrogen**
- ✓ **70.73% for nitrate–nitrogen**
- ✓ **84.32% for phosphate** (ADB, 2016).

Fig: Wildlife Habitat and Biodiversity

Fig: Nature Tourism

Fig: Research and Study Tour group

PUTRAJAYA WETLAND….Example of Green Infrastructure

PUTRAJAYA PARKS AND OPEN SPACE

PUTRAJAYA WETLAND….Example of Green Infrastructure

PUTRAJAYA LAKE ACTIVITIES

E. CONCLUSION

Smart City or not, GI brings plenty of benefits that would of course be much enhanced with smart city techniques and applications.

THANK YOU
Terima kasiH