NATIONAL WATER FORUM 2014

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*Roles of Wetlands

[+]Presented at the National Water Forum, 9-10 June 2014

*Presentation Outline

- ✧ Why do we need water?
- ✧ Water under pressure
- ✧ Wetlands – a solution
- ✧ Types of Wetlands
- ✧ Importance of Wetlands
- ✧ Usage of habitat creation

*Why do we need water?

Potable Water

Industry

Transportation

Commerce

Domestic Use

Power Generation

Tourism/ Recreation

Culture/ Religion

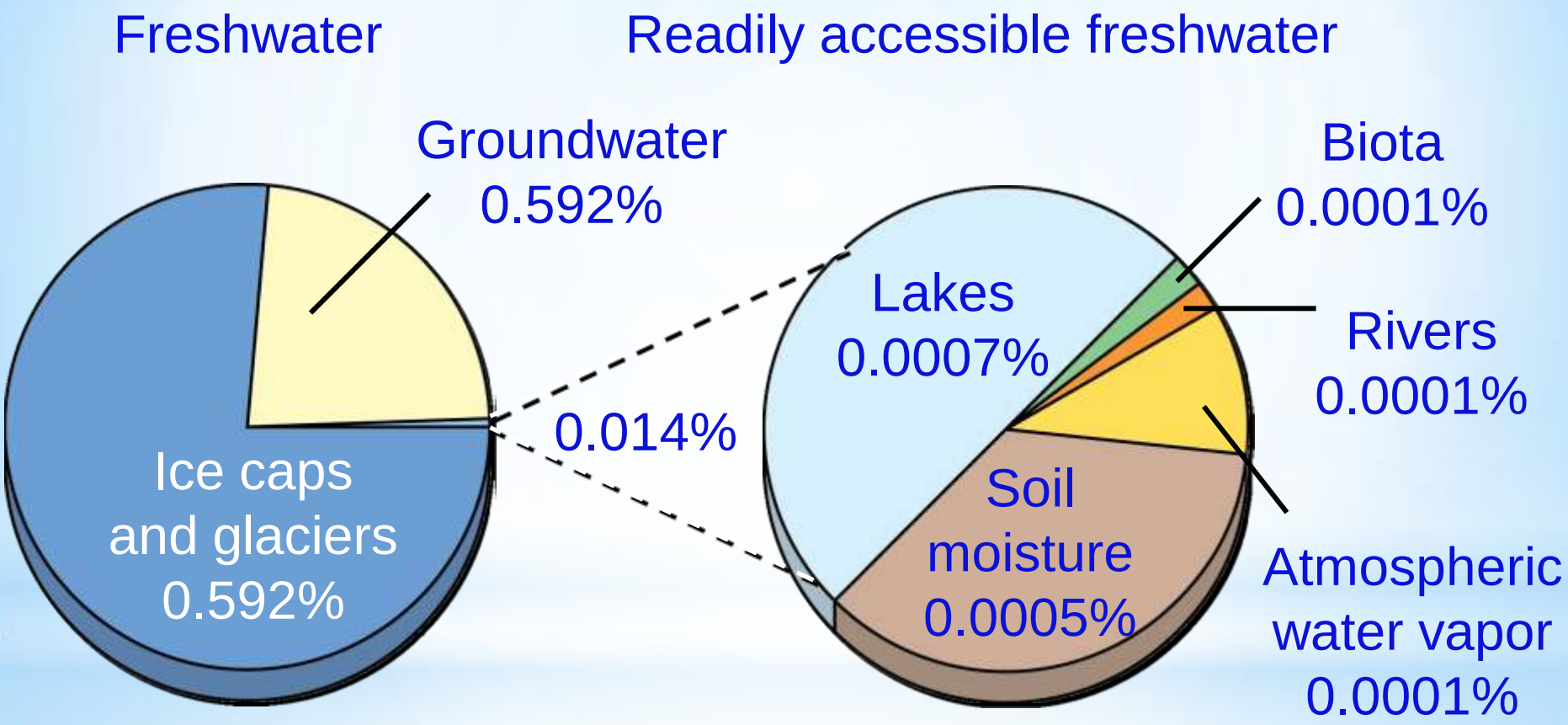
Agriculture

Aquaculture

Sanitation/ Health

Ecological Functions

Supply of Water Resources



Malaysian Water Vision

Malaysian Water Vision

"In support of Wawasan 2020 (towards achieving developed nation status), Malaysia will conserve and manage its water resources to ensure adequate and safe water for all (including the environment)"

From Vision to Mission (developed into the National Water Resources Policy, 2012)

Water for People

Water for Food and Rural Development

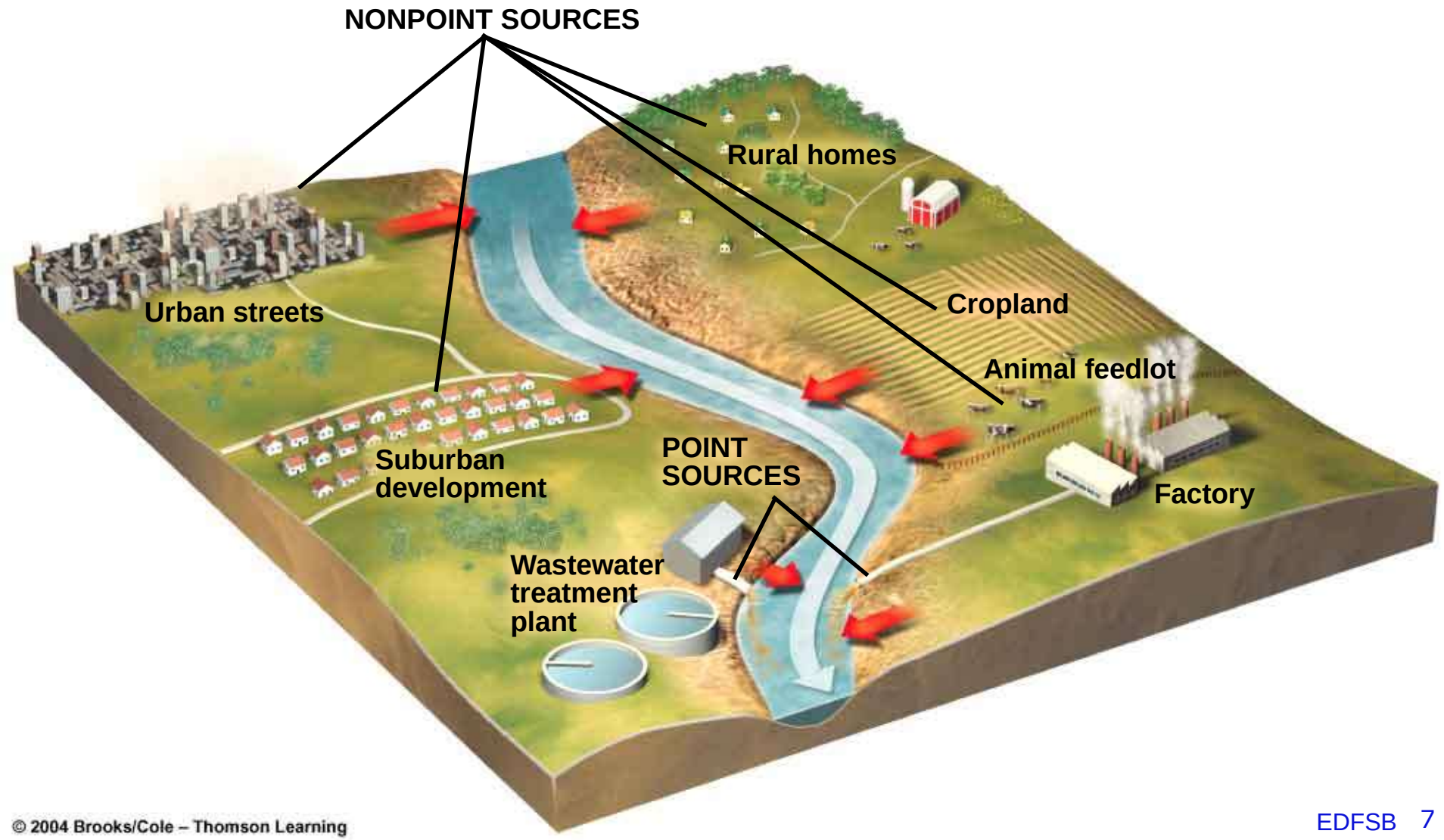
Water for Economic Development

Water for the Environment

Water for Energy

*Water under pressure

Pollution - Point and Nonpoint Sources



*Potential sources of pollutants agriculture/lawn/parks and residential areas

- *sediments from coastal urban and road, agricultural, construction, development
- *Pathogens, nutrients from detergents, fertilizers, leaky septic tanks, and domesticated animals
- *pesticides (home use, agricultural, & golf courses)
- *automobile wastes such as combusted motor oil, tire rubber, brake pad dust, coolant, etc.
- *waste water from swimming pools and aquaculture ponds
- *Debris: Litter and illegal dumping
- *Thermal: heated runoff, removal of streamside vegetation

Pollutant Transport Mechanisms

- NPS pollutants build up on land surfaces during dry weather
  - Atmospheric deposition
  - Fertilizer applications
  - Animal waste
  - Automotive exhaust/fluid leaks
- Pollutants are washed off land surfaces during precipitation events (stormwater runoff)
- Stormwater runoff will flow to wetlands lakes and streams

*Typical Urban Runoff Pollutant Sources

Pollutant Source	Solids	Nutrients	Pathogens	DO Demands	Metals	Oils	Synthetic Organics
Soil Erosion	√	√		√	√		
Cleared Land	√	√	√				
Fertilisers		√			√		
Human Waste	√	√	√	√			
Animal Waste	√	√	√	√	√		
Vehicle Fuels and Fluids	√		√	√	√		
Pesticides					√	√	√
Stormwater Facilities	√	√	√	√	√		

*Typical Urban Runoff Pollutant Sources

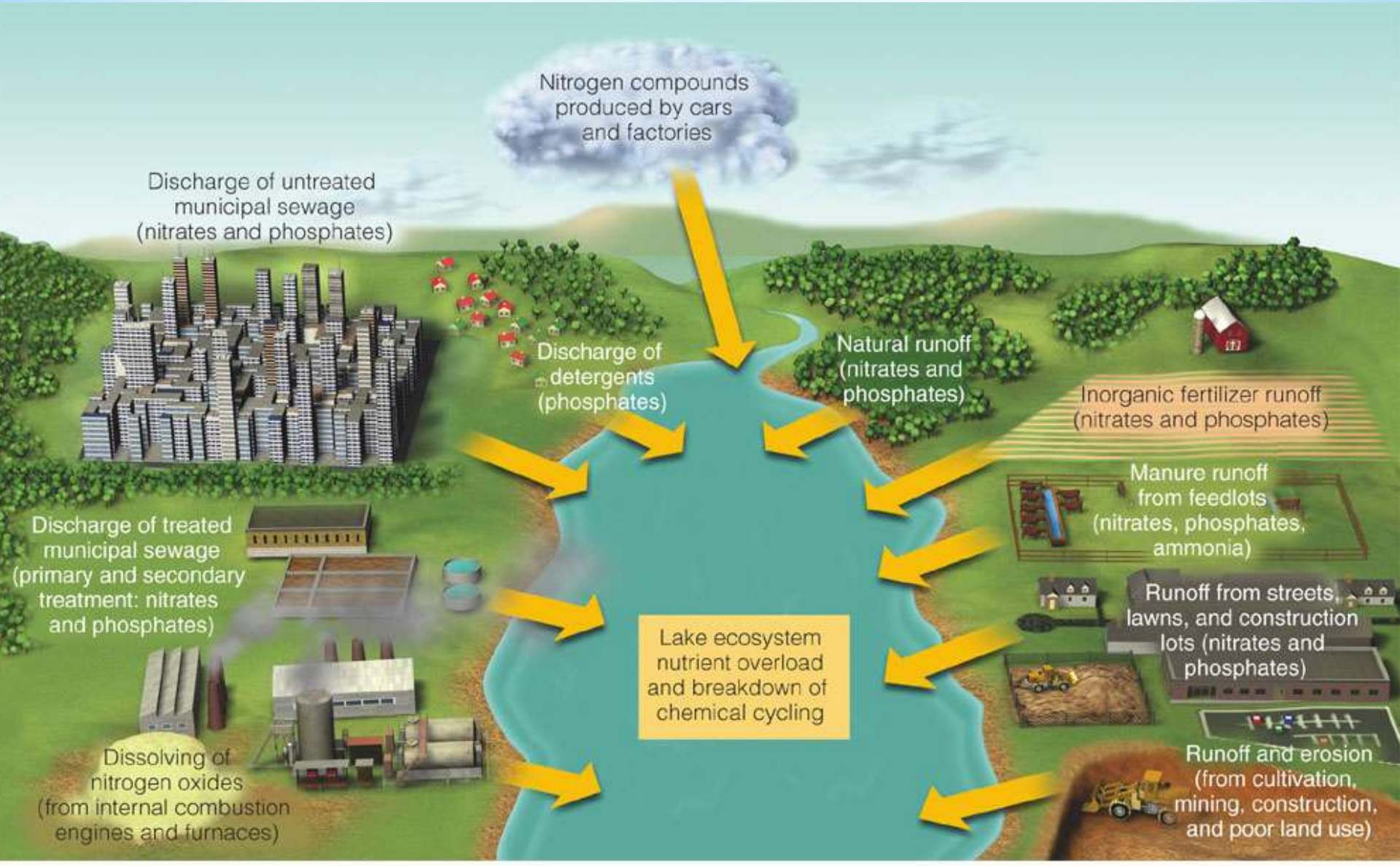
Pollutant Source	Solids	Nutrients	Pathogens	DO Demands	Metals	Oils	Synthetic Organics
Fuel Combustion		√			√	√	
Vehicle Wear	√				√		
Insdustrial and Household Chemicals	√	√			√	√	√
Insdustrial Processes	√	√			√	√	√
Paint and Preservatives					√	√	
Pesticides					√	√	√

Source: Brown, R.R and Wong, T.H.F (1995) Retrofitting a small urban catchment for stormwater polulution control, *Proceedings of the 2nd International Symposium on Urban Stormwater management , melbourne, Australia* July, pp. 381-386.

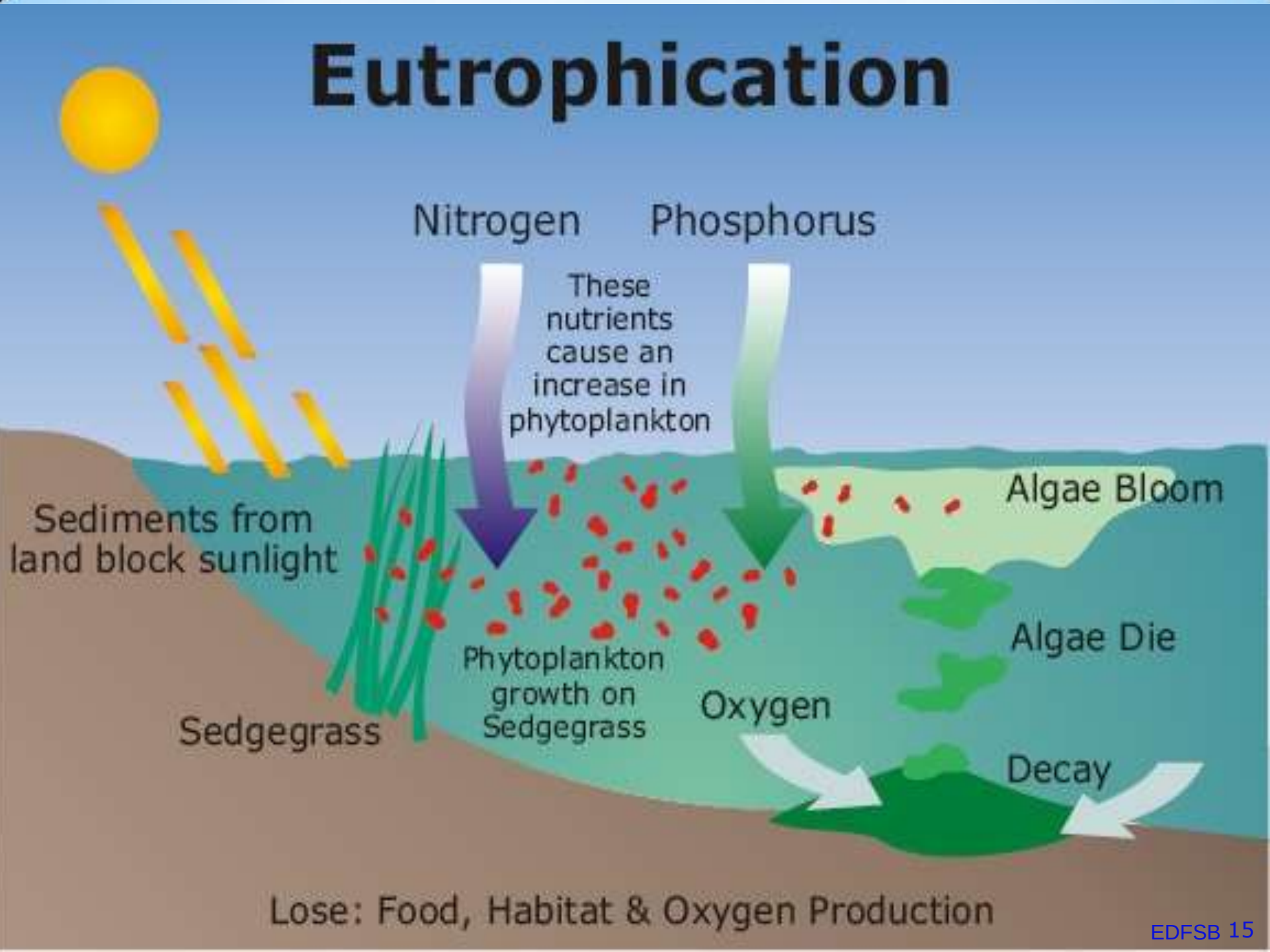
*Pollutants Associated With Urban Dust And Dirt (Mg/G Per Mg/L)

Contaminant	Particle Size Range					
	< 74 µm	74 - 105 µm	105 - 250 µm	250 - 840 µm	840-2000 µm	>2000 µm
Cu	7,100	12,000	66,000	5,900	1,600	344
Zn	28,000	41,000	31,000	11,000	4,100	371
Pd	37,000	55,000	62,000	86,000	19,000	15,000
Total P	3,000	4,800	5,400	2,500	3,000	3,900

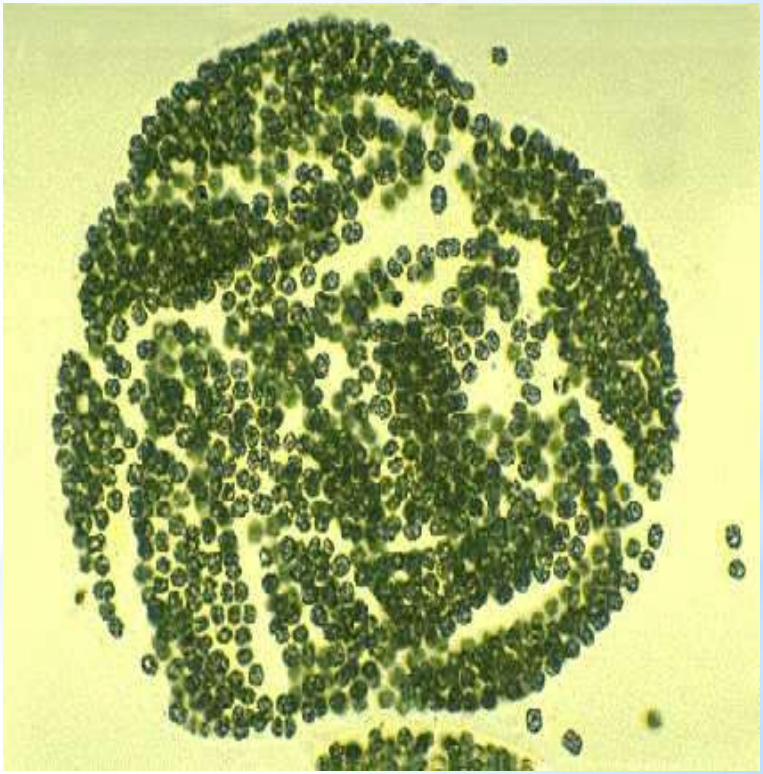
Source: Dempsey, B.A ., Tai, Y.L and Harrison, S.G. (1993) Mobilisation and removal of contaminants associated with urban dust and dirt, Water Science Technology, 28(3-5):225-230



Nutrients and Algae Growth


Eutrophication
Nitrogen
Phosphorus
These nutrients cause an increase in phytoplankton
Algae Bloom
Sediments from land block sunlight
Algae Die
Phytoplankton growth on Sedgegrass
Oxygen
Sedgegrass
Decay
Lose: Food, Habitat & Oxygen Production

Microcystis -A toxic blue-green alga



Eutrophication is apparent as increased turbidity in the northern part of the Caspian Sea, imaged from orbit

The eutrophication of the Potomac River is evident from its bright green water, caused by a dense bloom of cyanobacteria

Controlling Measures – Kaedah Kawalan

Wetlands – a solution

*Wetlands – lands covered with water all or part of a year

* DEFINISI : WETLAND @ Tanah Bencah

* Wetland = tanah lembap atau tanah bencah

* Kawasan berair sama ada buatan manusia atau semulajadi, bersifat kekal atau sementara, sama ada air tawar, payau atau air masin, yang mana kedalamannya tidak melebihi 6 meter semasa air surut.

(Definisi Wetland mengikut Persidangan Ramsar di Iran tahun 1971)

Wetlands – a solution

- Home to ~33% of nation's threatened and endangered species;
- Statistics – 50% loss since 1900 in US; cities on filled wetlands; rising sea level;
- Mitigation banking – National Academy: ~half of attempts to build a wetland fail.
- More than 500 wetland restoration banks in the US

Wetlands – a solution

* Mostly by draining for development or farming.

* To 'reclaim' land along coastlines

* How wetlands are destroyed

PEAT SWAMP FORESTS

VERNAL POOLS

BOG

MANGROVES

MARSH

SLOUGH

SWAMP

FEN

PRAIRIE POT HOLES

*Types Of Wetlands

*Wetland Classification Chart

Major Categories	General Location	Wetland types
Coastal Wetlands:		
Marine (undiluted salt water)	Open coast	Shrub wetland, salt marsh, mangrove swamp
Estuarine (salt/freshwater mix)	Estuaries (deltas, lagoons)	Brackish marsh, shrub wetland, salt marsh, mangrove swamp
Inland Wetlands:		
Riverine (associated w/ rivers and streams)	River channels and floodplains	Bottomlands, freshwater marsh, delta marsh
Lacustrine (associated w/ lakes)	Lakes and deltas	Freshwater marsh, shrub and forest wetlands
Palustrine (shallow ponds, misc. freshwater wetlands)	Ponds, peatlands, uplands, ground water seeps	Ephemeral ponds, tundra peatland, ground water spring oasis, bogs

Bogs

Bogs serve an important ecological function in preventing downstream flooding by absorbing precipitation. Bogs support some of the most interesting plants in the United States (like the carnivorous sundew), and provide habitat to animals threatened by human encroachment.

The northern pitcher plant (Sarracenia purpurea) overcomes the nutrient deficiencies of bog life by capturing insects in pools of water in its leaves and digesting them with the help of some local bacteria.

Marshes

- Current
- Herbaceous plants
- Mild acid/base
- No floating soil

carnivorous sundew

Swamps

- Current
- Woody plants
- More acid/base
- No floating soil

Swamps are forested wetlands. Like marshes, they are often found near rivers or lakes and have mineral soil that drains very slowly. Unlike marshes, they have trees and bushes. They may have water in them for the whole year or for only part of the year. Swamps vary in size and type. Some swamps have soil that is nutrient rich, other swamps have nutrient poor soil. Swamps are often classified by the types of trees that grow in them.

- Vernal pools are seasonal depressional wetlands that occur under the Mediterranean climate conditions of the West Coast. They are covered by shallow water for variable periods from winter to spring, but may be completely dry for most of the summer and fall. These wetlands range in size from small puddles to shallow lakes and are usually found in a gently sloping plain of grassland.

Vernal pools

The Everglades

- ~77,000 sq km; 3 sub-basins
- Thin sheet of water 40-60 miles wide
- Formed ~5000 yrs ago--how
- Human influences:
  - late 1880's—first dredging
  - 1907 and 1928: canals—saltwater; draining south of Lake O.
  - 1961-1971: Kissimee River channelized 65% now drained
- Plants and animals depend on water level timing—seriously disturbed
- Number of species of wading birds—dropped 95% since 1947

Fen

Fens, like bogs, are peatlands, but because they are fed by groundwater they are not so acidic as bogs.

*Malaysia's mangroves have declined over 45% from an estimated 1.1 million hectares to the current estimate of 564,970 hectares.

*Though the government has established a national committee to oversee research and replanting efforts, remaining mangroves continue to be threatened through illegal encroachment and drainage.

*Mangroves

With the onset of climate change and increase in sea levels, we need to ensure that our coastlines are resilient. An estimated 29% of our country's 4,000km coastline has been classified as facing serious erosion.

For example, Tanjung Piai, the southern most point of Asia's mainland and one of Malaysia's Ramsar sites, is suffering from severe erosion of up to 9 meters per year.

*Mangroves

*Peat swamp forests

While deforestation in non-peatland areas has declined, deforestation of tropical peatlands has increased over the last 20 years.

In 2005, 25% of all deforestation in Southeast Asia was on peatlands. Land use conversion and drainage of these valuable carbon stocks have led to fires on peatlands and large emissions of greenhouse gasses


Wetland Paya Indah

*Wetland semulajadi vs wetland buatan & kepentingannya

- ✓Wetland semulajadi = telah sedia ada
- ✓Wetland buatan = dibina untuk tujuan tertentu

*Ciri/contoh wetland semulajadi di Malaysia:

- *Tasik (cth: Tasik Bera dan Tasik Chini),
- *Sungai, Kuala (cth: Kuala Gula di Perak),
- *Paya gambut (cth: Paya Indah Wetlands di Selangor), serta
- *Delta (seperti Delta Rajang di Sarawak, iaitu Sungai Rajang).

*Wetland semulajadi vs wetland buatan & kepentingannya

Contoh tanah bencah buatan:

- Kawasan empangan (empangan Kenyir): janakuasa tenaga hidro ,
- Kawasan sawah padi seperti di Kedah, Perak dan Selangor, serta
- Bekas tapak lombong
- Kawasan rekreasi air seperti Tasik dan Wetland Putrajaya


Wetland Putrajaya

PUTRAJAYA WETLAND

- completed: August 1998
- construction duration: 17.5 month
- depth: 0.5 to 3 m
- surface area: 200 ha

Main objective

- surface run-off filtration system for Putrajaya Lake

PUTRAJAYA LAKE

- completed: May 2002
- construction duration: 62 month
- depth: 2 to 13 m
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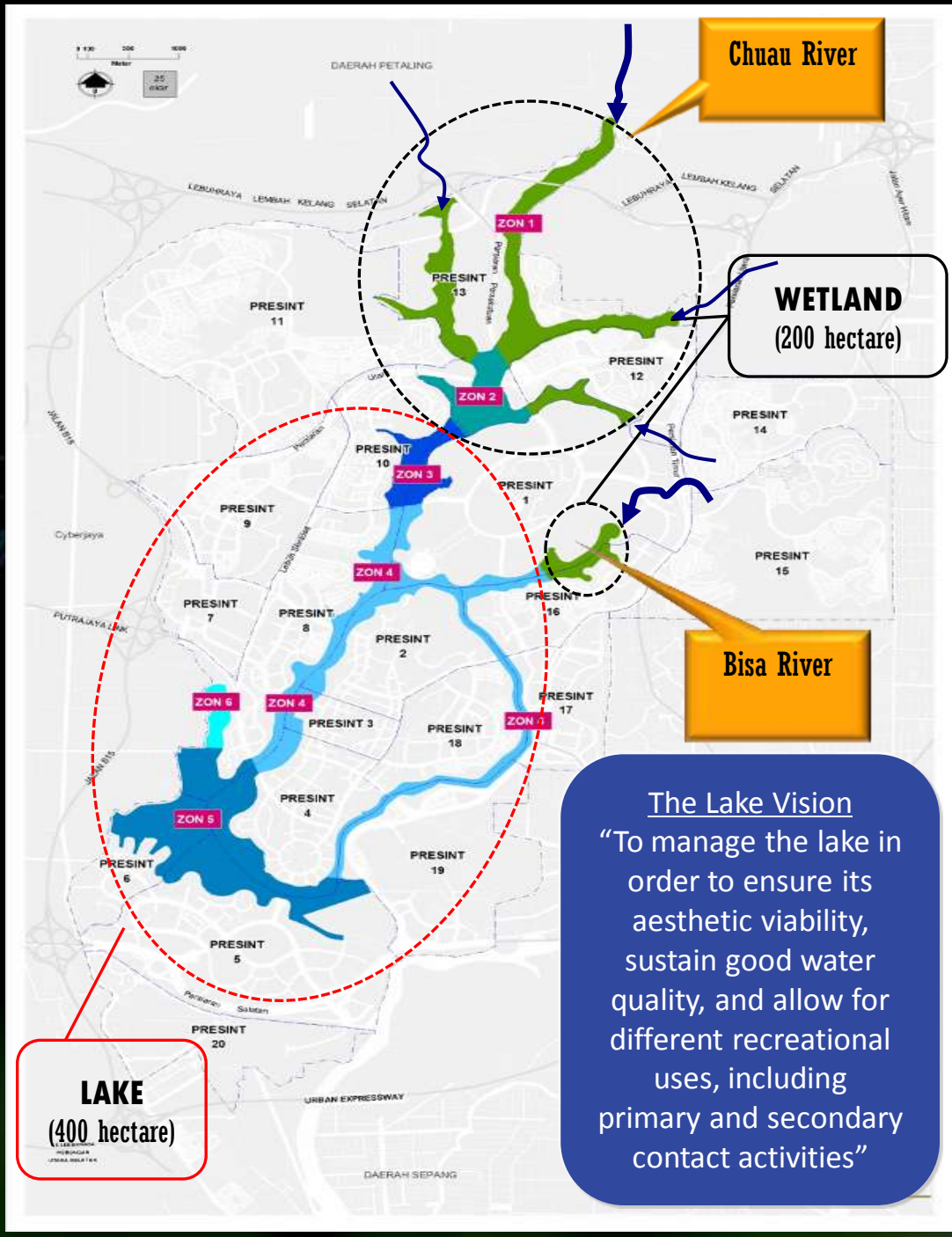
Main objective:

- centre for water sports, recreation and tourism



The Lake Vision

"To manage the lake in order to ensure its aesthetic viability, sustain good water quality, and allow for different recreational uses, including primary and secondary contact activities"

Wetlands

Algae Bloom

Euglena bloom
Wetland Cells - UN8, UN7, UN6, UN5 (2011-2012)

Upper North 7

Upper North 6a
Pada 29 Dis 2012

Upper North 6

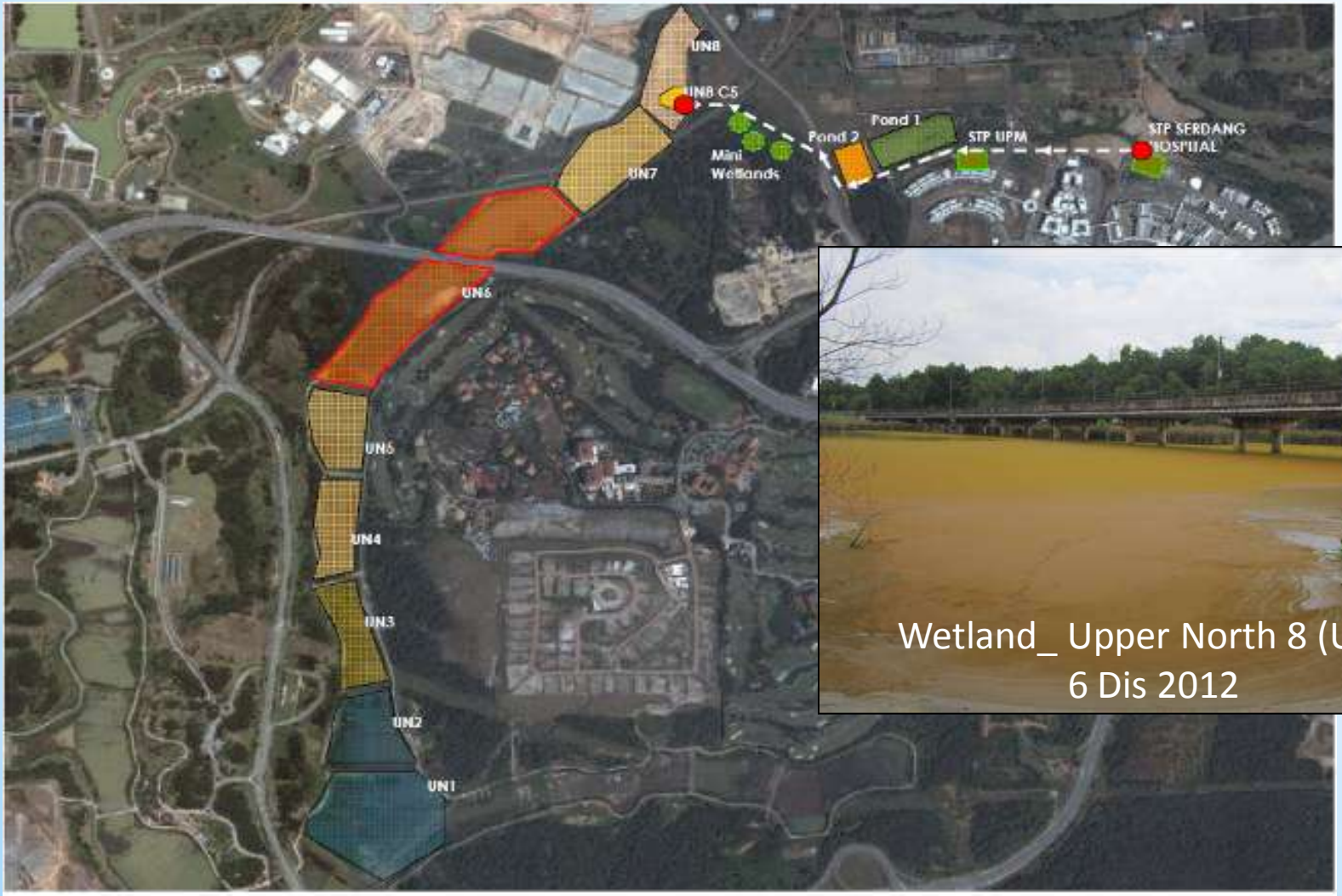
Upper North 5

Upper North 5
Pada 29 Dis 2012

Wetlands

Euglena bloom
Wetland cells
UN8, UN7, UN6, UN5 (2011-2012)

Algae Bloom



Wetland_ Upper North 8 (Un8)
6 Dis 2012

Technological Approach: Using Wetlands to Treat Sewage

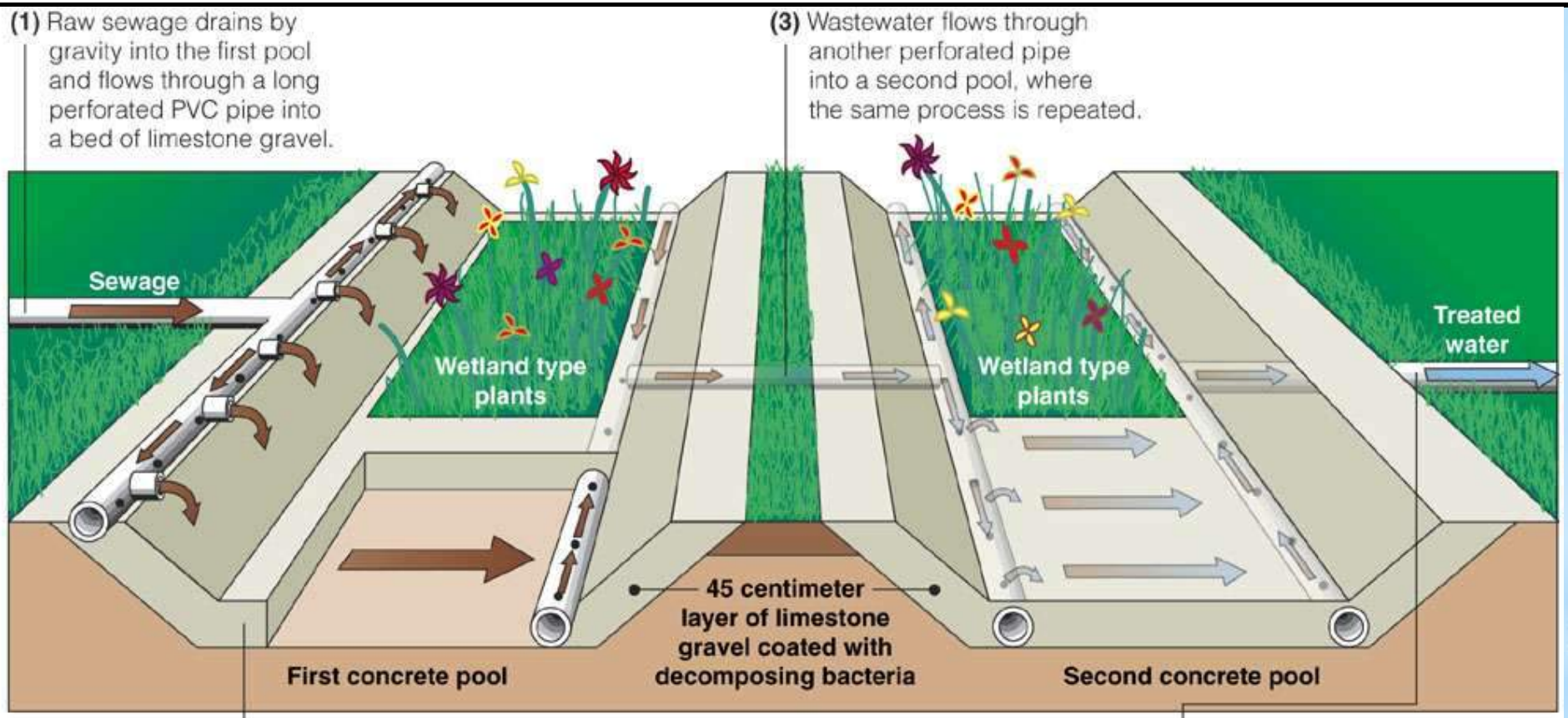


Fig. 22-13, p. 513

Senarai tapak RAMSAR di Malaysia

- ✓ Tasik Bera (Pahang), 10 Nov 1994
- ✓ Pulau Kukup (Johor), 31 Jan 2003
- ✓ Sungai Pulai (Johor), 31 Jan 2003
- ✓ Tanjung Piai (Johor), 31 Jan 2003
- ✓ Taman Negara Kuching (Sarawak), 8 Nov 2005
- ✓ Lower Kinabatangan – Segama Wetland (Sabah), 28 Okt 2008

Tasik Chini, Pahang
Man and Biosphere site

Tasik Kenyir, Terengganu

Sungai Kinabatangan


© 2010 Rabani HM, Ayob


tasik bera

*Presentation Outline

- ✧ Why do we need water?
- ✧ Water under pressure
- ✧ Wetlands – a solution
- ✧ Types of Wetlands
- ✧ **Importance of Wetlands**
- ✧ Usage of habitat creation

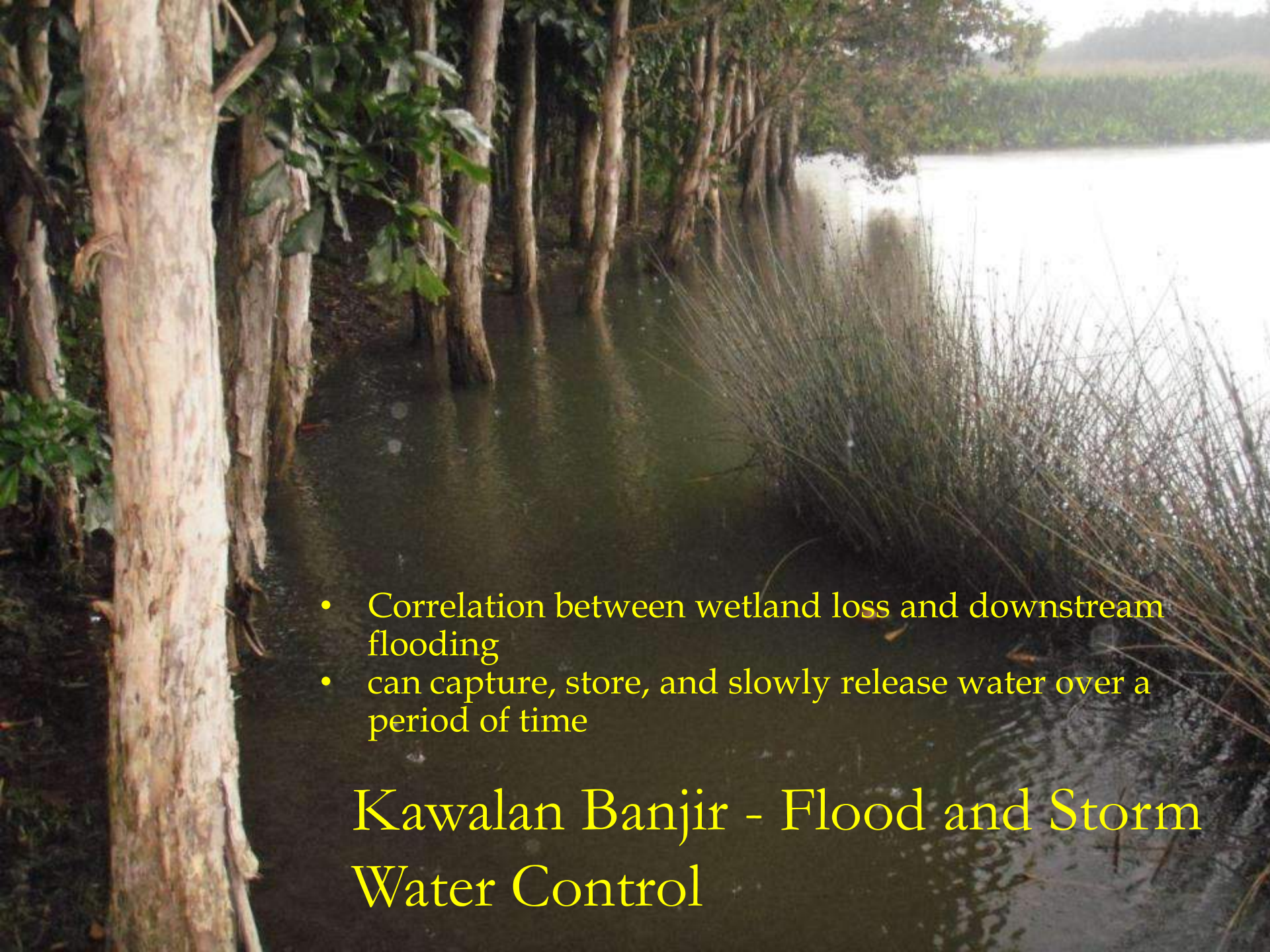
Why Are Wetlands Valuable?

i. Physical/Hydrological Functions of Wetlands
ii. Chemical Functions of Wetlands
iii. Wetland: water treatment processes
iv. Biological Functions of Wetlands
v. Ecosystem Services

*Importance Of Wetlands

Physical/Hydrological Functions of Wetlands

- **Flood Control**
  - Correlation between wetland loss and downstream flooding
  - can capture, store and slowly release water over a period of time
  - Storm Water Control/Floodflow alteration
- **Coastal and Slope Protection**
  - Serve as storm buffers –erosion control
- **Ground Water Recharge**
  - Water has more time to percolate through the soil
  - Surface and Groundwater Protection/ recharge and discharge
- **Natural filter - Sediment Traps**
  - Wetland plants help to remove sediment from flowing water
  - sediment stabilization /toxicant retention/removal
- **Atmospheric Equilibrium**
  - Can act as 'sinks' for excess carbon and sulfur
  - Can return N back to the atmosphere (denitrification)



- Correlation between wetland loss and downstream flooding
- can capture, store, and slowly release water over a period of time

Kawalan Banjir - Flood and Storm Water Control

Tanah bencah sebenarnya mampu memerangkap air sewaktu banjir dan membantu melindungi kawasan rendah daripada dilanda banjir. Oleh kerana tanah bencah merupakan kawasan yang rendah maka tahap takungan airnya tinggi.

Walaupun sudah berair...banyak tempat tanah bencah sekadar mempunyai air yang minimum sahaja dan mampu menampung air pada waktu hujan lebat.

Paya bakau merupakan penambak laut semulajadi. Sedimen serta kelodak yang terperangkap bertahun-tahun lamanya membolehkannya saiz tanah daratan bertambah luas.

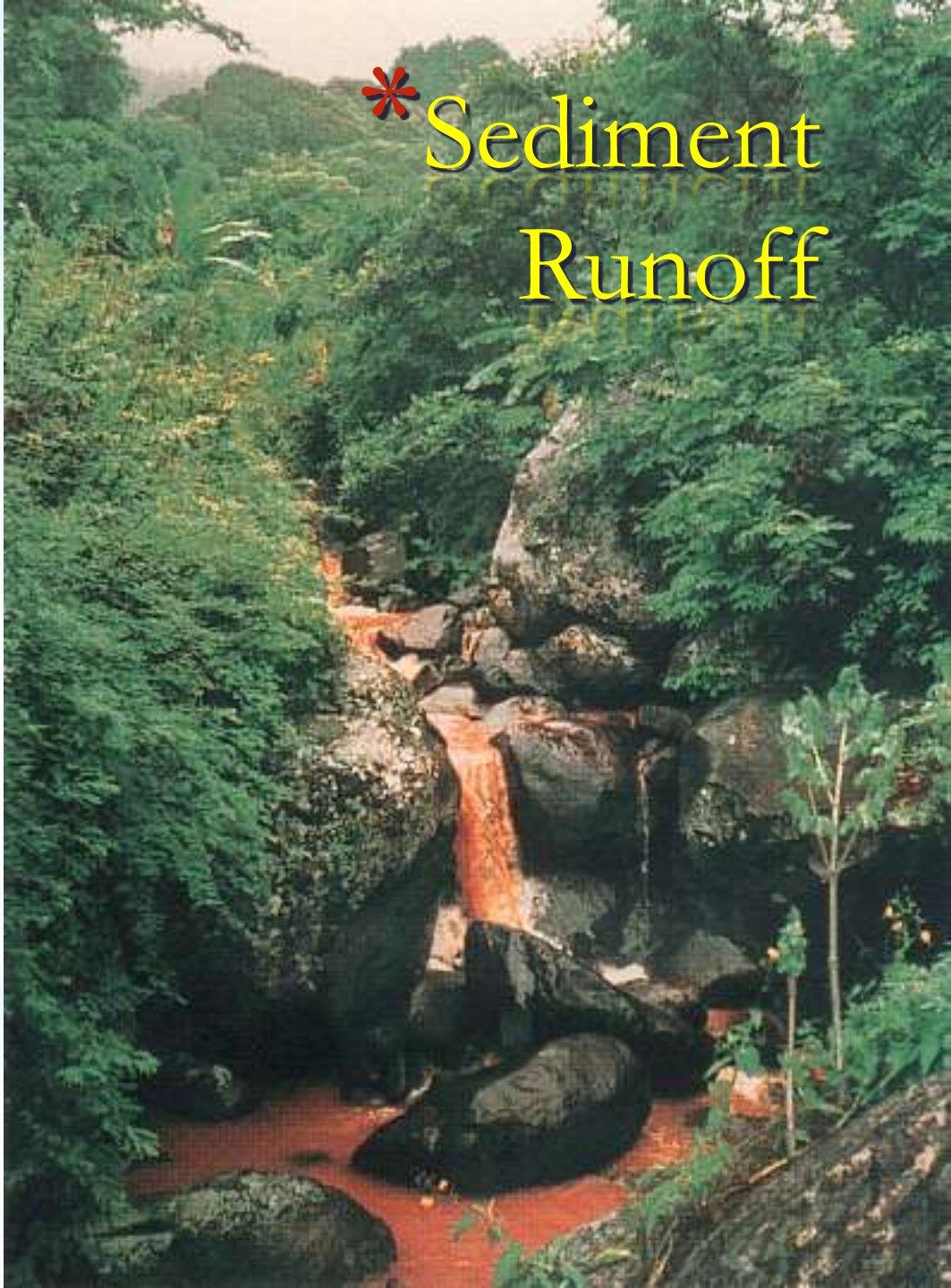
Penambak laut

Serve as storm buffers

Tanah bencah melindungi pinggir pantai daripada mengalami proses hakisan yang serius. Malahan tanah bencah juga merupakan penebat tenaga angin untuk menyerap tenaga angin ketika berlakunya ribut di pinggir pantai. Malahan dikatakan jika sepanjang pantai di Banda Acheh tanah bencahnya tidak diganggu untuk pembangunan, tanah bencah yang dipenuhi dengan pokok bakau mampu menyerap hentaman tsunami sebanyak 30%.

Pelindungan Pinggir Pantai (zon penampan)

Natural filter – sediment stabilization /toxicant retention

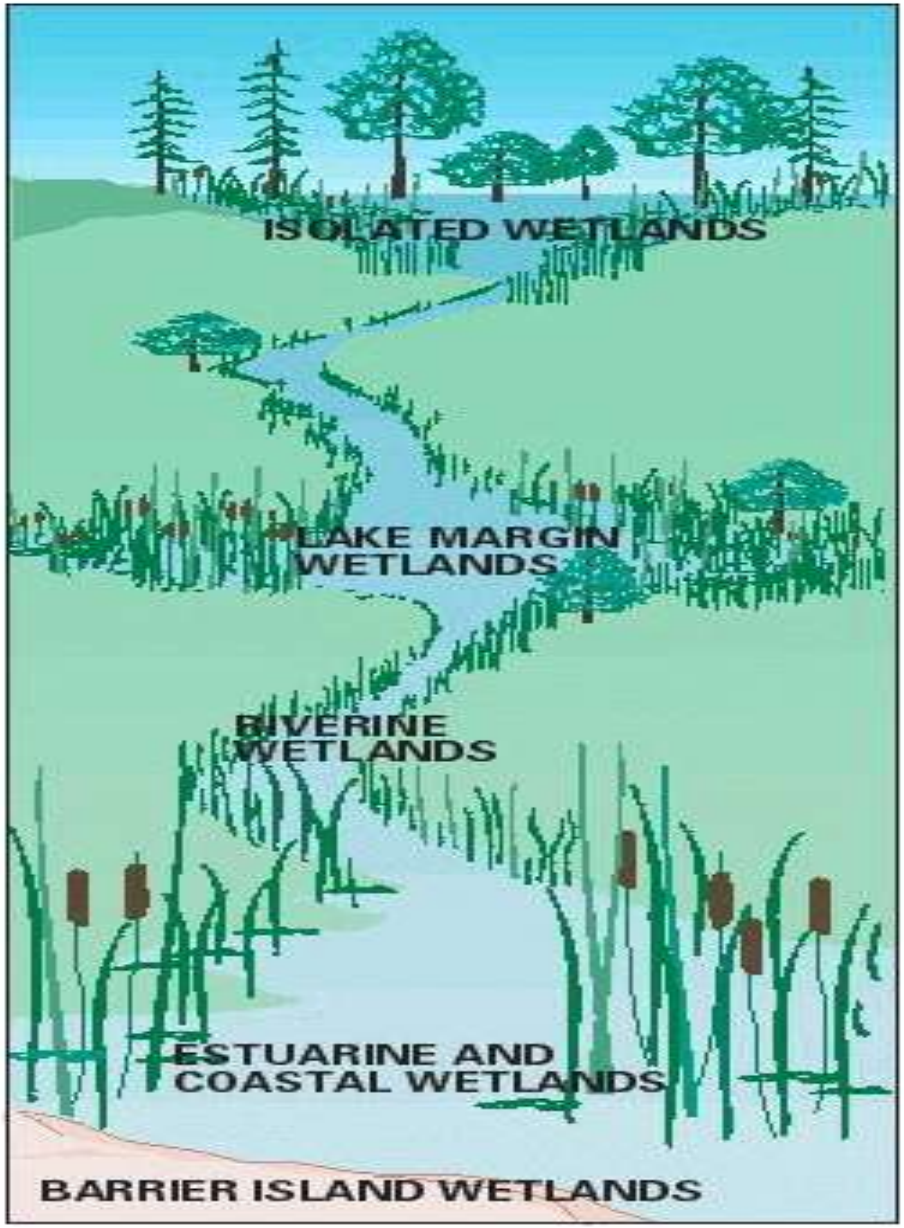


Memerangkap sedimen

Wetland plants help to remove sediment from flowing water

Tanah bencah berfungsi seolah-olah sebagai penuras yang boleh memerangkap sedimen seperti kelodak yang melaluinya sebelum menuju ke laut.

Cth: Di Wetland Putrajaya, tumbuhan wetland ditanam khusus untuk berfungsi menyerap serta menapis bahan pencemar. Dengan yang demikian, air yang melaluinya akan dapat ditambahbaik kualiti.



CHARACTERISTICS AND FUNCTIONS OF WETLANDS

Isolated Wetlands
1. Waterfowl feeding and nesting habitat
2. Habitat for both upland and wetland species of wildlife
3. Floodwater retention area
4. Sediment and nutrient retention area
5. Area of special scenic beauty

Lake Margin Wetlands
1. See "isolated wetlands" above
2. Removal of sediment and nutrients from inflowing waters
3. Fish spawning area

Riverine Wetlands
1. See "isolated wetlands" above
2. Sediment control, stabilization of river banks
3. Flood conveyance area

Estuarine and Coastal Wetlands
1. See "isolated wetlands" above
2. Fish and shellfish habitat and spawning areas
3. Nutrient source for marine fisheries
4. Protection from erosion and storm surges

Barrier Island Wetlands
1. Habitat for dune-associated plant and animal species
2. Protection of backlying lands from high-energy waves
3. Scenic beauty

Figure 50. Wetland functions depend upon the location of the wetland within a watershed. *(Source: Modified from J.A. Kusler, Our National Heritage: A Protection Guidebook. Copyright (c) 1983 by the Environmental Law Institute. Reprinted by permission.)*

Chemical Functions of Wetlands

- Pollution Interception
  - Nutrient uptake by plants
  - Settle in anaerobic soil and become reduced
  - Processed by bacterial action
- Toxic Residue Processing
  - Buried and neutralized in soils, taken up by plants, reduced through ion exchange
  - Large-scale / long-term additions can exceed a wetland's capacity

Wetland: water treatment processes

- Major water treatment processes in wetland
  - Attachment
  - Sedimentation
  - Die-off
  - Nutrient uptake
  - Microbial degradation of organics

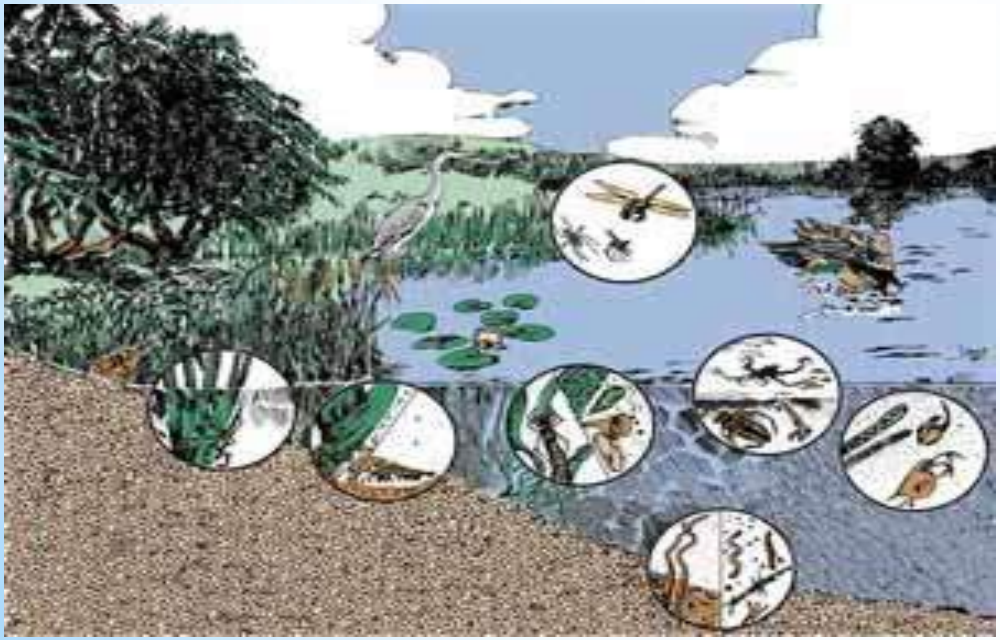
- Aquatic macrophytes create an enabling environment

Water Reuse

- Reclamation of wastewater provides
  - An alternative water source for Irrigation
    - Parks, Medians, schools and
    - Golf Courses
  - Water Treatment
    - Secondary Wastewater
    - Backwash Water from WW Treatment Plant
    - Stormwater Runoff
  - Riparian Habitat for Migratory birds
  - Production of New Problems

Treatment Methods

- Soil-Aquifer Treatment
  - The use of soil as a filter to reclaim wastewater
- Phytoremediation
  - the use of plants to enhance the degradation of pollutants in wastewater.



(Courtesy USGS)

How Aquatic Plants Remediate

* Reduction-Oxidation in oxygenated Rhizosphere (toxic trace metals)
* Accumulation of excess nutrients (N,P) into plant tissue
* S, Fe, Cu, Se

The use of plants to degrade a variety of pollutants present in wastewater.

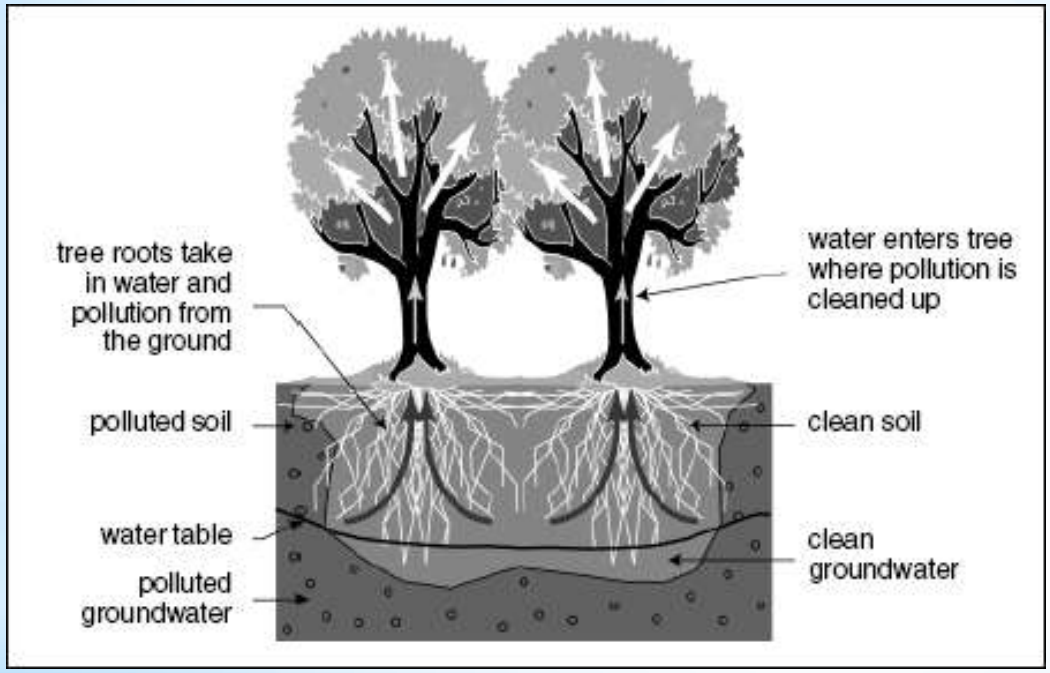


Diagram courtesy USEPA Office of Solid Waste
http://clu-in.org/download/citizens/citphyto.pdf

- Heavy Metals
- Trace metals
- Nutrients
- Organics
- Pathogens

*Phytoremediation

Phytoextraction or Phytoconcentration	contaminant is concentrated in roots, stem and leaves
Phytodegradation	breakdown of the contaminant molecule by plant enzymes which act as to help catalyze
Rhizosphere Biodegradation	plant roots release nutrients to microorganisms which are active in biodegradation of the contaminant molecule
Volatilization	transpiration of organics through leaves of the plant
Stabilization	plant converts the contaminant into a form which is not bioavailable, or the plant prevents the spreading of a contaminant plume

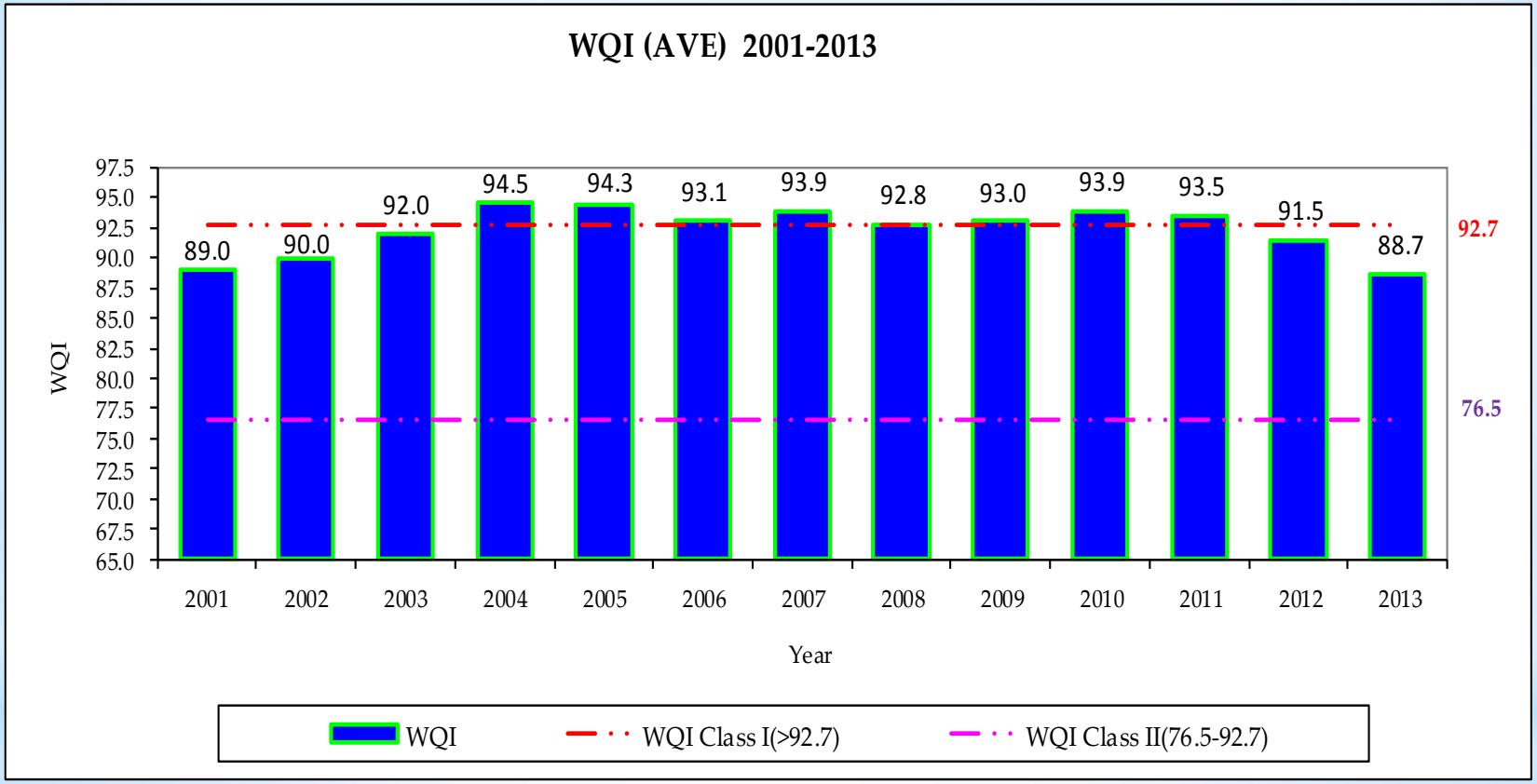
*Phytoremediation Processes

Kawalan nutrien dan kawalan bahan pencemaran

Ekosistem wetland berupaya memerangkap nutrien dan mengawal kandungan nutrien di dalam air.

Cth: kawasan penanaman padi sawah di Delta Kedah dan Delta Kemubu Kelantan yang mempunyai tanih aluvium yang sangat subur untuk penanaman padi.

Putrajaya Lake Water Quality



Putrajaya Lake water quality is monitored to ensure it is safe and suitable for body contact activities. Data collected since 2001 shows the quality has surpassed its target of minimum WQI = 76.5

PUTRAJAYA WETLAND

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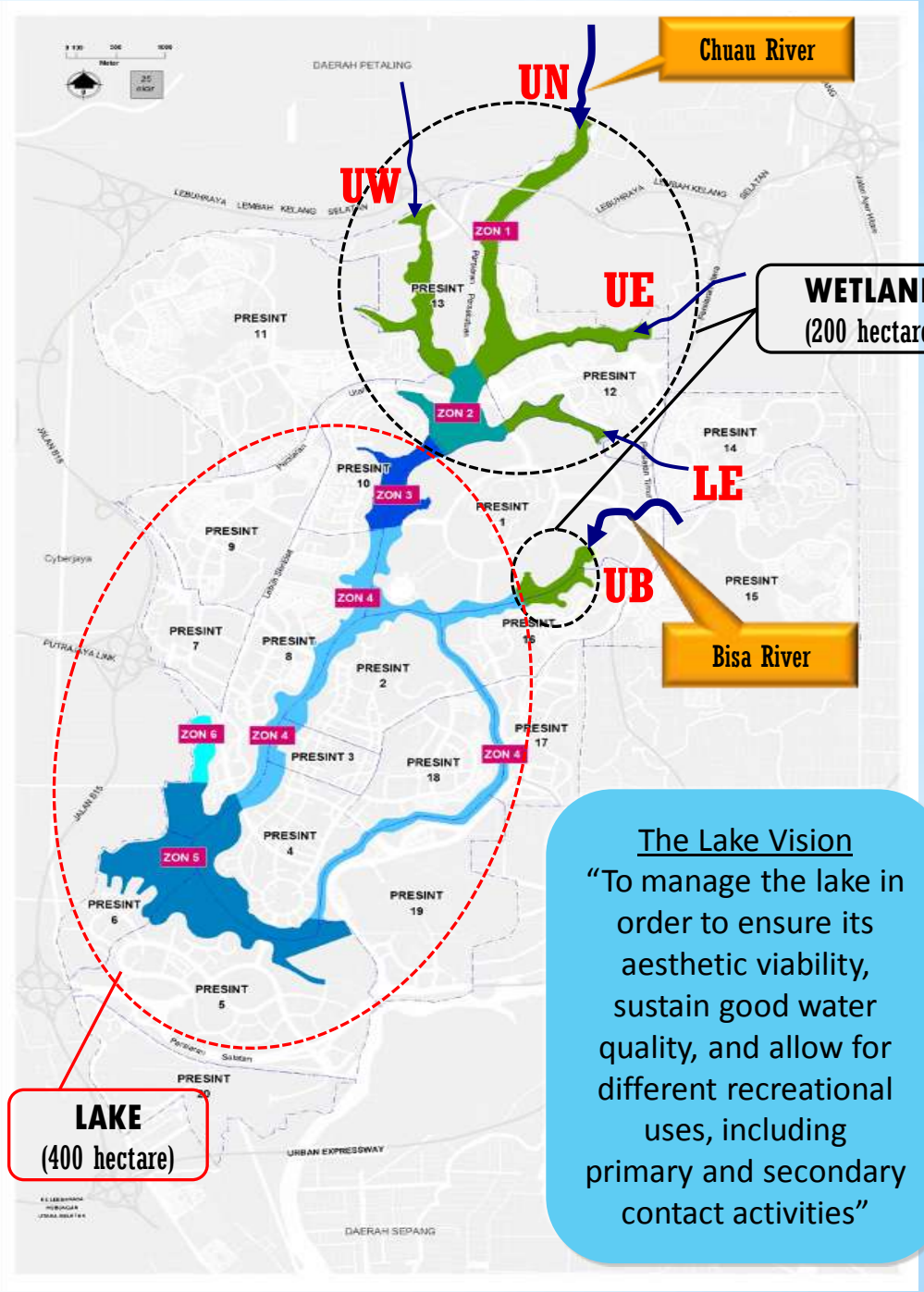

The Lake Vision

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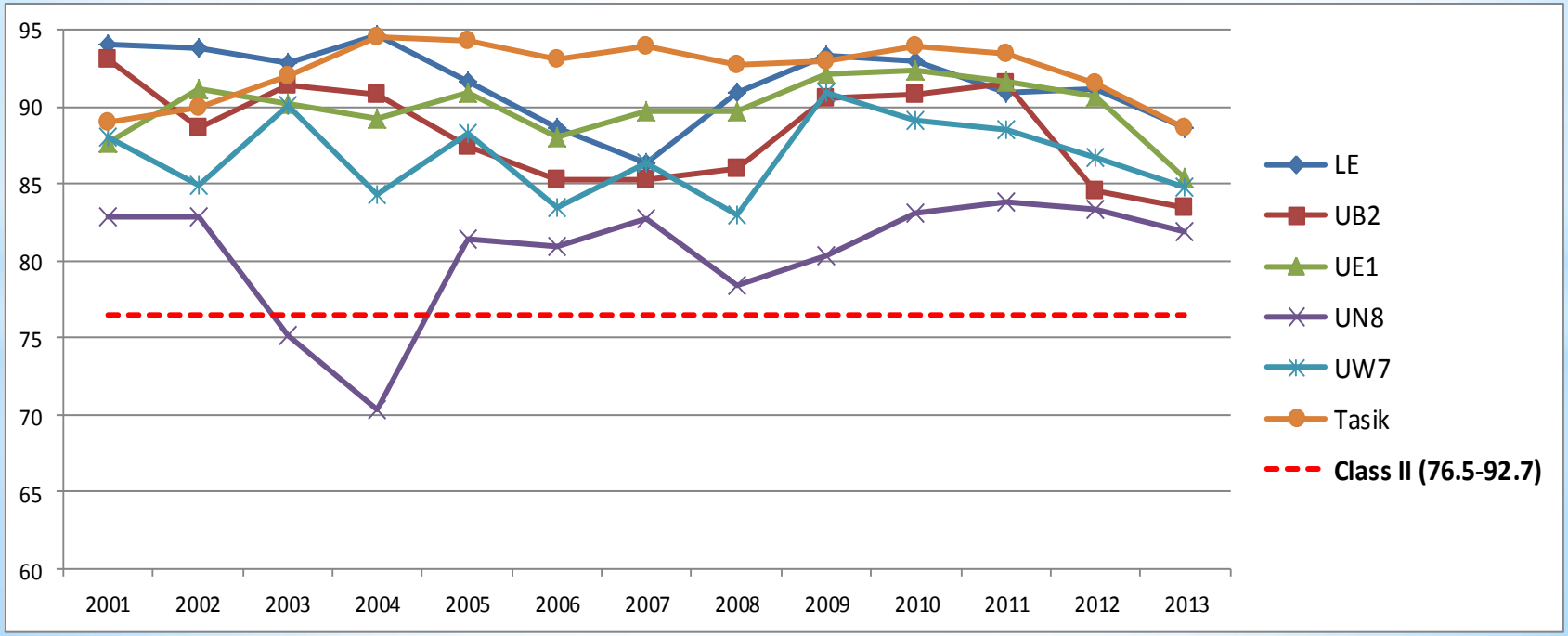
Putrajaya Wetland and Lake Water Quality Index (WQI)

Station	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LE1	94.1	93.8	92.9	94.7	91.7	88.7	86.4	90.9	93.4	93.0	90.9	91.2	88.6
UB2	93.2	88.6	91.5	90.8	87.5	85.3	85.3	86.0	90.6	90.8	91.6	84.6	83.5
UE1	87.7	91.2	90.2	89.3	91.0	88.0	89.7	89.7	92.2	92.4	91.7	90.7	85.4
UN8	**82.9**	**82.9**	**75.2**	**70.4**	**81.4**	**80.9**	**82.8**	**78.4**	**80.3**	**83.1**	**83.8**	**83.3**	**81.9**
UW7	88.1	84.9	90.1	84.3	88.3	83.5	86.4	83.0	90.9	89.1	88.5	86.7	84.8
Tasik	**89.0**	**90.0**	**92.0**	**94.5**	**94.3**	**93.1**	**93.9**	**92.8**	**93.0**	**93.9**	**93.5**	**91.5**	**88.7**



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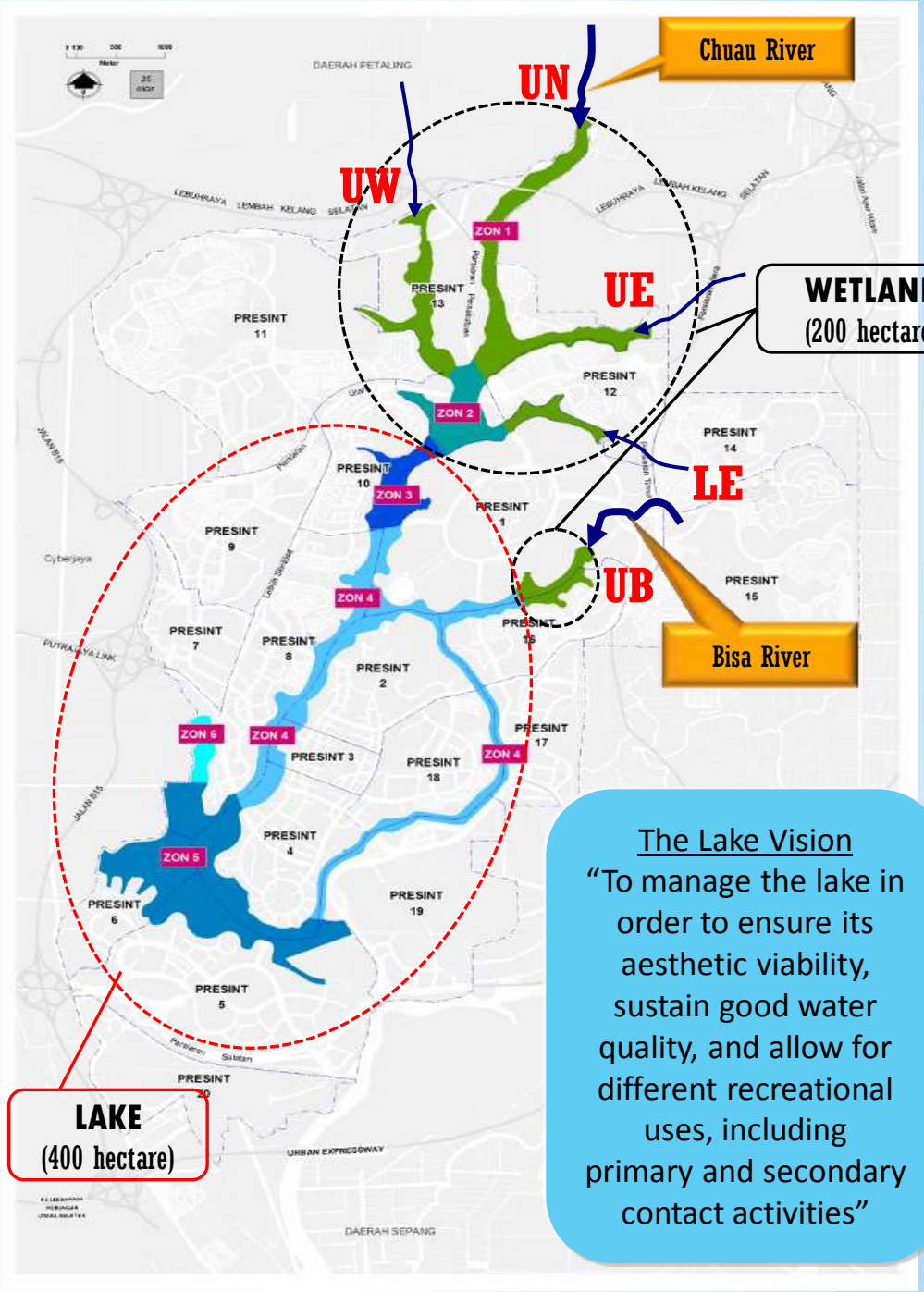
- completed: August 1998
- construction duration: 17.5 month
- depth: 0.5 to 3 m
- surface area: 200 ha

Main objective
- surface run-off filtration system for Putrajaya Lake

PUTRAJAYA LAKE

- completed: May 2002
- construction duration: 62 month
- depth: 2 to 13 m
- surface area: 400 ha

Main objective:
- centre for water sports, recreation and tourism



The Lake Vision

"To manage the lake in order to ensure its aesthetic viability, sustain good water quality, and allow for different recreational uses, including primary and secondary contact activities"

Biological Functions of Wetlands

- Biological Production
  - 6.4% of the Earth's surface → 24% of total global productivity
  - Detritus based food webs

- Habitat
  - 80% of all breeding bird populations along with >50% of the protected migratory bird species rely on wetlands at some point in their life
  - 95% of all U.S. commercial fish and shellfish species depends on wetlands to some extent

Tanah bencah merupakan khazanah daripada tuhan yang sangat bernilai kepada kita semua. Banyak tanah bencah telah diubah suai atau ditebus guna untuk kegiatan ekonomi terutamanya.

Kawasan tanah bencah yang diwartakan sebagai tanah bencah simpan perlu supaya generasi akan datang dapat mengenali tanah bencah serta fungsinya di masa akan datang.

Sumber
Genetik/Khazanah
Biodiversiti

Wetlands can treat surface run-off pollutants, as well as providing habitat for:

* Birds
* Mammals
* Reptiles and Amphibians
* Crustaceans
* Fish
* Human livelihood

Cth: Orang asli suku Semelai menghuni Tasik Bera, manakala kaum asli suku Jakun mendiami Tasik Chini.

* Habitat Creation

Advantages to Creating Habitat

- Wildlife Habitat
  - Migratory Birds
  - Opportunities for variety of wildlife

Purple Heron in Putrajaya Wetland

Function of Aquatic Plants

* Primary Production
  * Wildlife Food
  * Oxygen Production
* Shelter
  * Protection from predation for small fish
* Fish Spawning
  * Several fish attach eggs to aquatic macrophytes
  * Some fish build nests in plant beds
* Water Treatment
  * Wetland plants are very effective at removing nitrogen and phosphorous from polluted waters

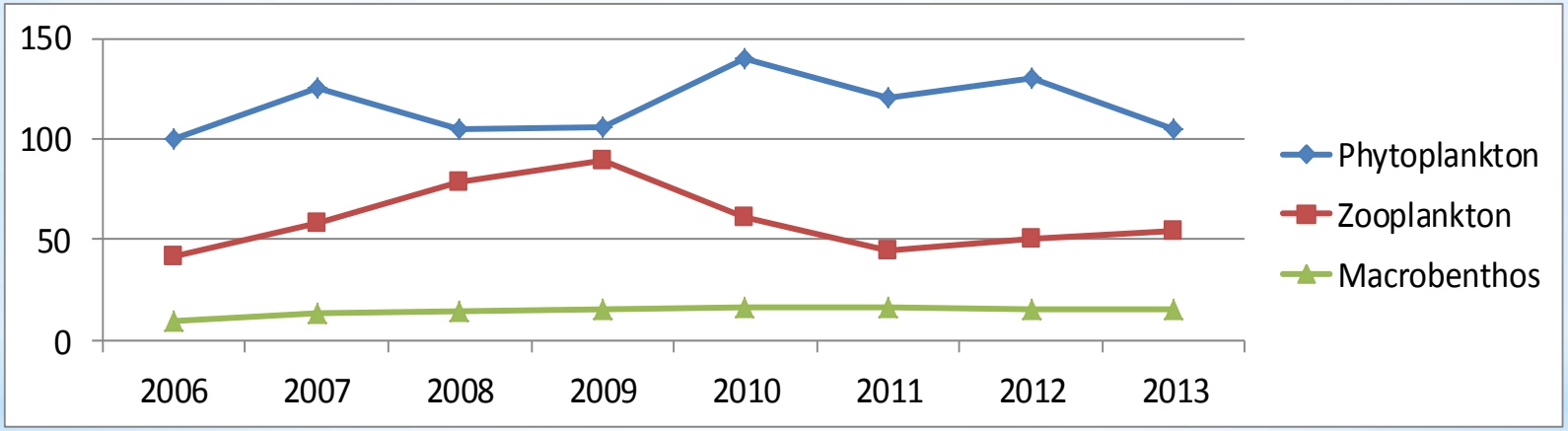
Some fish will attach their eggs to aquatic vegetation.

Submerged macrophytes can provide shelter for young fish as well as house an abundant food supply.

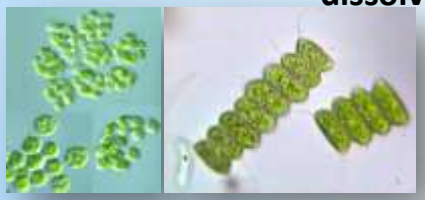
Putrajaya - Diversity of Aquatic Life

	2006 (baseline)	2007	2008	2009	2010	2011	2012	2013	Inventory data up to 2013
Phytoplankton	100	125	105	106	140	120	130	105	195
Zooplankton	42	58	79	89	61	44	50	54	111
Macrobenthos	09	13	14	15	16	16	15	15	20

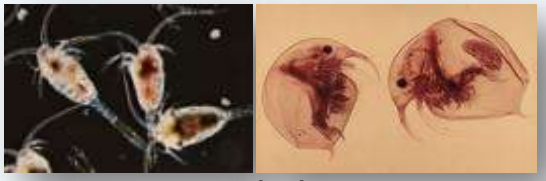
Nota : EIA (1995) – not recorded



Mayfly nymphs inhabit fast-flowing streams and shallow ponds with high levels of dissolved oxygen and low levels of pollutants. They serve as bioindicators of good water quality.



Phytoplankton



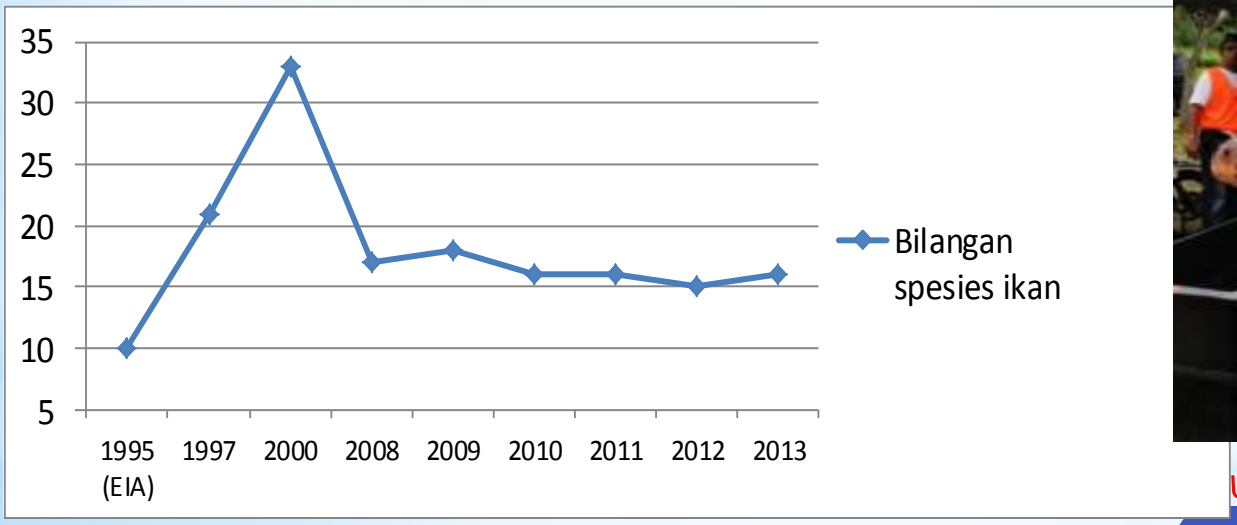
Zooplankton

Macrobenthos

Putrajaya - Diversity of Fish

Year	1995 (EIA)	1997	2000	2008	2009	2010	2011	2012	2013	Inventory data up to 2013
No of species	10	21	33	17	18	16	16	15	18	51

***EIA (1995) : 10 species of fish in riverine system**
****2008 onwards, fish monitoring in the lake done by Fisheries Department**



IUCN (Endangered Species)

This healthy 10.34 kg of *Probarbus jullieni* (Jullien's Golden Carp/ Temoleh) had been donated to Fishery Department to be induced for breeding




Birds

* Variety of migratory and non-migratory species
* Major food sources include submerged plants, plant seeds, grasses, fish, aquatic invertebrates, and terrestrial invertebrates that inhabit reeds and willows.
* Since many birds are migratory, the variety and number depends on the time of year.

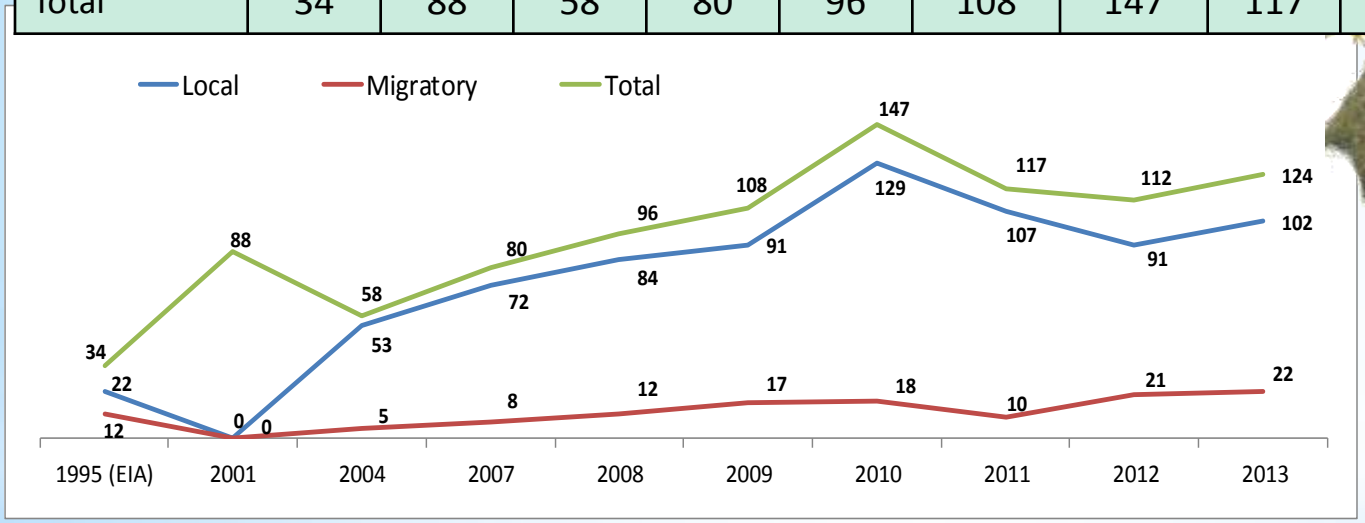
Birders at the Sweetwater Wetlands locating waterfowl

http://www.azstarnet.com/dailystar/snmedia/18572

* Wildlife

Putrajaya - Diversity of Birds (species)

Tahun	1995 (EIA)	2001	2004	2007	2008	2009	2010	2011	2012	2013	Inventory data up to 2013
Local	22	-	53	72	84	91	129	107	91	102	126
Migrant	12	-	5	8	12	17	18	10	21	22	51
Total	34	88	58	80	96	108	147	117	112	124	177



Baya Weaver's nesting

Purple Heron
(*Ardea purpurea*)

Painted Stork
(Mycteria leucocephala)
IUCN (Near Threatened)

Herons and Storks are found in big number and breeding at the lake and wetland


Painted Stork resting in
Central Wetland, Putrajaya


Asian openbill stork feeding in
Upper Bisa Wetland, Putrajaya


Striated Heron feeding in
Putrajaya Wetland


Grey Heron nesting in
Upper Bisa Wetland, Putrajaya

Mammals

- Otter, water vole, water shrew, mink, rats, etc.
- In some constructed wetlands, where previous conditions were not conducive to mammals, the distribution of wetland mammals is very limited.
- In the Sweetwater Wetlands, only mammals present are Arizona cotton rats (*Sigmodon arizonae*) and pack rats.

Muskrat in wetland habitat

http://www.mdc.mo.gov/landown/wetland/wetmng/18.htm

Wildlife

Invertebrates

* Insects and crustaceans
* Detritus feeders
  * Very important to treating the water
  * Help to break down nutrients and contaminants.

Detritus feeder along the bottom.

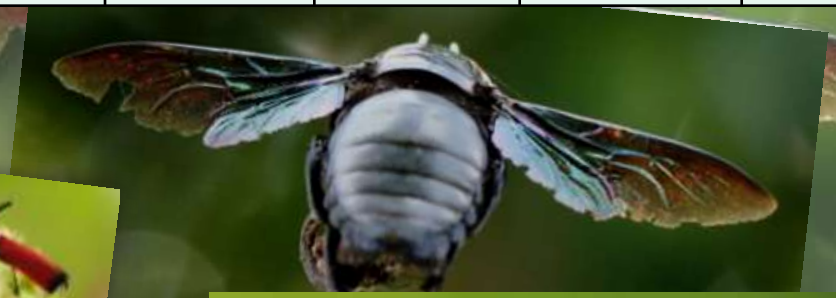
http://www.mesa.edu.au/friends/seashores/deposit_feeders.html

* Wildlife

Putrajaya - Diversity of Terrestrial Fauna

Fauna	1995 (EIA)	2007 (Baseline)	2010	2011	2012	2013	Inventory data up to 2013
Insects	-	21	21	343	445	767	1124*
Amphibians	-	2	5	5	8	13	13
Reptiles	-	5	4	15	15	14	19
Mammals	24	7	5	8	11	9	11

*no of insect morphospecies



Odonata larvae rely on precise water temperature, good oxygen level and unpolluted water to survive. This sensitivity means that dragonflies and damselflies are important bio indicators of good water quality.

General Types of Aquatic Macrophytes

- **Submergent** – Plants that grow entirely under water. Most are rooted at the bottom and some may have flowers that extend above the water surface.

- **Floating-leaved** – Plants rooted to the bottom with leaves that float on the water surface. Flowers are normally above water.

- **Free Floating** – Plants not rooted to the bottom and float on the surface.

- **Emergent** – herbaceous or woody plants that have the majority of their vegetative parts above the surface of the water.

Various Plant Types

Water Hyacinths	*Eichhornia crassipes*
Forage Kochia	*Kochia spp*
Poplar Trees	*Populus spp*
Willow Trees	*Salix spp*
Alfalfa	*Medicago sativa*
Cattail	Typha latifolia
Coontail	*Ceratophyllum demersvm L*
Bullrush	Scirpus spp
Reed	*Phragmites spp.*
American pondweed	*Potamogeton nodosus*
Common Arrowhead	*Sagittaria latifolia*

*"A major effect of [wastewater] treatment with plants was elimination of the disturbing smell …"

- Water Hyacinth – Heavy Metals
- Cattail, Reed – Nitrogen, TSS, BOD, COD
- Degradation

  Releases

*Phytoremediation Effects

Hydrilla

Coontail

Parrotfeather

Floating-Leaved Plants

Free Floating Plants

Emergent Plants

* *Cyperus papyrus* commonly known papyrus

Miscanthidium violaceum

Tumbuhan Wetland Putrajaya

Hanguana Malayana (Bakong)

Lepironia articulata (Purun)

Phragmites karka (Rumput gedabong)

Tumbuhan Wetland Putrajaya

Rhynchospora corymbosa (Rumput sendayan)

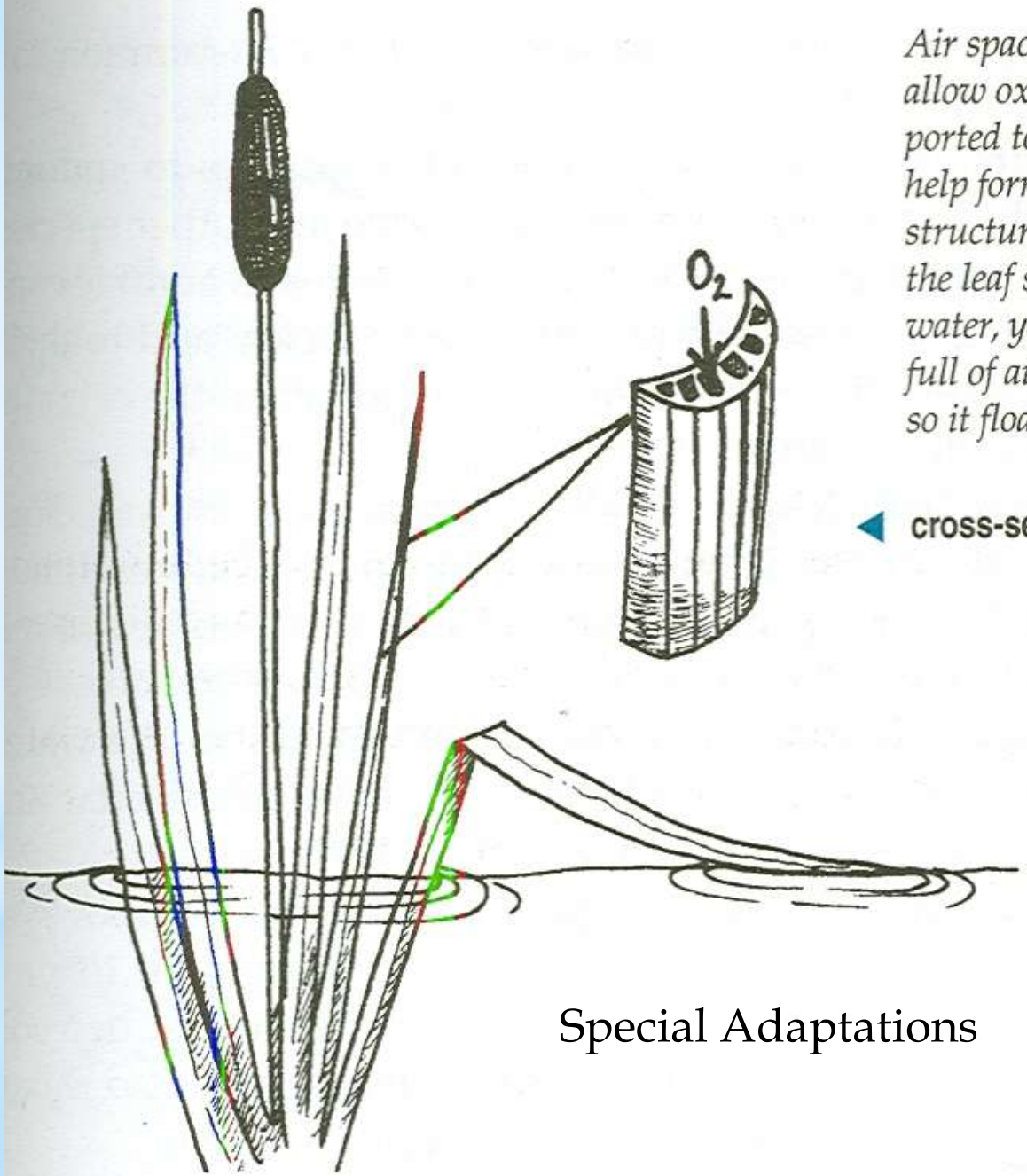
Typha angustifolia (Lembang)

Eriocaulan longifolium (Rumput butang)

Hanguana malayana
(Bakong)

Lepironia articulata (Purun)

Phragmites karka
(Rumput gedabong)



Air spaces in the cattail leaf allow oxygen to be transported to the roots. They also help form the leaf's support structure—rigid enough so the leaf stands upright in the water, yet lightweight and full of air (like Styrofoam) so it floats.

◀ **cross-section of leaf**

Special Adaptations

Putrajaya - Diversity Index

Biological Parameter		2010	2011	2012	2013
Fitoplankton	(H')	3.5 - 4.0	2.6 - 3.1	1.8 - 2.8	1.7 - 2.3
	(J')	0.7 – 0.9	0.7 - 0.8	0.5 - 0.8	0.5 - 0.7
Zooplankton	(H')	-	1.4 - 1.8	1.4 - 1.9	1.5 - 2.3
	(J')	-	0.6 - 0.7	0.5 - 0.7	0.6 - 0.8
Bentos	(H')	0.95 – 2.07	1.1 - 1.4	1.0 - 1.6	1.1 - 1.5
	(J')	0.81 – 0.97	0.7 - 0.8	0.5 - 0.9	0.8 - 0.9
Serangga	(H')	-	-	4.9 – 5.5	5.4 – 5.9
	(J')	-	80% minima 0.5	0.96 – 0.97	0.96 – 0.97
Burung	(H')	-	-	1.8 -3.5	1.8 – 3.5
	(J')	-	80% minima 0.5	0.93 – 0.97	0.5 – 0.9
Reptilia	(H')	-	-	0.6 – 1.1	0.6 – 1.4
	(J')	-	80% minima 0.5	0.8 – 0.9	0.6 – 0.9
Amfibia	(H')	-	-	0.7 – 1.6	1.1 – 1.8
	(J')	-	80% minima 0.5	0.92 – 0.99	0.5 – 0.9
Mamalia	(H')	-	-	1.2 – 1.6	0.2 – 1.4
	(J')	-	80% minima 0.5	0.89 – 0.96	0.3 – 0.8
ZII Vegetation	(H')	0.78 – 1.42	-	-	-
	(J')	0.69 – 0.87	-	-	-
Wetland Vegetation	(H')	0.05 – 0.48	-	-	-
	(J')	0.09 – 0.48	-	-	-

H’ = Diversity Index
J’ = Evenness

*Presentation Outline

- Why do we need water?
- Water under pressure
- Wetlands – a solution
- Types of Wetlands
- Importance of Wetlands
  i. Physical/Hydrological Functions of Wetlands
  ii. Chemical Functions of Wetlands
  iii. Wetland: water treatment processes
  iv. Biological Functions of Wetlands
  v. Ecosystem Services
- Usage of habitat creation

Why Are Wetlands Valuable? - Ecosystem Services

i. Flora diversity
ii. Fish and aquatic diversity/abundance
iii. Wildlife diversity/abundance
iv. Wildlife habitat/ Rare species habitat
v. Public Enjoyment – Recreation
vi. Uniqueness/heritage
vii. Education/Research
viii. Carbon Sink
ix. Source of income

*Importance Of Wetlands

Ecosystem services of wetlands

Ecosystem services	Economic values	Social values	Ecological values
Recharge of groundwater	Fundamental function for the maintenance of all other ecological processes		
Prevention of dust/salt transport by wind	Protection of irrigation schemes	living conditions / health	
Maintenance of biological diversity	genetic reservoirs (wild ancestors / medicinal)		Many red listed / threatened species
Fish spawning /nursing	fisheries and canning plant		survival aquatic organisms.
Pastures	cattle raising		
Reedlands	processing industry		
Water supply	agriculture, aquaculture		
Muskrat, waterfowl,	Fur & meat industry	Local hunting (meat /skins)	
Liquorice and other wood resources	Liquorice roots for export. Dried plants for fodder.	Fire and construction wood for local use.	

***Regulating services*:** "benefits obtained from the regulation of ecosystem processes" [12]

- carbon sequestration and climate regulation
- waste decomposition and detoxification
- purification of water and air
- crop pollination
- pest and disease control

ECOLOGICAL VALUES

Table 3.1 Examples of ecosystem service indicators – useful as quantitative measures of value of nature

Ecosystem service	Ecosystem Service Indicator
Regulating Services	
Climate/Climate Change Regulation: carbon sequestration, maintaining and controlling temperature and precipitation	Total amount of carbon sequestered/ stored=sequestration/storage capacity per hectare X total area (Gt CO2)
Moderation of extreme events: flood control, draught mitigation	Trends in number of damaging natural disasters Probability of incident
Water requlation: regulating surface water runoff, equifer recharge etc.	Infiltration capacity/rate of an ecosystem (e.g. amount of water/ surface area) – volume through unit area/ per time. Soil water storage capacity in mm/m Floodplain water storage capacity in mm/m
Water purification and waste management: decomposition/capture of nutrients and contaminants, prevention of eutrophication of water bodies etc.	Removal of nutrients by wetlands (tonnes or percentage) Water quality in aquatic ecosystems (sediment, turbidity, phosphorous, nutrients etc.)
Erosion control: maintenance of nutrients and soil cover and preventing negative effects of erosion (e.g.improverishing of soil, increased sedimentation of water bodies)	Soil erosion rate by land use type
Sources: building on, inter alia, MA (2005a); Kettunen et al.(2009); Balmford etl al.(2008); TEEB (2010; and ten Brink et al. (2011c)	

***Cultural services*:** "nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences" [12]

- cultural, intellectual and spiritual inspiration
- recreational experiences (including ecotourism)
- scientific discovery

SOCIAL VALUES

Table 3.1 Examples of ecosystem service indicators – useful as quantitative measures of value of nature

Ecosystem service	Ecosystem Service Indicator
Cultural and Social Services	
Landscape and amenity values: amenity of the ecosystem, cultural diversity and identity, spiritual values, cultural heritage values etc.	Changes in the number of residents and real estate values Number of visitors to sites per year Amount of natur tourism Total number of educational excursions at a site Number of Tv programmes, studies, books etc. featuring sites and the suurounding area Number of scientific publications and patents
Ecotourism and recreation: hiking, camping, nature walks, jogging, skiing, canoeing, rafting, recreational fishing, diving, animal watching etc.	
Cultural values and inspirational services, e.g. education, art and research	
Sources: building on, inter alia, MA (2005a); Kettunen et al.(2009); Balmford etl al.(2008); TEEB (2010; and ten Brink et al. (2011c)	

An attraction for recreational activities

- sightseeing via boat
- lake cruising
- fishing
- bird watching
- walking
- cycling
- jogging

Provisioning services: "products obtained from ecosystems" [12]

- food (including seafood and game), crops, wild foods, and spices
- water
- minerals (including diatomite)
- pharmaceuticals, biochemicals, and industrial products
- energy (hydropower, biomass fuels)

ECONOMIC VALUES

Table 3.1 Examples of ecosystem service indicators – useful as quantitative measures of value of nature

Ecosystem service	Ecosystem Service Indicator
Provisioning Services	
Food: Sustainably produced/harvested crops, fruit, wild berries, fungi, nuts, livestock, semi-domestic animals, game, fish and other aquatic resources etc.	Crop production from sustainable [organic] sources in tonnes and/or hectares Livestock from sustainable [organic] sources in tonnes and/or hectares Fish production from sustainable [organic] sources in tonnes live weight (e.g., proportion of fish stocks caught within safe biological limits)
Water quantity	Total freshwater resources in millions m3
Raw materials: sustainably produced/ harvested wool, skins, leather, plant fibre (cotton, straw etc.), timber, cork etc; sustainably produced/harvested firewood, biomass etc.	Timber for construction (million m3 from natural and/ or sustainable managed forests)
Sources: building on, inter alia, MA (2005a); Kettunen et al.(2009); Balmford etl al.(2008); TEEB (2010; and ten Brink et al. (2011c)	

***Supporting services*: ecosystem services** "that are necessary for the production of all other ecosystem services" [12]

- nutrient dispersal and cycling
- seed dispersal
- Primary production

Sometimes called Habitat Services (refer TEEB)

*Usage of habitat creation

* Education Outreach
  * Schools, k-12 +
  * Internships
  * Research
* Recreation
  * Walking Trail
  * Birding

Upper West Wetland

* Educational activities

Environment, Ecosystem And Educational Program (3ep)- 'Know Your Ecosystem'

- To engage the community/stakeholder particularly the school children to be involved in Putrajaya Lake and Wetland management.

- Objectives:
  - ✓ to create awareness, sense of belonging and ownership among communities especially young generation
  - ✓ To educate school children and be more responsible of what they discharge in order not to pollute environment and not to harm inhabitants.

- Target group: school children (primary and secondary school within the Putrajaya Lake Catchment)

- Field-based learning through actual monitoring of water quality, survey of vertebrates/invertebrates, know-what biological indicator of healthy ecosystem
  - ✓ Data collection, assessment and interpretation
  - ✓ Discussion on how to sustain the good ecosystem
  - ✓ Threat? How to get rid?

ENVIRONMENT , ECOSYSTEM & EDUCATIONAL PROGRAMME (3EP)

23 – 24 FEBRUARI 2013

BENGKEL DAN PERTANDINGAN FOTOGRAFI SEMPENA SAMBUTAN HARI WILAYAH PERSEKUTUAN DAN HARI WETLAND SEDUNIA

Penyertaan 428 orang


UNESCO-IHP, ECOHYDROLOGY PROGRAMME, PERBADANAN PUTRAJAYA
"APRESIASI EKOLOGI TASIK & WETLAND PUTRAJAYA"
Sempena Sambutan
Hari Belia Negara 2012
"PROGRAM MENGENALI DAN MENGENALPASTI BURUNG"
HIMPUNAN JUTAAN BELIA
PUTRAJAYA MEI 2012
Tarikh : 26 - 27 MEI 2012
Tempat : Wetland Putrajaya


Putrajaya Lake and Wetland
28 & 29 September 2013
EXPLORACE
UNESCO - IHP Ecohydrology Programme


071


SIRKIT RANCING PUTRAJAYA


VARSITY
BOAT RACE
WATER AWARENESS CAMPAIGN
26 - 27
OCTOBER
2013
UTM


WATER AWARENESS CAMPAIGN

5 – 6 FEBRUARI 2013

SEMINAR KEBANGSAAN PENGURUSAN EKOSISTEM TASIK DAN WETLAND

THE CENTRE OF REFERENCE (LOCAL)

	BEFORE	AFTER
✓ **Jabatan Perikanan Glami Lemi** To improve the quality of water (discharge from the fish pond) before release into the river nearby		
✓ **REDAC, USM (River Engineering and Urban Drainage Research Centre** To rehabilitate and improve wetland efficiency in treating surface run-off		

THE CENTRE OF REFERENCE (LOCAL)

	BEFORE	AFTER
✓ **NAHRIM (National Hydraulic Research Institute of Malaysia)** to improve water quality		
✓ **UPM** Mini wetland - for nutrient absorption before the water enters Putrajaya		

THE CENTRE OF REFERENCE (INTERNATIONAL)

Delegations from Thailand

Suwon City Council, Korea, 2010

University of Lubljana, Slovenia, 2012

Public Utilities Board, Singapore, 2010

King Soud University, Riyard, Kingdom of Saudi Arabia, 2012

Long Term Ecological Research East Asia Pacific Region 2012 participants

Korea Water Resources Association

You!

* Remember….

A conducive wetland surrounding starts from…..

TERIMA KASIH

THANK YOU