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BIO-ECOLOGICAL DRAINAGE SYSTEMS (BIOECODS)

AN ALTERNATIVE SUSTAINABLE APPROACH TO OVERCOME WATER RELATED ISSUES

BY BY PROF. DR. NOR AZAZI ZAKARIA, PROF. DR. AMINUDDIN AB. GHANI & IR. CHUN KIAT CHANG



Figure 1. BIOECODS as a National Pilot Project @ Engineering Campus, University Sains

BIOECODS is an innovative sustainable drainage system that helps restore the natural environment, maintain river flow and control ground subsidence. BIOECODS offers an exemplary model for urban stormwater management in tropical climates. It comprises of three components, namely ecological swales, biofiltration storage (Dry Ponds), and Ecological ponds (Wet Ponds, Detention Ponds, Constructed Wetlands, Wading Rivers and Recreational Ponds).

BIOECODS: A sustainable approach to overcome water related issues

BIOECODS is designed to solve three major water-related problems commonly encountered in Malaysia which are flash floods, river pollution and water scarcity during dry periods. After the 1998 crisis, when Kuala Lumpur and Selangor experienced water scarcity issues, the Malaysian government realized the importance of sustainable water management in urban areas. Therefore, it decided that reuse of water in urban areas should be implemented. However, it is difficult to reuse the water in urban areas since only polluted water is flowing through them. According to the Department of Environment, most of the river basins in Malaysia are polluted with suspended solids because of uncontrolled urban development.

The main cause of pollution comes from effluents of the industrial sector, which contain lower dissolved oxygen, as well as ammonia released from animal farms and domestic waste. A lot of effort has been devoted to

increase the quality of river water. However, the pollutant sources are still not being completely eliminated and thereby they are degrading the water quality of the rivers. Flash floods are a major problem caused by the degradation of streams. Flash floods have increased in urban areas due to reduced river hydraulic capacity as a result of sediment deposition, which causes clogging of the waterways and subsequently raises the water level leading to flooding.

Conventional drainage systems comprised of concrete drainage channels have been widely used in Malaysia. They have been designed to provide the fastest possible transport of stormwater runoff out of the catchments into the receiving water. However, these systems have led to an increase of flash flood occurrence at the downstream part of the catchments. In addition, more rivers have become polluted because of the open drainage system and thus the quality of life in many urban communities has suffered. Therefore, the conventional drainage systems are not the best solution for solving the flash flood problem in Malaysia.

BIOECODS as a National Pilot Project

There is a need to find a sustainable approach in order to mitigate the flash flood issues and to avoid the occurrence of such problems in new developed areas. In order to overcome the current flash flood problem, the Department of Irrigation and Drainage (DID) of Malaysia is embarking in a new solution of managing stormwater runoff called "control at source".

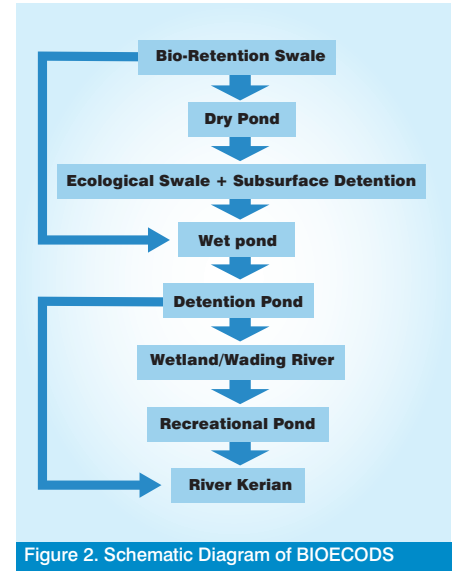


Figure 2. Schematic Diagram of BIOECODS

DID has collaborated with University Sains Malaysia (USM) to implement the Bio-Ecological Drainage System (BIOECODS) as a national pilot project at its Engineering Campus, USM which was completed by the end of the year 2002. Figure 2 shows the schematic diagram of BIOECODS.

BIOECODS Study

The research study on the capability of BIOECODS in managing stormwater runoff in the 320-acres catchment area of the Engineering Campus has been carried out since 2003. In terms of both quantity and quality, it has been proven that BIOECODS is able to minimize hydrological changes in a



Figure 3. Ecological Swale



Figure 4. Ecological Pond (Wading River)

catchment area. In addition, contaminated stormwater can be cleansed, the amenity value at USM Engineering Campus can be improved by promoting natural processes such as infiltration, flow retardation, storage and purification before discharging the treated stormwater at the downstream end of River Kerian.

The results of the study indicated that BIOECODS can be a viable and sustainable method for both water quantity management and water quality treatment in new development areas.

Conclusions

In conclusion, BIOECODS is a sustainable approach to overcome water related-problems such as flash floods, river pollution and water scarcity. This national pilot project of BIOECODS is viewed as a prototype for the development of new urban areas by implementing several components of BIOECODS that can meet the requirements of Urban Stormwater Management

Manual for Malaysia (MSMA) to manage and control stormwater runoff quantitatively and qualitatively at its source.

Way Forward

BIOECODS has been successfully adopted in various places in Malaysia. One of the recent applications of BIOECODS is located at the on-going new green township development of Kwasa Damansara, which will be one of the technical visit sites during the 37th IAHR World Congress in Kuala Lumpur. BIOECODS has paved the way for a promising development in the infrastructure design for the new green township development. ■

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Prof. Dr. Nor Azazi Zakaria has served in Universiti Sains Malaysia since 1994. He then established the River Engineering and Urban Drainage Research Centre (REDAC) in 2001 and has since remained as the Director. His main research interests are Sustainable Urban Drainage Systems and River Management. Prof. Dr. Nor Azazi is the leading researcher in the innovation of Bio-ecological Drainage System (BIOECODS), and is now an established figure in the field of stormwater management at national and international levels. He sits in the Executive Committee for Malaysian National Committee on Irrigation and Drainage (MANCID) and Malaysia Stormwater Organization (MSO), as well as IAHR APD.



Prof. Dr. Aminuddin Ab. Ghani is presently the Deputy Director of River Engineering and Urban Drainage Research Centre (REDAC) since 2001. His main research interests are Sediment Transport, Flood Risk Management (FRM) and Sustainable Urban Drainage Systems (SUDS). He is an exco member for Sewer System and Processes Working Group (SSPWG) under the auspices of International Water Association (IWA) and International Association for Hydro-Environment Engineering and Research (IAHR)'s Joint Committee on Urban Drainage. Presently Prof. Dr. Aminuddin is an Editorial Board Member for the *International Journal of River Basin Management (JRBM)*, published by IAHR and an Associate Editor for the *IWA's Water Science and Technology Journal*.



Ir. Chun Kiat Chang started working at the River Engineering and Urban Drainage Research Centre (REDAC) since June 2002. He received Bachelor of Engineering (Civil Engineering) from Universiti Sains Malaysia (USM) in 2002, and a Master of Science in River and Urban Drainage Management from USM in 2006. He has an experience in research and consultancy projects such as drainage improvement and flood mitigation projects, sediment transport modeling study as well as application of Sustainable Urban Drainage Systems (SUDS) and Bio-Ecological Drainage System (BIOECODS). He is member of Certified Professional in Erosion and Sediment Control (CPESC), corporate member of Institute of Engineer Malaysia (IEM) and also the Assistant Secretary for the IAHR Malaysia Chapter.



Figure 5. Visitors to BIOECODS