BIO-ECOLOGICAL DRAINAGE SYSTEM (BIOECODS): SELECTED PUBLICATIONS

Published by
River Engineering and Urban Drainage Research Centre (REDAC)
Engineering Campus, Universiti Sains Malaysia
Seri Ampangan, 14300 Nibong Tebal, Penang, MALAYSIA

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data
A catalogue record of this book is available from the Perpustakaan Negara Malaysia

BIO-ECOLOGICAL DRAINAGE SYSTEM (BIOECODS): SELECTED PUBLICATIONS

ISBN 983-3067-07-7

Cover design: P&Y Design Network

Printed in Malaysia by River Engineering and Urban Drainage Research Centre (REDAC)

Bio-Ecological Drainage System (BIOECODS): Selected Publications

Contributors: Assoc. Prof. Dr. Aminuddin Ab. Ghani
Assoc. Prof. Dr. Nor Azazi Zakaria
Assoc. Prof. Dr. Rozi Abdullah
Lariyah Mohd Sidek, P.E.
Anita Ainan

PREFACE

The Malaysian economy has gone through rapid structural changes since independence in 1957. Progressive development from agriculture to an industrialized economy has shifted the population into urban centers. Urban development is hence necessary to meet the need of urban population. Urbanization will increase the construction of impervious areas that will change significantly the hydrologic and hydraulic characteristics of the catchments. Therefore not surprisingly, incidence of flash flood in urban areas in Malaysia becomes more severe from year to year.

In order to mitigate flash flood in urban areas, a conventional drainage system made up of mainly open concrete drains, has been designed to provide the fastest possible transport of storm water runoff out of the catchments to the receiving waterways. The first urban drainage manual "Planning and Design Procedure No.1: Urban Drainage Design Standards and Procedure for Malaysia" was first published by the Department of Irrigation and Drainage (DID) in 1975. This manual has been used as a guideline for more than 25 years although there have been many new technological developments in urban storm water management. The conventional drainage system, unfortunately has led to increase in the occurrence of flash flood at the downstream of the development areas. Additionally, open concrete drains invite more polluted rivers and therefore have worsened the quality of life in urban community. As a result, conventional drainage system is no longer an effective measure in urban storm water management.

DID has taken a proactive step in urban storm water management by introducing the new manual known as Storm Water Management Manual for Malaysia (*Manual Saliran Mesra Alam* or MSMA). From 1st January 2001 onward all new development in Malaysia must comply with MSMA that requires the application of Best Management Practices (BMPs) to control storm water runoff from the aspects of quantity and quality to achieve zero development impact contribution. The application of BMPs will be able to preserve the natural condition of the existing rivers in Malaysia.

A smart partnership between Universiti Sains Malaysia (USM) and DID has resulted in the design and construction of Bio-Ecological Drainage System (BIOECODS) at USM Engineering Campus, Nibong Tebal, Penang. Several BMPs were implemented as components of BIOECODS including swales, subsurface modules, dry ponds, wet pond, detention pond, constructed wetland, wading river, and recreational pond to control the quantity and quality aspects of storm water runoff as a result of the development of the USM Engineering Campus. The construction of BIOECODS covers an area of 300 acres and was completed in December 2002. His Excellency the Governor of Penang has launched BIOECODS at national level on 4th February 2003. BIOECODS is expected to provide an insight of BMPs implementation to engineers and practioners in Malaysia and worldwide in designing a sustainable urban drainage system (SUDS) for a new development.

This Special Publication on BIOECODS represents the present status of the 10-year research programme beginning June 2003. It contains 12 papers published and presented at national and international levels. The Special Publication gives a summary on MSMA, concept, design and construction experience on BIOECODS and preliminary results of the on-going research. It is to be hoped that the Special Publication can be used as a vehicle to promote the dissemination of the on-going research on BIOECODS to engineers and practioners in Malaysia and worldwide.

Nor Azazi Zakaria
Aminuddin Ab. Ghani
Rozi Abdullah
Lariyah Mohd Sidek
Anita Ainan

River Engineering and Urban Drainage Research Centre (REDAC)
USM Engineering Campus, Nibong Tebal, Penang, Malaysia
September 2004

ACKNOWLEDGEMENTS

The authors would like to thank the Department of Irrigation and Drainage (DID), Malaysia for the support and providing the research grant for the pilot project on MSMA. The authors are also indebted to the full support given by the Vice Chancellor of Universiti Sains Malaysia (USM) for giving them the opportunity to construct BIOECODS at the new USM Engineering Campus, Nibong Tebal, Penang. They are also grateful to His Excellency the Governor of Penang for officially launching BIOECODS at national level on 4th February 2003.

The copyright of the 12 papers in the Special Publication is duly acknowledged remains with the original publishers: International Association of Hydraulic Engineering and Research (IAHR) for the article published in the International Journal of River Basin Management (JRBM); Board of Engineers Malaysia (BEM) for the two articles published in the BEM Bulletin; University of Mississippi, USA for the six papers in the Proceedings of the 6th International Conference on Hydro Science and Engineering (ICHE), Brisbane, Australia; International Hydrological Programme (IHP), UNESCO for the two papers in the Proceedings of Asia-Pacific Workshop on Ecohydrology, Cibinong-Bogor, Indonesia and International Conference on Urban Hydrology, Kuala Lumpur, Malaysia; and International Islamic University for the paper in the Proceedings of Seminar on Water Environmental Planning: Technologies of Water Resources Management, Kuala Lumpur, Malaysia.

Special thanks also go to the staff and postgraduate students of River Engineering and Urban Drainage Research Centre (REDAC) involved in the on-going research on BIOECODS.

CONTENTS

International Journal Article

Zakaria, N.A., Ab. Ghani, A., Abdullah, R., Mohd Sidek, L. & Ainan, A. (2003). Bio-Ecological Drainage System (BIOECODS) For Water Quantity And Quality Control, *International Journal River Basin Management*, International Association of Hydraulic Engineering and Research (IAHR), Vol. 1, No. 3, pp. 237-251.

National Journal Article

Mohd Sidek, L., Zakaria, N.A., Ab. Ghani, A., & Abdullah, R. (2002). Alternative Solutions to Conventional Drainage Systems using Bio-Ecological Drainage Systems: Design and Concepts, Part 1, *Bulletin Board of Engineers Malaysia*, Vol. 15, No.2, pp. 46-51, June.

Mohd Sidek, L., Zakaria, N.A., Ab. Ghani, A., & Abdullah, R. (2002). Alternative Solutions to Conventional Drainage Systems using Bio-Ecological Drainage Systems: Design and Concepts, Part 2, *Bulletin Board of Engineers Malaysia*, Vol. 15, No. 3, pp. 47-52, September.

International Conference Proceedings

Mohd Sidek, L., Ab. Ghani, A., Zakaria, N.A., Abustan, I., Abdullah, R. & Ashaari, F.A.H. (2001). Constructed Wetland for Water Quality Improvement Under Tropical Climates, *IHP's Asia- Pacific Workshop on Ecohydrology*, Cibinong - Bogor, West Java - Indonesia, 20-22 Mac, pp. 261 – 272.

Abdullah, R., Zakaria, N. A., Ab. Ghani, A., Mohd Sidek, L., & Ainan, A. (2002). Modeling Bio-Ecological Drainage System – A Case Study With Stormwater Management Model, *International Conference on Urban Hydrology for the 21st Century*, Kuala Lumpur, Malaysia, 14 – 16 October, pp. 572-582.

Zakaria, N.A., Ab. Ghani, A., Abdullah, R., L.M. Sidek , Kassim, A. H. & A. Ainan. (2004). MSMA - A New Urban Stormwater Management Manual for Malaysia. *6th International Conference on Hydroscience and Engineering (ICHE-2004)*, Brisbane, Australia, May 30-June 3.

Ab. Ghani, A., Zakaria, N.A., Abdullah, R., Yusof, M. F., Mohd Sidek, L., Kassim, A. H. & A. Ainan. (2004). Bio-Ecological Drainage System (BIOECODS): Concept, Design and Construction. *6th International Conference on Hydroscience and Engineering (ICHE-2004*), Brisbane, Australia, May 30-June 3.

Ainan, A., Zakaria, N.A., Ab. Ghani, A., Abdullah, R., Mohd Sidek, L., Yusof, M. F. & Wong, L.P. (2004). Peak Flow Attenuation Using Ecological Swale and Dry Pond. *6th International Conference on Hydroscience and Engineering (ICHE-2004)*, Brisbane, Australia, May 30-June 3.

Mohd Sidek, L., Ainan, A., Zakaria, N.A., Ab. Ghani, A., Abdullah, R. & Ayub, K. R. (2004). Stormwater Purification Capability of BIOECODS. *6th International Conference on Hydroscience and Engineering (ICHE-2004)*, Brisbane, Australia, May 30-June 3.

Abdullah, R., Zakaria, N.A., Ab. Ghani, A., Mohd Sidek, L., Ainan, A. & Wong, L.P. (2004). BIOECODS Modelling Using SWMM. *6th International Conference on Hydroscience and Engineering (ICHE-2004)*, Brisbane, Australia, May 30-June 3.

Lau, T.L., Zakaria, N.A., Ab. Ghani, A., Yusof, M. F., Abdullah, R., Mohd Sidek, L. & Ainan, A. (2004). Application of BIOECODS for a Government Complex: A Case Study. *6th International Conference on Hydroscience and Engineering (ICHE-2004)*, Brisbane, Australia, May 30-June 3.

National Conference Proceedings

Mohd Sidek, L., Takara, K., Ab Ghani, A., Zakaria, N.A. & Abdullah, R. (2002). Bio-Ecological Drainage System (BIOECODS): An Integrated Approach For Urban Water Environmental Planning. *Seminar on Water Environmental Planning: Technologies of Water Resources Management*, Kuala Lumpur, Malaysia, 15-16 October.