



Postgraduate Research Studies in River Engineering and Urban Drainage



River Engineering and Urban Drainage Research Centre (**REDAC**) welcomes any postgraduate research studies in the areas of **River Management**, **Urban Drainage Management**, **Hydro informatics**, and **Environmental Hydraulics Management**.

REDAC is a research centre of excellence approved by the Ministry of Higher Education, Malaysia in 2001. REDAC is leading research in the areas of Sustainable Urban Drainage System (**SUDS**) with its World Class Project i.e. the Bio-Ecological Drainage System (**BIOECODS™**) that is able to solve three problems commonly encountered in new developments namely flash flood, water quality degradation and water supply shortage. REDAC is also very active in River Rehabilitation research that aims to conserve rivers in Malaysia with application of sediment transport and river modeling. A number of research books and monographs on **BIOECODS™**, **SUDS** and River Engineering have been produced under contract research grants with the Department of Irrigation and Drainage (**DID**), Malaysia. Several other publications are also produced through participations in international associations such as International Water Association (**IWA**) and International Association of Hydraulic Engineering and Research (**IAHR**). Details of all these publications can be found at <http://redac.eng.usm.my/html/newsinfo.htm>.



Presently 25 postgraduate students (5 PhD, 20 MSc) have involved in the research on River Engineering and Urban Drainage whereby 20 of them have successfully completed their studies (5 PhD, 15 MSc). With the high number of completed postgraduate studies, REDAC would like to invite any interested candidates to carry their postgraduate studies at master, doctoral and post-doctoral levels to achieve a sustainable development that conserve rivers not only in Malaysia but also in the World. Any enquiry on the postgraduate research at REDAC can be obtained from Assoc. Prof. Aminuddin Ab. Ghani (redac02@eng.usm.my) or the postgraduate website: <http://redac.eng.usm.my/html/pgresearchmain.htm>



By Associate Prof Dr Nor Azazi Zakaria, REDAC Director

FOREWORD

Postgraduate research has been the backbone of the on-going research at REDAC since its commencement in 2001. Engineers, lecturers and scientists from government agencies, universities and consultancy firms local and abroad have pursued their research successfully. Sediment transport with the emphasis on river stability and rehabilitation has been the main research agenda while sustainable urban drainage system (SUDS) is the current preferred research area with the launching of Urban Storm Water Management Manual for Malaysia (MSMA) in 2001. Bio-Ecological Drainage System (BIOECODS™) is the SUDS pilot project in Malaysia and worldwide encompassing all tools in Best Management Practices (BMPs) including swales, dry ponds, wet pond, detention pond, wetland, wading river and recreational pond. Local and overseas visitors are welcome to USM Engineering Campus, Nibong Tebal, Penang to seek the uniqueness of BIOECODS™. Potential postgraduate students are welcome to conduct their research at REDAC in the areas of River Management, Urban Drainage Management, Hydro Informatics, and Environmental Hydraulics Management.

Besides research, REDAC is planning to offer a mixed-mode postgraduate programme called "Sustainable River Management" starting in 2006/2007 academic year. A collaborative mixed-mode programme with Colorado State University, USA is also planned for the 2006/2007 academic year.

Equipped with experience and resources on sediment transport data and SUDS applications in Malaysia, several short courses and seminars have been held including Urban Storm water Management Short Course (USWM™) and River Management Seminar (RiverM™). USWM™-3 is planned to be held in September 2005 while RiverM™-2 in April 2006.

REDAC recognizes the importance of publishing research results so that they are available to other worldwide researchers in the near future. As such a Special Issue of the International Journal River Basin Management (JRBM), International Association of Hydraulic Engineering and Research (IAHR) will soon be published containing the best selected 10 papers from Rivers'04 – 1st International Conference on Managing Rivers in the 21st Century. Furthermore, a research book on BIOECODS™ will be launched during the MOU signing ceremony between Universiti Sains Malaysia and the Department of Irrigation and Drainage Malaysia to be held at the end of 2005.

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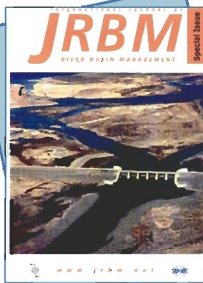
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A Special Issue (Vol. 3, No. 4 (2005)) of International Journal River Basin Management (JRBM) made up of the 10 best papers from the IAHR sponsored 1st International Conference on Managing Rivers in the 21st Century, held in Penang, Malaysia, in September 2004 and organised by the University of Science, Malaysia will be published in the last month of 2005 or early 2006. The following are the selected paper titles to be published together with the Guest Editorial. Latest information on JRBM can be found at:

www.jrbm.net

Authors (Organisation)	Title
Chan Ngai Weng (Universiti Sains Malaysia, Malaysia)	Sustainable Management of Rivers in Malaysia: Involving All Stakeholders
Emma Tate and Kris Cauwenberghs (Wallingford Software Ltd, UK)	An Innovative Flood Forecasting System for the Demer Basin: A Case Study
Roger A. Falconer, Binliang Lin and Richard Harpin (Cardiff University, UK)	Environmental Modeling in River Basin Management
Ahmad Fuad Embil (Department of Irrigation & Drainage, Malaysia)	What Will it Take to Bring Our Rivers Back to Life?
Pierre Y. Julien, Gigi Richard and Jason Albert (Colorado State University, USA)	Stream Restoration and Environmental River Mechanics
Chang Chun Kiat, Aminuddin Ab. Ghani, Nor Azazi Zakaria, Zorkeflee Abu Hassan and Rozi Abdullah (Universiti Sains Malaysia, Malaysia)	Sediment Transport Equation Assessment for Selected Rivers in Malaysia
Sajad Ahmad Hamidi and Firoz Bahadori Khoroshahy (Sazeh Pardazi Consulting Eng. Company, Iran)	Impacts of Hydraulics and Sediment Transport in River Training Works and Flood Control Schemes (Case Study: Shahrud River)
Khairul Rahmah Ayub, Lariyah Mohd Sidek, Anita Ainan, Nor Azazi Zakaria, Aminuddin Ab. Ghani and Rozi Abdullah (Universiti Sains Malaysia, Malaysia)	Storm Water Treatment using Bio-Ecological Drainage System
Azni Idris, Wan Noor Wan Azmin, Mohd Amin Mohd Soom and Abdullah Al Mamun (Universiti Putra Malaysia, Malaysia)	The Importance of Sullage (Grey-Water) Treatment in the Restoration and Conservation of Urban Streams
Nora Metsaranta, Jyrki Kotola and Jyrki Nurminen (Helsinki University of Technology, Finland)	Effects of Urbanization on Runoff Water Quantity and Quality



Name : Chang Chun Kiat (MSc Candidate)
(ck_redac@eng.usm.my / chunkiat.rem04@stud.usm.my)

Project Title : River Rehabilitation Using FLUVIAL-12: Case Study of Kulim River

Supervisors : 1. Assoc. Prof. Dr. Aminuddin Ab. Ghani 2. Assoc. Prof. Dr. Rozi Abdullah

Present Status : On-Going (1 October 2003 - 30 September 2009)

INTRODUCTION

Rapid urbanization has accelerated impact on the catchment hydrology and geomorphology. This development which takes place in river catchment areas will cause dramatic increase in the surface runoff and resulting in higher sediment yield. When this happens, it will not only affect river morphology but also cause instability in the river channel and hence serious damage to hydraulic structures along the river and reducing channel capacity to convey the flood water to downstream. Therefore, it is necessary to evaluate and predict the river channel stability for the purpose of river rehabilitation due to the existing and future developments in the river catchment.

STUDY OBJECTIVES

This study is carried out at Kulim River, a natural stream in Kedah, Malaysia, to examine river stability due to changes made by nature or human and the effectiveness of the planned flood mitigation projects as stated in Kulim Structure Plan 1990-2010. The results from FLUVIAL-12 modeling using several existing sediment transport equations will be used to rehabilitate critical reaches with serious bank and bed erosions.

STUDY AREA

The study area with the total catchment area of 130 km², is located at the southern part of the state of Kedah in the northwestern corner of Peninsular Malaysia (Figure 1). It lies within the district of Kulim and upstream of Seberang Perai in Penang. The study reach covers about 15km of Kulim River, from the upstream (CH 11800) to downstream at the Ara Kuda gauging station (CH 1), which is 2.5 km further downstream from the state boundary between Kedah and Penang. At the headwaters, the Kulim catchment is hilly and densely forested and Kulim River arises on the western slopes of Gunung Bongsu Range and flowing in a north-westerly direction. The river slopes are steep and the channel elevation drops from 500m to 20m average mean sea level over a distance of 9km. The central area of the catchment is undulating with elevations ranging from 100m down to 18m average mean sea level.

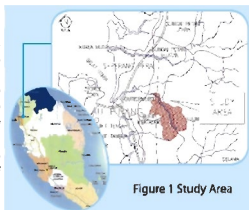


Figure 1 Study Area

The Kulim Structure Plan, 1990-2010 has outlined development strategies for the region. Rapid urbanization at Kulim River catchment especially construction for housing estate and on-going 1450 ha Kulim Hi-Tech Industrial Park will cause the catchment to become more impervious. However, these impacts are much greater when the impervious areas of the catchment are connected to the streams by efficient stormwater drainage systems. Flooding at Kulim River has been attributed to over bank spill from rivers and tributaries arising from a number of causes, such as undersized river channel and drains to cater flood discharge, high channel roughness, bank irregularity and in-river vegetation, siltation, blockages by debris and refuse. Siltation at study area has been identified as one of the common causes of such flooding brought about by soil erosion at constructions sites (Figure 2). Department of Irrigation and Drainage (DID) Kedah has reported that the river have to be desilted typically every 2 to 3 years with removal of one meter thick of silt.



Figure 2 Siltation at Study Area

Floods frequently occur in Kulim River Catchment caused extensive damage and inconvenience to the community. According to the information given by the DID Bandar Bahru and DID Hydrology Division (Figure 3), floods have occurred in October 1989, 31 May - 2 Jun 1991, April 1994, October 1997, November 1998, September 1999, September 2000, January 2001, April 2001, November 2002 and October 2003.

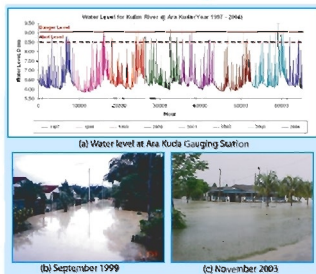


Figure 3 Floodings at Kulim River Catchment

EXPECTED RESULTS

In the study of morphological changes of Kulim River, a long term-simulation by using mathematical model, FLUVIAL-12 for water and sediment routing, will be developed and tested with field data up to year 2004. The model, which is applicable to alluvial streams with erodible banks, may be employed to simulate stream bed and width changes. The calibration and validation results of FLUVIAL-12 will be used to predict river stability for 100 year peak flood discharge design rainfall hydrograph for 2010 land use. Figure 5 shows the flow chart of computation for FLUVIAL-12 model and Graphic User Interface for FLUVIAL-12 in long-term simulation. Suggestions on river rehabilitation will then be made based on the modeling results.

CONCLUSIONS

River is a dynamic system governed by hydraulic and sediment transport process. Over time, the river response by changing in channel cross section, increased or decreased sediment carrying capacity, erosion and deposition along the channel, which affect bank stability and even morphological changes. Rapid development takes place at river catchment area will result high discharge, erosion and deposition which will cause river instability. The 100-year flood occurs during October 2003 causing extensive damage and inconvenience to the community. Therefore, it is necessary to predict the river channel stability that will happen due to the existing and future development in Kulim River catchments area. As a result, a design for stable channel for Kulim River based on the long-term simulation by using FLUVIAL-12 will be made.

LATEST PUBLICATIONS

Chang, C. K., Ab. Ghani, A., Zakaria, N. A., Abu Hasan, Z. & Abdullah, R. (2004). Effect of a 100-year Flood on River Stability: Case Study of Kulim River, 1st International Conference on Managing Rivers in the 21st Century: Issues & Challenges, 21st - 23rd September, Penang, Malaysia, pp. 584-590

Chang, C. K., Ab. Ghani, A., Zakaria, N. A., & Abdullah, R. (2005a). Sediment Transport in Kulim River, Malaysia. XXXI IAHR Congress: Water Engineering for the Future - Choice and Challenges, 11th - 16th September, Seoul, Korea (In Press)

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- Chang, C. K., Ab. Ghani, A., Zakaria, N. A., Abu Hasan, Z. & Abdullah, R. (2005b). Sediment Transport Equation Assessment for Selected Rivers in Malaysia. *Special Issue Rivers'04, International Journal River Basin Management, IAHR, Vol. 3, No. 4*.
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- Koay, B. C. (2004). *Evaluation of River Equilibrium: Case Study of Kulim River*. Final Year Project Thesis. Penang: Universiti Sains Malaysia.
- Lee, C. B. (2001). *Application of River Modeling (Fluvial-12): Case Studies of Kulim River and Melaka River*. Final Year Project Thesis. Penang: Universiti Sains Malaysia.
- Yahaya, N. K. (1999). *Development of Sediment Rating Curves for Rivers In Malaysia: Case Studies of Pari, Kerayong and Kulim Rivers*. MSc. Thesis. Penang: Universiti Sains Malaysia.

METHODOLOGY

The available data from the previous studies (DID 1996, Yahaya 1999, Lee 2001, Koey 2003) includes river survey geometry data, sediment data and hydrology data. These data together with those from the present study up to 2004 will be calibrated and validated with the present condition and used to predict river stability for future development (Figure 4). This will allow evaluation of river stability over a 13-year period by considering the effect of changes in cross section and sediment load.

Mathematical model, such as FLUVIAL-12 can be used to study sediment transport for a particular river reach. The model is formulated and developed for water and sediment routing in man-made or natural channel (Chang 1993). The combined effects of river hydraulics, sediment transport and river channel changes are simulated for a given flow period. The accuracy of sediment routing depends on the validity of the sediment transport equation used in the model. In order to select an equation for sediment routing, Graf, Yang, Englund-Hansen, Ackers-White and Meyer-Peter-Muller equation were tested and computed results were compared with the observed data (Chang et al. 2005b).

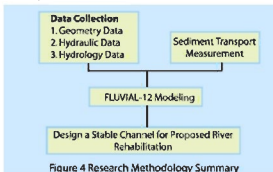


Figure 4 Research Methodology Summary

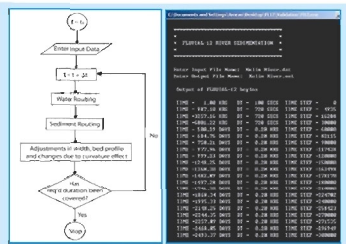


Figure 5 Major Steps of Computations for FLUVIAL-12

**River Rehabilitation Seminar,
24th - 26th May 2005
Sunway Hotel, Penang**

Organized by:



UNIVERSITI SAINS MALAYSIA



Department of Irrigation and Drainage



Wira Kerjasama Sdn. Bhd.

Background

Streams and rivers vary in character from place to place: from headwaters to mouth and from region to region. They also change over time, rapidly during floods and gradually over much longer periods. These phenomena are part of urban as much as natural rivers, and must be understood if we are to achieve and sustain urban renewal. In their natural state, river corridors offer many benefits. These include clean water, productive fisheries, a diverse range of plants and wide life in and out of water, navigation routes, and flood storage reservoirs (flood plains). But as rivers and their valleys become altered through urbanization, some of these benefits are lost and others become degraded and more costly to sustain.



The rehabilitation of degraded rivers is of growing interest to practitioners of river management worldwide. In urban areas, this interest has been raised by the recognition of the value of river corridors for amenity, recreation, and nature conservation, and the role of river corridors in enhancing the quality of urban living and in connecting different parts of the landscape. Today, the approach is to hold back flood waters (Sustainable Urban Drainage System), to restore flood plains and to create suitably designed flood and balancing areas with an interlinked green – and traffic free – network of river corridors. These corridors serve to connect different areas of the city, and sites of cultural and natural heritage.

Source: Petts, G., Heathcote, J. & Martin, D. (2002). "Urban Rivers - Our Inheritance and Future", IWA Publishing, London.

Objectives

This seminar is conducted with the following objectives:

- Describing river rehabilitation criteria
- Provide examples of river rehabilitation – Rio Grande, New Mexico, USA
- Provide alternatives for River Muda Flood Mitigation Scheme

**INVITED SPEAKER BIODATA**

PROF. PIERRE Y. JULIEN
Colorado State University, USA

Colorado
State
University
Knowledge to Go Places

Pierre Y. Julien is currently the editor of ASCE Journal of Hydraulic Engineering and Hydraulics Professor in Department of Civil Engineering, Colorado State University. Prof. Julien has more than 20 years of experience in the field of sediment transport and river engineering. He started his academic career as Substitute Professor at the Civil Engineering Department at Laval University in 1979. He completed his Ph.D. at Laval University in the field of hydraulics and sediment transport.

He pursued post-doctoral studies at the Department of Civil Engineering at Colorado State University in 1983 where he was Faculty Affiliate (1983-1985), Assistant Professor (1985-1989), Tenured Associate Professor (1989-1994), and Tenured Full Professor since 1995. Prof. Julien authored more than 225 scientific publications including two textbooks and at least 50 refereed journal publications. Under his guidance, 22 Ph.D. and 21 M.S. students completed their graduate degrees in Civil Engineering. He is currently member of 10 professional organizations. He has carried out research activities exceeding USD \$3 millions for more than 20 different professional organizations and governmental agencies.

Prof. Julien is the recipient of ASCE's 2004 Hans Albert Einstein Award.

Opening Ceremony

Welcoming Speech



REDAC Director



Collaboration Undertaking Signing Ceremony between USM, DID and CSU



River Rehabilitation Seminar, 24th - 26th May 2005 Sunway Hotel, Penang

The first River Management Seminar (RiverM™-1) was conducted successfully from 24th - 26th May 2005 at Sunway Hotel, Seberang Jaya, Penang. 80 participants from Department of Irrigation and Drainage (DID), consultants, Universities and Municipal Councils attended the seminar. The Keynote Address was given by DID Deputy General I, Ir. Ahmad Fuad Embi. Prof. P. Y. Julien, the Invited Speaker from Colorado State University (CSU), USA gave four presentations on River Rehabilitation. Two Case Studies on the on-going Flood Mitigation Projects were given i.e. Muda River (Dr. Fadhllillah Haji Mahmood, Wira Kerjaya Sdn Bhd) and Perai River (Ir. Mohamad Zaki Abdullah, Redmax Sdn Bhd) respectively.

Presentations



Ir. Ahmad Darus



Prof. P. Y. Julien



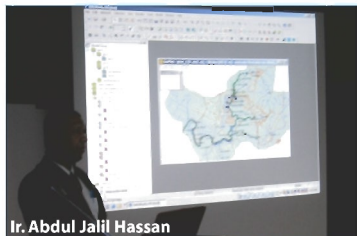
Ir. Ahmad Fuad Embi



Ir. Mohamad Zaki Abdullah



Dr. Fadhllillah Haji Mahmood



Ir. Abdul Jalil Hassan

**River Rehabilitation Seminar,
24th - 26th May 2005
Sunway Hotel, Penang**

Two presentations on the use of river models (Fluvial-12, Infowork RS) were also given by DID Senior Engineer, Ir. Ahmad Darus and National Hydraulic Research Institute Malaysia (NAHRIM) Senior Researcher, Ir. Abdul Jalil Hassan. Participants were also given briefings on the Muda River Flood Mitigation Project during Technical Visit on the second day of the seminar. A Collaboration Undertaking Signing Ceremony was also held during the last day of the seminar. DID, USM and CSU will collaborate in the postgraduate studies for DID engineers where the students will take courses and conduct research both at USM and CSU.

RiverM-1

Technical Visit Muda River Flood Mitigation Project (25th May 2005)



Muda River @ Merdeka Bridge



Muda River @ Merdeka Bridge



Muda River @ Sidam Kanan

**State Secretary of Penang,
26th February 2005**

The State Secretary of Penang, Honourable Jamaludin Hasan visited BIOECODS™ with several Penang State Department Heads to explore the uniqueness of BIOECODS™ in solving flooding problems. His delegation was given a briefing on the project by REDAC Director, Assoc. Prof. Dr. Nor Azazi Zakaria.

**Ecological Swale****Recreational Pond
Overlooking Wading River****Dry Pond****Recreational Pond****Recreational Pond****Recreational Pond**

VISIT TO BIOECODS™

Public Works Department of Penang,
27th May 2005



Souvenir Presentation



Engineered Waterway



Swale Outlet



Detention Pond

30 staff of Public Works Department (JKR), Penang visited BIOECODS™ project and a briefing was given by REDAC Director, Assoc. Prof. Dr. Nor Azazi Zakaria. They were also given briefing on the construction of BIOECODS™ by Mr. Mohd Fazly Yusof, REDAC Science Officer.

**URBAN STORMWATER
MANAGEMENT SHORT COURSE***Application of MSMA for Sustainable Urban
Drainage System (SUDS)**26th - 28th April 2005
USM Engineering Campus***SHORT COURSE**

36 Participants with majority of them from municipal councils throughout Malaysia attended the 3-day short course. Comprehensive presentations on MSMA via examples of completed projects were given. The next USWM™-3 will be held in September 2005.

USWM-2**Opening Ceremony by R&D Deputy Vice Chancellor, USM****Presentations**

USWM-2 Hands - On Workshop



USWM-2 Short Course Participants



USWM - 3



Urban Stormwater Management Short Course 2005

Theme

Application of Urban Stormwater Management Manual for Malaysia (MSMA) for Sustainable Urban Drainage System (SUDS)

Objectives

- To present the new design, concepts, criteria and regulatory requirements of MSMA
- To present examples of constructed projects based on MSMA
- To perform design calculation for urban drainage system that complies with MSMA

Speakers

The course will be conducted by a group of professional and experienced researchers from REDAC. They specialized in the field of stormwater management, river management, hydroinformatic and environmental management. They have involved extensively in research and consultancy project involving MSMA throughout Malaysia.

Who Should Attend

Engineers, regulators, planners and designers who are involved in stormwater management

Date: 6th - 8th September 2005
Location: USM Engineering Campus

Dry Ponds



BIOECODS™ @ USM



BIOECODS™ @ Tanjung Rambutan

'SUDS Applications in Malaysia'

USWM-3 Registration Form

Urban Stormwater Management Short Course

Application of MSMA for Sustainable Urban Drainage System (SUDS)

6th - 8th September 2005

Participant Name(s)	(1)		
	(2)		
	(3)		
Organization			
Address			
Email		Postal Code	
Telephone No.		Fax No.	
Registration Fee: RM 750.00 per person x _____ person(s)			= RM

Mode of Payment:

Cheque / Bank Draft Number		Bank / Branch	
L.O. Number		Agency	

The Registration Fee covers notes, lunch and refreshments during the short course. Registration Fee must be made to "USAINS HOLDING" using L.O./Cross Cheque/Bank Draft/Money Order. Registration will be on a "first come first served" basis. Cancellations will not be refunded but substitution of participants are allowed.

Accommodation

Phone numbers for some nearby hotels are listed below:

Pant Buntar Inn : 05-7176750

Damai Hotel : 05-7165222

Jawi Inn : 04-5820759

Bukit Merah Lake Town Resort : 05-8978888

Sunway Hotel : 04-3707788

Peart View Hotel : 04-3989888

Registration & Inquiry:

The completed registration form should be sent by fax or email to:

Ms. Noor Hasliza Wan Chik
 Secretariat,

Urban Stormwater Management Short Course
 River Engineering and Urban Drainage Research Centre (REDAC)
 Engineering Campus, Universiti Sains Malaysia, Seri Ampangan,
 14300 Nibong Tebal, Penang, MALAYSIA

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E-mail : redac@eng.usm.my, redac02@eng.usm.my, redac07@eng.usm.my, redac16@eng.usm.my

<http://redac.eng.usm.my>

Prof. P.Y. Julien, Colorado State University, USA
27th May 2005**Engineered Waterway**Discussion on R&D between Prof. Julien and
Assoc. Prof. Dr. Aminuddin, Deputy Director of REDAC**BIOECODS™****Peer
Review****BIOECODS™****Recreational Pond****Wading River****ANNOUNCEMENT****الجمعية العربية للمياه الصحية**
Arab Healthy Water Association<http://www.mgwwater.com/arabhwa.shtml>Assoc. Prof. Dr. Aminuddin, the Deputy Director of REDAC
has been appointed as the Abroad Advisor of AHWA
commencing on 14th June 2005**Bar Code**