

UNIVERSITI TEKNOLOGI MARA

**ENVIRONMENTAL FLOW
ASSESSMENT USING PHABSIM
MODELLING FOR TROPICAL
MOUNTAINOUS RIVER: A CASE
STUDY AT TEKAI RIVER SYSTEM,
MALAYSIA**

MAISARAH BINTI ABD GHANI

MSc

October 2021

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Postgraduate, Universiti Teknologi MARA, regulating the conduct of my study and research.


Name of Student : Maisarah Biti Abd Ghani

Student I.D. No. : 2016347869

Programme : Master of Science (Civil Engineering) – EC750

Faculty : College of Engineering

Thesis Title : Environmental Flow Assessment Using PHABSIM
Modelling for Tropical Mountainous River: A Case
Study At Tekai River System, Malaysia

Signature of Student : 

Date : October 2021

ABSTRACT

Environmental flow (EF) analysis was never been made a mandatory requirement in the dam construction in Malaysia. However, Department of Environment (DOE) had made the EF study scope to be included in the Environmental Impact Assessment (EIA) approval conditions for hydroelectric projects in Malaysia. Environmental flow releases from dam impoundments will eventually give tremendous effect not only on the environment but also on aquatic organisms from their construction and operation. As such, the potential significance effects on instream flow conditions due to the proposed construction of Upper Tekai Dam (UTD) and Lower Tekai Dam (LTD) on the natural integrity of Tekai River, which is located at Jerantut, Pahang was evaluated in this study. The main aim of this study is to verify the suggested EF requirements in the DEIA report with latest modelling tools supported with field verification. A Detailed Environmental Impact Assessment (DEIA) and Environmental Management Plan (EMP) outlined by Department of Environment Malaysia (DOE) as part of the approval conditions suggested that the water level at Tekai River should be maintained at a depth of 50 cm suggested whereby $5\text{m}^3/\text{s}$ and $8\text{m}^3/\text{s}$ should be released during wet and dry season subsequently at the impoundment stage though a detailed EF modelling and analysis was not performed to confirm the suggested EF values. The feasibility of the suggested environmental flow requirements was analyzed using PHABSIM habitat simulation model to determine the optimum environmental flows release during dry weather periods for typical fish species captured during fish sampling. The series of proposed environmental flows released was checked its compliances to sustain 50 cm depth of Tekai River evaluated using WinXSPRO analysis. Overall, it was found that the minimum environmental flows to be released for availability of fish habitat is $3\text{m}^3/\text{s}$ up to $7.8\text{m}^3/\text{s}$ whereby the WUA increases with the discharge up to a maximum value, then followed by a decreasing trend. Thus, the proposed environmental flow requirement of $8\text{m}^3/\text{s}$ during dry season can be reduced up to $3\text{m}^3/\text{s}$ which is adequate to sustain the downstream ecosystem and at the same time provide additional $5\text{m}^3/\text{s}$ to be sustained at the dam and utilized for power generation needs.

ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere appreciation to Prof. Ts. Dr. Shanker Kumar Sinnakaudan as my supervisor for invaluable guidance, supervision and supporting my efforts with his precious time throughout this study. His lessons, guidance, supervision and unparalleled knowledge shared will not be soon forgotten.

Special thanks also to my co-supervisor Dr Mohd Sofiyan Sulaiman and my fellow research teams, En Mohd Rizal Bin Shukor and research staff of TNB Research Sdn Bhd for sharing the information regarding available techniques and giving the endless idea, valuable comments and justification for results and analysis throughout the research period. This research was made possible through contract research funding from TNB Research Sdn. Bhd (100-IRMI/PRI 16/6/2 (019/2018)).

In the meantime, I would like also to express my appreciation to my family and friends who were being always supportive, encourage and motivate me during my research study.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	ix
LIST OF FIGURES	xi
LIST OF SYMBOLS	xv
LIST OF ABBREVIATIONS	xvi
CHAPTER ONE INTRODUCTION	1
1.1 Background of Study	1
1.2 Problem Statement	2
1.3 Objectives of the Study	6
1.4 Scope and Limitation of the Study	6
1.5 Significance of Study	7
1.6 Thesis Outline	7
CHAPTER TWO LITERATURE REVIEW	9
2.1 Introduction	9
2.2 Environmental Flows	9
2.2.1 Requirements of Environmental Flows Study in Hydroelectric Project	9
2.2.2 Study on Environmental Flows in Malaysia	10
2.2.3 The Concepts and Definitions of Environmental Flow	12
2.2.4 Environmental Flows Assessment (EFA) Method	13
2.3 River Morphology	21
2.4 Freshwater Fish Diversity	27
2.4.1 Freshwater Fish Diversity in Malaysia	27
2.4.2 Freshwater Fish Diversity in Pahang River Basin	28