UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

WASTE CONTAINER LOCATION IN KUALA TERENGGANU: A COVERING MODEL APPROACH

NURFARAHAIN BINTI BASAR (2021113017)

NUR NAJWA BINTI BAHARIN (2021120053)

PUTERI YUSRAH MARDIEHA BINTI YUSRI NENDIE (2021120385)

(P49M23)

Report submitted in part fulfilment of the requirement for the degree of

Bachelor of Science (Hons.) (Management Mathematics)

College of Computing, Informatics and Mathematics

AUGUST 2023

ACKNOWLEDGEMENTS

IN THE NAME OF ALLAH, THE MOST GRACIOUS THE MOST MERCIFUL

First, we are very grateful to Allah S.W.T for giving us the strength as a team to complete this final year project successfully.

We would like to extend our deepest gratitude to our supervisor, Dr Zati Aqmar Binti Zaharudin, for her guidance and support throughout the research process. Her feedback and insights were critical in shaping the research design and analysis. Also, her encouragement was essential in ensuring the quality and relevance of this case study since it was very challenging. Hence, with that, she would not be forgotten, and we are truly grateful to have her as our supervisor.

Next, we would also like to thank our family and friends for their unwavering support and encouragement throughout this project. Their belief in us gave us the motivation to persevere in the face of challenges and obstacles.

Finally, we acknowledge the dedication and hard work of our team members, who worked tirelessly to ensure the success of this project. Their collaborative efforts and commitment to excellence were critical in achieving the objectives of this case study. Without them, we would not have been able to carry out this research.

In conclusion, we express our sincere gratitude to all those who contributed to the success of this case study. Their support, guidance, and cooperation were invaluable, and we could not have completed this project without them. Thank you.

TABLE OF CONTENT

ACKNOWLEDGEMENTS ..... **ii**
LIST OF TABLES ..... **v**
LIST OF FIGURES ..... **v**
ABSTRACT ..... **viii**
CHAPTER 1 ..... **1**
1.1 Introduction of Study 1
1.2 Problem Statement 3
1.3 Objectives 3
1.4 Scope and Limitations 4
1.5 Summary 5
CHAPTER 2 ..... **6**
2.1 Background Covering Model 6
2.2 An Overview of Waste Containers in Malaysia 6
2.3 Existing Studies of Mathematical Model for Waste Containers 8
2.4 Application of Covering Model 12
2.5 Summary 16
CHAPTER 3 ..... **17**
3.1 Phase 1 17
3.2 Phase 2 21
3.3 Phase 3 23
3.3.1 Variation of parameters 24
3.3.2 Interface of CPLEX 25
3.4 Summary 27
CHAPTER 4 ..... **28**
4.1 Ideal Result for Location and Allocation of Waste Container 28
4.2 Summary 32
CHAPTER 5 ..... **33**
5.1 Conclusion 33
5.2 Recommendations 34
REFERENCES **36**
APPENDIX A **41**

APPENDIX B **43**
APPENDIX C **44**
APPENDIX D **46**
i. *T*=20 46
ii. *T*=15 47
iii. *T*=14 49
iv. *T*=13 50
v. *T*=12 51

ABSTRACT

A well-designed waste management system can prevent pollution and protect the environment, such as by allocating waste containers at optimal locations with a high accessibility level. Hence, the position of this waste container needs to be carefully considered. Kuala Nerus, Terengganu, is used as the study area, which has unstructured route networks, imprecise and inadequate waste container location, and allocation problems. Additionally, due to an increasing population and insufficient container capacity, the containers positioned along the roadsides and alleyways are hampered by persistent waste overflow issues. A covering-based model aims to determine the optimal locations of facilities such that all demands are covered or served within pre-specified distances or travel times. The first objective is to identify potential waste container locations based on pre-specified characteristics. As a result, six potential facility locations were identified in Kuala Nerus. The second objective is achieved by obtaining the relationship between the percentage of coverage based on variations in maximum time travel, the total number of waste containers allocated, the maximum number of total facility locations in the area, and the average service capacity of demand at each facility. Lastly, the optimal number of locations and allocations of waste containers from the decision-makers perspective is obtained using the calibration procedure. This is obtained by focusing only on 100% covering level. As a result, the minimum duration for travel between nodes *i* and *j* is set at 12 minutes, with a total of six distinct locations for a single RORO container with a capacity of 1500 persons are required for achieving 100% coverage.