

TABLE OF CONTENTS

	Page
Acknowledgement	iii
Abstract in Thai	iv
Abstract in English	vi
List of Tables	x
List of Illustrations	xi
Abbreviations and symbols	xiv
Chapter 1 Introduction	1
1.1 Significance of the problem	1
1.2 Literature review	2
1.3 Purpose of the study	6
1.4 Scope and methodology	6
1.5 Outline of the study area	8
1.6 Geology and hydrogeology	11
Chapter 2 Principle and Theory	17
2.1 Electrical resistivity method	17
2.2 Very low frequency electromagnetic method	21
2.3 The application of geophysical methods at hazardous waste sites	23
2.4 The application of resistivity survey at landfill sites	24
Chapter 3 Data Acquisition and Data Processing	34
3.1 Data acquisition	34
3.1.1 Electrical resistivity data acquisition	34

3.1.2 Very low frequency electromagnetic data acquisition	36
3.2 Data processing	37
3.2.1 Electrical resistivity data processing	37
3.2.2 Very low frequency electromagnetic data processing	38
3.2.3 Hydrochemical data processing	39
Chapter 4 Data Interpretation and Discussion	42
4.1 Resistivity data interpretation	42
4.1.1 Qualitative interpretation	42
4.1.2 Quantitative interpretation	44
4.1.3 Resistivity maps at selected elevations	50
4.1.4 Electrical resistivity profile	59
4.2 Very low frequency electromagnetic data interpretation	66
4.3 Integrated data interpretation	66
Chapter 5 Conclusion and Recommendation	81
References	84
Appendices	87
Appendix A Resistivity data	88
Appendix B Very low frequency electromagnetic data	110
Appendix C Hydrochemical data of shallow well water	114
Appendix D Borehole data	116
Curriculum Vitae	119

LIST OF TABLES

Table		Page
2.1	Resistivities of some common rocks and other materials.	18
2.2	Some industrial wastes commonly buried in landfill sites.	26
2.3	Typical changes in leachate concentrations with age of refuse.	27
3.1	Summary of data acquisitions.	37
4.1	The summary of interpreted geology from geophysical parameters.	49

LIST OF ILLUSTRATIONS

Figure	Page
1.1 Location map of the study area.	7
1.2 Map of study area showing landfill boundaries and geophysical measurement locations.	9
1.3 Geologic map of the study area.	13
1.4 Hydrogeological map of the study area.	14
1.5 Shallow groundwater flow pattern in the study area.	15
1.6 Estimated local groundwater flow direction.	16
2.1 Electrode arrays in common use.	20
2.2 A schematic diagram of the VLF principle.	22
2.3 Geometry of a typical three-dimensional contaminant plume migrating down gradient from a landfill site.	29
2.4 A conceptual resistivity model for old landfill sites with leachate generation and migration into groundwater system in granular substrate and environs.	31
2.5(a) Relationship between fluid conductivity and total dissolved solids.	33
2.5(b) Relationship between conductivity and chloride concentration.	33
3.1 An example of resistivity modeling.	38
3.2 Examples of an original data plot, filtered data plot, and vertical cross section of VLF data.	40
3.3 Schematic diagram of data processing.	41
4.1 Sounding curves of individual resistivity measurement stations.	43

4.2	Resistivity modeling of station (a) L6P1, (b) L1P3, (c) L7P2, and (d) L8P3.	46
4.3	The surface plot showing the thickness of layer earth model overlay with resistivity map.	48
4.4	Resistivity map at different elevations (a) 297 m, (b) 295 m, (c) 293 m, (d) 291 m, (e) 289 m, (f) 287 m, (g) 285 m, (h) 283 m, (i) 281 m, and (j) 279 m.	52
4.5	Plane section of resistivity.	57
4.6	Map showing resistivity and VLF profiles.	60
4.7	Resistivity profiles in east-west direction.	61
4.8	Resistivity profiles in north-south direction.	62
4.9	Schematic geologic cross section in east-west direction as interpreted using resistivity data.	63
4.10	Schematic geologic cross section in north-south direction as interpreted using resistivity data.	64
4.11	Map showing borehole data of wells located near the study area.	65
4.12	VLF original data plot, filtered plot and relative current density pseudosection of (a) profile 100, (b) profile 600, (c) profile 700, (d) profile 800, and (e) profile 900.	67
4.13	Comparison of resistivity profile BB' and current density pseudosections of profile 200 and 300.	74
4.14	Comparison of resistivity profile CC' and current density pseudosection of profile 400.	75
4.15	Comparison of resistivity profile DD' and current density pseudosection of profile 500.	76

4.16	Chloride concentration maps of shallow well water.	77
4.17	Total dissolved solids concentration maps of shallow well water.	78
4.18	Resistivity maps of shallow well water.	79
4.19	Map showing area of groundwater contamination.	80

ABBREVIATIONS AND SYMBOLS

ABEM	A company named Aktiebolaget Elektrisk Malmletning
AMSL	Above mean sea level
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
DC	Direct current
EM	Electromagnetic
Ohm-m	Ohm-meter (unit of resistivity)
ppb	part per billion
ppm	part per million
TOC	Total Organic Carbon
TDS	Total Dissolved Solids
VES	Vertical Electrical Sounding
VLF	Very Low Frequency
WHO	World Health Organization
ρ_a	Apparent Specific Resistivity