
CONTENTS

ABSTRACT	II
ACKNOWLEDGEMENTS	III
CONTENTS	IV
LIST OF TABLES	VIII
LIST OF FIGURES	IX
LIST OF PLATES	X
NOTATION	XII
1 INTRODUCTION	13
2 LITERATURE REVIEW	15
3 AIMS AND OBJECTIVES	18
3.1 Goals	18
3.2 Environmental Key Performance Indicators	19
3.2.1 Nature - Biodiversity Management	20
3.2.2 Water - Water Management	20
3.2.3 Turf - Turfgrass Management	20
3.2.4 Waste - Waste Management	20
3.2.5 Energy - Energy Management	21
3.2.6 Education and Awareness Raising	21
3.2.7 Management Planning	21
4 HYPOTHESIS	21
5 METHODOLOGY	22
5.1 Goals	22
5.2 Research Design and Data Collection	22
5.3 Data Analysis	25
6 RESULTS	25
6.1 General Information	26
6.1.1 General Club and Facilities Information	26
6.1.2 General Course, Environment and Climate Information	27
6.1.3 General Turf Management Information	30
6.2 Specific Turf Management Information on Greens	33
6.2.1 Predominant Species Composition	34

6.2.2	Rootzone Mixture and Soil Profile	34
6.2.3	Thatch Layer	34
6.2.4	Diseases affecting Greens	34
6.2.5	Pests affecting Greens	36
6.2.6	Weeds affecting Greens	36
6.2.7	Fertiliser and Amendment Products	37
6.3	Specific Turf Management Information on Tees	37
6.3.1	Predominant Species Composition	38
6.3.2	Rootzone Mixture and Soil Profile	38
6.3.3	Thatch Layer	38
6.3.4	Diseases affecting Tees	39
6.3.5	Pests affecting Tees	39
6.3.6	Weeds affecting Tees	40
6.3.7	Fertiliser and Amendment Products	40
6.4	Specific Turf Management Information on Fairways	41
6.4.1	Predominant Species Composition	41
6.4.2	Rootzone Mixture and Soil Profile	42
6.4.3	Thatch Layer	42
6.4.4	Diseases affecting Fairways	42
6.4.5	Pests affecting Fairways	43
6.4.6	Weeds affecting Fairways	43
6.4.7	Fertiliser and Amendment Products	44
6.5	Specific Management Information on Rough	44
6.5.1	Maintenance of Rough and Hard Rough	45
6.5.2	Extent of Rough and Hard Rough	45
6.5.3	Earliest cut of Hard Rough	46
6.5.4	Management of Wildlife Habitats	46
6.6	General Information on Management and Irrigation	53
6.6.1	Greens	53
6.6.2	Tees	54
6.6.3	Fairways	55
6.6.4	Roughs	55
6.6.5	Irrigation	56
6.6.6	Sand for Bunker Maintenance and Top-dressing	57
6.6.7	Drainage Issues	57
6.6.8	Waste Management	58
7	ANALYSIS OF RESULTS AND INDICATIONS	58
7.1	Availability of Information	58
7.2	Analysis Difficulties	58
7.3	Nature - Biodiversity Management	59

7.3.1	Surveys on Flora, Fauna and Habitats	59
7.3.2	Awareness and Implication of 3/3 Rule of BAFU	60
7.3.3	Extent of good Quality of Habitat	61
7.3.4	Management of good Quality Wildlife Habitats	62
7.3.5	Discussion (Nature)	62
7.4	Water - Water Management	63
7.4.1	Total Annual Irrigation Water Consumption	63
7.4.2	Source of Water for Irrigation Purpose	65
7.4.3	Alternative Water Sources incl. Recycling	66
7.4.4	Golf Green and Tee Construction	66
7.4.5	Water Retention on Site	66
7.4.6	Excess Water Flow and Runoff	67
7.4.7	Legal Compliance for all Hazardous Products	67
7.4.8	Discussion (Water)	68
7.5	Turf - Turfgrass Management	69
7.5.1	Awareness of Climate Data	69
7.5.2	Areas of Intensive Managed Turf (Greens, Tees and Fairways)	70
7.5.3	Locally adopted Turf Cultivars	70
7.5.4	Total annual Fertiliser Usage	72
7.5.5	Total annual Pesticide Usage	73
7.5.6	Improvement of Plant Health	76
7.5.7	Discussion (Turf)	82
7.6	Waste - Solid Waste Management	83
7.6.1	Recycling Programme for Solid Waste	83
7.6.2	Composting Programme	83
7.6.3	Discussion (Waste)	84
7.7	Energy - Energy Management	84
7.7.1	Total Energy Consumption for Golf Course Maintenance	84
7.7.2	Use of Renewable Energy	84
7.7.3	Source of Bunker and Top-dressing Sand	85
7.7.4	Discussion (Energy)	85
7.8	Education and Awareness Raising	86
7.8.1	Qualified Staff	86
7.8.2	Communication of Environmental Issues	87
7.8.3	Discussion (Education and Awareness Raising)	87
7.9	Management Planning	88
7.9.1	Awareness of existing Environmental Programmes	88
7.9.2	Implementation of an EMP	90
7.9.3	Discussion (Management Planning)	91

8	CONCLUSION AND FUTURE WORK	91
8.1	Thesis conclusion	91
8.2	Future Work	93
	RESOURCES	95
	REFERENCES	97
	APPENDIX I	101
	APPENDIX II	102
	APPENDIX III	103
	APPENDIX IV	104
	APPENDIX V	105
	APPENDIX VI	106
	APPENDIX VII	107