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Integrating Economics and Ecology: A Systems Approach to Sustainability in the Auckland Region

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Abstract

Urban sustainability has emerged as a central environmental and urban policy issue over the last decade, as our world becomes more urbanised. The purpose of this thesis is to operationalise systems modelling approaches (static, system dynamics) that will lead to improved understanding of urban sustainability in the Auckland Region.

The first part of the thesis critically reviews and synthesises both the *sustainability* and *urban development* literatures. Consideration of the sustainability literature focuses on the economic, ecological, and thermodynamic interpretations of the sustainability concept, leading to the identification of eight principles used to guide the modelling process. The urban development literature revealed a significant schism between the anthropocentric approach of the social sciences and the more biophysical approach of the ecological sciences. Some suggestions are made on how to resolve this impasse.

The static systems (input-output) analysis provided much *structural detail* about the Auckland Region economic system and its environmental system; more importantly, it also details the interdependencies between these systems. A significant achievement was the construction of a 48 industry physical (mass flows) input-output model of the Auckland Region economy, and how the economy depends on physical flows *to and from* the environmental system. This dependency of the economic system on natural capital and ecological services was further illustrated by an input-output analysis showing how the Auckland Region economy appropriates ecological services *within* the Auckland Region. This was supported by an ecological footprinting analysis that revealed how the Auckland Region economy depends on natural capital (land) from *outside* the Auckland Region economy.

The system dynamics modelling extends the static systems analysis, to build the Auckland Region Dynamic Ecological-Economic Model (ARDEEM). This dynamic model is designed to simulate future development pathways for Auckland Region; consequently it contains a number of interconnected modules that represent components critical for achieving urban sustainability in Auckland Region: population, labour force, growth driver (based on an adjusted form of Solow growth theory), economy (financial flows), economy (physical flows), and the economy-environment interface (physical flows). The ARDEEM model's use is illustrated by generating 3 scenarios for the future development of Auckland Region: 'Business as Usual', 'Cornucopian Growth' and 'Prudent Pessimism'.

Finally, several areas for future research are discussed. These should try to develop further the theory that underpins urban sustainability modelling, particularly regarding improved integration of disparate theories. The best prospects lie in the future development of ARDEEM, incorporating more sectoral detail (20 – 30 industries), spatial dynamics and ecological processes that were not originally included primarily due to the lack of data.

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Table of Contents

Abstract	iii
Acknowledgements	v
List of Figures	xvii
List of Tables	xx
 Chapter One Introduction	 1
1.1 Issues of Growth in the Auckland Region	1
1.2 Need for a Systems Approach to Urban Sustainability	3
1.3 Research Aims and Objectives	4
1.3.1 Overall Aim	4
1.3.2 Specific Objectives	4
1.4 Methodological Approach	5
1.5 Thesis Organisation	6
 PART I THEORETICAL FRAMEWORKS: HOW DO REGIONS DEVELOP AND GROW SUSTAINABLY?	 11
 Chapter Two What is Sustainability?	 13
2.1 Economic Interpretations of Sustainability	14
2.1.1 Classical Economic Perspectives	14
2.1.2 Emerging Neo-Classical Economic Perspectives	17
2.1.3 Neo-Malthusian View and its Repudiation	19
2.1.4 Contemporary Neo-Classical Economic Perspectives	20
2.1.4.1 Exhaustible Natural Resources and Sustainability	21
2.1.4.2 Renewable Natural Resources and Sustainability	23
2.1.4.3 Pollution and Sustainability	25
2.1.4.4 Weak and Strong Sustainability	27
2.2 Ecological Interpretations for Sustainability	30
2.2.1 Sustainability of the Biosphere	30
2.2.2 Sustainability of Ecosystems, Communities and Populations	32
2.2.2.1 Equilibrium Ecology	32
2.2.2.2 Non-Equilibrium Ecology	33
2.2.3 Key Ideas in Ecological Sustainability	35

2.2.3.1	Biological Diversity	35
2.2.3.2	Ecosystem Stability and Resilience	36
2.2.3.3	Carrying Capacity	37
2.3	Thermodynamic Interpretations of Sustainability	38
2.3.1	Statement of the Laws of Thermodynamics	38
2.3.1.1	The First Law of Thermodynamics and Sustainability	42
2.3.1.2	The Second Law of Thermodynamics and Sustainability	44
2.4	Key Principles for Assessing Auckland Region's Sustainability	46
Chapter Three	Approaches to Urban Development and Sustainability	53
3.1	The Human Exemptionalism Paradigm	53
3.1.1	Assumptions of the Human Exemptionalism Paradigm	54
3.1.2	Classical Sociological Theory	55
3.1.3	Urban Ecology	57
3.1.4	Urban Geography	61
3.1.5	Urban Psychology	64
3.1.6	Urban Political Economy	65
3.1.7	Brief Critique of the HEP-based Urban Schools of Thought	69
3.2	The New Ecological Paradigm	70
3.2.1	Assumptions of the New Ecological Paradigm	71
3.2.2	Cities as Ecosystems	71
3.2.3	Ecological Footprinting	80
3.3	Outstanding Theoretical Issues	83
3.3.1	Need for Maturation of the NEP-based Approaches to Urban Sustainability	83
3.3.2	Need to Integrate the HEP and NEP Approaches?	84
3.4	Summary	85
PART II	ENVIRONMENT-ECONOMY INTERACTIONS IN AUCKLAND REGION: A STATIC SYSTEM ANALYSIS	91
Chapter Four	Methodological Framework for a Static Systems Model of the Auckland Region	93
4.1	Why Build Static Models?	93
4.2	Input-Output Analysis as the Basis for an Integrated Environment-Economy	

	Systems Framework	95
4.3	Critical Review of Environmental Input-Output Modelling	96
4.3.1	Inter-Industry Environmental Input-Output Models	98
4.3.1.1	Cumberland Model	98
4.3.1.2	Daly Model	100
4.3.1.3	Ayres-Kneese Model	101
4.3.1.4	Leontief Model	102
4.3.2	Commodity-by-Industry Environmental Input-Output Models	104
4.3.2.1	Isard Model	105
4.3.2.2	Victor Model	107
4.3.2.3	Physical Input-Output Tables	108
4.4	Static Systems Framework Used in this Research for the Auckland Region	110
4.4.1	Conceptualisation of the Environment-Economy System	110
4.4.1.1	System Boundaries	112
4.4.1.2	System Flows	113
4.4.1.3	Caveats to the Conceptualisation	121
4.4.2	Mathematical Description of Auckland Region's Environment-Economy System	122
4.4.2.1	Economic Input-Output Model	122
4.4.2.2	Physical Input-Output Model	127
4.4.3	Conversion to an Inter-Industry Framework	135
4.4.3.1	Commodity Technology and Industry Technology Assumptions	136
4.4.3.2	Generating an Inter-Industry Matrix Using the Industry Technology Assumption	137
Chapter Five	Economic Input-Output Model: Financial Flows in the Auckland Region Economy	141
5.1	Generation of the Auckland Region Economic Input-Output Model	142
5.1.1	Previous Regional-Level Economic Input-Output Models	142
5.1.2	Methodological Process Used in the Auckland Region Study	143
5.1.3	Update of the New Zealand Input-Output Model	145
5.1.4	Regionalisation of the New Zealand Model to Generate an Auckland Region Model	148
5.1.5	Limitations of the Auckland Region Economic Input-Output Model	157
5.1.6	Accuracy of the Auckland Region Economic Input-Output Model	158

5.2	Structural Analysis of the Auckland Region Economy	160
5.2.1	Economic Production	160
5.2.2	Contribution to New Zealand GDP	162
5.2.3	Economic Specialisation and Comparative Advantage	165
5.2.4	Balance of Trade	167
5.2.5	Network Analysis of Financial Flows: Clusters of Comparative Advantage	170
5.2.5.1	Industries Driven by Export Demand	172
5.2.5.2	Support Industries Driven by Intermediate Demand	173
5.2.5.3	Service Industries Driven by Local Demand	173
5.2.6	Multiplier Analysis of Income and Employment Impacts	174
5.2.6.1	Output Multipliers	175
5.2.6.2	Value Added Multipliers	177
5.2.6.3	Employment Multipliers	178
5.2.6.4	A Final Note on Auckland Region's Structural Interdependencies	180
Chapter Six	Physical Input-Output Model: Physical Flows in the Auckland Region Economy and Environment	183
6.1	Generation of an Auckland Region Physical Input-Output Model	184
6.1.1	Methodological Process in the Auckland Region Study	185
6.1.2	Derivation of a National Physical Input-Output Model	186
6.1.3	Derivation of an Auckland Region Physical Input-Output Model	198
6.1.4	Derivation of Raw Material and Residual Flows for the Auckland Region/National Economy	200
6.1.5	Limitations of the Physical Input-Output Models	206
6.2	Analysis of Physical Flows in Auckland Region's Economy	208
6.2.1	Overview of Physical Flows	208
6.2.2	Sectoral Physical Flows: Network Diagram	211
6.2.2.1	Explanation of the Network Diagram	211
6.2.2.2	Interpretation of the Network Diagram for Significant Industries	212
6.2.2.3	Key Interlinkages in the Network Diagram	216
6.2.3	Physical Balance of Trade	216
6.3	Ecological Multiplier Analysis: Combining Physical and Economic Flows	217
6.3.1	Rationale and Method	217
6.3.2	Ecological Multipliers for the Auckland Region	218

6.3.3	Cumulative Effects Indicator	220
Chapter Seven	Extending the Input-Output Frameworks: Ecological Processes and Services in the Auckland Region	223
7.1	Input-Output Model of Ecological Processes in the Auckland Region	224
7.1.1	Previous Input-Output Models of Ecological Processes	224
7.1.2	Scope of the Auckland Region Input-Output Model of Ecological Processes	226
7.1.3	Auckland Region Carbon Cycle Module	230
7.1.4	Auckland Region Hydrological Cycle Module	235
7.1.5	Auckland Region Phosphorus Cycle Module	238
7.1.6	Auckland Region Sulphur Cycle Module	241
7.1.7	Auckland Region Nitrogen Cycle Module	244
7.1.8	Limitations and Caveats	247
7.2	Input-Output Model of Ecological Services Input into the Auckland Region Economy	248
7.2.1	Methodology	250
7.2.2	Direct Ecosystem Service Value by Industry	254
7.2.3	Direct and Indirect Ecosystem Services by Industry	257
Chapter Eight	Auckland Region's Ecological Footprint and Environmental Interdependencies with Other Regions	261
8.1	The Ecological Footprint Concept	261
8.1.1	What is the Ecological Footprint?	261
8.1.2	History of the Ecological Footprint	262
8.1.3	How is the Ecological Footprint Calculated?	263
8.2	Critique of the Ecological Footprint Concept	265
8.2.1	Lack of Common Definitions and Methodologies	265
8.2.2	Why Use Land as the Numeraire?	266
8.2.3	Why Include Hypothetical Energy Land?	267
8.2.4	Is All Land the Same?	267
8.2.5	What Spatial Boundaries?	268
8.2.6	Dynamics – What About the Future?	268
8.2.7	Policy Relevance – A Policy Evaluation Tool?	269

8.3	An Input-Output Method for Estimating Auckland Region's Ecological Footprint	269
8.3.1	Accounting Identity of the Component Parts of the Regional Ecological Footprint	270
8.3.2	Generation of Input-Output Tables	270
8.3.3	Calculation of the Land Appropriated Within the Study Region (α)	271
8.3.4	Calculation of the Land Appropriated from Other Regions ($\beta_1 + \beta_2 + \dots + \beta_{n-1}$)	271
8.3.5	Calculation of Land Appropriated from Other Countries (δ)	274
8.3.6	Limitations of Using Input-Output Analysis	274
8.4	Ecological Footprint of the Auckland Region	276
8.4.1	Brief Description of the Auckland Region	276
8.4.2	Data Sources	276
8.4.3	Auckland Region's Ecological Footprint Disaggregated by Land Type	277
8.4.4	Auckland Region's Ecological Footprint Disaggregated by Economic Industry	278
8.4.5	Auckland Region's Ecological Balance of Trade	280
8.4.6	Comparing Auckland Region's Ecological Footprint with Other Regions	283
8.4.7	Comparing Auckland Region's Ecological Footprint with International Ecological Footprints	286
PART III	ENVIRONMENT-ECONOMY INTERACTIONS IN AUCKLAND REGION: A DYNAMIC SYSTEMS ANALYSIS	289
Chapter Nine	System Dynamics Approach to Modelling Ecological-Economic Systems	291
9.1	Why Build Dynamic Models?	291
9.2	Why Build a System Dynamics Model?	292
9.3	Brief History of System Dynamics	293
9.4	Key Features of a System Dynamics Model	294
9.4.1	Dynamic System Behaviour	295
9.4.2	Building Blocks for System Dynamics Models	297
9.4.2.1	Stocks	298
9.4.2.2	Flows	298

9.4.2.3	Converters	299
9.4.2.4	Connectors	299
9.4.2.5	Bringing the Building Blocks Together	299
9.4.2.6	General Principles for Building Systems Models	300
9.4.2.7	Setting Delta Time	301
9.4.2.8	Hannon and Ruth's Four Model Set	301
9.5	Modelling Process	302
Chapter Ten	Critical Review of Growth Theories	309
10.1	Classical Growth Theories	309
10.2	Neo-classical Growth Theories	311
10.2.1	Harrod-Domar Growth Model	311
10.2.2	The Solow Model	312
10.2.3	The Solow Model with Technology	315
10.3	Endogenous or New Growth Theory	317
10.3.1	The Romer Model	319
10.3.2	Other Endogenous Growth Models	322
10.4	Critique of Growth Theories as Applied to Environmental and Regional Models	323
10.5	Natural Resources and Economic Growth	325
10.5.1	Modelling the Implications of Land Use	326
10.5.2	Modelling of the Depletion of a Non-Renewable Resource	326
Chapter Eleven	Auckland Region Dynamic Ecological-Economic Model	329
11.1	Structure of ARDEEM	329
11.2	ARDEEM Mathematical Nomenclature	331
11.3	Population Module	332
11.4	Labour Force Module	337
11.5	Growth Module	340
11.6	Economic Module	346
11.7	Economic Physical Flow Module	350
11.8	Environment-Economy Physical Flow Module	356
11.9	Validation and Verification of ARDEEM	362
11.9.1	Structural Validity of ARDEEM	362
11.9.2	Predictive Validity of ARDEEM	363

11.10	Scenario Analysis	363
11.10.1	ARDEEM Scenarios	365
11.10.2	Simulation Results	367
11.11	Limitations of the ARDEEM	373
11.11.1	Extending ARDEEM to Include Ecological Processes	374
Chapter Twelve Thesis Summary and Conclusions		377
12.1	Thesis Contributions	377
12.1.1	Theoretical Contributions	377
12.1.2	Methodological Contributions	378
12.1.3	Empirical and Knowledge Contributions	380
12.2	Limitations and Future Research	382
12.2.1	Theoretical Analysis	382
12.2.2	Static Systems Analysis	383
12.2.3	Dynamic Systems Analysis	384
List of PhD Outputs		387
References		391
APPENDICES		473
Appendix A	Input-Output Analysis: History, Mathematics and Assumptions	475
A.1	Brief History of Input-Output Modelling	475
A.2	Input-Output Tables	475
A.3	Technical Coefficients	478
A.4	The Leontief Inverse	479
A.5	Assumptions of Input-Output Modelling	480
Appendix B	Global Biogeochemical Cycling Model	481
B.1	Rationale for the Global Biogeochemical Cycling Model	481
B.2	Data Sources	483
B.2.1	Global Fluxes	484

B.2.2	Global Reservoirs	494
B.3	Description of Stocks, Flows and Converters in the GBCM	500
B.4	GBCM Mathematical Description	501
B.5	Steady State Analysis	509
B.6	Limitations and Caveats of the GBCM	512
B.7	Finite Difference Equations for the GBCM	513
B.7.1	Atmosphere Stocks	515
B.7.2	Terrestrial Stocks	518
B.7.3	Marine Stocks	520
B.7.4	Hydrosphere Stocks	523
B.7.5	Lithosphere Stocks	524
B.7.6	Oxygen Stock	525
 Appendix C	 Mathematical Description of the Interregional Trade Flows Optimisation used in the Ecological Footprint Analysis	 527
 Appendix D	 Non-Survey Regionalisation Methodologies	 529
D.1	Coefficient Reduction Methodologies	530
D.1.1	Location Quotient Methodologies	530
D.1.2	The Commodity Balance Approaches	531
D.1.3	Constrained Matrix Techniques	532
D.2	Other Approaches	534
D.2.1	Regional Weights	534
D.2.2	Representative Regional Coefficients	535
 Appendix E	 Industry Definitions and Concordances	 537
 Appendix F	 Aggregated Commodity-by-Industry Economic Input-Output Models For New Zealand and the Auckland Region, 1997-98	 549
 Appendix G	 Multiplier Analysis Methodology	 555
G.1	Input-Output Multipliers	555
G.1.1	Output Multipliers	557
G.1.2	Value Added Multipliers	557
G.1.3	Employment Multipliers	558

Appendix H	Aggregated Commodity-by-Industry Physical Input-Output Models For New Zealand and the Auckland Region, 1997-98	559
Appendix I	Raw Material and Residual Inputs/Outputs of the Auckland Region Economy, 1997-98	565
I.1	Raw Material Inputs	565
I.2	Residual Inputs	567
I.3	Raw Material Outputs	568
I.4	Residual Outputs	568
Appendix J	Assessing the Value of Auckland Region's Ecosystem Services	573
J.1	Valuation Approach	573
J.2	Valuation Methods	575
J.3	Methodological Sequence	575
J.3.1	Auckland Region's Ecosystem Types and Services	575
J.3.2	Estimates of the Direct Use-Value of Ecosystem Services	580
J.3.3	Estimates of the Indirect Use-Value of Ecosystem Services	580
J.3.4	Estimation of the Auckland Region's TEV	581
J.3.5	Distribution of Auckland Region's TEV across 48 Input-Output Industries	581
J.4	Theoretical and Methodological Issues	581
J.5	The Auckland Region TEV	582
J.5.1	By Terrestrial Ecosystem Type	582
J.5.2	By Terrestrial Ecosystem Service	583
J.5.3	Coastal Ecosystem Services	585
Appendix K	Environmental Flows of Land and Energy into the Auckland Region Economy	587
Appendix L	System Dynamics Model of Endogenous Growth	591
Appendix M	ARDEEM Regression Equations	593
Appendix N	CD-ROM Software	597

List of Figures

Figure 1.1	Interrelationships between Thesis Chapters	7
Figure 2.1	Non-Equilibrium and Equilibrium Points in Ecosystem Dynamics	34
Figure 2.2	Holling's Four Phase Model of Ecosystem Change and Resilience	37
Figure 2.3	Interrelationships between Key Principles of Sustainability	51
Figure 3.1	Urban Ecology Models of Urban Development	59
Figure 3.2	Urban Geography Models of Urban Development	62
Figure 3.3	Hierarchical and Spatial Arrangement of Central Places	64
Figure 3.4	Harvey's Model of the Circulation of Capital	67
Figure 3.5	Resource Inputs Consumed and Waste Outputs Discharged from Sydney, 1990	73
Figure 3.6	Extended Metabolism Model of Human Settlements	76
Figure 4.1	Cumberland Model	99
Figure 4.2	Daly Model	100
Figure 4.3	Ayres-Kneese Model	101
Figure 4.4	Leontief Model	103
Figure 4.5	Isard Model	106
Figure 4.6	Victor Model	107
Figure 4.7	A Physical Input-Output Model	109
Figure 4.8	Auckland Region's Environment-Economy System and its Relationship with Other Systems	111
Figure 4.9	Auckland Region's Environment-Economy System With an Expanded Environmental System	116
Figure 4.10	Auckland Region's Environment-Economy System With an Expanded Economic System	118
Figure 5.1	Methodological Process for Generating an Auckland Region Economic (Commodity-by-Industry) Input-Output Model	144
Figure 5.2	Top Ranking Auckland Region Industries, 1997-98 (Percentage Contribution to New Zealand GDP)	164
Figure 5.3	Auckland Region's Clusters of Comparative Advantage, 1997-98	169
Figure 6.1	Methodological Process for Deriving New Zealand and Auckland Region Physical Input-Output Models	186
Figure 6.2	Auckland Region's Major Environment-Economy Physical Flows, 1997-98	210
Figure 6.3	Network Diagram of the Main Flows in the Auckland Region Economy, 1997-98	215

Figure 7.1	Structure of the U - V Matrix of Ecological Flows in the Auckland Region	229
Figure 7.2	Auckland Region's Carbon Cycle, 1997-98	232
Figure 7.3	Auckland Region's Hydrological Cycle, 1997-98	236
Figure 7.4	Auckland Region's Phosphorus Cycle, 1997-98	239
Figure 7.5	Auckland Region's Sulphur Cycle, 1997-98	242
Figure 7.6	Auckland Region's Nitrogen Cycle, 1997-98	245
Figure 7.7	Input-Output Model Accounting Framework	250
Figure 7.8	Methodological Process for Calculating Ecological Multipliers and Tree Diagrams	251
Figure 7.9	Total Embodied Ecosystem Services Appropriated by the Auckland Region Air Transport Industry, 1997-98	258
Figure 7.10	Total Embodied Ecosystem Services Appropriated by the Auckland Region Business Services Industry, 1997-98	259
Figure 8.1	Regional and International Origins of Auckland Region's Ecological Footprint, 1997-98	282
Figure 8.2	Ecological Footprints of New Zealand Regions, 1997-98	284
Figure 8.3	Comparison of Auckland Region Ecological Footprint Per Capita with Other Regions in New Zealand, 1997-98	285
Figure 8.4	Comparison of Auckland Region Ecological Footprint Per Capita with Other Nations	287
Figure 9.1	Common Types of Dynamic Behaviour	297
Figure 9.2	Hannon and Ruth's Four Model Set	301
Figure 9.3	Key Steps in the System Dynamics Modelling Process	302
Figure 9.4	Bull's Eye Diagram	304
Figure 10.1	The Solow Diagram	315
Figure 11.1	Module Linkages	331
Figure 11.2	Population Module Influence Diagram	334
Figure 11.3	Labour Force Module Influence Diagram	338
Figure 11.4	Growth Module Influence Diagram	343
Figure 11.5	Economic Module Influence Diagram	347
Figure 11.6	Economic Physical Flow Influence Diagram	352
Figure 11.7	Environment-Economy Physical Flow Influence Diagram	357
Figure 11.8	ARDEEM Scenario Analysis: Business As Usual, Cornucopian Growth and Prudent Pessimism	370
Figure A.1	An Input-Output Table	477
Figure B.1	Carbon Cycle Influence Diagram	504

Figure B.2	Hydrological Cycle Influence Diagram	505
Figure B.3	Phosphorus Cycle Influence Diagram	506
Figure B.4	Sulphur Cycle Influence Diagram	507
Figure B.5	Nitrogen Cycle Influence Diagram	508
Figure B.6	Baseline Analysis of the Steady State Conditions of Critical Stocks in the GBCM, 2001-2051	510
Figure C.1	Structure of the Interregional Trade Flows Optimisation Problem	527
Figure J.1	Estimation of the Consumers and Producers Surplus for a Substitutable Ecosystem Service	574
Figure J.2	Estimation of the Consumers and Producers Surplus for a Non- Substitutable Ecosystem Service	574
Figure J.3	Methodological Sequence for the Estimation of the Total Economic Value (TEV) of Auckland Region's Ecosystem Services	577
Figure L.1	An Alternative Endogenous Growth Engine	592

List of Tables

Table 2.1	Theoretical Principles for Sustainable Development and their Application in this Thesis	47
Table 3.1(a)	Conceptual Foundations for HEP-based Urban Schools of Thought	87
Table 3.1(b)	Conceptual Foundations for NEP-based Urban Schools of Thought	88
Table 4.1	Commodity-by-Industry Financial Flow Matrix	123
Table 4.2	Commodity-by-Industry Physical Flow Matrix	129
Table 5.1	Contribution to Auckland Region GRP	162
Table 5.2	Location Quotients for the Auckland Region Economy	166
Table 5.3	Auckland Region's Financial Balance of Trade, 1997-98	169
Table 5.4	Output Multipliers for Auckland Region and New Zealand, 1997-98	176
Table 5.5	Value Added Multipliers for Auckland Region and New Zealand, 1997-98	178
Table 5.6	Employment Multipliers for Auckland Region and New Zealand, 1997-98	180
Table 6.1	International Exports as a Percentage of Commodity Output, 1997-98	190
Table 6.2	International Imports as a Percentage of Commodity Input, 1997-98	191
Table 6.3	Superior Data Inserted into the New Zealand Physical Input-Output Model, 1997-98	196
Table 6.4	Classification of Raw Materials and Residuals	201
Table 6.5	Data Sources for the Raw Material Inputs into the Auckland Region and New Zealand Economies, 1995-98	203
Table 6.6	Data Sources for the Residual Outputs from the Auckland Region and New Zealand Economies, 1995-98	204
Table 6.7	Physical Balance of Trade for the Auckland Region Disaggregated by Commodity Type, 1997-98 (kt)	217
Table 6.8	Ecological Multipliers for Auckland Region's Economic Industries, 1997-98	219
Table 6.9	Cumulative Effects Index for Auckland Region's Economic Industries, 1997-98	222
Table 7.1	World to Auckland Region Scalars Used to Generate the Prototype Input Output Model of Ecological Processes in the Auckland Region	227
Table 7.2	Input-Output Model of the Carbon Cycle Processes for Auckland Region, 1997-98	223
Table 7.3	Input-Output Model of the Hydrological Cycle Processes for Auckland Region, 1997-98	237

Table 7.4	Input-Output Model of the Phosphorus Cycle Processes for Auckland Region, 1997-98	240
Table 7.5	Input-Output Model of the Sulphur Cycle Processes for Auckland Region, 1997-98	243
Table 7.6	Input-Output Model of the Nitrogen Cycle Processes for Auckland Region, 1997-98	246
Table 7.7	Summary of the Ecosystem Services Assessed	249
Table 7.8	Direct Value Derived from Auckland Region's Terrestrial Ecosystems, by Economic Industry, 1997-98	256
Table 8.1	Assumptions Made by Three Different Ecological Footprint Calculation Methods	266
Table 8.2	Illustrative Example of the Matrix T: Land Appropriated From Other Regions $\beta_1 + \beta_2 + \dots + \beta_{n-1}$	274
Table 8.3	Auckland Region Ecological Footprint Disaggregated by Land Type, 1997-98	277
Table 8.4	Auckland Region Ecological Footprint Disaggregated by Economic Industry, 1997-98	279
Table 8.5	Ecological Balance of Trade for the Auckland Region Disaggregated by Land Type, 1997-98	280
Table 9.1	Four Systems Components and their Modelling Symbols	298
Table 11.1	Summary of Drivers under Each Scenario	367
Table B.1	Biosphere Inputs Into Processes	486
Table B.2	Biosphere Outputs From Processes	490
Table B.3	Global Carbon Reservoirs	495
Table B.4	Global Hydrogen Reservoirs	496
Table B.5	Global Phosphorus Reservoirs	497
Table B.6	Global Sulphur Reservoirs	498
Table B.7	Global Nitrogen Reservoirs	499
Table B.8	Non-marker Arrayed Flows and Sets of Processes	514
Table D.1	Hypothetical Transactions Table (Target Year)	532
Table D.2	Hypothetical Transactions Table (Base Year)	533
Table D.3	Hypothetical Transactions Table (Target Year) – 1 st Iteration	533
Table D.4	Hypothetical Transactions Table (Target Year) – 2 nd Iteration	533
Table D.5	Hypothetical Transactions Table (Target Year) – 3 rd Iteration	534
Table D.6	Hypothetical Transactions Table (Target Year) – Final Iteration	534
Table E.1	Industry Definitions	537
Table E.2	Industry Definitions Concordance	539

Table E.3	Commodity Definitions	542
Table E.4	Commodity Definitions Concordance	545
Table F.1	Aggregated Commodity-by-Industry Input-Output Model for New Zealand, 1997-98 (\$ mil)	550
Table F.2	Aggregated Commodity-by-Industry Input-Output Model for the Auckland Region, 1997-98 (\$ mil)	551
Table F.3	Aggregated Industry-by-Industry Input-Output Model for New Zealand, 1997-98 (\$ mil)	552
Table F.4	Aggregated Industry-by-Industry Input-Output Model for the Auckland Region, 1997-98 (\$ mil)	553
Table G.1	Technical Coefficients Table for a Hypothetical Region	555
Table G.2	Leontief Matrix (I-A) for a Hypothetical Region	555
Table G.3	Leontief Inverse Matrix (I-A) ⁻¹ for a Hypothetical Region	556
Table G.4	Closed Leontief Matrix (I-A*) for a Hypothetical Region	556
Table G.5	Closed Leontief Inverse Matrix (I-A*) ⁻¹ for a Hypothetical Region	556
Table H.1	Aggregated Commodity-by-Industry Physical Input-Output Model for New Zealand, 1997-98 ('000s t)	560
Table H.2	Aggregated Commodity-by-Industry Physical Input-Output Model for the Auckland Region, 1997-98 ('000s t)	562
Table I.1	Raw Material Inputs by 48 Industries and Households in the Auckland Region Economy, 1997-98 ('000s t)	566
Table I.2	Residual Outputs by 48 Industries, Final Consumption, and Gross Capital Formation and Man-made Assets in the Auckland Region Economy, 1997-98 ('000s t)	569
Table J.1	Direct and Indirect Use Value Derived from Auckland Region's Terrestrial Ecosystem Types, 1997-98	583
Table J.2	Direct and Indirect Use Value Derived from Auckland Region's Terrestrial Ecosystems, by Ecosystem Service, 1997-98	585
Table K.1	Summary of Methodologies Used to Estimate Physical Flows of Land and Energy	588
Table K.2	Energy and Land Inputs by 48 Industries and Households, 1997-98	589
Table M.1	ARDEEM Fertility Rate Regression Equations	593
Table M.2	ARDEEM Mortality Rate Regression Equations	594
Table M.3	ARDEEM Labour Force Participation Rate Regression Equations	595
Table M.4	ARDEEM Employment by Industry Distribution Regression Equations	595
Table M.5	ARDEEM Depreciation Rate Regression Equations	595

Table M.6	ARDEEM Investment Rate Regression Equations	596
Table M.7	ARDEEM International Exports to Gross Output Regression Equation	596
Table M.8	ARDEEM Factors of Production Elasticities with Respect to Output	596