
Contents

Preface	ix
Notation	xi
Chapter 1. Introduction	1
Chapter 2. Definition and Classification	5
Definition	5
Classification of Estuaries	6
Classification by Tides	6
Classification by Topography	8
Morphological Classification	10
Classification on Salinity Structure	14
Quantified Classifications	22
Classification Using a Stratification-circulation Diagram	25
Chapter 3. Tides in Estuaries	33
Equilibrium Estuaries	38
Chapter 4. Mixing	41
Characterization of Flow	41
Mixing in Stratified Flows	44
Internal Mixing	44
Boundary Layer Turbulence	48
Estuarine Mixing	52
Mixing Coefficients	54
Dispersion	55
Averaging	58

Chapter 5.	Cross-channel Effects	62
	Vertical Velocities	62
	Secondary Flows	65
	Cross-sectional Averaging	68
Chapter 6.	Salt Balance	69
	General Formulation	69
	Knudsen's Hydrographical Theorem	76
	Partially Mixed Estuaries	77
	Well-mixed Estuaries	79
	Cross-sectional Salt Fluxes	79
	Transverse Shear	85
Chapter 7.	Dynamic Balance	91
	General Formulation	91
	Vertical Dynamic Balance	94
	Longitudinal Dynamic Balance	94
	Lateral Dynamic Balance	102
Chapter 8.	Highly Stratified Estuaries	107
	Arrested Salt Wedge	108
	Highly Stratified with Tidal Motion	110
	Vellar Estuary	110
	Palmiet Estuary	115
	Fraser River Estuary	118
	Intense Mixing Periods	120
	Fjords	121
	Hardanger Fjord, Norway	121
	Knight Inlet, British Columbia	125
	Deep Water Renewal	127
	Effects at the Mouth	128
	Tidal Intrusion Fronts	130
	Plumes	134
Chapter 9.	Partially Mixed and Well-mixed Estuaries	136
	James River, Virginia	138
	Mersey Narrows, England	141
	Tamar Estuary, England	146
	Conwy Estuary, North Wales	147
	Vertical Gravitational circulation	152
	Tidal Straining	155
	Effect of Weather on Estuaries	156

<i>Contents</i>	vii
Turbidity Maximum	157
Vertical Gravitational Circulation	159
Tidal Pumping	159
Sediment Dynamics	160
Chapter 10. Flushing and Pollution Distribution Prediction	165
Flushing Time	165
Tidal Prism Method	165
Fraction of Fresh Water Method	166
Water and Salt Budget Method	167
Modified Tidal Prism Method	167
Theory of a Mixing Length	168
Flushing Rate	170
Exchange Through the Mouth	170
Pollution Dispersion Prediction	172
Conservative Pollutants	172
Non-conservative Pollutants	176
Glossary	180
References	184
Index	193