Contents

Preface v

Acknowledgements vii

Abbreviations and Principal Notation viii

About this Manual ix

1. Introduction 1
  1.1 The need for sanitation 1
  1.2 Simplified sewerage 3
  1.3 Promotion of simplified sewerage 9

2. Theory of Simplified Sewerage 11
  2.1 Wastewater flow 11
     2.1.1 Minimum daily peak flow 12
  2.2 Properties of a circular section 12
  2.3 Gauckler-Manning equation 15
  2.4 Tractive tension 15
  2.5 Minimum sewer gradient 16
  2.6 Sewer diameter 17
  2.7 Number of houses served 18
  2.8 Design comparisons 19

3. Planning and Design 21
  3.1 Initial assessment of sanitation options 21
     3.1.1 Technical options 22
     3.1.2 Management options 23
  3.2 Planning for sewerage 24
     3.2.1 Collection of existing information 25
     3.2.2 Area to be included 25
     3.2.3 Development of a draft sewerage plan 26
     3.2.4 Physical and social surveys 27
     3.2.5 Final sewer routes 29
  3.3 Detailed design 29
     3.3.1 Introduction to the design process 29
     3.3.2 Categories of design parameters 30
     3.3.3 Design input parameters 30
     3.3.4 Design over-riding parameters 32
     3.3.5 Design output parameter – minimum sewer gradient 33
     3.3.6 Design of condominial sewers 34
     3.3.7 Design of public collector sewers 39
4. **PC-based Simplified Sewer Design 41**
   4.1 Overview 41
      4.1.1 System requirements 41
      4.1.2 Obtaining the program 41
      4.1.3 The definition of a sewer network used in the program 42
      4.1.4 The minimum information necessary to use the program 42
      4.1.5 Getting started 42
   4.2 Visual editor screen 44
   4.3 Data entry/edit screen 52
   4.4 Results table screen 56
   4.5 Calculator screen 59
   4.6 Main menu options 62
      4.6.1 File menu 62
      4.6.2 View menu 63
      4.6.3 Option menu 64
      4.6.4 Tools menu 65
      4.6.5 Help menu 66
   4.7 Quick Start examples 66
      4.7.1 Example 1 – A single line of sewers 67
      4.7.2 Example 2 – Adding a branch sewer 74
      4.7.3 Example 3 – Branch conversion to two sub-networks 76
      4.7.4 Example 4 – The UNCHS design example 79

5. **Simplified Sewerage in Practice 81**
   5.1 Simplified sewer construction 81
      5.1.1 The need for good construction practice 81
      5.1.2 Sewer gradient and ground slope 81
      5.1.3 Grease/grit traps 84
      5.1.4 Sewer pipe materials 85
      5.1.5 Sewer appurtenances 85
   5.2 Operation and maintenance 87
   5.3 System sustainability 89

References and Further Reading 91
   Publications available on the Internet 96

Appendix 1. **Velocity of Flow Equations 97**
   A1.1 The Chézy equation 97
   A1.2 The Gauckler-Manning equation 98
      A1.2.1 Dimensions of n 98
      A1.2.2 A modern form for the Gauckler-Manning equation 100
   A1.3 The Colebrook-White equation 100
   A1.4 The Escritt equation 101

Appendix 2. **Comparative Simplified Sewer Design Trials 103**
   A2.1 UNCHS design example 103
   A2.2 World Bank – UNDP design example 104

Appendix 3. **Hydrogen Sulphide Generation 109**