

Practical Guide to the Operation and Optimisation of Distribution Systems



THIRD EDITION

Peter Mosse and Dan Deere



General Introduction

Foreword

Chapter 1	Distribution Systems And Public Health	7
Chapter 2	Hazards, Risks And Control Points	11
	• Hazards And Drinking Water	11
	• Pathogens Are The Main Hazards In Drinking Water	11
	• Other Hazards.....	15
	• Control Points.....	16
	• Targets And Critical Limits.....	17
	◦ <i>Corrective Actions</i>	17
	• Monitoring	18
	• Responsibilities	18
Chapter 3	Distribution System Targets	19
	• The Importance Of Good Distribution System Operation	19
	• Specific Targets.....	19
Chapter 4	Distribution System Optimisation	24
	• 1. Know Your System	25
	◦ <i>Valves</i>	25
	◦ <i>Mains</i>	26
	◦ <i>Disused System Components</i>	26
	• 2. Prevent Contamination In Treated Water Storages	27
	◦ <i>Sediment Accumulation In Treated Water Storages</i>	33
	◦ <i>Storage Security</i>	33
	◦ <i>Inspection Of Treated Water Storages</i>	34
	• 3. Prevent Contamination In Distribution Mains.....	38
	◦ <i>Maintain Positive Pressure At All Times</i>	39
	◦ <i>Keep Mains In Good Repair And Above The Levels Of Groundwater</i>	40
	◦ <i>Avoid Rapid Increases In Flow</i>	41
	◦ <i>Avoid Water Hammer</i>	41
	◦ <i>Install Backflow Prevention Devices</i>	41
	◦ <i>Use Hygienic Work Practices</i>	42
	◦ <i>Consider Impact Of Alternative Water Supply Arrangements</i>	43
	• 4. Ensure Minimum Detention Times	43
	◦ <i>In Treated Water Storages</i>	43
	◦ <i>In Distribution Mains</i>	44
	• 5. Optimise Disinfection.....	45
	• 6. Maintain Disinfectant Residuals	47
	• 7. Balance Chlorine Residuals Across The System.....	49
	• 8. Install Residual Trim Chlorination.....	51
	• 9. Use Materials Compatible With Drinking Water	52
	• 10. Stabilise Water Entering The Distribution System	52
	• 11. Minimise Copper Corrosion	53
	• 12. Optimise Chloraminated Distribution Systems	55
	◦ <i>Nitrification</i>	56
	◦ <i>Monitoring And Management Of Chloraminated Systems</i>	57

Chapter 5	Monitoring Distribution Systems	59
	• Essential Monitoring Equipment.....	59
	• More Sophisticated Monitoring Equipment.....	60
	• Monitoring Disinfection.....	61
	• Laboratory Testing.....	63
	◦ <i>E. coli</i>	64
	◦ <i>Total Coliforms</i>	64
	◦ <i>Heterotrophic Plate Counts (HPCs)</i>	65
	• Integrated Analysis.....	65
	• Consumers As Water Quality Monitors.....	66
	◦ <i>Pattern Analysis</i>	67
	• Proactive Taste And Odour Surveys.....	67
Chapter 6	Maintaining A Clean Distribution System	70
	• Flushing.....	70
	• Air Scouring.....	72
	• Swabbing.....	73
	• Ice Pigging.....	75
	• Which Cleaning Method Is Best?.....	76
	• How Much Does Cleaning Cost?.....	77
	• How Often Should It Be Cleaned?.....	78
	• Mains Cleaning, Drought And Wasted Water.....	80
	• Keeping Treated Water Storages Clean.....	80
Chapter 7	Mains Breaks, Mains Replacement And New Mains	83
	• New And Replacement Mains.....	83
	◦ <i>Cleaning</i>	84
	◦ <i>Hydrostatic Pressure Testing</i>	85
	◦ <i>Disinfection</i>	85
	◦ <i>Testing</i>	85
	• Mains Breaks.....	86
	• Mains Repair Procedure.....	87
	1. <i>Hygienic Work Practices</i>	87
	2. <i>Storage Of Pipe Sections And Fittings</i>	88
	3. <i>Assess The Break</i>	89
	4. <i>Isolation Of The Main</i>	89
	5. <i>Excavation And Pumping</i>	90
	6. <i>Tools And Equipment</i>	91
	7. <i>Removal And Replacement Of Pipe Section</i>	92
	8. <i>Flushing</i>	92
	9. <i>Disinfection</i>	94
	10. <i>What To Do With Discharged Water</i>	96
	11. <i>Auditing</i>	96
	• Approved Materials.....	97
	• Summary.....	98
Chapter 8	Operational Audits	99
Chapter 9	Closing Words	101

Appendices

Appendix 1	Distribution System Contamination Case Studies	102
	• Case Study 1. Central Queensland, Australia, 1999	102
	• Case Study 2. Gideon, USA, 1993	103
	• Case Study 3. Queensland, Australia, 2005.....	103
	• Case Study 4. Pennsylvania, USA, 2005	104
	• Case Study 5. Alabama, USA, 1986	104
	• Case Study 6. Oulu, Finland, 1998.....	105
Appendix 2	Optimisation Case Study	106
	• Dirty Water, Taste And Odour In Sale, Victoria	106
Appendix 3	Summary Of Distribution System Hazards, Hazardous Events And Preventive Measures	117
Appendix 4	A Simple Method For The Measurement Of Chlorine Demand	122
Appendix 5	Water Research Foundation (WRF 2014) Effective Microbial Control Strategies For Mains Repair And Depressurisation	125
References	126