



WATER SERVICES  
ASSOCIATION OF AUSTRALIA

# SEWAGE PUMPING STATION CODE OF AUSTRALIA

Version 3.2

(Incorporating Amendment No 1)

WSA 04-2022

## Contents

FRONTMATTER.....	2
GENERAL.....	2
ACKNOWLEDGEMENTS.....	2
PUBLICATION HISTORY.....	3
ABOUT WSAA.....	3
ACKNOWLEDGEMENT OF COUNTRY.....	3
DISCLAIMER.....	3
COPYRIGHT.....	3
ALL RIGHTS RESERVED .....	3
FOREWORD.....	4
PREFACE.....	5
THE NEED FOR TECHNICAL DOCUMENTATION.....	5
THE BENEFITS OF NATIONAL CODES.....	5
INNOVATION.....	5
HYPOTHETICAL EXAMPLE OF THE USE OF THE GRAVITY SEWERAGE AND SEWAGE PUMPING STATION CODES.....	6
Concept Plan.....	6
Agency/Development Agreement.....	6
Project Manager.....	6
Design.....	7
Specification.....	7
Constructor.....	7
Testing.....	7
The WSAA Website.....	7
INTRODUCTION.....	8
Scope of Code.....	8
Code Purpose.....	8
Mandatory and Informative.....	8
Appendices.....	8
Standard Drawings and Figures.....	9
Product Specifications.....	9
General.....	9
Quality Assurance.....	9
Packaging, Transportation and Delivery.....	9
Products and Material Information and Guidance.....	9
Water Industry Standards.....	9
WORK HEALTH AND SAFETY (WHS) LAWS.....	10
NATIONAL STANDARD FOR CONSTRUCTION WORK.....	10
SAFE DESIGN OF STRUCTURES.....	11
PROPOSED AMENDMENTS.....	12
PART 0 GLOSSARY, ABBREVIATIONS AND REFERENCES.....	
I GLOSSARY OF TERMS.....	47
II ABBREVIATIONS.....	54
III REFERENCED DOCUMENTS.....	60
PART 1: PLANNING AND DESIGN.....	72
PREFACE.....	73
1 GENERAL.....	75

1.1 SCOPE.....	75
1.2 PLANNING.....	75
1.2.1 General.....	75
1.2.2 Pumping alternatives.....	75
1.3 SEWAGE PUMPING STATIONS.....	76
1.3.1 Pumping philosophy.....	76
1.4 PURPOSE AND APPLICATION.....	76
1.5 PLANNING AND DESIGN RESPONSIBILITIES AND INTERFACES.....	77
1.5.1 General.....	77
1.5.2 Planning responsibilities.....	77
1.5.3 Design responsibilities.....	77
1.5.4 Critical infrastructure protection.....	79
1.5.4.1 General.....	79
1.5.4.2 Asset categorisation.....	79
1.5.4.3 All hazards – infrastructure protection.....	80
1.5.5 Consultation with other parties.....	80
1.6 SEWER SYSTEM DESIGN APPROACH.....	80
1.6.1 Overall objective.....	80
1.6.2 System design life.....	81
1.6.3 Instrumentation and control systems.....	81
1.6.4 Objectives of design.....	81
1.6.5 Design output.....	84
2 CONCEPT DESIGN.....	85
2.1 LIFE CYCLE CONSIDERATIONS.....	85
2.2 FUNCTIONALITY.....	85
2.3 MAINTAINABILITY.....	86
2.4 RELIABILITY.....	86
2.5 DUE DILIGENCE REQUIREMENTS.....	86
2.6 MATERIALS DESIGN.....	88
2.7 STAGING.....	88
2.8 SEPTICITY CONTROL.....	88
2.8.1 General.....	88
2.8.2 Detention time.....	89
2.9 ODOUR MANAGEMENT.....	89
2.10 NOISE CONTROL.....	89
2.11 SERVICES.....	90
2.12 ACCESS.....	90
2.13 SECURITY.....	90
2.14 SIGNAGE.....	90
2.15 SUPPORTING SYSTEMS.....	91
2.16 HEALTH AND SAFETY.....	91
3 GENERAL DESIGN.....	92
3.1 GENERAL.....	92
3.2 DESIGN ACCURACY.....	92
3.3 LEVELS.....	92
3.4 UNFORESEEN GROUND CONDITIONS.....	93
3.5 IMPACT OF CONSEQUENTIAL DAMAGE.....	93
3.6 ENVIRONMENTAL, CULTURAL AND HERITAGE CONSIDERATIONS.....	93

3.6.1 General.....	93
3.6.2 Urban salinity.....	94
3.6.3 Acid sulphate soils.....	94
3.6.4 Effect on vegetation.....	95
3.6.5 Contaminated sites.....	95
3.6.6 Climate change impacts.....	96
3.6.6.1 Context.....	96
3.6.6.2 AdaptWater tool.....	96
3.6.6.3 Australian infrastructure adaptation platform, the Cross Dependency Initiative (XDI).....	96
3.6.7 Coastal zones.....	97
3.7 EASEMENTS.....	97
3.8 CROSSINGS.....	98
3.8.1 General.....	98
3.8.1.1 Requirements for encased pipe installations.....	99
3.8.1.2 Railway reserves.....	99
3.8.2 Creeks and drainage reserves.....	99
3.8.3 Major roads.....	100
3.9 FUTURE MAINTENANCE.....	100
3.10 OVERHEAD POWER LINES AND TRANSMISSION TOWERS.....	100
3.11 OBSTRUCTIONS AND CLEARANCES.....	100
3.11.1 General.....	100
3.11.2 Surface obstructions.....	100
3.11.3 Clearance from transmission towers.....	101
3.11.4 Clearance from structures.....	101
3.11.5 Underground obstructions and services.....	101
3.11.5.1 General.....	101
3.11.5.2 Clearance requirements.....	101
3.11.6 Crossing services.....	102
3.11.7 Location markers.....	102
3.11.8 Marking tape.....	103
3.11.8.1 General.....	103
3.11.8.2 Pressure mains.....	103
3.12 DISUSED OR REDUNDANT ITEMS.....	103
3.13 SEWAGE QUALITY.....	104
3.13.1 Septicity.....	104
3.13.2 ARC Sewer Corrosion and Odour Research (SCORE) Linkage Project.....	105
3.13.3 Sewage quality/Trade waste management.....	105
3.13.4 Australian Sewage Quality Management Guidelines.....	105
3.14 COMMISSIONING PLAN.....	106
3.14.1 General.....	106
3.14.2 Pre-commissioning.....	106
3.14.3 Commissioning.....	107
4 MATERIALS DESIGN.....	109
4.1 GENERAL.....	109
4.2 PROTECTION AGAINST DEGRADATION.....	109
4.2.1 General.....	109
4.2.2 Protective coatings.....	109

4.2.3 Concrete surfaces.....	109
4.2.4 Metallic materials.....	109
4.2.5 Stainless steels.....	110
4.2.5.1 Grade selection.....	110
4.2.5.2 Welding.....	110
4.2.5.3 Threaded components.....	111
4.2.6 Corrosion protection against aggressive environments.....	111
4.2.7 Cathodic protection.....	111
4.2.8 Stray current corrosion.....	112
4.2.9 Protection against contaminated ground.....	112
4.2.10 Bolted connection.....	113
5 PRODUCTS AND MATERIALS.....	115
5.1 GENERAL.....	115
5.1.1 Selection Guide for Pipeline Systems.....	115
5.2 IDENTIFICATION OF SEWER SYSTEMS.....	116
5.3 SERVICABILITY OF SEWER SYSTEMS.....	119
5.4 PVC PIPELINE SYSTEMS.....	119
5.4.1 Product Specifications.....	119
5.4.2 PVC Pressure Pipeline Systems.....	120
5.4.2.1 Sizes and configurations.....	120
5.4.3 PVC Non-Pressure Systems.....	120
5.4.3.1 Sizes and configurations.....	120
5.5 PE PIPELINE SYSTEMS.....	121
5.5.1 Product Specifications.....	121
5.5.2 PE Pressure Pipeline Systems.....	122
5.5.2.1 Size and Configuration.....	122
5.5.2.2 PE fabricated fittings for pressure applications .....	122
5.5.3 PE non-pressure pipeline systems.....	122
5.5.3.1 Size and Configuration.....	122
5.6 PP PIPELINE SYSTEMS.....	123
5.6.1 Product Specifications.....	123
5.6.2 Sizes and configurations.....	123
5.7 DUCTILE IRON PIPE SYSTEMS.....	123
5.7.1 Product Specifications.....	123
5.7.2 Sizes and configurations.....	124
5.7.3 Lining.....	124
5.7.4 Coatings.....	124
5.7.5 Sleeving.....	126
5.7.6 Screw-on flanges for DI pipes.....	126
5.7.7 Flanged joints.....	126
5.7.8 Pump discharge flanged ductile iron pipework .....	126
5.8 GRP PIPELINE SYSTEMS.....	126
5.8.1 Product Specifications.....	126
5.8.2 Sizes and configurations.....	127
5.9 ABS PRESSURE PIPE SYSTEMS.....	127
5.9.1 Product Specifications.....	127
5.9.2 Size and configuration.....	127
5.10 STEEL PRESSURE PIPE SYSTEMS.....	128

5.10.1	Product Specifications.....	128
5.10.2	Sizes and configurations.....	128
5.10.3	Joints.....	128
5.10.4	Lining.....	128
5.10.5	Field welding.....	129
5.10.6	Flanged joints.....	129
5.11	ACCESS COVERS AND FRAMES.....	130
5.11.1	Product Specifications.....	130
5.11.2	Application.....	130
5.11.3	Cast ductile iron access covers and frames.....	130
5.11.4	Aluminium checker plate access covers and frames.....	131
5.11.5	Stainless steel checker plate access covers and frames.....	131
5.11.6	Polymeric access covers and frames.....	131
5.11.7	Safety Grates.....	131
5.11.8	Size and configuration.....	132
5.11.9	Marking of access covers and frames.....	132
5.12	VENT SHAFTS.....	132
5.12.1	Product Specification.....	132
5.12.2	Application.....	132
6	PUMPING STATION DESIGN.....	133
6.1	INTRODUCTION.....	133
6.2	SITE SELECTION, LOCATION AND LAYOUT.....	133
6.2.1	Site selection.....	133
6.2.2	Right of occupancy and access.....	133
6.2.3	Location and layout.....	133
6.2.4	Site area.....	134
6.2.5	Site layout and access.....	134
6.2.6	Landscaping.....	134
6.3	INLET MH.....	135
6.3.1	Location.....	135
6.3.2	Design.....	135
6.3.3	Pumping station wet-well isolating valve.....	136
6.4	WET-WELL DESIGN.....	136
6.4.1	General.....	136
6.4.2	Sizing.....	137
6.4.3	Pumping control volume and pump starts.....	137
6.4.4	Control levels.....	138
6.4.5	Detention time.....	138
6.4.6	Benching.....	138
6.4.7	Washers.....	139
6.5	WET-WELL VENTILATION.....	139
6.5.1	General.....	139
6.5.2	Natural ventilation.....	140
6.5.3	Forced ventilation.....	140
6.6	OVERFLOW CONTAINMENT.....	141
6.6.1	General.....	141
6.6.2	Emergency storage.....	141
6.6.2.1	General.....	141

6.6.2.2 Configurations.....	141
6.6.2.3 Design.....	143
6.6.2.4 Access and cover arrangements for emergency storage structure.....	152
6.6.2.5 Type of construction.....	152
6.6.3 Future storage provisions.....	153
6.6.4 Emergency relief system.....	153
6.7 LADDERS AND PLATFORMS.....	153
6.8 WET-WELL ACCESS COVERS.....	154
6.9 SAFETY SYSTEMS.....	155
6.10 GRIT COLLECTION.....	155
6.11 SCREENS.....	155
6.12 MIXERS.....	155
7 PUMPING SYSTEM.....	156
7.1 STAGING.....	156
7.2 HYDRAULIC DESIGN.....	156
7.3 PUMP EQUIPMENT.....	157
7.4 PUMP SELECTION.....	157
7.5 MULTIPLE-PUMP PUMPING STATIONS.....	158
7.6 SUBMERSIBLE PUMPS.....	158
7.6.1 General.....	158
7.6.2 Impeller selection.....	159
7.6.3 Motor selection.....	159
7.6.4 Standard discharge connection.....	159
7.6.5 Motor cables.....	160
7.6.6 Pump lifting equipment.....	160
7.7 ANCILLARY EQUIPMENT.....	161
7.7.1 Flushing valves.....	161
7.8 PUMP STARTERS AND VARIABLE SPEED DRIVES.....	161
7.8.1 General.....	161
7.8.2 Motor starters.....	161
7.8.3 Soft starters.....	162
7.8.4 Variable speed drives.....	162
7.9 HARMONICS AND RADIO FREQUENCY INTERFERENCE.....	163
7.10 EMERGENCY STOP.....	163
8 POWER SYSTEM.....	164
8.1 GENERAL.....	164
8.2 POWER SUPPLIES.....	164
8.2.1 General.....	164
8.2.2 Security of supply.....	164
8.2.3 Primary supply.....	164
8.2.4 Duplicate supply.....	165
8.2.5 Emergency power.....	165
8.2.6 On-site generator.....	165
8.2.7 Mobile generator.....	166
8.2.8 High voltage/Low voltage switching.....	166
8.2.9 Power factor correction.....	166
8.3 POWER AND CONTROL CUBICLE.....	166
8.3.1 Design.....	166

8.3.2 Low voltage switchboards.....	167
8.3.2.1 Standards.....	167
8.3.2.2 Construction.....	168
8.3.2.3 Rated diversity factor.....	168
8.3.2.4 Degree of protection.....	168
8.3.2.5 Rated insulation and operating voltages.....	169
8.3.2.6 Creepage distances.....	169
8.3.2.7 Rated impulse withstand voltage.....	169
8.3.2.8 Rated short-time current.....	169
8.3.2.9 Internal arcing fault protection.....	169
8.3.3 Meter requirements.....	169
8.3.4 Lighting.....	170
9 CONTROL AND TELEMETRY SYSTEM.....	171
9.1 GENERAL.....	171
9.2 OPERATING LEVELS AND SETTINGS.....	171
9.3 PUMPING CONTROL.....	171
9.3.1 Control design.....	171
9.3.2 Control switches.....	172
9.3.3 Control systems.....	172
9.3.4 Emergency back-up control.....	172
9.3.5 Pump starts and interlocks.....	172
9.4 ALARMS.....	173
9.4.1 General.....	173
9.4.2 Locally displayed alarms.....	173
9.4.3 Remote alarms.....	173
9.5 ALARM, STATUS MONITORING AND CONTROL TELEMETRY.....	173
9.5.1 General design principles.....	173
9.5.2 Reliability.....	173
9.5.3 Alarm creation function.....	174
9.5.4 Status monitoring function.....	175
9.5.5 Control function.....	176
9.6 TELEMETRY HARDWARE.....	177
9.6.1 General.....	177
9.6.2 Software.....	177
9.6.3 Inputs and outputs.....	177
9.6.4 Telemetry communications.....	178
9.6.5 Communication validation.....	178
9.7 OPERATING LEVELS AND DEFAULT SETTINGS.....	178
9.7.1 General.....	178
9.7.2 Cut-in and cut-out levels.....	178
9.7.3 Alarm levels.....	179
9.8 EQUIPMENT AND DEVICES.....	179
9.8.1 General.....	179
9.8.2 Flow measurement.....	180
9.8.3 Flowmeter cabling.....	180
9.8.4 Suction safety switch.....	180
9.8.5 Level sensors.....	180
9.8.6 Float-switch or fail-safe level probe.....	181



9.8.7 Site access monitoring.....	181
9.8.8 Protection devices.....	181
9.8.8.1 Fuse and fuse-links.....	181
9.8.8.2 Moulded-case circuit-breakers.....	181
9.8.8.3 Miniature circuit-breakers.....	182
9.8.8.4 Residual current devices.....	182
9.8.8.5 Thermal-overload relays.....	182
9.8.8.6 Electronic motor protection relays.....	182
9.8.8.7 Thermistor and RTD motor protection devices.....	183
9.8.9 Switching devices.....	183
9.8.9.1 Switches.....	183
9.8.9.2 Selector switches.....	184
9.8.10 Contactors.....	184
9.8.11 Push-buttons.....	184
9.8.12 Emergency stop-buttons.....	184
9.8.13 Time-switches.....	184
9.8.14 Control devices.....	184
9.8.14.1 Control relays.....	184
9.8.14.2 Time-delay relays and timers.....	185
9.8.15 ELV control transformers.....	185
9.8.16 Current transformers.....	185
9.9 INSTRUMENTATION (DISPLAYS).....	185
9.10 WIRE NUMBERING CONVENTION.....	186
9.11 SYSTEMS INCORPORATING PROGRAMMABLE CONTROLLER / TELEMETRY RTU.....	186
9.11.1 Digital inputs and outputs.....	186
9.11.2 Analog inputs and outputs.....	186
9.11.3 Address codes for communication link devices.....	186
9.12 SYSTEMS INCORPORATING RELAY CONTROL.....	186
9.12.1 General.....	186
9.12.2 Loop tag definition guidelines.....	186
10 PUMPING STATION PIPEWORK.....	187
10.1 PUMP DISCHARGE PIPEWORK.....	187
10.1.1 General.....	187
10.1.2 Sizing.....	187
10.1.3 Type.....	187
10.2 VALVE APPLICATIONS.....	187
10.2.1 Isolating valves.....	187
10.2.2 Non-return valves.....	188
10.3 VALVE CHAMBER.....	188
10.3.1 General.....	188
10.3.2 Design.....	189
10.3.3 Dismantling joints.....	190
10.3.4 Pipework support.....	190
10.3.5 Pressure main tapping points.....	190
10.3.6 Access covers.....	190
10.4 EMERGENCY PUMPING ARRANGEMENTS.....	191
10.4.1 General.....	191
10.4.2 Temporary pumping from inlet MH into pressure main.....	191

10.4.3	Temporary pumping from wet-well into tanker trucks.....	192
10.4.4	Using on-board tanker truck pumps.....	192
10.5	CONDITION MONITORING AND MAINTENANCE.....	193
11	PRESSURE MAINS.....	194
11.1	DESIGN.....	194
11.1.1	General.....	194
11.1.2	Pressure mains shared by Multiple pump stations.....	194
11.2	LOCATION OF PRESSURE MAINS.....	194
11.2.1	General.....	194
11.2.2	Road reserves.....	195
11.2.3	Railway reserves.....	195
11.2.4	Vertical alignment.....	195
11.2.4.1	Falling Main.....	196
11.2.4.2	Barometric pipe loop.....	197
11.2.4.3	Connecting different pipe dimeters and materials.....	198
11.2.5	Horizontal alignment.....	198
11.2.6	Deviation of pressure mains around structures.....	198
11.2.6.1	General.....	198
11.2.6.2	Methods to deviate pressure mains around structures.....	199
11.2.6.3	Horizontal deviation of pressure mains.....	199
11.2.6.4	Vertical deviation of pressure mains.....	200
11.2.6.5	Curving of pressure mains to avoid obstructions or on curved alignments.....	203
11.3	PUMP HEAD CALCULATIONS.....	203
11.3.1	Total head.....	203
11.3.2	Mean static head.....	203
11.3.3	Friction head loss.....	204
11.3.4	Head loss in fittings and valves.....	205
11.3.5	System characteristic curves.....	205
11.3.6	Velocity in pressure mains (including flush cycles).....	205
11.3.7	Sizing of pressure mains.....	207
11.4	DESIGN PRESSURES.....	208
11.4.1	General.....	208
11.4.2	Design pressure.....	208
11.4.3	Surge.....	209
11.4.4	Maximum design pressure range.....	210
11.5	SELECTION OF PIPE AND FITTINGS PRESSURE CLASS.....	210
11.5.1	General.....	210
11.5.2	Maximum allowable operating pressure.....	210
11.5.3	Maximum cyclic pressure range – Thermoplastics pipes and fittings.....	210
11.5.4	Minimum pressure class.....	210
11.5.5	Other considerations.....	210
11.6	PLASTICS PIPES.....	211
11.6.1	Plastics pipes and fittings requirements.....	211
11.6.2	Fatigue design for thermoplastics pipes.....	212
11.6.3	Fatigue design for thermoplastic fittings.....	213
11.6.4	Fatigue design for thermosetting pipes and fittings.....	214
11.6.5	Combined effects of fatigue and temperature.....	214
11.7	METALLIC PIPES AND FITTINGS.....	214

11.8 PIPELINE MATERIALS.....	214
11.9 PRESSURE MAIN VALVES.....	214
11.9.1 General.....	214
11.9.2 Isolating valves.....	214
11.9.3 Air release valves.....	215
11.9.4 Non-return valves.....	215
11.9.5 Scours.....	216
11.9.6 Low points without a scour.....	216
11.10 ODOUR AND SEPTICITY CONTROL.....	217
11.11 RECEIVING SYSTEM.....	217
11.11.1 General.....	217
11.11.2 Discharge MHs.....	218
12 STRUCTURAL DESIGN.....	219
12.1 GROUND CONDITIONS.....	219
12.1.1 Foundation design and ground water control.....	219
12.1.2 Geotechnical assessment.....	219
12.2 STRUCTURES.....	220
12.2.1 Design loads and forces.....	220
12.2.2 Concrete structures.....	221
12.2.2.1 General.....	221
12.2.2.2 Concrete strength.....	221
12.2.2.3 Minimum cover.....	221
12.2.2.4 Crack control requirement for serviceability.....	221
12.2.2.5 Areas to be designed as liquid retaining surfaces.....	221
12.2.3 Steel structures.....	221
12.2.4 Foundations.....	222
12.2.5 Pumping station walls.....	222
12.2.6 Base slab.....	223
12.2.7 Top slab.....	223
12.2.8 Emergency storage structures.....	223
12.3 PRESSURE MAINS.....	223
12.3.1 General.....	223
12.3.2 Structural consideration.....	224
12.3.3 Internal forces.....	224
12.3.4 External forces.....	224
12.3.4.1 General.....	224
12.3.4.2 Pipe cover.....	224
12.3.4.3 Trench design.....	225
12.3.4.4 Pipe embedment.....	225
12.3.4.5 Buoyancy.....	225
12.3.5 Specific geotechnical considerations.....	226
12.3.5.1 Pressure mains in engineered and/or controlled fill.....	226
12.3.5.2 Pressure mains in non-engineered fill.....	226
12.3.5.3 Filling along route of pressure main.....	226
12.3.5.4 Mine subsidence.....	226
12.3.5.5 Slip areas.....	227
12.3.5.6 Water-changed ground.....	227
12.3.6 Concrete encasement.....	227

12.3.6.1	General.....	227
12.3.6.2	Requirements.....	228
12.3.6.3	Encased steel pipelines.....	229
12.3.6.4	Existing steel pipelines.....	230
12.3.6.5	Encased PE pipelines .....	230
12.3.7	Above ground crossings.....	231
12.3.8	Bulkheads and trenchstops.....	231
12.3.9	Trenchless technology.....	232
12.3.9.1	Geotechnical Investigations.....	233
12.3.10	Pressure main anchorage.....	234
12.3.10.1	General.....	234
12.3.10.2	Thrust blocks.....	234
12.3.10.3	Anchor blocks.....	235
12.3.11	Restrained elastomeric seal joint pressure mains.....	235
12.3.12	Restraint requirements for special situations.....	236
12.3.12.1	Above ground pressure mains with unrestrained flexible joints.....	236
12.3.12.2	Steel mains with welded joints, buried.....	236
12.3.12.3	Steel mains with welded joints, above ground.....	236
12.3.12.4	Ductile iron or steel mains with flanged joints.....	236
12.3.12.5	PE mains.....	236
13	SUPPORTING SYSTEMS.....	237
13.1	SERVICES.....	237
13.1.1	General.....	237
13.1.2	Water.....	237
13.1.3	Telephone/Telemetry lines.....	237
13.1.4	General lighting and power.....	237
13.1.5	Drainage.....	238
13.1.6	Water closet.....	238
13.2	MATERIALS HANDLING.....	238
13.2.1	Lifting equipment.....	238
13.2.2	Handling and storage of hazardous material.....	238
13.3	SECURITY.....	238
13.4	FIRE CONTROL.....	238
14	DESIGN REVIEW.....	240
15	DESIGN DOCUMENTATION AND DRAWINGS.....	241
15.1	DOCUMENTATION.....	241
15.2	DESIGN DRAWINGS.....	241
15.2.1	General.....	241
15.2.2	Real property information.....	241
15.2.3	Pumping station and emergency storage.....	242
15.2.4	Structures.....	242
15.2.5	Pressure mains and sewers - general.....	242
15.2.6	Pressure mains and sewers - longitudinal sections (profiles).....	243
15.2.7	Electrical and telemetry.....	243
15.2.8	Title block notation and standard notes.....	244
15.2.9	Other.....	244
15.3	SPECIFICATIONS.....	245
15.4	DRAFTING STANDARDS.....	245

15.4.1 General.....	245
15.4.2 Scale.....	245
15.4.3 Recording of as-constructed information.....	245
APPENDIX A — GENERIC INFRASTRUCTURE PROTECTION GUIDANCE.....	246
A1 INFRASTRUCTURE PROTECTION TREATMENTS - SELECTION AND DEFINITION.....	246
A2 RISK MANAGEMENT - INFRASTRUCTURE PROTECTION RISK ASSESSMENTS.....	246
A3 INFRASTRUCTURE PROTECTION DESIGN CONSIDERATIONS.....	246
A4 INFRASTRUCTURE PROTECTION TREATMENTS.....	247
A5 SECURITY DESIGN CONCEPTS.....	247
A6 ENVIRONMENTAL DESIGN CONSIDERATIONS.....	247
A7 SEWER FAILURE IMPACT ASSESSMENT.....	248
A8 WATER AGENCY'S ENVIRONMENTAL AESTHETICS GUIDANCE.....	249
APPENDIX B — AC VOLTAGE MITIGATION OF STEEL PIPELINES.....	258
B1 INTRODUCTION.....	258
B2 INDUCTIVE COUPLING HAZARD.....	258
B3 CONDUCTIVE COUPLING HAZARD.....	258
B4 CAPACITIVE COUPLING HAZARD.....	258
B5 MITIGATION.....	258
APPENDIX C — TYPICAL PRECOMMISSIONING SCHEDULE.....	259
APPENDIX D — TYPICAL COMMISSIONING SCHEDULE.....	266
APPENDIX E — PROTECTION AGAINST DEGRADATION.....	268
E1 GENERAL.....	268
E2 PROTECTION AGAINST INTERNAL CORROSION.....	268
E3 PROTECTION AGAINST EXTERNAL AGGRESSIVE ENVIRONMENT.....	269
E4 PROTECTION AGAINST EXTERNAL CONTAMINATED GROUND.....	269
APPENDIX F — GUIDELINES FOR VENTILATION OF RETICULATION SEWERS.....	271
F1 INTRODUCTION.....	271
F1.1 Impact of climate change.....	272
F1.1.1 Context.....	272
F1.1.2 Methodology.....	272
F1.1.3 Application.....	272
F2 VENTING OF RETICULATION SEWERS.....	272
F2.1 Location and spacing of educt and induct vents.....	272
F3 EDUCT VENT SHAFTS.....	273
F3.1 Types.....	273
F3.2 Design requirements.....	273
F3.2.1 Material selection.....	273
F3.3 Educt vent cowls.....	274
F3.4 Installation limitations.....	274
F3.4.1 Guy-wire vents.....	274
F3.4.2 Post type vents.....	274
F3.4.3 Wall vents.....	274
F4 INDUCT VENT SHAFTS.....	274
F5 STANDARD DRAWINGS.....	274
APPENDIX G — PRESSURE MAIN CALCULATIONS.....	276
G1 NOMENCLATURE.....	276
G2 PRINCIPLES AND CRITERIA.....	276
G2.1 Design flows.....	276

G2.2 Detention time.....	277
G2.3 Minimum internal diameter of pressure main.....	277
G2.4 Maximum internal diameter of pressure main.....	277
G2.5 Minimum pumping rate.....	277
G2.6 Maximum pumping rate.....	278
G2.7 Pump control volume (cut-in / cut-out volume) and pump starts.....	278
APPENDIX H — PIPELINES IN SLIP AND POTENTIALLY UNSTABLE AREAS.....	279
H1 INTRODUCTION.....	279
H2 SLIP AND UNSTABLE AREAS.....	279
H2.1 FACTORS INFLUENCING STABILITY OF SLOPES.....	280
H2.1.1 Soil and rock condition.....	280
H2.1.2 Angle of slope.....	280
H2.1.3 Groundwater and surface water.....	280
H2.1.4 Domestic development.....	280
H2.1.5 Vegetation.....	280
H2.1.6 Road construction.....	280
H3 IDENTIFICATION OF POTENTIALLY UNSTABLE AREAS.....	280
H4 PRECAUTIONS.....	282
H4.1 GRAVITY SEWERS AND RISING MAINS.....	282
Gravity sewers.....	282
Rising mains.....	282
H4.2 ALTERNATIVE SEWERAGE SYSTEMS AND CONSTRUCTION TECHNIQUES.....	284
H4.3 SHALLOW TRENCH OR ABOVE-GROUND CONSTRUCTION.....	284
H4.4 DESIGN FOR POSSIBLE GROUND MOVEMENT.....	285
H4.5 CONSIDER GROUNDWATER AND DRAINAGE.....	285
H4.6 PRECAUTIONS DURING CONTRUCTION.....	287
APPENDIX I — TRENCHLESS TECHNOLOGIES.....	289
I1 GENERAL.....	289
I2 HORIZONTAL DIRECTIONAL DRILLING (HDD).....	289
I3 MICRO-TUNNELLING.....	289
I4 UNGUIDED BORING/THRUST BORING/AUGER BORING.....	290
I5 PIPE JACKING.....	290
I6 MINI-TUNNELLING.....	291
APPENDIX J — DETAILED DESIGN CHECKLIST.....	294
PART 2: CONSTRUCTION.....	302
16 GENERAL.....	303
16.1 SCOPE.....	303
16.2 INTERPRETATION.....	303
17 GENERAL CONSTRUCTION.....	306
17.1 GENERAL.....	306
17.2 ORDER OF CONSTRUCTION, TESTING AND COMMISSIONING.....	306
17.2.1 Pumping stations.....	306
17.2.2 Inlet works, emergency storage and ERS.....	306
17.2.3 Pressure mains.....	307
17.3 CONTRACT INTERFACES.....	307
17.4 CUSTOMER FOCUS.....	307
17.4.1 General.....	307
17.4.2 Resolution of complaints.....	307

17.5 PROTECTION OF PEOPLE, PROPERTY AND ENVIRONMENT.....	307
17.5.1 Protection of other services.....	307
17.5.2 Road reserves or other thoroughfares.....	308
17.5.2.1 Road Opening Permits.....	308
17.5.2.2 Treatment of pavements and other surfaces.....	308
17.5.2.3 Cleanliness of roads, paths, accesses and drainage paths.....	308
17.5.2.4 Storage of products, materials and equipment.....	309
17.5.2.5 Obstruction of street drainage.....	309
17.5.3 Private and public properties.....	309
17.5.4 Protection of the environment and heritage areas.....	309
17.5.4.1 General.....	309
17.5.4.2 Collection and disposal of wastes.....	309
17.5.4.3 Protection of adjacent lands and vegetation.....	310
17.5.4.4 Control of water pollution.....	310
17.5.4.5 Contaminated soils.....	312
17.5.4.6 Control of noise and atmospheric pollution.....	312
17.5.4.7 Equipment and machinery use in bush fire prone areas.....	313
17.5.4.8 Recycled, reused and waste materials.....	313
17.6 DISUSED / REDUNDANT SEWERS AND PRESSURE MAINS.....	313
17.7 ALTERATION OF EXISTING SERVICES.....	313
17.8 SURVEY MARKS.....	314
17.9 CONSTRUCTION TOLERANCES.....	314
17.10 LATENT CONDITIONS.....	314
18 PRODUCTS, MATERIALS AND EQUIPMENT.....	315
18.1 AUTHORISED PRODUCTS, MATERIALS AND EQUIPMENT.....	315
18.2 DELIVERY INSPECTION OF PRODUCTS AND MATERIALS.....	315
18.3 ELECTRICAL EQUIPMENT.....	315
18.4 PUMPS.....	316
18.5 TRANSPORTATION, HANDLING AND STORAGE OF PRODUCTS AND MATERIALS.....	316
18.5.1 General.....	316
18.5.2 Transportation.....	316
18.5.3 Unloading and handling.....	316
18.5.4 On-site storage.....	316
18.5.5 Plastics-lined concrete products.....	317
18.5.6 Coiled plastics pipe.....	318
18.6 FASTENERS.....	318
18.7 WORKS INSPECTION AND TESTING.....	319
18.7.1 Switchboards.....	319
18.7.2 Pumps.....	320
18.7.3 Motors.....	320
18.8 CONCRETE WORKS.....	320
18.9 SUPPLY OF WATER TO THE WORKS.....	321
19 ELECTRICAL WORKS.....	322
19.1 COMPLIANCE WITH AUTHORITIES, STATUTES, REGULATIONS AND STANDARDS.....	322
19.2 SCOPE OF WORK.....	322
19.3 SUPPLY AUTHORITY REQUIREMENTS AND METERING.....	323
19.4 CONSUMER MAINS.....	323
19.4.1 Point of supply.....	323

19.4.2	Cable size.....	323
19.4.3	Maximum demand.....	323
19.4.4	Calculations to be submitted.....	323
19.4.5	Mains in reserves.....	323
19.4.6	Mains requirements.....	323
19.4.7	Lead-in pole and overhead mains construction.....	324
19.4.7.1	Lead-in pole.....	324
19.4.7.2	Poles.....	324
19.4.7.3	Installation of poles.....	325
19.4.7.4	Aerial cables.....	325
19.4.8	Underground cable installation.....	325
19.4.8.1	General.....	325
19.4.8.2	Location.....	325
19.4.8.3	Excavation and bedding.....	325
19.4.8.4	Underground cable marking.....	325
19.4.8.5	Cable installation on poles.....	326
19.4.8.6	Road crossings.....	326
19.5	EARTHING.....	326
19.5.1	General.....	326
19.5.2	Earth circuits.....	327
19.5.3	Labelling.....	327
19.6	SWITCHBOARD INSTALLATION.....	327
19.6.1	General.....	327
19.6.2	Equipment mounting.....	328
19.6.3	Thermal derating of equipment.....	328
19.6.4	Labelling.....	328
19.6.4.1	General.....	328
19.6.4.2	Incoming mains and pump and motor detail labels.....	328
19.6.4.3	Main labels.....	329
19.6.4.4	Cubicle labels.....	329
19.6.4.5	Danger notices.....	329
19.6.4.6	Asset and equipment number labels.....	329
19.7	CIRCUITS.....	329
19.7.1	Main circuits.....	329
19.7.2	Control circuit wiring.....	330
19.8	CABLING.....	331
19.8.1	General.....	331
19.8.2	Conduits.....	331
19.8.3	Cable protection.....	332
19.8.4	Cable trays.....	332
19.8.5	Junction boxes.....	332
19.9	INSTALLATION OF PUMP CABLES.....	332
19.9.1	Numbering of pumps.....	332
19.9.2	Installation.....	332
19.10	INSTALLATION OF LEVEL SENSORS.....	333
19.10.1	General.....	333
19.10.2	Wet-well level sensor probes.....	333
19.11	TERMINATIONS.....	333



19.11.1 General.....	333
19.11.2 Glands.....	334
19.11.3 Mains and pump terminations.....	334
19.12 PAINTING.....	334
19.12.1 General.....	334
19.12.2 Paint materials.....	334
19.12.3 Surface preparation.....	334
19.12.4 Painting and finish.....	335
19.13 INSTALLATION IN VALVE PITS.....	335
19.13.1 General.....	335
19.13.2 Cables.....	335
19.14 NOTIFICATION OF ELECTRICAL WORK.....	335
20 TELEMETRY SYSTEM.....	336
20.1 COMPLIANCE WITH AUTHORITIES, STATUTES, REGULATIONS AND STANDARDS.....	336
20.2 SCOPE OF WORK.....	336
20.3 HARDWARE INSTALLATION.....	336
20.4 PLC PROGRAMMING.....	336
20.5 SCADA DATABASE CONFIGURATION.....	336
21 ODOUR CONTROL SYSTEM.....	338
22 MECHANICAL INSTALLATION OF PUMPS, VALVES AND FITTINGS.....	339
22.1 GENERAL.....	339
22.2 FLANGED JOINTS.....	339
22.3 INSTALLATION OF PUMPING UNITS.....	339
22.3.1 General.....	339
22.3.2 Machinery alignment.....	339
22.3.3 Unit members.....	340
22.3.4 Test tapping points.....	340
22.4 GAUGES AND RECORDERS.....	340
22.4.1 Pressure gauges.....	340
22.4.2 Pressure recorder.....	340
23 METALWORK.....	341
23.1 STEELWORK.....	341
23.2 ALUMINIUM ALLOY COMPONENTS.....	341
23.3 STAINLESS STEEL COMPONENTS.....	341
23.4 FASTENERS.....	341
24 ACCESS ROAD AND HARDSTAND AREAS.....	343
24.1 GENERAL.....	343
24.2 SUBGRADE.....	343
24.3 BASECOURSE.....	343
24.4 SPRAYED BITUMINOUS SEALING.....	343
24.5 ASPHALTIC CONCRETE.....	344
24.6 TIMBER GUARDRAIL.....	344
24.7 REINFORCED CONCRETE.....	344
25 RETAINING WALLS.....	345
25.1 RETAINING WALLS - TIMBER CANTILEVER.....	345
25.1.1 General.....	345
25.1.2 Handrails.....	345
25.2 RETAINING WALLS - CONCRETE - CRIB WALL.....	345

25.2.1	General.....	345
25.2.2	Foundations.....	346
25.2.3	Cribfill and backfill.....	346
25.2.4	Drainage.....	346
25.2.5	Handrails.....	347
25.3	RETAINING WALLS – CONCRETE – BLOCK-WORK.....	347
25.4	RETAINING WALLS – CONCRETE – CAST IN-SITU.....	347
26	EXCAVATION.....	348
26.1	SAFETY.....	348
26.2	LIMITS OF CLEARING AND EXCAVATION.....	348
26.3	EXCAVATION ACROSS IMPROVED SURFACES.....	348
26.4	PROTECTION OF TREES.....	348
26.4.1	General precautions.....	348
26.4.2	Protection of roots.....	348
26.5	BLASTING.....	349
26.6	SUPPORT OF EXCAVATIONS.....	349
26.7	DRAINAGE AND DEWATERING.....	349
26.8	TRENCH EXCAVATION.....	350
26.8.1	General.....	350
26.8.2	Construction of embankment.....	350
26.8.3	Clearances for on-site works.....	350
26.9	REFILL OF EXCESSIVE EXCAVATION.....	350
26.10	FOUNDATIONS AND FOUNDATION STABILISATION.....	351
26.11	SURPLUS EXCAVATED MATERIAL.....	351
26.12	EXCAVATION AND PIPELAYING USING TRENCHLESS TECHNIQUES.....	352
27	BEDDING FOR PIPES, BENDS, WET-WELLS AND MAINTENANCE STRUCTURES.....	353
27.1	TRENCH FLOOR PREPARATION.....	353
27.2	BEDDING MATERIALS.....	353
27.3	PLACEMENT OF BEDDING.....	353
27.4	SPECIAL PIPE SUPPORT FOR NON-SUPPORTIVE SOILS.....	353
27.5	BEDDING FOR PIPES, VALVES AND FITTINGS.....	354
27.6	BEDDING FOR CONCRETE STRUCTURES.....	354
27.7	BEDDING FOR MAINTENANCE CHAMBERS, MAINTENANCE SHAFTS, INSPECTION SHAFTS AND VARIABLE BENDS.....	354
28	PIPE LAYING AND JOINTING.....	355
28.1	INSTALLATION OF PIPES IN TRENCHES.....	355
28.1.1	General.....	355
28.1.2	Cleaning, inspection and joint preparation.....	355
28.1.2.1	Socket and spigot with elastomeric seal joints.....	355
28.1.2.2	Solvent welded joint .....	355
28.1.2.3	Butt Fusion and Electrofusion Welding.....	356
28.1.2.4	Coiled Plastics pipes.....	356
28.1.3	Positioning of the pipeline.....	356
28.1.4	Pipe laying and joining pipes and fittings with elastomeric seals.....	357
28.1.4.1	Laying and joining pipes and fittings with elastomeric seal incorporated into socket.....	357
28.1.4.2	Laying and joining pipes and fittings with elastomeric seal mounted on the spigot end of corrugated pipe.....	358

28.1.5 Laying and joining pipes and fittings with solvent cement joints.....	359
28.1.6 Laying and jointing of polyethylene pipes and fittings.....	360
28.1.7 Laying and welding of steel pipes and fitting.....	360
28.2 HORIZONTAL AND VERTICAL DEFLECTION OF GRAVITY SEWERS AND PRESSURE	
MAINS.....	361
28.2.1 General.....	361
28.2.2 Methods of deflection for Gravity Sewers.....	361
28.2.3 Horizontal curves for Gravity Sewers.....	361
28.2.4 Vertical curves for Gravity Sewers.....	361
28.2.5 Compound curves for Gravity Sewers.....	362
28.2.6 Methods of deflection at the pipe joint for Pressure mains.....	362
28.2.7 Horizontal curves and deviations for Pressure Mains.....	362
28.3 HORIZONTAL AND VERTICAL SEPARATION OF CROSSING PIPELINES.....	363
28.4 FLOTATION CONTROL.....	363
28.5 THRUST AND ANCHOR BLOCKS AND RESTRAINED JOINTS FOR PRESSURE MAINS.....	363
28.6 MARKING TAPES / TRACER WIRES.....	364
28.6.1 Non-detectable marking tape.....	364
28.6.2 Detectable marking tape.....	364
28.6.3 Tracer wire.....	364
28.7 VALVES AND SURFACE FITTINGS.....	365
28.7.1 Installation.....	365
28.7.2 Scours for pressure mains.....	365
28.8 BORED PIPES UNDER ROADS, DRIVEWAYS AND ELSEWHERE.....	365
28.9 BRIDGE CROSSINGS.....	366
28.10 TRENCH STOPS FOR PRESSURE MAINS.....	366
28.11 BULKHEADS FOR PRESSURE MAINS.....	366
28.12 CORROSION PROTECTION OF CAST IRON FOR PRESSURE MAINS.....	366
28.13 AQUEDUCTS.....	366
28.14 LOCATION MARKERS.....	366
28.15 FLANGED JOINTS.....	367
28.16 WELDING OF STEEL PRESSURE MAINS.....	367
28.16.1 General.....	367
28.16.2 Field welding of flanges.....	367
28.16.3 Reinstatement of cement mortar lining.....	368
28.16.4 Reinstatement of external corrosion protection at joints using a tape system.....	368
28.16.4.1 General.....	368
28.16.4.2 Surface preparation.....	368
28.16.4.3 Priming surfaces.....	368
28.16.4.4 Mastic filler.....	369
28.16.4.5 Tape application.....	369
28.16.5 Reinstatement of external corrosion protection at joints using a heat-shrinkable sleeve	
system.....	370
28.16.5.1 Surface preparation.....	370
28.16.5.2 Priming surfaces.....	370
28.16.5.3 Priming surfaces.....	371
28.16.5.4 Mastic filler.....	371
28.16.5.5 Heat-shrinkable sleeve preparation.....	371
28.16.5.6 Heat-shrinkable sleeve application.....	371

28.17 WELDING OF PE PIPELINES.....	371
28.17.1 General.....	371
28.17.2 PE Butt Fusion Welding .....	372
28.17.3 PE Electrofusion Welding.....	372
28.17.4 Weld Testing Butt Fusion and Electrofusion Joints.....	372
28.17.4.1 Butt Fusion – Pre-Construction Test Welds.....	372
28.17.4.2 Electrofusion – Pre-Construction test welds.....	373
28.17.5 Quality plans.....	374
28.17.5.1 General.....	374
28.17.5.2 Butt fusion – Test Sampling Plan during construction.....	374
28.17.5.3 Butt fusion – Visual inspection .....	375
28.17.5.4 Butt fusion – Destructive testing .....	375
28.17.5.5 Electrofusion – Test Sampling Plan during construction.....	375
28.17.5.6 Electrofusion – Visual inspection.....	375
28.17.5.7 Electrofusion – Destructive testing .....	376
28.17.6 Welder qualifications.....	376
28.17.7 Connections to pipes of other materials.....	377
29 WET-WELLS AND MAINTENANCE HOLES (MHS).....	378
29.1 GENERAL.....	378
29.2 WET-WELL AND MH BASES.....	378
29.3 TRENCH DRAINAGE AROUND WET-WELLS AND MHs.....	378
29.4 PRECAST CONCRETE SYSTEMS.....	378
29.5 CAST IN-SITU CONCRETE WET-WELLS AND MHs.....	379
29.6 BENCHING AND CHANNELS.....	379
29.7 INTERNAL COATING OF CONCRETE WET-WELLS AND MHs.....	379
29.8 GLASS REINFORCED PLASTICS (GRP) MHs.....	379
29.9 POLYETHYLENE (PE) MHs.....	379
29.10 POLYPROPYLENE (PP) MHs.....	379
29.11 COVERS.....	379
29.12 CONNECTIONS TO WET-WELLS AND MHs.....	380
29.13 MH DROPS.....	380
29.14 MAINTENANCE CHAMBERS (MC), MAINTENANCE SHAFTS (MS AND TMS) AND INSPECTION OPENINGS (IO) OR INSPECTION SHAFTS (IS).....	380
29.14.1 General.....	380
29.14.2 Sealing caps.....	380
29.14.3 Covers.....	380
29.14.4 Connections to MCs, MSs and TMSs.....	380
30 PIPE EMBEDMENT AND SUPPORT.....	382
30.1 GENERAL.....	382
30.2 EMBEDMENT MATERIALS.....	382
30.2.1 General.....	382
30.2.2 Recycled, reused and waste materials.....	382
30.3 COMPACTION OF EMBEDMENT.....	382
30.3.1 General.....	382
30.3.2 Methods.....	383
30.3.3 Compaction trials/Pre-qualification of embedment compaction method.....	383
30.3.3.1 Pressure mains.....	383
30.3.3.2 Gravity Sewers.....	383

30.3.3.3 Test Method.....	383
30.3.3.4 Interpretation and applicability.....	384
30.3.4 Compaction control.....	384
30.4 SPECIAL BEDDING AND EMBEDMENTS/GEOTEXTILE SURROUND AND PILLOW.....	384
30.5 REMOVAL OF TRENCH SUPPORTS.....	384
30.6 CONCRETE EMBEDMENT AND ENCASEMENT.....	384
31 FILL.....	385
31.1 TRENCH FILL.....	385
31.1.1 Material requirements.....	385
31.1.1.1 Trafficable areas.....	385
31.1.1.2 Non-trafficable areas.....	385
31.1.2 Placement.....	386
31.1.3 Compaction of trench fill.....	386
31.2 EMBANKMENT FILL.....	386
31.3 DRIVES AND TUNNEL FILL.....	387
32 CONNECTION TO EXISTING GRAVITY SEWERS.....	388
33 RESTORATION.....	389
33.1 GENERAL.....	389
33.2 PAVEMENTS.....	389
33.3 LAWNS.....	389
33.4 GRASSED AREAS.....	390
33.5 BUSHLAND.....	390
33.6 PROVISION FOR SETTLEMENT.....	390
33.7 MAINTENANCE OF RESTORED SURFACES.....	390
34 ACCEPTANCE TESTING.....	391
34.1 PIPELINES.....	391
34.2 VISUAL EXTERNAL INSPECTION.....	392
34.3 COMPACTION TESTING.....	392
34.3.1 General.....	392
34.3.2 Compaction testing requirements.....	394
34.3.2.1 General.....	394
34.3.3 Embedment compaction testing.....	394
34.3.3.1 Applicable pipe sizes.....	394
34.3.3.2 Frequency and location of embedment tests.....	394
34.3.3.3 Retesting.....	394
34.3.4 Trench fill compaction testing.....	394
34.3.4.1 Trafficable test zone.....	394
34.3.4.2 Non-trafficable test zone.....	394
34.3.4.3 Test method.....	395
34.3.4.4 Frequency and location of tests.....	395
34.3.4.5 Retesting.....	395
34.3.5 Other fill compaction testing.....	395
34.3.5.1 General.....	395
34.3.5.2 Trafficable test zone.....	395
34.3.5.3 Non-trafficable test zone.....	395
34.3.5.4 Frequency and location of tests.....	395
34.3.5.5 Retesting.....	396
34.4 AIR PRESSURE AND VACUUM TESTING OF GRAVITY SEWERS.....	396

34.4.1	General.....	396
34.4.2	Air testing methods for sewers.....	396
34.4.2.1	Vacuum testing.....	396
34.4.2.2	Low pressure air testing.....	397
34.4.3	Testing of sewers >DN 1500.....	398
34.4.3.1	General.....	398
34.4.3.2	Method of test.....	398
34.4.3.3	Testing of non-pressure PE sewers.....	398
34.4.4	Watertightness of wet-well.....	398
34.4.5	Testing of concrete emergency storage and maintenance holes.....	399
34.4.5.1	General.....	399
34.4.5.2	Test method.....	399
34.5	HYDROSTATIC PRESSURE TESTING OF PRESSURE MAINS.....	400
34.6	INFILTRATION TESTING.....	401
34.7	DEFLECTION (OVALITY) TESTING OF FLEXIBLE GRAVITY SEWERS.....	401
34.7.1	General.....	401
34.7.2	Ovality proving tools.....	401
34.7.3	Flexible sewers ≤DN 300.....	402
34.7.4	Flexible sewers >DN 300.....	402
34.7.4.1	General.....	402
34.7.4.2	Flexible sewers >DN 300 and <DN 750.....	403
34.7.4.3	Flexible sewers ≥DN 750.....	403
34.8	MEASUREMENT OF SEWER GRADE.....	404
34.9	INTERNAL INSPECTION.....	404
34.10	INSPECTION AND TESTING OF THERMOPLASTICS LINED CONCRETE SEWERS AND MHs.....	404
34.10.1	Visual inspection.....	404
34.10.2	Spark testing.....	405
34.10.3	Locking key pull-out tests.....	405
34.11	PRESSURE TESTING OF INVERTED SYPHONS.....	405
34.11.1	General.....	405
34.11.2	Hydrostatic system test pressure.....	406
34.11.3	Satisfactory pressure test.....	406
34.12	ELECTRICAL WORKS.....	406
35	COMMISSIONING.....	408
35.1	GENERAL.....	408
35.2	PUMPING STATION.....	408
35.2.1	Requirements.....	408
35.2.2	Pre-commissioning.....	408
35.2.2.1	Commissioning.....	408
35.2.3	Handover.....	409
35.3	ODOUR CONTROL SYSTEM.....	409
35.4	COMMISSIONING REPORT.....	409
36	TOLERANCES ON AS-CONSTRUCTED WORK.....	410
36.1	HORIZONTAL TOLERANCES.....	410
36.1.1	Sewers, mains, valves, in-line structures, pumping stations, roads.....	410
36.2	VERTICAL TOLERANCES.....	410
36.2.1	Sewers, pressure mains, structures, pumping stations, roads.....	410

36.2.2 Grade.....	410
36.3 VERTICALITY (“PLUMB”).....	411
36.4 TOLERANCES ON FINISHED SURFACE STRUCTURES AND FITTINGS.....	411
36.5 CAST IN-SITU CONCRETE STRUCTURES AND SLABS.....	411
37 WORK AS-CONSTRUCTED DETAILS.....	412
37.1 GENERAL.....	412
37.2 ELECTRICAL WORKS.....	412
37.2.1 Electrical Contractors Installation Drawings.....	412
37.2.2 Principal Supplied Installation Drawings and Equipment Schedules.....	412
APPENDIX K — OVALITY TESTING OF GRAVITY SEWERS.....	413
K1 GENERAL.....	413
K2 REQUIREMENTS.....	413
APPENDIX L — SPECIFICATION FOR INTERNAL INSPECTION.....	415
L1 INTRODUCTION.....	415
L2 INSPECTION REQUIREMENTS.....	415
L3 QUALIFICATIONS OF INSPECTORS AND ACCEPTANCE ASSESSORS.....	415
L4 WORK AS CONSTRUCTED.....	416
L5 REPORTING SUMMARIES.....	416
L6 ACCEPTANCE INSPECTION REPORTS.....	417
L7 MATERIALS.....	418
L8 STEEL REINFORCEMENT CONCRETE PIPE.....	419
L9 DEFORMATION OF FLEXIBLE CONDUITS.....	419
L10 LATERAL INSPECTION.....	420
L11 INSPECTION AT THE END OF DEFECTS LIABILITY PERIOD.....	420
L12 MANUFACTURING DEFECTS.....	420
L13 RISK ASSESSMENT AND RECTIFICATION.....	420
L14 ACCEPTANCE PARAMETERS.....	421
APPENDIX M — MAXIMUM DEPTH TO INVERT FOR STANDARD SUPPORT TYPES.....	429
M1 GENERAL.....	429
M2 STRUCTURAL DESIGN.....	429
M2.1 Flexible buried pipelines.....	429
M2.2 Precast concrete pipes pipelines.....	429
M2.3 Trench width dimensions.....	430
M3 EMBEDMENT MATERIAL.....	430
M4 TRENCH FILL.....	430
M5 COMPACTION.....	431
M6 MAXIMUM DEPTH TO INVERT FOR SUPPORT TYPES.....	431
PART 3: STANDARD DRAWINGS.....	438
38 INTRODUCTION.....	439
38.1 GENERAL.....	439
38.2 DRAWING COMMENTARY.....	439
38.3 COMMENTARY ON SPS-1100 SERIES – PLANNING AND CONCEPT DESIGN.....	439
38.3.1 General.....	439
38.3.2 SPS-1100 Concept Plan - Typical Catchment Plan.....	440
38.3.3 SPS-1101 and SPS-1102 Pumping Station Concept Design - Site Layout.....	440
38.3.4 SPS-1103 Pumping Station Concept Design - Power and Control Cubicle, Base and Conduit Details.....	440
38.3.5 SPS-1104-1 and SPS 1104-2 shows a Static Head Calculation.....	441

38.3.5.1 SPS–1104–1.....	441
38.3.5.2 SPS–1104–2.....	441
38.3.5.3 SPS-1105 Typical Hydraulic Profile.....	442
38.4 COMMENTARY ON SPS–1200 SERIES – PUMPING STATION LAYOUT.....	442
38.4.1 SPS–1200, SPS–1201, SPS–1202, SPS–1203 and SPS–1204 Typical Site Plan Fronting and Not Fronting Adjacent Roadway.....	442
38.4.2 SPS–1205 Access Roadway Cross Section and Drainage Details.....	443
38.4.3 SPS–1206 Typical Site Plan Conceptual Site Layout and SPS–1207 Typical Site Access Arrangements.....	443
38.5 COMMENTARY ON SPS–1300 SERIES – PUMP STATION ARRANGEMENT.....	443
38.5.1 SPS–1300 General Arrangement - Inlet MH, Wet-Well and Valve Chamber.....	443
38.5.2 SPS–1301 Detailed Arrangement - Wet-Well, Buried Valves, DN100 Pipework.....	443
38.5.3 SPS–1302 Civil Plan - Wet-Well and Valve Chamber.....	443
38.5.4 SPS–1303 Wet Well Construction - Precast Concrete Components.....	444
38.5.5 SPS–1304 Wet Well Construction - Cover and Access Hole Details.....	444
38.5.6 SPS–1305 Electrical and Telemetry Conduit Details.....	444
38.5.7 SPS–1306 Valve Chamber Adjacent to Wet-well - Plan Section and Cover - Non- Trafficable.....	444
38.5.8 SPS–1307 Valve Chamber Adjacent to Wet-Well Pipework.....	444
38.5.9 SPS–1308 Water Supply DN50 Reduced Pressure Zone Device arrangement & details.....	444
38.5.10 SPS–1309 Mobile Pump Connection Arrangement - Pumping Stations < 40 L/s and SPS– 1310 Mobile Pump Connection Arrangement - Pumping Stations > 40 L/s.....	444
38.5.11 SPS–1350 and SPS–1351 Wet Well, Valve Chamber & Inlet Maintenance Hole general arrangement and section.....	444
38.5.12 SPS–1352 and SPS–1353 Valve Chamber and Cover - general and typical arrangement.....	444
38.5.13 SPS–1354, SPS–1355, and SPS–1356 Valve Chamber Covers - Support Beam Details, Cover & Hinge Details, and Additional Details.....	444
38.5.14 SPS–1357 Inlet Maintenance Hole - Hinged Access Cover (Non Trafficable Areas) Typical Arrangement.....	445
38.6 COMMENTARY ON SPS–1400 SERIES – STRUCTURES.....	445
38.6.1 <i>SPS–1400 and SPS–1401 Grit Collection MH - Detailed Arrangement</i> .....	445
38.6.2 SPS–1402 Emergency Storage - Typical Arrangement and Levels - Configuration 1.....	445
38.6.3 SPS–1403 Emergency Storage Details - Shallow and Deep Installations and Brickwork.....	445
38.6.4 SPS–1404 Emergency Relief System - Arrangement and Cross Section for DN150 to DN375 Overflow Pipes.....	445
38.6.5 SPS–1405 Discharge Maintenance Hole Arrangement & Cross Section Pressure Mains < DN375.....	445
38.6.6 SPS–1406 and SPS–1408 Emergency Storage Structure (ESS) in Trafficable and Non- Trafficable Areas - General Arrangement.....	445
38.6.7 SPS–1407 and SPS–1409 Emergency Storage Structure (ESS) in Trafficable and Non- Trafficable Areas - Details.....	445
38.6.8 SPS–1410 and SPS–1411 Inlet Maintenance Hole (IMH) (Up to 6m Depth to Invert Plans/ Section).....	445
38.6.9 SPS–1412 and SPS–1413 Emergency Relief System for Wet Well Inlet Sewers.....	446
38.6.10 SPS–1414 Inlet Maintenance Hole with Grit Collection - General Arrangement.....	446



38.6.11 SPS–1415 and SPS–1416 Emergency By-Pass Connection Security Enclosure Arrangement including Details.....	446
38.6.12 SPS–1417 Emergency By-Pass Connection with Bunded Area Arrangements & Details.....	446
38.7 COMMENTARY ON SPS–1500 SERIES - WET-WELL APPURTENANCES.....	446
38.7.1 SPS–1500, SPS–1501, SPS–1503, SPS–1504 Pump to Pressure Main Connection.....	446
38.7.2 SPS–1505 Hydrostatic Level Sensor - Stilling Tube.....	446
38.7.3 SPS–1506 and SPS–1507 External Hinged Covers - Opening Grate Type.....	446
38.7.4 SPS–1508 Miscellaneous Labels - Survey Label Plate, Pump Label Plate, Valve Spindle Access & Signage.....	446
38.7.5 SPS–1550 and SPS–1551 Wet Well Access Hatches Typical Arrangement - Plan & Section.....	446
38.8 COMMENTARY ON SPS–1600 SERIES – PRESSURE MAINS.....	447
38.8.1 SPS–1600 Design Typical Pressure Main Characteristic Curve.....	447
38.8.2 SPS–1601 Pipe Installation, Support & Trench Fill Pressure Mains < DN300.....	447
38.8.3 SPS–1602 Scour Arrangement - Pump & Gravity.....	447
38.8.4 SPS–1603 and SPS–1604 Scour Arrangement - Pressure Mains.....	447
38.8.5 SPS–1605 and SPS–1606 Gas Release Arrangement - Pressure Mains .....	447
38.8.6 SPS–1607 Pressure Main - Manual Air Release Arrangement.....	447
38.8.7 SPS–1608 Pipe Absolute Roughness v. Mean Velocity Chart.....	447
38.9 COMMENTARY ON SEW–1200 SERIES – EMBEDMENT / TRENCHFILL & SUPPORT SYSTEMS.....	447
38.9.1 General.....	447
38.9.2 Maximum Depth to Invert for Standard Support Types.....	449
38.9.3 SEW–1200 SOIL CLASSIFICATION GUIDELINES.....	449
38.9.4 SEW–1201– Embedment and trenchfill- typical arrangements.....	449
38.9.5 SEW–1202 Standard Embedment flexible and rigid pipes.....	450
38.9.6 SEW–1203 – SPECIAL EMBEDMENT INADEQUATE FOUNDATIONS.....	450
38.9.7 SEW–1204 – SPECIAL EMBEDMENT SUPPORT USING PILES.....	450
38.9.8 SEW–1205 – SPECIAL EMBEDMENT CONCRETE AND STABILISED SUPPORTS.....	450
38.9.9 SEW–1206 – BULKHEADS AND TRENCHSTOP.....	451
38.9.10 SEW–1207 – TRENCH DRAINAGE TYPICAL SYSTEMS.....	451
38.9.11 SEW–1208 – VERTICALS AND NEAR VERTICALS EXPOSED AND CONCEALED METHODS.....	451
38.10 COMMENTARY ON SEW–1300 SERIES – ACCESS STRUCTURES.....	451
38.10.1 SEW–1300 – SEWERS ≤DN 300 PRECAST MH TYPES P1 AND P2.....	451
38.10.2 SEW–1301 – CAST IN-SITU MH TYPES C1 AND C2.....	451
38.10.3 SEW–1302 – MH PIPE CONNECTION DETAILS.....	452
38.10.4 SEW–1303 – SEWERS ≤ DN 300 MH CHANGE IN LEVEL ARRANGEMENTS.....	452
38.10.5 SEW–1304 AND SEW–1305 – MH CHANNEL ARRANGEMENTS AND DETAILS.....	452
38.10.6 SEW–1306 – ALTERNATIVE MH DROP CONNECTIONS.....	452
38.10.7 SEW–1307 – STEP IRONS AND LADDERS.....	452
38.10.8 SEW–1308 – TYPICAL MH COVER ARRANGEMENTS.....	453
38.10.9 SEW–1309 AND SEW–1310 – LARGE AND SPECIAL MHs.....	453
38.10.10 SEW–1309 – Sewers DN 375 to DN 750 MHs.....	453
38.10.11 SEW–1310 – Special MHs using permanent formwork.....	453
38.10.12 SEW–1311 AND SEW–1312 – DEEP MHs.....	454

38.10.13 SEW-1313 – MH CONNECTION DETAILS PE AND PP PIPE.....	454
38.10.14 SEW-1314, SEW-1315, SEW-1316 AND SEW-1317 – MAINTENANCE CHAMBERS.....	454
38.11 COMMENTARY ON SEW-1400 SERIES – SPECIAL CROSSINGS / STRUCTURES ARRANGEMENTS.....	454
38.11.1 GENERAL.....	454
38.11.2 SEW-1400 – SYPHON ARRANGEMENT .....	455
38.11.3 SEW-1401, SEW-1402 AND SEW-1403 – BURIED CROSSINGS.....	455
38.11.4 SEW-1404, SEW-1405, SEW-1406 AND SEW-1455 – AERIAL CROSSINGS .....	455
38.11.5 SEW-1407, SEW-1408, SEW-1410, SEW-1451 AND SEW- 1456 – VENTILATION SYSTEMS.....	456
38.11.6 SEW-1409, SEW-1411, SEW-1413 and SEW- 1414 – WATER SEAL ARRANGEMENTS.....	456
38.11.7 SEW-1412 – EMERGENCY RELIEF STRUCTURES.....	457
38.12 COMMENTARY ON WAT-1200 SERIES – EMBEDMENT / TRENCHFILL AND SUPPORT SYSTEMS.....	457
38.12.1 GENERAL.....	457
38.12.2 WAT-1200 – SOIL CLASSIFICATION GUIDELINES.....	459
38.12.3 WAT-1201 – EMBEDMENT AND TRENCH FILL.....	459
38.12.4 WAT-1202 – STANDARD EMBEDMENT – ALL PIPE TYPES.....	459
38.12.5 WAT-1203 – SPECIAL EMBEDMENTS – INADEQUATE AND POOR FOUNDATION.....	459
38.12.6 WAT-1204 – SPECIAL EMBEDMENTS – CONCRETE, GEOTEXTILE AND CEMENT STABILISED SYSTEMS.....	459
38.12.7 WAT-1205 – THRUST BLOCK DETAILS – CONCRETE BLOCKS.....	460
38.12.8 WAT-1207 – THRUST AND ANCHOR BLOCKS – GATE VALVES AND VERTICAL BENDS.....	460
38.12.9 WAT-1208 – RESTRAINED JOINT SYSTEM – DN 100 TO DN 375 DI MAINS.....	460
38.12.10 WAT-1209 – TRENCH DRAINAGE – BULKHEADS AND TRENCHSTOP.....	460
38.12.11 28.12 WAT-1210 – TRENCH DRAINAGE – TYPICAL SYSTEMS.....	461
38.12.12 WAT-1211, WAT-1212, WAT-1213 AND WAT-1214 – BURIED CROSSINGS.....	461
38.12.13 WAT-1250 AND WAT-1251 – STANDARD TRENCH DETAILS.....	461
38.12.14 WAT-1252 – THRUST BLOCK DETAILS.....	461
38.12.15 WAT-1253 AND WAT-1254 – ANCHORAGE DETAILS – STOP VALVE INSTALLATIONS.....	461
38.12.16 WAT-1255 – BURIED CROSSINGS.....	461
38.13 COMMENTARY ON WAT-1300 SERIES – INSTALLATION PRACTICES/ STRUCTURES.....	461
38.13.1 GENERAL.....	461
38.13.2 WAT-1300 – VALVE AND HYDRANT IDENTIFICATION.....	462
38.13.3 WAT-1301 AND WAT-1302 – TYPICAL VALVE.....	462
38.13.4 WAT-1303 AND WAT-1304 – TYPICAL SURFACE FITTING INSTALLATION.....	462
38.13.5 WAT-1307 – TYPICAL APPURTENANCE (SCOUR) INSTALLATION.....	462
38.13.6 WAT-1313 – FLANGED JOINTS.....	463
38.13.7 WAT-1320, WAT-1321 AND WAT-1322 – AERIAL CROSSINGS.....	463
38.14 COMMENTARY ON WAT-1400 SERIES – FABRICATION DETAILS.....	464
38.14.1 GENERAL.....	464
38.14.2 WAT-1400 – TYPICAL STEEL PIPE JOINTING – BUTT WELDING OF JOINTS.....	464
38.14.3 WAT-1401 – TYPICAL STEEL PIPE JOINTING – RRJ SPIGOT BANDS.....	464
38.14.4 WAT-1402 – TYPICAL STEEL PIPE JOINTING – WELDED PIPE COLLARS.....	464

38.14.5 WAT-1403 – TYPICAL STEEL FABRICATION – BENDS.....	464
38.14.6 WAT-1408 – JOINT CORROSION PROTECTION.....	464
39 LISTING OF STANDARD DRAWINGS.....	465
40 SEWAGE PUMPING STATION DRAWINGS.....	473
PLANNING AND CONCEPT DESIGN.....	473
Concept plan.....	473
Pumping Station Concept Design.....	474
Pressure Main Concept Design.....	477
Typical Hydraulic Profile.....	479
PUMPING STATION LAYOUT.....	480
Typical Site Plan.....	480
Typical Site Plan.....	481
Typical Site Plan.....	483
Typical Site Plan.....	484
Access Roadway.....	485
Typical Site Plan.....	486
PUMPING STATION ARRANGEMENT.....	488
General Arrangement.....	488
Detailed Arrangement.....	489
Civil Plan.....	490
Wet-Well Construction.....	491
Electrical and Telemetry.....	493
Valve Chamber Adjacent to Wet-Well.....	494
Water Supply.....	496
Mobile Pump Connection Arrangement.....	497
Wet-Well, Valve Chamber and Inlet Maintenance Hole.....	499
Valve Chamber.....	501
Valve Chamber Covers.....	502
Inlet Maintenance Hole Hinged Access Cover.....	506
STRUCTURES.....	507
Grit Collection MH.....	507
Emergency Storage.....	509
Emergency Storage Details.....	510
Emergency Relief System.....	511
Discharge MH.....	512
Emergency Storage Structure.....	513
Inlet MH.....	517
Emergency Relief System.....	519
Inlet MH (Grit Collection).....	521
Emergency Bypass Connection Security Enclosure.....	522
Emergency Bypass Connection With Bunded Area.....	524
Maintenance Holes.....	525
Maintenance Shafts.....	539
WET-WELL APPURTENANCES.....	543
Pump to Pressure Main Connection.....	543
Hydraulic Level Sensor.....	548
External Hinged Covers.....	549
Miscellaneous Details.....	551

Wet-Well Access Hatches.....	552
PRESSURE MAINS.....	554
Design.....	554
Pipe Installation, Support and Trench Fill.....	555
Scour Arrangement.....	556
Gas Release Arrangement.....	559
Hydraulic Design.....	562
EMBEDMENT / TRENCHFILL AND SUPPORT SYSTEMS.....	563
Soil Classification Guidelines And.....	563
Embedment and Trenchfill.....	564
Standard Embedment.....	565
Special Embedment.....	566
Trench Drainage.....	569
Verticals and Near Verticals.....	571
Embedment and Trenchfill.....	572
Standard Embedment.....	574
Special Embedment.....	575
Thrust Block Details.....	577
Thrust and Anchor Blocks.....	578
Restrained Joint System.....	579
Trench Drainage.....	580
Buried Crossings.....	582
Standard Trench Details.....	586
Thrust Block Details.....	588
Anchorage Details.....	589
Buried Crossings.....	591
SPECIAL CROSSINGS / STRUCTURES ARRANGEMENTS.....	592
Buried Crossings.....	592
Aerial Crossings.....	596
Ventilation Systems.....	599
Water Seal Arrangements.....	601
Emergency Relief Structures.....	604
Ventilation Systems.....	605
Aerial Crossings.....	606
Ventilation Systems.....	607
INSTALLATION PRACTICES / STRUCTURES.....	608
Valve and Hydrant Identification.....	608
Typical Surface Fitting Installation.....	609
Typical Appurtenance Installation.....	611
Aerial Crossings.....	612
Flanged Joints.....	615
FABRICATION DETAILS.....	616
Typical Steel Pipe Jointing.....	616
Typical Steel Fabrication.....	619
Joint Corrosion Protection.....	620
Abbreviations.....	621
Definitions.....	622

## List of Figures

FIGURE I SYSTEM DISAGGREGATION DIAGRAM.....	74
Figure 1.1 CONCEPT DESIGN FLOWCHART (Informative).....	83
Figure 2.1 SPS OVERFLOW RISK REDUCTION DECISION DIAGRAM.....	87
Figure 3.1 TYPICAL PRE-COMMISSIONING AND COMMISSIONING PROCESS.....	107
Figure 3.2 TYPICAL HANDOVER TO WATER AGENCY.....	108
Figure 4.1 TYPICAL BOLTED CONNECTION DETAIL FOR FUSION BONDED COATED DUCTILE IRON FLANGES WITH STAINLESS STEEL FASTENERS.....	114
Figure 4.2 TYPICAL BOLTED CONNECTION DETAIL AND CORROSION PROTECTION PROCEDURE FOR BURIED DUCTILE IRON FLANGES WITH GALVANISED STEEL FASTENERS.....	114
Figure 4.3 TYPICAL BOLTED CONNECTION DETAIL FOR PE STUB FLANGE AND RAISED DUCTILE IRON FLANGE WITH STAINLESS STEEL FASTENERS AND BACKING PLATE.....	114
Figure 5.1 FLANGE FASTENER TIGHTENING SEQUENCE.....	126
Figure 5.2 TYPICAL INSULATED FLANGED JOINT FOR CATHODICALLY PROTECTED STEEL MAINS.....	129
Figure 6.1 TYPICAL EMERGENCY STORAGE STRUCTURE– CONFIGURATION 1.....	145
Figure 6.2 TYPICAL EMERGENCY STORAGE STRUCTURE – CONFIGURATION 2.....	147
Figure 6.3 TYPICAL EMERGENCY STORAGE STRUCTURE – CONFIGURATION 3.....	149
Figure 6.4 TYPICAL EMERGENCY STORAGE STRUCTURE – CONFIGURATION 4.....	151
Figure 9.1 ALARM LEVEL CONTROL SETTINGS.....	179
Figure 11.1 HORIZONTAL DEVIATION BY DEFLECTION AT PIPE JOINTS – PLAN VIEW.....	199
Figure 11.2 HORIZONTAL DEFLECTION USING A DI SOC-SOC CONNECTOR AND PERMITTED JOINT DEFLECTIONS FOR DI PIPES AND OTHER APPLICABLE PIPE TYPES – PLAN VIEW.....	200
Figure 11.3 DEFLECTION USING DI BENDS WITH DI AND OTHER PERMITTED PIPE TYPES – PLAN VIEW.....	200
Figure 11.4 VERTICAL DEVIATION BY DEFLECTION AT PIPE JOINTS – SECTION VIEW.....	201
Figure 11.5 VERTICAL DEVIATION USING DI BENDS – SECTION VIEW.....	201
Figure 11.6 TYPICAL ANCHOR BLOCK DETAIL FOR VERTICAL BENDS.....	202
Figure 11.7 VERTICAL DEFLECTIONS USING FABRICATED PIPE AND FLANGES – SECTION VIEW.....	202
Figure 11.8 VERTICAL DEFLECTIONS USING DOUBLE OFFSET FABRICATED PIPE AND FLANGES – SECTION VIEW.....	202
Figure 11.9 SELF-CLEANSING FLOW CONDITIONS FOR INVERTED SIPHONS.....	206
Figure 11.10 TYPICAL SURGE WAVE.....	209
Figure 11.11 TYPICAL FATIGUE CYCLE.....	212
Figure 12.1 ALTERNATIVE END TREATMENT FOR CONCRETE ENCASED STEEL PIPELINES.....	229
FIGURE J1.....	282
FIGURE J2 POTENTIALLY UNSTABLE/LANDSLIP AREAS MONITORING PITS FOR DN 100 AND DN 150 RETICULATION MAINS IN ROAD RESERVES.....	283
FIGURE J3.....	286
FIGURE J4.....	287
Figure 28.1 BALL AND SOCKET JOINT.....	369
Figure 28.2 SLIP-IN WELDED JOINT.....	369
Figure 28.3 PLAIN END WELDED COLLAR JOINT.....	370
Figure 28.4 PLAIN END BUTT WELDED JOINT.....	370
Figure 28.5 CML/FBPE WELDED JOINT (CLPEWJ).....	370
Figure L.1 Summary Report Template (blue text is example only).....	417
SPS–1100 Typical Catchment Plan.....	473
SPS–1101 Site Layout.....	474
SPS–1102 Site Plan.....	475
SPS–1103 Power and Control Cubicle, Base and Conduit Details.....	476

SPS-1104-1 Sections and Mean Static Head Calculation.....	477
SPS-1104-2 Sections and Mean Static Head Calculation.....	478
SPS-1105 Typical Hydraulic Profile.....	479
SPS-1200 Fronting and Not Fronting Adjacent Roadway.....	480
SPS-1201 Fronting Adjacent Roadway.....	481
SPS-1202 Not Fronting Adjacent Roadway.....	482
SPS-1203 Fronting Adjacent Roadway.....	483
SPS-1204 Fronting Adjacent Roadway.....	484
SPS-1205 Cross Section and Drainage Details.....	485
SPS-1206 Conceptual Site Layout.....	486
SPS-1207 Site Access Arrangements.....	487
SPS-1300 Inlet MH, Wet-Well and Valve Chamber.....	488
SPS-1301 Wet-Well, Buried Valves, DN 100 Pipework.....	489
SPS-1302 Wet-Well and Valve Chamber.....	490
SPS-1303 Pre-Cast Concrete Components.....	491
SPS-1304 Cover and Access Hole Details.....	492
SPS-1305 Conduit Details.....	493
SPS-1306 Plan, Section and Cover – Non-Trafficable.....	494
SPS-1307 Pipework.....	495
SPS-1308 DN 50 Reduced Pressure Zone Device – Arrangement & Details.....	496
SPS-1309 Pumping Stations ≤40 L/s.....	497
SPS-1310 Pumping Stations >40 L/s.....	498
SPS-1350 General Arrangement Plan.....	499
SPS-1351 General Arrangement Section.....	500
SPS-1352 General Arrangement.....	501
SPS-1353 Typical Arrangement.....	502
SPS-1354 Support Beam Details.....	503
SPS-1355 Cover & Hinge Details.....	504
SPS-1356 Additional Details.....	505
SPS-1357 Typical Arrangement (non-trafficable).....	506
SPS-1400 Detailed Arrangement.....	507
SPS-1401 Detailed Arrangement.....	508
SPS-1402 Typical Arrangement and Levels Configuration 1.....	509
SPS-1403 Shallow and Deep Installations and Brickwork.....	510
SPS-1404 Arrangement and Cross Section for DN 150 to DN 375 Overflow Pipes.....	511
SPS-1405 Arrangement and Cross Section for Pressure Mains ≤ DN 300.....	512
SPS-1406 General Arrangement (Trafficable).....	513
SPS-1407 Details (Trafficable).....	514
SPS-1408 General Arrangement (Non-Trafficable).....	515
SPS-1409 Details (Non-Trafficable).....	516
SPS-1410 Plans ≤6m Depth.....	517
SPS-1411 Section ≤6m Depth.....	518
SPS-1412 Wet-Well Inlet Sewers DN 150 to DN 250.....	519
SPS-1413 Wet-Well Inlet Sewers DN 300 to DN 450.....	520
SPS-1414 General Arrangement.....	521
SPS-1415 General Arrangement.....	522
SPS-1416 Details.....	523
SPS-1417 Arrangement and Details.....	524

SEW-1300 Sewers ≤ DN 300 Precast Types P1 & P2.....	525
SEW-1301 Sewers ≤ DN 300 Cast Insitu Types C1 & C2.....	526
SEW-1302 Pipe Connection Details.....	527
SEW-1303 Sewers ≤ DN 300 Changes in Level Details.....	528
SEW-1304 For Sewers ≤ DN 300 Typical Channel Arrangements .....	529
SEW-1305 Typical Channel Details.....	530
SEW-1306 Alternative Drop Connections.....	531
SEW-1307 Step Irons & Ladders.....	532
SEW-1308 Typical MH Cover Arrangements.....	533
SEW-1309 Sewers DN 375 to DN 750.....	534
SEW-1310 Permanent Formwork > DN 375.....	535
SEW-1311 Depth to Invert 6m to 15m.....	536
SEW-1312 Depth to Invert >15m.....	537
SEW-1313 MH Connection Details DN 110 to DN 450 PE Pipe.....	538
SEW-1314 Typical Installation.....	539
SEW-1315 MS & Variable Bend Installations.....	540
SEW-1316 TMS and Connection Installations.....	541
SEW-1317 Typical MS Cover Arrangements.....	542
SPS-1500 Hose Connection Bend Assemblies.....	543
SPS-1501 Wall Pipe Bracket Assemblies.....	544
SPS-1502 Wall Pipe Bracket Details.....	545
SPS-1503 Hose Connection Bends.....	546
SPS-1504 Hose Connection Bend Quick Coupling Details.....	547
SPS-1505 Stilling Tube.....	548
SPS-1506 Opening Grate Type.....	549
SPS-1507 Opening Grate Type.....	550
SPS-1508 Survey Plate, Pump Label Plate, Valve Spindle Access.....	551
SPS-1550 Typical Arrangement Plan & Section.....	552
SPS-1551 Typical Arrangement Sections.....	553
SPS-1600 Typical Pressure Main Characteristic Curve.....	554
SPS-1601 Pressure Mains ≤DN 300.....	555
SPS-1602 Pump and Gravity.....	556
SPS-1603 Pressure Mains ≤DN 300 ≤2.2 m to Invert.....	557
SPS-1604 Pressure Mains ≤DN 300 >2.2 m to Invert.....	558
SPS-1605 Pressure Mains ≤DN 300.....	559
SPS-1606 Pressure Mains >DN 300.....	560
SPS-1607 Manual Air Release Arrangement.....	561
SPS-1608 Pipe Absolute Roughness Versus Mean Velocity Chart.....	562
SEW-1200 Allowable Bearing Pressures for Bulkheads.....	563
SEW-1201 Typical Arrangements.....	564
SEW-1202 Flexible & Rigid Pipes.....	565
SEW-1203 Inadequate Foundations Requiring Over Excavation & Replacement.....	566
SEW-1204 Support Utilising Piles.....	567
SEW-1205 Concrete & Stabilised Supports.....	568
SEW-1206 Bulkheads & Trenchstop.....	569
SEW-1207 Typical Systems.....	570
SEW-1208 Exposed & Concealed Methods.....	571
WAT-1200 Soil Classification Guidelines.....	572

WAT-1201 Typical Arrangement.....	573
WAT-1202 All Pipe Types.....	574
WAT-1203 Inadequate and Poor Foundation.....	575
WAT-1204 Concrete, Geotextile and Cement Stabilised Systems.....	576
WAT-1205 Concrete Blocks.....	577
WAT-1207 Gate Valves and Vertical Bends.....	578
WAT-1208 DN 100 to DN 375 DI Mains.....	579
WAT-1209 Bulkheads and Trenchstop.....	580
WAT-1210 Typical Systems.....	581
WAT-1211 Under Obstructions.....	582
WAT-1212 Major Roadways.....	583
WAT-1213 Railways.....	584
WAT-1214 Bored & Jacked Encasing Pipe Details.....	585
WAT-1250 Reticulation Mains DN 100 to DN 375.....	586
WAT-1251 Transfer and Distribution Mains DN 300 to DN 750.....	587
WAT-1252 DN 450 to DN 750.....	588
WAT-1253 Stop valves Installations up to DN1200 SCL Mains.....	589
WAT-1254 Stop valves Installations up to DN 750 DICL Mains.....	590
WAT-1255 Under Minor Obstructions.....	591
SEW-1400 Syphon Arrangement.....	592
SEW-1401 Railways.....	593
SEW-1402 Major Roadways.....	594
SEW-1403 Bored & Jacked Encasing Pipe Details.....	595
SEW-1404 Aqueduct Crossings.....	596
SEW-1405 Aqueduct Protection Grille.....	597
SEW-1406 Bridge Crossing Concepts.....	598
SEW-1407 Induct Vent.....	599
SEW-1408 Educt Vent.....	600
SEW-1409 Main Type.....	601
SEW-1410 MAINTENACE HOLE SYSTEM.....	602
SEW-1411 TWIN MAINTENANCE HOLES.....	603
SEW-1412 Typical Arrangement DN 150 to DN 375.....	604
SEW-1451 Educt Vent Shaft Base Block Details.....	605
SEW-1455 Circular RC Piers in Non-Flood Conditions for DN 150 to DN 750 Sewers.....	606
SEW-1456 Educt Vent Stack and Holding Down Bolt Details.....	607
WAT-1300 Identification Markers & Marker Posts.....	608
WAT-1303 Gate Valve Surface Boxes Non-Trafficable.....	609
WAT-1304 Gate Valve Surface Boxes Trafficable.....	610
WAT-1307 Scour Arrangements.....	611
WAT-1320 Aqueduct.....	612
WAT-1321 Aqueduct Protection Grille.....	613
WAT-1322 Bridge Crossing Concepts.....	614
WAT-1313 Bolting Details.....	615
WAT-1400 Butt Welding of Joints.....	616
WAT-1401 Rubber Ring Joint Spigot Bands.....	617
WAT-1402 Welded Pipe Collars.....	618
WAT-1403 Bends.....	619
WAT-1408 Cement Mortar Lined Steel Pipe DN 300 to DN 1200.....	620



## List of Tables

Table 1.1 ASSET CATEGORIES.....	79
Table 1.2 TYPICAL ASSET DESIGN LIFE.....	81
Table 3.1 CLEARANCES BETWEEN PRESSURE MAINS AND UNDERGROUND SERVICES.....	101
Table 5.1 COLOUR IDENTIFICATION OF COMPONENTS IN RETICULATION SEWER SYSTEMS.....	116
Table 6.1 DEFAULT CONTROL LEVELS.....	138
Table 9.1 DEFAULT ALARM LEVELS.....	174
Table 9.2 TYPICAL LOCAL AND REMOTE ALARMS (Informative).....	174
Table 9.3 TYPICAL REMOTE MONITORED CONDITIONS (Informative).....	176
Table 10.1 BYPASS CONNECTION SIZES.....	192
Table 11.1 TEMPERATURE RE-RATING FACTORS FOR PLASTIC PIPES AT ELEVATED TEMPERATURES.....	211
Table 11.2 FATIGUE DE-RATING FACTORS FOR THERMOPLASTIC PIPES.....	213
Table 11.3 SCOUR SIZES.....	216
Table 12.1 REQUIREMENT FOR BULKHEADS AND TRENCHSTOPS.....	232
TABLE A1 ASSET CATEGORISATION AND INDICATIVE PROTECTIVE TREATMENT SCHEDULE.....	250
TABLE I1 GENERAL PERFORMANCE CHARACTERISTICS OF BOREHOLE AND TUNNELLING TECHNOLOGIES.....	291
Table 19.1 CONTROL CIRCUIT WIRING INSULATION COLOUR CODING.....	330
Table 24.1 TIMBER GUARDRAIL DEFAULT CONSTRUCTION DIMENSIONS.....	344
Table 25.1 RETAINING WALL DEFAULT CONSTRUCTION DIMENSIONS.....	345
Table 25.2 TIMBER HANDRAIL DEFAULT CONSTRUCTION DIMENSIONS.....	347
Table 28.1 JOINTING TECHNIQUES FOR PE PIPE.....	360
Table 28.2 Electrofusion socket and saddle joint testing qualification requirements.....	373
Table 34.1 ORDER OF ACCEPTANCE TESTING OF CIVIL ITEMS.....	391
Table 34.2 FLEXIBLE PIPES – MINIMUM COMPACTION EMBEDMENT, TRENCH FILL AND EMBANKMENT OF FLEXIBLE PIPES.....	392
Table 34.3 RIGID PIPES – MINIMUM COMPACTION EMBEDMENT, TRENCH FILL AND EMBANKMENT.....	393
Table 34.4 PRESSURE AND VACUUM AIR TESTING ACCEPTANCE TIMES FOR 7 KPA PRESSURE CHANGE.....	397
Table 34.5 CONCRETE MH TESTING FREQUENCY.....	399
Table 34.6 MINIMUM TEST TIMES FOR CONCRETE STRUCTURES.....	400
Table 34.7 MAXIMUM ALLOWABLE SHORT-TERM PIPE DEFLECTIONS.....	402
Table 36.1 SEWER GRADE TOLERANCES.....	410
Table K.1 PROVER OUTSIDE DIAMETER FOR PVC PIPES.....	413
Table L.1 General Comments GC.....	420
Table L.2 ACCEPTANCE PARAMETERS FOR RIGID SEWERS – VITRIFIED CLAY, STEEL REINFORCED CONCRETE.....	421
Table L.3 ACCEPTANCE CRITERIA - CONFIGURATION OF PIPEWORK AND FITTINGS – ALL SEWERS.....	426
Table M.1 MAXIMUM DEPTH TO TOP OF PIPE OR PVC-U SEWERS (Excluding Traffic Loads).....	432
Table M.2 MAXIMUM DEPTH TO TOP OF PIPE FOR PVC-U SEWERS including SM1600 Wheel loads - (AS 5100 distribution method).....	432
Table M.3 MAXIMUM DEPTH TO TOP OF PIPE FOR PP SEWERS (Excluding Traffic Loads).....	433
Table M.4 MAXIMUM DEPTH TO TOP OF PIPE FOR PP SEWERS including SM1600 Wheel loads - (AS 5100 distribution method).....	433
Table M.5 MAXIMUM DEPTH TO TOP OF FW-GRP (PN1) SEWERS (Excluding Traffic Loads).....	434

---

Table M.6 MAXIMUM DEPTH TO TOP OF FW-GRP (PN1) SEWERS including SM1600 Wheel loads - (AS 5100 distribution method).....	435
Table M.7 MAXIMUM DEPTH TO TOP OF PE100 ( Excluding Traffic Loads) .....	435
Table M.8 MAXIMUM DEPTH TO TOP OF PE100 SEWERS including SM1600 Wheel loads - (AS 5100 distribution method).....	436
Table 38.1 MAXIMUM PARTICLE SIZE.....	450
Table 38.2 MINIMUM TRENCH DIMENSIONS (Informative).....	457
LISTING OF STANDARD DRAWINGS.....	465



WATER SERVICES  
ASSOCIATION OF AUSTRALIA

# **PART 0: GLOSSARY, ABBREVIATIONS AND REFERENCES**

Sewage Pumping Station Code of Australia  
Version 3.2  
(Incorporating Amendment No 1)



WATER SERVICES  
ASSOCIATION OF AUSTRALIA

# PART 1: PLANNING AND DESIGN

Sewage Pumping Station Code of Australia  
Version 3.2  
(Incorporating Amendment No 1)



WATER SERVICES  
ASSOCIATION OF AUSTRALIA



# **PART 2: CONSTRUCTION**

Sewage Pumping Station Code of Australia  
Version 3.2  
(Incorporating Amendment No 1)



WATER SERVICES  
ASSOCIATION OF AUSTRALIA

# **PART 3: DRAWINGS**

Sewage Pumping Station Code of Australia

Version 3.2

(Incorporating Amendment No 1)

**39 LISTING OF STANDARD DRAWINGS**

## LISTING OF STANDARD DRAWINGS

DRAWING NUMBER	ACTIVITY	TITLE
<b>PLANNING AND CONCEPT DESIGN</b>		
<a href="#"><u>SPS-1100</u></a>	Concept Plan	Typical Catchment Plan
<a href="#"><u>SPS-1101</u></a>	Pumping Station Concept Design	Site Layout
<a href="#"><u>SPS-1102</u></a>	Pumping Station Concept Design	Site Plan
<a href="#"><u>SPS-1103</u></a>	Pumping Station Concept Design	Power and Control Cubicle, Base and Conduit Details
<a href="#"><u>SPS-1104-1</u></a>	Pressure Main Concept Design	Sections and Mean Static Head Calculation
<a href="#"><u>SPS-1104-2</u></a>	Pressure Main Concept Design	Sections and Mean Static Head Calculation
<a href="#"><u>SPS-1105</u></a>	Pumping Station Concept Design	Typical Hydraulic Profile
<b>PUMPING STATION LAYOUT</b>		
<a href="#"><u>SPS-1200</u></a>	Typical Site Plan	Fronting and Not Fronting Adjacent Roadway
<a href="#"><u>SPS-1201</u></a>	Typical Site Plan	Fronting Adjacent Roadway
<a href="#"><u>SPS-1202</u></a>	Typical Site Plan	Not Fronting Adjacent Roadway
<a href="#"><u>SPS-1203</u></a>	Typical Site Plan	Fronting Adjacent Roadway
<a href="#"><u>SPS-1204</u></a>	Typical Site Plan	Fronting Adjacent Roadway
<a href="#"><u>SPS-1205</u></a>	Access Roadway	Cross Section and Drainage Details
<a href="#"><u>SPS-1206</u></a>	Typical Site Plan	Conceptual Site Layout
<a href="#"><u>SPS-1207</u></a>	Typical Site Plan	Site Access Arrangements

DRAWING NUMBER	ACTIVITY	TITLE
<b>PUMPING STATION ARRANGEMENT</b>		
<a href="#"><u>SPS-1300</u></a>	General Arrangement	Inlet MH, Wet-Well and Valve Chamber
<a href="#"><u>SPS-1301</u></a>	Detailed Arrangement	Wet-Well, Buried Valves, DN 100 Pipework
<a href="#"><u>SPS-1302</u></a>	Civil Plan	Wet-Well and Valve Chamber
<a href="#"><u>SPS-1303</u></a>	Wet-Well Construction	Pre-Cast Concrete Components
<a href="#"><u>SPS-1304</u></a>	Wet-Well Construction	Cover and Access Hole Details
<a href="#"><u>SPS-1305</u></a>	Electrical and Telemetry	Conduit Details
<a href="#"><u>SPS-1306</u></a>	Valve Chamber Adjacent to Wet-Well	Plan, Section and Cover – Non-Trafficable
<a href="#"><u>SPS-1307</u></a>	Valve Chamber Adjacent to Wet-Well	Pipework
<a href="#"><u>SPS-1308</u></a>	Water Supply	DN 50 Reduced Pressure Zone Device – Arrangement & Details
<a href="#"><u>SPS-1309</u></a>	Mobile Pump Connection Arrangement	Pumping Stations ≤40 L/s
<a href="#"><u>SPS-1310</u></a>	Mobile Pump Connection Arrangement	Pumping Stations >40 L/s
<a href="#"><u>SPS-1350</u></a>	Wet-Well, Valve Chamber & Inlet Maintenance Hole	General Arrangement Plan
<a href="#"><u>SPS-1351</u></a>	Wet-Well, Valve Chamber & Inlet Maintenance Hole	General Arrangement Section
<a href="#"><u>SPS-1352</u></a>	Valve Chamber	General Arrangement
<a href="#"><u>SPS-1353</u></a>	Valve Chamber Covers	Typical Arrangement
<a href="#"><u>SPS-1354</u></a>	Valve Chamber Covers	Support Beam Details
<a href="#"><u>SPS-1355</u></a>	Valve Chamber Covers	Cover & Hinge Details
<a href="#"><u>SPS-1356</u></a>	Valve Chamber Covers	Additional Details



DRAWING NUMBER		ACTIVITY	TITLE
<a href="#">SPS-1357</a>	Inlet Maintenance Hole Hinged Access Cover		Typical Arrangement (non-trafficable)
<b>STRUCTURES</b>			
<a href="#">SPS-1400</a>	Grit Collection MH		Detailed Arrangement
<a href="#">SPS-1401</a>	Grit Collection MH		Detailed Arrangement
<a href="#">SPS-1402</a>	Emergency Storage		Typical Arrangement and Levels Configuration 1
<a href="#">SPS-1403</a>	Emergency Storage Details		Shallow and Deep Installations and Brickwork
<a href="#">SPS-1404</a>	Emergency Relief System		Arrangement and Cross Section for DN 150 to DN 375 Overflow Pipes
<a href="#">SPS-1405</a>	Discharge MH		Arrangement and Cross Section for Pressure Mains ≤ DN 300
<a href="#">SPS-1406</a>	Emergency Storage Structure		General Arrangement (Trafficable)
<a href="#">SPS-1407</a>	Emergency Storage Structure		Details (Trafficable)
<a href="#">SPS-1408</a>	Emergency Storage Structure		General Arrangement (Non-Trafficable)
<a href="#">SPS-1409</a>	Emergency Storage Structure		Details (Non-Trafficable)
<a href="#">SPS-1410</a>	Inlet MH		Plans ≤6m Depth
<a href="#">SPS-1411</a>	Inlet MH		Section ≤6m Depth
<a href="#">SPS-1412</a>	Emergency Relief System		Wet-Well Inlet Sewers DN 150 to DN 250
<a href="#">SPS-1413</a>	Emergency Relief System		Wet-Well Inlet Sewers DN 300 to DN 450
<a href="#">SPS-1414</a>	Inlet MH (Grit Collection)		General Arrangement
<a href="#">SPS-1415</a>	Emergency Bypass Connection Security Enclosure		General Arrangement
<a href="#">SPS-1416</a>	Emergency Bypass Connection Security Enclosure		Details

DRAWING NUMBER	ACTIVITY	TITLE
<a href="#">SPS-1417</a>	Emergency Bypass Connection With Bunded Area	Arrangement and Details
<a href="#">SEW-1300</a>	Maintenance Holes	Sewers ≤ DN 300 Precast Types P1 & P2
<a href="#">SEW-1301</a>	Maintenance Holes	Sewers ≤ DN 300 Cast Insitu Types C1 & C2
<a href="#">SEW-1302</a>	Maintenance Holes	Pipe Connection Details
<a href="#">SEW-1303</a>	Maintenance Holes	Sewers ≤ DN 300 Changes in Level Details
<a href="#">SEW-1304</a>	Maintenance Holes	For Sewers ≤ DN 300 Typical Channel Arrangements
<a href="#">SEW-1305</a>	Maintenance Holes	Typical Channel Details
<a href="#">SEW-1306</a>	Maintenance Holes	Alternative Drop Connections
<a href="#">SEW-1307</a>	Maintenance Holes	Step Irons & Ladders
<a href="#">SEW-1308</a>	Maintenance Holes	Typical MH Cover Arrangements
<a href="#">SEW-1309</a>	Maintenance Holes	Sewers DN 375 to DN 750
<a href="#">SEW-1310</a>	Maintenance Holes	Permanent Formwork > DN 375
<a href="#">SEW-1311</a>	Maintenance Holes	Depth to Invert 6m to 15m
<a href="#">SEW-1312</a>	Maintenance Holes	Depth to Invert >15m
<a href="#">SEW-1313</a>	Maintenance Holes	MH Connection Details DN 110 to DN 450 PE Pipe
<a href="#">SEW-1314</a>	Maintenance Shafts	Typical Installation
<a href="#">SEW-1315</a>	Maintenance Shafts	MS & Variable Bend Installations
<a href="#">SEW-1316</a>	Maintenance Shafts	TMS and Connection Installations

DRAWING NUMBER	ACTIVITY	TITLE
<a href="#">SEW-1317</a>	Maintenance Shafts	Typical MS Cover Arrangements
<b>WET-WELL APPURTENANCES</b>		
<a href="#">SPS-1500</a>	Pump to Pressure Main Connection	Hose Connection Bend Assemblies
<a href="#">SPS-1501</a>	Pump to Pressure Main Connection	Wall Pipe Bracket Assemblies
<a href="#">SPS-1502</a>	Pump to Pressure Main Connection	Wall Pipe Bracket Details
<a href="#">SPS-1503</a>	Pump to Pressure Main Connection	Hose Connection Bends
<a href="#">SPS-1504</a>	Pump to Pressure Main Connection	Hose Connection Bend Quick Coupling Details
<a href="#">SPS-1505</a>	Hydraulic Level Sensor	Stilling Tube
<a href="#">SPS-1506</a>	External Hinged Covers	Opening Grate Type
<a href="#">SPS-1507</a>	External Hinged Covers	Opening Grate Type
<a href="#">SPS-1508</a>	Miscellaneous Details	Survey Plate, Pump Label Plate, Valve Spindle Access
<a href="#">SPS-1550</a>	Wet-Well Access Hatches	Typical Arrangement Plan & Section
<a href="#">SPS-1551</a>	Wet-Well Access Hatches	Typical Arrangement Sections
<b>PRESSURE MAINS</b>		
<a href="#">SPS-1600</a>	Design	Typical Pressure Main Characteristic Curve
<a href="#">SPS-1601</a>	Pipe Installation, Support and Trench Fill	Pressure Mains $\leq$ DN 300
<a href="#">SPS-1602</a>	Scour Arrangement	Pump and Gravity
<a href="#">SPS-1603</a>	Scour Arrangement	Pressure Mains $\leq$ DN 300 $\leq$ 2.2 m to Invert
<a href="#">SPS-1604</a>	Scour Arrangement	Pressure Mains $\leq$ DN 300 $>$ 2.2 m to Invert

DRAWING NUMBER		ACTIVITY	TITLE
<a href="#">SPS-1605</a>	Gas Release Arrangement		Pressure Mains ≤ DN 300
<a href="#">SPS-1606</a>	Gas Release Arrangement		Pressure Mains >DN 300
<a href="#">SPS-1607</a>	Gas Release Arrangement		Manual Air Release Arrangement
<a href="#">SPS-1608</a>	Hydraulic Design		Pipe Absolute Roughness Versus Mean Velocity Chart
<b>EMBEDMENT / TRENCHFILL AND SUPPORT SYSTEMS</b>			
<a href="#">SEW-1200</a>	Soil Classification Guidelines And		Allowable Bearing Pressures for Bulkheads
<a href="#">SEW-1201</a>	Embedment and Trenchfill		Typical Arrangements
<a href="#">SEW-1202</a>	Standard Embedment		Flexible & Rigid Pipes
<a href="#">SEW-1203</a>	Special Embedment		Inadequate Foundations Requiring Over Excavation & Replacement
<a href="#">SEW-1204</a>	Special Embedment		Support Utilising Piles
<a href="#">SEW-1205</a>	Special Embedment		Concrete & Stabilised Supports
<a href="#">SEW-1206</a>	Trench Drainage		Bulkheads & Trenchstop
<a href="#">SEW-1207</a>	Trench Drainage		Typical Systems
<a href="#">SEW-1208</a>	Verticals & Near Verticals		Exposed & Concealed Methods
<a href="#">WAT-1200</a>	Soil Classification Guideline and		Allowable Bearing Pressure for Anchor blocks and bulk heads
<a href="#">WAT-1201</a>	Embedment & Trenchfill		Typical Arrangement
<a href="#">WAT-1202</a>	Standard Embedment		All Pipe Types
<a href="#">WAT-1203</a>	Special Embedments		Inadequate and Poor Foundation
<a href="#">WAT-1204</a>	Special Embedments		Concrete, Geotextile and Cement Stabilised Systems
<a href="#">WAT-1205</a>	Thrust Block Details		Concrete Blocks
<a href="#">WAT-1207</a>	Thrust and Anchor Blocks		Gate Valves and Vertical Bends

DRAWING NUMBER	ACTIVITY		TITLE
<a href="#">WAT-1208</a>	Restrained Joint System	DN 100 to DN 375 DI Mains	
<a href="#">WAT-1209</a>	Trench Drainage	Bulkheads and Trenchstop	
<a href="#">WAT-1210</a>	Trench Drainage	Typical Systems	
<a href="#">WAT-1211</a>	Buried Crossings	Under Obstructions	
<a href="#">WAT-1212</a>	Buried Crossings	Major Roadways	
<a href="#">WAT-1213</a>	Buried Crossings	Railways	
<a href="#">WAT-1214</a>	Buried Crossings	Bored & Jacked Encasing Pipe Details	
<a href="#">WAT-1250</a>	Standard Trench Details	Reticulation Mains DN 100 to DN 375	
<a href="#">WAT-1251</a>	Standard Trench Details	Transfer and Distribution Mains DN 300 to DN 750	
<a href="#">WAT-1252</a>	Thrust Block details	DN 450 to DN 750	
<a href="#">WAT-1253</a>	Anchorage Details	Stop valves Installations up to DN1200 SCL Mains	
<a href="#">WAT-1254</a>	Anchorage Details	Stop valves Installations up to DN 750 DICL Mains	
<a href="#">WAT-1255</a>	Buried Crossings	Under Minor Obstructions	
<b>SPECIAL CROSSINGS / STRUCTURES ARRANGEMENTS</b>			
<a href="#">SEW-1400</a>	Buried Crossings	Syphon Arrangement	
<a href="#">SEW-1401</a>	Buried Crossings	Railways	
<a href="#">SEW-1402</a>	Buried Crossings	Major Roadways	
<a href="#">SEW-1403</a>	Buried Crossings	Bored & Jacked Encasing Pipe Details	
<a href="#">SEW-1404</a>	Aerial Crossing	Aqueduct Crossings	
<a href="#">SEW-1405</a>	Aerial Crossing	Aqueduct Protection Grille	
<a href="#">SEW-1406</a>	Aerial Crossings	Bridge Crossing Concepts	
<a href="#">SEW-1407</a>	Ventilation Systems	Induct Vent	
<a href="#">SEW-1408</a>	Ventilation Systems	Educt Vent	
<a href="#">SEW-1410</a>	Ventilation Systems	Educt Vent Shaft Base Block Details	
<a href="#">SEW-1411</a>	Water Seal Arrangement	Twin Maintenance Holes	

DRAWING NUMBER	ACTIVITY		TITLE
<a href="#">SEW-1412</a>	Emergency Relief Structures	Typical Arrangement DN 150 to DN 375	
<a href="#">SEW-1451</a>	Ventilation Systems	Educt Vent Shaft Base Block Details	
<a href="#">SEW-1455</a>	Aerial Crossings	Circular RC Piers in Non Flood Conditions for DN 150 to DN 750 Sewers	
<a href="#">SEW-1456</a>	Ventilation Systems	Educt Vent Stack and Holding Down Bolt Details	
<b>INSTALLATION PRACTICES/ STRUCTURES</b>			
<a href="#">WAT-1300</a>	Valve and Hydrant Identification	Identification Markers & Marker Posts	
<a href="#">WAT-1303</a>	Typical Surface Fitting Installation	Gate Valve Surface Boxes Non-Trafficable	
<a href="#">WAT-1304</a>	Typical Surface Fitting Installation	Gate Valve Surface Boxes Trafficable	
<a href="#">WAT-1307</a>	Typical Appurtenance Installation	Scour Arrangements	
<a href="#">WAT-1320</a>	Aerial Crossings	Aqueduct	
<a href="#">WAT-1321</a>	Aerial Crossings	Aqueduct Protection Grille	
<a href="#">WAT-1322</a>	Aerial Crossings	Bridge Crossing Concepts	
<a href="#">WAT-1313</a>	Flanged Joints	Bolting Details	
<b>FABRICATION DETAILS</b>			
<a href="#">WAT-1400</a>	Typical Steel Pipe Jointing	Butt Welding of Joints	
<a href="#">WAT-1401</a>	Typical Steel Pipe Jointing	Rubber Ring Joint Spigot Bands	
<a href="#">WAT-1402</a>	Typical Steel Pipe Jointing	Welded Pipe Collars	
<a href="#">WAT-1403</a>	Typical Steel Fabrication	Bends	
<a href="#">WAT-1408</a>	Joint Corrosion Protection	Cement Mortar Lined Steel Pipe DN 300 to DN 1200	