

## List of Tables

	<u>Page</u>
3.1 - Residential Land Use Densities	15
3.2 - Water Demands Within Massaponax Creek Drainage Basin	21
3.3 - Hazel Run Sub-Basins Pumped to Massaponax Creek Drainage Basin	23
3.4 - Water Demands Within American Central Drainage Basin	24
3.5 - Water Demands Within Rappahannock River Drainage Basin	24
3.6 - Water Demands Within Hazel Run Drainage Basin	25
3.7 - Water Demands Within Deep Run Drainage Basin	26
3.8 - Water Demands Within Ni River Drainage Basin	26
3.9 - Water Demands Within Po River Drainage Basin	28
3.10 - Water Demands Within Matta River Drainage Basin	29
3.11 - Summary of Water Demands By Drainage Basins	29
3.12 - Water Demand Data By Pressure Zones	31
3.13 - Water Demand Data By Pressure Zone (Including Unaccounted Losses)	33
4.1 - Thornburg Development District Water Demands and Sewage Flows	35
4.2 - American Central System Sewage Pumping Stations	39
4.3 - FMC Wastewater Treatment Plant Measured Sewage Flows	41
4.4 - Build-Out Sewage Flow to FMC Wastewater Treatment Plant	41
4.5 - FMC Wastewater Treatment Plant Required Effluent Concentrations	42
4.6 - Massaponax Wastewater Treatment Plant Build-Out Sewage Flows	43
4.7 - Massaponax Wastewater Treatment Plant Required Effluent Concentrations	44
5.1 - Capital Costs for 7-mgd Po-Ni Wastewater Treatment Plant	45
5.2 - Annual Operating Budget for Po-Ni Wastewater Treatment Plant	46
5.3 - Capital Costs to Pump Sewage From Thornburg Development District to Massaponax Wastewater Treatment Plant	48
5.4 - Comparative Costs, Thornburg Development District Wastewater Treatment Options	49
5.5 - Thornburg Development District Sewage Collection Capital Costs	52
5.6 - Hazel Run Drainage Basin, Interceptor and Trunk Main Sizes	55
5.7 - Required Improvements to Hazel Run Interceptor Inside City of Fredericksburg	56
5.8 - Cost of Hazel Run Interceptor Improvements Inside City of Fredericksburg	58
5.9 - Deep Run Drainage Basin Interceptor and Trunk Main Sizes	60
5.10 - FMC Wastewater Treatment Plant Build-out Sewage Flows	61
5.11 - Capital Costs to Expand FMC Wastewater Treatment Plant	62
5.12 - Annual Operating Budget for FMC Wastewater Treatment Plant	63
5.13 - Costs to Abandon FMC Wastewater Treatment Plant	65
5.14 - Massaponax Wastewater Treatment Plant Build-Out Sewage Flows	65
5.15 - Costs to Expand Massaponax Wastewater Treatment Plant	66
5.16 - American Central System Gravity Sewer and Force Main Sizes	67
5.17 - American Central System, Build-out Pumping Station Requirements	68
5.18 - Massaponax Creek Interceptor Build-out Pipe Sizes	71
5.19 - Massaponax Creek Interceptor Growth Factors	72
6.1 - Capital Costs For Thornburg Development District CIP	76
6.2 - Capital Costs For Additional Thornburg Development District Improvements	76
6.3 - Capital Costs For Hazel Run Drainage Basin CIP	79

## List of Tables

	<u>Page</u>
6.4 - Capital Costs For Secondary Hazel Run Drainage Basin Improvements	80
6.5 - Capital Costs For Improvements to City of Fredericksburg Hazel Run Interceptor	80
6.6 - Capital Costs for Deep Run Drainage Basin CIP	81
6.7 - Capital Costs For Secondary American Central System Improvements	83
6.8 - Capital Costs For Massaponax Creek Drainage Basin CIP	87
6.9 - Capital Costs For Secondary Massaponax Creek Drainage Basin Improvements	88
6.10 – Capital Costs for Courthouse Area CIP	90
6.11 – Estimated Capital Costs For Secondary Courthouse Area Improvements	90
6.12 - Massaponax Wastewater Treatment Plant Build-out Capacity Requirements	91
6.12 - Costs of Massaponax Wastewater Treatment Plant Expansion	91
6.14 - Summary of Sewer System CIP Projects and Capital Costs	92
7.1 - Water Pressure Zones	93
7.2 - City and County Water Pumping Facilities	94
7.3 - Water Storage Tanks, Spotsylvania County and City of Fredericksburg	95
7.4 - Effective Finished Water Storage For 1999 Conditions	97
7.5 - Effective Finished Water Storage For Build-Out Conditions	98
7.6 - Fire Flow Calculations	100
7.7 - Needed Fire Flow For One and Two Family Dwellings	100
7.8 - Recommended Fire Flow Requirements	101
7.9 – Ni River Reservoir Safe Yield	102
7.10 - Estimated Safe Yield of Existing Reservoirs	107
8.1 - Capital Costs For Thornburg Development District Water Distribution Alternatives	109
8.2 – American Central and Five Mile Fork Pressure Zones Finished Water Storage Requirements	111
8.3 – Capital Costs of CIP Water Project	123
10.1 – Water Improvement Area Flows and Estimated Costs	138
10.2 – Sewer Improvement Area Flows and Estimated Costs	139

## List of Figures

	<u>Page</u>
Figure 1 – Water Pressure Zone Hydraulic Grade Lines	9
Figure 2 – Water Demand Hourly Diurnal Pattern	32
Figure 3 – Thornburg Development District Interceptors and Trunk Mains	51
Figure 4 – Hazel Run Drainage Basin Interceptors and Trunk Mains	54
Figure 5 – Deep Run Drainage Basin Interceptors and Trunk Mains	59
Figure 6 – Massaponax Creek Drainage Basin Interceptors and Trunk Mains	70
Figure 7 – Battlefield Zone	110
Figure 8 – American Central and Five Mile Fork Zones	113
Figure 9 – Courtland, College, Mine Road and Downtown Zones	120