

GOOCHLAND COUNTY WATER SUPPLY PLAN

Goochland County's Plan
A portion of the
Regional Water Supply Plan
For
Henrico County, Goochland County,
Powhatan County and Cumberland County



Prepared For:
Goochland County

July 2011



TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	Purpose of the Study	1
1.2	Regional Nature of the Study.....	1
1.3	General Location and Description	1
1.4	Abbreviations and Definitions Used in This Plan.....	2
2.0	EVALUATION OF EXISTING WATER SUPPLY	6
2.1	Existing Water Sources	6
2.2	Community Water Systems Using Groundwater.....	6
2.2.1	Crozier.....	7
2.2.2	Elk Hill Farm	9
2.2.3	Jenkins Trailer Park	10
2.2.4	Manakin Farms	12
2.2.5	Meadows Nursing Center	17
2.3	Community Water Systems Using Surface Water Reservoirs.....	24
2.4	Community Systems Using Stream Intakes.....	24
2.4.1	James River Correctional Center Treatment Plant.....	24
2.5	Non-Agricultural, Self-Supplied Users of More than 300,000 Gallons per Month of Surface Water	32
2.5.1	Hermitage Country Club.....	32
2.5.2	Kinloch Country Club.....	32
2.5.3	Richmond Country Club	33
2.5.4	Royal Virginia Golf Club.....	33
2.5.5	Sycamore Creek Golf Course	33
2.5.6	Luck Stone	34
2.5.7	Martin Marietta Materials – Anderson Creek Quarry.....	34
2.5.8	Vulcan Construction Materials – Royal Stone Plant	34
2.6	Non-Agricultural, Self-Supplied Users of More than 300,000 Gallons per Month of Groundwater	37
2.6.1	Kanawha Club.....	37
2.7	Amount of Ground or Surface Water Purchased from Water Supply Systems Outside the Geographic Boundaries of the County	39
2.7.1	Eastern Goochland Water System	39
2.8	Amount of Water Available to be Purchased from Outside the County from any Source with the Capacity to Withdraw more than 300,000 Gallons per Month of Surface and Groundwater	44

2.9	Agricultural Users Who Utilize More than 300,000 Gallons per Month, Estimate of Total Agricultural Usage by Source, Irrigation vs. Non-Irrigation and Source	44
2.10	Residences and Businesses that are Self-Supplied and Individual Wells Withdrawing less than 300,000 Gallons per Month	45
2.10.1	Self-Supplied Residences.....	45
2.10.2	Self-Supplied Businesses and Public Facilities	47
2.11	Summary of Findings and Recommendations from Source Water Assessment Plans and Wellhead Protection Plans.....	54
3.0	EXISTING WATER USE INFORMATION.....	57
3.1	Community Water Systems	60
3.1.1	James River Correctional Center	60
3.1.2	Goochland Courthouse.....	63
3.1.3	Eastern Goochland Water System	65
3.1.4	Groundwater Community Systems	67
3.2	Self-Supplied Non-Agricultural Users of More than 300,000 Gallons per Month of Surface and Groundwater Within the Service Area of a Community System .	69
3.2.1	Hermitage Country Club.....	69
3.2.2	Kinloch Country Club.....	70
3.2.3	Richmond Country Club.....	71
3.2.4	Sycamore Creek Golf Course	71
3.2.5	Luck Stone	71
3.3	Self-Supplied Agricultural Users of More than 300,000 Gallons per Month of Surface and Groundwater Within the Service Area of a Community System.....	71
3.4	Self-Supplied Users of Less than 300,000 Gallons per Month of Groundwater Within the Service Area of a Community System.....	72
3.5	Self-Supplied Non-Agricultural Users of More than 300,000 Gallons per Month of Surface and Groundwater Outside the Service Areas of the Community Water Systems	72
3.5.1	Kanawha Club.....	73
3.5.2	Royal Virginia Golf Club.....	73
3.5.3	Martin Marietta Materials.....	73
3.5.4	Vulcan Construction Materials	74
3.6	Self-Supplied Agricultural Users of More than 300,000 Gallons per Month of Surface and Groundwater Outside the Service Areas of the Community Water Systems	75
3.7	Estimate of Water used by Self-Supplied Users of Less than 300,000 Gallons per Month of Groundwater and an Outside the Service Areas of the Community Water Systems	76
3.7.1	Self-Supplied Residences.....	76
3.7.2	Self-Supplied Businesses and Public Facilities	76

4.0	EXISTING RESOURCE INFORMATION	79
4.1	Geologic, Hydrologic and Meteorological Conditions	79
4.1.1	Geologic Conditions	79
4.1.2	Hydrologic Conditions.....	82
4.1.3	Meteorological Conditions.....	92
4.2	Existing Environmental Conditions that Pertain to or May Affect In-Stream Flow, In-Stream Uses, and Sources that Provide the Current Supply	93
4.2.1	State or Federal Listed Threatened or Endangered Species or Habitats of Concern	93
4.2.2	Anadromous, Trout and other Significant Fisheries	94
4.2.3	River Segments that have Recreational Significance including Scenic River Status	94
4.2.4	Sites of Historical Significance.....	95
4.2.5	Sites of Archaeological Significance	98
4.2.6	Unusual Geologic Formations or Special Soil Types	100
4.2.7	Wetlands	102
4.2.8	Riparian Buffers.....	102
4.2.9	Conservation Easements	104
4.2.10	Land Use and Land Coverage.....	105
4.2.11	Presence of Impaired Streams and Type of Impairment.....	107
4.2.12	Location of Point Source Discharges.....	108
4.2.13	Other Potential Threats to the Existing Water Quantity and Quality	109
5.0	PROJECTED POPULATION AND WATER DEMANDS	111
5.1	Past Trends.....	111
5.2	Current Conditions.....	112
5.3	Demand Projections Based on Population.....	114
5.3.1	Goochland County and Surrounding Counties	114
5.3.2	Goochland County Growth Rates	117
5.3.3	Population Projections	117
5.3.4	Daily Demand Projections	121
5.3.5	Peak Demand Projections	125
5.3.6	Public and Community System Demands vs. Self-Supplied Demands..	127
5.4	Demand Projections Based on Land Use.....	130
5.4.1	Future Land Use.....	130
5.4.2	Village Land Use Demand Projections.....	131
5.4.3	Land Use Demand by Census Tracts	144
5.4.4	Population and Land Use Projection Comparison	145
5.5	Comparison of Population-Based and Land-Use Based Projections	150
6.0	WATER DEMAND MANAGEMENT	152

6.1	Practices for More Efficient Use of Water	152
6.2	Water Conservation Measures Used in the Planning Area.....	152
6.2.1	Technical Conservation Measures	152
6.2.2	Educational Conservation Measures.....	154
6.2.3	Financial Water Conservation Methods.....	155
6.3	Practices that Address Water Loss.....	156
6.4	Potential Water Savings.....	156
7.0	DROUGHT RESPONSE AND CONTINGENCY PLAN	158
7.1	Drought Declaration and Notice	158
7.2	Drought Stages.....	158
7.2.1	Alert Stage	159
7.2.2	Voluntary Stage	159
7.2.3	Mandatory Stage	160
7.3	Enforcement.....	161
7.4	Other Water Users.....	162
7.4.1	Community Systems and Self-Supplied Groundwater Users	162
7.4.2	Recommendation	163
8.0	STATEMENT OF NEED	164
8.1	Eastern Goochland.....	164
8.2	Courthouse Village and Correctional Center.....	165
8.3	Other Village Areas	165
8.4	Rural Residential Development	166
9.0	ALTERNATIVES ANALYSIS	167
9.1	Eastern Goochland.....	167
9.2	Courthouse Village and Correctional Center.....	167
9.3	Major Village Areas.....	167
9.4	Rural Villages	167
9.5	Regional Solution.....	167
9.6	Reuse.....	168

TABLES

Table 1:	Abbreviations Used.....	2
Table 2:	Crozier Well Yields	8
Table 3:	Crozier Pump Capacities.....	8
Table 4:	Crozier Storage Capacities.....	8
Table 5:	Elk Hill Farm Well Capacity	9
Table 6:	Elk Hill Farm Pump Capacity.....	10
Table 7:	Elk Hill Farm Storage Capacity	10
Table 8:	Jenkins Trailer Park Pump Capacity.....	12
Table 9:	Jenkins Trailer Park Storage Capacity	12
Table 10:	Manakin Farms Well Capacity	16
Table 11:	Manakin Farms Pump Capacity.....	16
Table 12:	Manakin Farms Storage Capacity	17
Table 13:	Manakin Farms Effective Capacity	17
Table 14:	Meadows Nursing Center Well Capacity	20
Table 15:	Meadows Nursing Center Pump Capacity.....	20
Table 16:	Meadows Nursing Center Storage Capacity	21
Table 17:	Meadows Nursing Center Filtration Capacity	21
Table 18:	Summary of Community Groundwater Systems	22
Table 19:	Regulated Dams within Community Systems in Goochland County	24
Table 20:	Population Served by the James River Correctional Center Treatment Plant	25
Table 21:	James River Correctional Center Treatment Plant Filtration Capacity	28
Table 22:	James River Correctional Center Storage Capacity.....	28
Table 23:	Goochland Courthouse Storage Capacity	30
Table 24:	Summary of Water Purchased from Henrico County	41
Table 25:	Eastern Goochland Storage Capacity.....	41
Table 26:	Goochland County Livestock Information	45
Table 27:	Goochland County Crop Information	45
Table 28:	Estimated Population Served by Public or Community Systems	46
Table 29:	Summary of Non-Transient-Non-Community Groundwater Systems	49
Table 30:	Summary of Transient-Non-Community Groundwater Systems	52
Table 31:	Source Water Assessment Areas	54
Table 32:	Community System’s Source Water Susceptibility to Contamination	55
Table 33:	Non-Transient-Non-Community System’s Source Water Susceptibility to Contamination.....	55
Table 34:	Transient-Non-Community System’s Source Water Susceptibility to Contamination.....	56
Table 35:	Goochland County Water Usage Summary	58
Table 36:	James River Correctional Center Treatment Plant Average Daily Production, 2006-2007	61
Table 37:	James River Correctional Center Water Distribution	62
Table 38:	Maximum Daily Production for the James River Correctional Center Treatment Plant	63
Table 39:	Goochland Courthouse Usage, 2006-2007	64
Table 40:	Goochland Courthouse Maximum Daily Demands, 2006-2007.....	64

Table 41:	Goochland Courthouse Disaggregated Water Usage, 2006-2007	65
Table 42:	Eastern Goochland Purchased Water, 2006.....	65
Table 43:	Eastern Goochland Purchased Water, 2007	66
Table 44:	Eastern Goochland Disaggregated Water Usage	67
Table 45:	Water Usage for Community Groundwater Systems, 2006.....	68
Table 46:	Non-Agricultural Self-Supplied Water Use Within a Community System	69
Table 47:	Hermitage Country Club Water Usage for Irrigation, 2006	70
Table 48:	Non-Agricultural Self-Supplied Water Use Outside a Community System.....	72
Table 49:	Martin Marietta Materials Water Usage, 2006	74
Table 50:	Vulcan Construction Materials Water Usage, 2006	74
Table 51:	Goochland County Livestock Water Use	75
Table 52:	Goochland County Crop Water Use	76
Table 53:	Non-Transient-Non-Community Water Use, 2006.....	78
Table 54:	Goochland County Geologic Regions and Rock Types	80
Table 55:	Goochland County Groundwater Recharge Potential.....	85
Table 56:	USGS Stream Gage in Goochland County	86
Table 57:	Sub-Watersheds in Goochland County.....	88
Table 58:	Regulated Dams	91
Table 59:	Historic Places	96
Table 60:	Sites of Archaeological Significance in Goochland County.....	98
Table 61:	Summary of Land Conservation Easements	104
Table 62:	Impaired Waters of Goochland County	107
Table 63:	Waters of Concern of Goochland County.....	108
Table 64:	Point Source Discharge Sites	108
Table 65:	Goochland County's Past Population Trends	111
Table 66:	Surrounding County Growth.....	112
Table 67:	Population and Distribution by Census Tract	114
Table 68:	Historical and Projected Population in Surrounding Counties	115
Table 69:	Historical and Projected Annual Growth Rates in Surrounding Counties.....	115
Table 70:	Projected Population in Goochland County.....	117
Table 71:	Projected Growth Rate Comparison	117
Table 72:	Growth Rates and Population Projections	118
Table 73:	Estimated Adjusted Gross Gallons Per Capita Day	122
Table 74:	Average Daily Water Demand Projections Based on Population.....	123
Table 75:	Peak Water Demand Projections Based on Population	126
Table 76:	Demand Percentage of Community/Self-Supplied Residential Systems.....	127
Table 77:	Demand Projections for Each Community System	129
Table 78:	Land Use Demand Projections for Villages and Established Growth Areas.....	132
Table 79:	Census Tract Land Use Demand Projections.....	145
Table 80:	Average Daily Water Demand Projections (Mid-range Population and Land Use)	151
Table 81:	Water Billing Rates.....	155
Table 82:	Potential Water Savings with a Decrease in Demand.....	157
Table 83:	Drought Stages During November 1 through June 30.....	159
Table 84:	Drought Stages During July 1 through October 31	159
Table 85:	Goochland County Voluntary Water Conservation Measures.....	160

Table 86:	Henrico and Goochland County Mandatory Water Restrictions	161
Table 87:	Water Reuse Opportunities in Virginia.....	169

FIGURES

Figure 1:	Goochland and Surrounding Counties	4
Figure 2:	Goochland County	5
Figure 3:	Community Groundwater Systems	23
Figure 4:	James River Correctional Center Treatment Plant and Courthouse System.....	31
Figure 5:	Non-Agricultural Self-Supplied Surface Water Users.....	36
Figure 6:	Non-Agricultural Self-Supplied Groundwater Users.....	38
Figure 7:	Eastern Goochland Water System	43
Figure 8:	Non-Transient-Non-Community Groundwater Systems	50
Figure 9:	Transient-Non-Community Groundwater Systems	53
Figure 10:	Geological Conditions	81
Figure 11:	Groundwater Hydrology	84
Figure 12:	Surface Hydrology	87
Figure 13:	Major Watersheds	89
Figure 14:	Sub-Watersheds	90
Figure 15:	Architectural Sites.....	97
Figure 16:	Archaeological Sites	99
Figure 17:	Soil Limitations.....	101
Figure 18:	Existing Wetlands	103
Figure 19:	Existing Land Use.....	106
Figure 20:	Point Source Discharge Sites	110
Figure 21:	Goochland County Census Tracts.....	113
Figure 22:	Surrounding County Growth Rates.....	116
Figure 23:	Mid-Range Population Projections by Census Tract	120
Figure 24:	Low, Mid, and High-Range Population Projections for the Entire County.....	121
Figure 25:	Projected Total Water Demands for the Entire County	125
Figure 26:	Eastern Goochland Future Land Use (North)	136
Figure 27:	Eastern Goochland Future Land Use (South)	137
Figure 28:	Hadensville Village Future Land Use.....	138
Figure 29:	Oilville Village Future land Use	139
Figure 30:	Sandy Hook Village Future Land Use	140
Figure 31:	George’s Tavern-Fife Village Future Land Use	141
Figure 32:	Crozier Village Future Land Use	142
Figure 33:	Courthouse Village Future Land Use	143
Figure 34:	Census Tract 4001 Population and Land Use Demand Comparison	146
Figure 35:	Census Tract 4002 Population and Land Use Demand Comparison	147
Figure 36:	Census Tract 4003 Population and Land Use Demand Comparison	148
Figure 37:	Census Tract 4004 Population and Land Use Demand Comparison	149
Figure 38:	Census Tract 4005 Population and Land Use Demand Comparison	150

APPENDICES

- Appendix A: Virginia Department of Health Engineering Description Sheets
- Appendix B: Water Agreement between the Commonwealth of Virginia Department of Corrections and the County of Goochland
- Appendix C: Department of Environmental Quality Water Usage Records
- Appendix D: Water Agreement between the County of Henrico and the County of Goochland
- Appendix E: Residential Well Survey
- Appendix F: Virginia Department of Health Sanitary Survey Reports
- Appendix G: Virginia Department of Health Source Water Assessment Reports