2.0 EVALUATION OF EXISTING WATER SUPPLY

As required by the Regulation[3], current information on existing water sources is detailed in the following sections.

2.1 Existing Water Sources

The residential, commercial, industrial, institutional, and agricultural sectors of Goochland County rely on water from three sources: the James River, purchased water from Henrico County, and groundwater. In total, five community water systems withdraw from a groundwater source and supply water to approximately 1,050 people. The James River Correctional Center withdraws water from the James River and sells water to the Courthouse Village. This system services approximately 1,662 inmates in Goochland County and 392 people in the Courthouse Village. However, the James River Correctional Center Treatment Plant also serves approximately 3,707 inmates in Powhatan County. The Eastern Goochland Water System purchases water from Henrico County and provides water to the Tuckahoe Creek Service District and to the developed areas along River Road. According to the contractual agreement between the two counties, Goochland can purchase up to 25 million gallons of treated surface water per day from Henrico County. Currently, the Eastern Goochland Water System services approximately 1,546 people. The remaining population in Goochland County, approximately 15,431 people, is self-supplied by well systems.

2.2 Community Water Systems Using Groundwater[4]

There are five community water systems in Goochland County that use groundwater. These systems include: Crozier, Elk Hill Farm, Jenkins Trailer Park, Manakin Farms, and Meadows Nursing Center. These community groundwater systems are detailed below and include information concerning the identification number, permit number, well depths, casing depths, water zone levels, well diameters, well yields, pump capacities, storage capacities, treatment capacities, design capacity, and system capacity permitted by the

[3] 9 VAC 25-780-70.
[4] 9 VAC 25-780-70 B.

Virginia Department of Health (VDH). Figure 3 depicts the general location of each community system.

Goochland County does not fall within a Groundwater Management Area and, therefore, groundwater withdrawal permits are not required.

2.2.1 Crozier[5]

The Crozier community water system is located on Route 6, approximately 10.6 miles west of the Goochland-Henrico line within the Crozier Village. The water system is certified as a Class IV system and is owned by Sydnor Hydro, Inc. The permit number for the system is 4075100-A; the permit was last issued October 7, 1997. The waterworks includes two drilled wells, corrosion control facilities, and one 5,000-gallon hydropneumatic tank. One of the drilled wells is no longer in use. The design capacity of the Crozier system allows for the 24 existing connections, which includes one restaurant.

Well No. 1-A is currently connected to the waterworks, but is no longer in use or included in the operation permit.

Well No. 1 is located in the center of a 6-feet x 6-feet x 6-inch pad and is located approximately 15 feet from the well house. It is constructed from a 10-inch hole drilled to a depth of 39 feet, and a 6-inch hole from 39 feet to 465 feet in depth. The depth of the well was extended from 79 feet to 465 feet in July 1996. A 6-inch casing is installed from +2 feet to 39 feet in depth, and the well is grouted with neat cement from ground level to a depth of 39 feet. When originally drilled in 1955, this well yielded 5.5 gpm after 1.5 hours of continuous pumping. A yield and drawdown test was not conducted in 1996 when the well was deepened, but the driller recorded that the well had a yield exceeding 30 gpm. A 3-HP submersible pump, rated at 20 gpm at 347 feet TDH, delivers water from the well to the corrosion control facilities and the 5,000-gallon hydropneumatic tank. The

[5] Virginia Department of Health Engineering Description Sheet dated September 26, 1997. See **Appendix A**.

well pump had an instantaneous output of 21 gpm during an inspection on September 29, 1997. It operates between tank pressures of 48 and 60 psi.

Design Criteria:

Well No. 1 has a yield of 24,000 gpd and Well No. 1A is not in use. The following table reveals the source capacity of each well in the Crozier groundwater system.

Table 2: Crozier Well Yields[6]

Well ID	Well Yield	
	(gpm)	(gpd)
Well No. 1	30	24,000
Well No. 1A	NA	NA
	Total	**24,000**

The pump for Well No. 1 is rated at 20 gpm at 347 feet TDH and has a capacity of 16,000 gpd. The following table depicts the pumping capacity for each well in the Crozier system.

Table 3: Crozier Pump Capacities[7]

Pump	Pump Capacity	
	(gpm)	(gpd)
Well No. 1	20	16,000
Well No. 1A	NA	NA
	Total	**16,000**

The storage facility for the Crozier system is a single 5,000-gallon hydropneumatic tank. The total effective storage is 3,200 gpd as shown below.

Table 4: Crozier Storage Capacities[8]

Storage Units	Quantity	Storage Volume (gal)	Effective Storage Volume (gal)	System Design Capacity Based on Storage (gpd)
Hydropneumatic Tank	1	5,000	1,667	3,200

The capacity of the caustic soda feed system is 0.345 gpd. The capacity of the orthophosphate-polyphosphate feed system is 0.018 gpd. Both of these treatment feed systems are adequate for the system.

[6] Well Yield = gpm ÷ 0.5 gpm/ERC x 400 gpd/ERC.
[7] Pump Capacity = gpm ÷ 0.5 gpm/ERC x 400 gpd/ERC.
[8] Effective Storage Capacity = Effective Storage Volume ÷ 200 gal/ERC x 400 gpd/ERC.

The effective capacity of the system is limited by the storage capacity, which allows for a maximum usage of 8 ERCs or 3,200 gpd. However, the system is permitted by the Virginia Department of Health for the existing 23 ERCs and one restaurant.

2.2.2 Elk Hill Farm[9]

The Elk Hill Farm waterworks is located on Route 608, approximately 10.6 miles west of Route 522 at Goochland Courthouse and approximately one mile west of Route 606 at George's Tavern. This community system is owned by Elk Hill Farm, Inc. The permit number is for the system is 4075200; the permit was last amended on February 4, 2000. The waterworks includes one drilled well, one 10,000-gallon gravity storage tank, two 3-HP booster pumps, and one 5,000-gallon hydropneumatic tank with appropriate appurtenances. The Elk Hill Farm waterworks has a design capacity of 12,800 gpd.

The well was constructed from an 11-inch hole drilled to a depth of 108 feet with a 6-inch hole extended from 108 feet to 305 feet in depth. A 6-inch casing was installed from +2 feet to 108 feet in depth, and the well was grouted with neat cement from ground level to the same depth. This well yielded 11.5 gpm after 24 hours of continuous pumping in a test conducted in October 1973. A more recent 12-hour pump test conducted on July 31, 1998 revealed a well yield of 16.5 gpm.

Design Criteria:

The well yield for the Elk Hill Farm well is 13,200 gpd. The following table reveals the source capacity for the Elk Hill Farm well.

Table 5: Elk Hill Farm Well Capacity[10]

Well ID	Well Yield	
	(gpm)	(gpd)
Well	16.5	13,200

[9] Virginia Department of Health Engineering Description Sheet dated January 27, 2000. See Appendix A.
[10] Well Yield = gpm ÷ 0.5 gpm/ERC x 400 gpd/ERC.

The instantaneous output was 16 gpm on December 21, 1999. The total capacity for the well pump is 12,800 gpd. The two 3-HP pumps in parallel operation have a capacity of 44,000 gpd. The following table depicts the pumping capacity for the well in the Elk Hill system.

Table 6: Elk Hill Farm Pump Capacity[11]

Pump	Pump Capacity	
	(gpm)	(gpd)
Well	16	12,800

The storage capacity of the system includes one 10,000-gallon gravity storage tank with an effective storage volume of 7,738 gallons, and one 5,000-gallon hydropneumatic tank with an effective storage volume of 1,667 gallons. The system's effective storage capacity is tabulated below.

Table 7: Elk Hill Farm Storage Capacity[12]

Storage Units	Quantity	Storage Volume of Each Unit (gal)	Combined Effective Storage Volume (gal)	System Design Capacity Based on Storage (gpd)
Gravity Storage Tank	1	10,000	7,738	15,476
Hydropneumatic Tank	1	5,000	1,667	3,334
			Total	**18,810**

The effective capacity of the system is limited by the well pump capacity, which allows for a maximum usage of 32 ERCs or 12,800 gpd. Hence, the waterworks is permitted by the Virginia Department of Health to a maximum usage of 12,800 gpd.

2.2.3 Jenkins Trailer Park [13]

The Jenkins Trailer Park waterworks is located on Route 6, approximately 0.4 miles past its intersection with US Route 522 North, on the left side of the road. Frederick P. Jenkins is the owner of the waterworks system. The permit number is 4075420, and was last amended on July 7, 1999. This waterworks consists of two bored wells, two 86-gallon bladder tanks, two 82-gallon bladder tanks, chlorination facilities, and corrosion control facilities. Each well is equipped with

[11] Pump Capacity = gpm ÷ 0.5 gpm/ERC x 400 gpd/ERC.
[12] Effective Storage Capacity = Effective Storage Volume ÷ 200 gal/ERC x 400 gpd/ERC.
[13] Virginia Department of Health Engineering Description Sheet dated June 30, 1999. See **Appendix A.**

a well pump which delivers water to the four bladder tanks, and then to the distribution system. The design capacity for the Jenkins Trailer Park waterworks is limited to 52 trailer connections.

Well No. 1 was constructed from a hole of unknown diameter to a depth of 60 feet. A 36-inch diameter casing is installed from +2 to 60 feet in depth. This well is grouted with cement from ground level to a depth of 32 feet. No other well construction data is available. The well yield and pump capacity for Well No. 1 is also unknown. During an inspection on July 30, 1998, the instantaneous output of Well No. 1 was 12 gpm.

Well No. 2 was constructed from a hole of unknown diameter to a depth of 40 feet. A 36-inch diameter casing is installed from +2 to 40 feet in depth. The well is grouted with cement from ground level to a depth of 20 feet. No other well construction data is available. Also, no data is available on the well yield. Well No. 2 is equipped with a 0.5-HP submersible pump. During an inspection on July 30, 1998, the instantaneous output of Well No. 2 was 9 gpm.

The chlorination equipment includes a 50-gallon polyethylene solution tank and a diaphragm feed pump with a maximum feed rate of 12 gpd. The Aqua-Mag feed equipment includes a 55-gallon polyethylene solution tank and a diaphragm feed pump with a maximum feed rate of 3 gpd.

The chlorine and Aqua-Mag are both injected upstream of the bladder tanks, with Aqua-Mag injected ahead of the chlorine. Both diaphragm pumps automatically operate whenever the well pumps are operating. Sample taps are included upstream and downstream of the chemical injection points.

Design Criteria:

The well yields for the system are unknown. However, the combined pump capacity for the system is 16,800 gpd. The table below depicts the observed instantaneous outputs for each well in the Jenkins Trailer Park system.

Table 8: Jenkins Trailer Park Pump Capacity[14]

Pump	Pump Capacity	
	(gpm)	(gpd)
Well No. 1	12	9,600
Well No. 2	9	7,200
	Total	**16,800**

The Jenkins Trailer Park waterworks system contains four bladder storage tanks. Two of the bladder tanks have a volume of 86 gallons, with an effective storage volume of 29 gallons each. The other two bladder tanks have a storage volume of 82 gallons, with an effective storage volume of 27 gallons each. The total effective storage capacity for the system is 224 gpd. However, the storage capacity is considered to be equivalent to 1 ERC or 400 gpd. The following table reveals the storage capacity for each storage unit in the Jenkins Trailer Park system.

Table 9: Jenkins Trailer Park Storage Capacity[15]

Storage Units	Quantity	Storage Volume of Each Unit (gal)	Combined Effective Storage Volume (gal)	System Design Capacity Based on Storage (gpd)
Bladder Tank	2	86	58	116
Bladder Tank	2	82	54	108
			Total	**224**

The effective capacity of the system is limited by the total effective storage capacity to a maximum usage of 1 ERC or 400 gpd. However, the amended operation permit from the Virginia Department of Health allows for the existing 52 trailer connections.

2.2.4 Manakin Farms[16]

The Manakin Farms waterworks is located on Route 6, approximately 5.8 miles west of the Goochland-Henrico County line within the Manakin Village. The permit number is 4075500; the permit was last amended on July 26, 1999. This waterworks consists of five drilled wells, one 30,000-gallon and one 20,000-gallon ground storage tank, two 7.5-HP booster pumps, two 5,000-gallon

[14] Pump Capacity = gpm ÷ 0.5 gpm/ERC x 400 gpd/ERC.
[15] Effective Storage Capacity = Effective Storage Volume ÷ 200 gal/ERC x 400 gpd/ERC.
[16] Virginia Department of Health Engineering Description Sheet dated July, 16, 1999. See **Appendix A.**

hydropneumatic tanks, two 119-gallon and two 42-gallon bladder tanks, chlorination, iron and manganese removal, and corrosion control treatment. Two other wells in the system are presently deactivated. The design capacity for the Manakin Farms system is limited to 170 ERCs or 68,000 gpd.

Well No. 2 is located in a small brick structure behind 121 Willway Drive and is currently disconnected from the system.

Well No. 4 is located behind the home at 114 Holly Drive. The well is constructed from a 10-inch hole drilled to a depth of 50 feet and a 6-inch hole extending from 50 feet to 190 feet in depth. A 6-inch casing is installed from +2 feet to 78 feet in depth, and the well is grouted with cement from ground level to 50 feet in depth. This well yielded 5 gpm with 142 feet of drawdown after 12 hours of continuous pumping in a test conducted on October 1, 1996. A 1-HP submersible pump with an unknown rating delivers the water through two cartridge filters and a 42-gallon bladder tank, and then to the distribution system. The well pump's observed output was 3 gpm during an inspection on July 13, 1999.

Well No. 5 is located behind a home on Birch Circle, at the northeast end of the subdivision. This well is also currently disconnected from the system.

Well No. 6 is located on the west side of Willway Drive, approximately 150 feet beyond its intersection with Sawdust Drive. The well is constructed from a 10-inch hole drilled to a depth of 64 feet and a 6-inch hole extending from 64 feet to 320 feet in depth. The well is cased with 6-inch casing from +2 feet to 51 feet and from 61 to 64 feet in depth. It is screened from 51 feet to 61 feet in depth. The well is gravel packed from 50 to 64 feet in depth, and is grouted with cement from ground level to a depth of 50 feet. This well yielded 21.5 gpm with 41 feet of drawdown after 12 hours of continuous pumping in a test conducted on June 7, 1999. A 2-HP submersible pump with an unknown rating discharges water into the on-site 5,000-gallon hydropneumatic tank, and then into the distribution system. The well pump output was 21 gpm during an inspection on July 13, 1999.

Well No. 7 is located on Maple Drive, near its intersection with Willway Drive. The well is constructed from a 13-inch hole drilled to a depth of 18 feet, an 11.5-inch hole extending from 18 feet to 29 feet, a 10-inch hole extending from 29 feet to 55 feet in depth, and a 6-inch hole extending from 55 feet to 603 feet in depth. A 6-inch steel casing is installed from +1 feet to 55 feet in depth, and the well is grouted with neat cement from ground level to a depth of 55 feet. The water zones are at depths of 495 to 497 feet and 540 to 543 feet. This well yielded 28 gpm with 140 feet of drawdown after 12 hours of continuous pumping in a test conducted on October 3, 1996. It reportedly yielded 30 gpm for 26 continuous hours on October 12, 1998 in a simultaneous test with future Well No. 10, but no water level data was collected during the test.

Water from Well No. 7 is pumped by a 3-HP submersible, rated at 31 gpm at 200 feet TDH, into the 30,000-gallon and 20,000-gallon ground storage tanks. Operation of the well pump is controlled by electrodes set at 28 feet and 29 feet, respectively, above the bottom of the tanks. The well pump is also capable of pumping 18.5 gpm at 318 TDH (tank pressure of 60 psi) directly to the hydropneumatic tank. The well pump output was 46 gpm at the system head conditions during an inspection on July 13, 1999.

A 10-HP and a 7.5-HP booster pump transfer water from the ground storage tanks into the 5,000-gallon hydropneumatic tank, and then into the distribution system. The 10-HP pump and the 7.5-HP pump are rated at 200 gpm at 137 feet TDH and 75 gpm at 130 feet TDH, respectively, at a hydropneumatic tank pressure of 68 psi. The two pumps operating together are rated at 245 gpm at 136 TDH, at a hydropneumatic tank pressure of 68 psi. Lead-lag pressure switches on the hydropneumatic tank set at 68-78 psi and 66-76 psi, respectively, control them. The lead-lag sequence is manually alternated. Low level electrodes in the ground storage tanks set at 3.0 feet and 4.5 feet, respectively, from the tank bottom, deactivate and re-activate the booster pumps, if needed. A 0.5-HP air compressor helps to maintain the proper air to water ratio in the tank. Operation of the air

compressor is controlled by a mercoid float set at the center of the pressure tank and by a pressure switch set at 70-80 psi.

Well No. 8 is located approximately 650 feet west of the end of the cul-de-sac on Dogwood Drive. It is constructed from a 10-inch hole drilled to a depth of 102 feet and a 6-inch hole extending from 102 feet to 600 feet in depth. A 6-inch steel casing is installed from +2 feet to 70 feet in depth, and the well is grouted with neat cement from ground level to a depth of 70 feet. Bedrock was encountered at a depth of 69 feet. The water zone is from 71 to 72 feet in depth. This well yielded 9 gpm with 42 feet of drawdown after 12 hours of continuous pumping in a test completed on October 1, 1996. A 1-HP submersible pump, rated at 9 gpm at 270 feet TDH, delivers the water from the well to the 42-gallon bladder tank, and then to the distribution system. The well pump output was 10 gpm during an inspection on July 13, 1999.

Well No. 9 is located on the west side of Hermitage Road, at its intersection with Elm Creek Drive. The well is constructed from a 10-inch hole drilled to a depth of 52 feet, with a 6-inch hole extending from 52 feet to 450 feet in depth. A 6-inch casing is installed from +2 feet to 52 feet in depth. The well is grouted with neat cement from ground level to a depth of 52 feet. Bedrock was encountered at a depth of 20 feet. This well yielded 25 gpm after 48 hours of continuous pumping, with a drawdown of 238 feet, in a test completed on May 22, 1996. A 7.5-HP submersible pump, rated at 23 gpm at 500 feet TDH, transfers water from the well to two 119-gallon (26 inch diameter, 62 inch height) bladder tanks, and then to the distribution system. The well pump output was 24 gpm at a tank pressure of 80 psi during an inspection on July 13, 1999.

Design Criteria:

The combined well yield for all five active wells within the Manakin Farms system is 71,200 gpd. The table below depicts the well yield for each well in the Manakin Farms system.

Table 10: Manakin Farms Well Capacity[17]

Well ID	Well Yield	
	(gpm)	(gpd)
Well No. 4	5	4,000
Well No. 6	22	17,600
Well No. 7	28	22,400
Well No. 8	9	7,200
Well No. 9	25	20,000
	Total	**71,200**

The combined pump capacity for the system is 83,200 gpd. The table below depicts the pumping capacity of each well in the Manakin Farms system.

Table 11: Manakin Farms Pump Capacity[18]

Pump	Pump Capacity	
	(gpm)	(gpd)
Well No. 4	3	2,400
Well No. 6	21	16,800
Well No. 7	46	36,800
Well No. 8	10	8,000
Well No. 9	24	19,200
	Total	**83,200**

The storage capacity of the system includes a 30,000 and a 20,000-gallon gravity storage tank with effective storage volumes of 25,805 gallons and 18,209 gallons, respectively. The system also contains two 5,000-gallon hydropneumatic tanks with each having an effective storage volume of 1,667 gallons. Four bladder tanks are also connected to the system. Two of the tanks contain a storage volume of 119 gallons and the other two bladder tanks contain a storage volume of 42 gallons. The effective storage volumes of the bladder tanks are 40 gallons and 14 gallons, respectively. The total effective storage capacity for the system is 94,912 gpd. The storage capacity for each storage unit in the Manakin Farms system is tabulated below.

[17] Well Yield = gpm ÷ 0.5 gpm/ERC x 400 gpd/ERC.
[18] Pump Capacity = gpm ÷ 0.5 gpm/ERC x 400 gpd/ERC.

Table 12: Manakin Farms Storage Capacity[19]

Storage Units	Quantity	Storage Volume of Each Unit (gal)	Combined Effective Storage Volume (gal)	System Design Capacity Based on Storage (gpd)
Gravity Storage Tank	1	30,000	25,805	51,610
Gravity Storage Tank	1	20,000	18,209	36,418
Hydropneumatic Tank	2	5,000	3,334	6,668
Bladder Tank	2	119	80	160
Bladder Tank	2	42	28	56
			Total	**94,912**

The effective capacity for each well is limited by either the source capacity or the pump capacity, whichever is lower. The total effective capacity for the system allows for a maximum usage of 170 equivalent residential connections or 68,000 gpd. The following table depicts the limiting factor for each well.

Table 13: Manakin Farms Effective Capacity[20]

Well ID	Well Yield		Pump Capacity		Effective Capacity (gpd)
	(gpm)	(gpd)	(gpm)	(gpd)	
Well No. 4	5	4,000	3	**2,400**	**2,400**
Well No. 6	22	17,600	21	**16,800**	**16,800**
Well No. 7	28	**22,400**	46	36,800	**22,400**
Well No. 8	9	**7,200**	10	8,000	**7,200**
Well No. 9	25	20,000	24	**19,200**	**19,200**
				Total	**68,000**

Based on the effective capacity of the system, the Manakin Farms waterworks is permitted by the Virginia Department of Health for a maximum usage of 68,000 gpd.

2.2.5 Meadows Nursing Center[21]

The Meadows Nursing Center waterworks is located on Route 614, which is approximately 2.9 miles west of the intersection of Route 6 and US Route 522. The permit number for the Meadows Nursing Center waterworks is 404499; the permit was last amended on September 7, 2000. This water system includes one drilled well, one 29,600-gallon gravity storage tank, one 5,000-gallon hydropneumatic tank, two 5-HP booster pumps, iron and manganese treatment,

[19] Effective Storage Capacity = Effective Storage Volume ÷ 200 gal/ERC x 400 gpd/ERC.
[20] Limiting factors are shown in bold.
[21] Virginia Department of Health Engineering Description Sheet dated August 29, 2000. See **Appendix A**.

and corrosion control treatment. The capacity of this waterworks is limited to 97 ERCs or 14,400 gpd.

The well is constructed from a 9.875-inch hole drilled to a depth of 84 feet and an 8.75-inch hole extending from 84 feet to 306 feet in depth. Bedrock was encountered at a depth of 80 feet. The well is cased with 6.25-inch steel casing from +2 feet to a depth of 84 feet. The well is grouted with neat cement from ground level to 84 feet in depth. In a test completed on March 30, 1989, the well yielded 42 gpm with 170 feet of drawdown after 48 hours of continuous pumping

A 3-HP submersible pump, rated at 31 gpm at 280 feet TDH, delivers the well water into the 29,600-gallon gravity storage tank via the iron and manganese treatment system and the corrosion control system. The well pump is controlled by on-off rod electrodes in the gravity storage tank, set at 33 feet and 34 feet respectively, above the bottom of the tank. The well pump is also capable of pumping 18 gpm at 380 feet TDH (includes 60 psi discharge pressure) to the hydropneumatic tank or the distribution system during periods when the gravity storage tank is out of service. The observed output of the well pump was 18 gpm during an inspection on August 28, 2000.

The iron and manganese treatment facilities include a 13-inch x 54-inch pressure aerator tank, a 360-gallon (3 feet diameter; 8 feet high) detention tank for settling of the precipitate, and two 24-inch x 71-inch multi-media filters. The filter media consists of equal volumes of aluminum sulfate, aluminum sulfate coated with magnesium oxide, and calcium carbonate (white marble). Flow control valves limit the flow rate to each filter to 9 gpm (3 gpm/ft^2).

The multi-media filters are backwashed with water from the hydropneumatic tank at a controlled rate of 30 gpm (9.55 gpm/ft^2) for a design time of 32 minutes per filter. The filter backwash wastes are settled in a 1,200-gallon settling tank. Supernatant from the tank is discharged to a nearby drainage swale.

The corrosion control facilities include feed equipment for solutions of phosphate (Aqua-Mag) and caustic soda. Each feed system includes a solution tank and a diaphragm feed pump with a maximum feed rate of 1 gph. The solution tank size is 55 gallons for caustic soda and 15 gallons for phosphate. The solution pumps operate simultaneously with the well pump. The injection points for the two chemical feed systems are located downstream of the iron and manganese treatment units and upstream of the gravity storage tank. Sample taps are installed upstream and downstream of the injection points for the two corrosion control chemicals.

The storage facilities for the system include a 29,600-gallon gravity storage tank and a 5,000-gallon hydropneumatic tank. The 29,600-gallon gravity storage tank is 12 feet in diameter and 35 feet in height. It provides an effective storage capacity of 20,295 gallons allocated for fire storage and 9,305 gallons allocated for potable water storage. Both the ground storage tank and hydropneumatic tank may be bypassed if necessary for maintenance and/or repairs.

Two 5-HP booster pumps with 6-inch impellers transfer water from the gravity storage tank into the 5,000-gallon hydropneumatic tank and then into the distribution system. The two pumps are each rated at 75 gpm at 138 feet TDH. Operating in parallel, the two pumps have a rated capacity of 140 gpm at 140 feet TDH.

The lead booster pump turns on when the hydropneumatic tank pressure drops to 45 psi. If the tank pressure continues to drop, the lag pump turns on when it reaches 35 psi. Both pumps shut off when the tank pressure reaches 60 psi. If the water level reaches the midpoint of the tank before the shut-off pressure is reached, both pumps are shut off by a mercoid switch. The 0.75-HP air compressor then turns on, and operates until the tank pressure is raised to 60 psi. The lead-lag sequence of the booster pumps automatically alternates after each pumping cycle.

A water level rod electrode set at 24 feet above the bottom of the gravity storage tank shuts the booster pump off to reserve the water in the tank allocated for fire protection. Another electrode set at 25 feet above the tank bottom reactivates the booster pump when needed.

A 25-HP booster pump is installed in the pump house to meet fire flow demands. It is rated at 300 gpm at 75 feet TDH with an efficiency of 65%. With an effective fire storage capacity of 20,295 gallons, this pump provides fire pumping capacity for approximately 68 minutes.

Design Criteria:

The single well in the waterworks has a yield of 33,600 gpd. The following table reveals the source capacity for the Meadows Nursing Center well.

Table 14: Meadows Nursing Center Well Capacity[22]

Well ID	Well Yield	
	(gpm)	(gpd)
Well	42	33,600

The total effective pumping capacity for the Meadows Nursing Center is 14,400 gpd. The table below depicts the pumping capacity of the Meadows Nursing Center well.

Table 15: Meadows Nursing Center Pump Capacity[23]

Pump	Pump Capacity	
	(gpm)	(gpd)
Well	18	14,400

The storage capacity of the system includes a 5,000-gallon hydropneumatic tank with an effective storage volume of 1,667 gallons. The system also contains a 29,600-gallon gravity storage tank, which allocates only 9,305 gallons of its total effective storage to potable water storage. The total effective storage capacity for the system is approximately 22,000 gpd. The following table depicts the storage capacity for each storage unit in the Meadows Nursing Center system.

[22] Well Yield = gpm ÷ 0.5 gpm/ERC x 400 gpd/ERC.
[23] Pump Capacity = gpm ÷ 0.5 gpm/ERC x 400 gpd/ERC.

Table 16: Meadows Nursing Center Storage Capacity[24]

Storage Units	Quantity	Storage Volume of Each Unit (gal)	Combined Effective Storage Volume (gal)	System Design Capacity Based on Storage (gpd)
Hydropneumatic Tank	1	5,000	1,667	3,334
Gravity Storage Tank	1	29,600	9,305	18,610
			Total:	**21,944**

The filtration capacity for the system containing two sand filters is approximately 15,000 gpd. The following table depicts the filtration capacity for each filter in the system.

Table 17: Meadows Nursing Center Filtration Capacity[25]

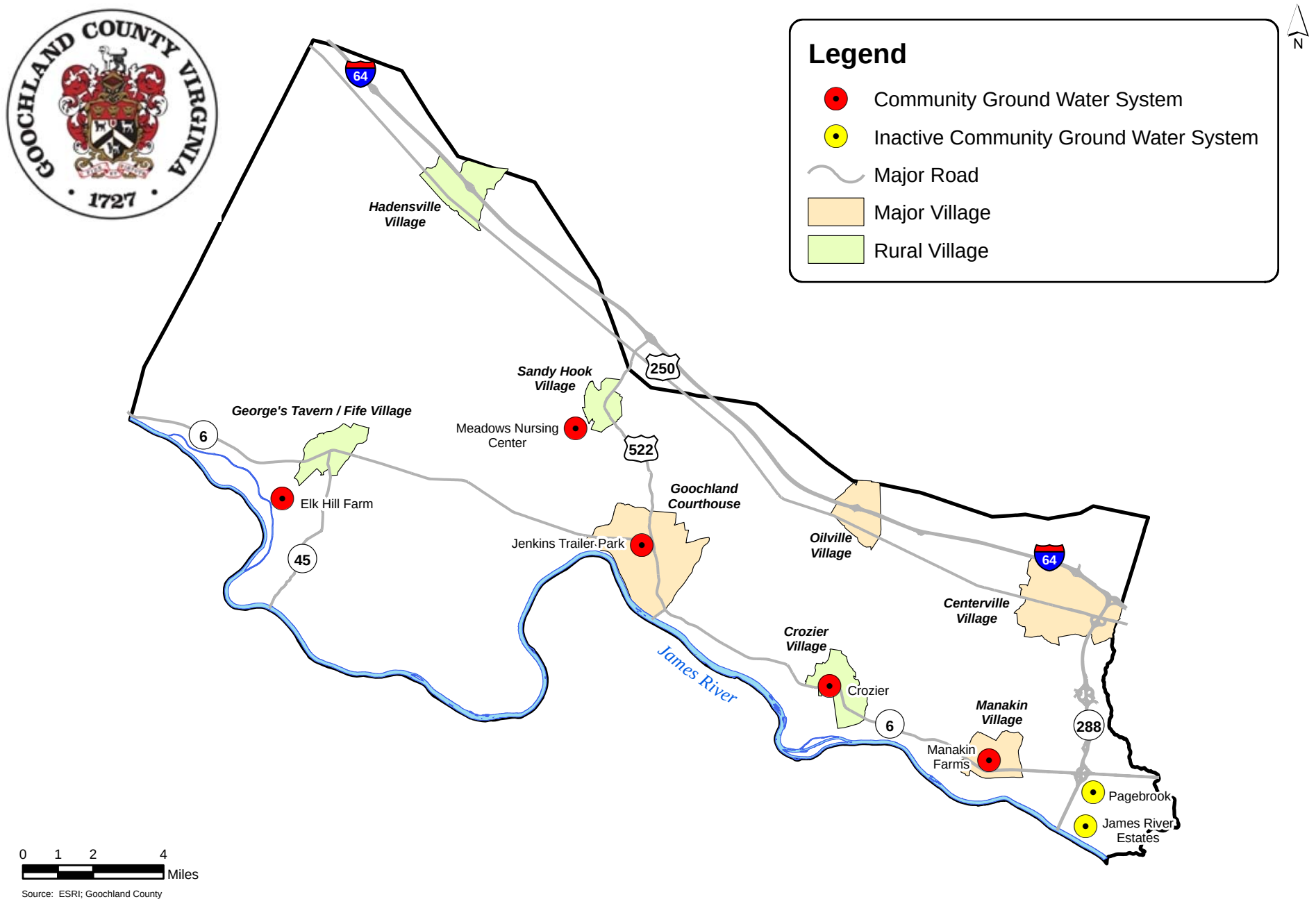
Filter Diameter (in)	Filter Area (ft^2)	Filtration Rate (gpm/ft^2)	Filtration Capacity (gpm)	Filtration Capacity (gpd)
24	3.14	3	9.42	7,536
24	3.14	3	9.42	7,536
			Total:	**15,072**

The effective capacity of the Meadows Nursing Center waterworks system is limited by the well pump capacity and the filtration capacity, which allows for maximum usage of 97 residents or 14,400 gpd. The waterworks is permitted by the Virginia Department of Health to a maximum usage of 14,000 gpd.

[24] Effective Storage Capacity = Effective Storage Volume ÷ 200 gal/ERC x 400 gpd/ERC.
[25] Filtration Capacity = Filtration Capacity (gpm) ÷ 0.5 gpm/ERC x 400 gpd/ERC.

Table 18: Summary of Community Ground Water Systems

FACILITY NAME	LOCATION/ADDRESS	FACILITY (R, Ag, Com, Ind, CW, M)	ACTIVE (A) INACTIVE (I)	POPULATION SERVED	WATER SOURCE	WELL TYPE (Bored or Drilled)	WELL DEPTH	DEPTH TO BEDROCK	OPEN BOREHOLE (NO SCREEN)		CASING SIZE	CASING DEPTH (FT)		WELL YIELD	PUMP CAPACITY	STORAGE CAPACITY	EFFECTIVE CAPACITY	PERMITTED CAPACITY	TAX MAP NUMBER	VDH PERMIT ID
							(FT)	(FT)	FROM (FT)	TO (FT)	(INCHES)	FROM	TO	(GPD)	(GPD)	(GPD)	(GPD)	(GPD)		
Crozier	W on Rt 6, approx 10.6 mi past Goochland/Henrico line, left on dirt road, just beyond Crozier Post Office, well is on the left side of dirt road, 100 yds from intersect with Rt 6	CW	A	72	Well	D	465	39	39	465	6	+2	39	24,000	16,000	3,200	3,200	23 ERC, 1 Restaurant	55-1-0-89-0	4075100-A
Elk Hill Farm	Rt 6 to Rt 608, Rt 608 is approx 10.6 mi W of US 522 (N) at Goochland Courthouse, approx 1.0 mi. W of Rt 606 at George's Tavern, turn L (S) on Rt 608 and go approx 1.5 mi, entrance road on L	CW	A	125	Well	D	305	108	108	305	6	+2	108	13,200	12,800	18,800	12,800	32 ERC	26-1-0-28-A	4075200
Jenkins Mobile Home Park (Well 1)	W on Rt 6 to Goochland Courthouse, the trailer park is on Rt 6, approx 0.4 mi past the intersect with 522 N on the L side of the road	CW	A	100	Well	B	60	---	—	---	36	+2	60	---	9,600	400	400	52 ERC	42-1-0-62-0	4075420
Jenkins Mobile Home Park (Well 2)		CW	A		Well	B	40	---	---	---	36	+2	40	---	7,200				42-1-0-62-0	4075420
Manakin Farms (Well 4)	W on Rt 6, approx 5.8 mi past Goochland-Henrico line, turn R on Willway Drive (Rt 662). Public water supply owned by Sydnor.	CW	A	585	Well	D	190	---	50	190	6	+2	78	4,000	2,400	94,800	68,000	170 ERC	62-4-E-11-A	4075500
Manakin Farms (Well 6)		CW	A		Well	D	320	---	64	320	6	+2	64	17,600	16,800				62-2-B-18-A	4075500
Manakin Farms (Well 7)		CW	A		Well	D	603	---	55	603	6	+ 1	55	22,400	36,800				62-20-D-A-0	4075500
Manakin Farms (Well 8)		CW	A		Well	D	600	69	102	600	6	+2	70	7,200	8,000				62-2-A-4-A	4075500
Manakin Farms (Well 9)		CW	A		Well	D	450	20	52	450	6	+2	52	20,000	19,200				62-32-0-A-1	4075500
Meadows Nursing Center	W on Rt 6 to Rt 614 (Dogtown Rd) approx 2.9 mi past intersection of Rt 6 and US 522 N; R on Dogtown Rd. and go approx 2.8 mi. Nursing center is on the R.	Com	A	172	Well	D	306	80	84	306	6¼	+2	84	33,600	14,400	22,000	14,400	36 ERC	29-1-0-99-0	404499
Hickory Haven (Well 1) (No Longer in Use)	I-64 W to Rockville/Manakin exit (Rt 623), go approx 0.6 mi to US 250, turn R on 250, go about 0.2 mi, turn L, continue S on 623, entrance to subdivision is on Holly Ln (Rt 1006) on L side of 623, 0.2 mi S of US 250	CW	I	---	Well	D	300	50	50	300	6	+2	50	9,600	2,800	6,800	6,800	40 ERC	58-3-A-12-0	NA
Hickory Haven (Well 2) (No Longer in Use)		CW	I		Well	D	180	44	50	180	6	---	---	28,000	4000				58-3-A-12-0	NA
James River Estates (Well 1)	Go W on River Rd., Rt 650, approx 5 mi beyond Henrico County line. Development is on S (L) side of River Rd. just past intersect with Rt649	CW and Purchased Treated	I	219	Well	D	343	38	50	343	6	+2	50	20,000	1,600	26,400	26,400	68 ERC	67-2-B-6-A	4075400
James River Estates (Well 1A)		CW	I		Well	D	400	---	51	400	6	+2	51	4,800	2,400				67-3-G-C-0	4075400
James River Estates (Well 2)		CW	I		Well	D	257	---	51	257	6½	+2	51	15,200	3,200				67-3-G-D-0	4075400
James River Estates (Well 2A)		CW	I		Well	D	200	---	51	200	7	+2	51	3,200	2,400				67-3-G-D-0	4075400
Mary Mother of the Church Abbey (Well #1)		Com	I	---	Well (Auxiliary)	D	516	38	38	51	7	+2	51	2,400	---	---	---	---	66-1-0-2-0	4075725-A
Mary Mother of the Church Abbey (Well #2)		Com	I		Well (Auxiliary)	D	504	40	40	51	7	+2	51.5	10,400	---	---	---	---	66-1-0-2-0	4075725-A
Pagebrook (Well 1)	W on Rt 6, approx 2 mi. past Goochland-Henrico Line, turn L on Rt 647. Well is at NE corner of Rt 647 & Briarwood Drive.	Com	A	60	Well	D	247	27	54	247	6	+2	54	27,600	1,200	22,000	7,200	20 ERC	64-12-C-5-A	400599
Pagebrook (Well 2)	Well #3 is on the R (south side) of Briarwood Drive in a stand of pine trees	Com	A		Well	D	400	---	51	400	6	+2	51	12,800	1,200				64-12-B-14-A	400599
Pagebrook (Well 4)	Well #4 is located at the end of Knollwood Drive, one block S of Briarwood Drive (AquaSource - Owner)	Com	A		Well	D	440	74	81	440	6	+2	81	8,000	4,800				64-1-0-32-A	400599
Samary Forest	I-64 W to Rt 623 (Rockville/Manakin) exit, S (L) on 623 approx 1.1 mi to 250. E on 250, approx 0.3 mi to Whipporwill Drive, R on Whipporwill Drive. Go approx on 0.2 mi, well house access rd on R	CW	I	---	Well	D	98	NA	58	98	6	+2	58	---	4,800	3,200	3,200	15 ERC	58-2-0-5-0	4075710



Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Community Ground Water Systems

Goochland County, Virginia

FIGURE 3

DAA# R07246-01

2.3 Community Water Systems Using Surface Water Reservoirs[26]

According to records provided by the Virginia Department of Health and the Department of Environmental Quality (DEQ), there are no community water systems withdrawing from surface water reservoirs in Goochland County. After reviewing the regulated dams in Goochland County, it became evident that most of the reservoirs in Goochland County are used for recreational purposes. The following table provides a list of the regulated dams within community systems in Goochland County and their purposes.

Table 19: Regulated Dams within Community Systems in Goochland County

Regulated Dam	Community	Purpose
Carneal Pond Dam	James River Correctional Facility	Recreation
Recreation Pond	James River Correctional Facility	Recreation

As shown above, the James River Correctional Facility dams are used for recreational purposes only. There are no other known reservoirs within the community systems of Goochland County. However, there are other regulated dams in Goochland County that are not within community systems. These reservoirs are outlined in **Section 4.1.2.5** of the Plan.

2.4 Community Systems Using Stream Intakes[27]

In Goochland County, the James River Correctional Center Treatment Plant is the only community system that withdraws water from a stream or river. The waterworks serves seven correctional facilities and sells water to the Goochland Courthouse District. The contractual water agreement between the Commonwealth of Virginia Department of Corrections and the County of Goochland can be found in **Appendix B**.

2.4.1 James River Correctional Center Treatment Plant[28]

The James River Correctional Center Treatment Plant is located on Route 6, approximately 1.9 miles west of Crozier. The permit number is 4075735T and was issued February 15, 2008. The system has a design capacity of 1.8 mgd at a filtration rate of 2 gpm/ft^2. This waterworks serves five correctional facilities

[26] 9 VAC 25-780-70 C.
[27] 9 VAC 25-780-70 D.
[28] Virginia Department of Health Engineering Description Sheet dated February 5, 2008. See **Appendix A.**

including: James River Correctional Center, Powhatan Correctional Center and Receiving Unit, Deep Meadow Correctional Center, Virginia Correctional Center for Women, and the Beaumont Juvenile Correctional Center. The James River Correctional Treatment Plant also sells water to the Goochland Courthouse District, which serves 392 customers.[29] The following table depicts the population served at each correctional facility and the Goochland Courthouse District. A map of the James River Correctional Center Treatment Plant and distribution system can be seen in **Figure 4**.

Table 20: Population Served by the James River Correctional Center Treatment Plant[30]

Service Area	Population Served
Goochland County	
James River Correctional Center	673
Virginia Correctional Center for Women	989
Goochland Courthouse	392
Sub-Total	**2,054**
Powhatan County	
Powhatan Correctional Center and Receiving Unit	1,950
Deep Meadow Correctional Center	1,168
Beaumont Juvenile Correctional Center	589
Sub-Total	**3,707**
Total	**5,761**

Of the correctional facilities listed above, only the James River Correctional Center and the Virginia Correctional Center for Women are located in Goochland County. The Powhatan Correctional Center and Receiving Unit, Deep Meadow Correctional Center, and Beaumont Juvenile Correctional Center are located within Powhatan County limits. Of the 5,761 people served by the treatment plant, approximately 1,662 inmates are located in Goochland County. In total, the waterworks serves approximately 2,054 people in Goochland County, which includes the inmates that reside in Goochland County and those served in the Goochland Courthouse District.

[29] Goochland County 2006 County Wide Statistics.

[30] The population served by the James River Correctional Center was estimated based on values from the Virginia Department of Health Engineering Description Sheets and the U.S. Census Bureau's recorded institutionalized population in Goochland County.

The water treatment plant withdraws water from the James River under the Virginia Water Protection Individual Permit No. 02-V2288 with a limit of 2.0 mgd. The intake is on the north side of the James River, approximately 200 feet west of the confluence of Beaverdam Creek and the river. The intake consists of three 18-inch diameter cylindrical tee screens with wedge wire (1-mm slot openings). The screens are cleaned by an air-backwash cleaning system. A 24-inch line conveys the water from the intake to the raw water pumping station.

The raw water is delivered to the treatment plant by two submersible pumps, each rated at 2,292 gpm at 152 feet TDH. Each pump is powered by a 125-HP motor. The raw water is conveyed through approximately 7,000 feet of 16-inch ductile iron pipe to the rapid mix unit at the water treatment plant.

The 6.7 feet x 7.5 feet x 19.5 feet rapid mix basin provides a detention time of 191 seconds at the design flow of 3.3 mgd. Two flocculation and sedimentation basins each have dimensions of 32 feet x 16 feet x 17 feet and provide an overflow rate of 2.25 gpm/ft^2 with a detention time of 44 minutes.

The treatment plant also contains three parallel 14 feet x 14 feet high-rate filters with a design filtration rate of 4.0 gpm/ft^2. The filter media consists of 42-inches of granular activated carbon and 12 inches of sand. A 16-inch ductile iron line conveys the filtered water to three 100,000-gallon steel tanks located in parallel across from the parking lot of the main treatment building.

The finished water is pumped into the distribution system by two parallel 200-HP horizontal split case centrifugal pumps, each rated at 2,083 gpm (3.0 mgd) at 244 feet TDH, through a 12-inch waterline to the 300,000-gallon elevated storage tank located at the James River Correctional Center.

Waterlines from the 300,000-gallon elevated storage tank at James River Correctional Center extend westward to serve the Virginia Correctional Center for Women (VCCW) and the Goochland Courthouse service area; eastward to serve the Training Academy and the Work Release Facility; and southward to serve the

James River Correctional Center. Beaumont Juvenile Correctional Center is served by an 8-inch and 6-inch waterline tied into the waterline extending westward to VCCW. Deep Meadows Correctional Center and Powhatan Correctional Center are served by a 6-inch waterline tied into the 8-inch waterline serving the James River Correctional Center. Flows are monitored by individual meters.

The system has several storage facilities. The James River Correctional Center Water Treatment Plant has a 300,000-gallon elevated tank and three 100,000-gallon clearwells, which are part of the treatment process. The Powhatan Correctional Center has two elevated storage tanks with effective capacities of 200,000 and 100,000 gallons, respectively. The Powhatan Correctional Center also has a concrete ground storage tank with an effective storage volume of 200,000 gallons. The Virginia Correctional Center for Women contains a 300,000-gallon elevated storage tank and the Beaumont Juvenile Correctional Center contains a 200,000-gallon elevated storage tank for their facilities.

Design Criteria:

No safe yield criteria or withdrawal limit has been set by the Virginia Department of Environmental Quality (DEQ) for Beaverdam Creek, the primary source, or the James River, the secondary source.

The raw water pumping capacity is limited by the two submersible pumps each rated at 3.3 mgd at 152 feet TDH. The flocculation and sedimentation basins contain a surface loading rate of 2.25 gpm/ft^2 and a design flow rate of 3.67 mgd.

The filters for the treatment plant have a total treatment area of 588 ft^2 and a surface loading rate of 4.0 gpm/ft^2. The following table reveals the filtration capacity for the James River Correctional Center Treatment Plant.

Table 21: James River Correctional Center Treatment Plant Filtration Capacity[31]

Filter Diameter (ft)	Number of Filters	Filter Area (ft^2)	Filtration Rate (gpm/ft^2)	Filtration Capacity (gpm)	Filtration Capacity (mgd)
14	3	588	4.0	2,352	3.4

The total storage capacity for the James River Correctional Center system is approximately 2.6 mgd. The following table depicts the effective storage capacities of each storage facility in the system.

Table 22: James River Correctional Center Storage Capacity[32]

Storage Units	Quantity	Storage Volume of Each Unit (gal)	Combined Effective Storage Volume (gal)	System Design Capacity Based on Storage (gpd)
On-Site Storage				
Clearwells[33]	3	100,000	300,000	N/A
James River Correctional Center Elevated Storage	1	300,000	300,000	600,000
Off-Site Storage				
Virginia Correctional Center for Women Elevated Storage	1	300,000	300,000	600,000
Powhatan Correctional Center Ground Storage	1	200,000	200,000	400,000
Powhatan Correctional Center Elevated Storage	1	200,000	200,000	400,000
Powhatan Correctional Center Elevated Storage	1	100,000	100,000	200,000
Beaumont Juvenile Correctional Center Elevated Storage	1	200,000	200,000	400,000
			Total	**2,600,000**

This waterworks has a design capacity of 2.0 mgd; however, it is being permitted for a design capacity of 1.8 mgd with a maximum filtration rate of 2 gpm/ft^2.

2.4.2 Goochland Courthouse[34]

The Goochland Courthouse system, which purchases water from the James River Correctional Center Water Treatment Plant, is located on Route 6 just west of its intersection with Route 522, approximately 20 miles west of Richmond. The permit number is 4075280 and was issued May 04, 1995. This waterworks

[31] Filtration Capacity = Filtration Area x Surface Loading Rate x 1,440 min/day.
[32] Effective Storage Capacity = Effective Storage Volume ÷ 200 gal/ERC x 400 gpd/ERC.
[33] The 100,000-gallon clearwells at the James River Correctional Center are part of the treatment process and are not used when determining the Effective Storage Capacity for the system.
[34] Virginia Department of Health Engineering Description Sheet dated April 20, 1995. See **Appendix A.**

includes a 300,000-gallon elevated storage tank that is shared with the Virginia Department of Corrections and a distribution system consisting of 10-inch, 6-inch, and 4-inch waterlines with appropriate appurtenances. The system was limited to 100,000 gpd by a contractual agreement with the James River Correctional Center Treatment Plant that has been increased to 200,000 gpd effective November 2010 and will be increased to 300,000 gpd effective November 2013

There are three wells which formerly served the Goochland Courthouse. These wells are no longer utilized and have been disconnected from the system. The storage facilities associated with these wells are also no longer utilized.

The storage tank is supplied by the 1.8 mgd James River Correctional Center Water Treatment Plant via an 8-inch waterline extending along Route 6 to serve the Virginia Correctional Center for Women (VCCW). The waterline diameter increases to 10-inches in the vicinity of the tank. An altitude valve located at the base of the elevated storage tank allows the tank to fill from system pressure during non-peak usage hours.

The tank has a diameter of approximately 43 feet and an overflow elevation of approximately 29.65 feet above the low water level in the tank. The low water level in the tank is approximately 118.13 feet above the ground level. The over flow level of this tank is approximately 11 feet below the overflow level of the 300,000-gallon tank at the James River Correctional Center Water Treatment Plant, which ensures that water is supplied as needed to the Courthouse elevated tank.

The water agreement between the Commonwealth of Virginia Department of Corrections and the County of Goochland is included in **Appendix B**. The provisions of the water agreement include[35]:

- The Department of Corrections will permit the County of Goochland to make a connection at the county's expense to the existing water supply lines from the James River Correctional Center to serve the

[35] Contractual Water Agreement between the Virginia Department of Corrections and the County of Goochland dated June 23, 1989. See **Appendix B.**

storage tank. This water will be metered and paid for by the County of Goochland at a rate found mutually agreeable.

- The Department of Corrections intends to correct existing difficulties with the waterworks system and to insure improved services in the Goochland Courthouse area.
- Goochland County has determined that the contract is in the best interest of the residents in the Goochland Courthouse and surrounding area.

Design Criteria:

The James River Correctional Center has an effective capacity of 1.8 mgd; 300,000 gpd are allocated to Goochland County to serve the Goochland Courthouse District.

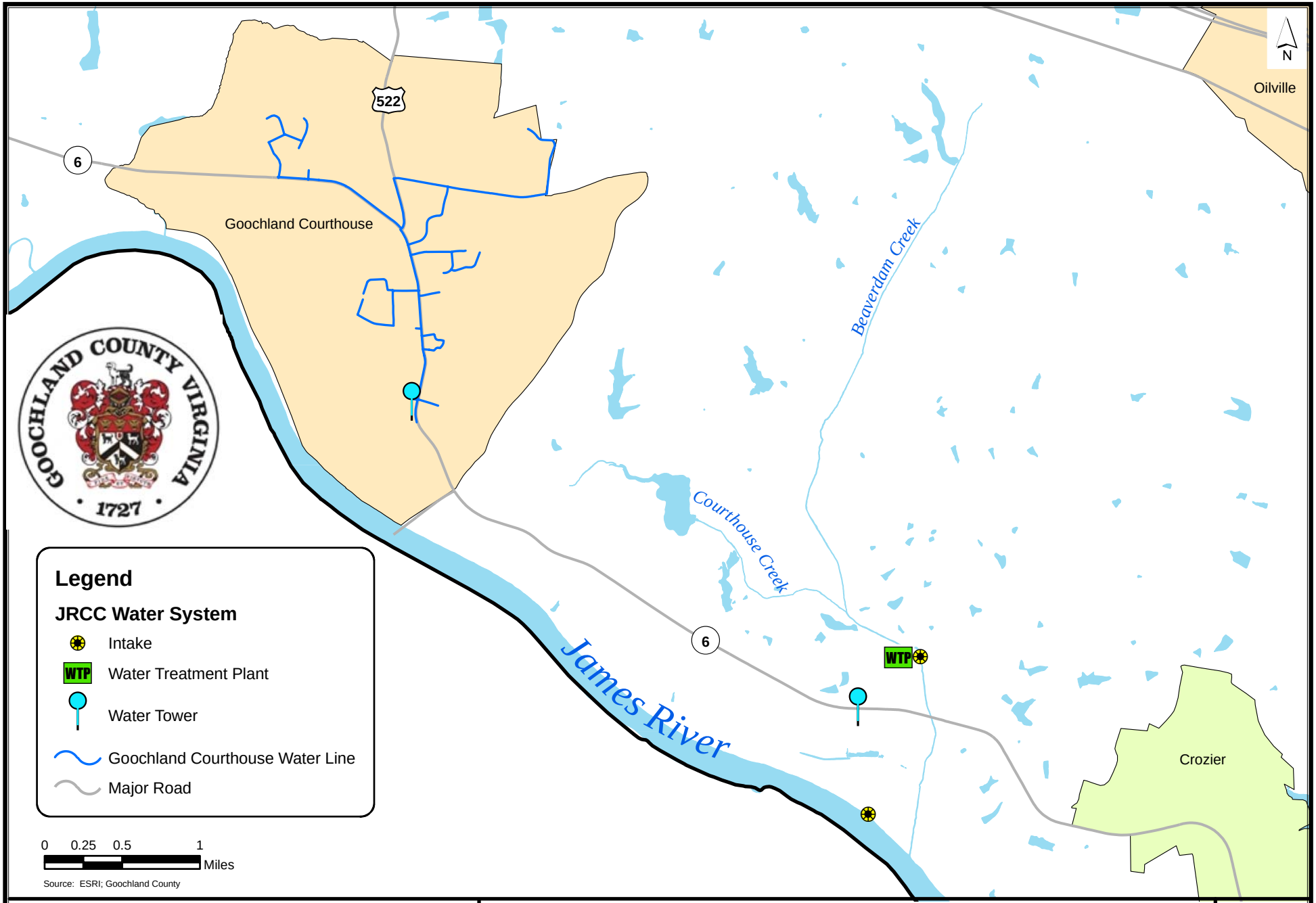
The storage capacity for the Goochland Courthouse system is limited by the shared 300,000-gallon elevated storage tank, which allocates 100,000 gallons of storage to Goochland County to serve the Goochland Courthouse area. As depicted below, a total effective storage capacity of 200,000 gpd is allocated for the Goochland County system.

Table 23: Goochland Courthouse Storage Capacity[36]

Storage Units	Quantity	Storage Volume of Each Unit (gal)	Combined Effective Storage Volume (gal)	System Design Capacity Based on Storage (gpd)
Elevated Tank	1	100,000	100,000	200,000

The effective capacity of the Goochland Courthouse system is currently limited to 200,000 gpd due to the contractual limitation stated in the agreement between the Virginia Department of Corrections and the County of Goochland.

[36] Effective Storage Capacity = Effective Storage Volume ÷ 200 gal/ERC x 400 gpd/ERC.



Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

James River Correctional Center
Treatment Plant & Courthouse System
Goochland County, Virginia

DAA# R07246-01

FIGURE
4

2.5 Non-Agricultural, Self-Supplied Users of More than 300,000 Gallons per Month of Surface Water[37]

There are several non-agricultural users in Goochland County that depend on self-supplied surface water. After examining records from the Virginia Department of Health and the Department of Environmental Quality and conducting research on golf courses and quarries in Goochland County, the following self-supplied non-agricultural surface water users were identified: Hermitage Country Club, Kinloch Country Club, Richmond Country Club, Royal Virginia Golf Club, Sycamore Creek Golf Club, Luck Stone, Martin Marietta Material, and Vulcan Construction Materials. These non-agricultural self-supplied surface water users are detailed in the following sections of this Plan. **Figure 5** depicts the general location of each non-agricultural self-supplied surface water user in Goochland County.

2.5.1 Hermitage Country Club[38]

The Hermitage Country Club uses an on-site pond to irrigate the golfing greens of its 36-hole course. This irrigation pond is supplied by surface run-off from the surrounding area. The golf course irrigates its greens for nine months out of the year. In 2006, according to DEQ records, the club used an estimated 66.71 million gallons of water[39]. A well is used to service the club house; however, the Country Club plans to connect into the public system by 2009.

2.5.2 Kinloch Country Club[40]

The Kinloch clubhouse, cottage, and training facility are all served by Goochland's public water system. Irrigation for the 36-hole golf course, including the fairways and greens, comes from an on-site lake. A well is used for the maintenance building and the on-course restroom facilities. No information concerning the total amount of water used by the country club for irrigation is

[37] 9 VAC 25-780-70 E.
[38] Phone interview with Hermitage Country Club Manager.
[39] Department of Environmental Quality Water Use Records. See **Appendix C**.
[40] Phone interview with Kinloch Country Club.

known, since the Kinloch Country Club is not required to monitor or report their water usage.

2.5.3 Richmond Country Club[41]

The clubhouse, pro-shop, and clubhouse pool are all connected to the county's municipal water supply. Irrigation for the 18-hole golf course comes from three on-site ponds, which are fed by runoff during the winter months. Both the greens and the fairways are irrigated from March to October. An estimated 100,000 gpd are used for irrigation during these months. In total, an estimated 24 million gallons per year of water is used to irrigate the Richmond Country Club's golf course. Several wells are also located within the Richmond Country Club property, but none of the wells are active due to poor yields.

2.5.4 Royal Virginia Golf Club[42]

The Royal Virginia clubhouse's water is supplied by a well with a yield of 8,000 gpd. The 18-hole course is irrigated with water from a pond, which is fed by several small streams. No information concerning the total amount of water consumed by the golf club for irrigation is known, since the Royal Virginia Golf Club is not required to monitor or report their water usage.

2.5.5 Sycamore Creek Golf Course[43]

The Sycamore Creek Golf Course clubhouse is supplied by a well with a yield of 11,520 gpd; however, the clubhouse may connect to the county system in the near future. The 18-hole golf course is irrigated using water from nearby lakes. The greens, fairways, tees, and roughs are watered daily. The golf course owners estimate that the course uses approximately 200,000 gallons of water per day from mid-March to mid-October. In total, the Sycamore Creek Golf Course uses approximately 48 million gallons of water per year to irrigate their course.

[41] Phone interview with superintendent of the Richmond Country Club.
[42] Phone interview with Royal Virginia Gold Club Manager.
[43] Phone interview with the Sycamore Creek Golf Club Owners.

2.5.6 Luck Stone[44]

There are two Luck Stone aggregate quarries in Goochland County. One is located on Route 6 and the other is located off Ashland Road.

The quarry on Ashland Road has only 15 – 20 employees. There is a well for the office, restrooms, and drinking water. Most of the quarry's water use is for dust suppression on roads, equipment, and aggregate washing. Water used by the quarry is pumped from the sump of the quarry, where water is collected at the bottom of the quarry from surface runoff, rain collection, and seepage. This collected sump water is then pumped out of the quarry and used for dust suppression and aggregate washing. The volume of water used by the quarry is unknown, since the quarry is not required to record or monitor their water usage.

The Route 6 facility includes the corporate headquarters, which employs over 250 people. Here, the drinking water is supplied by the Manakin Farms community water system. Water used for dust suppression on roads and equipment is pumped from the Little River, a tributary of the James. The volume of water extracted from the river is unknown.

2.5.7 Martin Marietta Materials – Anderson Creek Quarry[45]

Water used for dust suppression and aggregate washing is collected in an on-site pond, which is fed by rain and surface water runoff. Sump water at the bottom of the quarry is also pumped into the collection pond. Most of the water that is used for dust suppression and aggregate washing is pumped back to the pond and reused. In 2006, according to records from Department of Environmental Quality, the quarry used an average of approximately 127,000 gpd from the pond.

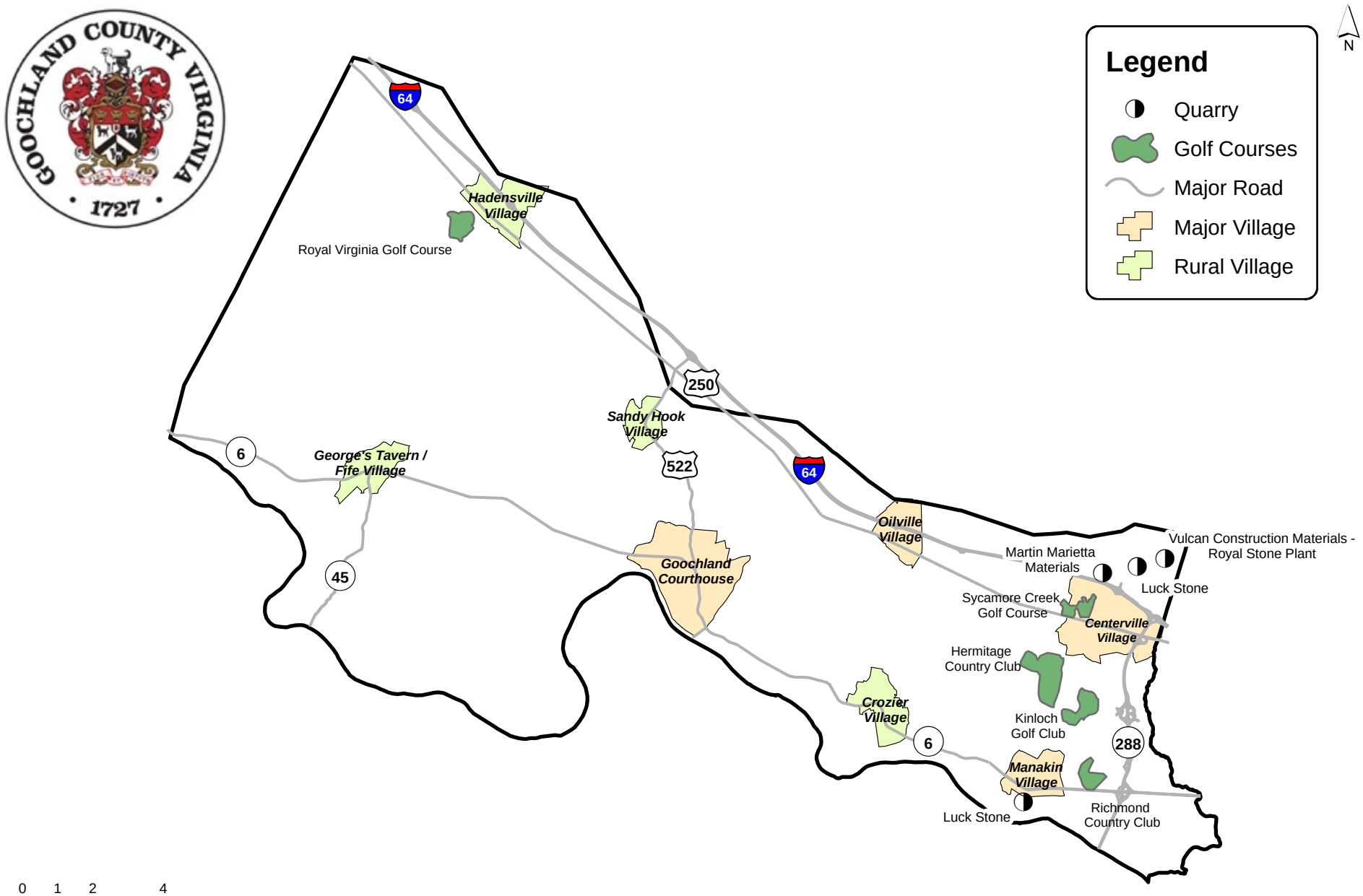
2.5.8 Vulcan Construction Materials – Royal Stone Plant[46]

The Royal Stone Plant's office building is supplied by a well. The surface water system at the plant consists of sump water collection and withdrawal from the

[44] Phone interview with Luck Stone Operation Manager.
[45] Phone interview with Anderson Creek Quarry Manager.
[46] Phone interview with Vulcan Construction Materials Plant Manager.

Little Tuckahoe Creek. In 2006, according to records from the Department of Environmental Quality, the quarry used an average of 1,310,000 gpd of surface water; 600,000 gpd from the Little Tuckahoe Creek and 710,000 gpd from the sump of the quarry. [47] The sump water collected at the bottom of the quarry, which mainly consists of surface runoff from rainfall, is pumped into the Little Tuckahoe Creek after the majority of sediment is allowed to settle. According to the plant manager, surface water at the Royal Stone Plant is used for dust suppression and stone washing. The plant is considering connecting to the municipal water system to supply the plant's office building.

[47] Department of Environmental Quality Water Use Records. See **Appendix C.**



Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Non-Agricultural Self-Supplied Surface Water Users

Goochland County, Virginia

DAA# R07246-01

FIGURE
5

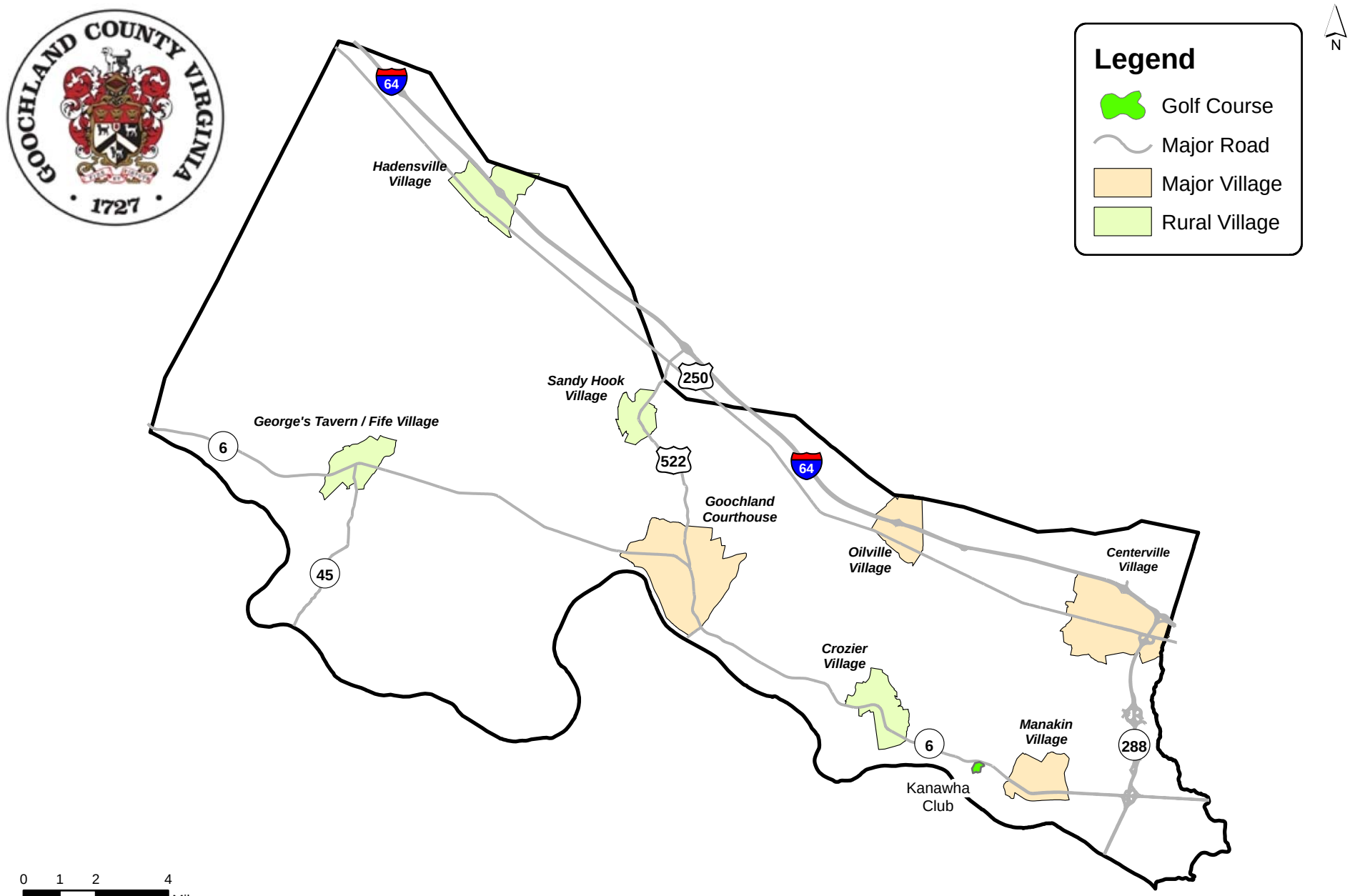
2.6 Non-Agricultural, Self-Supplied Users of More than 300,000 Gallons per Month of Groundwater[48]

After reviewing records from the Virginia Department of Health and the Department of Environmental Quality, the only non-agricultural, self-supplied systems that use more than 300,000 gallons per month of groundwater in Goochland County is the Kanawha Club. This non-agricultural self-supplied groundwater user is detailed in the following sections of this Plan. The following figure depicts the location of the Kanawha Club in Goochland County.

2.6.1 Kanawha Club[49]

The Kanawha Club is a 9-hole course that is located on the south side of Route 6 near Hermitage Road. The clubhouse and other club facilities are supplied by three wells. However, the withdrawal from these wells to service the club's facilities is unknown. Water for irrigation of the 9-hole course is supplied by four wells, which fill a holding pond. Water is then withdrawn from this pond and used for irrigation of the course's greens and fairways for eight months out of the year. The course is closed for the remaining four months and does not irrigate during this time. According to the club manager, the Kanawha Golf Course uses approximately 4.0 million gallons of water a year for irrigation purposes.

[48] 9 VAC 25-780-70 F.
[49] Phone interview with Kanawha Club Manager.



Source: US Census Bureau; USGS; Goochland County

Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Non-Agricultural Self-Supplied Ground Water Users

Goochland County, Virginia

DAA# R07246-01

FIGURE
6

2.7 Amount of Ground or Surface Water Purchased from Water Supply Systems Outside the Geographic Boundaries of the County[50]

The Eastern Goochland Water System, which includes the Tuckahoe Creek Service District, is the only waterworks in Goochland County that purchases water outside of the planning area. Goochland County has a contract with Henrico County to purchase up to 5.25 million gallons of treated surface water per day. This allocation to Goochland County recently increased due to an upgrade in capacity for the Henrico County Water Treatment Plant. The current capacity for the Henrico Water Treatment Plant is 55 mgd. The agreement between the County of Henrico and the County of Goochland can be seen in **Appendix D**.

2.7.1 Eastern Goochland Water System[51]

The Eastern Goochland service area is generally bounded by Route 623 on the west, Route 6 on the south, and the Hanover County line on the north. The permit number for the Eastern Goochland waterworks is 4075283; the permit was issued May 17, 2006. The Eastern Goochland Water System, which purchases water from Henrico County, consists of a 1 million-gallon elevated storage tank, a 600,000-gallon elevated storage tank, two in-line booster pumping stations, and a distribution system. The purchased water is delivered to four metered points: River Road, Patterson Avenue, Centerville and Ridgefield Parkway. The design capacity of the system is limited to 3.2 mgd due to storage capabilities. A map of the Eastern Goochland Water System can be seen in **Figure 7**.

The 1 million-gallon Centerville Elevated Storage Tank is located on the eastern side of St. Matthews Lane (Route 708), just north of Broad Street Road (U.S. Route 250). The tank has a single column pedestal and concrete support foundation. The bowl of the 68-feet diameter tank is 40 feet high and has an effective capacity of 1 million gallons. The drain line ties into the overflow line, which discharges into a drop inlet. A 25-inch air gap is provided between the overflow line and the drop inlet.

[50] 9 VAC 25-780-70 G.
[51] Virginia Department of Health Engineering Description Sheet dated April 24, 2006. See **Appendix A.**

The 600,000-gallon West Creek Elevated Storage Tank is located off of Route 640 in an open field at the western end of the West Creek commercial park. The bowl of the 56-feet diameter tank is 35.5 feet high and has an effective volume of 600,000 gallons. The overflow line and drain line are equipped with flap valves. They discharge into a drainage pit, which directs the water to a nearby creek.

The Centerville Pumping Station is located on U.S Route 250, just west of the Henrico County line and approximately 1.5 mile east of its intersection with Route 623 in the Centerville area. The pumping station is equipped with three horizontal, split case centrifugal pumps, which are powered by 75-HP motors with variable frequency drives. Each pump is rated for 1,250 gpm at 110 feet TDH, and is equipped with a butterfly valve and a pressure gage on the discharging line. The three pumps may be alternated either manually or automatically. The pumping station has a firm pumping capacity of 2,500 gpm with two pumps in service.

The River Road Pumping Station is located on the north side of River Road (Route 650), less than one mile west of the intersection of River Road and Rivergate. The River Road Pumping Station is equipped with three pumps that contain a firm pumping capacity of 1,000 gpm.

Goochland County entered into a water agreement (herein referred to as the "Agreement") with Henrico County in December of 1994. The Agreement was amended in 1995 and again in June 2002. The June 11, 2002 Agreement is included in **Appendix D.** The provisions of the Agreement include: [52]

- Henrico shall provide water to Goochland for resale by Goochland to water customers located within Goochland….Henrico or Goochland may provide water service directly to customers located within the other jurisdiction along the Henrico-Goochland boundary if mutually agreed upon; [53]
- The maximum quantity of water to be supplied to Goochland is phased as follows:[54]

[52] Contractual Water Agreement between County of Henrico and the County of Goochland. See **Appendix D**.
[53] See Section 2, page 1 of the Agreement.
[54] See Section 4, page 2 of the Agreement.

- 786,000 gpd as of the effective date of the Agreement;
- 5.25 mgd when Henrico's 55 mgd water treatment plant begins operations (expected to be January 1, 2003);
- 11.54 mgd when Henrico's water treatment plant begins operations at 80 mgd (estimated to be in 2010 or later); and
- 25 mgd when Henrico's water treatment plant begins operations at 120 mgd, or a *pro rata* amount between 11.54 mgd and 25 mgd if Henrico is not permitted for a full 120 mgd water treatment plant.

♦ The Agreement is in effect through June 30, 2032 and will continue thereafter until terminated by either party. The party terminating the Agreement must give the other party 10 years written notice.[55]

Design Criteria:

The following table summarizes the volume of water purchased from Henrico over the seven-year period from 2000 – 2007.

Table 24: Summary of Water Purchased from Henrico County

Year	Total (MG)	Average (MGD)	Maximum (MGD)
2000	49.398	0.135	0.271
2001	69.479	0.190	0.381
2002	72.467	0.199	0.397
2003	73.125	0.200	0.401
2004	75.572	0.207	0.414
2005	67.568	0.185	0.370
2006	87.943	0.241	0.482
2007	194.290	0.532	1.065

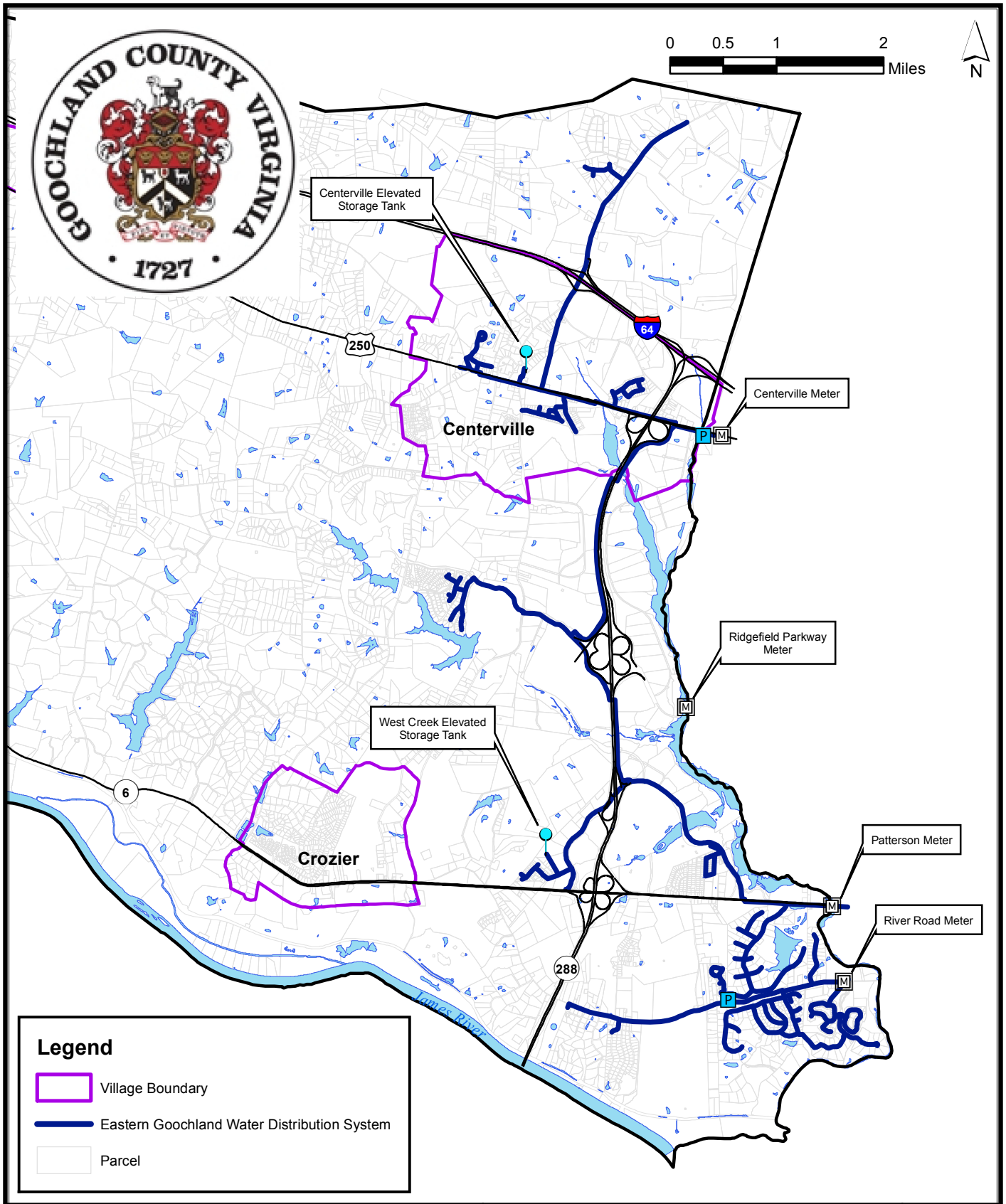
The total effective storage capacity for the waterworks is 3.2 mgd. The following table depicts the effective storage capacity for each storage facility in the system.

Table 25: Eastern Goochland Storage Capacity[56]

Storage Units	Quantity	Storage Volume of Each Unit (gal)	Combined Effective Storage Volume (gal)	System Design Capacity Based on Storage (gpd)
Centerville Elevated Storage Tank	1	1,000,000	1,000,000	2,000,000
West Creek Elevated Storage Tank	1	600,000	600,000	1,200,000
			Total:	**3,200,000**

[55] See Section 20, page 7 of the Agreement.
[56] Effective Storage Capacity = Effective Storage Volume ÷ 200 gal/ERC x 400 gpd/ERC.

The system currently is allowed to purchase up to 5.25 mgd of treated water from Henrico County according to the contractual water agreement. However, the capacity of the system is limited by the total effective storage capacity to 3.2 mgd.



Draper Aden Associates
Engineering • Surveying • Environmental Services

Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

EASTERN GOOCHLAND WATER SYSTEM

Goochland County, Virginia

DAA# R07246-01

FIGURE 7

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[57]

In the event that more potable water is needed for the citizens of Goochland County, Goochland may increase the volume of water purchased from Henrico County. According to the current contract, Goochland County can purchase up to 11.54 mgd once the Henrico Water Treatment Plant upgrades its capacity to 80 mgd, which is anticipated to occur by 2010. Once the treatment plant upgrades its capacity to 120 mgd, Goochland County will be allowed to purchase up to 25 mgd. However, the Eastern Goochland Central System only has a capacity of purchasing 3.2 mgd due to limiting storage capacities. In order to increase the volume of water that Goochland County is capable of purchasing from Henrico County, the Eastern Goochland Central System must increase its storage capacity.

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[58]

The Virginia Department of Health and the Department of Environmental Quality records provide no information concerning specific agricultural users who utilize more than 300,000 gallons per month for livestock or crops. Also, no information detailing the water sources for each agricultural user is available. However, general information concerning the agricultural sector of Goochland County is provided by the 2002 Census of Agriculture. The following tables depict the amount of livestock and crops in Goochland County.

[57] 9 VAC 25-780-70 H.
[58] 9 VAC 25-780-70 I.

Table 26: Goochland County Livestock Information[59]

Type of Livestock	# in 2002	Number of Farms
Beef Cattle and Calves	3,281	141
Milk Cows	611	10
Hogs and Pigs	93	5
Sheep and Lambs	151	9
Poultry – Layers	381	7
Poultry – Broilers	329,000	3
Horses	2,400	Not Known

Table 27: Goochland County Crop Information[60]

Type of Crop	Acres in 2002	Number of Farms
Corn for Silage	1,489	9
Corn for Grain	1,883	15
Wheat for Grain	1,667	10
Oats for Grain	10	3
Soybeans	1,512	5

Using the information above in accordance with average gallons of water needed per day for the different types of livestock and crops, approximate volume of water used by the agricultural sector in Goochland County can be estimate. This water usage is outlined in Section 3.6 of the Plan.

2.10 Residences and Businesses that are Self-Supplied and Individual Wells Withdrawing less than 300,000 Gallons per Month[61]

2.10.1 Self-Supplied Residences

Residential well records were reviewed at the local Health Department and the results are summarized in the Residential Well Survey table in **Appendix E**. The Health Department compiles well records by map grids. In Goochland County, 54 grids have been established. Due to the large number of records available, 10 percent of the records for each map grid were reviewed and tabulated.

Of the 328 wells reviewed, 20 wells, or approximately 6 percent, are shallow bored (overburden) wells that range in depth from 30 feet to 73 feet. The Residential Well Survey revealed well yields ranging from 1 to 5 gpm for these

[59] 2002 Census of Agriculture.
[60] 2002 Census of Agriculture.
[61] 9 VAC 25-780-70 J.

shallow bored wells. Since pumping tests are not required for residential wells, it is assumed that these are short term yields and not representative of available yields for long term pumping (continuous pumping for 24 hours).

Information was obtained from 303 bedrock (drilled) wells ranging from 85 feet to 900 feet in depth. The reported well yields ranged from 1 gpm to 100 gpm. Of the 303 bedrock wells, 253 or 83 percent have yields of 10 gpm or less. [62]

In order to estimate the population served by residential self-supplied water systems, the population connected to municipal or community water systems must be analyzed. After reviewing the Virginia Department of Health Engineering Description Sheets, a total of 4,654 residential users were found to be connected to municipal or community well systems in Goochland County. The following table depicts the populations served by each municipal and community waterworks.

Table 28: Estimated Population Served by Public or Community Systems[63]

Facility	Estimated Population Served
Crozier	72
Elk Hill Farm	125
Jenkins Mobile Home Park	100
Manakin Farms	585
Meadows Nursing Center	172
James River Correctional Center[64]	1,662
Goochland Courthouse District[65]	392
Eastern Goochland Water System[70]	1,546
Total	**4,654**

The 2006 population of Goochland County was estimated to be 20,085. With approximately 4,654 residents served by municipal or community systems, the remaining population of approximately 15,431 is assumed to withdraw water from individual self-supplied wells. Using the average persons per household of

[62] Residential Wells Survey. See **Appendix E**.
[63] Virginia Department of Health Sanitary Survey Reports. See **Appendix F**.
[64] Inmate population that resides in Goochland County, Virginia Department of Corrections.
[65] 2006 County Wide Statistic.

2.51, the number of Goochland County residences supplied by self-supplied water is estimated to be approximately 6,148 homes[66].

Within the Tuckahoe Creek Service District and the Courthouse Service Area, there are several individual/private wells that are used for irrigation purposes. Municipal water users in the Goochland Courthouse service area and users within the Eastern Goochland Water System service area that are not part of the Tuckahoe Creek Service District are not allowed to use municipal water to irrigate their lawns. This restriction has caused people in these areas to develop individual wells for irrigation purposes. However, the number of individual wells used for irrigation in these areas is unknown.

2.10.2 Self-Supplied Businesses and Public Facilities

There are several non-transient-non-community systems that withdraw from the groundwater supply in Goochland County. These include Byrd Elementary School, the former Goochland Middle School, Hermitage Country Club, Randolph Elementary School, Richmond Country Club, Sabot Hill Farm, Salem Baptist Church, and the Veterinary Referral and Care Institute.

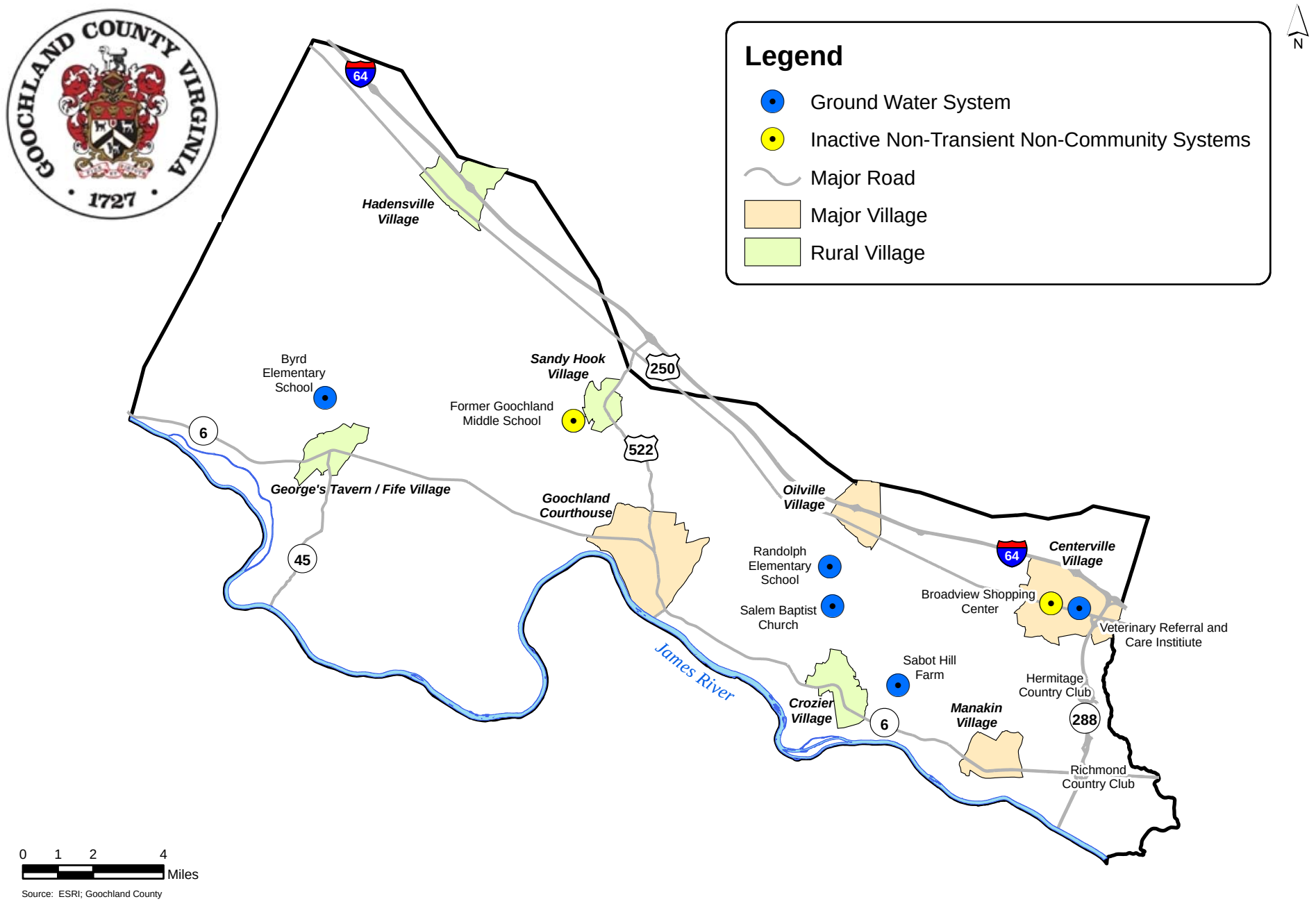
However, with the county's municipal water supply expanding, several of the non-transient-non-community groundwater systems will become inactive and connect to the county water distribution system. For example, Broadview Shopping Center has recently connected to the municipal water system and the Veterinary Referral and Critical Care Institute has been given the option of connecting to the municipal water system through payment of a connection fee. As of now, though, the Veterinary Referral and Critical Care Center is still relying on their groundwater sources. The former Goochland Middle School groundwater system is temporarily inactive due to the development of a new middle school. However, the county plans to continue using this well system to provide water for the facilities future uses. The following table provides a summary for all of the above non-transient-non-community systems in Goochland

[66] U.S. Census Bureau.

County. The general location of each non-transient-non-community groundwater system is shown in **Figure 8**.

Table 29: Summary of Non-Transient-Non-Community Ground Water Systems

FACILITY NAME	LOCATION/ADDRESS	FACILITY (R, Ag, Com, Ind, CW, M)	ACTIVE (A) INACTIVE (I)	POPULATION SERVED	WATER SOURCE (Well, Surface Water, Outside Source)	WELL TYPE (Bored or Drilled)	WELL DEPTH	DEPTH TO BEDROCK	OPEN BOREHOLE (NO SCREEN)		CASING SIZE	CASING DEPTH (FT)		WELL YIELD	PUMP CAPACITY	STORAGE CAPACITY	EFFECTIVE CAPACITY	PERMITTED CAPACITY	TAX MAP NUMBER	VDH PERMIT ID
							(FT)	(FT)	FROM (FT)	TO (FT)	(INCHES)	FROM	TO	(GPD)	(GPD)	(GPD)	(GPD)	(GPD)		
Byrd Elementary School	Rt 6 W, approx. 9.5 mi beyond Goochland Courthouse to George's Tavern (Rt. 606) N on Rt 606; the school is located approx. 1.6 mi N of Rt 6, L side of the road	M	A	323	Well	D	---	---	---	---	---	---	---	15,200	16,000	4,400	4,400	4,400	17-1-0-82-0	4075040-A
Hermitage Country Club	I-64 W to Manakin (Rt 623), L (S) on Rt 623 approx 1 mile to US 250 R (W) on US 250 approx 0.7 mi to Rt 621, L (S) on Rt 621 approx 1.2 mi to Rt 676.Turn L (E) on Rt 676, approx 1.5 mi. to entrance on R	Com	A	100	Well	D	150	63	63	150	6	+2	63	40,000	40,000	3,200	3,200	48,000	58-28-0-1-A	4075350-A
Randolph Elementary School	Rt 6 W to Crozier, N on Rt 670 approx 3.5 mi to intersect with Rt 639. L (W) on Rt 639. The school is approx 0.2 mi W of Rt 670 on the R side of Rt 639	CW	A	439	Well	D	198	35	50	198	6	+2	50	12,800	14,400	4,400	4,400	4,400	44-1-0-46-0	4075660-A
Richmond Country Club	On Patterson Ave (Rt 6) approx 3.2 mi W of Henrico County line, and directly across from the intersection of Patterson Ave and River Road (Rt 650)	Com	A	125	Well	D	---	---	---	---	---	---	---	---	21,600	2,800	2,800	Existing 2 Buildings	63-1-0-161-0	4075670
Sabot Hill Farm	Rt 6 W approx 4.9 mi from its intersect with River Rd (Rt 650) to Dover Rd (Rt 642), go R (N) on Dover, approx 1.1 mi to farm entrance, on the R side of road, go approx 0.2 mi on entrance road	Com	A	38	Well	D	231	---	---	---	6	---	---	---	72,000	3,334	3,334	7 ERC	56-15-0-9-A	4075705
Salem Baptist Church	Rt 6 W to intersect with Rt 670 (Crozier), N on Rt 670 approx 2.4 mi to its intersect with Taylor Rd. (Rt 641) The church is on the R side of Rt 670 across from Taylor Rd.	CW	A	500	Well	D	---	---	---	---	---	---	---	---	---	26	26	Existing Church and School	44-1-0-69-0	4075708
Veterinary Referral & Critical Care (Well #1)	I-64 W to Exit 173 (Manakin/Rockville exit). Turn left (south) onto Route 623. Go approx. 1.1 miles and turn right (west) onto U.S. Route 250. Go approx. 0.1 mi, turn left (south) onto Route 623. The vet is on the right side of 623	CW	A	62	Well	D	200	50	---	30	6¼	+2	30	7,200	7,920	54	54	7,200	47-27-0-8-B	4075880
Veterinary Referral & Critical Care (Well #2)		CW	A		Well	D	300	50	---	50	6¼	+2	50	17,280	15,120				47-27-0-8-B	4075880
Broadview Shopping Center (Well 1)	I-64 W to Manakin/Rockville (Rt 623) exit L on Rt. 623, approx 1.1 mi to US 250, turn R. Shopping center is on right side of road, about 0.2 mi from intersection with Rt 623.	Com	I	200	Well	D	505	35	63	505	6	+2	63	102,240	63,360	28,000	28,000	61,056	47-1-0-43-P	401301
Broadview Shopping Center (Well 3)		Com	I		Well	D	1013	34	63	1013	6	---	---	5,760	2,880				47-1-0-43-P	401301
Former Goochland Middle School	W on Rt 6, approx 3.0 mi past its intersect with US 522 N (at Goochland Courthouse) to Rt 614 (Dogtown Rd), N on Rt 614, approx 3.1 mi. School is on L side of road across from nursing center.	M	Temporarily Inactive	445	Well	D	405	87	100	405	6	+2	100	33,600	18,400	19,300	16,800	16,800	29-1-0-86-0	400300



Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Non-Transient-Non-Community Ground Water Systems

Goochland County, Virginia

DAA# R07246-01

FIGURE 8

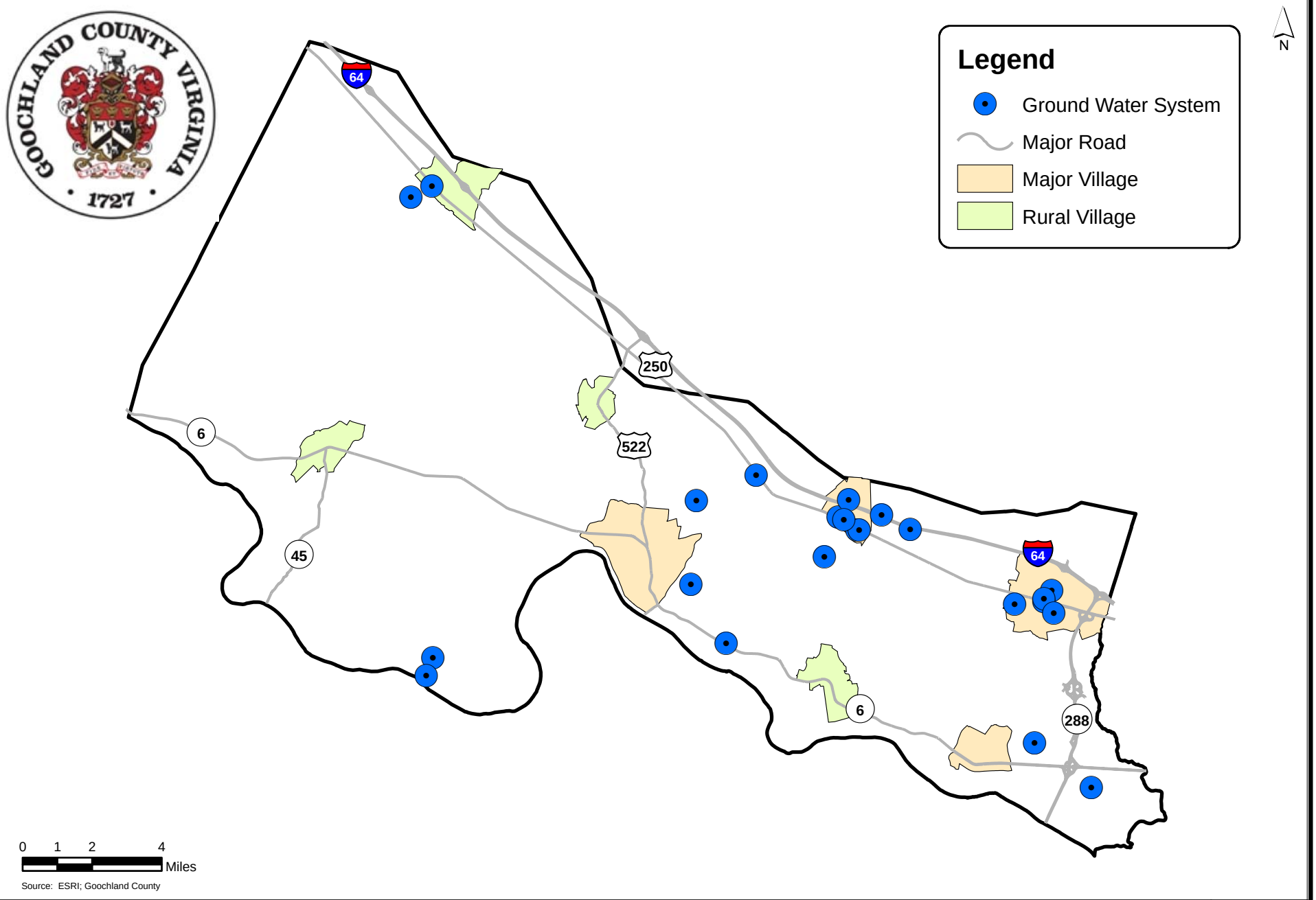
There are also several transient-non-community systems that withdraw water from the groundwater supply in Goochland County. These active waterworks systems include: Alleys Motel, Bogey's Sports Park, Brothers Italian Restaurant, Camp T. Brandy Saunders, Camp Hilbert, Camp Little Hawk, Collegiate Athletic Campus, Country House Café, The Farm House Inn, Hickory Notch Grill, I-64 Rest Area-EBL, I-64 Rest Area-WBL, Country Folks, Oilville Exxon, Oilville Office Park, Royal Virginia Country Club, St. Catherine's Athletic Complex, Seibert's Oilville BP, Sycamore Creek Golf Course, Tanglewood Ordinary, and Westview on the James.

Other transient-non-community groundwater systems such as the County Store, Fas Mart #16, Sunset Grill and Satterwhite's Restaurant have recently become inactive and connected to the Eastern Goochland Water System. The Collegiate Athletic Campus is in the process of connecting to the Eastern Goochland Water System, but will continue to use their groundwater system for irrigation. The following table provides a summary for all of the transient-non-community systems listed above. Their general locations are shown on **Figure 9**.

No records of other self-supplied businesses or public facilities are available. However, the businesses and public facilities detailed in this section provide a baseline estimate of businesses served by individual self supplied wells in Goochland County.

Table 30: Summary of Transient-Non-Community Ground Water Systems

FACILITY NAME	LOCATION/ADDRESS	FACILITY (C, NTNC, or TNC)	FACILITY (R, Ag, Com, Ind, CW, M)	ACTIVE (A) INACTIVE (I)	POPULATION SERVED	WATER SOURCE (Well, Surface Water, Outside Source)	WELL TYPE (Bored or Drilled)	WELL DEPTH	DEPTH TO BEDROCK	OPEN BOREHOLE (NO SCREEN)		CASING SIZE	CASING DEPTH (FT)		WELL YIELD	PUMP CAPACITY	STORAGE CAPACITY	EFFECTIVE CAPACITY	PERMITTED CAPACITY	TAX MAP NUMBER	VDH PERMIT ID
								(FT)	(FT)	FROM (FT)	TO (FT)	(INCHES)	FROM	TO	(GPD)	(GPD)	(GPD)	(GPD)	(GPD)		
Alley's Motel	I-64 to exit 173, turn L on Rt 623, Go approx. 1.1 mi turn L onto US 250 E. Motel is 0.2 mi. E. on the R hand side of the road	TNC	Com	A	124	Well	D	---	---	---	---	4	---	---	---	---	36	36	12 Motels, 2 Homes, 1 Restaurant	58-12-0-A-0	4075010
Bogey's Sport Park	I-64 W to exit 173, turn L onto Rt. 623, go approx. 1 mi. Sports Park is on the L side of Rt 623	TNC	Com	A	604	Well	D	400	9	50	400	6	+ 1	50	7,200	---	22	22	Existing Pro Shop	47-1-0-91-0	4075025
Camp Hilbert	I-64 to Oilville exit (Rt 617) Go south (L) on Rt 617 0.5 mi to US 250 Go W on US 250 to Rt 632, Go west on 632 3.4 mi to Rt 634 Go N on Rt 634 about 0.9 mi	TNC	CW	A	270	Well	D	225	---	81	225	6	+ 1	81	50,400	21,600	3,334	3,334	Existing Camp Facilities	31-1-0-25-0	4075049
Camp Little Hawk	I-64 to Oilville exit (Rt 617). S on 617 about 0.5 mi to 250, E on 250 about 0.5 mi S on Cardwell Road (Rt 670) go 1.2 mi to Cardwell Road	TNC	CW	A	85	Well	D	---	---	---	---	---	---	---	---	---	58	58	Existing Camp Facilities	44-1-0-45-0	4075055
Camp T. Brady Saunders (Well 1) (Backup)	I-64 W to Oilville exit, go S on Rt 617 approx 0.5 mi to US 250, go W on US 250, 0.8 mi to Rt 632 go W on 632 about 6.4 mi to Rt 634, go S o Rt 634 1 mi.	TNC	CW	A	677	Well	D	---	---	---	---	---	---	---	---	28,800	78,994	63,360	Existing Camp Facilities	43-1-0-34-0	4075045
Camp T. Brady Saunders (Well 2) (Primary)		TNC	CW	A	---	Well	D	---	---	---	---	---	---	---	---	34,560				43-1-0-34-0	4075045
Stewart's Café	I-64 W to Hadensville exit, go S on 629 approx 0.7 mi to US 250, go W on 250 for 0.4 mi to restaurant, restaurant on S side of 250.	TNC	Com	A	492	Well	D	---	---	---	---	---	---	---	---	2,880	30	30	Existing Restaurant, Gas Station	6-1-0-19-A	4075465
Collegiate Athletic Complex	W on Patterson Ave. (Rt 6), approx 1.2 mi beyond Henrico County line to Blair Rd (Rt 649), turn L onto Blair Rd, go approx 0.5 mi, athletic complex is on the right side of the road.	TNC	CW	A	200	Well	D	805	---	63	805	6	+2	63	35,200	35,200	140	140	3600	64-1-0-31-0	4075085
The Farm House	I-64 W to Exit 173, L (S) on 623, go approx 1.1 mi and turn R (W) onto 250. Go approx 0.6 mi, turn L (S) onto Rt 621, inn is 0.5 mi down Rt 621 on right hand side	TNC	Com	A	26	Well	B	---	---	---	---	---	---	---	---	---	58	58	Existing Restaurant	47-1-0-28-0	4075240
Hickory Notch Grill	I-64 W to Oilville exit (Rt617), go S (L) on 617 approx 0.5 mi to US 250 Go W (R) on 250 approx 2.6 mi, restaurant on L side of road, almost directly across from Rt 636	TNC	Com	A	112	Well	D	NA	NA	NA	NA	6	---	---	---	---	58	58	Existing Restaurant	32-3-0-7-A	4075368
I-64 Rest Area EBL	I-64 W to Oilville (Rt 617), S on 617 to I-64 E, 1.7 mi E of Rt 617. Well on west side of Rest Area.	TNC	Com	A	1000	Well	D	370	50	50	370	6	+2	50	89,280	54,720	18,334	18,334	18334	46-1-0-1-0	4075390
I-64 Rest Area WBL	I-64 W to Exit 173, L (S) on 623, go approx 1.1 mi and turn R (W) (Rt 623) exit approx 1 mi E of Oilville exit (Rt 617) Well W side of Rest Area	TNC	Com	A	1000	Well	D	369	70	70	369	6	+2	70	128,160	105,120	18,334	18,334	18334	45-1-0-135-0	4075391
County Folk (formerly Manakin Grill)	I-64 W to Exit 173, turn L at end of exit ramp onto 623, go approx 0.8 mi, turn R onto Plaza Drive. Restaurant is on R side of road, directly behind Fas-Mart on Rt 623.	TNC	Com	A	70	Well	D	380	40	50	380	6	+ 1	50	4,320	---	80	80	Existing Restaurant	47-21-0-7-0	4075030
Oilville Exxon and Convenience Center	I-64 W to Oilville Exit (Rt 617), go N (R) on Rt 617 approx 0.1 mi gas station/convenience store on L side	TNC	Com	A	365	Well	D	---	---	---	---	---	---	---	---	---	26	26	Existing Gas Station/Store/Rest.	33-1-0-20-0	4075610
Oilville Office Park	I-64 W to Oilville exit (Rt 617), go S (L) on Rt 617 approx 0.5 mi to 250, go E (L) on 250, approx 0.3 mi. Office park is on the N (L) side of 250	TNC	Com	A	115	Well	D	300	30	100	300	6	+ 1	100	21,600	18,720	64	64	4 Businesses, 1 Restaurant	45-1-0-3-B	4075615
Royal Virginia Golf Club	I-64W to Hadensville Exit (Rt 629- exit 152), go S (L) on 629 approx 0.7 mi to 250. Go W (R) on 250 approx 0.2 mi to Three Chopt Road (Rt 606), Go S on Three Chopt approx 0.2 mi to Royal Virginia Parkway (Rt 679) Turn R and go approx 0.4 mi. Clubhouse on R side	TNC	Com	A	103	Well	D	404	71	72	404	6	+ 1	72	8,000	---	20	20	Existing Club House	5-24-0-B-0	4075701
Brothers Italian Restaurant	I-64 W to Oilville exit (Rt 617) Turn L at end of exit ramp and go approx 0.6 mi to Broad Street Rd. (US 250) Go E (L) on 250, approx 0.7 mi, restaurant is on the S (R) side of 250.	TNC	Com	A	65	Well	D	125	30	50	125	6	+1	30	28,800	14,400	20	20	60 Seat Restaurant	45-1-0-11-0	4075720
Seibert's Oilville BP	I-64 W to Oilville exit (Rt 617) Go S (L) on Rt 617 approx 0.5 mi to 250. Gas station/convenience store is on L side at the intersection of Rt 617 and 250	TNC	Com	A	906	Well	D	400	58	68	400	6	+1	68	21,600	7,920	46	46	Existing Gas Station/Store/Rest.	45-1-0-1-E1	4075600
Sycamore Creek Golf Course	I-64 W to exit 173, turn L (S) onto Rt 623, go approx 1.1 mi turn R (W) onto 250. Go approx 0.70 mi. and turn R (N) onto Rt 621. Go approx 0.1 mi Rt 621, entrance to golf course club house on R side of road	TNC	Com	A	158	Well	D	---	---	---	---	---	---	---	---	11,520	14	14	Existing Club House	47-1-0-42-B	4075780
Tanglewood Ordinary	On Patterson Avenue (Rt 6) approx 10.2 mi W of intersection with River Road (Rt 650) and approx 0.7 mi W of the elevated water storage tank at James River Correctional Ctr. Restaurant on R side of road.	TNC	Com	A	512	Well	D	---	---	---	---	6	---	---	---	---	60	60	Existing Restaurant	54-1-0-5-0	4075790
Westview on the James (Well 1)	Go W on Patterson Ave (Rt 6) to Rt 600 which is approx 17.6 mi W of its intersection with River Rd. (Rt 650) and approx 3.2 mi W of its intersection with US 522 N at Goochland Courthouse. Turn S (L) on Rt 600, and go approx 4.9 mi to R. 643, turn S (R) on Rt 643 to reach the camp entrance and the camp office.	TNC	Com	A	200	Well	D	485	183	183	183	6	+1	183	---	5,040	54,140	10,080	Existing Camp Facilities	50-1-0-21-0	401405
Westview on the James (Well 2)		TNC	Com	A	---	Well	D	400	181	181	184	6	+2	184	10,080	11,520				50-1-0-21-0	401405
St. Catherine's Athletic Complex	W on River Rd. approx 0.5 mi beyond where it crosses over Rt 288. Entrance to athletic complex is on the R (N) side of River Road.	TNC	CW	A	100	Well	D	1000	60	60	60	6	+2	60	1,872	3,888	2,834	1,872	Existing Concessions and Maintenance Building	63-1-0-191-A	4075703
Country Store/Bill's BBQ	I-64 W to Exit 173, L onto Rt 623, go approx 1.1 mi turn R (W) onto 250. Store 0.3 mi on left	TNC	Com	I	908	Well	D	---	---	---	---	---	---	---	---	---	14	14	Existing Gas Station/Store/Rest.	47-1-0-81-A1	4075020
Fas Mart # 16	I-64 W to Exit 173, L at end of ramp onto 623 (Ashland Rd.), store is about 0.8 mi down Rt 623 on R side of road, intersection of Rt 623 and Plaza Drive	TNC	Com	I	---	Well	D	520	50	52	520	6	+ 1	52	2,880	---	130	130	Existing Gas Station/Store/Rest.	47-21-0-8-0	4075225
Sunset Grill (formerly Red Oak Café)	I-64 W to Exit 173, turn L (S) onto Rt 623, go approx 1.1 mi turn R (W) onto 250, go approx 0.10 mi and turn L (S) onto Rt 623. Restaurant is on SE corner of intersect of US 250 and Rt 623	TNC	Com	I	103	Well	D	---	---	---	---	---	---	---	---	---	58	58	2 Businesses	47-1-0-80-G	4075060
Satterwhite's Restaurant	I-64 W to Exit 173, turn L (S) onto Rt 623, go approx 1.1 mi turn R (W) onto 250. Restaurant is approximately 0.75 mi down 250 on R hand side (NW corner of the intersection of 250/Rt 621)	TNC	Com	I	---	Well	D	---	---	---	---	4	---	---	---	---	4	4	Existing Restaurant	47-1-0-33-0	4075714



Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Transient-Non-Community Ground Water Systems

Goochland County, Virginia

DAA# R07246-01

FIGURE 9

2.11 Summary of Findings and Recommendations from Source Water Assessment Plans and Wellhead Protection Plans[67]

Wellhead Protection Plans are intended to prevent drinking water from becoming polluted by managing potential sources of contamination in the area which supplies water to a public well. On May of 2005, the Environmental Protection Agency (EPA) granted final approval to Virginia's Wellhead Protection Program. Protection of the public groundwater supply will be achieved through ongoing regulatory and non-regulatory state programs and through voluntary participation of local governments. The Virginia Department of Environmental Quality serves as the lead agency for coordination and funding of these voluntary protection programs.[68] With these plans being a voluntary action towards managing groundwater contamination, no Wellhead Protection Plans currently exist in Goochland County.[69]

Source Water Assessments Reports conducted by the Virginia Department of Health assess the susceptibility of the public water supply to contaminants regulated by the Safe Drinking Water Act. This assessment is accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The assessment area for both groundwater and surface water sources is divided into two zones. The following table reveals the specific assessment area delineations for both groundwater and surface water sources.

Table 31: Source Water Assessment Areas[70]

Source	Assessment Areas	
	Zone 1	Zone 2
Groundwater	1,000 -foot fixed radius surrounding source	1-mile fixed radius surrounding source and outside of Zone 1
Surface Water	Watershed area within 5-mile fixed radius of the raw water intake	Total watershed area outside of Zone 1

[67] 9 VAC 25-780-70 K.
[68] Water resource Management, Virginia Department of Environmental Quality.
[69] Goochland County Environmental Planning Department.
[70] Source Water Assessment Reports, Virginia Department of Health.

The goal of the Source Water Assessment Reports is to assist with source water protection efforts. The susceptibility to contamination of each active community, non-transient-non-community, and transient-non-community system in Goochland County is shown in the following tables. The VDH Source Water Assessment Reports containing a detailed explanation of each source's susceptibility to contamination in each of the assessment zones is provided in **Appendix G**.

Table 32: Community System's Source Water Susceptibility to Contamination[71]

Waterworks	VDH Permit ID	Source	Source ID	Susceptibility to Contamination
Crozier	4075100-A	Groundwater	Well No. 1	High
Elk Hill Farm	4075200	Groundwater	Well No. 1	High
Henrico County WTP	4087125	Surface Water	James River	High
James River Correctional Center WTP	4075735	Surface Water	Beaverdam Creek	High
			James River	High
Jenkins Mobile Home Park	4075420	Groundwater	Well No. 1	High
			Well No. 2	High
Manakin Farms	4075500	Groundwater	Well No. 10	High
			Well No. 11	High
			Well No. 12	High
Meadows Nursing Center	4075520	Groundwater	Well No. 1	High

Table 33: Non-Transient-Non-Community System's Source Water Susceptibility to Contamination[72]

Waterworks	VDH Permit ID	Source	Source ID	Susceptibility to Contamination
Byrd Elementary School	4075040	Groundwater	Well No. 1	High
Hermitage Country Club	4075350	Groundwater	Well No. 1	High
Randolph Elementary School	4075660	Groundwater	Well No. 1	High
Richmond Country Club	4075670	Groundwater	Well No. 1	High
Sabot Hill Farm	4075705	Groundwater	Well No. 1	High
Salem Baptist Church	4075708	Groundwater	Well No. 1	High
Veterinary Referral & Critical Care	4075880	Groundwater	-	-

[71] Virginia Department of Health. Source Water Assessment Reports. See **Appendix G**.
[72] Virginia Department of Health. Source Water Assessment Reports. See **Appendix G.**

Table 34: Transient-Non-Community System's Source Water Susceptibility to Contamination[73]

Waterworks	VDH Permit ID	Source	Source ID	Susceptibility to Contamination
Alley's Motel	4075010	Groundwater	Well No. 1	High
Bogey's Sports Park	4075025	Groundwater	Well No. 1	High
Brother's Italian Restaurant	4075720	Groundwater	Well No. 1	High
Camp Hilbert	4075049	Groundwater	Well No. 1	High
Camp Little Hawk	4075055	Groundwater	Well No. 1	High
Camp T. Brandy Saunders	4075045	Groundwater	Well No. 1	High
Collegiate Athletic Complex	4075085	Groundwater	Well No. 1	High
The Farm House	4075240	Groundwater	Well No. 1	High
Hickory Notch Grill	4075368	Groundwater	Well No. 1	High
I-64 Rest Area (EBL)	4075390	Groundwater	Well No. 1	High
I-64 Rest Area (WBL)	4075391	Groundwater	Well No. 1	High
Country Folks	4075030	Groundwater	Old Well	High
			New Well	High
Oilville Exxon & Convenience	4075610	Groundwater	Well No. 1	High
Oilville Office Park	4075615	Groundwater	Well No. 1	High
Royal Virginia Golf Club	4075701	Groundwater	Well No. 1	High
Seiberts' Oilville BP	4075600	Groundwater	Well No. 1	High
St. Catherine's School Athletic Complex	4075703	Groundwater	Well No. 1	Low
Stewart's Café	4075465	Groundwater	Well No. 1	High
Sycamore Creek Golf Course	4075780	Groundwater	Well No. 1	High
Tanglewood Ordinary	4075790	Groundwater	Well No. 1	High
Westview on the James	4075920	Groundwater	Well No. 1	Moderate
			Well No. 2	Moderate

As shown in the tables above, most of the public water sources have a high susceptibility to contamination. This high susceptibility for most of the public groundwater sources is due to the surrounding land uses that promote the migration of contaminants. The surface water sources for Goochland County have a high susceptibility to contaminants at varying concentrations due to hydrologic, hydraulic, and atmospheric conditions.

[73] Virginia Department of Health, Source Water Assessment Reports. See **Appendix G**.