APPENDICES

A. Virginia Department of Health Engineering Description Sheets

B. Water Agreement between the Commonwealth of Virginia Department of Corrections and the County of Goochland

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F. Virginia Department of Health Sanitary Survey Reports

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APPENDIX A

Virginia Department of Health Engineering Description Sheets

Community Water Systems

Crozier
Eastern Goochland Central Water System
Elk Hill Farm
Hickory Haven
James River Correctional Center
James River Estates
Jenkins Trailer Park
Manakin Farms
Mary Mother of the Church Abbey
Meadows Nursing Center
Pagebrook
Samary Forest

Non-Transient Non-Community Systems

Broadview Shopping Center
Byrd Elementary School
Goochland Middle School
Hermitage Country Club
Randolph Elementary School
Richmond County Club
Sabot Hill Farm
Salem Baptist Church
Veterinary Referral and Critical Care

Transient Non-Community Systems

Alleys Motel
Bogeys Sports Park
Brothers Italian Restaurant
Sam and Jessie's
Camp T. Brady Saunders
Camp Hilbert
Camp Little Hawk
Collegiate Athletic Campus
Country House Café
Country Store/Bill's BBQ
Fas Mart #16
Fox Head Inn
Hickory Notch Grill
I 64 Rest Area – East Bound Lane
I64 Rest Area – West Bound Lane
Manakin Grill
Oilville Exxon
Oilville Office Park
Red Oak Café
Royal VA Golf Club
St. Catherine's Athletic Campus
Satterwhite's Restaurant
Seibert's Oilville BP
Sycamore Golf Course
Tanglewood Ordinary
Westview on the James

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE September 26, 1997

WATERWORKS NAME Crozier CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Community

LOCATION West on Route 6, approximately 10.6 miles past the Goochland-Henrico line. Turn left onto a dirt road, just beyond the Crozier post office. The well is on the left side of the dirt road, approximately 100 yards from its intersection with Route 6.

OWNER Sydnor Hydrodynamics, Inc.
P. O. Box 27186
Richmond, Virginia 23261
Contact Mr. Jesse L. Royall, Jr., P.E.
Vice-President of Utilities
Telephone: (804) 643-2725

OPERATOR Mr. Herbert Talbott, Class III
Telephone: (804) 643-2725

PERMIT NUMBER	432	4075100	402297	4075100-A
DATE ISSUED	4/4/47	4/27/77	4/22/97	10/7/97

TYPE OF TREATMENT Corrosion Control

SOURCE Groundwater - one drilled well

DESIGN CAPACITY 24 existing connections (includes a restaurant)

DESCRIPTION OF SYSTEM:

This waterworks includes one drilled well, corrosion control facilities, and one 5,000-gallon hydropneumatic tank, with appropriate appurtenances.

Well No. 1-A - This well is located inside of the well house. It is no longer in use. It was drilled in 1947, and reportedly has a yield of approximately 1 gpm. Although the well is still connected to the waterworks, it is not included in this operation permit.

Well No. 1 - This well is located in the center of a 6-ft x 6-ft x 6-inch concrete pad, 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).

Six-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. Appurtenances to the well include a sanitary seal, a screened casing vent, a check valve, a gate valve, a sample tap (same tap as for Well No. 1-A), a discharge meter, and a blow-off line (same as for Well No. 1-A).

A 3-HP submersible pump, rated at 20 gpm @ 347 feet TDH, delivers water from the well to the corrosion control facilities and the 5,000-gallon hydropneumatic tank. The 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.

The corrosion control facilities consist of a caustic soda feed system and an orthophosphate-polyphosphate (Aqua-Mag) feed system. The caustic soda and orthophosphate-polyphosphate feed equipment each include a 50-gallon solution tank and a diaphragm feed pump with a maximum feed rate of 1 gallon/hour (24 gallons/day). The pumps automatically operate whenever the well pump is operating. The chemicals are injected upstream of the 5,000-gallon hydropneumatic tank. A sample tap is included downstream of the chemical feed points.

Appurtenances to the 5,000-gallon hydropneumatic tank include pressure sensing switches, a sight glass, a pressure gage, an air relief valve, a drain, an access manhole, and a sample tap. A 1/3-HP air compressor maintains the proper air:water ratio in the tank.

The corrosion control facilities and the control end of the hydropneumatic tank are housed in a 10-ft x 10-ft x 8-ft concrete block well house. Appurtenances to the well house include lighting, heat, drainage, and ventilation.

DESIGN CRITERIA:		Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*.
1.	Well Yield:	unknown
2.	Well Pump Capacity:	(0.5 gpm per ERC) The pump is rated at 20 gpm @ 347 feet TDH 20 gpm @ 0.5 gpm per ERC = 40 ERCs or 16,000 gpd

3. Capacity of Caustic Soda Feed System:

$N_1V_1 = N_2V_2$
V_1 = required output of chemical feed pump
N_1 = 50% = 500,000 ppm
V_2 = 20 gpm (well output)
N_2 = 6 ppm (RTW Model - to raise the pH to 7.4)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(20)\ (6)}{500{,}000} = 0.00024 \text{ gpm} = 0.345 \text{ gpd}$$

The 24 gpd diaphragm feed pump is therefore adequate for the caustic soda feed system. The caustic soda will be diluted in the solution tank to achieve a strength compatible with the 24 gpd feed pump.

4. Capacity of Orthophosphate-Polyphosphate Feed System:

Aqua-Mag has a specific weight of 11.4 lb/gal, and a total phosphate concentration of 34.5%. Therefore, the concentration of total phosphate in Aqua-Mag is 471,583 ppm.

$N_1V_1 = N_2V_2$
V_1 = required output of Aqua-Mag feed pump
N_1 = 471,583 ppm
V_2 = 20 gpm (well output)
N_2 = 0.289 ppm (dosage based on water quality - formula from manufacturer)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(0.289)\ (20)}{471{,}583} = 0.0000123 \text{ gpm}$$
$$= 0.018 \text{ gpd}$$

The 24 gpd diaphragm feed pump is therefore adequate for the Aqua-Mag feed system. The Aqua-Mag will be diluted in the solution tank achieve a strength compatible with the 24 gpd feed pump.

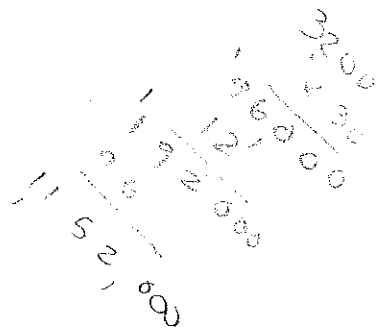
5. Storage Capacity: (200 gallons per ERC)

one 5,000-gallon hydropneumatic tank

Effective Storage Volume:
5,000/3 = 1,667 gallons

Total Effective Storage Capacity:
1,667 gallons @ 200 gallons per ERC =
8 ERCs or 3,200 gpd

The waterworks is limited by the total effective storage capacity to a maximum usage of 8 equivalent residential connections or 3,200 gpd, but is being issued for the existing 23 residential connections and 1 restaurant connection.



VIRGINIA DEPARTMENT OF HEALTH

ENGINEERING DESCRIPTION SHEET

DATE: April 24, 2006

WATERWORKS NAME:	Eastern Goochland Central Water System	**CERTIFIED CLASS:** V	
COUNTY/CITY:	Goochland County	**TYPE:** Community	
LOCATION:	The service area is generally bounded by Route 623 on the west, Route 6 on the south, and the Hanover County line on the north. However, it also includes a 12-inch and 8-inch waterline on River Road, a 16-inch waterline on Broad Street Road west from Route 623 to Route 621, and a 16-inch waterline on Tuckahoe Creek Parkway west of Route 623.		
OWNER:	County of Goochland P. O. Box 119 Goochland, Virginia 23069 **Contact:** Mr. W. Douglas Harvey, P.E., County Engineer **Phone:** (804) 556-5869; **Fax:** (804) 556-5176		
OPERATOR:	Mr. Gerry Anthony Langfitt, Class I **Phone:** (804) 556-5836, Ext. 1; **Fax:** (804) 556-5176		
PERMIT NUMBER:	4075283	Amended	Amended
EFFECTIVE DATE:	07/09/78	11/11/02	05/17/06
TYPE OF TREATMENT:	None		
SOURCE:	Purchased Surface Water – Henrico County		
DESIGN CAPACITY:	3.2 MGD – limited by the total effective storage capacity		

DESCRIPTION OF SYSTEM

This waterworks consists of a 1 MG elevated storage tank, a 0.6 MG elevated storage tank, two in-line booster pumping stations, and the distribution system.

Source

Goochland County has a contract with Henrico County to purchase up to 5.2 MGD of treated surface water. Water is obtained from Henrico County through four waterlines:

A. River Road – 12-inch waterline
B. Patterson Avenue (Route 6) – 16-inch waterline
C. Ridgefield Parkway – 16-inch waterline
D. Broad Street Road (U. S. Route 250) – 16-inch waterline

Storage

A. 1 MG Centerville Elevated Storage Tank - The welded steel 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 -foot diameter tank is 40 feet high and has an effective capacity of 1 MG. The tank is equipped with an altitude valve, an access ladder with a safety climbing device, an atmospheric vent, two 30-inch square access hatches in the tank roof, an overflow line, a drain, a 30-inch diameter manhole through the tank floor, and a sample tap. Cathodic protection, pressure sensors, and a pressure gauge for determining the water level are also provided. 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.

B. 0.6 MG West Creek Elevated Storage Tank – The toro-ellipsoidal welded steel 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-foot diameter tank is 35.5 feet high and has an effective volume of 0.6 MG. The tank is equipped with an atmospheric vent, an access manhole, an overflow line, and a drain. 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.

Pumping

A. Centerville Pumping Station – The pumping station is located on U. S. Route 250, just west of the Henrico County line and approximately 1.5 miles east of its intersection with Route 623 in the Centerville area.

Building
The pump station building is constructed of concrete masonry block with a brick veneer. The controls are housed in a separate room from the main piping and equipment. The building is provided with heat, ventilation, overhead lighting, a drain, and a locked entrance. The pump room is provided with a 3-ton hoist and trolley system, and a roll-up access door.

Booster Pumps, Instrumentation and Controls
The three horizontal, split-case centrifugal pumps are powered by 75-HP motors with variable frequency drives. Each pump is rated for 1,250 gpm @ 110 feet TDH, and is equipped with a butterfly valve and pressure gauge on the suction line, and an electric check valve, butterfly valve and pressure gauge on the discharge line. The three pumps may be alternated either manually or automatically. The pumping station has a firm pumping capacity of 2,500 gpm (two pumps in service).

The 24-inch suction header is provided with an air release valve, a pressure monitoring assembly (pressure gauge, sensor, transducer, sample tap), and a magnetic flow meter. The 24-inch discharge header is provided with a pressure monitoring assembly, a connection to a chlorine residual analyzer, an air release valve, and a surge relief valve. The surge relief valve discharges to a storm sewer drop inlet.

The pumping station is furnished with a Remote Terminal Unit (RTU) that is programmable logic controller (PLC) based. It will interface with the Goochland County SCADA system, once that system is installed.

Emergency Generator
A 300 KW, 480 V diesel powered electrical generator is installed on a concrete slab outside of the building. The generator is designed to power two pumps and all other normal station loads simultaneously. A 1,200-gallon double walled diesel fuel tank is at the base of the generator. The pumping station is furnished with an automatic load transfer switch.

B. River Road Pumping Station – The 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 Drive.

EVALUATION OF THE SYSTEM

Design Criteria: The system is evaluated on the basis of the equivalent residential connection (ERC). One ERC will utilize 400 gallons/day (gpd).

1. Actual Usage: 52,530 gpd (2005)

2. Source Capacity: 5.2 MGD – contract with Henrico County

3. Delivery Capacity:
   a. Centerville Pumping Station – three pumps provided
      Firm pumping capacity – 2,500 gpm (two pumps in service)
   b. River Road Pumping Station – three pumps provided
      Firm pumping capacity – 1,000 gpm (two pumps in service)
   TOTAL: 3,500 gpm

   3,500 gpm x 1,440 minutes/day = 5,040,000 gpd (5.04 MGD)

4. Storage Capacity: (200 gallons/ERC)
   a. Centerville Elevated Storage Tank – 1.0 MG
   b. West Creek Elevated Storage Tank – 0.6 MG
   TOTAL: 1.6 MG

   1.6 MG / 200 gallons/ERC = 8,000 ERCs
   8,000 ERCs x 400 gallons/ERC = 3,200,000 gpd (3.2 MGD)

Based on the calculations above, the permitted capacity is limited by the total effective storage capacity to 3.2 MGD.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE January 27, 2000

WATERWORKS NAME Elk Hill Farm CERTIFIED CLASS N/A

CITY/COUNTY Goochland County TYPE Community

LOCATION Route 6 west to Route 608. Route 608 is approximately 10.6 miles west of U. S. Route 522 (North) at Goochland Courthouse, and approximately 1.0 miles west of Route 606 at George's Tavern. Turn left (south) on Route 608 and proceed approximately 1.5 miles. The entrance road is located on the left, ahead of the railroad tracks.

OWNER Elk Hill Farm, Inc.
P. O. Box 99
Goochland, Virginia 23063
Contact Mr. Michael C. Farley, Executive Director
(Telephone: ~~784-4392~~ 457-4866; Fax: ~~784-2960~~ 457-2836 (9/1/06))

OPERATOR Mr. Patrick Bailey, Maintenance Supervisor

PERMIT NUMBER 4075200 Amended

DATE ISSUED June 24, 1977 February 4, 2000

TYPE OF TREATMENT None

SOURCE Groundwater - one drilled well

DESIGN CAPACITY 12,800 gpd

DESCRIPTION OF SYSTEM:

This 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.

Well: 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. Six-inch casing was installed from +2 feet to 108 feet in depth, and the well was grouted with neat cement from ground level to a depth of 108 feet. This well yielded 11.5 gpm after 24 hours of continuous pumping in a test conducted in October 1973. The well appurtenances include a sanitary seal, a screened casing vent, a check valve, a gate valve, a discharge meter, a blow-off line, and a sample tap.

DESIGN CRITERIA: Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*

1. Design Usage:

60 staff @ 25 gpd/staff	1,500 gpd
50 resident students @ 100 gpd/student	5,000 gpd
20 day students @ 10 gpd/student	200 gpd
Total	6,700 gpd

The following calculations are based on a design water usage of 100 gpd/person.

2. Well Yield: (0.5 gpm per ERC)

16.5 gpm - 12-hour pump test conducted on July 31, 1998
16.5 gpm @ 0.5 gpm per ERC = 33 ERCs or 13,200 gpd
13,200 gpd @ 100 gpd/person = 132 persons

3. Well Pump Capacity: (0.5 gpm per ERC)

1-HP pump, rated at 13 gpm @ 198 feet TDH
The instantaneous output was 16 gpm on December 21, 1999.
16 gpm @ 0.5 gpm per ERC = 32 ERCs or 12,800 gpd
12,800 gpd @ 100 gpd/person = 128 persons

4. Booster Pump Capacity: ($Q = 11.4\ N^{0.544}$)

Two 3-HP pumps, each rated at 78 gpm @ 107 feet TDH
Parallel operation is rated at 148 gpm @ 109 feet TDH
$Q = 11.4\ N^{0.544}$
Q = 148 gpm
N = 111 ERCs or 44,400 gpd
44,000 gpd @ 100 gpd/person = 440 persons

5. Storage Capacity: (200 gallons per ERC)

One 10,000-gallon gravity storage tank
(the effective storage volume is 7,738 gallons)
One 5,000-gallon hydropneumatic tank

Effective storage volume:
7,738 gallons + 1/3(5,000 gallons) = 9,405 gallons
Effective storage capacity:
9,405 gallons @ 200 gallons/ERC = 47 ERCs
47 ERCs x 400 gpd/ERC = 18,800 gpd
18,800 gpd @ 100 gpd/person = 188 persons

This waterworks is limited by the well pump capacity to a maximum usage of 12,800 gpd or 128 persons @ 100 gpd/person.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE April 20, 1995

WATERWORKS NAME Goochland Courthouse CERTIFIED CLASS ~~III~~ V (10/61)

COUNTY/CITY Goochland County TYPE Community

LOCATION On Route 6, just west of its intersection with Route 522, approximately 20 miles west of Richmond.

OWNER County of Goochland
Mr. Gregory K. Wolfrey, County Administrator
P. O. Box 119
Goochland, Virginia 23063

OPERATOR Contact Mr. W. Douglas Harvey, P.E., County Engineer
Telephone: 556-5369

PERMIT NUMBER 403091 4075280

DATE ISSUED 11/6/91 5/4/95

TYPE OF TREATMENT None

SOURCE Purchased water from the James River Correctional Center water treatment plant

DESIGN CAPACITY 250 equivalent residential connections or 0.100 MGD - limited by the source capacity

DESCRIPTION OF SYSTEM:

This waterworks includes a 300,000-gallon elevated storage tank 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 elevated storage tank is located on the west side of Route 6, between the Virginia Correctional Center for Women and the Goochland Courthouse area.

The tank is supplied by the 1.5 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. 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 is approximately 118.33 feet above the ground level. The tank is equipped with a screened overflow pipe, a screened mushroom vent, a drain line with a valve, an access hatch on top of the tank, an access ladder (extending from 10 feet above ground level to the access hatch), an interior ladder extending downward from the access hatch, an access manhole on the riser pipe (3 feet above the base of the riser pipe), a balcony with a railing around the exterior circumference of the tank, two access manholes on the exterior of the tank (180 degrees from each other and 3 feet above the tank balcony), and a water level indicator on the exterior of the tank. The overflow level of this tank is approximately 11 feet below the overflow level of the 0.300 MG tank at the James River Correctional Center water treatment plant, which ensures that water is supplied as needed to the Courthouse elevated tank.

The three wells which formerly served the Goochland Courthouse - Venice Heights waterworks are no longer utilized and have been disconnected from the waterworks. The storage facilities associated with these wells are also no longer utilized.

DESIGN CRITERIA Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1993 Waterworks Regulations

1. Source Capacity:

Source - 1.5 MGD water treatment plant at James River Correctional Center
0.100 MGD allocated to Goochland County to serve the Goochland Courthouse area (see letter dated November 22, 1991 from Mr. Gregory K. Wolfrey, County Administrator)

0.100 MGD (100,000 gpd) @ 400 gpd/ERC = 250 ERCs

2. Effective Storage Capacity: (200 gallons per ERC)

1 - 300,000-gallon elevated storage tank
0.100 MG allocated to Goochland County to serve the Goochland Courthouse area (see letter dated November 22, 1991 from Mr. Gregory K. Wolfrey, County Administrator)

0.100 MG (100,000 gallons) @ 200 gallons/ERC = 500 ERCs or 200,000 gpd

This waterworks is limited by the source capacity to a maximum capacity of 250 equivalent residential connections or 100,000 gpd.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE January 17, 2001

WATERWORKS NAME Hickory Haven CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Community

LOCATION I-64 West to the Rockville-Manakin (Route 623) exit. Turn left (south) on Route 623. Go approximately 0.6 miles to U. S. Route 250. Turn right on U. S. Route 250. Go about 0.2 miles, then turn left to continue south on Route 623. The entrance to the subdivision is on Holly Lane (Route 1006), which is on the left side of Route 623, approximately 0.2 miles south of its intersection with Route U. S. Route 250.

OWNER Mr. H. E. Thompson
11920 Murray Hill Drive
Midlothian, Virginia 23113-2344

OPERATOR Hickory Haven Homeowners Association
c/o Mr. Garland N. Gregory, Sr.
12873 Holly Lane
Manakin-Sabot, Virginia 23103
Telephone: (804) 784-3722

Todd Van der Poel - Class IV
Issued 1/3/03

PERMIT NUMBER	2190	0-830	4075365	401098	Amended
DATE ISSUED	8/2/74	9/2/75	6/24/77	2/18/98	1/26/01

TYPE OF TREATMENT Corrosion Control

SOURCE Groundwater - 2 drilled wells

DESIGN CAPACITY 40 existing residential connections

DESCRIPTION OF SYSTEM:

This waterworks includes two drilled wells, corrosion control facilities, and two 5,000-gallon hydropneumatic tanks, with appropriate appurtenances.

Well No. 1

Well - Well No. 1 is located on the right (south) side of Holly Lane (Route 1006) next door to the Gregory residence at 12873 Holly Lane, and just beyond the intersection of Holly Lane with Birch Road (Route 1008).

The well is constructed from a 12-inch hole drilled to a depth of 50 feet, with a 6-inch hole extended from 50 feet to 300 feet in depth. Six-inch steel casing is installed from +2 feet to 50 feet in depth. The well is grouted with neat cement from ground level to a depth of 50 feet. In May 1960, this well yielded 12 gpm after 24 hours of continuous pumping. The well appurtenances include a sanitary seal, a screened casing vent, a check valve, a gate valve, a discharge meter, and a sample tap. No blow-off is provided.

A 1.5-HP submersible well pump with an unknown rated capacity delivers the water through the neutralizer filters to a 5,000-gallon hydropneumatic tank and the distribution system. Pressure switches on the hydropneumatic tank control the well pump. The settings of the switches are unknown. The well pump output was 3.5 gpm during an instantaneous reading on December 22, 1999.

Well No. 2

Well - Well No. 2 is located on the north side of Cedar Circle, at the far end of a vacant lot. To reach it, turn left from Holly Lane onto Cedar Circle, about 0.1 miles east of the lot for Well No. 1.

The well is constructed from a 12-inch hole drilled to a depth of 50 feet, with a 6-inch hole extended from 50 to 180 feet in depth. Bedrock was encountered at a depth of 44 feet. In December 1962, this well yielded 35 gpm after 24 hours of continuous pumping. The well appurtenances include a sanitary seal, a screened casing vent, a check valve, a gate valve, a discharge meter, and a sample tap. No blow-off is provided.

A 0.5-HP submersible well pump with an unknown rated capacity delivers the water through the corrosion control equipment to a 5,000-gallon hydropneumatic tank and the distribution system. Pressure switches on the hydropneumatic tank control the well pump. The settings of the switches are unknown. The well pump output was 5 gpm during an instantaneous reading on December 22, 1999.

Corrosion Control Equipment - The corrosion control equipment at each well house includes a cartridge-type filter and two neutralizer filters installed in series. The sediment type filter (4.5-inch diameter, 9.75-inch height) is installed upstream of the two neutralizer filters (13-inch diameter, 54-inch height). Each neutralizer filter is an upflow filter, designed for a flow rate of 8 gpm. The filter media is a proprietary blend of calcium carbonates and magnesium oxides. Sample taps and pressure gauges are installed both upstream and downstream of the filters. The filters may be bypassed.

When necessary, backwash water is provided from the hydropneumatic tanks. The backwash water is discharged through the floor drains to the ground surface.

Storage - The storage facilities at each well house include a 5,000-gallon hydropneumatic tank. Appurtenances to each 5,000-gallon hydropneumatic tank include an access manhole, a sample tap, a pressure gauge, a sight glass, an air release valve, a vacuum release valve, and a drain.

Well Houses - The wells, the corrosion control equipment, and the operational end of each hydropneumatic tank are housed in 10-ft x 10-ft x 8-ft concrete block well houses. Each well house includes lighting, heat, drainage, and overhead access to the well.

DESIGN CRITERIA: Equivalent Residential Connection (ERC) = 400 gpd, in accordance with the 1995 *Waterworks Regulations*

1. Existing Connections: 40 residential connections

2. Well Yield: (0.5 gpm per ERC)
   Well No. 1: 12 gpm for 24 continuous hours of pumping - 1960
   Well No. 2: 35 gpm for 24 continuous hours of pumping - 1962
   47 gpm - Total Well Yield

   47 gpm at 0.5 gpm/ERC = 94 ERCs or 37,600 gpd

3. Well Pump Capacity: (0.5 gpm per ERC)
   Well No. 1: 3.5 gpm - instantaneous output on 12/22/99
   Well No. 2: 5.0 gpm - instantaneous output on 12/22/99
   8.5 gpm - Total Well Pump Capacity

   8.5 gpm at 0.5 gpm/ERC = 17 ERCs or 6,800 gpd

4. Storage Capacity: (200 gallons per ERC)

   Two 5,000-gallon hydropneumatic storage tanks
   Effective Storage Volume: 2(1/3 x 5,000) = 3,333 gallons
   Effective Storage Capacity:
   3,333 gallons @ 200 gallons/ERC = 17 ERCs or 6,800 gpd

5. Capacity of Neutralizer Filters: (0.5 gpm per ERC)

	Well No. 1	Well No. 2
No. of Filters	2	2
Diameter	13 inches	13 inches
Area	0.92 ft^2	0.92 ft^2
Filtration Capacity	8 gpm*	8 gpm*

*Manufacturer's literature

Total Filtration Rate: 16 gpm
16 gpm @ 0.5 gpm/ERC = 32 ERCs or 12,800 gpd

This waterworks is limited by the well pump capacity and the effective storage capacity to a maximum capacity of 17 equivalent residential connections or 6,800 gpd. However, it is being permitted for the 40 existing residential connections.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE July 16, 1998

WATERWORKS NAME James River Correctional Center Water Treatment Plant

CERTIFIED CLASS II

CITY/COUNTY Goochland County

TYPE Community

LOCATION Route 6 west, approximately 1.9 miles west of Crozier. The entrance road to the water treatment plant is a gravel road located at the base of the elevated storage tank, on the north side of Route 6 and approximately 0.2 miles beyond the main entrance to James River Correctional Center.

OWNER Commonwealth of Virginia Department of Corrections
James River Correctional Center
State Farm, Virginia 23160
Mr. ~~Sam Prunty~~ J. D. Netherland, Warden (Telephone: 784-3551)

OPERATOR Mr. Randy Wilson, Water Systems Treatment Plant Supervisor
Telephone: 784-3551, Ext. 2283 2298 Fax 556-5168
321-7997 or 784-3540 2299 - Randy Wilson

PERMIT NUMBER	63A	492	1021	0-833	4075735	403091
DATE ISSUED	10/11/20	6/17/48	9/9/59	8/21/75	6/24/77	11/6/91

PERMIT NUMBER	4075735-A	401297	4075735-A
DATE ISSUED	11/20/95	3/5/97	7/27/98

TYPE OF TREATMENT flocculation, sedimentation, filtration, chlorination, and corrosion control

SOURCE Surface Water - Beaverdam Creek (primary) and James River (secondary)

DESIGN CAPACITY 1.5 MGD @ 2 gpm/ft^2

DESCRIPTION OF SYSTEM:

RAW WATER WITHDRAWAL

The main sources of supply for this waterworks are Beaverdam Creek and Courthouse Creek, which have a combined drainage area of 42 square miles above the confluence of the creeks. The screened intake is located below the point of confluence of the two creeks and just above a small dam on Beaverdam Creek. The intake structure is part of the western wing wall of the dam. The invert of the 18-inch intake pipe is about 1 foot above the stream bed. Creek water flows by gravity through the intake to the raw water pump station. Two electrically driven deep well turbine pumps, each rated at 1,200 gpm (1.728 MGD) @ 40 feet TDH, deliver water to the nearby treatment plant. An earthen levee has been constructed between the raw water pumping station and Beaverdam Creek for flood protection.

A secondary intake is located on the James River, at the site of the bridge between James River Correctional Center and Powhatan Correctional Center. It consists of a portable 50-HP pump with a capacity of 600 gpm (0.864 MGD) @ 259 feet TDH.

The pump conveys river water through a 6-inch waterline to the 18-inch gravity line between Beaverdam Creek and the raw water pump station.

TREATMENT WORKS

Coagulation

Alum, soda ash, and chlorine are added to the raw water inlet pipe in the WTP basement just prior to its entry into the covered basin called the "mixing flume". There is no mechanical mixer in this basin. The "mixing flume" provides a detention period of 55 seconds at the plant design rate of 1.5 mgd.

Flocculation

Two covered concrete flocculation basins (each 13.5-ft x 13.5-ft x 12-ft SWD) operate in series to provide tapered flocculation. The flocculation basins provide a detention time of approximately 31 minutes at the design flow of 1.5 mgd. Each basin is equipped with one set of horizontally mounted turbine type paddles with a four-speed drive system. The drive systems in the first and second flocculation basins normally operate at 580 rpm and 430 rpm, respectively.

Sedimentation

The two parallel sedimentation basins (each 73-ft x 18-ft x 12.5-ft SWD (avg)) provide a detention time of 4 hours at the design flow of 1.5 mgd.

Filtration and Clearwell

The settled water is filtered by two rapid sand filters with Wheeler false bottom underdrain systems. Each filter has an area of 270 ft^2 (18 ft x 15 ft), and has a capacity of 0.75 mgd at a design filtration rate of 2.0 gpm/ft^2. Chlorine, soda ash, and hexametaphosphate (corrosion inhibitor) are added to the filtered water as it flows by gravity into the 103,000-gallon clearwell-sump area (30.85-ft x 37-ft x 9.5-ft (clearwell) + 16.8-ft x 16.8-ft x 11-ft (sump area)).

Finished Water Pumps

The finished water is pumped by two 125-HP high service pumps, each rated at 1,200 gpm (1.728 mgd) @ 310 feet TDH, through a 12-inch waterline to the 300,000-gallon elevated storage tank. The tank is located at the intersection of Route 6 and the WTP access road. Bypass piping is provided.

Chemical Feed Equipment

The chemical feed equipment includes dry chemical feeders for alum and soda ash, a diaphragm pump for the hexametaphosphate solution, and two gaseous chlorinators for pre- and post-chlorination. The rotameters for pre- and post-chlorination have capacities of 100 lb/day and 25 lb/day, respectively.

Filter Backwash

A 200 gpm turbine-type pump located in the WTP pipe gallery discharges finished water to an on-site 60,000-gallon elevated washwater tank. Each filter is backwashed directly from the tank by gravity flow. The backwash water is conveyed to the plant drain pump station. Equipped with two submersible pumps (10.5-inch impeller), each powered by a 30-HP motor and rated at 1,300 gpm at system head conditions, the plant drain pump station delivers wastes to the two 120,000-gallon backwash lagoons. The supernatant from the lagoons is discharged into Beaverdam Creek, approximately 300 feet downstream of the raw water intake. The sludge collected from the lagoons is dried and transported to a landfill for disposal.

Emergency Power
An emergency electrical generator with sufficient power to operate the water treatment plant (WTP) is located on the west side of the sedimentation basins.

Laboratory
The on-site laboratory performs essential routine chemical control. A continuous residual chlorine monitor for the finished water is installed there.

DISTRIBUTION AND STORAGE

Waterlines to the Service Areas
Waterlines from the 300,000-gallon elevated storage tank at James River Correctional Center extend westward (8-inch) to serve the Virginia Correctional Center for Women (VCCW) and the Goochland Courthouse service area; eastward (10-inch) to serve the Training Academy and the Work Release Facility; and southward (8-inch) 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 to the above mentioned facilities and service area (with the exception of the Training Academy and Deep Meadows Correctional Center) are monitored by individual water meters.

200,000-Gallon Ground Storage Tank - Powhatan Correctional Center
A 200,000-gallon concrete ground storage tank at Powhatan Correctional Center receives water from JRCC. Water is pumped from this tank to a 200,000-gallon and a 100,000-gallon elevated steel tank by two 5-stage turbine pumps, each rated at 500 gpm @ 180 feet TDH. Eight (8)-inch and 12-inch waterlines interconnect the distribution systems for Powhatan Correctional Center and Deep Meadows Correctional Center.

In-Line Booster Station - Virginia Correctional Center for Women
An in-line booster station, located on Route 6 approximately 100 feet east of the paved entrance road to the Virginia Correctional Center for Women, boosts the pressure of water conveyed to the Goochland Courthouse service area, and to Beaumont Juvenile Correctional Center in Powhatan County. The increased pressure allows the 200,000-gallon elevated storage tank at Beaumont Juvenile Correctional Center and the 300,000-gallon elevated storage tank at Goochland Courthouse to be filled.

Two centrifugal pumps are housed in a 12-ft X 9-ft X 6-ft precast concrete vault. Appurtenances to the vault include a drain, a lockable cover, and two access ladders. Each pump is rated at 275 gpm @ 100 feet TDH, and powered by a 15-HP motor. Appurtenances to each pump include a low pressure cut-off switch, a compound guage, and a gate valve on the suction side, and a check valve, a gate valve, an air relief valve, and a pressure guage on the discharge side. The pumps take suction from and discharge to an 8-inch waterline.

An automatic electrically-actuated control valve, installed in a 4-ft diameter precast manhole upstream of the secondary metering facility for the Courthouse area, control flows to the 300,000-gallon elevated tank which serves the Goochland Courthouse area.

A pressure reducing valve (PRV) is installed in a 10.25-ft x 5 -ft x 5.75-ft concrete vault on the 8-inch waterline which serves Beaumont Juvenile

Correctional Center. It is set to keep the maximum pressure at 80 psi. Appurtenances to the vault include a lockable hatch and an access ladder.

DESIGN CRITERIA Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*

I. Safe Yield

A. Primary Source - Beaverdam Creek

No safe yield criteria or withdrawal limit has been set by the Department of Environmental Quality (DEQ).

B. Secondary Source - James River

No safe yield criteria or withdrawal limit has been set by the DEQ.

II. Raw Water Pumping Capacity:

A. Primary: Two pumps, each with a capacity of 1.728 MGD.

B. Secondary: One 0.864 MGD pump for emergency service.

III. Filtration Capacity:

Filter No. 1 rated at 0.75 MGD
Filter No. 2 rated at 0.75 MGD
Total Filtration Capacity - 1.50 MGD

IV. Finished Water Pump Capacity:

A. High Service Pumps - Two constant speed pumps, each rated at 1.728 MGD @ 310 feet TDH. They transfer water from the clearwell to a 300,000-gallon elevated storage tank for the distribution system.

B. Backwash Supply Pump - One 0.288 MGD turbine pump furnishes clearwell water for the backwash tank.

V. Booster Pump Capacity:

A. Powhatan Correctional Center

Two 5-stage deep well pumps, each rated at 500 gpm (0.72 MGD) @ 180 feet TDH, transfer water from a concrete ground storage tank to two elevated tanks.

B. Virginia Correctional Center for Women (VCCW)

Two centrifugal pumps, each rated at 275 gpm @ 100 feet TDH, and each powered by a 15-HP motor, transfer water to the on-site 300,000-gallon elevated tank for VCCW and Goochland Courthouse, and to the 200,000-gallon elevated tank at Beaumont Juvenile Correctional Center.

VI. Storage Capacity: (200 gallons per ERC)

	Capacity
James River Correctional Center:	
Elevated Tank	0.300 Mgal
Powhatan Correctional Center:	
One 200,000-gallon elevated Tank	0.200 Mgal
One 100,000-gallon elevated Tank	0.100 Mgal
Concrete Ground Staorage Tank	0.200 Mgal
Virginia Correctional Center for Women	
Elevated Tank	0.200*Mgal
Beaumont Juvenile Correctional Center	
Elevated Tank	0.200 Mgal
Total Storage	1.200 Mgal

Total Effective Storage Capacity:
1.200 Mgal @ 200 gal/ERC = 6,000 ERCs or 2.400 MGD

*Additional 0.100 Mgal is allocated to Goochland County for the Goochland Courthouse waterworks (PWS ID No. 4075280)

VII. Approximate population served (June 1998): 7,460 persons

	Water Distribution Area	Population Served
(1)	James River Correctional Center (JRCC)	673
(2)	Powhatan Correctional Center & Receiving Unit	1,950
(3)	Deep Meadow Correctional Center	1,168
(4)	Virginia Correctional Center for Women (VCCW)	989
(5)	Goochland Courthouse	1,500
(6)	Beaumont Juvenile Correctional Center	589
(7)	Work Release Center	340
(8)	Training Academy	198
	Total	7,460

This water treatment plant is limited by the filtration capacity to a maximum usage of 1.5 mgd.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET
of Proposed Construction

DATE: 2 September 2004

WATERWORKS NAME:	James River Correctional Center Water Treatment Plant	CERTIFIED CLASS: II
PERMIT NUMBER:	402204	
EFFECTIVE DATE:	20 September 2004	
EXPIRATION DATE:	20 September 2009	
SOURCE:	Surface Water - James River	

DESCRIPTION OF PROJECT

This project consists of the construction of a surface water treatment plant employing conventional treatment. It also includes the installation of a raw water intake on the James River.

The treatment scheme consists of pre-oxidation with potassium permanganate injection into the raw water transmission main, coagulation with alum in one rapid mix basin, combined flocculation and sedimentation in dual solids contact clarifiers (Superpulsator®), dual media gravity filtration using three filters, and disinfection with chlorine. Fluoridation is included, and hexametaphosphate is added for corrosion control.

Raw Water Intake & Pump Station

A. Intake Screens
- Quantity: 3
- Type: 18-inch max. diameter, wedge-wire tee screens with max. 1-mm slot openings
- Capacity: 1146 gpm/each, 3438 gpm (4.95 mgd) total @ max. 0.24 fps through-slot velocity
- Appurtenances: air-backwash cleaning system consisting of 3.6-cfm air compressor and 400-gal receiver tank in pump station

B. Raw Water Pumps
- Quantity: 2
- Type: submersible
- Rating: 2292 gpm (3.30 mgd)@ 152 ft TDH each pump
- Motor: 125 HP; 1750 rpm constant speed
- Appurtenances: sump level controls, pump removal guide rails

- Separate valve vault for pump discharge check and butterfly valves, common purge valve (electrically-operated butterfly) and surge relief valve

C. Potassium Permanganate Feed System
- Function: pre-oxidant for manganese, biocide
- Application Point: 12-inch raw water pipe in valve vault
- Feed Equipment: one installed diaphragm metering pump rated at 6.5 gph with variable speed drive, flow paced from raw water; 50 gal saturator tank
- Storage: pallets of dry (bagged) chemical

D. Emergency Generator
- Quantity: 1
- Type: skid-mounted, diesel engine driven
- Capacity: 230 KW
- Equipment powered: lights, heat, air compressors, metering pump, 1 raw water pump

Water Treatment Plant

E. Rapid Mix
- Quantity: 1 single-stage basin
- Dimensions: 6 ft – 8 in x 7 ft – 6 in x 19 ft – 6 in SWD
- Detention Time T: 191 sec @ 3.3 MGD
- Appurtenances: vertical shaft, pitched blade turbine mixer with 2-HP motor with variable frequency drive

F. Flocculation & Sedimentation (Superpulsator®)
- Quantity: 2 basins
- Dimensions: 32 ft x 16 ft x 17 ft SWD
- Detention Time T: 32min @ 3.3 MGD
- Surface Loading Rate: 2.39 gpm / sf

G. Filtration
- Quantity: 3 filters
- Surface Area: 196 sf [14 ft x 14 ft] each filter
- Filtration Rate: @ 4.0 gpm/sf for each filter = 3.40 mgd total
- Media: 42 inches Granular Activated Carbon, 12 inches sand
- Appurtenances: Air & Water Backwash system including one 800 scfm positive displacement blower, 10-inch backwash control valve
- Max. backwash rate = 20 gpm/sf , Max. airwash rate = 4 scfm/sf

H. Clearwells
- Quantity: 2 tanks
- Capacity (each): 15 ft diameter x 19 ft max. depth; 100,000 gal
- Appurtenances: concentric baffles in each tank (Baffling Factor = 1); separate influent, effluent, overflow and drain lines, vent, external ladder, cathodic protection system

I. Chemical Feed Systems

1. Aluminum Sulfate (liquid Alum)
   - Function: 1° coagulant
   - Application Point: rapid mix basin
   - Feed Equipment: two diaphragm metering pumps rated at 21 gph with variable speed drives, flow paced from plant influent
   - Storage: heated fiberglass-reinforced plastic tank, 8,000 gal total capacity

2. Sodium Hydroxide (Caustic Soda)
   - Function: pH adjustment
   - Application Points:1) rapid mix basin; 2) 16-inch combined filtered water pipe
   - Feed Equipment: one installed diaphragm metering pump rated at 19 gph, flow paced from plant influent and combined filter flow rate
   - Storage: heated fiberglass-reinforced plastic tank, 11,000 gal total capacity

3. Lime/Soda Ash
   - Function: pH adjustment
   - Application Points: 1) 16-inch raw water pipe 2) 16-inch combined filtered water pipe
   - Feed Equipment: one volumetric feeder rated at 80 lb/hr; 50 gal solution tank with ¼- hp mixer and solution feed pump rated at 36 – 230 gph, flow paced from plant influent
   - Storage: pallets of dry (bagged) chemical

4. Polymer
   - Function: 1) coagulant aid; 2) filter aid
   - Application Points: 1) rapid mix basin effluent weirs; 2)clarifier effluent junction box
   - Feed Equipment: two hydrodynamic blending units to activate and dilute neat polymer. Units include neat polymer metering pump with 0.02 – 0.60 GPH range; dilution water max. 300 gph; flow paced from plant influent
   - Storage: 55-gal drums

5. Chlorine
   - Function: 1° disinfection
   - Application Points: 1) 16-inch raw water pipe ; 2) clarifier effluent junction box; 3) 16-inch combined filtered water pipe
   - Feed Equipment: one auto cylinder changeover; three vacuum chlorinators with valve positioners and solution ejectors; manually controlled for raw water and applied water, controlled by plant computer (chlorine analyzer) for post-filter
   - Storage: 1-ton cylinders on storage trunnions

6. Hexametaphosphate
   - Function: corrosion inhibitor
   - Application Point: 16-inch combined filtered water pipe
   - Feed Equipment: one installed diaphragm metering pump rated at 0.8 gph, with variable speed drive and flow paced from combined filter flow rate
   - Storage: 55-gal drums

7. Fluoride
   - Function: fluoride addition
   - Application Point: 16-inch combined filtered water pipe
   - Feed Equipment: one installed diaphragm metering pump rated at 1 gph with variable speed drive; flow paced from combined filter flow rate
   - Storage: 55-gal drum with scale

8. Sodium Sulfite
   - Function: dechlorination of washwater waste
   - Application Point: 16-inch filtered waste pipe
   - Feed Equipment: one 210 gal polyethylene solution tank; one installed diaphragm metering pump rated at 14.1 gph with variable speed drive; on/off control from computer or manual
   - Storage: pallets of dry (bagged) chemical

Chemical	Max. Dose	Maximum Feed Capacity	Solution Properties	Maximum Treatment Capacity
Aluminum Sulfate	100 mg/l	1 metering pump[2] @ 21 gph/pump	48.5 %, 11.1 lb/gal	6.71 MGD
Sodium Hydroxide	38.2 mg/l	1 metering pump @ 19 gph	25%, 2.6 lb/gal	3.72 MGD
Lime Soda Ash	35 mg/l 50 mg/l	1 feeder @ 80 lb/hr; 1 metering pump @ 200 gph	0.5 lb/gal solution	6.58 MGD[3] 4.60 MGD[3]
Polymer • coagulant aid • filter aid	 1 mg/l 1 mg/l	 2 blend units @ 0.02 – 0.60 gph/blend unit	30%, 2.7 lb/gal	 4.66 MGD 4.66 MGD
Chlorine	15 mg/l [1]	2 chlorinators[2]@ 400 lb/d/chlorinator	NA – gas feed	6.39 MGD
Hexametaphosphate	2 mg/l	1 metering pump @ 0.8 gph	10 lb/gal	11.5 MGD
Fluoride	1 mg/l	1 metering pump @ 1 gph	23.7% hydrofluosilic acid; 1.8 lb F^-/gal	5.18 MGD
Potassium Permanganate	3.0 mg/l	1 metering pump @ 6.5 gph	0.54 lb/gal @ 20°C	3.37 MGD

[1] Maximum dose per *Waterworks Regulations.*
[2] Firm capacity with one feeder out of service.
[3] Volumetric feeder capacity

J. Finished Water Pumps
   - Quantity: 2
   - Type: horizontal, split case centrifugal
   - Rating: 2083 gpm @ 244 ft TDH
   - Motor: 200 HP, 1770 rpm constant speed
   - Appurtenances: flow control valves, butterfly valves, pressure gauges, flowmeter

K. Sludge Storage and Washwater Waste Basins - existing

L. Emergency Generator
- Quantity: 1
- Type: skid-mounted, diesel engine driven
- Capacity: 500 KW
- Equipment powered: lights, HVAC, 2 vacuum pumps (Superpulsator), 1 finished water pump

M. Process Instrumentation & Controls
- Distributed Control System
- Analytical Instruments:
  1. Turbidity Monitors
     Raw Water – 1
     Settled Water – 2
     Filtered Water – 4 (3 filters + 1 combined filters)
     Finished Water (Service Pump Suction) - 1
  2. Chlorine Analyzer & Transmitter:
     Finished Water (Clearwell Inlet) - 1
     Finished Water (Service Pump Suction) - 1
  3. pH Analyzers
     Raw Water – 1
     Mixed Water – 1
     Finished Water (Service Pump Discharge) - 1
  4. Streaming Current Monitor (SCM): Raw Water -1
- Field Instruments:
  1. Flow Meters & Transmitters
     Raw Water – 1
     Finished Water (Service Pump Discharge) - 1
  2. Level Meters & Transmitters
     Alum Tank - 1
     Caustic Soda Tank - 1
     Clearwells - 2
  3. Pressure Transmitter – Finished Water (Service Pump Discharge) - 1
  4. Differential Pressure Transmitters – Filters -3

PROJECT CAPACITY EVALUATION

1. Source Capacity
   a. Raw Water Withdrawal Permit No. 02-V2288 (DEQ/VMRC/COE):
      Maximum Daily Withdrawal = 2.0 Mgal
      Maximum Instantaneous Withdrawal Rate = 2,292 gpm (3.3 mgd) } withdrawal limit = 2.0 mgd
      Maximum Annual Withdrawal = 730 Mgal

   b. Intake Screens: three, @ through velocity = 0.24 fps, total capacity = 4.95 mgd

   c. Raw Water Pumps: two @ 3.3 mgd/pump firm capacity = 3.3 mgd

2. Treatment Capacity
   a. Rapid Mix: 1 basin; Vol = 7300 gal
      @ T_{det} = 3.18 min
      7300 gal / 3.18 min = 2300 gpm = 3.3 mgd

   b. Flocculation/Sedimentation: 2 basins; SA = 510 sf/basin
      @ SOR = 2.39 gpm/sf
      2 (510 sf/basin) (2.39 gpm/sf) = 2440 gpm = 3.5 mgd

   c. Filtration: 3 Filters; Surface Area = 196 sf/filter
      @ Loading Rate = 4.0 gpm/sf,
      (3 filters)(196 sf/filter)(4.0 gpm/sf) = 2350 gpm = 3.4 mgd

3. Transfer Capacity
   Service Water Pumps: two @ 3.0 mgd/pump firm capacity = 3.0 mgd

The capacity of the water treatment plant is limited by the high service pumps to 3.0 mgd. However, the DEQ Withdrawal Permit limits the plant to a maximum daily production of 2.0 Mgal, with a peak instantaneous withdrawal rate of 3.3 mgd.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: February 5, 2008

WATERWORKS NAME:	James River Correctional Center Water Treatment Plant	**WATERWORKS CLASS:** II	
COUNTY/CITY:	Goochland County	**TYPE:** Community	

LOCATION: Route 6 west, approximately 1.9 miles west of Crozier. The entrance road to the water treatment plant is a paved road located at the base of the elevated storage tank, on the north side of Route 6 and approximately 0.2 miles beyond the main entrance to James River Correctional Center.

OWNER: State of Virginia – Department of Corrections
Contact: Mr. Timothy Newton, Environmental Services Administrator
6900 Atmore Drive
Richmond, Virginia 23225
Phone: (804) 674-3102

OPERATOR: Licensed Class II Operator Required
Mr. Herbert Lee Puett, Class II (Water Treatment Plant Supervisor)
Phone: (804) 556-5778

PERMIT NUMBER:	63A	492	1021	0-833	4075735	Amended	Amended
EFFECTIVE DATE:	10/11/20	6/17/48	9/9/59	8/21/75	6/24/77	11/20/95	7/27/98

PERMIT NUMBER	402204	4075735T
EFFECTIVE DATE:	9/20/04	2/15/08

TYPE OF TREATMENT: coagulation, combined flocculation and sedimentation, filtration, disinfection, fluoridation, corrosion control

SOURCE: Surface water – James River

DESIGN CAPACITY: 1.8 MGD with a maximum filtration rate of 2.0 gpm/ft^2

DESCRIPTION OF THE WATERWORKS

The waterworks consists of a raw water intake and pumping station, combined flocculation and sedimentation, filtration, three clearwells, and a finished water pumping station.

Raw Water Source
The water treatment plant withdraws water from the James River under Virginia Water Protection Individual Permit No. 02-V2288 with a limit of 2.0 MGD.

Compliance with the conditions and requirements of the Virginia Water Protection Individual Permit shall not limit the authority of the Health Department to assign a capacity to the waterworks, based on the evaluation as follows.

Intake
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.

Raw Water Pumping Station
Two submersible pumps, each rated at 2,292 gpm (3.30 MGD) @ 152 feet TDH and powered by a 125-HP motor, deliver water to the water treatment plant. Appurtenances to each pump include a check valve and a butterfly valve on the discharge line. A potassium permanganate feed system, consisting of a 6.5 gph diaphragm metering pump and a 50-gallon saturator tank, is housed at the pumping station. The feed system is paced by the raw water flow.

The raw water pumps and the potassium permanganate feed system are housed in a 25.3-ft x 20-ft x 12-ft brick building. The building is equipped with lighting, heat, ventilation, and guide rails for pump removal. The check valves, butterfly valves, and the potassium permanganate solution injection point are housed in a 12-ft x 13.5-ft x 6.5-ft concrete valve box located outside of the pumping station.

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 rapid mix and Superpulsator® units are installed outside of the main building, and the filters are installed inside of the main building.

Rapid Mix
The 6.67-ft x 7.5-ft x 19.5-ft rapid mix basin is located at the head of the two Superpulsator® units. The vertical shaft turbine mixer is powered by a 2-HP motor. The basin provides a detention time of 191 seconds at the design flow of 3.3 MGD.

Flocculation & Sedimentation
Two parallel Superpulsator® units, each 32-ft x 16-ft x 17-ft, provide a surface overflow rate of 2.25 gpm/ft^2 and a detention time of 44 minutes at the design flow of 3.3 MGD. Three 3-HP vacuum pumps, each with a capacity of 79 scfm @ 40" water column, pulsate the sludge blanket. The waste sludge, when extracted, is conveyed to the two backwash lagoons.

Filtration
Three parallel 14-ft x 14-ft high-rate (4.0 gpm/ft^2) filters are installed. The filter media consists of 42 inches of granular activated carbon and 12 inches of sand. The backwash operations include air scour followed by water backwash. Two 800-cfm blowers are provided for the air scour (4 scfm/ft^2). Two backwash pumps, each rated at 2,083 gpm @ 244 ft TDH, are provided for the water backwash. A 3,920 gpm flow control valve limits the backwash rate to 20 gpm/ft^2. The backwash wastes are conveyed by a 16-inch ductile iron line to the two backwash lagoons.

Clearwells
A 16-inch ductile iron line conveys the water from the filters to three 100,000-gallon welded steel tanks (15-ft. diameter, 19-ft max. water depth) constructed in parallel across from the parking lot for the main treatment plant building. The tank interiors are provided with two circular concentric baffles to maximize CT. Appurtenances to each tank include a mushroom vent, a screened overflow pipe, an external access ladder to an access manway, a valved drain line, and a cathodic protection system.

Finished Water Pumping Station
Two horizontal, split case centrifugal pumps are installed in parallel. Each pump is rated at 2,083 gpm (3.0 MGD) @ 244 feet TDH, and is powered by a 200-HP motor. Appurtenances to each pump include butterfly valves and pressure gauges on the suction and discharge lines, and a check valve on the discharge line.

The finished water pumps are housed in a 30-ft x 20-ft x 12-ft brick building constructed beside the three clearwell tanks. Appurtenances to the building include lighting, heat, ventilation, a floor drain, and a hoist and trolley system for pump removal.

Sludge Storage

Two 120,000-gallon backwash lagoons are provided for plant wastes. The supernatant from the lagoons is discharged into Beaverdam Creek under VPDES Permit No. VA0006149. The sludge collected from the lagoons is dried and transported to a landfill for disposal.

Chemical Feed Systems

1. Potassium Permanganate
    A. Function: preoxidation for iron and manganese control
    B. Application Point: raw water main at the raw water pumping station
    C. Feed Equipment: a volumetric feeder with a 50-gallon saturator tanks; a 6.5 gph diaphragm metering pump
    D. Storage: 5-gallon buckets of dry chemical

2. Aluminum Sulfate (liquid Alum)
    A. Function: primary coagulant
    B. Application Point: rapid mix basin
    C. Feed Equipment: two diaphragm metering pumps rated at 22.5 gph with variable speed drives, flow paced from plant influent
    D. Storage: heated fiberglass-reinforced plastic tank, 8,000 gallons total capacity

3. Sodium Hydroxide (Caustic Soda)
    A. Function: pH adjustment
    B. Application Points:1) rapid mix basin; 2) 16-inch combined filtered water pipe
    C. Feed Equipment: one installed diaphragm metering pump rated at 5 gph (120 gpd), flow paced from plant influent and one diaphragm metering pump rated at 22.5 gph (post-caustic soda), manually controlled
    D. Storage: heated fiberglass-reinforced plastic tank, 11,000 gallons total capacity

4. Lime/Soda Ash
    A. Function: pH adjustment
    B. Application Points: 1) 16-inch raw water pipe 2) 16-inch combined filtered water pipe
    C. Feed Equipment: one volumetric feeder rated at 80 lb/hr; 50 gallon solution tank with ¼- hp mixer and solution feed pump rated at 36 – 230 gph, flow paced from plant influent
    D. Storage: pallets of dry (bagged) chemical

5. Polymer
    A. Function: 1) coagulant aid; 2) filter aid
    B. Application Points: 1) rapid mix basin effluent weirs; 2) clarifier effluent junction box
    C. Feed Equipment: two hydrodynamic blending units to activate and dilute neat polymer. Units include neat polymer metering pump with 0.02 – 0.92 gph range; dilution water max. 300 gph; flow paced from plant influent
    D. Storage: 55-gallon drums

6. Chlorine
    A. Function: primary disinfection
    B. Application Points: 1) 16-inch raw water pipe ; 2) clarifier effluent junction box; 3) 16-inch combined filtered water pipe
    C. Feed Equipment: one auto cylinder changeover; three vacuum chlorinators with valve positioners and solution ejectors; manually controlled for raw water and applied water, controlled by plant computer (chlorine analyzer) for finished water
    D. Storage: 1-ton cylinders on storage trunnions

7. Blended Phosphate (Aqua-Mag)
    A. Function: corrosion inhibitor
    B. Application Point: 16-inch combined filtered water pipe
    C. Feed Equipment: one installed diaphragm metering pump rated at 0.92 gph, manually controlled
    D. Storage: 55-gal drums

8. Fluoride
    A. Function: fluoride addition
    B. Application Point: 16-inch combined filtered water pipe
    C. Feed Equipment: one installed diaphragm metering pump rated at 1 gph with variable speed drive; flow paced from combined filter flow rate
    D. Storage: 55-gallon drum with scale

9. Sodium Sulfite
    A. Function: dechlorination of washwater waste
    B. Application Point: 16-inch filtered waste pipe
    C. Feed Equipment: one 210 gallon polyethylene solution tank; one installed diaphragm metering pump rated at 21 gph (504 gpd) with variable speed drive; on/off control from computer or manual
    D. Storage: pallets of dry (bagged) chemical

Continuous Monitoring Instrumentation

1. Raw Water – pH and turbidity (at raw water pump station); flow, also streaming current monitor (at WTP)
2. Mixed Water – pH
3. Settled Water – turbidity (each Superpulsator)
4. Filtered Water – turbidity (each filter + combined filters)
5. Finished Water – pH, turbidity, chlorine

Data from the wall mounted units are transmitted to the SCADA system as well as being readable on-site.

SCADA System

In addition to the above, the SCADA system monitors water flows, chemical dosages, chemical tank levels, pump operations, clearwell levels, off-site water tank levels, etc. It allows to operators to control pump operations, chemical feed dosages, and valves. The monitoring units are located in the operator control room and in the chief operator's office.

Laboratory

The on-site laboratory performs essential routine chemical control. The equipment has the capability of analyzing pH, turbidity, hardness, chlorine, fluoride, iron, and manganese.

Emergency Power

1. Raw Water Pumping Station – 230 kW diesel generator – will power one raw water pump, as well as the lights, heat, air compressors and metering pump at the pumping station. A 1,400-gallon fuel tank is located beside the generator.
2. Water Treatment Plant – 500 kW diesel generator – will power one finished water pump, the two vacuum pumps for the Superpulsators, lights, HVAC unit, and the SCADA system. A 2,500-gallon fuel tank is located beside the generator.

DISTRIBUTION AND STORAGE

Waterlines to the Service Areas

Flows to the below mentioned facilities and service area (with the exception of the Training Academy and Deep Meadows Correctional Center) are monitored by individual water meters.

Waterline Diameter	Waterline Extends From	Waterline Serves	Waterline also serves
8 inches	300,000-gallon elevated tank at James River Correctional Center (JRCC)	James River Correctional Center	
10 inches	300,000-gallon elevated tank at JRCC	Training Academy	Work Release Center
8 inches	300,000-gallon elevated tank at JRCC	Virginia Correctional Center for Women (VCCW)	In-line booster station at VCCW
8 inches	In-line booster station at VCCW	0.3 MG elevated tank at VCCW	Goochland Courthouse (consecutive connection)
8 inches and 6 inches	In-line booster station at VCCW	Beaumont Juvenile Correctional Center	0.2 MG elevated tank at Beaumont
6 inches	8-inch waterline serving JRCC	Powhatan Correctional Center	0.2 MG ground storage tank at Powhatan Correctional Center
12 inches and 8 inches	6-inch waterline serving Powhatan Correctional Center	Deep Meadows Correctional Center	
6 inches	500 gpm booster pumping station at Powhatan Correctional Center	0.2 MG and 0.1 MG elevated tanks at Powhatan Correctional Center	

In-line Booster Stations

1. Powhatan Correctional Center – Two 5-stage turbine pumps, each rated at 500 gpm @ 180 ft TDH, are housed in a 6-ft x 6-ft brick structure that sits on top of the 200,000-gallon ground storage tank. The pumps fill the on-site 0.2 MG and 0.1 MG elevated storage tanks at Powhatan Correctional Center.
2. Virginia Correctional Center for Women – Two centrifugal pumps, each rated at 275 gpm @ 100 ft TDH, and each powered by a 15-HP motor, are housed in a 12-ft x 9-ft precast concrete vault. The pumps take suction from an 8-inch waterline and fill the on-site 0.3 MG elevated storage tank that serves Goochland Courthouse and the 0.2 MG elevated storage tank at Beaumont Juvenile Correctional Center.

   Appurtenances to each pump include a low pressure cut-off switch, a compound gauge, and a gate valve on the suction side, and a check valve, a gate valve, an air relief valve, and a pressure gauge on the discharge side.

   An automatic electrically-actuated control valve, installed in a 4-ft diameter precast manhole upstream of the secondary metering facility for the Courthouse area, control flows to the 300,000-gallon elevated tank which serves Goochland Courthouse.

   A pressure reducing valve (PRV) is installed in a 10.25-ft x 5-ft x 5.75-ft concrete vault on the 8-inch waterline which serves Beaumont Juvenile Correctional Center. It is set to keep the maximum pressure at 80 psi. Appurtenances to the vault include a lockable hatch and an access ladder.

Storage Facilities

A. Water Treatment Plant:	0.3 MG elevated storage tank
B. Powhatan Correctional Center:	0.2 MG ground storage tank
	0.2 MG elevated storage tank
	0.1 MG elevated storage tank
C. Virginia Correctional Center for Women:	0.3 MG elevated storage tank
D. Beaumont Juvenile Correctional Center:	0.2 MG elevated storage tank

CAPACITY EVALUATION OF THE WATERWORKS

Design Basis: per §12 VAC 5-590-690 of the *Waterworks Regulations*

1. Source Capacity: James River
   Withdrawal Permit - 2 MGD (Virginia Water Protection Permit No. 02-2288 dated June 16, 2003 and modified on April 20, 2004)

2. Raw Water Pumping Capacity: Two pumps each rated at 3.3 MGD @ 152 feet TDH – firm capacity

3. Rapid Mix:
   Volume: 6.67-ft * 7.5-ft *19.5-ft *7.48 gallons/ft^3 = 7,297 gallons
   7,297 gallons * [(60 * 1,440) seconds/day]/ 10 seconds = 63 MGD at 10 seconds detention time

4. Flocculation & Sedimentation (Superpulsator®):
   Basin volume = (30 ft * 17 ft * 13.25 ft * 2 basins) = 13,515 ft^3
   13,515 ft^3 * 7.48 gallons/ft^3 = 101,092 gallons = 0.101 MG
   Detention time = 0.101 MG/3.3 MGD * 1440 minutes/day = 44 minutes
   Surface Loading Rate: (3.3 MGD)(1,000,000 gal/MG)/1440 minutes/day) / (30 ft * 17 ft *2)
   = 2.25 gpm/ft^2
   Design Flow[1] = (30 ft * 17 ft *2) * 2.5 gpm/ft^2 * 1,440 minutes/day / 1,000,000 gal/MG = 3.67 MGD

5. Filtration:
   Filter Area = (14 ft * 14 ft * 3 filters) = 588 ft^2
   Surface loading rate = 4.0 gpm/ft^2
   Design Flow = 588 ft^2 * 4 gpm/ft^2 * 1,440 minutes/day / 1,000,000 gal/MG = 3.4 MGD

6. Finished Water Pumping Capacity: Two pumps each rated at 2,083 gpm (3.0 MGD) – firm pumping capacity

7. Storage:
   A. On-site
      i. 0.3 MG (three 100,000-gallon clearwells)
      ii. 0.3 MG elevated storage tank
   B. Off-site
      i. 0.3 MG elevated storage tank – Virginia Correctional Center for Women
      ii. 0.2 MG ground storage tank – Powhatan Correctional Center
      iii. 0.2 MG elevated storage tank – Powhatan Correctional Center
      iv. 0.1 MG elevated storage tank – Powhatan Correctional Center
      v. 0.2 MG elevated storage tank – Beaumont Juvenile Correctional Center
      1.3 MG – Total (excluding clearwells)
      1.3 MG/0.5 days = 2.6 MGD

[1] Design surface loading rate for Superpulsator units

Water production and storage is allocated to the following consecutive waterworks as follows:

Waterworks Name	PWSID	Permit Capacity (gpd)	Delivered Capacity (gpd)	Total Storage Required [1] (gal* 1000)	Storage Provided-Consecutive[2] (gal*1000)	Storage Provided – Primary[3] (gal*1000)
Goochland Courthouse	4075280	100,000	396,000	50	0	100

1. Total storage required by the consecutive waterworks.
2. Total effective storage provided by the consecutive waterworks.
3. Total effective storage provided by this (primary) waterworks.

Conclusion:

This waterworks has a design capacity of 2.0 MGD, due to limited source capacity described above. However, it is being permitted for a design capacity of 1.8 MGD with a maximum filtration rate of 2 gpm/ft^2, in accordance with the January 14, 2008 letter from Mr. Timothy Newton, ESU Director, Virginia Department of Corrections. This permit does not suspend, minimize, or otherwise alter this owner's obligation to comply with applicable federal, state, or local laws and regulations or permits.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET
of Proposed Construction

DATE: 2 September 2004

WATERWORKS NAME:	James River Correctional Center Water Treatment Plant	CERTIFIED CLASS: II
PERMIT NUMBER:	402204	
EFFECTIVE DATE:	20 September 2004	
EXPIRATION DATE:	20 September 2009	
SOURCE:	Surface Water - James River	

DESCRIPTION OF PROJECT

This project consists of the construction of a surface water treatment plant employing conventional treatment. It also includes the installation of a raw water intake on the James River.

The treatment scheme consists of pre-oxidation with potassium permanganate injection into the raw water transmission main, coagulation with alum in one rapid mix basin, combined flocculation and sedimentation in dual solids contact clarifiers (Superpulsator®), dual media gravity filtration using three filters, and disinfection with chlorine. Fluoridation is included, and hexametaphosphate is added for corrosion control.

Raw Water Intake & Pump Station

A. Intake Screens
- Quantity: 3
- Type: 18-inch max. diameter, wedge-wire tee screens with max. 1-mm slot openings
- Capacity: 1146 gpm/each, 3438 gpm (4.95 mgd) total @ max. 0.24 fps through-slot velocity
- Appurtenances: air-backwash cleaning system consisting of 3.6-cfm air compressor and 400-gal receiver tank in pump station

B. Raw Water Pumps
- Quantity: 2
- Type: submersible
- Rating: 2292 gpm (3.30 mgd)@ 152 ft TDH each pump
- Motor: 125 HP; 1750 rpm constant speed
- Appurtenances: sump level controls, pump removal guide rails

- Separate valve vault for pump discharge check and butterfly valves, common purge valve (electrically-operated butterfly) and surge relief valve

C. Potassium Permanganate Feed System
- Function: pre-oxidant for manganese, biocide
- Application Point: 12-inch raw water pipe in valve vault
- Feed Equipment: one installed diaphragm metering pump rated at 6.5 gph with variable speed drive, flow paced from raw water; 50 gal saturator tank
- Storage: pallets of dry (bagged) chemical

D. Emergency Generator
- Quantity: 1
- Type: skid-mounted, diesel engine driven
- Capacity: 230 KW
- Equipment powered: lights, heat, air compressors, metering pump, 1 raw water pump

Water Treatment Plant

E. Rapid Mix
- Quantity: 1 single-stage basin
- Dimensions: 6 ft – 8 in x 7 ft – 6 in x 19 ft – 6 in SWD
- Detention Time T: 191 sec @ 3.3 MGD
- Appurtenances: vertical shaft, pitched blade turbine mixer with 2-HP motor with variable frequency drive

F. Flocculation & Sedimentation (Superpulsator®)
- Quantity: 2 basins
- Dimensions: 32 ft x 16 ft x 17 ft SWD
- Detention Time T: 32min @ 3.3 MGD
- Surface Loading Rate: 2.39 gpm / sf

G. Filtration
- Quantity: 3 filters
- Surface Area: 196 sf [14 ft x 14 ft] each filter
- Filtration Rate: @ 4.0 gpm/sf for each filter = 3.40 mgd total
- Media: 42 inches Granular Activated Carbon, 12 inches sand
- Appurtenances: Air & Water Backwash system including one 800 scfm positive displacement blower, 10-inch backwash control valve
- Max. backwash rate = 20 gpm/sf , Max. airwash rate = 4 scfm/sf

H. Clearwells
- Quantity: 2 tanks
- Capacity (each): 15 ft diameter x 19 ft max. depth; 100,000 gal
- Appurtenances: concentric baffles in each tank (Baffling Factor = 1); separate influent, effluent, overflow and drain lines, vent, external ladder, cathodic protection system

I. Chemical Feed Systems

1. Aluminum Sulfate (liquid Alum)
   - Function: 1° coagulant
   - Application Point: rapid mix basin
   - Feed Equipment: two diaphragm metering pumps rated at 21 gph with variable speed drives, flow paced from plant influent
   - Storage: heated fiberglass-reinforced plastic tank, 8,000 gal total capacity

2. Sodium Hydroxide (Caustic Soda)
   - Function: pH adjustment
   - Application Points:1) rapid mix basin; 2) 16-inch combined filtered water pipe
   - Feed Equipment: one installed diaphragm metering pump rated at 19 gph, flow paced from plant influent and combined filter flow rate
   - Storage: heated fiberglass-reinforced plastic tank, 11,000 gal total capacity

3. Lime/Soda Ash
   - Function: pH adjustment
   - Application Points: 1) 16-inch raw water pipe 2) 16-inch combined filtered water pipe
   - Feed Equipment: one volumetric feeder rated at 80 lb/hr; 50 gal solution tank with ¼- hp mixer and solution feed pump rated at 36 – 230 gph, flow paced from plant influent
   - Storage: pallets of dry (bagged) chemical

4. Polymer
   - Function: 1) coagulant aid; 2) filter aid
   - Application Points: 1) rapid mix basin effluent weirs; 2)clarifier effluent junction box
   - Feed Equipment: two hydrodynamic blending units to activate and dilute neat polymer. Units include neat polymer metering pump with 0.02 – 0.60 GPH range; dilution water max. 300 gph; flow paced from plant influent
   - Storage: 55-gal drums

5. Chlorine
   - Function: 1° disinfection
   - Application Points: 1) 16-inch raw water pipe ; 2) clarifier effluent junction box; 3) 16-inch combined filtered water pipe
   - Feed Equipment: one auto cylinder changeover; three vacuum chlorinators with valve positioners and solution ejectors; manually controlled for raw water and applied water, controlled by plant computer (chlorine analyzer) for post-filter
   - Storage: 1-ton cylinders on storage trunnions

6. Hexametaphosphate
   - Function: corrosion inhibitor
   - Application Point: 16-inch combined filtered water pipe
   - Feed Equipment: one installed diaphragm metering pump rated at 0.8 gph, with variable speed drive and flow paced from combined filter flow rate
   - Storage: 55-gal drums

7. Fluoride
   - Function: fluoride addition
   - Application Point: 16-inch combined filtered water pipe
   - Feed Equipment: one installed diaphragm metering pump rated at 1 gph with variable speed drive; flow paced from combined filter flow rate
   - Storage: 55-gal drum with scale

8. Sodium Sulfite
   - Function: dechlorination of washwater waste
   - Application Point: 16-inch filtered waste pipe
   - Feed Equipment: one 210 gal polyethylene solution tank; one installed diaphragm metering pump rated at 14.1 gph with variable speed drive; on/off control from computer or manual
   - Storage: pallets of dry (bagged) chemical

Chemical	Max. Dose	Maximum Feed Capacity	Solution Properties	Maximum Treatment Capacity
Aluminum Sulfate	100 mg/l	1 metering pump[2] @ 21 gph/pump	48.5 %, 11.1 lb/gal	6.71 MGD
Sodium Hydroxide	38.2 mg/l	1 metering pump @ 19 gph	25%, 2.6 lb/gal	3.72 MGD
Lime Soda Ash	35 mg/l 50 mg/l	1 feeder @ 80 lb/hr; 1 metering pump @ 200 gph	0.5 lb/gal solution	6.58 MGD[3] 4.60 MGD[3]
Polymer • coagulant aid • filter aid	 1 mg/l 1 mg/l	 2 blend units @ 0.02 – 0.60 gph/blend unit	 30%, 2.7 lb/gal	 4.66 MGD 4.66 MGD
Chlorine	15 mg/l [1]	2 chlorinators[2]@ 400 lb/d/chlorinator	NA – gas feed	6.39 MGD
Hexametaphosphate	2 mg/l	1 metering pump @ 0.8 gph	10 lb/gal	11.5 MGD
Fluoride	1 mg/l	1 metering pump @ 1 gph	23.7% hydrofluosilic acid; 1.8 lb F^-/gal	5.18 MGD
Potassium Permanganate	3.0 mg/l	1 metering pump @ 6.5 gph	0.54 lb/gal @ 20°C	3.37 MGD

[1] Maximum dose per *Waterworks Regulations.*
[2] Firm capacity with one feeder out of service.
[3] Volumetric feeder capacity

J. Finished Water Pumps
   - Quantity: 2
   - Type: horizontal, split case centrifugal
   - Rating: 2083 gpm @ 244 ft TDH
   - Motor: 200 HP, 1770 rpm constant speed
   - Appurtenances: flow control valves, butterfly valves, pressure gauges, flowmeter

K. Sludge Storage and Washwater Waste Basins - existing

L. Emergency Generator
- Quantity: 1
- Type: skid-mounted, diesel engine driven
- Capacity: 500 KW
- Equipment powered: lights, HVAC, 2 vacuum pumps (Superpulsator), 1 finished water pump

M. Process Instrumentation & Controls
- Distributed Control System
- Analytical Instruments:
  1. Turbidity Monitors
     Raw Water – 1
     Settled Water – 2
     Filtered Water – 4 (3 filters + 1 combined filters)
     Finished Water (Service Pump Suction) - 1
  2. Chlorine Analyzer & Transmitter:
     Finished Water (Clearwell Inlet) - 1
     Finished Water (Service Pump Suction) - 1
  3. pH Analyzers
     Raw Water – 1
     Mixed Water – 1
     Finished Water (Service Pump Discharge) - 1
  4. Streaming Current Monitor (SCM): Raw Water -1
- Field Instruments:
  1. Flow Meters & Transmitters
     Raw Water – 1
     Finished Water (Service Pump Discharge) - 1
  2. Level Meters & Transmitters
     Alum Tank - 1
     Caustic Soda Tank - 1
     Clearwells - 2
  3. Pressure Transmitter – Finished Water (Service Pump Discharge) - 1
  4. Differential Pressure Transmitters – Filters -3

PROJECT CAPACITY EVALUATION

1. Source Capacity
   a. Raw Water Withdrawal Permit No. 02-V2288 (DEQ/VMRC/COE):
      Maximum Daily Withdrawal = 2.0 Mgal
      Maximum Instantaneous Withdrawal Rate = 2,292 gpm (3.3 mgd) } withdrawal limit = 2.0 mgd
      Maximum Annual Withdrawal = 730 Mgal

   b. Intake Screens: three, @ through velocity = 0.24 fps, total capacity = 4.95 mgd

   c. Raw Water Pumps: two @ 3.3 mgd/pump firm capacity = 3.3 mgd

2. Treatment Capacity
   a. Rapid Mix: 1 basin; Vol = 7300 gal
      @ T_{det} = 3.18 min
      7300 gal / 3.18 min = 2300 gpm = 3.3 mgd

   b. Flocculation/Sedimentation: 2 basins; SA = 510 sf/basin
      @ SOR = 2.39 gpm/sf
      2 (510 sf/basin) (2.39 gpm/sf) = 2440 gpm = 3.5 mgd

   c. Filtration: 3 Filters; Surface Area = 196 sf/filter
      @ Loading Rate = 4.0 gpm/sf,
      (3 filters)(196 sf/filter)(4.0 gpm/sf) = 2350 gpm = 3.4 mgd

3. Transfer Capacity
   Service Water Pumps: two @ 3.0 mgd/pump firm capacity = 3.0 mgd

The capacity of the water treatment plant is limited by the high service pumps to 3.0 mgd. However, the DEQ Withdrawal Permit limits the plant to a maximum daily production of 2.0 Mgal, with a peak instantaneous withdrawal rate of 3.3 mgd.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: August 22, 2001

WATERWORKS NAME:	James River Estates	CERTIFIED CLASS: IV	
CITY/COUNTY:	Goochland County	TYPE: Community	
LOCATION:	Go west on River Road (Route 650), approximately 5 miles beyond the Henrico County line. The development is located on the south (left) side of River Road, just past its intersection with Route 649.		
OWNER:	AquaSource Mr. Kevin Read, Northeast Regional Manager 601 Jefferson Boulevard Warwick, Rhode Island 02886		
OPERATOR:	Sydnor Hydro, Inc. P. O. Box 27186 Richmond, Virginia 23261 Contact: Mr. Jesse L. Royall, Jr., P.E., Vice-President of Utilities Telephone: 643-2725 Mr. Ed Held (Class III)		

PERMIT NUMBER:	872	O-944	4075400	Amended	Amended
DATE ISSUED:	12/17/56	11/14/75	6/24/77	5/7/82	10/11/95
PERMIT NUMBER:	Amended	Amended	Amended		
DATE ISSUED:	9/15/97	9/8/00	9/4/01		

TYPE OF TREATMENT:	Iron and manganese treatment
SOURCE:	Purchased Treated Surface Water – Goochland-Henrico Contract and Groundwater - four drilled wells
DESIGN CAPACITY:	68 existing residential connections

DESCRIPTION OF SYSTEM:

This waterworks consists of four drilled wells, one 10,000-gallon gravity storage tank, two 3-HP booster pumps, two 5,000-gallon hydropneumatic tanks, and two iron and manganese treatment systems with related appurtenances. A consecutive connection for purchase of County water is also provided at the 10,000-gallon tank.

WELL NOS. 1 & 1A

Well No. 1 - This well is located at 102 West Brook Run Drive. It is constructed from an 8-inch (unspecified) hole drilled to a depth of 50 feet with a 6-inch hole extended from 50 feet to 343 feet in depth. The well is cased with 6-inch steel casing from +2 feet to 50 feet in depth and grouted with neat cement from ground level to a depth of 50 feet. Bedrock (blue slate) was encountered at a depth of 38 feet. This well yielded 25 gpm after 24 continuous hours of pumping in a test conducted around 1956.

Appurtenances to the well include a sanitary seal, a screened casing vent, a check valve, a gate valve, a sample tap, a meter, and a blow-off upstream of the meter.

Well No. 1A - This well is constructed from an 11-inch hole drilled to a depth of 51 feet and a 6-inch hole extended from 51 feet to 400 feet in depth. The well is cased with 6-inch steel casing from +2 feet to 51 feet in depth and grouted with neat cement from ground level to a depth of 51 feet. The well yielded 16 gpm with 85 feet of drawdown after 48 hours of continuous pumping during a test completed on March 27, 1981. The well casing is centered in a 6.67-ft x 7.33-ft x 6-inch thick concrete pad.

Appurtenances to the well include a pitless adapter unit, a sanitary well cap, a screened casing vent, a check valve, a gate valve, a sample tap, a meter, and a blow-off.

Well Pumps – The submersible pumps in Well Nos. 1 and 1A deliver the water to the 10,000-gallon gravity storage tank via the iron and manganese treatment facilities. Well No. 1 is equipped with a 3-HP pump of unknown capacity. The observed output of this well pump was 2 gpm on June 25, 2001. Well No. 1A is equipped with a 1-HP pump rated at 14 gpm @ 233 feet TDH. The observed output of this well pump was 3 gpm on June 25, 2001.

Well House - Well No. 1, the control panels, the iron and manganese treatment facilities for Well Nos. 1 and 1A, and the operational end of the hydropneumatic tank are housed in an 8-ft x 18-ft x 8-ft concrete block well house. Appurtenances to the well house include lighting, heat, overhead access, a concrete floor with a floor drain, and a locked entrance.

Iron and Manganese Treatment – The water from Well Nos. 1 and 1A is combined upstream of the iron and manganese treatment facilities. The iron and manganese treatment facilities include a 2.0-foot diameter manganese greensand filter, two 50-gallon polyethylene solution tanks, an 11.3-gpd diaphragm feed pump for sodium hypochlorite solution, and a 20-gpd diaphragm feed pump for potassium permanganate solution. An impulse contactor installed in the pipe carrying the combined flow from the two wells controls the sodium hypochlorite and potassium permanganate solution feed rates. Sample taps are provided upstream of the point of sodium hypochlorite addition, between the point of potassium permanganate addition and the greensand filter, at the interface between the anthracite and the manganese greensand in the filter, at the midpoint of the manganese greensand layer, and on the filter effluent line. No flow control valve is provided for the filter.

Backwash water is provided from the 5,000-gallon hydropneumatic tank, supplemented by the 10,000-gallon ground storage tank. A flow control valve on the drain line for the filter set at 31 gpm (10 gpm/ft^2) controls the backwash flow rate. The backwash water discharges into a nearby drainage ditch.

Storage Facilities – The storage facilities include a 10,000-gallon gravity storage tank and a 5,000-gallon hydropneumatic tank. The 10,000-gallon gravity storage tank (10-ft diameter, 17.5-ft length) has an effective storage volume of 9,900 gallons. Appurtenances to the tank include an access manway, a screened overflow, a screened vent, a drain line, and a sample tap. Bypass piping is provided.

The hydropneumatic tank is provided with a sight glass, a pressure gauge, a sample tap, a drain, an access manhole, an air relief valve, a vacuum relief valve, and a 0.75-HP air compressor to help maintain the proper air:water ratio. There is also a solenoid valve on the discharge line for the hydropneumatic tank. When the system pressure is high and the water level in the gravity storage tank is 9.0 feet or less above the bottom of the tank, the solenoid valve will open, and allow distribution system water to fill the gravity storage tank. Well Nos. 2 & 2A, located at a lower elevation, will help ensure that the system pressure is maintained while the gravity storage tank is being filled.

Booster Pumps - Two 3-HP centrifugal booster pumps transfer the water from the gravity storage tank to the hydropneumatic tank and then to the distribution system. One pump is rated at 86 gpm @ 92 feet TDH. The other pump is rated at 95 gpm @ 92 feet TDH. The two pumps are rated at 164 feet TDH @ 119 feet TDH operating in parallel. Each booster pump is equipped with a pressure gauge and gate valve on the suction side, and a pressure gauge, gate valve, and check valve on the discharge side.

Air Compressor and Booster Pump Operation - If the hydropneumatic tank pressure drops to 47 psi and the water level is above the center of the tank, the air compressor turns on and operates until the tank pressure is raised to 57 psi. If the water level drops below the center of the tank, the air compressor shuts off. The lead booster pump then operates at tank pressures of 46-56 psi. If this pump cannot satisfy the system demand by itself, the lag pump operates at tank pressures of 44-54 psi. When the water level again reaches the center of the tank, the air compressor is re-activated, and shuts off when the tank pressure is raised to 57 psi. The booster pumps are manually alternated in sequence of operation.

A low-level probe in the gravity storage tank, located 0.5 feet above the tank bottom, will shut off the booster pumps. An additional probe, located 1.0 feet above the tank bottom, will reactivate them.

PURCHASED WATER CONNECTION

Approximately 250 feet of 1½-inch waterline extends from an 8-inch Goochland County waterline on West Brook Run Drive to the well house. The County meter is located beside the entrance road to the well house, near West Brook Run Drive. The County water is piped directly into the gravity storage tank. If necessary, a valve on the County line can be opened to allow County water directly into the James River Estates distribution system. However, this is not normally done because of low pressure in the County water.

Operation of Well Nos. 1 and 1A and Purchased Water - Under normal operation, the two well pumps activate when the water level in the gravity storage tank drops to 9.0 feet above the bottom of the tank, and deactivate when the water level is raised to 9.5 feet above the tank bottom. If the water level in the tank continues to drop and reaches 5 feet above the tank bottom, a solenoid valve in the well house will open and allow County water into the gravity storage tank. Once the water level in the tank is raised to 9.5 feet, the solenoid valve will shut off the County water. The well pumps will also turn off at this water level.

WELL NOS. 2 & 2A

Well No. 2 - To locate this well, follow West Brook Run Drive to the rear of the subdivision, and turn left on Ashley Drive. The well is approximately 0.1 miles on the right, between SweetBriar Drive and East Brook Run Drive. No well completion report is included in VDH files, but Sydnor Hydro, Inc. has reported that the well is constructed from a hole of unknown diameter drilled to a depth of 257 feet. The well is cased with 6 1/2-inch casing from +2 feet to a depth of 51 feet, and is grouted with neat cement from ground level to 50 feet in depth. The well yielded 19 gpm in 1977, according to information supplied by Sydnor Hydro, Inc.

Appurtenances to the well include a sanitary seal, a screened casing vent, a check valve, a gate valve, a blow-off, a sample tap, and a discharge meter.

Well No. 2A – To locate this well, follow East Brook Run Drive to its intersection with Ashley Drive at the rear of the subdivision. The well is located approximately 0.1 miles directly east from this intersection. It is reached by a foot path through the woods. Vehicle access is currently through an existing pasture on the adjacent property to the south.

The well is constructed from an 11-inch hole drilled to a depth of 51 feet, with a 6-inch hole extended from 51 feet to 200 feet in depth. The well is cased with 7-inch casing from +2 feet to a depth of 51 feet, and is grouted with neat cement from ground level to 51 feet in depth. No pump test has been conducted on the well. The well yielded 4 gpm while pumping continuously in July and August 1995 during drought conditions.

The well is centered on a 6-ft x 6-ft x 6-inch thick concrete pad. Appurtenances to the well include a sanitary well cap, a screened casing vent, a check valve, a gate valve, a blow-off, a sample tap, and a discharge meter. A 43-inch x 30-inch x 36-inch fiberglass enclosure covers the well and its appurtenances. All exposed piping outside of the enclosure is insulated.

Well Pumps – The well pumps for Well Nos. 2 and 2A operate simultaneously. They are controlled by pressure switches on the hydropneumatic tank set at tank pressures of 60-70 psi.

Well No. 2 is equipped with a 3-HP pump of unknown capacity. The observed output of this well pump was 4 gpm on July 19, 2001. Well No. 2A is equipped with a 1.5-HP submersible well pump, rated at 11 gpm @ 346 feet TDH. The observed output of this well pump was 3 gpm on July 19, 2001.

Well House - Well No. 2, the control panel, the iron and manganese treatment facilities, and the operational end of the hydropneumatic tank are enclosed in a 8-ft x 18.33-ft x 8-ft concrete block well house. Appurtenances to the well house include lighting, heat, overhead access, a floor drain, and a locked entrance.

Iron and manganese treatment - The iron and manganese treatment facilities include a sodium hypochlorite and potassium permanganate feed system for oxidation, and a 30-inch manganese greensand filter. The sodium hypochlorite feed system is comprised of a 30-gallon solution tank and an 11.3-gpd diaphragm pump. The potassium permanganate system consists of a 50-gallon solution tank and a 20-gpd diaphragm pump.

Sample taps are provided at the same locations as for the filter in Well House No. 1. Flow through the 30-inch filter is limited by a 15-gpm flow control valve on the influent line. Backwash water is provided from the 5,000-gallon hydropneumatic tank and is limited to 49 gpm (10 gpm/ft^2) by a flow control valve installed on the drain line. The backwash waste is discharged into a nearby drainage ditch.

Also provided is an orthophosphate-polyphosphate blend feed system to sequester the remaining iron and manganese. The phosphate feed equipment includes a 50-gallon solution tank and a diaphragm feed pump with a maximum capacity of 1 gallon/hour. The diaphragm pump operates simultaneously with the two well pumps. The phosphate solution is injected into the water downstream of the manganese greensand filter and upstream of the hydropneumatic tank. Sample taps are installed upstream and downstream of the chemical feed point.

Storage Facilities - The 5,000-gallon hydropneumatic tank is equipped with a sight glass, a pressure gauge, a sample tap, an access manhole, a drain, an air relief valve, a pressure relief valve, and a 0.5-HP air compressor to help maintain the proper air:water ratio.

CAPACITY EVALUATION:

DESIGN CRITERIA: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*

1. Source Capacity:

   A. Goochland-Henrico Contract: 30,000 gpd

   B. Well Yield*: (0.5 gpm per ERC)
   Well No. 1 - 25 gpm for 24 continuous hours (1956)
   Well No. 1A - 6 gpm for 48 continuous hours (1981)
   Well No. 2 - 19 gpm for unknown duration (1977)
   Well No. 2A - 4 gpm – continuous pumping in July 1995
   Total: 64 gpm

   64 gpm / 0.5 gpm/ERC = 128 ERCs or 51,200 gpd

   *The respective yields of these wells have significantly decreased since the above mentioned yield and drawdown tests were conducted. The current yields are approximately equal to the well pump capacities.

   Well Pump Capacity: (0.5 gpm per ERC)
   Well No. 1 2 gpm (observed output on 6/25/01 – Sydnor)
   Well No. 1A 3 gpm (observed output on 6/25/01 – Sydnor)
   Well No. 2 4 gpm (observed output on 7/19/01 – VDH)
   Well No. 2A 3 gpm (observed output on 7/19/01 – VDH)
   Total: 12 gpm

   12 gpm / 0.5 gpm/ERC = 24 ERCs or 9,600 gpd

   Total Source Capacity: (9,600 + 30,000) gpd = 39,600 gpd
   39,600 gpd / 400 gpd/ERC = 99 ERCs

2. Filtration Capacity: (3 gpm/ft^2)

	Well Nos. 1 & 1A	Well Nos. 2 & 2A	Total
Filter Diameter	24"	30"	-
Filter Area	3.14 ft^2	4.91 ft^2	-
Maximum Filtration Capacity	9.5 gpm	15 gpm	24.5 gpm
Source Capacity	5 gpm	7 gpm	

   24.5 gpm / 0.5 gpm/ERC = 49 ERCs or 19,600 gpd

   The filters have adequate capacity for the source waters that they are designed to treat.

Potassium Permanganate Feed Systems:
A 50-gallon solution tank and a 20-gpd diaphragm feed pump are provided for each well house.

N_1 = 100,000 mg/l (10% concentration)
V_1 = required chemical feed pump output
N_2 = 0.66 mg/l dosage[1] (for iron & manganese removal)
V_2 = 7 gpm = combined capacity of well pumps for Well Nos. 2 & 2A*
*The combined capacity of the well pumps for Well Nos.1 & 1A is 5 gpm.

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(0.66 \text{ mg/l})(7 \text{ gpm})}{100{,}000 \text{ mg/l}} = 0.000046 \text{ gpm} = 0.067 \text{ gpd}$$

The 20-gpd diaphragm feed pump will have adequate capacity for the potassium permanganate feed system serving either pair of wells.

Phosphate Feed System (Well Nos. 2 & 2A):
The phosphate feed equipment includes a 50-gallon solution tank and a diaphragm feed pump with a maximum capacity of 1 gallon/hour (24 gallons/day).

Aqua-Mag ® has a specific weight of 11.4 lb/gal, and a total phosphate concentration of 34.5%. Therefore, the concentration of total phosphate is 471,583 ppm.

$N_1V_1 = N_2V_2$
V_1 = required chemical feed pump output
N_1 = 471,583 ppm
V_2 = 7 gpm (combined well output)
N_2 = 1.60 ppm (dosage based on water quality - formula from manufacturer)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(1.60)(7)}{471{,}583} = 0.000024 \text{ gpm or } 0.034 \text{ gpd}$$

The 24-gpd diaphragm feed pump is therefore adequate for the phosphate feed system.

This waterworks is limited by the total effective storage capacity to a maximum usage of 66 equivalent residential connections or 26,400 gpd, but is being issued for the existing 68 residential connections, in accordance with previously issued operation permits.

[1] Based on iron and manganese concentrations of 1.3 mg/l and 0.2 mg/l, respectively, and a required KMnO4 dosage of 0.2[Fe] + 2[Mn] following chlorination.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE June 30, 1999

WATERWORKS NAME Jenkins Trailer Park CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Community

LOCATION West on Route 6 to Goochland Courthouse. The trailer park is on Route 6, approximately 0.4 miles past its intersection with U. S Route 522 North, on the left side of the road.

OWNER Mr. Frederick P. Jenkins
P. O. Box 23
Goochland, Virginia 23063
Telephone: 556-4568

OPERATOR Same

PERMIT NUMBER 4075420 Amended

DATE ISSUED November 3, 1980 July 7, 1999

TYPE OF TREATMENT Chlorination and Corrosion Control

SOURCE Groundwater - Two bored wells

DESIGN CAPACITY 52 trailer connections

DESCRIPTION OF SYSTEM:

This waterworks consists of two bored wells, two 86-gallon bladder tanks, two 82-gallon bladder tanks, chlorination facilities, and corrosion control facilities, with appropriate appurtenances.

Well No. 1 was constructed from a hole of unknown diameter(s) to a depth of 60 feet. Thirty-six-inch diameter casing is installed from +2 to 60 feet in depth. The well is grouted with cement from ground level to a depth of 32 feet. No other well construction data is available, and no data is available on the well yield.

Well No. 2 was constructed from a hole of unknown diameter(s) to a depth of 40 feet. Thirty-six-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, and no data is available on the well yield.

The two wells have individual sample taps, but share a common check valve, gate valve, blow-off line, and discharge meter.

Each well is equipped with a well pump which delivers water to the four bladder tanks, and then to the distribution system. The horsepower of the pump in Well No. 1 is unknown. Well No. 2 is equipped with a 0.5-Hp submersible pump. The rating of each well pump is unknown. In an inspection on July 30, 1998, the instantaneous output of the two wells was 12 gpm and 9 gpm, respectively. The well pumps are controlled by pressure switches on the bladder tanks, set at 40-60 psi.

Well No. 1, the bladder tanks, the chlorination facilities, and the corrosion control facilities, are housed in a 12-ft x 10-ft x 6-ft concrete block well house. The floor of the well house is approximately two feet below the ground surface, adding some working height to the building. Well No. 2 is located just outside of the rear wall of the well house. Appurtenances to the well house include lighting, heat, and a lockable entrance.

The four bladder tanks are equipped with pressure gauges, drains, and sample taps.

Chemical Feed Equipment

The chlorination equipment includes a 50-gallon polyethylene solution tank and a diaphragm feed pump with a maximum feed rate of 12 gallons/day.

The Aqua-Mag feed equipment includes a 55-gallon polyethylene solution tank and a diaphragm feed pump with a maximum feed rate of 3 gallons/day.

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: Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*.

1. Well Yield: unknown

2. Well Pump Capacity: (0.5 gpm per ERC)
Well No. 1 - 12 gpm
Well No. 2 - 9 gpm
Total - 21 gpm

21 gpm @ 0.5 gpm per ERC = 42 ERCs or 16,800 gpd

3. Hypochlorite Feed System

One 50-gallon solution tank and one 12-gpd diaphragm feed pump. Sodium hypochlorite (5.25% chlorine) is used.

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 5.25% = 52,500 ppm
V_2 = 21 gpm (total from the two wells)
N_2 = 7.5 ppm

$$V_1 = \frac{(7.5)(21)}{52,500} = 0.003 \text{ gpm or } 4.3 \text{ gpd}$$

The 12-gpd diaphragm feed pump is therefore adequate for the chlorination system.

4. Capacity of Orthophosphate-Polyphosphate Feed System:

Aqua-Mag has a specific weight of 11.4 lb/gal, and a total phosphate concentration of 34.5%. Therefore, the concentration of total phosphate in Aqua-Mag is 471,583 ppm.

$N_1V_1 = N_2V_2$
V_1 = required output of Aqua-Mag feed pump
N_1 = 471,583 ppm (total phosphate concentration in Aqua-Mag)
V_2 = 21 gpm (combined well output)
N_2 = 0.322 ppm (required total phosphate dosage based on water quality - formula from manufacturer)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(0.322)(21)}{471,583} = 0.0000143 \text{ gpm}$$

$$= 0.021 \text{ gpd}$$

The 3-gpd diaphragm feed pump is therefore adequate for the Aqua-Mag feed system.

5. Storage Capacity: (200 gallons per ERC)

two 86-gallon bladder tanks
two 82-gallon bladder tanks

Effective Storage Volume:
[(86 x 2) + (82 x 2)]/3 = 112 gallons
Total Effective Storage Capacity:
112 gallons @ 200 gallons per ERC =
1 ERC or 400 gpd

This waterworks is limited by the total effective storage capacity to a maximum usage of 1 equivalent residential connection or 400 gpd. However, the amended operation permit is being issued for the existing 52 trailer connections.

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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE July 16, 1999

WATERWORKS NAME Manakin Farms CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Community

LOCATION West on Route 6, approximately 5.8 miles past the Goochland-Henrico line. Turn right on Willway Drive (Route 662).

OWNER James River Service Corporation
c/o Sydnor Hydrodynamics, Inc.
P. O. Box 27186
Richmond, Virginia 23261
contact Mr. Jesse L. Royall, Jr., P.E.
Vice-President of Utilities (Telephone: 643-2825)

OPERATOR Mr. Ed Held (Class II)
Telephone: 643-2725

PERMIT NUMBER	0-962	4075500	Amended	Amended	Amended	Amended
DATE ISSUED	5/6/76	6/24/77	10/24/84	7/14/92	8/31/98	7/26/99

TYPE OF TREATMENT Chlorination and Iron and Manganese Removal (Well No. 9) and Corrosion Control (Well Nos. 6, 7, 8 and 9)

SOURCE Groundwater - five drilled wells

DESIGN CAPACITY 170 equivalent residential connections or 68,000 gpd - limited by the well yield and well pump capacity

DESCRIPTION OF SYSTEM:

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 hydropneumatic tanks, two 199-gallon and two 42-gallon bladder tanks, chlorination, iron and manganese removal, and corrosion control treatment, with appropriate appurtenances. Two other wells in the system are presently deactivated.

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

Well No. 4 - This well 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, with a 6-inch hole extending from 50 feet to 190 feet in depth. Six-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 (unknown rating) delivers the water through two cartridge filters and a 42-gallon bladder tank, and then to the distribution system. The well pump output was 3 gpm during an inspection on July 13, 1999.

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

Well No. 6 - This well 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, with 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 feet 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 (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. This facility is also equipped with a 1/6-HP air compressor for manual air addition to the tank.

The well, the air compressor, and the operational end of the hydropneumatic tank are housed in an 8-ft x 8-ft x 8-ft well house. Appurtenances to the well and well house are listed later in the description.

Well No. 7 - This well 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, with an 11.5-inch hole extending from 18 to 29 feet in depth, a 10-inch hole extending from 29 to 55 feet in depth, and a 6-inch hole extending from 55 to 603 feet in depth. Six-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. There are no screens. 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. The well is housed in an 8-ft x 8-ft x 8-ft concrete block well house. Appurtenances to the well and well house are listed later in the description.

Water from the well is pumped by a 3-HP submersible pump, rated at 31 gpm @ 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 @ 318 feet 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 @ 137 feet TDH and 75 gpm @ 130 feet TDH, respectively, at a hydropneumatic tank pressure of 68 psi. The two pumps operating together are rated at 245 gpm @ 136 feet 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 ft and 4.5 ft, respectively, from the tank bottom, deactivate and re-activate the booster pumps, if needed. A 1/2-HP air compressor helps to maintain the proper air: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.

Both the ground storage tanks and the hydropneumatic tank may be bypassed for maintenance, if necessary. Appurtenances to the storage tanks are listed later in the description.

Well No. 8 - This well 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, with a 6-inch hole extending from 102 feet to 600 feet in depth. Six-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 feet 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.

The well is centered on a 6-ft x 6-ft x 6-inch thick concrete pad. A 1-HP submersible pump, rated at 9 gpm @ 270 feet TDH, delivers the water from the well to the 42-gallon bladder tank, and then to the distribution system. The well pump operates at tank pressures of 55-65 psi. The well pump output was 10 gpm during an inspection on July 13, 1999.

The well, its appurtenances, and the bladder tank are housed in a 5-ft x 4-ft x 4-ft fiberglass enclosure. Appurtenances to the well and well house are listed later in the description.

Well No. 9 - This well 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. Six-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. The well is centered on a 6-ft x 6-ft x 6-inch thick concrete pad, located approximately 10 feet from the 11.5-ft x 9.5-ft x 8-ft prefabricated composite concrete well house. Appurtenances to the well and well house are listed later in the description.

A 7.5-HP submersible pump, rated at 23 gpm @ 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 operates at tank pressures of 78-90 psi. The well pump output was 24 gpm at a tank pressure of 80 psi during an inspection on July 13, 1999.

Well and Well House Appurtenances

Each well is equipped with a sanitary seal, a screened vent, a check valve, a gate valve, a flow meter, a blow-off, and a sample tap. Well No. 9 also includes a pitless adapter unit and a well cap with a screened vent.

Each well house includes heat, a floor drain, and a locking entrance door. Every well house also has lighting, except for the house for Well No. 8, which has a removable roof.

Storage Tank Appurtenances

Each gravity storage tank is equipped with a screened overflow, a screened vent, an access hatch, a drain line, and a sample tap. Each hydropneumatic tank is equipped with an access manway, a sight glass, a pressure gauge, an air release valve, a drain, and a sample tap. Each bladder tank is equipped with a pressure gauge, a drain, and a sample tap.

Chemical Treatment

The treatment at each well house includes feed systems for the following chemicals:

Well No.	Chemicals	Injection Point	Purpose
4	Aqua-Mag*	upstream of the bladder tank	Corrosion Control
6	Caustic soda, Aqua-Mag	upstream of the hydropneumatic tank	Corrosion Control
7	Aqua-Mag	upstream of the ground storage tanks	Corrosion Control
8	Aqua-Mag	upstream of the bladder tank	Corrosion Control
9	Chlorine	upstream of the filter	Hydrogen Sulfide Control, Iron and Manganese Treatment
	Potassium Permanganate	upstream of the filter	Iron and Manganese Treatment
	Aqua-Mag	downstream of the filter	Corrosion Control

*Aqua-Mag is an orthophosphate-polyphosphate blend.

Each chemical feed system includes a 50-gallon polyethylene tank and a diaphragm pump with a maximum feed rate of 24 gpd. Sample taps are located both upstream and downstream of the injection points at each well.

Well No. 9 includes an impulse contactor on the meter, for controlling the feed of potassium permanganate solution.

The iron and manganese treatment facilities at Well No. 9 also include a 42-inch diameter (60-inch height) manganese greensand filter. The manganese greensand filter has a capacity of 29 gpm at a filtration rate of 3 gpm/ft^2. However, there is a flow control device on the well discharge line to limit the flow to 24 gpm.

Appurtenances to the greensand filter include an access manway, an air release valve, and a pressure gauge on the influent line. There is also a differential pressure gauge on the discharge end of the filter, for measuring the pressure loss through the filter. Sample taps are installed at the top of the filter, at the center of the filter, and on the filter discharge line.

A flow control valve is installed on the filter backwash line to maximize the backwash rate at 115 gpm, or 12 gpm/ft^2. The backwash water will drain into two 1,500-gallon settling tanks. A submersible pump, rated at 10 gpm at system head conditions, will transfer the supernatant from the settling tank through approximately 466 feet of 2-inch force main into an existing 8-inch gravity sewer. The supernatant will be treated at the existing 0.1 mgd Manakin Farms sewage treatment works.

DESIGN CRITERIA - Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*.

1. Well Yield: (0.5 gpm per ERC)

Well No. 4 - 5 gpm after 12-hour pumping test on October 1, 1996
Well No. 6 - 22 gpm after 12-hour pumping test on June 7, 1999
Well No. 7 - 28 gpm after 12-hour pumping test on October 3, 1996
Well No. 8 - 9 gpm after 12-hour pumping test on October 1, 1996
Well No. 9 - 25 gpm after 48-hour pumping test on May 22, 1996
TOTAL 89 gpm

89 gpm @ 0.5 gpm per ERC = 178 ERCs or 71,200 gpd

2. Well Pump Capacity: (0.5 gpm per ERC)

Well No. 4 - 3 gpm
Well No. 6 - 21 gpm
Well No. 7 - 46 gpm
Well No. 8 - 10 gpm
Well No. 9 - 24 gpm
TOTAL 104 gpm (all data is from instantaneous readings on July 13, 1999)

104 gpm @ 0.5 gpm per ERC = 208 ERCs or 83,200 gpd

SUMMARY OF WELL YIELD AND WELL PUMP CAPACITY:

Well No.	Well Yield	Pump Capacity	Limiting Value
4	5 gpm	3 gpm	3 gpm
6	22 gpm	21 gpm	21 gpm
7	28 gpm	46 gpm	28 gpm
8	9 gpm	10 gpm	9 gpm
9	25 gpm	24 gpm	24 gpm
			85 gpm

85 gpm @ 0.5 gpm per ERC = 170 ERCs or 68,000 gpd

3. Booster Pump Capacity: ($Q = 11.4\ N^{0.544}$) (for Well No. 7 only)

Well No. 7: one 10 -HP pump, rated at 200 gpm @ 137 feet TDH
one 7.5-HP pump, rated at 75 gpm @ 130 feet TDH
The combined capacity of the booster pumps is 245 gpm @ 136 feet TDH
Q = 245 gpm; N = 281 ERCs or 112,400 gpd

4. Storage Capacity: (200 gallons per ERC)

One 30,000-gallon gravity storage tank
(Effective volume = 25,805 gallons)
One 20,000-gallon gravity storage tank
(Effective volume = 18,209 gallons)
Two 5,000-gallon hydropneumatic tanks
Two 119-gallon bladder tanks
Two 42-gallon bladder tanks

Effective Storage Volume:
25,805 + 18,209 + [1/3 x (5,000 + 5,000 + 119 + 119 + 42 + 42)]
= 47,455 gallons

Total Effective Storage Capacity:
47,455 gallons @ 200 gpd/ERC = 237 ERCs or 94,800 gpd

5. Capacity of Caustic Soda Feed System (for Well No. 6 only):

$$N_1V_1 = N_2V_2$$

V_1 = required output of the chemical feed pump
N_1 = 50% = 500,000 ppm
V_2 = 19 gpm
N_2 = 12 ppm (RTW Model) - to raise the pH to 7.5

$$V_1 = \frac{(12)(19)}{500,000} = 0.000456 \text{ gpm or } 0.657 \text{ gpd}$$

The 24-gpd diaphragm feed pump is therefore adequate for the caustic soda feed system. The caustic soda will be diluted in the solution tank to achieve a strength compatible with the 24 gpd feed pump.

6. Capacity of Aqua-Mag Feed System (for Well Nos. 6, 7, 8 and 9):

Aqua-Mag has a specific weight of 11.4 lb/gal, and a total phosphate concentration of 34.5%. Therefore, the concentration of total phosphate in Aqua-Mag is 471,583 ppm. **The worst case scenario is at Well No. 7.**

$N_1V_1 = N_2V_2$
V_1 = required output of Aqua-Mag feed pump
N_1 = 471,583 ppm
V_2 = 46 gpm (well pump output - Well No. 7)
N_2 = required Aqua-Mag dosage = 1.673 ppm (Well No. 7)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(1.673)(46)}{471,583} = 0.000163 \text{ gpm or } 0.235 \text{ gpd}$$

The 24-gpd diaphragm feed pump is therefore adequate for the Aqua-Mag feed system at each well. The Aqua-Mag will be diluted as needed in the solution tank for each feed system to achieve a strength compatible with the 24-gpd feed pump.

7. Chlorination System (for Well No. 9 only):

$N_1V_1 = N_2V_2$
V_1 = required output of chlorination pump
N_1 = 52,500 ppm (5.25%)
V_2 = 24 gpm (well pump output)
N_2 = 7.5 ppm (maximum dosage rate anticipated for groundwater systems)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(7.5)(24)}{52,500} = 0.0034 \text{ gpm or } 4.9 \text{ gpd}$$

The 24 gpd diaphragm feed pump is therefore adequate for the chlorination system.

8. Manganese Greensand Filter (3 gpm/ft^2) (for Well No. 9 only)

Diameter = 42 inches; Area = 9.62 ft^2
Maximum Filtration Rate = (9.62 ft^2) (3.0 gpm/ft^2) = 28.9 gpm
A flow control device will limit the flow to the filter to 24 gpm
24 gpm @ 0.5 gpm/ERC = 48 ERCs or 19,200 gpd

The greensand filter is adequate for Well No. 9, which also has a capacity of 24 gpm.

9. Potassium Permanganate System (for Well No. 9 only):

$N_1V_1 = N_2V_2$
V_1 = required output of potassium permanganate pump
N_1 = 10,440 ppm (5 fluid oz*/10 gallons - Sydnor's mixture)
V_2 = 24 gpm (well pump output)
N_2 = 0.9 ppm (Fe + 2Mn)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(0.9)(24)}{10,440} = 0.00207 \text{ gpm or } 3 \text{ gpd}$$

The 24 gpd diaphragm feed pump is therefore adequate for the potassium permanganate feed system.

* Potassium permanganate has a specific gravity of 2.7.

This waterworks is limited by the well yield and well pump capacity to a maximum usage of 170 equivalent residential connections or 68,000 gpd.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE October 6, 1995

WATERWORKS NAME Mary Mother of the Church Abbey CERTIFIED CLASS III

CITY/COUNTY Goochland County TYPE Community

LOCATION 12617 River Road (Route 650) - approximately 0.6 miles west of its intersection with Route 647.

OWNER Benedictine Society of Virginia
c/o Mary Mother of the Church Abbey
12839 ~~12617~~ River Road
Richmond, Virginia 23223-6139
Contact Right Reverend Benedict R. McDermott, D.S.B.
President & Abbot Telephone: 784-3508

OPERATOR Mr. James E. Baty, W-I; Mr. Jay Straight (unlicensed)
Telephone: 784-3508 Ext. 251
Mark Gentry 359-4903 (Cell Phone) FAX 784-2214 Jim Baty - 836-7720

PERMIT NUMBER	1128	1625	4075725	4075725-A
DATE ISSUED	10/24/61	1/24/68	7/1/77	10/20/95

TYPE OF TREATMENT Retention pond, rapid mix, flocculation, sedimentation, filtration, chlorination

SOURCE Surface water - James River (primary); ground water - two drilled wells (auxiliary)

DESIGN CAPACITY 250 persons @ 100 gpd/person or 25,000 gpd

DESCRIPTION OF SYSTEM:

This waterworks includes one surface water treatment plant and two auxiliary drilled wells, one 10,000-gallon gravity storage tank, one 3,000-gallon hydropneumatic tank, one 5 HP submersible pump, one(1) HP centrifugal pump, one 0.5 HP centrifugal pump, and two 15 HP booster pumps with appropriate appurtenances.

The main source of supply is the water treatment plant which utilizes the James River as its sole raw water source. A 5 HP submersible pump (capacity unknown) transfers raw water from the James River to the 0.526 MG on-site retention pond. This pond is 350' x 85' with a maximum depth of 10 feet. A 1 HP centrifugal pump (capacity unknown) transfers the raw water from the retention pond to the water treatment facilities. Alum, soda ash, and chlorine (hypochlorite solution) are added to the raw water upstream of a rapid mix chamber with hydraulic mixing (venturi) and a volume of 172 gallons. The water then flows to a circular flocculation basin with two horizontal flocculators and a volume of approximately 2,770 gallons, a circular settling basin with a volume of approximately 17,200 gallons (10.5' diameter; 26.6' length), and a circular sand filter with 30 inches of sand and an area of 27.5 square feet (5.92' ID). The treatment units are designed for an operating rate of 52.5 gallons per minute. However, the maximum daily capacity of these facilities is 25,000 gallons per day. It is limited by the volume of the raw water retention pond and based on a maximum of 8 hours operation per day. A 1 HP centrifugal pump (capacity unknown) transfers the filtered water to the 15,000-gallon steel clearwell. Soda ash and post-chlorine (hypochlorite solution) are added to the filtered water upstream of the clearwell.

A 1/2 HP centrifugal pump (capacity unknown) transfers the finished water from the clearwell to the 10,000-gallon (10.5 ft. diameter; 15.5 ft. length) steel gravity storage tank. Appurtenances to the gravity storage tank include a sample tap, drain, screened vent, screened overflow line, and access hatch. Two 15 HP centrifugal booster pumps (capacity unknown) deliver water from the gravity storage tank to the 3,000-gallon pressure storage tank and the distribution system. Appurtenances to the booster pumps include a gate valve on the suction side, and a gate valve, check valve, and pressure guage on the discharge side. The booster pumps automatically alternate in sequence of operation after each pumping cycle. Appurtenances to the pressure tank include a sample tap, pressure gauge, sight glass, air release valve, vacuum release valve, drain, and access manway. An air compressor helps maintain the proper air:water ratio in this tank. The 10,000-gallon gravity storage tank is located outside of the main building, and is buried. The 3,000-gallon pressurized tank is located in the boiler room, which is in the basement of the main building.

A 10 HP centrifugal pump (capacity unknown) is provided for backwashing the filter. It takes suction from the clearwell.

Chemical feed equipment includes solution tanks and diaphragm solution pumps for the alum, soda ash, and chlorine. The solution tanks for alum and post-chlorine are 45-gallon. The solution tanks for pre-chlorine and soda ash are 50-gallon. Each pump has a maximum capacity of 8 gph. In the automatic mode, all of the chemical feed systems operate whenever the water treatment units are operating. The feed systems for soda ash and post-chlorine can be manually shut off during plant start-up.

Well No. 2 - This well is located near River Road in the athletic field in front of the abbey building. The well is constructed from a 9 7/8-inch hole drilled to a depth of 51 feet, a 6 1/2-inch hole from 51 feet to 245 feet in depth, and a 6 1/4-inch hole from 245 feet to 516 feet in depth. Bedrock was encountered at a depth of 38 feet. The well is cased with 7-inch casing from +2 feet to a depth of 51 feet, and grouted with neat cement from ground level to a depth of 51 feet. This well yielded 3 gpm after 24 hours of continuous pumping with a drawdown level of 289 feet, in a test conducted in 1962. At the time of testing, the static water level was 61 feet. A submersible well pump of unknown capacity discharges water from the well to the 10,000-gallon gravity storage tank. Appurtenances to the well include a sanitary seal, screened casing vent, sample tap, and discharge meter. The well is centered on a 4' x 4' x 6" concrete pad and is enclosed in a 36-inch concrete pipe section with a cover. This well is used as needed to provide an auxioiary source of water. In recent years, it has been utilized as the secondary auxiliary well.

Well No. 3 - This well is located in the athletic field between Well No. 2 and the abbey building. The well is constructed from a 9 7/8-inch hole drilled to a depth of 51 feet, and a 6 1/4-inch hole extended from 51 feet to 504 feet in depth. Bedrock was encountered at a depth of 40 feet. The well is cased with 7-inch casng from +2 feet to a depth of 51.5 feet, and grouted with neat cement from ground level to a depth of 51 feet. This well yielded 13 gpm after 24 hours of continuous pumping with a drawdown level of 201 feet in a test conducted in 1962. At the time of testing, the static water level was 49 feet. A submersible well pump of unknown capacity discharges water from the well to the 10,000-gallon gravity storage tank. The well pump output was 12 gpm during an inspection on December 14, 1994. Appurtenances to the well include a sanitary seal, screened casing vent, check valve, blow-off, sample tap and a discharge meter. The well is centered on a 4' x 4' x 6" concrete pad and is enclosed in a 36-inch concrete casing with a cover. This well is used as needed to provide an auxiliary source of water. In recent years, it has been used as the primary auxiliary well.

DESIGN CRITIERIA: Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1993 *Waterworks Regulations*

1. Source Capacity:
   - A. The safe yield of the James River in the vicinity of the abbey has not been established, but it is not a limiting factor for this treatment plant.
   - B. Well No. 2 - 3 gpm (1962 - 24 continuous hours)
   - C. Well No. 3 - 13 gpm (1962 - 24 continuous hours)

2. Raw Water Pumping Capacity:
   one 5 HP submersible pump - capacity unknown (James River to retention pond)
   one 1 HP centrifugal pump - capacity unknown (retention pond to treatment plant)

3. Filtration Capacity:
   (2 gpm/ft.^{2})
   one circular sand filter - 5.92 ft. diameter
   Area = 27.5 ft.^{2}
   Maximum Filtration Rate: (27.5 ft^2)(2 gpm/ft^2) = 55 gpm
   55 gpm x 1,440 minutes/day = 79,200 gpd
   79,200 gpd @ 100 gpd/person = 792 persons

4. Finished Water Pumping Capacity:
   - A. Surface Water: ($Q = 11.4\ N^{0.544}$)
     One 1/2 HP centrifugal pump (clearwell to 10,000-gallon storage tank) - capacity unknown
   - B. Groundwater: (0.5 gpm per ERC)
     1. Well No. 2 - unknown
     2. Well No. 3 - 12 gpm (instantaneous reading on December 14, 1994)

5. Booster Pump Capacity:
   ($Q = 11.4\ N^{0.544}$)
   Two 15 HP booster pumps - capacity unknown

5. Storage Capacity:
   (200 gallons per ERC)
   one 15,000-gallon clearwell
   one 10,000-gallon gravity storage tank
   one 3,000-gallon hydropneumatic tank

   Effective Storage Volume:
   15,000 + 10,000 + 1/3(3,000) = 26,000 gallons

   Total Effective Storage Capacity:
   26,000 gallons @ 200 gallons/ERC = 130 ERCs or 52,000 gpd
   52,000 gpd @ 100 gpd/person = 520 persons

This waterworks is limited by the total effective storage capacity to a maximum usage of 520 persons @ 100 gpd/person or 52,000 gpd, but is being issued for a maximum usage of 250 persons @ 100 gpd/person or 25,000 gpd. The reduced design capacity is due to the unknown raw water and finished water pumping capacities. This design capacity is in accordance with previously issued operation permits for this waterworks.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE August 29, 2000

WATERWORKS NAME Meadows Nursing Center

CERTIFIED CLASS IV

CITY/COUNTY Goochland County

TYPE Community

LOCATION West on Route 6 to Route 614 (Dogtown Road), which is approximately 2.9 miles past the intersection of Route 6 and U. S. Route 522 (North). Turn right onto Dogtown Road, and go approximately 2.8 miles. The nursing center is on the right.

OWNER Capstone of Virginia Limited Partnership
P. O. Box 281454
Altanta, Georgia 30384

ADMINISTRATOR Life Care Centers of America, Inc. → Matthew Farmer
Contact Ms. ~~Paula Powers, Acting~~ Administrator
The Meadows Nursing Center
2715 Dogtown Road
Goochland, Virginia 23063
Telephone: (804) 556-4418

OPERATOR Mr. Michael L. Cook, TetraOps (Class I)
P. O. Box 13
Doswell, Virginia 23047
Telephone: (804) 994-2088

PERMIT NUMBER	4075900	4075520	404499	Amended
DATE ISSUED	4/3/91	3/30/92	12/20/99	9/7/00

TYPE OF TREATMENT Iron and Manganese Treatment, and Corrosion Control

SOURCE Groundwater - one drilled well

DESIGN CAPACITY 97 residents or 14,400 gpd - limited by the well pump capacity and the filtration capacity

DESCRIPTION OF SYSTEM:

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 and corrosion control treatment.

Well - The well is located on the north side of the nursing center, behind the main building. It is constructed from a 9 7/8-inch hole drilled to a depth of 84 feet, with a 8¾-inch hole extended from 84 feet to 306 feet in depth. Bedrock was encountered at a depth of 80 feet. The well is cased with 6¼-inch steel casing from +2 feet to a depth of 84 feet. The well was grouted with neat cement from ground level to 84 feet in depth. The well yielded 42 gpm with 170 feet of drawdown after 48 hours of continuous pumping in a test completed on March 30, 1989.

The well is centered on a 6-ft x 6-ft x 6-inch thick concrete pad. It is equipped with a pitless adapter unit. Appurtenances to the well located inside of the pump house include a gate valve, a check valve, a discharge meter, and a sample tap. A blow-off can be attached to the connection now used for the sample tap, if it is needed.

The 20.5-ft x 20.75-ft x 12-ft brick pump house, which houses the booster pumps, treatment facilities, and the operational end of the hydropneumatic tank, is located at the rear of the maintenance shop on the east side of the property. The pump house is equipped with lighting, heat, a floor drain, and a locked entrance.

A 3-HP submersible pump, rated at 31 gpm @ 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 33.0 feet and 34.0 feet, respectively, above the bottom of the tank. The well pump is also capable of pumping 18.0 gpm @ 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.

Iron and Manganese Treatment - The iron and manganese treatment facilities include a 13" x 54" pressure aerator tank, a 360-gallon (3 feet diameter; 8 feet high) detention tank for settling of the precipitate, and two 24" x 71" 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.

Corrosion Control - 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 gallon/hour (24 gallons/day). The solution tank size is 55 gallons for the caustic soda and 15 gallons for the 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.

Storage Facilities - The storage facilities include a 29,600-gallon gravity storage tank and a 5,000-gallon hydropneumatic tank.

The 29,600-gallon gravity storage tank is 12.0 feet in diameter, and 35.0 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. The tank is equipped with bolted access manholes on the top and the side, a screened overflow line, a capped drain line, a screened vent, an access ladder, and shut-off valves on the inlet and outlet lines. The shut-off valves are located inside of the pump house.

The hydropneumatic tank is provided with a sight glass, a pressure gauge, a vacuum relief valve, a pressure relief valve, an access manhole, a sample tap, and a drain.

Both the ground storage tank and hydropneumatic tank may be bypassed if necessary for maintenance and/or repairs.

Booster Pumps - 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 @ 138 feet TDH. Operating in parallel, the two pumps have a rated capacity of 140 gpm @ 140 feet TDH. Appurtenances to each booster pump includes a gate valve on the suction side, and a check valve, gate valve, and pressure gauge on the discharge side.

Operation - 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 shutoff pressure is reached, both pumps are shut off by a mercoid switch. The ¾-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 24.0 feet above the bottom of the gravity storage tank shuts the booster pumps off to reserve the water in the tank allocated for fire protection. Another electrode set at 25.0 feet above the tank bottom reactivates the booster pumps when needed.

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

DESIGN CRITERIA: Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*.

1. Actual Usage: 150 gpd per resident (1999 water usage data)

2. Well Yield: (0.5 gpm per ERC)
42 gpm - 48 hours of continuous pumping (1989)
42 gpm @ 0.5 gpm/ERC = 84 ERCs or 33,600 gpd
33,600 gpd @ 150 gpd/resident = 224 residents

3. Well Pump Capacity: (0.5 gpm per ERC)
18 gpm - observed output (8/28/00)
18 gpm @ 0.5 gpm/ERC = 36 ERCs or 14,400 gpd
14,400 gpd @ 150 gpd/resident = 96 residents

4. Booster Pump Capacity: ($Q = 11.4\ N^{0.544}$)
Each pump is rated at 75 gpm @ 138 feet TDH
The combined capacity of the booster pumps is 140 gpm @ 142 feet TDH
$Q = 140$ gpm
$Q = 11.4\ N^{0.544}$
N = 100 ERCs or 40,000 gpd
40,000 gpd @ 150 gpd/resident = 267 residents

5. Storage Capacity: (200 gallons per ERC)
1-5,000 gallon hydropneumatic tank
1-29,600 gallon gravity storage tank
9,305 gallons is allocated for potable water storage

Effective Storage Volume: 9,305 + 1/3(5,000) = 10,972 gallons
Effective Storage Capacity: 10,972 gallons/200 gallons per ERC = 55 ERCs or 22,000 gpd
22,000 gpd @ 150 gpd/resident = 147 residents

6. Filtration Capacity: (3 gpm per ft^2)

Two 24-inch diameter filters
Area per filter = 3.14 ft^2; total area = 6.28 ft^2
Filtration Rate = 3 gpm/$ft.^2$
6.28 ft^2 x 3 gpm/$ft.^2$ = 18.84 gpm
(say 18 gpm - 9 gpm flow control valve on each filter)
18 gpm @ 0.5 gpm per ERC = 36 ERCs or 14,400 gpd
14,400 gpd @ 150 gpd/resident = 96 residents

7. Capacity of the Aqua-Mag (Orthophosphate-Polyphosphate) Feed System:

One 15-gallon solution tank and one 24-gpd diaphragm feed pump. Aqua-Mag has a specific weight of 11.4 lb/gal, and a total phosphate concentration of 34.5%. Therefore, the concentration of total phosphate in Aqua-Mag is 471,583 ppm.

$N_1V_1 = N_2V_2$
V_1 = required output of Aqua-Mag feed pump
N_1 = 471;583 ppm
V_2 = 18 gpm (well pump output)
N_2 = 0.286 ppm (dosage based on water quality - formula from manufacturer)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(0.286)(18)}{471,583} = 0.000011 \text{ gpm}$$
$$= 0.015 \text{ gpd}$$

The 24-gpd diaphragm feed pump is therefore adequate for the Aqua-Mag feed system.

8. Capacity of the Caustic Soda Feed System:

One 30-gallon solution tank and one 24 gpd diaphragm feed pump. The feed equipment will utilize a 50% caustic soda solution.

$N_1V_1 = N_2V_2$
V_1 = required output of chemical feed pump
N_1 = 50% = 500,000 ppm
V_2 = 18 gpm (well pump output)
N_2 = 50 ppm (RTW Model - to raise the pH to 7.4)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(50)(18)}{500,000} = 0.0018 \text{ gpm} = 2.6 \text{ gpd}$$

The 24-gpd diaphragm feed pump is therefore adequate for the caustic soda feed system.

This water system is limited by the well pump capacity and the filtration capacity to a maximum capacity of 97 residents or 14,400 gpd.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE September 21, 2000

WATERWORKS NAME Pagebrook CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Community

LOCATION West on Route 6, approximately 2 miles past the Goochland-Henrico line. Turn left onto State Route 647. Well No. 1 is at the N.E. corner of Route 647 and Briarwood Drive. Well No. 3 is on the right side (south side) of Briarwood Drive in a stand of pine trees. Well No. 4 is located at the end of Knollwood Drive, which is one block south of Briarwood Drive.

OWNER AquaSource
Mr. Kevin Read, Northeast Regional Manager
601 Jefferson Boulevard
Warwick, Rhode Island 02886

OPERATOR Sydnor Hydro, Inc.
P. O. Box 27186
Richmond, Virginia 23261
Contact Mr. Jesse L. Royall, Jr., P.E., Vice-President of Utilities, Telephone: 643-2725
Mr. Ed Held (Class II)

PERMIT NUMBER	1762	4075630	Amended	400599	Amended
DATE ISSUED	2/3/70	4/27/77	5/8/87	2/5/99	10/2/00

TYPE OF TREATMENT Iron and manganese treatment

SOURCE Groundwater - three drilled wells

DESIGN CAPACITY 20 existing residential connections

DESCRIPTION OF SYSTEM:

This waterworks consists of three drilled wells, one 10,000-gallon gravity storage tank, one 5-HP booster pump, one 5,000-gallon hydropneumatic tank, one 215-gallon pressure tank, and two iron and manganese treatment systems, with related appurtenances.

Well Nos. 1 and 3

Well No. 1 - This well is located at the northeast corner of Route 647 and Briarwood Drive. It is constructed from an 11-inch hole drilled to a depth of 54 feet with a 6-inch hole extended from 54 feet to 247 feet in depth. The well is cased with 6-inch steel casing from +2 feet to 54 feet in depth and grouted with neat cement from ground level to a depth of 54 feet. Bedrock was encountered at a depth of 27 feet. This well yielded 22 gpm after 4 continuous hours of pumping in a test conducted around 1969.

Appurtenances to the well include a sanitary seal, a screened casing vent, a check valve, a gate valve, a sample tap, a meter, and a blow-off upstream of the meter.

Well No. 1 is only used during emergency conditions (dry weather, etc.) because of hydrogen sulfide odors and iron precipitates.

Well No. 3 - This well is on the right side (south side) of Briarwood Drive in a stand of pine trees. It is constructed from an 11-inch hole drilled to a depth of 51 feet and a 6-inch hole extended from 51 feet to 400 feet in depth. The well is cased with 6-inch steel casing from +2 feet to 51 feet in depth and grouted with neat cement from ground level to a depth of 51 feet. The well yielded 16 gpm with 85 feet of drawdown after 48 hours of continuous pumping during a test completed on March 27, 1981. The well casing is centered in a 6-ft x 6-ft x 6-inch thick concrete pad.

Appurtenances to the well include a pitless adapter unit, a sanitary seal, a screened casing vent, a check valve, a gate valve, a sample tap, a meter, and a blow-off. The well and its appurtenances are protected by a 3-ft x 3.25-ft x 5-ft fiberglass enclosure.

Well Pumps - The submersible pumps in Well Nos. 1 and 3 deliver the water to the 10,000-gallon gravity storage tank via the iron and manganese treatment facilities. Well No. 1 is equipped with a pump of unknown horsepower and rated capacity. The observed output of this well pump was 1.5 gpm on June 28, 1999. This well is not in service at the present time. Well No. 3 is equipped with a 1-HP pump of unknown rated capacity. The observed output of this well pump was 6 gpm on August 28, 2000.

Well House - Well No. 1, the control panel, the iron and manganese treatment facilities for Well Nos. 1 and 3, and the operational end of the hydropneumatic tank are housed in an 8-ft x 8-ft x 8-ft concrete block well house. Appurtenances to the well house include lighting, heat, overhead access for Well No. 1, a concrete floor with a floor drain, and a locked entrance.

Iron and Manganese Treatment - Orthophosphate-polyphosphate (Aqua-Mag) is fed periodically (about one month in every two-three months) to sequester iron and manganese. The Aqua-Mag feed equipment includes a 50-gallon solution tank and a diaphragm feed pump with a maximum capacity of 1 gallon/hour (24 gallons/day). The Aqua-Mag solution is injected into the combined well discharge line for Well Nos. 1 and 3. Four parallel cartridge filters (4-inch diameter, 24-inch height) are provided immediately downstream of the chemical injection point.

Odor Control - Chorine is fed whenever Well No. 1 is being used to control hydrogen sulfide odors. The chlorine feed equipment includes a 50-gallon solution tank and a diaphragm feed pump with a maximum capacity of 1 gallon/hour (24 gallons/day). The chlorine solution is injected into the influent line to the hydropneumatic tank.

Sample taps - Sample taps in the well house are installed on each well discharge line, downstream of the cartridge filters, and on the influent line to the hydropneumatic tank.

Storage Facilities - The storage facilities include a 10,000-gallon (10-ft diameter, 17.5-ft length) gravity storage tank and a 5,000-gallon hydropneumatic tank.

Appurtenances to the gravity storage tank include an access manway, a screened overflow, a screened vent, a drain line, and a sample tap. There is no bypass piping provided. The effective storage volume of the tank is 9,210 gallons. Operational electrodes in the storage tank are at approximately the following elevations:

Function	Height Above Bottom Of Storage Tank
Well Pump Shut-Off	9.0 ft
Well Pump Cut-On	8.0 ft
Booster Pump Reactivation	2.0 ft
Booster Pump Shut-Off	1.0 ft

Appurtenances to the hydropneumatic tank include a sight glass, a pressure gauge, a sample tap, a drain, an access manhole, an air relief valve, a vacuum relief valve, and a 1/2-HP air compressor to help maintain the proper air:water ratio.

Booster Pump - One 5-HP centrifugal booster pump with a rating of 140 gpm @ 110 ft TDH transfers the water from the gravity storage tank to the hydropneumatic tank and then to the distribution system. The booster pump is equipped with a gate valve on the suction side, and a pressure gauge, gate valve, and check valve on the discharge side.

Air Compressor and Booster Pump Operation - If the hydropneumatic tank pressure drops to 47 psi and the water level is above the center of the tank, the air compressor turns on and operates until the tank pressure is raised to 57 psi. If the water level drops below the center of the tank, the air compressor shuts off. The booster pump then operates at tank pressures of 46-56 psi. When the water level again reaches the center of the tank, the air compressor is re-activated, and shuts off when the tank pressure is raised to 57 psi.

Well No. 4

Well No. 4 - This well is located at the end of Knollwood Drive. The well lot sits about 100 feet off of Knollwood Drive; a gravel road provides all-weather access to this well. The well is constructed from a 10-inch hole drilled to a depth of 81 feet, with a 6-inch hole extended from 81 feet to 440 feet in depth. Bedrock was encountered at a depth of 74 feet. The well is cased with 6-inch casing from +2 feet to a depth of 81 feet, and is grouted with neat cement from ground level to 81 feet in depth. The well yielded 10 gpm after 48 hours of continuous pumping, in a test completed on April 6, 1984.

Appurtenances to the well include a sanitary seal, a screened casing vent, a check valve, a gate valve, a blow-off, a sample tap, and a discharge meter.

Well Pump - Well No. 4 is equipped with a 2-HP submersible well pump, rated at 23 gpm @ 225 feet TDH. The well pump is controlled by pressure switches on the pressure tank set at 35-45 psi. The observed output of this well pump was 6 gpm on August 28, 2000.

Well House - Well No. 4, the control panel, the iron and manganese treatment facilities, and the pressure tank are enclosed in a 10-ft x 10-ft x 8-ft concrete block well house. Appurtenances to the well house include lighting, heat, overhead access, a floor drain, and a locked entrance.

Iron and manganese treatment - The iron and manganese treatment facilities include sodium hypochlorite and potassium permanganate feed systems and a 24-inch manganese greensand filter. Each chemical feed system includes a 50-gallon solution tank and a 24-gpd diaphragm solution pump. The atomerator (with a 1/3-HP air compressor) installed ahead of the greensand filter is not in use.

The diaphragm pumps for the chlorine and the potassium permanganate solutions are controlled by an impulse contactor. Sample taps are provided upstream of the chemical injection points, after the chemical injection points, and after the filter. No flow control valve is provided for the filter.

Backwash water is provided from the 215-gallon pressure tank and the distribution system. No flow control valve is provided for the backwash line. The backwash waste is discharged through the blow-off line to the outside of the well house.

Storage Facilities - The 215-gallon pressure tank is equipped with a sight glass, a pressure gauge, a sample tap, and a drain.

DESIGN CRITERIA

Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*

1. Well Yield: (0.5 gpm per ERC)

Well No. 1 - 22 gpm for 4 continuous hours (1968)
Well No. 3 - unknown
Well No. 4 - 10 gpm for 48 continuous house (1984)
Total Well Yield: 32 gpm

32 gpm @ 0.5 gpm/ERC = 64 ERCs or 25,600 gpd

*The respective yields of these wells have significantly decreased since the above mentioned yield and drawdown tests were conducted. The current yields are approximately equal to the well pump capacities.

2. Well Pump Capacity: (0.5 gpm per ERC)

Well No. 1 - 1.5 gpm (observed output on 6/28/99 - Sydnor)
Well No. 3 - 1.5 gpm (observed output on 9/12/00 - VDH)
Well No. 4 - 6 gpm (observed output on 8/28/00 - Sydnor)
Total Well Pump Capacity: 9 gpm

8 gpm @ 0.5 gpm/ERC = 18 ERCs or 7,200 gpd

3. Filtration Capacity - **Well No. 4 only:** (3 gpm/ft^2)

Filter Diameter: 24inch
Filter Area: 3.14 ft^2
Maximum Filtration Capacity: 9.5 gpm

9.5 gpm @ 0.5 gpm/ERC = 19 ERCs or 7,600 gpd

4. Booster Pump Capacity - **Well Nos. 1 & 3 only:**

One 5-HP booster pump - rated at 140 gpm @ 110 ft TDH
$Q = 11.4N^{0.544}$
Q = 140 gpm
N = 100 ERCs or 40,000 gpd

The booster pump capacity is <u>not</u> the limiting criteria for Well Nos. 1 and 3.

5. Storage Capacity: (200 gallons per ERC)

One 10,000-gallon gravity storage tank
(Effective storage volume = 9,210 gallons)
One 5,000-gallon hydropneumatic tank
One 215-gallon pressure tank

Effective storage volume:
(5,000 + 215)/3 + 9,210 gallons = 10,948 gallons

Total effective storage capacity:
10,948 gallons @ 200 gallons/ERC = 55 ERCs or 22,000 gpd

6. Capacity of Phosphate Feed System - **Well Nos.1 & 3 only:**

The orthophosphate-polyphosphate (Aqua-Mag) feed equipment includes a 50-gallon solution tank and a diaphragm feed pump with a maximum capacity of 1 gallon/hour (24 gallons/day).

Aqua-Mag has a specific weight of 11.4 lb/gal, and a total phosphate concentration of 34.5%. Therefore, the concentration of total phosphate in Aqua-Mag is 471,583 ppm.

$N_1V_1 = N_2V_2$
V_1 = required output of Aqua-Mag feed pump
N_1 = 471,583 ppm
V_2 = 3 gpm (combined well output)
N_2 = 3.30 ppm (dosage based on water quality - formula from manufacturer)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(3.30)(3)}{471,583} = 0.000021 \text{ gpm or } 0.030 \text{ gpd}$$

The 24 gpd diaphragm feed pump is therefore adequate for the Aqua-Mag feed system.

7. Capacity of the Sodium Hypochlorite Feed System - **Well Nos. 1 & 3 and Well No. 4:**

One 50-gallon solution tank and one 24-gpd diaphragm solution feed pump. The operator uses 5.25% chlorine solution.

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 5.25% = 52,500 ppm
V_2 = 6 gpm - observed output of Well No. 4*
N_2 = 7.5 ppm

$$V_1 = \frac{(7.5)(6)}{52,500} = 0.000857 \text{ gpm or } 1.23 \text{ gpd}$$

*The combined well pump output for Well Nos. 1 and 3 is 3 gpm, which is less than the well pump output for Well No. 4.

The 24-gpd solution feed pump is therefore adequate for the sodium hypochlorite feed system at each well house.

8. Capacity of the Potassium Permanganate Feed System - **Well No.4 only:**

One 50-gallon solution tank and one 24-gpd diaphragm solution feed pump. The operator uses 0.23% permanganate solution (3 oz of permanganate per 10 gallons of water).

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 0.23% = 2,300 ppm
V_2 = 6 gpm - observed output of Well No. 4
N_2 = 5 ppm (estimated)

$$V_1 = \frac{(6)(5)}{2,300} = 0.013 \text{ gpm or } 18.8 \text{ gpd}$$

The 24-gpd solution feed pump is therefore adequate for the potassium permanganate feed system at Well No. 4.

This waterworks is limited by the total well pump capacity to a maximum usage of 18 equivalent residential connections or 7,200 gpd, but is being issued for the 20 existing residential connections, in accordance with previously issued operation permits.

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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE December 20, 1999

WATERWORKS NAME Samary Forest CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Community

LOCATION I-64 west to Route 623 (Rockville - Manakin exit). South (left) on Route 623 approximately 1.1 miles to U. S. Route 250. East on U. S. Route 250 approximately 0.3 miles to Whippoorwill Drive. Right on Whippoorwill Drive. Go approximately 0.2 miles; the well house access road is on the right.

OWNER Mr. Timothy Smith
4416 Belfast Road
Glen Allen, Virginia 23060
Telephone: 556-5374 (work); 270-7820 (home)

OPERATOR Same

PERMIT NUMBER 4075710 Amended

DATE ISSUED June 24, 1977 December 28, 1999

TYPE OF TREATMENT Corrosion control

SOURCE Groundwater - one drilled well

DESIGN CAPACITY 15 residential connections - existing

DESCRIPTION OF SYSTEM:

This waterworks includes one drilled well, one 5,000-gallon hydropneumatic tank, and corrosion control facilities, with appropriate appurtenances.

The well was constructed in 1956 from a hole of unknown diameter(s) drilled to a depth of 98 feet. Six-inch steel casing was installed from +2 feet to 58 feet in depth, and the well was grouted with neat cement from ground level to a depth of 58 feet. There is no record of a yield and drawdown test. Appurtenances to the well include a sanitary seal, a screened casing vent, a check valve, a gate valve, a sample tap, a discharge meter, and a blow-off line.

Water from the well is delivered by a ¾-HP submersible pump (rating unknown) through the corrosion control treatment to the 5,000-gallon hydropneumatic tank, and thence to the distribution system. Pressure switches on the hydropneumatic tank, set at 35-45 psi, control the well pump. The well pump had an instantaneous output of 6 gpm during an inspection on June 19, 1999.

The corrosion control facilities include a cartridge-type sediment filter (4.5-inch diameter, 9.75-inch height) and two neutralizer filters (13-inch diameter, 54-inch height) installed in series, with appropriate appurtenances. The equipment is installed upstream of the well discharge meter and the 5,000-gallon hydropneumatic tank.

Each neutralizer filter is an upflow filter, designed for a flow rate of 8 gpm, with a peak capacity of 10 gpm. A flow control valve is installed on the influent line to the filters will limit the flow rate to 8.8 gpm. The filter media will be a proprietary blend of calcium carbonates and magnesium oxides.

Appurtenances to the filters include gate valves, check valves, sample taps, and pressure gauges, both upstream and downstream of the filters. Bypass piping around the filters is provided.

When necessary, backwash water is provided by the hydropneumatic tank. The backwash waste will be discharged through the floor drains to the ground surface.

Appurtenances to the hydropneumatic tank include a sight glass, pressure gauge, pressure relief valve, vacuum relief valve, access manhole, drain, and sample tap. Air is added manually with a portable air compressor.

The well, the corrosion control facilities, and the control end of the hydropneumatic tank, are housed in a 30-ft x 15-ft x 10-ft concrete block well house. The well house is equipped with lighting, heat, drainage, and ventilation.

DESIGN CRITERIA:		Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*.
1.	Well Yield:	unknown
2.	Well Pump Capacity:	(0.5 gpm per ERC) 6 gpm at unknown TDH - instantaneous output on June 19, 1999 6 gpm @ 0.5 gpm per ERC = 12 ERCs or 4,800 gpd

3. Capacity of Neutralizer Filters: (0.5 gpm per ERC)

No. of Filters	2
Diameter	13 inches
Area	0.92 ft^2
Filtration Capacity	8.8 gpm*

8.8 gpm @ 0.5 gpm/ERC =
17 ERCs or 6,800 gpd

*The manufacturer's literature indicates that these filters have a maximum capacity of 8-10 gpm. The flow control valve will limit the flow rate to 8.8 gpm.

4. Storage Capacity: (200 gallons per ERC)

one 5,000-gallon hydropneumatic tank

Effective Storage Volume:
5,000/3 = 1,667 gallons

Total Effective Storage Capacity:
1,667 gallons @ 200 gallons per ERC =
8 ERCs or 3,200 gpd

This waterworks is limited by the total effective storage capacity to a maximum usage of 8 equivalent residential connections or 3,200 gpd. However, the amended operation permit is being issued for the existing 15 residential connections.

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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: May 20, 2005

WATERWORKS NAME:	Broadview Shopping Center	CERTIFIED CLASS:	IV
COUNTY/CITY:	Goochland County	TYPE:	Non-transient Non-community

LOCATION: I-64 West to the Rockville-Manakin (Route 623) exit. Turn left on Route 623, travel approximately 1.1 miles to U. S. Route 250. Turn right on U. S. Route 250. The shopping center is on the right side of the road, about 0.2 miles from its intersection with Route 623. The wells, pump house, and storage tanks are at the back of the shopping center property.

OWNER: Broadview Associates
38 Broad Street
Manakin-Sabot, Virginia 23103
Contact Mr. W. Douglas Elliott, Jr., President
Telephone: (804) 784-0407 Pager 759-3266 FAX 784-0185

OPERATOR: Mr. Michael L. Cook – Class I
TetraOps
P. O. Box 13
Doswell, Virginia 23047
Telephone: (804) 994-2088 or (804) 387-6362 (cell)

PERMIT NUMBER:	4075036	401301	Amended
EFFECTIVE DATE:	07/31/86	04/16/01	05/31/05

TYPE OF TREATMENT: Iron and manganese removal, pH adjustment

SOURCE: Groundwater – two drilled wells

DESIGN CAPACITY: 61,056 gpd – limited by the filtration capacity

DESCRIPTION OF THE SYSTEM

This waterworks consists of two drilled wells, a 10,000-gallon and a 6,000-gallon gravity storage tank, treatment facilities for pH adjustment and iron and manganese removal, two 5-HP booster pumps, and a 1,000-gallon hydropneumatic tank, with appropriate appurtenances.

Well No. 1

This well is located approximately 600 feet southeast of the pump house, adjacent to the Bradshaw Small Engine Repair property. The well was constructed from a 10-inch hole drilled to a depth of 63 feet, with a 6-inch hole extended to a depth of 505 feet. Bedrock was encountered at a depth of 35 feet. Six-inch steel casing was installed from +2 feet to a depth of 63 feet, and the well was grouted

with neat cement from ground level to a depth of 63 feet. This well yielded 71 gpm with 149 feet of drawdown after 24 hours of continuous pumping in a test conducted on September 19, 2000.

The well head is centered on a 6-ft x 6-ft x 6-inch concrete apron. Appurtenances to the well at the well head include a pitless adapter unit, and a sanitary well cap with a screened casing vent.

A 3-HP submersible pump, rated at 42 gpm @ 175 feet TDH, delivers the water from the well via approximately 750 feet of 3-inch Schedule 40 PVC pipe to the treatment facilities, and then to the gravity storage tanks. Electrodes in the 10,000-gallon gravity storage tank control the operation of the well pump.

Well No. 3

This well is located approximately 50 ft south of the pump house. It was constructed from a 10-inch hole drilled to a depth of 63 feet, with a 6-inch hole extended to a depth of 1,013 feet. Bedrock was encountered at a depth of 34 feet. Six-inch steel casing was installed from +2 feet to a depth of 63 feet, and the well was grouted with neat cement from ground level to a depth of 63 feet. This well yielded 4 gpm with 257 feet of drawdown after 24 hours of continuous pumping in a test conducted on September 19, 2000.

The well head is centered on a 6-ft x 6-ft x 6-inch concrete apron. Appurtenances to the well at the well head include a pitless adapter unit, and a sanitary well cap with a screened casing vent.

A 0.5-HP submersible pump, rated at 4 gpm @ 320 feet TDH, delivers the water from the well via approximately 50 feet of 1.5-inch Schedule 40 PVC pipe to the treatment facilities, and then to the gravity storage tanks. Electrodes in the 10,000-gallon gravity storage tank control the operation of the well pump.

Pump House

The treatment facilities and the control end of the hydropneumatic tank are housed in a 20-ft x 10-ft x 10-ft (interior dimensions) masonry block pump house. The pump house is equipped with lighting, heat, a concrete floor with a floor drain, and a lockable entrance.

Appurtenances on the discharge line from each well include a liquid pressure relief valve, a pressure gauge, a sample tap, and a check valve. The common discharge line for the two wells includes a meter and a valved blow-off. The discharge end of the blow-off is screened, and a splash block is provided for erosion control.

Chemical Feed Systems

A caustic soda feed system is installed for pH adjustment. It consists of a 22-gpd diaphragm pump that feeds directly from the caustic soda purchase container.

A sodium hypochlorite feed system and a potassium permanganate feed system are provided to oxidize the iron and manganese in the water and optimize the effectiveness of the manganese greensand filters for removing iron and manganese. Each chemical feed system consists of a 50-gallon polyethylene solution tank and a 24-gpd diaphragm pump. The potassium permanganate feed system also includes an impulse contactor for the feed pump and a 1/20-HP mixer for the solution tank.

The caustic soda, chlorine, and potassium permanganate are injected into the water directly upstream of the greensand filters. The solution pumps operate whenever the well pumps are operating, using auxiliary contacts on the well pump starter.

Manganese Greensand Filters

The two 36-inch manganese greensand filters operate in parallel. The filter media is comprised of 8 inches of anthracite, 24 inches of manganese greensand, and 10 inches of gravel. Backwash water is provided from the 10,000-gallon and 6,000-gallon gravity storage tanks. The backwash and rewash wastewater is discharged to the Backwash Waste Settling Tank located outside of the Pump House.

Backwash Waste Settling Tank

A horizontal gravity settling tank (8-ft diameter, 13.5-ft length) is provided for washwater waste from the greensand filters. The tank has a supernatant storage capacity of 3,555 gallons, and a sludge storage volume of 922 gallons. The tank is equipped with a framed access manhole with overlapping (shoe box type) cover on top, a 10-inch inlet connection on the top, a valved draw-off located 2.5 feet above the tank bottom, and a vent. The decant water is conveyed to a nearby drainage ditch with a garden hose.

Storage Facilities

The 10,000-gallon (10.5 ft diameter, 15.33 ft length) and the 6,000-gallon (8 ft diameter, 16 ft length) gravity storage tanks are installed in parallel. The tops of the two tanks are at approximately the same elevation. Electrodes for controlling the operation of the well pumps are installed in the 10,000-gallon tank:

Function	Height Above Bottom of 10,000-Gallon Tank	Equivalent Height Above Bottom of 6,000-Gallon Tank
Well Pump Cut Off	9.5 feet	7.0 feet
Well Pump Cut On	9.0 feet	6.5 feet
Booster Pump Reactivation	3.0 feet	0.5 feet
Booster Pump Cut Off	2.0 feet	N/A (empty)

The effective storage volumes are therefore 8,135 gallons for the 10,000-gallon tank and 5,581 gallons for the 6,000-gallon tank.

Appurtenances to each gravity storage tank include a hinged and lockable shoebox type access, a screened vent, a screened overflow, and a plugged drain. The tanks can be sampled from the sample tap on the discharge side of the booster pumps.

Appurtenances to the 1,000-gallon hydropneumatic tank (3.5-ft diameter, 14-ft length) include a sight glass, an access manhole, a drain, a pressure gauge, a sample tap, and air and vacuum relief valves. An air compressor is provided to help maintain the proper air:water ratio in the hydropneumatic tank. There is an H-O-A switch for the air compressor.

Booster Pumps

Two 5-HP booster pumps are installed in parallel for transferring the water from the gravity storage tanks to the hydropneumatic tank. Each booster is rated at 68 gpm @ 145 feet TDH. Operating in parallel, they are rated at 105 gpm @ 158 feet TDH. Appurtenances to each booster pump include an H-O-A switch, a gate valve on the suction side, and a gate valve and a check valve on the discharge side. There is a sample tap on the common discharge line for the pumps. The operation of the booster pumps is controlled by pressure switches on the hydropneumatic tank. Automatic alternation of the pumps after each pumping cycle is provided. The lead pump is set to operate at pressures of 55-70 psi on the hydropneumatic tank. The pressure settings for the lag pump are unknown.

Distribution System

The distribution system consists of 4-inch PVC piping from the pump house to the shopping center, and 3-inch PVC piping in the shopping center area.

EVALUATION OF THE SYSTEM

1. Well Yield:

Well No. 1 - 71 gpm
Well No. 3 - 4 gpm
TOTAL - 75 gpm

75 gpm x 1,440 minutes/day = 108,000 gpd

2. Well Pump Capacity:

Well No. 1 - 44 gpm -- observed output on 4/21/05
Well No. 3 - 2 gpm – observed output on 4/21/05
TOTAL - 46 gpm

46 gpm x 1,440 minutes/day = 66,240 gpd

3. Filtration Capacity

2 greensand filters, 36-inch diameter each
Total Filter Area = $2\ (36/12)^2\ \pi / 4 = 14.14$ sf
Filtration rate = 3 gpm/sf
(14.14 sf) (3 gpm/sf) = 42.4 gpm

42.4 gpm x 1,440 minutes/day = 61,056 gpd

4. Chemical Feed Equipment: caustic soda, sodium hypochlorite, potassium permanganate

$N_1V_1 = N_2V_2$ or $V_1 = N_2V_2/N_1$

Caustic Soda

N_1 = 500,000 mg/l (total 50% concentration)
V_1 = required chemical feed pump output
N_2 = 18 mg/l dosage
V_2 = 46 gpm = capacity of both well pumps

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(18\ mg/l)(46\ gpm)}{500{,}000\ mg/l} = 0.0017\ gpm = 2.4\ gpd$$

The 22-gpd diaphragm pump is adequate.

Sodium Hypochlorite N_1 = 52,500 mg/l (total 5.25% concentration)
V_1 = required chemical feed pump output
N_2 = 2 mg/l dosage
V_2 = 46 gpm = capacity of both well pumps

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(2\text{ mg/l})(46\text{ gpm})}{52{,}500\text{ mg/l}} = 0.0018\text{ gpm} = 2.5\text{ gpd}$$

The 24-gpd diaphragm pump is adequate.

Potassium Permanganate N_1 = 14,800 mg/l (2 oz $KMnO_4$ per 1 gal water)
V_1 = required chemical feed pump output
N_2 = 2 mg/l dosage
V_2 = 46 gpm = capacity of both well pumps

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(2\text{ mg/l})(46\text{ gpm})}{14{,}800\text{ mg/l}} = 0.006\text{ gpm} = 9.0\text{ gpd}$$

The 24-gpd diaphragm pump is adequate.

5. Storage Capacity:
one 10,000-gallon gravity storage tank
Effective volume = 8,135 gallons
one 6,000-gallon gravity storage tank
Effective volume = 5,581 gallons
one 1,000-gallon hydropneumatic tank
Effective volume = 1/3(1,000 gallons) = 333 gallons

Total Effective Storage Volume: 8,135 + 5,581 + 333 = 14,049 gallons

6. Booster Pump Capacity: Two 5-HP pumps are provided
Each pump is rated at 68 gpm @ 145 feet TDH
Operating in parallel, the pumps are rated at 105 gpm @ 158 feet TDH

105 gpm x 1,440 minutes/day = 151,200 gpd

7. Existing Usage: 6,306 gpd (4/17/03 – 4/22/05)

8. Delivery Capacity: [Booster Pump Output (gpm) x 60 minutes] + Pressure Storage Volume
(105 gpm)(60 minutes) + 1000 gallons/3 = 6633 gallons
Operational Time: 10 hours/day (600 minutes)
Peak Hour Factor: 4

Peak Hour Demand: (6,306 gpd)(4)/ 10 hours/day = 2,522 gallons

Delivery Capacity (6633 gallons) exceeds Peak Hour Demand (2,522 gallons)

Based on the above evaluation, this waterworks is limited by the filtration capacity to a maximum capacity of 61,056 gpd.

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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE September 12, 1997

WATERWORKS NAME Byrd Elementary School CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Non-transient Non-community

LOCATION Route 6 west, approximately 9.5 miles beyond Goochland Courthouse to George's Tavern (Route 606). North (right) on Route 606 (Route 606 bears to the right approximately 1.0 miles north of Route 6). The school is located approximately 1.6 miles north of Route 6, on the left side of the road.

OWNER Goochland County Public Schools
P. O. Box 169
Goochland, Virginia 23063
Dr. Harold Absher, Superintendent of Schools
Contact Mr. Lewis Blakely, Director of School Administration
Telephone: 556-5316

Byrd School 556-5380

OPERATOR Mr. Dale Carros, Maintenance Supervisor
Mr. Robert E. Lawrence, Class IV Telephone: 556-5360

PERMIT NUMBER 4075040 401796 4075040-A

DATE ISSUED March 11, 1992 May 10, 1996 September 24, 1997

TYPE OF TREATMENT Chlorination and Corrosion Control

SOURCE Groundwater - one drilled well (existing)

DESIGN CAPACITY 600 persons (students and staff) or 4,400 gallons/school day - limited by the total effective storage capacity

DESCRIPTION OF SYSTEM:

This waterworks includes one drilled well, one 2,500-gallon gravity storage tank, two 5-HP booster pumps, one 1,000-gallon hydropneumatic tank, and chlorination and corrosion control facilities, with appropriate appurtenances.

No well construction details are known. The well is located in a 6-ft x 6-ft x 8-ft brick well house, located in the courtyard area. The well yielded 19 gpm after 12 hours of continuous pumping in a test completed on August 6, 1997. Appurtenances inside of this well house include a sanitary seal, a screened casing vent, a check valve, a gate valve, and a sample tap.

A submersible well pump of unknown horsepower discharges water through approximately 155 feet of 2-inch waterline to the 2,500-gallon gravity storage tank. The well pump discharge was 20 gpm during an instantaneous reading on November 8, 1996. The 2,500-gallon gravity storage tank is located in a 16-ft x 43-ft x 8.67-ft room in the new addition to the school. A butterfly valve is installed on the well discharge line, to maintain the same head conditions as when the well pump formerly delivered water directly to a hydropneumatic tank, and thus prevent overpumping of the well. The storage/pump room also houses the discharge meter and blow-off line for the well, two 5-HP booster pumps, and the chlorination and corrosion control feed equipment. A locked entrance and interior lighting are provided for the room. The floor of the room is at ground level. The floor is gravel, except for reinforced concrete pads under the storage tank (14-ft x 5-ft x 8-in) and the booster pumps (8-ft x 8-ft x 8-in).

The chlorination system includes a diaphragm feed pump (30 gpd - max.) and a 15-gallon polyethylene solution tank. The caustic soda feed system for corrosion control includes a diaphragm feed pump (24 gpd - max.) and a 25-gallon polyethylene solution tank. The injection points for both the chlorination system and the caustic soda feed system are located upstream of the gravity storage tank.

Electrodes are installed in the 2,500-gallon gravity storage tank at elevations of 3.83 feet and 4.33 feet above the bottom of the tank, to activate and deactivate the well pump, respectively. There is also a low level electrode, located 0.67 feet above the bottom of the gravity storage tank, to shut off the booster pumps. An additional electrode, located 1.5 feet above the tank bottom, reactivates the booster pumps once the water has reached this level. The effective storage volume in the tank is approximately 1,998 gallons.

Appurtenances to the gravity storage tank include a bolted hatch, a screened vent, an overflow line, a drain line, and a sample tap. The drain line is connected to the overflow line, which is piped to the outside of the building and discharges to the atmosphere, with a splash block at the discharge point. Bypass piping is provided for this tank.

The two booster pumps are each rated at 50 gpm @ 149 feet TDH, and a 5-HP motor powers each. They operate at hydropneumatic tank pressures of 40-53 psi. The pumps are controlled so that they cannot operate simultaneously. Automatic alternation of the booster pumps occurs after each pumping cycle.

Each booster pump is equipped with a gate valve on the suction side, and a check valve and gate valve on the discharge side. Approximately 155 feet of 2-inch waterline conveys the water from the booster pumps to the 1,000-gallon hydropneumatic tank, located at the well house.

The 1,000-gallon hydropneumatic tank is approximately 3.5 feet in diameter and 15.0 feet in length. Appurtenances to the tank include an access manhole (on top), a sample tap, a pressure gauge, a sight glass, an air release valve, a vacuum release valve, and a drain. Bypass piping is provided for this tank. A 1/2-HP air compressor is installed to help maintain the proper air:water ratio in the tank. It is activated when the booster pumps raise the water level in the hydropneumatic tank to 60% full, and is deactivated when the tank pressure is raised to 60 psi.

DESIGN CRITERIA: Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance *with* the 1995 *Waterworks Regulations*

1. Existing Per Capita Usage: 8.0 gallons/school day/person

2. Well Yield: (0.5 gpm per ERC)
   19 gpm - 12-hour pump test conducted on 8/6/97
   19 gpm @ 0.5 gpm/ERC = 38 ERCs or 15,200 gpd
   15,200 gpd @ 8.0 gpd/person = 1,900 persons

3. Well Pump Capacity: (0.5 gpm per ERC)
   20 gpm - instantaneous reading on 11/8/96
   20 gpm @ 0.5 gpm/ERC = 40 ERCs or 16,000 gpd
   16,000 gpd @ 8.0 gpd/person = 2,000 persons

4. Booster Pump Capacity: ($Q = 11.4\ N^{0.544}$)
Two 5-HP pumps, each rated at 50 gpm @ 149 feet TDH - the pumps do not operate in parallel
Q = 50 gpm
N = 15 ERCs or 6,000 gpd
6,000 gpd @ 8.0 gpd/person = 750 persons

5. Storage Capacity: (200 gallons per ERC)
One 2,500-gallon gravity storage tank
(Effective volume = 1,998 gallons)
One 1,000-gallon hydropneumatic tank

Total Effective Storage Capacity:
1,998 + (1,000)/3 = 2,331 gallons
2,331 gallons @ 200 gallons/ERC = 12 ERCs
12 ERCs x 400 gpd/ERC = 4,800 gpd
4,800 gpd @ 8.0 gpd/person = 600 persons

6. Hypochlorite Feed System

One 15-gallon solution tank and one 30 gpd diaphragm feed pump. The feed equipment utilizes chlorine bleach (5.25% chlorine).

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 5.25% = 52,500 ppm
V_2 = 20 gpm
N_2 = 7.5 ppm

$$V_1 = \frac{(7.5)(20)}{52,500} = 0.00286 \text{ gpm or } 4.1 \text{ gpd}$$

The 30 gpd diaphragm feed pump is therefore adequate for this usage.

7. Caustic Soda Feed Equipment

One 25-gallon solution tank and one 24 gpd diaphragm feed pump.

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 50% = 500,000 ppm
V_2 = 20 gpm
N_2 = 35 ppm (RTW Model)

$$V_1 = \frac{(35)(20)}{500,000} = 0.0014 \text{ gpm or } 2.0 \text{ gpd}$$

The 24 gpd diaphragm feed pump is therefore adequate for this usage.

This waterworks is limited by the total effective storage capacity to a maximum usage of 600 persons or 4,400 gallons/school day.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE December 12, 2000

WATERWORKS NAME Goochland Middle School CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Non-Transient Non-Community

LOCATION West on Route 6, approximately 3.0 miles past its intersection with U. S. Route 522 North (at Goochland Courthouse), to Route 614 (Dogtown Road). North on Route 614, approximately 3.1 miles. The school is located on the left side of the road, across from the Meadows Nursing Center.

OWNER Goochland County Public Schools
P. O. Box 169
Goochland, Virginia 23063
Contact Mr. Lewis Blakely, Director of School Administration (Telephone: 556-5316)

Goochland Middle School - 556-5320

OPERATOR Mr. Sonny Turner, Maintenance Supervisor
Mr. Robert E. Lawrence, Class IV
(Telephone: 556-5360) FAX - 556-3847

PERMIT NUMBER	075 4127285	Amended	400300	Amended
DATE ISSUED	1/12/92	1/9/98	2/28/00	12/21/00

TYPE OF TREATMENT Chlorination, Corrosion Control and Iron and Manganese Treatment

SOURCE Groundwater - one drilled well

DESIGN CAPACITY 1,680 persons (students and staff) or 16,800 gallons per school day

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, a 10,000-gallon gravity storage tank, two 3-HP booster pumps, a 2,000-gallon hydropneumatic storage tank, corrosion control equipment, and iron and manganese treatment equipment, with appropriate appurtenances.

Well - The well (Well No. 2) is located in the front yard of the school property. It is constructed from an 11½-inch hole drilled to a depth of 70 feet, with an 8¾-inch hole extending from 70 feet to 100 feet in depth, and a 6-inch hole extending from 100 feet to 405 feet in depth. Six-inch steel casing is installed from +2 feet to 100 feet in depth. Bedrock was encountered at a depth of 87 feet. There are no screens installed. The casing is grouted with neat cement from ground level to a depth of 70 feet. This well yielded 42 gpm with approximately 135 feet of drawdown after 48 hours of continuous pumping, in a test completed on April 22, 1999. The static water level was approximately 30 feet at the beginning of the test.

The well is equipped with a pitless adapter unit that is provided with a watertight cap with a screened vent. The well pump is set at a depth of 315 feet. A check valve is installed above the well pump in the riser piping. Drawdown gauge tubing is attached to the riser piping. The well head is centered on a 6-ft x 6-ft x 6-inch thick concrete apron.

A 3-HP submersible well pump transfers the water through approximately 365 feet of 2-inch pipe to the treatment facilities and the 10,000-gallon steel gravity storage tank. The well pump is rated at 23 gpm @ 212 feet TDH.

The well discharge piping is equipped with a vacuum breaker, a pressure relief valve, a pressure gauge, a sample tap, a check valve, a one-inch water meter with impulse contactor, a valved blow-off line downstream of the meter, and several gate valves for operational control. All of these appurtenances are located in the pump house.

Pump House - The treatment facilities, booster pumps, and the control end of the hydropneumatic tank are housed in a 12-ft x 20-ft x 8-ft prefabricated concrete building. Appurtenances to the pump house include lighting, a ceiling-mounted heater, screened vents, drainage ports for the floor, and a lockable entry door.

Treatment Facilities - Solutions of caustic soda for corrosion control, and sodium hypochlorite and potassium permanganate for iron and manganese treatment, are injected into the water downstream of the water meter and upstream of the manganese greensand filter.

Each of the three solution feed systems consists of a 50-gallon solution tank and a diaphragm feed pump with a maximum feed rate of 1 gallon/hour (24 gallons/day). The tank for potassium permanganate solution is equipped with a 1/20-HP mixer. The caustic soda and chlorine solution feed pumps operate simultaneously with the well pump. An impulse contactor activates the potassium permanganate solution feed pump.

Appurtenances to the 2,000-gallon (4.5-ft diameter, 18-ft length) steel hydropneumatic tank include pressure switches, a pressure gauge, pressure relief and vacuum relief valves, a sight glass, an access manhole, a sample spigot, and a valved drain with a pressure relief valve. A 1/3-HP air compressor (rated at 0.75 cfm) will help maintain the appropriate air:water ratio in the tank.

A manually set position switch and an additional pressure switch on the hydropnuematic tank will cause the well pump to operate between hydropneumatic tank pressures of 46-56 psi when the gravity storage tank is being bypassed.

Booster Pumps - Two 3-HP booster pumps transfer water from the gravity storage tank to the hydropneumatic tank. Each pump is rated at 40 gpm @ 138 feet TDH. The pumps have a rated capacity of 122 gpm @ 112 feet TDH when operating in parallel. Pressure switches mounted on the hydropneumatic tank control the operation of the booster pumps.

Hydropneumatic Tank and Booster Pump Operation - If the hydropneumatic tank pressure drops to 47 psi and the water level is above the center of the tank, the air compressor cuts on and operates until the tank pressure is raised to 57 psi. If the water level drops below the center of the tank, the air compressor shuts off. The lead booster pump operates at tank pressures of 46-56 psi. If this pump cannot satisfy the system demand by itself, the lag pump operates at tank pressures of 44-54 psi. When the water level again reaches the center of the tank, the air compressor is re-activated, and shuts off when the tank pressure is raised to 57 psi. The booster pumps alternate in sequence of operation after each cycle.

A low-level probe in the gravity storage tank, located 1.5 feet above the tank bottom, will shut off the booster pumps. An additional probe, located 2.0 feet above the tank bottom, will reactivate them.

DESIGN CRITERIA:

Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations.*

1. Existing Water Usage:
   USE 10 GPD/PERSON - the average daily usage based on annual inspections between 1994 and 2000 ranged from 5.9 to 15.0 gpd/person, with the usage being about 6 gpd/person for 5 of the 7 years

2. Well Yield:
   (0.5 gpm per ERC)
   42 gpm
   42 gpm @ 0.5 gpm/ERC = 84 ERCs or 33,600
   33,600 gpd @ 10 gpd/person = 3,360 persons

The 24-gpd diaphragm feed pump is therefore adequate for the caustic soda feed system.

8. Capacity of the Manganese Greensand Filter (3 gpm/ft^2):

Diameter = 36 inches; Area = 7.07 ft^2
Maximum Filtration Rate = (7.07 ft^2) (3.0 gpm/ft^2)
= 21 gpm
21 gpm @ 0.5 gpm/ERC = 42 ERCs or 16,800 gpd
16,800 gpd @ 10 gpd/person = 1,680 persons

9. Capacity of the Potassium Permanganate ($KMnO_4$) Feed System:

$KMnO_4$ powder is diluted at the rate of 2 ounces per 10 gallons of water. This equates to a feed solution concentration of:

$$\frac{(2 \text{ oz})}{(16 \text{ oz/lb})(8.34 \text{ lb/gallon})(10 \text{ gallons})} \times 1{,}000{,}000 = 1{,}500 \text{ ppm}$$

Required dosage (with chlorination):
0.2 ppm/ppm of Fe + 2 ppm/ppm of Mn

= (0.2)(3.5) + (2)(0.08) = 0.86 ppm of $KMnO_4$ solution required

The feed equipment includes a 24-gpd diaphragm pump and a 50-gallon solution tank with a 1/20-HP mixer.

$N_1V_1 = N_2V_2$
V_1 = required output of the feed pump
N_1 = 1,500 ppm (0.15%)
V_2 = 21 gpm (well pump output)
N_2 = 0.86 ppm (required $KMnO_4$ feed rate)

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(0.86)(21)}{1{,}500} = 0.012 \text{ gpm} = 17.3 \text{ gpd}$$

The 24-gpd diaphragm feed pump is therefore adequate for the potassium permanganate feed system.

The waterworks is limited by the well pump capacity (with the flow control device) and the capacity of the manganese greensand filter to a maximum usage of 16,800 gpd or 1,680 persons (students and staff).

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE September 12, 1996
(Revised April 24, 1997)

WATERWORKS NAME Hermitage Country Club CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Non-transient Non-Community

LOCATION I-64 west to Manakin (Route 623). Left (south) on Route 623 approximately 1 mile to U. S. Route 250. Right (west) on U. S. Route 250 approximately 0.7 miles to Route 621. Left(south) on Route 621 approximately 1.2 miles to Route 676. Left(east) on Route 676 approximately 1.5 miles to the entrance of the Country Club. The entrance road to the club is on the right side of Route 676.

OWNER Hermitage Country Club, Inc.
P. O. Box 222
Manakin-Sabot, Virginia 23103
Contact Mr A. B. Berry, III, President (784-5234)
Mr. Joseph M. Mills, Maintenance Superintendent (784-5234)
EW, 223

OPERATOR Long & Associates
P. O. Box 161
Aylett, Virginia 23009
Contact Mr. W. Cody Long, W-1

PERMIT NUMBER	O-914	4075350	402996	4075350-A
DATE ISSUED	10/30/75	06/24/77	08/13/96	09/20/96

TYPE OF TREATMENT disinfection and corrosion control

SOURCE groundwater - one drilled well (existing)

DESIGN CAPACITY 48,000 gpd (50 gpm for a period of 16 hours per day)

DESCRIPTION OF SYSTEM:

This waterworks includes one drilled well with disinfection and corrosion control facilities, and a 5,000-gallon hydropneumatic tank with appropriate appurtenances.

The well is located adjacent to the repair shop/storage shed for the golf equipment (named the "cart barn"). The well is housed in a covered concrete pipe section (5 ft. diameter, 5 ft. height), resting on a 8 ft. x 7 ft. concrete slab. Entrance is through a manhole type cover on the top. The well was constructed from a 12-inch hole drilled to a depth of 63 feet, with a 6-inch hole extended from 63 feet to 150 feet in depth. Six-inch steel casing is installed from +2 feet to 63 feet in depth. The well is grouted with cement from ground level to a depth of 63 feet. This well yielded 50 gpm after pumping for 10 continuous hours in a test conducted in February 1972.

Appurtenances to the well include a sanitary seal, a screened casing vent, a check valve, a gate valve, a discharge meter, and a sample tap. There is no well blow-off line. Appurtenances to the well house include lighting, heat, and a floor drain.

Water from the well is pumped by a 5-HP pump (capacity unknown) to the 5,000-gallon hydropneumatic tank, and thence into the distribution system. The well pump was delivering 50 gpm to the tank during an instantaneous reading on April 15, 1996. Hypochlorite and soda ash are injected into the water upstream of the hydropneumatic tank. The feed pumps operate whenever the well pump is operating, through an impulse contactor.

Each chemical feed system includes one 55-gallon polyurethane solution tank and one diaphragm metering pump. A 1/20-HP mixer is installed on the tank storing soda ash. The hypochlorite and soda ash feed pumps have maximum capacities of 21 gpd and 22 gpd, respectively. A sample tap is installed for monitoring the water quality downstream of the injection points for the chemical solutions.

Appurtenances to the hydropneumatic tank include a sight glass, an access manhole, a drain, a pressure gage, an air release valve, a vacuum release valve, and a sample tap.

The chemical feed equipment and the hydropneumatic tank are housed in a room in the "cart barn". Lighting, heat, and a floor drain are provided.

DESIGN CRITERIA: Note: Equivalent Residential Connection (ERC) = 400 gpd, in accordance with the 1993 *Waterworks Regulations*

1. Well Yield: (0.5 gpm per ERC)
   50 gpm in a 10-hour pump test (1972)
   50 gpm @ 0.5 gpm per ERC = 100 ERCs or 40,000 gpd

2. Well Pump Capacity: (0.5 gpm per ERC)
   50 gpm (instantaneous output on April 15, 1996)
   50 gpm @ 0.5 gpm per ERC = 100 ERCs or 40,000 gpd

3. Hypochlorite Feed System:

   One 55-gallon solution tank & one 21 gpd diaphragm feed pump are installed. The feed equipment utilizes sodium hypochlorite (NaOCl - 12% Cl_2).

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 12% = 120,000 ppm
V_2 = 50 gpm
N_2 = 7.5 ppm

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(7.5)(50)}{120,000} = 0.003 \text{ gpm} = 4.5 \text{ gpd}$$

The 21 gpd diaphragm feed pump is therefore adequate for this usage.

4. Soda Ash Feed System:

The RTW computer model indicated that a feed rate of 56 mg/l will provide a precipitation potential of 4 mg/l (desired range: 4-10 mg/l). One 55-gallon solution tank & one 22 gpd diaphragm feed pump are installed. The feed equipment utilizes a 58% solution of soda ash (Na_2O).

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 58% = 580,000 ppm
V_2 = 50 gpm
N_2 = 56 ppm

$$V_1 = \frac{N_2V_2}{N_1} = \frac{(56)(50)}{580,000} = 0.0048 \text{ gpm} = 7.0 \text{ gpd}$$

The 22 gpd diaphragm feed pump is therefore adequate for this usage.

5. Effective Storage Capacity: (200 gallons per ERC)

One 5,000-gallon hydropneumatic tank
Total effective storage volume: 1/3(5,000) = 1,667 gallons

Total effective storage capacity:

1,667 gallons at 200 gallons/ERC = 8 ERCs or 3,200 gpd

This waterworks is permitted for a design capacity of 48,000 gpd, in accordance with previously issued operation permits.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE September 9, 1997

WATERWORKS NAME Randolph Elementary School CERTIFIED CLASS IV

CITY/COUNTY Goochland County TYPE Non-transient Non-community

LOCATION Route 6 west to Crozier. North on Route 670 approximately 3.5 miles to its intersection with Route 639. Left (west) on Route 639. The school is approximately 0.2 miles west of Route 670, on the right side of Route 639.

OWNER Goochland County Public Schools
P. O. Box 169
Goochland, Virginia 23063
Dr. Harold Absher, Superintendent of Schools
Contact Mr. Lewis Blakely, Director of School Administration 556-5316
Telephone: 556-5316

OPERATOR Mr. Dale Carros, Maintenance Supervisor
Mr. Robert E. Lawrence, Class IV Telephone: 556-5360
Randolph School: 556-5385

PERMIT NUMBER 4075660 401896 4075660-A

DATE ISSUED 9/30/91 5/10/96 9/15/97

TYPE OF TREATMENT Chlorination and Corrosion Control

SOURCE Groundwater - one drilled well

DESIGN CAPACITY 721 persons (students and staff) or 4,400 gallons/ school day - limited by the total effective storage capacity

DESCRIPTION OF SYSTEM:

This water system consists of one drilled well, one 2,500-gallon gravity storage tank, one 1,000-gallon hydropneumatic tank, two 5-HP booster pumps, and chlorination and corrosion control facilities, all with appropriate appurtenances.

The well is located on the north side of the school property, approximately 420 feet from the extended school building. It was drilled in 1958 to a depth of 198 feet. It is constructed from a 10-inch hole drilled to a depth of 50 feet, with a 6-inch hole extended from 50 feet to 198 feet in depth. Bedrock was encountered at a depth of 35 feet. A 6-inch casing was installed from + 2 feet to a depth of 50 feet. The well is grouted with cement from ground level to 50 feet in depth. The well is centered on a 6-ft x 6-ft x 6-in concrete pad, and is equipped with a pitless adapter. It is located in a 30-inch diameter concrete pipe section with a concrete top. The well yielded 16 gpm after 12 hours of pumping in a test conducted on August 8, 1997.

A 2-HP well pump, installed at a depth of 115 feet, delivers water from the well to the 2,500-gallon gravity storage tank. The well pump is rated at 18 gpm at system head conditions.

Approximately 540 feet of 2-inch waterline with appropriate appurtenances conveys the groundwater from the well to the 2,500-gallon gravity storage tank. The tank is housed in a 16-ft x 43-ft x 8.67-ft storage/pump room located in the basement of the new addition of the school. A butterfly valve is installed on the well discharge line, to maintain the same head conditions as when the well pump formerly delivered water directly to a hydropneumatic tank, and thus prevent overpumping of the well. The storage/pump room also houses some of the well appurtenances (gate valve, check valve, discharge meter, blow-off line), the 1,000-gallon hydropneumatic tank, the two 5-HP booster pumps, and the chlorination and corrosion control feed equipment. The floor of the room is at ground level, and a locked entrance and interior lighting are provided. The floor is gravel, except for the reinforced concrete pads under the storage tanks, the booster pumps, and the above ground water piping.

The chlorination system includes a diaphragm feed pump (20 gpd - max.) and a 30-gallon polyethylene solution tank. The caustic soda feed system for corrosion control includes a diaphragm feed pump (24 gpd - max.) and a 30-gallon polyethylene solution tank. The injection points for both the chlorination system and the caustic soda feed system are located at points upstream of the gravity storage tank. A sample tap is installed prior to the injection points for chlorine solution and caustic soda, to allow monitoring of the untreated groundwater.

Electrodes are installed in the 2,500-gallon gravity storage tank at elevations of 3.83 feet and 4.33 feet above the bottom of the tank, to activate and deactivate the well pump, respectively. There is also a low level electrode, located 0.67 feet above the bottom of the gravity storage tank, to shut off the booster pumps. An additional electrode, located 1.5 feet above the tank bottom, reactivates the booster pumps once the water has reached this level. The effective storage volume in the tank is approximately 1,998 gallons.

Appurtenances to the gravity storage tank include a bolted hatch, a screened vent, an overflow line, a drain line, and a sample tap. The drain line is connected to the overflow line, which is piped to the outside of the building and discharges to the atmosphere, with a splash block at the discharge point.

The two booster pumps are each rated at 50 gpm @ 176 feet TDH, and each is powered by a 5-HP motor. The pumps are controlled so that they never operate simultaneously. They operate at hydropneumatic tank pressures of 40-56 psi. A 1/2-HP air compressor is installed to help maintain the proper air:water ratio in the tank. It is activated when the booster pumps raise the water level in the hydropneumatic tank to 60% full, and is deactivated when the tank pressure is raised to 60 psi.

Each booster pump is equipped with a gate valve on the suction side, and a check valve and gate valve on the discharge side. Automatic alternation of the booster pumps occurs after each pumping cycle.

The 1,000-gallon hydropneumatic tank is approximately 3.5 feet in diameter and 15.0 feet in length. Appurtenances to the tank include an access manhole (on top), a sample tap, a pressure gauge, a sight glass, an air release valve, a vacuum release valve, and a drain. The drain line is tied into the piping for the drain line for the 2,500-gallon gravity storage tank. Bypass piping is provided for the two storage tanks.

Approximately 280 feet of 2-inch waterline conveys the treated water from the storage/pump room to a valve vault in the courtyard area, and then to the three connections at the school building.

DESIGN CRITERIA: Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance *with* the 1995 *Waterworks Regulations*

1. Existing Per Capita Usage: 6.1 gallons/school day/person

2. Design Population: 540 persons (students and staff)

3. Well Yield: (0.5 gpm per ERC)
16 gpm - 12-hour pump test conducted on 8/8/97
16 gpm @ 0.5 gpm/ERC = 32 ERCs or 12,800 gpd
12,800 gpd @ 6.1 gpd/person = 2,098 persons

4. Well Pump Capacity: (0.5 gpm per ERC)
18 gpm @ 0.5 gpm/ERC = 36 ERCs or 14,400 gpd
14,400 gpd @ 6.1 gpd/person = 2,360 persons

5. Booster Pump Capacity: ($Q = 11.4\ N^{0.544}$)
Two 5-HP pumps, each rated at 50 gpm @ 176 feet TDH - the pumps do not operate in parallel
Q = 50 gpm
N = 15 ERCs or 6,000 gpd
6,000 gpd @ 6.1 gpd/person = 984 persons

6. Storage Capacity: (200 gallons per ERC)
One 2,500-gallon gravity storage tank
(Effective volume = 1,998 gallons)
One 1,000-gallon hydropneumatic tank

Total Effective Storage Capacity:
1,998 + 1/3 (1,000) = 2,331 gallons
2,331 gallons @ 200 gallons/ERC = 11 ERCs
11 ERCs x 400 gpd/ERC = 4,400 gpd
4,400 gpd @ 6.1 gpd/person = 721 persons

7. Hypochlorite Feed System

One 30-gallon solution tank and one 20 gpd diaphragm feed pump. The feed equipment utilizes chlorine bleach (5.25% chlorine).

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 5.25% = 52,500 ppm
V_2 = 18 gpm
N_2 = 7.5 ppm

$$V_1 = \frac{(7.5)(18)}{52,500} = 0.00257 \text{ gpm or } 3.7 \text{ gpd}$$

The 20 gpd diaphragm feed pump is therefore adequate for this usage.

8. Caustic Soda Feed Equipment

One 30-gallon solution tank and one 24 gpd diaphragm feed pump.

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 50% = 500,000 ppm
V_2 = 18 gpm
N_2 = 41 ppm (RTW Model)

$$V_1 = \frac{(41)(18)}{500,000} = 0.00147 \text{ gpm or } 2.1 \text{ gpd}$$

The 24 gpd diaphragm feed pump is therefore adequate for this usage.

This waterworks is limited by the total effective storage capacity to a maximum usage of 721 persons or 4,400 gallons/school day.

VIRGINIA DEPARTMENT OF HEALTH

ENGINEERING DESCRIPTION SHEET

DATE: October 20, 2005

WATERWORKS NAME:	Richmond Country Club	**CERTIFIED CLASS:**	VI
COUNTY/CITY:	Goochland County	**TYPE:**	Non-Transient Non-Community

LOCATION: On Patterson Avenue (Route 6), approximately 3.2 miles west of the Henrico County line, and directly across from the intersection of Patterson Avenue and River Road (Route 650).

OWNER:
Richmond Country Club, Inc.
P.O. Box 37
Manakin-Sabot, Virginia 23103
Mr. Bruce Forebaugh, General Manager
Contact Mr. Mike Kensky, Clubhouse Manager
Phone: (804) 784-5272; **Fax:** (804) 784-5589

OPERATOR:
Sydnor Hydro, Inc.
P. O. Box 27186
Richmond, Virginia 23261-7186
Contact Mr. W. S. Shaw, P.E., Senior Project Manager
Phone: (804) 643-2725, Ext. 226; **Fax:** (804) 788-9058

PERMIT NUMBER:	4075670	Amended
EFFECTIVE DATE:	03/27/03	10/31/05

TYPE OF TREATMENT: Iron and Manganese Treatment

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing two buildings (clubhouse and pro shop)

DESCRIPTION OF SYSTEM

This waterworks consists of a drilled well, iron and manganese treatment facilities, and a 4,600-gallon hydropneumatic tank.

Well

The well is located adjacent to Monacan Drive (a dirt road), on the west side of the clubhouse. No information is known about the construction of the well except that it includes 6-inch steel casing, which extends about 6 inches above the well house floor. The well is provided with a sanitary seal and screened casing vent. A gate valve, check valve and a sample tap, and totalizing meter are provided on the well discharge pipe. A valved blow-off is installed upstream of the meter. There is bypass piping around the meter, but it is normally valved off. A pressure gauge is installed on the meter bypass piping.

The well is equipped with a submersible pump with an observed capacity of 15 gpm on October 18, 2005. Well pump operation is controlled by pressure switches mounted on the 4,600-gallon hydropneumatic tank. The normal operating range is 45-68 psi.

Well House
The well house is 8.33 feet x 8.08 feet and is constructed of masonry block. It houses the iron and manganese treatment facilities and the control end of the hydropneumatic tank. The building is equipped with heat, light, a floor drain, and an overhead access for the well pump.

Iron and Manganese Treatment

A. Chlorine - The chlorine feed system is provided for the Kinetico filters and consists of an 11-gpd diaphragm feed pump and a 50-gallon graduated solution tank and an 11-gpd, diaphragm type feed pump. Chlorine solution is injected into the water upstream of the Kinetico filters. The chemical feed pumps operates when the well pump runs.
B. Potassium Permanganate - The potassium permanganate feed system is provided for the Kinetico filters and consists of a 15-gallon graduated solution tank and a 11-gpd, diaphragm-type chemical feed pump. Permanagante is injected into the water directly upstream of the Kinetico filters. The chemical feed pump operates when the well pump runs.
C. Aqua-Mag (blended phosphate) - The phosphate feed system consists of a 15-gallon graduated solution tank and a 11-gpd, diaphragm-type chemical feed pump. Phosphate is injected into the water just downstream of the Kinetico filters. The chemical feed pump operates when the well pump runs.

Storage
The 4,600-gallon hydropneumatic tank is equipped with a drain, a sight glass, a snifter valve, a pressure gauge, a sample tap, an access manway, and a pressure relief valve.

Distribution System
The distribution system generally consists of 2-inch PVC pipe, SDR 21 (200) and SDR 26 (160). It has not been designed for fire protection, and fire hydrants are not provided. The pipe was installed in 1989.

EVALUATION OF THE SYSTEM

Design Criteria: Based on the actual reported water usage as follows:

1. Estimated Water Usage:

35 employees @ 25 gpd/employee	=	875 gpd
90 customers @ 5 gpd/customer	=	450 gpd
65 golf carts @ 10 gpd/cart*	=	650 gpd
TOTAL:		1,975 gpd

*washing the golf carts

2. Actual Water Usage:

(10/04 – 9/05)	Average Daily Demand = 3,650 gpd
(July 2005)	Maximum Month Demand = 6,607 gpd
	Using a Peaking Factor of 4 (x Average Daily Demand),
	Peak Hour Demand = (4) (3,650 gpd) / 24 hrs/day = 608 gal/hr

3. Source Capacity:

Well Yield:	Unknown
Well Pump Capacity:	15 gpm – observed output on 10/18/05
	15 gpm x 1440 minutes/day = 21,600 gpd

4. Storage Capacity: One 4,600-gallon hydropneumatic tank

   Effective Storage Volume: 1/3(4,600 gallons) = 1,533 gallons
   Because this is a direct delivery, non-community system, the storage requirement is waived. The recommended storage capacity is one-half day's usage.

5. Peak Delivery Capacity: Transfer Capacity = well pump + effective storage
   = (15 gpm)(60 min/hr) + 1,533 gallons = 2,433 gallons-peak hour

   2,433 gallons Peak Delivery Capacity > 608 gallons Peak Hour Demand

Based on the above evaluation, the permitted capacity is limited to the existing two buildings until a 24-hour yield and drawdown test is conducted on the well.

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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: March 25, 2004

WATERWORKS:	Sabot Hill Farm	CERTIFIED CLASS: VI
CITY/COUNTY:	Goochland County	TYPE: Non-Transient Non-Community

LOCATION: Take Route 6 west, approximately 4.9 miles from its intersection with River Road (Route 650), to Dover Road (Route 642). Go right (north) on Dover Road approximately 1.1 miles to the farm entrance, which is on the right. Follow the farm entrance road approximately 0.2 miles. The well house is downgrade of the entrance road, and is not visible from the entrance road.

OWNER: Sabot Hill Farm, Inc.
P. O. Box 290
290 ~~2000~~ River Road West
Manakin-Sabot, Virginia 23103
Contact Mr. Hunter H. McGuire III, President
Telephone: (804) 784-3413

OPERATOR: Mr. W. L. Branch, Jr., Farm Manager
Telephone: (804) 784-5024

PERMIT NUMBER: 4075705

DATE ISSUED: April 9, 2004

TREATMENT: Corrosion Control (caustic soda addition)

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing 7 houses, church and church outbuilding

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, a 5,000-gallon hydropneumatic tank, corrosion control treatment, and related appurtenances.

Well
The well is located in a grassy area on the left side of the farm road, approximately 0.2 miles from the farm entrance. However, the well is not visible from the farm road because of shrubbery. It was drilled in 1962 by Sydnor Hydrodynamics, Inc. (currently Sydnor Hydro, Inc.). All that is known about well construction is that it has a depth of 231 feet and is cased with 6-inch steel casing. Appurtenances to the well include a sanitary seal, a screened casing vent, a gate valve, a check valve, a meter, and a sample tap.

Well House
The well, the corrosion control treatment, and the control end of the hydropneumatic tank are housed in an 8-ft x 8-ft x 8-ft concrete block well house. The well house is equipped with lighting, heat (portable heater), a concrete floor, a floor drain, a locked entrance, and overhead access to the well. Although the well house is downgrade of the farm road, the surrounding land is graded to divert surface runoff away from the well house.

Water is pumped from the well by a 5-HP submersible pump (unknown rating) to the hydropneumatic tank and to the distribution system. A pressure switch on the hydropneumatic tank controls the operation of the well pump. The operating pressures are 70-75 psi. The well pump had an instantaneous output of 50 gpm on March 19, 2004.

Storage Facility
Appurtenances to the 5,000-gallon hydropneumatic tank include a sight glass, a pressure gauge, an air release valve, an access manhole, and a sample tap. A 0.5-HP air compressor and a snifter valve help to maintain the proper air: water ratio in the hydropneumatic tank. The air compressor is set to operate automatically when the tank pressure falls to 67 psi and the water level is above the centerline of the tank. It will shut off when the tank pressure rises to 80 psi.

Treatment Facilities
The caustic soda feed system for corrosion control includes a 24-gpd diaphragm pump and a 100-gallon polyethylene solution tank. The injection point for the caustic soda solution is located between the meter and the hydropneumatic tank. The feed system operates simultaneously with the well pump.

EVALUATION OF THE SYSTEM

DESIGN BASIS: Based on the *Waterworks Regulations*, 12 VAC 5-590-690, water usage is 400 gpd/house, 10 gpd/person at pre-school, and 5 gpd/church visitor.

1. Existing connections: 7 houses, church (Hebron Presbyterian Church) and church out building (former parish house)

2. Estimated Usage:

(7 houses)(400 gpd/house)		= 2,800 gpd
Church – weekdays	(24 persons)(10 gpd/person)	= 240 gpd
Church – Sundays	(120 persons)(5 gpd/person)	= 600 gpd
church out-building:	(5 persons)(5 gpd/person)	= 25 gpd

3. Source Capacity
   Well Yield: Unknown
   Well Pump Capacity: 50 gpm – instantaneous reading on 3/19/04
   (50 gpm)(1440 minutes/day) = 72,000 gpd

4. Storage Capacity: Based on one-half of average daily demand:
   One 5,000-gallon hydropneumatic tank
   Effective Volume: 1/3(5,000 gallons) = 1,667 gallons
   1,667 gallons / 0.5 days = 3,334 gpd

5. Caustic Soda Feed System:

The feed system includes a 24-gpd diaphragm pump and a 100-gallon solution tank. The purchased caustic soda has a concentration of 50%. The quality of the untreated water is unknown.

$N_1V_1 = N_2V_2$
V_1 = required output of chemical feed pump
N_1 = 50% = 500,000 ppm
V_2 = 50 gpm (well pump output)
N_2 = 10 ppm (estimated)

$V_1 = N_2V_2 / N_1 = (50)(10) / 500{,}000 = 0.001$ gpm = 1.44 gpd

The 24-gpd diaphragm feed pump is therefore believed to be adequate for the caustic soda feed system.

This waterworks is being permitted for the existing 7 houses, the church, and the church out-building until information about the well yield is provided, and the need for additional storage capacity is evaluated.

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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: May 7, 2003

WATERWORKS:	Salem Baptist Church	CERTIFIED CLASS: VI
CITY/COUNTY:	Goochland County	TYPE: Non-Transient Non-Community
LOCATION:	Route 6 west to its intersection with Route 670 at Crozier. North on Route 670 approximately 2.4 miles to its intersection with Taylor Road (Route 641). The church is on the right side of Route 670, across from Taylor Road.	
OWNER:	Salem Baptist Church 1701 Cardwell Road Crozier, Virginia 23039 Contact Pastor Zachery Zbinden (804) 784-4171 FAX 784-0432	
OPERATOR:	Mr. Hugh McGuire, Maintenance Supervisor (804) 556-6226 or (804) ~~805-5929~~ 641-5913 (cell)	
PERMIT NUMBER:	4075708	
DATE ISSUED:	May 16, 2003	
TREATMENT:	Corrosion Control	
SOURCE:	Groundwater – one drilled well	
DESIGN CAPACITY:	Existing church and school building	

Rick Gardner
1482 Timber Ridge Road
Manakin, VA 23103
556-2348
556-6274
FAX 556-2120

Mid-Atlantic Testing Laboratory
00213

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, a neutralizer filter, and a 40-gallon bladder storage tank.

Well

The drilled well is located on the north side of the church building. It is located beneath a 4-ft x 4-ft lockable heavy metal cover that is embedded in the sidewalk. This metal cover overlays a 30-inch diameter concrete well curbing that extends to a depth of about 5 feet. The well head is inside of the concrete well curbing. An earthen floor is at the bottom of the concrete well curbing. No information is known about the construction of the drilled well except that it includes 6-inch steel casing which extends about 12 inches above the earthen floor, or about 48 inches below the top of the vault. Appurtenances to the well at the well head include a sanitary well seal and an inverted "U" vent.

Water from the well is pumped by a submersible pump (unknown HP and rating) to the neutralizer (calcite) filter, the bladder storage tank, and the distribution system. A pressure switch mounted on the well discharge piping near the bladder tank controls the operation of the well pump.

Maintenance Room

The neutralizer filter and the bladder tank are housed in the Maintenance Room, which is located in the basement of the church building. The maintenance room is provided with lighting, heat, and a locked entrance.

Neutralizer Filter

The neutralizer filter (10-inch diameter, 54-inch height) includes calcite media for raising the pH of the well water for corrosion control. No other information about the filter is available.

Storage Facility

The 40-gallon bladder tank (21-inch diameter, 27-inch height) is equipped with a pressure gauge, and a hose bib for sampling and draining the tank.

EVALUATION OF THE SYSTEM

1. Present Connections: 1

2. Present Population: Weekdays: 131 (school)
   Sundays: 475

3. Estimated Usage: Weekdays: 131 persons @ 10 gpd/person = 1,310 gpd
   Sundays: 475 persons @ 5 gpd/person = 2,375 gpd

4. Well Yield: Unknown

5. Well Pump Capacity: Unknown

6. Treatment Capacity: Neutralizer Filter – Unknown Capacity

7. Storage Capacity: (one-half of average daily demand)
   One 40-gallon bladder tank

Effective Storage Volume: 1/3(40 gallons) = 13 gallons
Effective Storage Capacity: $\frac{13 \text{ gallons}}{0.5 \text{ days}}$ = 26 gpd

This waterworks is being permitted for the existing church and school building until information about the well yield and well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH

ENGINEERING DESCRIPTION SHEET

DATE: March 2, 2006

WATERWORKS NAME:	Veterinary Referral & Critical Care **CERTIFIED CLASS:** IV
COUNTY/CITY:	Goochland County **TYPE** Non-Transient Non Community
LOCATION:	Take I-64 West from Richmond to Exit 173 (Manakin/Rockville exit). Turn left (south) onto Route 623. Go approximately 1.1 miles and turn right (west) onto U. S. Route 250. Go approximately 0.10 miles, and turn left (south) onto Route 623. The veterinary center is on the right side of Route 623, about 0.2 miles south of its intersection with U. S. Route 250.
OWNER:	Veterinary Referral & Critical Care, LLC 1596 Hockett Road Manakin-Sabot, Virginia 23103 **Contact:** Mrs. Brenda Hubbard, Administrator **Phone:** (804) 784-8722; **Fax:** (804) 784-1960
OPERATOR:	Mr. Michael L. Cook, Class I TetraOps P. O. Box 13 Doswell, Virginia 23047 **Phone:** (804) 994-2088; **Fax:** (804) 994-2324
PERMIT NUMBER:	4075880
EFFECTIVE DATE:	March 13, 2006
TYPE OF TREATMENT:	Iron and Manganese Removal
SOURCE:	Groundwater – two drilled wells
DESIGN CAPACITY:	7,200 gpd – limited by the source capacity

DESCRIPTION OF SYSTEM

The system consists of two drilled wells, iron and manganese treatment facilities, and an 80-gallon bladder tank.

Wells

Both wells are located on the north side of the veterinary center. Well No. 1 is located about 20 feet closer to the center than Well No. 2. Only one well is operated at a time.

Well No. 1

The well was completed on January 9, 1997 and is constructed from a 10-inch diameter hole drilled to a depth of 30 feet, and a 6-inch hole drilled from 30 feet to 200 feet in depth. The 6 1/4-inch PVC pipe outer casing extends to a depth of 30 feet. The 4-inch PVC pipe inner casing extends to a depth of 50 feet. The outside of the 6 1/4-inch casing is grouted with cement from ground level to a depth of 30 feet and the space between the 6-inch and 4-inch casings is grouted with cement to a depth of 50 feet. The well is fitted with a pitless adapter unit, which is provided

with a well cap and screened casing vent. The well is located outside of the treatment and storage room and is centered on a 6-foot by 6-foot concrete apron. A gate valve, a check valve, a sample tap, and a totalizing meter are provided on the well discharge pipe. The well yielded 5 gpm after 1 hour of continuous pumping during a test conducted on January 9, 1997. The well is equipped with a ½-HP submersible pump with an observed output of 5.5 gpm on March 10, 2005.

Well No. 2

The well was completed on June 26, 2002 and is constructed from a 9 7/8-inch diameter hole drilled to a depth of 50 feet, and a 6 1/8-inch hole drilled from 50 feet to 300 feet in depth. The 6 1/8-inch PVC pipe casing extends to a depth of 50 feet. The outside of the 6 1/8-inch casing is grouted with benseal from ground level to a depth of 50 feet. The well is fitted with a pitless adapter unit, which is provided with a well cap and screened casing vent. The well is located outside of the treatment and storage room and is centered on a 6-foot by 6-foot concrete apron. A gate valve, a check valve, a sample tap, and a totalizing meter are provided on the well discharge pipe. The well yielded 12 gpm after 24 hours of continuous pumping during a test conducted on June 2-3, 2004. The well is equipped with a 1-HP submersible pump with a rated capacity of 10.5 gpm at 210 feet TDH.

Operation of the Well Pumps

Well pump operation is controlled by a pressure switch mounted on an 80-gallon bladder tank. The normal operating range is 40 to 60 psi.

Treatment Facilities

The iron and manganese treatment includes chlorination for oxidation, a bladder tank for contact time, a neutralizer filter for pH adjustment, and two carbon filters for removal of the iron and manganese particulates and the residual chlorine.

A. Pellet Chlorination – at each well
B. Bladder Tank (see below)
C. Neutralizer Filter – The neutralizer filter is 10 inches in diameter and 58 inches in height. The media volume is approximately 2.5 feet.
D. Carbon Filters – Each filter is 10 inches in diameter and 60 inches in height.

Sample taps are located at each well and at the bladder tank.

Storage Facilities

The 80-gallon bladder tank is housed in the mechanical room of the veterinary center. The tank is equipped with a pressure gauge, a snifter valve and a hose bib for draining the tank. The tank is used to provide contact time following the addition of chlorine.

EVALUATION OF THE SYSTEM

Design Criteria: Based on the *Waterworks Regulations*, §12 VAC5-590-690, the average daily water demand is 25 gpd/employee

1. Design Population: 62 employees

2. Estimated Usage: 25 gpd/employee x 62 employees = 1550 gallons
   (Actual usage: 1,553 gpd (8/31/05 – 1/31/06))
   Use a peak factor of 4.0
   Peak Hour Demand: (4)(1553 gpd) / 24 hrs/day = 259 gallons/hr

3. Source Capacity:

Well Yield: Well No. 1 – 5 gpm for 1 hour of continuous pumping (1997)
Well No. 2 – 12 gpm for 24 hours of continuous pumping (2004)
Only one well operates at a time.
5 gpm x 1440 minutes/day = 7,200 gpd

Well Pump Capacity: Well No. 1 – 5.5 gpm (observed capacity on 3/10/05)
Well No. 2 – 10.5 gpm @ 210 feet TDH
Only one well operates at a time.
5.5 gpm x 1440 minutes/day = 7,920 gpd

4. Storage Capacity: One 80-gallon bladder tank

Effective Storage Volume: 1/3(80 gallons) = 27 gallons
Because this is a direct delivery, non-community system, the storage requirement is waived. The recommended storage capacity is one-half day's usage.

5. Peak Delivery Capacity: Transfer Capacity = well pump + effective storage
= (5.5 gpm)(60 min/hr) + 27 gallons = 357 gallons-peak hour
357 gallons Peak Delivery Capacity > 259 gallons Peak Hour Demand

Based on the above evaluation, the permitted capacity is limited by the source capacity to a maximum usage of 7,200 gpd.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: February 13, 2003

WATERWORKS:	Alleys Motel	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community
LOCATION:	Take I-64 West from Richmond to Exit 173 (Manakin/Rockville exit). Turn left (south) onto Route 623. Go approximately 1.1 miles and turn left (east) onto U. S. Route 250. The motel is 0.2 miles east on U. S. Route 250, on the right hand side.	
OWNER:	Mr. Forest Alley, Jr. 12855 Broad Street Road Richmond, Virginia 23233 (804) 784-3985	
OPERATOR:	Same as above	
PERMIT NUMBER:	4075010	
DATE ISSUED:	March 3, 2003	
TREATMENT:	None	
SOURCE:	Groundwater -- one drilled well	
DESIGN CAPACITY:	Existing 12-unit motel, two homes, and restaurant	

7/14/06
Dixie 250 LLC t/a
Grandpa Eddie's Alabama Ribs Barbecue
Carey Freidman
784-7200
12859 Broad Street Road
Richmond VA 23233

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well and two bladder storage tanks (34-gallon and 20-gallon).

Well

The well is located in a fenced area about 150 feet behind the boiler room building for the motel. No information is available on the construction of the well, except that it includes 4-inch steel casing. Appurtenances to the well include a sanitary seal and screened casing vent. The well pump drop pipe is flexible piping, so an overhead well access hatch is not required.

Water from the well is pumped by a submersible pump (unknown HP and rating) to the two bladder storage tanks and/or to the distribution system. A pressure switch on the piping connecting the well discharge to the bladder tanks controls the operation of the well pump. The operating range is 25-48 psi. The well discharge piping includes two 5-micron cartridge filters installed in series, and gate valves prior to the two connections to the distribution system.

Well House

The well, well appurtenances, and the two bladder tanks are housed in an 8-ft x 8-ft x 8-ft wood framed well house, with galvanized steel siding and galvanized roofing. Appurtenances to the well house include lighting, heat, a concrete floor, and a locked entrance.

Storage Facility

The 34-gallon and 20-gallon bladder tanks are equipped with a single hose bib for tank drainage and a pressure gauge.

EVALUATION OF THE SYSTEM

1. Present Connections: 12-unit motel, two homes, and a restaurant.

2. Estimated Usage:

12-unit motel @ 50 gpd/unit	=	600 gpd
2 homes @ 300 gpd/home	=	600 gpd
Restaurant:		
10 employees @ 25 gpd/employee	=	250 gpd
100 customers @ 5 gpd/customer	=	500 gpd
	TOTAL:	1,950 gpd

3. Well Yield: Unknown

4. Well Pump Capacity: Unknown

5. Storage Capacity: (one-half of average daily demand)
One 34-gallon and one 20- bladder tank

Effective Storage Volume: 1/3(34 + 20 gallons) = 18 gallons

Effective Storage Capacity: $\frac{18 \text{ gallons}}{0.5 \text{ days}}$ = 36 gpd

36 gpd @ 50 gpd/ motel unit = 1 motel unit

This waterworks would be limited by the total effective storage capacity to a maximum usage of one motel unit. However, it is being permitted for the existing 12 motel units, two homes, and restaurant until information about the well yield and well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: April 2, 2003

WATERWORKS:	Bogey's Sports Park	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community

LOCATION: Take I-64 West from Richmond to Exit 173 (Manakin/Rockville exit). Turn left (south) onto Route 623. Go approximately 1.0 miles. The sports park is on the left side of Route 623.

OWNER: F.G. Pruitt, Inc.
2415 Grenoble Road
Richmond, Virginia 23294
Contact Mr. Thomas Pruitt, President
(804) 672-6487

OPERATOR: Mr. Tyler Carlo, General Manager
Bogey's Sports Park
1675 Ashland Road
Richmond, Virginia 23233
(804) 784-1544

PERMIT NUMBER: 4075025

DATE ISSUED: April 11, 2003

TREATMENT: Ultraviolet Light Disinfection

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing Pro Shop

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, a 34-gallon bladder tank, and an ultraviolet light disinfection unit.

Well

The well is located in a grassy area on the east side of the sports park, about 400 feet from the pro shop. The well was constructed from a 10-inch hole drilled to a depth of 50 feet, with a 6-inch hole probably extending from 50 feet to 400 feet in depth. Bedrock was encountered at a depth of 9 feet. The well was cased with 6-inch steel casing from +1 feet to 50 feet in depth, and was grouted with neat cement from ground level to 50 feet in depth. The well yielded 5 gpm for 1 hour with 385 feet of drawdown (to a depth of 400 feet) when it was drilled in March 1994.

The well head is protected by a 48-inch concrete well curbing with a concrete cover. The well curbing extends approximately 33 inches above the ground level. A gravel floor is provided inside of the curbing. Fiberglass insulation is wrapped around the well head and the well discharge piping for freeze protection. Appurtenances to the well at the well head include a sanitary seal, a screened vent, a check valve, and a sample tap.

Water is pumped from the well by a submersible pump (unknown HP and capacity) through approximately 400 feet of pipe (material and diameter unknown) to the bladder tank and the ultraviolet light unit, and into the distribution system. A pressure switch on the well discharge line located just upstream of its connection to the bladder tank controls the operation of the well pump. The well pump is set to operate at a pressure range of 38-58 psi at the pressure switch.

Utility Room

The bladder tank and the ultraviolet light unit are housed in the utility room in the back of the pro shop. The utility room is provided with lighting, heat, and a locked entrance. An isolation valve on the well discharge line is located just downstream of the bladder tank.

Storage Facilities

Appurtenances to the 34-gallon bladder tank include a pressure gauge, and a hose bib for sampling and for draining the tank.

Ultraviolet Light Disinfection

The 30" x 6" x 5" ultraviolet light disinfection unit is designed for a flow of 8 gpm. The ultraviolet (UV) light bulb is replaced approximately annually.

EVALUATION OF THE SYSTEM

1. Present Population: 4 employees and about 605 customers

2. Estimated Usage:
   25 gpd/employee x 4 employees = 100 gpd
   1 gpd/customer x 605 customers = 605 gpd
   TOTAL: 705 gpd

3. Well Yield:
   5 gpm – reported
   5 gpm x 1,440 minutes/day = 7,200 gpd

4. Well Pump Capacity: Unknown

5. Storage Capacity: (one-half of average daily demand)
   One 34-gallon bladder tank

   Effective Storage Volume: 1/3(34 gallons) = 11 gallons
   Effective Storage Capacity: $\frac{11 \text{ gallons}}{0.5 \text{ days}}$ = 22 gpd

6. Capacity of Ultraviolet Light Unit: 8 gpm
   8 gpm x 1,440 minutes/day = 11,520 gpd

This waterworks is permitted for the existing pro shop until information about the well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: August 30, 2005

WATERWORKS NAME: Brothers Italian Restaurant **CERTIFIED CLASS:** N/A

COUNTY/CITY: Goochland County **TYPE:** Transient Non-Community

LOCATION: I-64 West to the Oilville Exit (Route 617). Turn left at the end of the exit ramp, and go approximately 0.6 miles to Broad Street Road (U. S. Route 250). Go east (left) on U. S. Route 250 approximately 0.7 miles. The restaurant is on the south (right) side of U. S. Route 250, in a building that resembles a barn.

OWNER: Mr. William E. Swift, Sr.
1450 Cardwell Road
P. O. Box 64
Crozier, Virginia 23039
Phone: (804) 784-5534; **Fax:** (804) 784-2617

OPERATOR: Mr. William E. Swift, Sr.
Phone: (804) 784-5534; **Fax:** (804) 784-2617

PERMIT NUMBER: 4075720 Amended

EFFECTIVE DATE: 02/10/03 09/09/05

TYPE OF TREATMENT: Iron and Manganese Treatment

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing 60-seat restaurant

DESCRIPTION OF SYSTEM

This waterworks consists of a drilled well, iron and manganese treatment facilities, and a 36-gallon bladder tank.

Well

The well is located in the grassy area east of the restaurant, just in front of the tree line and approximately 120 feet from the restaurant building. It is constructed from a 10-inch hole drilled to a depth of 30 feet, with a 6-inch hole extended from 30 feet to 125 feet in depth. Bedrock was encountered at a depth of 30 feet. A 6-inch steel outer casing was installed from +1 to 30 feet in depth. In addition, a 4.5-inch PVC inner casing was installed from +1 to 50 feet in depth. A packer was installed at a depth of 50 feet, and the well was grouted with neat cement from ground level to a depth of 50 feet between the inner and outer casings. The well was also grouted with neat cement from ground level to a depth of 30 feet around the exterior of the outer casing. The well reportedly yielded 20 gpm after being pumped continuously for one hour.

The well casing is enclosed in a 30-inch diameter concrete pipe section with a concrete cover that is centered on a 6-ft x 6-ft x 6-inch concrete pad. Fiberglass insulation is packed inside of the concrete

enclosure. Appurtenances to the well at the well head include a sanitary seal, a screened vent, a valved blow-off, a check valve, and a gate valve.

Water from the well is pumped by a ¾-HP submersible pump rated at 10 gpm through approximately 140 feet of 1-inch Schedule 40 PVC piping to the bladder tank and the treatment system, and then to the distribution system. A pressure switch on the well discharge line near the bladder tank controls the operation of the well pump. The well pump is currently set to operate at 37-57 psi. A well pump output of 10 gpm was estimated on August 26, 2005[1]. A water meter is installed downstream of the bladder tank.

The bladder tank and the iron and manganese treatment units are housed in the storage area for the restaurant. The storage area includes light, heat, and a locked entrance.

Storage Facilities
The flow from the well is initially split between the 36-gallon bladder tank and the 42-gallon detention/settling tank. The bladder tank is equipped with a hose bib for sampling and draining the tank, a pressure gauge, a snifter valve for manual air addition, and a liquid pressure relief valve.

Iron and Manganese Treatment
The iron and manganese treatment includes air oxidation, settling, filtration through calcite media, and softening. The 42-gallon (16-inch diameter, 49-inch height) galvanized steel detention/settling tank is equipped with an aspirator for air injection, a pressure gauge, an air release valve, and a drain. The bladder tank and the detention/settling tank have a common liquid pressure relief valve.

The pressurized water from both tanks flows through two parallel calcite filters. The calcite filters are 13 inches in diameter and 55 inches tall, and operate in a downflow mode. Each filter is designed for a flow rate of 11 gpm. The filter media is a proprietary blend of calcium carbonates and magnesium oxides. Backwash water is provided by untreated well water. The backwash is automatically initiated and controlled by a timer. The backwash rate is 7 gpm. One filter is backwashed each night.

The softening unit consists of an ion exchange bed and a brine tank for regeneration. The softener is 10 inches in diameter and 55 inches in height. The resin bed is 18 inches in depth. The flow rate through the resin bed is restricted to 11 gpm. The brine tank is 18.5 inches in diameter and 33 inches high and holds 250 pounds of salt for regeneration. The ion exchange bed produces 2,100 gallons of treated water between regeneration cycles. The sequence of operation is completely automatic and the number of gallons of water processed triggers regeneration.

The filter backwash water line ties into the softener waste water line, which discharges via a 1-inch plastic pipe and a French drain to a 1.33-ft x 62-ft x 1.5-ft backwash pit and a 4-inch drain line on the west side of the rear of the restaurant.

Sample taps are installed outside of the building (raw water), just upstream of the calcite filters, between the calcite filters and the softener, and downstream of the softener.

EVALUATION OF THE SYSTEM

Design Criteria: Based on the *Waterworks Regulations*, §12 VAC5-590-690, the average daily water demand is 25 gpd/employee and 5 gpd/customer

[1] Based on a metered discharge rate of 14 gpm to atmosphere at the well head, as reported by Mr. Swift.

1. Estimated Water Usage:

25 gpd/employee x 5 employees	=	125 gpd
5 gpd/customer x 60 customers	=	300 gpd
Total Average Flow =		425 gpd

Use a peak factor of 4.0
Peak Hour Demand: (4)(425 gpd) / 24 hrs/day = 71 gallons/hr

2. Source Capacity:
   Well Yield: 20 gpm – continuous pumping for one hour (1989)
   20 gpm x 1440 minutes/day = 28,800 gpd

   Well Pump Capacity: 10 gpm – estimated output on 8/26/05
   10 gpm x 1440 minutes/day = 14,400 gpd

3. Storage Capacity: One 36-gallon bladder tank

   Effective Storage Volume: 1/3(36 gallons) = 12 gallons
   Because this is a direct delivery, non-community system, the storage requirement is waived. The recommended storage capacity is one-half day's usage.

4. Peak Delivery Capacity: Transfer Capacity = well pump + effective storage
   = (10 gpm)(60 min/hr) + 12 gallons = 612 gallons-peak hour

   612 gallons Peak Delivery Capacity > 71 gallons Peak Hour Demand

5. Treatment Capacity:
   a. Calcite Filters:
   Two 13-inch diameter filters –11 gpm each *(manufacturer)*
   Alternate filters backwashed daily – 20 min. duration
   22 gpm x (1,440 -10 minutes)/day = 31,460 gpd

   The calcite filters are adequate for the water system.

   b. Ion Exchange Softener –11 gpm each *(manufacturer)*
   Resin Capacity provided: 46,000 grains
   Resin Volume provided: 1.5 cf
   Softener unit: 10-inch diameter, 55-inch height; area = 0.545 ft^2
   Flow rate: 10 gpm (capacity of the well pump)
   Hydraulic Loading Rate = 10 gpm / 0.545 ft^2 = 18.3 gpm/ft^2
   Peak day flow: 850 gpd (Average Flow = 425 gpd; Peak Factor = 2.0)
   Total Hardness = 121 mg/L (7.1 gpg) (prior to treatment)
   Resin Capacity = (121 mg/L)(850 gpd) / (1.5 cf)(17.1 mg/L/gr/gal)
   = 4,010 gr removed / cf resin (< 20,000 gr/cf per Regulations)

   The softener unit is adequate for the water system.

Based on the above evaluation, the permitted capacity is limited to the existing 60-seat restaurant until a 24-hour yield and drawdown test is conducted on the well.

R:\15b\eds.opr/Brothers Italian Restaurant-2005

Same as Brothers Italian Restaurant

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: January 31, 2003

WATERWORKS: Sam & Jessie's

CERTIFIED CLASS: N/A

CITY/COUNTY: Goochland County

TYPE: Transient Non-Community

LOCATION: I-64 West to the Oilville Exit (Route 617). Turn left at the end of the exit ramp, and go approximately 0.6 miles to Broad Street Road (U. S. Route 250). Go east (left) on U. S. Route 250 approximately 0.7 miles. The restaurant is on the south (right) side of U. S. Route 250.

OWNER: Mr. William E. Swift, Sr.
P. O. Box 64
Crozier, Virginia 23039
(804) 784-5534

1450 Cardwell Road

OPERATOR: Mr. David Dembicer, Owner
Sam & Jessie's Restaurant
1299 Broad Street Road
Oilville, Virginia 23129
(804) 784-0166

PERMIT NUMBER: 4075720

DATE ISSUED: February 10, 2003

TREATMENT: Iron and manganese treatment

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing restaurant

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, iron and manganese treatment facilities, and a 36-gallon bladder tank.

Well

The well is located in the grassy area east of the restaurant, just in front of the tree line and approximately 120 feet from the restaurant building. It is constructed from a 10-inch hole drilled to a depth of 30 feet, with a 6-inch hole extended from 30 feet to 125 feet in depth. Bedrock was encountered at a depth of 30 feet. A 6-inch steel outer casing was installed from +1 to 30 feet in depth. In addition, a 4.5-inch PVC inner casing was installed from +1 to 50 feet in depth. A packer was installed at a depth of 50 feet, and the well was grouted with neat cement from ground level to a depth of 50 feet between the inner and outer casings. The well was also grouted with neat cement from ground level to a depth of 30 feet on the exterior of the outer casing. The well reportedly yielded

20 gpm after being pumped continuously for one hour.

The well casing is protected by a 30-inch concrete well curbing with a concrete cover that is set directly on the ground surface around the well head. Fiberglass insulation is packed inside of the concrete curbing. Appurtenances to the well at the well head include a sanitary seal, a screened vent, and a plugged tee that can be used as a blow-off. A meter is installed in the well discharge line upstream of the iron and manganese treatment facilities.

Water from the well is pumped by a ¾-HP submersible pump reportedly rated at 10 gpm through approximately 140 feet of 1-inch Schedule 40 PVC piping to the treatment system and bladder tank, and then to the distribution system. A pressure switch near the bladder tank on the well discharge line controls the operation of the well pump.

The iron and manganese treatment units and the bladder tank are housed in the storage area for the restaurant. The storage area includes light, heat, and a locked entrance.

Iron and Manganese Treatment

The iron and manganese treatment includes air oxidation, settling, and filtration through calcite media. The 42-gallon galvanized steel detention/settling/air release tank is equipped with an aspirator for air injection, a pressure gauge, an air release valve, a drain, and a liquid pressure relief valve. The two calcite filters are operated in parallel. The filter backwash water is discharged to a French drain.

Storage

The 36-gallon bladder tank is equipped with a hose bib for sampling and draining the tank, a pressure gauge, and a liquid pressure relief valve.

EVALUATION OF THE SYSTEM

Design Criteria: The system is evaluated on the basis of an equivalent residential connection (ERC). One ERC will utilize 400 gallons/day (gpd).

1. Present Population: 6 employees and about 50 customers

2. Estimated Usage:
   25 gpd/employee x 6 employees = 150 gpd
   5 gpd/customer x 50 customers = 250 gpd
   Total: 400 gpd

3. Well Yield:
   (0.5 gpm/ERC)
   20 gpm – continuous pumping for one hour (1989)
   20 gpm @ 0.5 gpm/ERC = 40 ERCs or 16,000 gpd

4. Well Pump Capacity:
   (0.5 gpm/ERC)
   10 gpm – information from William Swift
   10 gpm @ 0.5 gpm/ERC = 20 ERCs or 8,000 gpd

5. Storage Capacity: (200 gallons/ERC)
One 36-gallon bladder tank

Effective Storage Volume: 1/3(36 gallons) = 12 gallons
Effective Storage Capacity: 12 gallons @ 200 gallons/ERC
= 0.05 ERCs or 20 gpd
20 gpd @ 25 gpd/employee = 1 employee

Based on the above evaluation, this waterworks would be limited by the total effective storage capacity to a maximum population of 1 employee. However, it is being permitted for the existing restaurant until the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: May 1, 2003

WATERWORKS:	Camp T. Brady Saunders	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community

LOCATION: I-64 West to the Oilville exit (Route 617). Go south (left) on Route 617 approximately 0.5 miles to U. S. Route 250. Go west (right) on U. S. Route 250 about 0.8 miles to Route 632. Go west (left) on Route 632 about 3.4 miles to Route 634. Go south (left) on Route 634 about 1.1 miles. The camp entrance is on the left side of the road.

OWNER: Robert E Lee Council, Inc.
Boy Scouts of America
4015 Fitzhugh Avenue
Richmond, Virginia 23230 Todd Martin (3bks7)
Contact Mr. ~~Terry Coffman~~, Deputy Scout Executive
804-355-4306 or 804-204-2613; FAX: 804-353-6109

OPERATOR: Mr. John Hankins, Reservation Superintendent
Camp T. Brady Saunders
1699 Maidens Road
Maidens, Virginia 23102
804-556-9875 or 804-467-1896

PERMIT NUMBER: 4075045

DATE ISSUED: May 9, 2003

TREATMENT: None

SOURCE: Groundwater – two drilled wells

DESIGN CAPACITY: Existing Camp Facilities

DESCRIPTION OF SYSTEM:

This waterworks consists of two drilled wells, a 40,000-gallon standpipe, a 10,000-gallon pressurized storage tank, two 5-HP booster pumps, four 120-gallon bladder tanks, and the distribution system.

Wells

Both wells are located in the Boy Scout Camp. To reach them, turn left where the main entrance tees (left towards the Boy Scout Camp, right towards the Cub Scout Camp). Turn right at the end of this road. The 40,000-gallon standpipe is about 500 feet down the road, and the wells are about 200 feet beyond the standpipe. Well No. 2 is the most visible well. It is located in a cleared area on the left side of the road.

Well No. 1 (backup well)

To reach Well No. 1, follow the overhead power line across the street from Well No. 2 about 250 feet, and turn left at the first power pole. The well is down the hill, approximately 250 feet from the power pole.

No information is available on the construction of the well, except that it includes 6-inch steel casing which extends about 6 inches above the ground surface. The well head is protected by a 36-inch diameter concrete well curbing with a concrete top, which rests on the ground surface. The top of the curbing is about 24 inches above the ground surface. Appurtenances to the well at the well head include a sanitary seal, a screened casing vent, and an isolation valve.

The electrical controls for the well are housed in a 3.5-ft x 5-ft wooden structure open on one side, and with a slanted shingled roof. The structure is about 6 feet high on the open end, and 5 feet high on the closed end.

A submersible well pump (reportedly 2-HP) delivers water to the 40,000-gallon standpipe. The well pump is reportedly rated at 20 gpm.

Well No. 2 (primary well)

No information is known about the construction of Well No. 2, except that it includes 6-inch steel casing which extends about 12 inches above the ground surface. Appurtenances to the well include a pitless adapter unit and a sanitary well cap with two screened vents. A check valve is reportedly installed in the well drop piping.

A submersible pump (unknown HP) reportedly rated at 24 gpm delivers water to the 40,000-gallon standpipe.

40,000-Gallon Standpipe

The 40,000-gallon standpipe (12-ft diameter, 48-ft height) is equipped with a shoebox type manhole with a hinge and a lock, a screened vent, a water level indicator (cable and disc), a screened overflow pipe, and a drain. Drainage will flow into a nearby ditch.

The float probes for cutting on and shutting off the well pump are approximately 47.0 feet and 47.5 feet, respectively, above the tank bottom. The inlet and outlet pipes are 12 inches above the tank bottom. Therefore, the effective storage volume is approximately 39,337 gallons.

10,000-Gallon Pressurized Tank

This tank is located at the center of the Boy Scout Camp, near the main shower house. It is pressurized by the height of the water in the 40,000-gallon standpipe, and does not increase the pressure in the waterlines serving the Boy Scout Camp. Appurtenances to the tank include an access manhole and a plugged drain. Manual air release is possible through the hose bibbs on the discharge line from the pressurized tank.

Booster Pumping Station

There is a small valley between the Boy Scout Camp and the Cub Scout Camp. The booster pumping station is located in the valley. It takes suction from the adjacent waterline, and boosts the pressure in the waterlines serving the Cub Scout Camp. Two 5-HP booster pumps and four 120-gallon bladder tanks are housed in a 15-ft x 15-ft x 10-ft frame and siding building with insulation and a concrete floor. Appurtenances to the building include lighting, heat, louver vents, and an exhaust fan.

The booster pumps sit on a 27" x 27" x 24" concrete pad. Each booster pump is equipped with a gate valve, a pressure gauge, and a sample tap on the suction side. A check valve, gate valve, pressure gauge and sample tap are installed on the discharge side. An H-O-A switch is provided for each booster pump.

The four 120-gallon bladder tanks are installed in parallel. Appurtenances to each bladder tank include an isolation valve and a hose bibb for draining the tank.

Distribution System

The distribution system includes approximately 4,400 feet of 4-inch, 250 feet of 3-inch, 500 feet of 2-inch, and 500 feet of 1.5-inch PVC waterlines with appropriate appurtenances.

EVALUATION OF THE SYSTEM

1. Present Connections:
   - Boy Scout Camp: 18 - Administration Building, Dining Hall, Trading Post & Health Lodge, Shower House, and 14 Campsites
   - Cub Scout Camp: 6 - Welcome Center, Multi-Purpose Building, Nature Center, Western Fort Lodge, and Castle Pool

2. Present Population (peak):

Full-Time (year round) staff:	2
Boy Scout Camp:	
Camp Staff (Summer)*:	40
Campers:	327
Volunteer Leaders (day)**:	33*
Cub Scout Camp:	
Camp Staff (Summer):	25
Campers:	227
Volunteer Leaders (day):	23

*camp staff and campers stay overnight; volunteer leaders and full-time staff are day people
**estimated 1 leader/10 scouts

3. Estimated Usage (peak):

25 gpd/year round staff x 2 staff	=	50 gpd
50 gpd/summer staff x 65 staff	=	3,250 gpd
50 gpd/camper x 554 campers	=	27,700 gpd
25 gpd/volunteer leader x 56 leaders	=	1,400 gpd
TOTAL:		32,400 gpd

4. Well Yield: Unknown

5. Well Pump Capacity:
   Well No. 1 – 20 gpm
   Well No. 2 – 24 gpm
   TOTAL: 44 gpm

   44 gpm x 1,440 minutes/day = 63,360 gpd

6. Storage Capacity:
   (one-half of average daily demand)
   One 40,000-gallon gravity storage tank
   (effective storage volume – 39,337 gallons)
   Four 120-gallon bladder tanks

Effective Storage Volume: [39,337 + 1/3(4)(120)] gallons = 39,497 gallons
Effective Storage Capacity: $\frac{39{,}497 \text{ gallons}}{0.5 \text{ days}}$ = 78,994 gpd

This waterworks is being permitted for the existing camp facilities until information about the well yields is provided.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: April 7, 2003

WATERWORKS:	Camp Hilbert	CERTIFIED CLASS: VI
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community
LOCATION:	I-64 West to the Oilville exit (Route 617). Go south (left) on Route 617 approximately 0.5 miles to U. S. Route 250. Go west (right) on U. S. Route 250 about 0.8 miles to Route 632. Go west (left) on Route 632 about 3.4 miles to Route 634. Go north (right) on Route 634 about 0.9 miles. The camp entrance is on the left side of the road.	
OWNER:	Jewish Community Center of Richmond 5403 Monument Avenue Richmond, Virginia 23226 Contact Mr. Eric Koehler, Assistant Executive Director (804) 288-6091, Ext. 3011 Fax (804) 285-3139	
OPERATOR:	Mr. Mike Haskins, Operations Manager (804) 285-6500, Ext. 3021	Robbie Etzkin 556-3521
PERMIT NUMBER:	4075049	Amended
DATE ISSUED:	January 1, 1980	April 18, 2003
TREATMENT:	Iron and Manganese Treatment	
SOURCE:	Groundwater – one drilled well	
DESIGN CAPACITY:	Existing Camp Facilities	

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, an iron and manganese treatment system, and a 5,000-gallon hydropneumatic tank.

Well

The well is located in the grassy area on the left side of the parking lot. It was constructed from a 10-inch hole drilled to a depth of 81 feet, and a 6-inch hole extended from 81 feet to 225 feet in depth. Six-inch steel casing was installed from +1 feet to a depth of 81 feet, and the well was grouted with neat cement from ground level to 81 feet in depth. The well yielded 35 gpm with 189 feet of drawdown after pumping continuously for 48 hours, in a test completed in June 1985.

Appurtenances to the well include a sanitary seal, a screened casing vent, a drawdown gauge, a discharge meter, a gate valve, a check valve, and a valved blow-off.

Water is pumped from the well by a 5-HP submersible pump (rating unknown) to the treatment facilities, the hydropneumatic tank, and into the distribution system. A pressure switch on the air piping near the top of the hydropneumatic tank controls the operation of the well pump. The well pump is set to operate at a pressure range of about 30-45 psi at the pressure switch. The well pump had an output of 15 gpm during an instantaneous reading on August 13, 2002.

Well House

The well, the iron and manganese treatment system, and the hydropneumatic tank are housed in a 10-ft x 20-ft x 8-ft framed well house with wooden siding. Appurtenances to the well house include lighting, heat, a concrete floor with a floor drain, overhead well access, and a locked entrance.

Treatment Facilities

The iron and manganese treatment system includes an aspirator for air injection, an 82-gallon aeration tank, and two parallel filters with calcite and sand media. Each filter is 30 inches in diameter and 72 inches in height. The filter media includes a 30-inch layer (12 ft^3) of calcite and sand (0.32-0.34 mm) underlain by a 3-inch layer of 1/8"-1/16" gravel, a 4-inch layer of ¼"-1/8" gravel, and a 3-inch layer of ½"-1/4" gravel.

Sample taps are installed on the raw water line, at the sand layer on the filters, and on the filter effluent line. Pressure gauges are installed on the entrance line to the filters and on the effluent line from the filters. Bypass piping is included for each filter.

Treated water from the hydropneumatic tank is used to backwash the filters. The filters are automatically backwashed every three days. The filter backwash water discharges through a 4-inch drain to a ravine near the well house.

Storage Facilities

Appurtenances to the 5,000-gallon hydropneumatic tank include a sight glass, a pressure gauge, an access manhole, a vacuum relief valve, a drain, a snifter valve for manual air addition, and a sample tap. A 0.5-HP air compressor helps to maintain the proper air:water ratio in the hydropneumatic tank.

Distribution System - The distribution system consists of 2-inch PVC piping.

EVALUATION OF THE SYSTEM

1. Existing Connections: 5 – Camp Office and Kitchen, Pavilion, Arts & Crafts Building, Swimming Pool Bathhouse, and Camp Bathhouse

2. Present Population: 40 non-residential employees, 230 day campers

3. Estimated Usage:

25 gpd/employee x 40 employees = 1,000 gpd
25 gpd/camper x 230 campers = 5,750 gpd
TOTAL: 6,750 gpd

4. Well Yield:

35 gpm – 48 hours of continuous pumping (1985)
35 gpm x 1,440 minutes/day = 50,400 gpd

5. Well Pump Capacity:

15 gpm – instantaneous reading on 8/13/02
15 gpm x 1,440 minutes/day = 21,600 gpd

6. Storage Capacity:

(one-half of average daily demand)
One 5,000-galllon hydropneumatic tank

Effective Storage Volume: 1/3(5,000 gallons) = 1,667 gallons
Effective Storage Capacity: $\frac{1{,}667 \text{ gallons}}{0.5 \text{ days}}$ = 3,334 gpd

7. Filtration Capacity:

(3 gpm/ft^2)
Two 30-inch diameter filters
Filtration Area: (3.14159)(1.25)^2(2 filters) = 9.82 ft^2
9.82 ft^2 x 3 gpm/ft^2 = 29.5 gpm
29.5 gpm x 1,440 minutes/day = 42,480 gpd

This waterworks is being permitted for the existing camp facilities until information on the well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: April 3, 2003

WATERWORKS:	Camp Little Hawk	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community

LOCATION: I-64 West to the Oilville exit (Route 617). Go south (left) on Route 617 about 0.5 miles to U. S. Route 250. Go east (left) on U. S. Route 250 about 0.5 miles, and turn south (right) onto Cardwell Road (Route 670). Go about 1.2 miles on Cardwell Road. The camp entrance is on the right side of the road, across from Bethel Church.

OWNER: Boys and Girls Club of Metro Richmond
2601 West Broad Street
Richmond, Virginia 23220 → Chet Emerson, Interim CEO
Contact Mr. Don Williams, ~~Senior Vice-President of Operations~~ Todd McFarlane Ext. 224
(804) 359-5250, Ext. ~~228~~ 224 ~~359-5930~~
FAX 353-5750

OPERATOR: Mr. Charlie Long
Senior Program and Facilities Director
Tuckahoe Family YMCA
9211 Patterson Avenue
Richmond, Virginia 23229
(804) 740-9622 Ext. 142
Danny Thompson 8/15/03
540-273-3879
Floyd Johnson
359-5250 Ext. 224

PERMIT NUMBER: 4075055

DATE ISSUED: April 11, 2003

TREATMENT: None

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing Camp Office, Pavilion, and Shower House

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well and an 86-gallon bladder storage tank.

Well

The well is located at the edge of the woods beside the recreational field, and approximately 200 feet from the swimming pool. No information is available on the construction of the well, except that it includes 4-inch steel casing. Appurtenances to the well include a sanitary seal, a shutoff valve, and a sample tap.

Water from the well is pumped by a submersible pump (unknown HP and rating) to the bladder storage tank and to the distribution system. A pressure switch on the piping connecting the well

discharge to the bladder tank controls the operation of the well pump. The operating range is around 45-55 psi.

Well House

The well, well appurtenances, and the bladder tank are housed in an 8-ft x 8-ft x 8-ft masonry block well house. Appurtenances to the well house include lighting, a concrete floor, overhead access to the well, and a locked entrance. Drainage would flow under the door.

Storage Facility

The 86-gallon bladder tank is equipped with a pressure gauge, a liquid pressure relief valve, and a hose bib for sampling and draining the tank.

EVALUATION OF THE SYSTEM

1. Present Connections: 3 – Camp Office, Pavilion, and Shower House

2. Present Population: 85 (3 overnight staff, 25 overnight campers, 7 day staff, 50 day campers)

3. Estimated Usage:

50 gpd/overnight staff x 3 overnight staff	=	150 gpd
50 gpd/overnight camper x 25 overnight campers	=	1,250 gpd
25 gpd/day staff x 7 day staff	=	175 gpd
25 gpd/day camper x 50 day campers	=	1,250 gpd
TOTAL:		2,825 gpd

4. Well Yield: Unknown

5. Well Pump Capacity: Unknown

6. Storage Capacity: (one-half of average daily demand)
One 86-gallon bladder tank

Effective Storage Volume: 1/3(86 gallons) = 29 gallons
Effective Storage Capacity: $\frac{29 \text{ gallons}}{0.5 \text{ days}}$ = 58 gpd

This waterworks is being permitted for the existing Camp Office, Pavilion, and Shower House until information about the well yield and well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: September 6, 2002

WATERWORKS NAME:	Collegiate Athletic Campus	CERTIFIED CLASS: N/A
COUNTY/CITY:	Goochland County	TYPE: Transient Non-Community
LOCATION:	West on Patterson Avenue (Route 6), approximately 1.2 miles beyond the Henrico County line, to Blair Road (Route 649). Turn left onto Blair Road. Go approximately 0.5 miles. The athletic complex will be on the right side of the road.	
OWNER:	Collegiate School 201 N. Mooreland Road Richmond, Virginia 23229 Contact Mr. Robert Sedivy, Vice-President of Finance Phone: 804-741-9799	
OPERATOR:	Mr. David Hamblen, Director of Physical Plant Phone: 804-741-6265	
PERMIT NUMBER:	400502	4075085
EFFECTIVE DATE:	March 13, 2002	September 17, 2002
TYPE OF TREATMENT:	Manganese Removal	
SOURCE:	Groundwater – one drilled well	
DESIGN CAPACITY:	3,600 gpd	

DESCRIPTION OF SYSTEM

This waterworks includes one drilled well, one 211-gallon bladder tank, manganese removal equipment, and approximately 1,510 feet of 3-inch waterline with appropriate appurtenances.

Well

The well was constructed from an 11-inch hole drilled to a depth of 50 feet, with an 8¾-inch hole extended from 50 feet to 63 feet in depth, and a 6 1/8-inch hole extended from 63 feet to 805 feet in depth. The well was cased with 6-inch PVC (Schedule 40) casing from +2 feet to 63 feet in depth, and was grouted with neat cement from ground level to 63 feet in depth. The well yielded 44 gpm with 294 feet of drawdown after 48 hours of continuous pumping in a test completed on August 27, 2001.

Appurtenances to the well at the well head include a pitless adapter unit, a sanitary well cap with a screened vent, a pressure transducer for determining the depth of water in the well, and a 6-ft x 6-ftx 6-inch concrete pad. A 7.5-HP submersible well pump, rated at 44 gpm @ 480 feet TDH,

TDH, conveys the water through approximately 70 feet of 3-inch PVC waterline to a 7-ft x 14-ft x 6-ft concrete vault. In the vault, the water will either be diverted to the irrigation pond via approximately 160 feet of 2-inch PVC waterline, or conveyed to the athletic building via approximately 1,440 feet of 3-inch PVC waterline. Positive drainage will be provided for the vault.

The vault also houses a flow sensor for all of the water pumped from the well, and a check valve, gate valve and meter for the domestic water.

Pump House

The 15-ft x 23-ft x 9-ft vinyl sided pump room is attached to the athletic building. The pump room houses the bladder tank and the manganese treatment facilities. Appurtenances to the room include lighting and heating.

Storage Facilities

The 211-gallon bladder tank has a diameter of 36 inches and a standing height of 63 inches. The height of the pressure vessel is approximately 48 inches. Appurtenances to the bladder tank include a pressure gauge, a sample tap, and a drain.

Manganese Treatment Facilities

The manganese treatment facilities include two downflow greensand filters. Each filter is 21 inches in diameter and 62 inches in height. At a filtration rate of 3 gpm/ft^2, the two filters have a filtration capacity of 14.5 gpm. The flow through the filters is limited by the peak demand of 17 gpm. Potassium permanganate solution is stored in 5-gallon containers and injected into the water through a venturi unit on each filter. Backwash water is provided from the well at a controlled rate of 25 gpm or 10 gpm/ft^2 (a flow control valve is installed on the filter drain line). The backwash water is discharged through the 1¼-inch filter drain line and the 3-inch floor drain to the septic tank-drainfield system for the domestic wastewater. A 2-inch air gap is provided between the filter drain line and the floor drain.

DESIGN CRITERIA

Note: ERC = Equivalent Residential Connection or 400 gpd, in accordance with the 1995 *Waterworks Regulations*

1. Design Water Usage: 760 gpd (average) on weekdays (range: 400-1,000 gpd)
   3,600 gpd (peak) on tournament days
   17 gpm – peak hour usage (based on fixture counts)

2. Well Yield: (0.5 gpm per ERC)
   44 gpm for 48 hours of continuous pumping
   44 gpm @ 0.5 gpm/ERC = 88 ERCs
   88 ERCs @ 400 gpd/ERC = 35,200 gpd

3. Well Pump Capacity: (0.5 gpm per ERC)
   44 gpm @ 480 feet TDH
   44 gpm @ 0.5 gpm/ERC = 88 ERCs
   88 ERCs @ 400 gpd/ERC = 35,200 gpd

4. Storage Capacity: (200 gallons per ERC)

   One 211-gallon bladder tank

   Effective Storage Volume: 1/3(211) = 70 gallons
   Effective Storage Capacity: 70 gallons @ 200 gallons per ERC = 0.35 ERCs
   0.35 ERCs @ 400 gpd/ERC = 140 gpd

5. Capacity of Treatment System: (3 gpm per ft^2)

   Two 21-inch diameter filters
   Area: $[(21/12)/2)]^2(3.14) = 2.40\ ft^2$ per filter
   Total Area: (2 filters)(2.40 ft^2 per filter) = 4.80 ft^2
   Filtration Capacity: (3 gpm/ft^2)(4.80 ft^2) = 14.5 gpm*
   14.5 gpm @ 0.5 gpm per ERC = 29 ERCs or 11,600 gpd

   *14.5 gpm is approximately equivalent to the design peak hour domestic flow of 17 gpm

This waterworks is limited by the effective storage capacity to a maximum usage of 0.35 equivalent residential connections or 140 gpd. However, since it is a non-community waterworks with a direct delivery system, it is being permitted for the peak day design usage of 3,600 gpd.

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Stewart's Cafe

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: February 19, 2003

WATERWORKS:	Country House Café	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community

LOCATION: I-64 West to the Hadensville exit (Route 629 - Exit #152). Go south (left) on Route 629 approximately 0.7 miles to U. S. Route 250. Go west (right) on U. S. Route 250 approximately 0.4 miles to the restaurant. The restaurant is on the south (left) side of U. S. Route 250.

OWNER: Kiser Enterprises, Inc. L.L.C.
4833 Broad Street Road
Louisa, Virginia 23093
Contact Ms. Brenda Kiser, President
(804) 457-9025

OPERATOR: Stoner Enterprises, Inc.
t/a Culligan Water Conditioning
501 Maryland Avenue
Hagerstown, Maryland 21740
Contact Mr. Rusty Stoner
(800) 451-7512 or (301) 797-0311

c/o
Doreen Stewart
457-3039 FAX - 457-2998
(H) 556-3107

Ali's Investments Inc.
4833 Broad Street Road
Louisa, Va 23093
(804) 640-6098

PERMIT NUMBER: 4075465

DATE ISSUED: March 3, 2003

TREATMENT: Granular Activated Carbon Filtration, Ultraviolet Disinfection

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing restaurant and gas station/convenience store

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, treatment for the removal of volatile organic chemicals, and a 44-gallon bladder tank.

Well

The well is located on the west side of the restaurant and store, at the back of the parking lot. No information is known about the construction of the well except that it includes 6-inch PVC casing that extends about 7.5 inches above the ground surface. Appurtenances to the well include a pitless adapter unit, a shutoff valve, a sample tap, and a meter.

Water is pumped from the well by a submersible pump (unknown HP and rating) through approximately 30 feet of pipe (material and diameter unknown) to the treatment facilities, then to the

bladder tank, and into the distribution system. A pressure switch on the well discharge line near the bladder tank controls the operation of the well pump. The well pump had an output of 2 gpm during an instantaneous reading on October 17, 2002.

Pump House – The bladder tank is housed in a 7.5-ft x 7.5-ft x 7-ft metal framed building that was the pump house for the abandoned bored well. The building is partially below grade. The treatment facilities are housed in a 6-ft x 8-ft x 8-ft wood framed shed attached to the back of the pump house. Appurtenances to each building include an electrical outlet for a drop light, a heat lamp, and a locked entrance.

Treatment Facilities – The treatment facilities include a particle filter, pressurized granular activated carbon (GAC) filtration for the removal of benzene and methyl-tert butyl ether (MtBE), and an ultraviolet light unit for disinfection.

The particulate filter is approximately 10 inches in diameter and 16 inches tall. The filter material is paper.

The six GAC filters are aligned in two parallel sets of three filters in series. Each filter is 12 inches in diameter and 52 inches in height, and contains 3.3 ft^3 of GAC media. The GAC media has an effective size of 0.6-0.85 mm and a uniformity coefficient of 2.0. Each filter is designed for a flow of 5 gpm.

The ultraviolet light unit (36 inches x 4 1/8 inches x 6¾ inches) is designed for a maximum flow of 15 gpm.

Sample taps are installed prior to any treatment, and after the second GAC filter in each set. The meter is installed on the downstream side of the UV unit.

The treatment facilities were installed under a grant program for groundwater remediation by the Department of Environmental Quality. Mr. Harmon Fisher (Telephone: (804) 698-4292) manages the groundwater remediation program. Stoner Enterprises, Inc. has a contract to operate and maintain the treatment facilities. The contact person is Mr. Rusty Stoner (Telephone: (800) 451-7512).

Storage Facilities

Appurtenances to the 44-gallon bladder tank include a drain, a liquid pressure relief valve, and a pressure gauge.

EVALUATION OF THE SYSTEM

1. Present Population: Restaurant – 4 employees and 82 customers
   Store – 6 employees and 400 customers

2. Well Yield: Unknown

3. Well Pump Capacity: 2 gpm – instantaneous reading on 10/17/02
   2 gpm x 1,440 minutes/day = 2,880 gpd

4. Storage Capacity: (one-half of average daily demand)
   One 44-gallon bladder tank

   Effective Storage Volume: 1/3(44 gallons) = 15 gallons

   Effective Storage Capacity: $\frac{15 \text{ gallons}}{0.5 \text{ days}}$ = 30 gpd

   30 gpd @ 25 gpd/employee = 1 employee

5. Filtration Capacity: Two sets of three GAC filters installed in series
   Each filter is designed for a flow rate of 5 gpm
   5 gpm/filter x 2 sets of filters = 10 gpm
   10 gpm x 1,440 minutes/day = 14,400 gpd

6. Ultraviolet Light Capacity: The unit has a design capacity of 15 gpm
   15 gpm x 1,440 minutes/day = 21,600 gpd

This waterworks would be limited by the total effective storage capacity to a maximum population of 1 employee. However, it is being permitted for the existing restaurant and gas station/convenience store until information about the well yield is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: March 31, 2003

WATERWORKS:	The Country Store/Bill's BBQ	CERTIFIED CLASS: VI
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community
LOCATION:	Take I-64 West from Richmond to Exit 173 (Manakin/Rockville exit). Turn left (south) onto Route 623. Go approximately 1.1 miles and turn right (west) onto U. S. Route 250. The gas station/store/fast food restaurant is approximately 0.3 miles down U. S. Route 250, on the left side.	
OWNER:	Stations, L.C. t/a The Country Store 45 Broad Street Road Manakin-Sabot, Virginia 23103 Contact Mr. K. Marshall Cook, Manager (804) 784-1263	
OPERATOR:	Ms. Sandi Cook, Operations Manager (804) 784-1263	
PERMIT NUMBER:	4075020	
DATE ISSUED:	April 9, 2003	
TREATMENT:	Filtration (Calcite, Carbon, and Cartridge) and Ultraviolet Light Disinfection	
SOURCE:	Groundwater – one drilled well	
DESIGN CAPACITY:	Existing gas station/store/fast food restaurant	

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, a 20-gallon bladder tank, iron and manganese treatment facilities, ultraviolet light disinfection, and filtration for particulate removal and taste and odor control.

Well

The well is located in a grassy area on the east (left) side of the front of the gas station/store/fast food restaurant, almost directly under the "Bill's Bar-B-Q" sign. No information is available on the well construction except that it includes PVC well casing that extends approximately 12 inches above the ground. Appurtenances to the well at the well head include a pitless adapter unit and a well cap.

Water from the well is pumped by a submersible pump (unknown HP and rating) through approximately 200 feet of piping (unknown material and diameter) to the bladder tank and treatment units, and then to the distribution system. A pressure switch located just downstream of the bladder tank on the well discharge line controls the operation of the well pump. The well pump operates in the range of 40-60 psi at the pressure gauge.

The bladder tank, the iron and manganese treatment facilities, the ultraviolet light unit, and the filters are housed in the manager's office for the store/fast food restaurant. The office area includes light, heat, and a locked entrance. There is a gate valve on the well discharge line, just upstream of the connection to the bladder tank.

Storage

The 20-gallon bladder tank is equipped with a hose bib for sampling and draining the tank, a pressure gauge, and a liquid pressure relief valve.

Oxidation and Filtration

An aspirator injects air into the well discharge line upstream of the bladder tank to oxidize iron and manganese. Downstream of the bladder tank, a calcite filter and a cartridge filter are piped in series. The calcite filter is 13 inches in diameter and 54 inches in height. The cartridge filter is 4 inches in diameter and 24 inches in height, and is changed approximately once per month.

Ultraviolet Light

The ultraviolet light disinfection unit is designed for a flow of 10 gpm.

Additional Filtration and Taste and Odor Control

Two carbon filters (4-inch diameter, 24-inch height) and two cartridge filters (4-inch diameter, 12-inch height) are installed in series downstream of the ultraviolet light unit, on a branch waterline serving the store/fast food restaurant. The filter units are changed approximately once per month.

There is a sample tap in the office area downstream of all of the treatment units.

EVALUATION OF THE SYSTEM

1. Present Population: 6 employees, about 706 store customers, and about 249 restaurant customers

2. Estimated Usage:

25 gpd/employee x 6 employees	=	150 gpd
1 gpd/store customer x 706 customers	=	706 gpd
5 gpd/restaurant customer x 249 customers	=	1,245 gpd
TOTAL:		2,101 gpd

3. Well Yield: Unknown

4. Well Pump Capacity: Unknown

5. Storage Capacity: (One-half day of average usage)

   One 20-gallon bladder tank

   Effective Storage Volume: 1/3(20 gallons) = 7 gallons
   Effective Storage Capacity: $\frac{7 \text{ gallons}}{0.5 \text{ days}}$ = 14 gpd

6. Capacity of Calcite Filter: Unknown

7. Capacity of Ultraviolet Light Unit: 10 gpm
   10 gpm x 1,440 minutes/day = 14,400 gpd

8. Capacity of Cartridge Filters: Unknown

9. Capacity of Carbon Filters: Unknown

This waterworks is being permitted for the existing gas station/store/fast food restaurant until information about the well yield and the well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: April 1, 2003

WATERWORKS: Fas Mart #16 CERTIFIED CLASS: N/A

CITY/COUNTY: Goochland County TYPE: Transient Non-Community

LOCATION: Take I-64 West from Richmond to Exit #173 (Rockville/Manakin exit). Turn left at the end of the ramp onto Route 623 (Ashland Road). The store is about 0.8 miles down Route 623, on the right side of the road, at the intersection of Route 623 and Plaza Drive.

OWNER: GPM Investments, L.L.C. t/a Fas Mart #16
~~6400 Mechanicsville Turnpike~~ 2443 Lee Davis Road 559-9308
Mechanicsville, Virginia 23111
Contact: Ms. Phyllis Stinson
804-730-1568 Ext: ~~147~~ 1011
~~Pat McLaughlin (3/18/04)~~ Peggy Scratch Deli Manager

OPERATOR: Mr. ~~John Dowdy~~, Store Manager 1700 Ashland Road
804-784-2912 ~~Dick Parkinson~~ Richmond 23233
Gloria (3/24/05) (10/05)
Joseph

PERMIT NUMBER: 4075225

DATE ISSUED: April 10, 2003

TREATMENT: None

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing gas station/convenience store/deli/fast food restaurant

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well and a 195-gallon galvanized steel pressure tank.

Well

The well is located in a grassy area on the north side of the convenience store, about 6 feet from the curb on that side of the building. The well was constructed from a 9 7/8-inch hole drilled to a depth of 520 feet. The well was cased with 6-inch steel casing from +1 feet to 52 feet in depth, and was grouted with neat cement from ground level to 50 feet in depth. The well yielded 2 gpm with 403 feet of drawdown after 8 hours of continuous pumping in a test completed on October 18, 1995.

Appurtenances to the well at the well head include a pitless adapter unit, a sanitary well cap with a screened vent, and a 5-ft x 6-ft x 6-inch concrete pad.

Water from the well is pumped by a submersible pump (unknown HP and capacity) through approximately 100 feet of piping (pipe material and diameter unknown) to the pressure tank, and then to the distribution system. A pressure switch on the well discharge line, located just upstream of the pressure tank, controls the operation of the well pump. The well pump will operate at pressures of 45-67 psi at the pressure tank. An isolation valve on the well discharge line is also located near the tank.

Storage Facilities

The pressure tank is housed at the back end of the convenience store, in the walkway between the deli and the fast food restaurant. Appurtenances to the 195-gallon (28-inch diameter, 74-inch height) galvanized steel pressure tank include a pressure gauge, a liquid pressure relief valve, and a hose bib for sampling and for draining the tank.

EVALUATION OF THE SYSTEM

1. Present Population: 4 employees and about 605 customers

2. Estimated Usage:
   25 gpd/employee x 4 employees = 100 gpd
   1 gpd/customer x 605 customers = 605 gpd
   TOTAL: 705 gpd

3. Well Yield: 2 gpm – 8 hours of continuous pumping on 10/18/95
   2 gpm x 1,440 minutes/day = 2,880 gpd

4. Well Pump Capacity: Unknown

5. Storage Capacity: (one-half of average daily demand)
   One 211-gallon pressure tank

Effective Storage Volume: 1/3(195 gallons) = 65 gallons
Effective Storage Capacity: $\frac{65 \text{ gallons}}{0.5 \text{ days}}$ = 130 gpd

This waterworks is permitted for the existing gas station/convenience store/deli/fast food restaurant until information about the well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: October 29, 2004

WATERWORKS:	Fox Head Inn	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community
LOCATION:	Take I-64 West from Richmond to Exit 173 (Manakin/Rockville exit). Turn left (south) onto Route 623. Go approximately 1.1 miles and turn right (west) onto U. S. Route 250. Go approximately 0.6 miles and turn left (south) onto Route 621. The Fox Head Inn is approximately 0.5 miles down Route 621, on the right hand side.	
OWNER:	Fox Head Inn Ltd. Mr. Robert Ramsey, Inn Manager 1840 Manakin Road Manakin-Sabot, Virginia 23103 (804) 784-5126 FAX 784-9302	
OPERATOR:	Mr. Brad Hungate (804) 784-5126	
PERMIT NUMBER:	4075240	Amended
DATE ISSUED:	February 26, 2003	November 5, 2004
TREATMENT:	None	
SOURCE:	Groundwater – one drilled well	
DESIGN CAPACITY:	Existing restaurant	

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well and an 86-gallon bladder tank.

Well

The well is located in a grassy area approximately 16 feet southwest of the left (southwest) corner of the front of the restaurant. No information is known about the construction of the well except that it includes 6-inch steel casing. A 30-inch (ID) concrete well curbing with a concrete cover protects the well casing. The 30-inch curbing contains a concrete floor that is about 20 inches below grade. The concrete cover is about 2 inches above grade. The top of the well casing is about 18 inches below grade. The well casing is equipped with a sanitary seal and a screened casing vent. A check valve is installed on the portion of the well discharge line located in the furnace room.

Water from the well is pumped by a submersible pump of unknown capacity and horsepower via approximately 50 feet of piping (unknown diameter and material) to the bladder tank and distribution system. A pressure switch on the well discharge line that is located just upstream of the connection to the bladder tank controls the well pump's operation.

Storage Facilities

The 86-gallon bladder tank is housed in the utility room off of the kitchen. Its appurtenances, including a hose bib for sampling and draining the tank and a pressure gauge, are installed in the piping located in the furnace room. The utility room and the furnace room have lighting, heat, and a locked entrance.

EVALUATION OF THE SYSTEM

1.	Estimated Water Usage:	6 employees @ 25 gpd/employee = 150 gpd 20 customers @ 5 gpd/customer = 100 gpd 250 gpd
2.	Well Yield:	Unknown
3.	Well Pump Capacity:	Unknown
4.	Storage Capacity:	(one-half of average daily demand) One 86-gallon hydropneumatic tank
	Effective Storage Volume; Effective Storage Capacity:	1/3(86 gallons) = 29 gallons 29 gallons = 58 gpd 0.5 days
		58 gpd @ 25 gpd/employee = 2 employees

Based on the above evaluation, this waterworks would be limited by the total effective storage capacity to a maximum population of 2 employees. However, it is being permitted for the existing restaurant until information about the well yield and pump capacity is provided, and the need for additional storage capacity is evaluated.

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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: March 31, 2003

WATERWORKS: Hickory Notch Grill

CERTIFIED CLASS: N/A

CITY/COUNTY: Goochland County

TYPE: Transient Non-Community

LOCATION: I-64 West to the Oilville exit (Route 617). Go south (left) on Route 617 approximately 0.5 miles to U. S. Route 250. Go west (right) on U. S. Route 250 approximately 2.6 miles. The restaurant is on the left side of the road, almost directly across from Route 636.

OWNER: Mr. Lars and Mrs. Sherie Bors-Koefoed
2031 Broad Street Road
Maidens, Virginia 23102
(804) 556-2742, FAX: (804) 556-9876

OPERATOR: Stoner Enterprises, Inc.
t/a Culligan Water Conditioning
501 Maryland Avenue
Hagerstown, Maryland 21740
Contact Mr. Rusty Stoner
(800) 451-7512 or (301) 797-0311

Harmon Fisher (804) 598-4292

PERMIT NUMBER: 4075368

DATE ISSUED: April 9, 2003

TREATMENT: Filtration (Cartridge and Granular Activated Carbon) and Ultraviolet Disinfection

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing restaurant

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, an 86-gallon bladder tank, and treatment for the removal of volatile organic chemicals.

Well

The well is located on the west side of the restaurant, at the back of the property (about 250 feet behind the restaurant). No information is known about the construction of the well except that it includes 6-inch PVC casing that extends about 12 inches above the ground surface.

The well head is protected by a 24-inch diameter concrete well curbing with a concrete top. The well curbing extends about 33 inches above the ground surface and has a concrete floor. Appurtenances to the well at the well head include a sanitary well seal, a screened casing vent, and a check valve.

Fiberglass insulation has been placed around the well head and well appurtenances within the well curbing for freeze protection.

Water is pumped from the well by a submersible pump (unknown HP and rating) through approximately 300 feet of pipe (material and diameter unknown) to the bladder tank, the treatment facilities, and into the distribution system. A pressure switch installed on the top of the bladder tank controls the operation of the well pump.

Treatment Room - The bladder tank and the treatment facilities are housed in a 5-ft x 10-ft room at the back of the restaurant, on the right (west) side of the kitchen. The well discharge meter is also installed in that room, downstream of the bladder tank. The room is equipped with lighting and a locked entrance. Access to the room is from the outside of the restaurant.

Storage Facilities - Appurtenances to the 86-gallon bladder tank include a liquid pressure relief valve and a pressure gauge. The tank can be drained through a hose bib in the piping to the loading dock area.

Treatment Facilities – The treatment facilities include cartridge filters, pressurized granular activated carbon (GAC) filtration for the removal of benzene and methyl-tert butyl ether (MtBE), and ultraviolet light units for disinfection.

The treatment facilities are divided into two parallel treatment trains. Each treatment train includes a meter, a 20-micron cartridge filter, two GAC filters installed in series, a second 20-micron cartridge filter, and an ultraviolet light unit.

Each GAC filter is 12 inches in diameter and 52 inches in height, and contains 3.3 ft^3 of GAC media. The GAC media has an effective size of 0.6-0.85 mm and a uniformity coefficient of 2.0. Each filter is designed for a flow of 5 gpm. Each ultraviolet light unit is 36 inches x 4 1/8 inches x 6¾ inches, and is designed for a maximum flow of 15 gpm.

Sample taps are installed prior to any treatment, and after the first GAC filter in each set. A meter is installed in the common discharge line downstream of the UV units.

The treatment facilities were installed under a grant program for groundwater remediation by the Department of Environmental Quality. Mr. Harmon Fisher (Telephone: (804) 698-4292) manages the groundwater remediation program. Stoner Enterprises, Inc. has a contract to operate and maintain the treatment facilities. The contact person is Mr. Rusty Stoner (Telephone: (800) 451-7512).

EVALUATION OF THE SYSTEM

1. Present Population: 12 employees and 100 customers

2. Estimated Water Usage: 12 employees x 25 gpd/employee = 300 gpd
   100 customers x 5 gpd/customer = 500 gpd
   TOTAL: 800 gpd

3. Well Yield: Unknown

4. Well Pump Capacity: Unknown

5. Storage Capacity: (one-half of average daily demand)
   One 86-gallon bladder tank

   Effective Storage Volume: 1/3(86 gallons) = 29 gallons

   Effective Storage Capacity: $\frac{29 \text{ gallons}}{0.5 \text{ days}}$ = 58 gpd

6. Filtration Capacity: Two sets of two GAC filters installed in series
   Each filter is designed for a flow rate of 5 gpm
   5 gpm/filter x 2 sets of filters = 10 gpm
   10 gpm x 1,440 minutes/day = 14,400 gpd

7. Ultraviolet Light Capacity: Two units installed in parallel
   Each unit has a design capacity of 15 gpm
   2 x 15 gpm x 1,440 minutes/day = 43,200 gpd

This waterworks is being permitted for the existing restaurant until information about the well yield and the well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE May 16, 2003

WATERWORKS NAME: I-64 Rest Area - EBL CERTIFIED CLASS: N/A

CITY/COUNTY: Goochland County TYPE : Transient Non-community

LOCATION: Take I-64 west from Richmond to the Oilville (Route 617) exit. South on Route 617, and return to I-64, headed east. The rest area is located approximately 1.7 miles east of Route 617.

OWNER: Virginia Department of Transportation
1201 East Broad Street
Richmond, Virginia 23219-1939
Contact Mr. Dan Liston, Maintenance Engineer
(Telephone: 786-2847, Ext. 7594)

OPERATOR: Mr. Vincent B. Lofton, Sr., Long and Associates (Class I)
Contact Mr. W. Cody Long
Telephone: 559-9300 (Cell phone: 241-2132; Pager 351-8078)

PERMIT NUMBER:	4075390	amended	amended
DATE ISSUED:	4/30/84	9/2/97	5/23/03

TYPE OF TREATMENT: Chlorination

SOURCE: Groundwater - one drilled well

DESIGN CAPACITY: 18,334 gpd

DESCRIPTION OF SYSTEM

This waterworks includes one drilled well, one 10,000-gallon gravity storage tank, one 2,000-gallon hydropneumatic tank, two 7.5-HP booster pumps, and the distribution system, with appropriate appurtenances.

Well
The well is located on the west side of the rest area. It was constructed from an 11-inch hole drilled to a depth of 50 feet, with a 6-inch hole extended from 50 feet to 370 feet deep into bedrock. A 6-inch steel casing was installed from +2 feet to 50 feet in depth. The well was grouted with neat cement to a depth of 50 feet. This well yielded 62 gpm after 16 hours of continuous pumping during a test completed on November 23, 1968.

The well is equipped with a sanitary seal, a drawdown gauge, a check valve, a gate valve, a screened vent, a sample tap, a pressure gauge, a pressure sustaining valve, and a discharge meter. There is no blow-off line. The well is located in an 8 ft x 12 ft x 14 ft brick well house. Approximately four feet of the well house is above ground level. Drainage is provided by a sump pump. The well casing extends approximately 12 feet above the bottom of the pit, and approximately 1.5 feet above ground level. Appurtenances to the well house include lighting, heat, ventilation, a dehumidifier, and a locked entrance.

A 5-HP submersible well pump pumps water from the well to the 10,000-gallon horizontal gravity storage tank. Electrodes in the tank control operation of the well pump. It will normally be activated when the water level in the gravity storage tank falls to 7.67 feet above the bottom of the tank, and will shut off when the water level rises to 9.17 feet above the bottom of the tank. The well pump was delivering 38 gpm @ 26 psi during an instantaneous reading on July 19, 2001.

Chlorination

A sodium hypochlorite feed system is installed for disinfection. The feed system consists of a 30-gallon polyethylene solution tank and a 30-gpd diaphragm feed pump. The feed pump is controlled to activate and deactivate in conjunction with the well pump. The sodium hypochlorite solution is injected into the well discharge line, upstream of the horizontal gravity storage tank. Sample taps are located upstream and downstream of the injection point.

Storage Facilities

A 10,000-gallon horizontal gravity storage tank is provided. The tank is equipped with a framed access hatch with overlapping lid, a screened overflow with splash block, a drain line with splash block, and a sample tap. There is no separate vent. The tank has an effective storage volume of 8,500 gallons.

The 2,000-gallon hydropneumatic tank include pressure sensing switches, a sight glass, a pressure relief valve, a pressure gauge, a sample tap, a drain, and an access manhole.

Booster Pumps

The two booster pumps are each rated at 80 gpm @ 163 feet TDH, and are furnished with 7.5-HP motors. The two pumps have a combined capacity of 150 gpd @ 175 feet TDH. Each booster pump is equipped with a gate valve on the suction side, and a check valve and gate valve on the discharge side.

The two booster pumps operate in a lead lag mode. The sequence of pump operation automatically alternates after each pumping cycle. The lead pump is activated when the pressure in the hydropneumatic tank drops to 45 psi. The lag pump is activated when the tank pressure drops to 40 psi. If the water level has fallen below a probe at the center of the tank, the 1-HP air compressor is activated and the booster pumps are deactivated when the water level is raised to the level at the center of the tank. The air compressor operates until the tank pressure is raised to 66 psi. The air compressor is also deactivated if the water level falls to below 1/3 of the tank volume. If the water level never falls below the probe at the center of the tank, the booster pumps are deactivated when the tank pressure is raised to 63 psi. A low level electrode, installed 1.67 feet above the bottom of the gravity storage tank, will deactivate the booster pumps. An additional electrode, installed 5.67 feet above the tank bottom, will reactivate the booster pumps once water has been restored to this level.

PWSID No. 4075391

EVALUATION OF SYSTEM

Well Yield: 62 gpm for 16 continuous hours of pumping (1968)
(62 gpm)(1,440 min/day) = 89,280 gpd

Well Pump Capacity: 38 gpm - instantaneous reading on July 19, 2001
(38 gpm)(1,440 min/day) = 54,720 gpd

Booster Pump Capacity: Two 7.5-HP pumps; combined capacity of 150 gpm @ 175 feet TDH
(150 gpm)(1440 min/day) = 216,000 gpd

Storage Capacity: (One-half of average daily demand)
One 10,000-gallon gravity storage tank, Effective volume = 8,500 gallons
One 2,000-gallon hydropneumatic tank
Total Effective Storage Volume: 8,500 + (2,000/3) = 9,167 gallons
Total Effective Storage Capacity: 9,167 gallons / 0.5 days = 18,334 gpd

This waterworks is limited by the total effective storage capacity to a maximum usage of 18,334 gpd

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: May 16, 2003

WATERWORKS NAME: I-64 Rest Area - WBL CERTIFIED CLASS: N/A

CITY/COUNTY: Goochland County TYPE: Transient Non-community

LOCATION: Take I-64 west from Richmond. The rest area is located approximately 5.5 miles west of the Manakin (Route 623) exit and approximately 1.0 miles east of the Oilville (Route 617) exit.

OWNER: Virginia Department of Transportation
1201 East Broad Street
Richmond, Virginia 23219-1939
Contact Mr. Dan Liston, Maintenance Engineer
Telephone: 786-2847, ext. 7594

OPERATOR: Mr. Vincent B. Lofton, Sr., Long and Associates (Class I)
Contact Mr. W. Cody Long
Telephone: 559-9300 (Cell phone: 241-2132; Pager 351-8078)

PERMIT NUMBER:	4075391	amended	amended
DATE ISSUED	4/30/84	9/2/97	5/23/03

TYPE OF TREATMENT Chlorination

SOURCE Groundwater - one drilled well

DESIGN CAPACITY 18,334 gpd

DESCRIPTION OF SYSTEM:

This waterworks includes one drilled well, one 10,000-gallon gravity storage tank, one 2,000-gallon hydropneumatic tank, two 7.5-HP booster pumps, and the distribution system, with appropriate appurtenances.

Well
The well is located on the west side of the rest area. It was constructed from a 10-inch hole drilled to a depth of 70 feet, with a 6-inch hole extended from 70 feet to 369 feet in depth. A 6-inch steel casing was installed from +2 feet to 70 feet in depth. The well was grouted with neat cement to a depth of 70 feet. This well yielded 89 gpm after 16 hours of continuous pumping during a test completed on December 6, 1968.

The well is equipped with a sanitary seal, a check valve, a gate valve, a screened vent, a sample tap, a pressure gauge, a pressure sustaining valve, and a discharge meter. There is no blow-off line. The well is located in an 8 ft x 12 ft x 14 ft brick well house. Approximately four feet of the well house is above ground level. A drain line runs to grade outside the well house. The well casing extends approximately 12 feet above the bottom of the pit, and approximately 1.5 feet above ground level. Appurtenances to the well house include lighting, heat, ventilation, a dehumidifier, and a locked entrance.

A 5-HP submersible well pump pumps water from the well to the 10,000-gallon gravity storage tank. Electrodes in the tank control operation of the well pump. It will normally be activated when the water level in the gravity storage tank falls to 7.67 feet above the bottom of the tank, and will shut off when the water level rises to 9.17 feet above the bottom of the tank. The well pump was delivering 73 gpm @ 24 psi during an instantaneous reading on July 19, 2001.

There is also a cartridge filter on the well discharge line, for removal of sediments.

Chlorination

The sodium hypochlorite feed system consists of a diaphragm feed pump with a maximum capacity of 24 gpd and a 55-gallon plastic solution tank. The chlorination system operates whenever the well pump operates. The sodium hypochlorite solution is injected into the well discharge line, upstream of the gravity storage tank.

Storage Facilities

Appurtenances to the 10,000-gallon gravity storage tank include a framed access hatch with overlapping lid, a screened overflow with splash block, a drain line with splash block, and a sample tap. There is no separate vent. The tank has an effective storage volume of 8,500 gallons.

Appurtenances to the 2,000-gallon hydropneumatic tank include pressure sensing switches, a sight glass, a pressure relief valve, a pressure gauge, a sample tap, a drain, and an access manhole.

Booster Pumps

The two booster pumps are each rated at 80 gpm @ 163 feet TDH, and each is powered by a 7.5-HP motor. The two pumps have a combined capacity of 150 gpm @ 175 feet TDH. Each booster pump is equipped with a gate valve on the suction side, and a check valve and gate valve on the discharge side.

The two booster pumps operate in a lead-lag mode. The sequence of pump operation automatically alternates after each pumping cycle. The lead pump is activated when the pressure in the hydropneumatic tank drops to 45 psi. The lag pump is activated when the tank pressure drops to 40 psi. If the water level has fallen below a probe at the center of the tank, the 1-HP air compressor is activated when both (1) the water level is raised to the level at the center of the tank and (2) the tank pressure is raised to 52 psi. The booster pump(s) operate until the tank pressure is raised to 63 psi. The air compressor operates until the tank pressure is raised to 66 psi. The air compressor is also deactivated if the water level falls to below 1/3 of the tank volume. A low level electrode, installed 1.67 feet above the bottom of the gravity storage tank, will

deactivate the booster pumps. An additional electrode, installed 5.67 feet above the tank bottom, will reactivate the booster pumps once water has been restored to this level.

EVALUATION OF SYSTEM

Well Yield:	89 gpm for 16 continuous hours of pumping (1968) (89 gpm)(1,440 min/day) = 128,160 gpd
Well Pump Capacity:	73 gpm - instantaneous reading on July 19, 2001 (73 gpm)(1,440 min/day) = 105,120 gpd
Booster Pump Capacity:	Two 7.5-HP pumps;combined capacity of 150 gpm @ 175 feet TDH (150 gpm)(1440 min/day) = 216,000 gpd
Storage Capacity:	One 10,000-gallon gravity storage tank; Effective volume = 8,500 gallons One 2,000-gallon hydropneumatic tank Total Effective Storage Volume: 8,500 + (2,000/3) = 9,167 gallons Total Effective Storage Capacity: 9167 gallons / 0.5 days = 18,334 gpd

This waterworks is limited by the total effective storage capacity to a maximum usage of 18, 334 gpd.

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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: March 11, 2003

WATERWORKS:	Manakin Grill	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community

LOCATION: I-64 West to the Rockville Exit (#173). Turn left at the end of the exit ramp onto Route 623. Go about 0.8 miles, and turn right onto Plaza Drive. The restaurant is on the right side of the road, directly behind the Fas-Mart on Route 623.

OWNER: Witten Enterprises, Inc.
12912 Plaza Drive
Richmond, Virginia 23233
Contact Mr. Darren Witten
(804) 784-0544 FAX: (804) 784-0546

OPERATOR: Same as above

PERMIT NUMBER: 4075030

DATE ISSUED: March 20, 2003

TREATMENT: None

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing restaurant

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well and a 119-gallon bladder tank.

Well

The well is located in the grassy island between Plaza Drive and the restaurant parking lot. It is enclosed in a plastic valve box with a cover. The well was constructed from a 10-inch hole drilled to a depth of 50 feet, and a hole (probably 6-inch) extending from 50 feet to 380 feet in depth. Bedrock was encountered at a depth of 40 feet. Six-inch PVC well casing (SDR 27) was installed from +1 feet to a depth of 50 feet. The well was grouted with neat cement from ground level to 50 feet in depth. This well yielded 3 gpm with 263 feet of drawdown after 3 hours of continuous pumping, at the time of drilling in March 1989.

Appurtenances to the well at the well head include a pitless adapter unit and a well cap.

Water is pumped from the well by a submersible pump (unknown HP and rating) through approximately 100 feet of pipe (diameter unknown) to the bladder tank, and then into the distribution system. A pressure switch on the well discharge line near the bladder tank controls the operation of the well pump.

The well discharge piping, the pressure switch and the bladder tank are housed in a room within the restaurant's smoke room (for barbecue preparation). The room is equipped with lighting, heat, and a locked entrance.

Storage Facilities

Appurtenances to the 119-gallon bladder tank include a hose bib for sampling and for draining the tanks, a liquid pressure relief valve, and a pressure gauge. A shutoff valve is installed on the waterline between the bladder tanks.

EVALUATION OF THE SYSTEM

1. Present Population: 10 employees and 60 customers

2. Estimated Usage:
   25 gpd/employee x 10 employees = 250 gpd
   5 gpd/customer x 60 customers = 300 gpd
   TOTAL: 550 gpd

3. Well Yield:
   3 gpm – 3 hours of continuous pumping (1989)
   3 gpm x 1,440 minutes/day = 4,320 gpd

4. Well Pump Capacity: Unknown

5. Storage Capacity:
   (one-half of average daily demand)
   One 119-gallon bladder tank

   Effective Storage Volume: 1/3(119 gallons) = 40 gallons
   Effective Storage Capacity: $\frac{40 \text{ gallons}}{0.5 \text{ days}}$ = 80 gpd

   80 gpd @ 25 gpd/employee = 3 employees

This waterworks would be limited by the total effective storage capacity to a maximum population of 3 employees. However, it is being permitted for the existing restaurant until information is provided on the well pump capacity, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: March 11, 2003

WATERWORKS:	Oilville Exxon & Convenience Center	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community
LOCATION:	I-64 West to the Oilville exit (Route 617). Go north (right) on Route 617 approximately 0.1 miles. The gas station/convenience store is on the left hand side.	
OWNER:	Mr. William Carter Oilville Exxon & Convenience Center 2400 Oilville Road Oilville, Virginia 23129 (804) 749-4175 Fax: (804) 749-8130	
OPERATOR:	Same as above	
PERMIT NUMBER:	4075610	
DATE ISSUED:	March 20, 2003	
TREATMENT:	Cartridge Filters	
SOURCE:	Groundwater – one drilled well	
DESIGN CAPACITY:	Existing gas station/convenience store	

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well and two 20-gallon bladder tanks.

Well

The well is located in the grassy area on the south (left) side of the gas station/convenience store. No information is known about the construction of the well except that it includes 6-inch PVC well casing. A 24-inch (ID) concrete well curbing with a concrete cover protects the well casing. The concrete cover is about 20 inches above grade. The top of the well casing is about 10 inches above grade. The well casing is equipped with a sanitary seal and a slotted plastic well casing vent. A check valve is installed on the portion of the well discharge line located in the vicinity of the bladder tanks.

Water from the well is pumped by a submersible pump of unknown capacity and horsepower via approximately 100 feet of piping (unknown diameter and material) to the two bladder tanks and the distribution system. A pressure switch installed on the well discharge line just upstream of the connection to the bladder tanks controls the operation of the well pump.

Storage Facilities

The two 20-gallon bladder tanks are housed in the attic above the walk-in freezer in the gas station/convenience store. Appurtenances for the bladder tanks include a pressure gauge and a hose bibb for sample collection and for draining the tanks. The attic has lighting and heat.

Cartridge Filters

Five cartridge filters installed in series are provided to remove sediment from the water supplied to the post-mix drink machine and to the coffee station sink. The filters include a sediment filter (5-inch diameter, 14-inch length) and four 1-micron carbon filters (3-inch diameter, 12-inch length). The cartridges in all five filters are replaced every three months.

EVALUATION OF THE SYSTEM

1. Current Population: 15 employees and about 350 customers/day

2. Estimated Water Usage:
   15 employees @ 25 gpd/employee = 375 gpd
   350 customers @ 1 gpd/customer = 350 gpd
   TOTAL: 725 gpd

3. Well Yield: Unknown

4. Well Pump Capacity: Unknown

5. Storage Capacity: (one-half of average daily demand)
   Two 20-gallon bladder tanks

Effective Storage Volume; 1/3(2 x 20 gallons) = 13 gallons

Effective Storage Capacity: $\frac{13 \text{ gallons}}{0.5 \text{ days}} = 26$ gpd

26 gpd @ 25 gpd/employee = 1 employee

Based on the above evaluation, this waterworks would be limited by the total effective storage capacity to a maximum population of 1 employee. However, it is being permitted for the existing gas station/convenience store until information about the well yield and pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: December 9, 2003

WATERWORKS:	Oilville Office Park	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community

LOCATION: I-64 West to the Oilville exit (Route 617). Go south (left) on Route 617 approximately 0.5 miles to U. S. Route 250. Go east (left) on U. S. Route 250, approximately 0.3 miles. The office park is on the north (left) side of U. S. Route 250.

OWNER: DES, L.L.C.
1390-B Broad Street Road
Oilville, Virginia 23129
Contact Mr. Doug Thompson
(804) 784-2679

OPERATOR:	Mr. Doug Thompson	
PERMIT NUMBER:	403403	4075615
EFFECTIVE DATE:	Oct 30, 2003	Dec 19, 2003
TYPE OF TREATMENT:	Iron and Manganese Treatment, Cation Exchange Softener	
SOURCE:	Groundwater – one drilled well	
DESIGN CAPACITY:	Existing building with 4 businesses and a restaurant	

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, a 96-gallon bladder tank, iron and manganese treatment, cation exchange softener, and approximately 450 feet of 1¼-inch waterline, all with appropriate appurtenances.

Well
The well is located at the back of the property, in the northeast corner. It was constructed from a 10-inch hole drilled to a depth of 100 feet, and a hole (probably 6-inch) extending from 100 feet to 300 feet in depth. Bedrock was encountered at a depth of 30 feet. Six-inch steel casing was installed from +1 feet to a depth of 100 feet. The well was grouted with neat cement from ground level to 100 feet in depth. This well yielded 15 gpm with 17 feet of drawdown after 24 hours of continuous pumping in a test conducted on May 24, 2003. The static water level at the time of the pump test was 27 feet.

Appurtenances at the well head include a pitless adapter unit, a sanitary well cap with a screened vent, and a check valve installed below the ground surface at the pitless adapter connection. The well head is centered on a 6-ft x 6-ft x 6-inch concrete pad.

Water is pumped from the well by a ¾-HP submersible pump rated at 14 gpm @ 185 feet TDH through approximately 450 feet of 1¼-inch HDPE pipe to thepressure tank and treatment facilities, and then into the distribution system. A pressure switch on the well discharge line at the base of the bladder tank controls the operation of the well pump. The well pump is set to operate at a pressure range of 35-55 psi at the pressure switch. An instantaneous well pump output of 13 gpm was observed during an inspection on November 3, 2003.

The pressure tank and treatment facilities are housed in a room at the back of the DES office. The office is equipped with lighting, heat, and a locked entrance. Appurtenances to the well in this room include a pump "auto-off" switch, a discharge meter, a gate valve, and a sample tap. A hose bib located upstream of the static mixer can serve as a blow-off, if needed.

Storage Facilities

The pressure storage tank is a 96-gallon bladder tank (23.5 inches in diameter and 63.5 inches in total height). It is provided with a pressure gauge, a drain, a liquid pressure relief valve, and a snifter valve for manual air addition.

Treatment Facilities

A. Iron and Manganese Treatment

The iron and manganese treatment facilities include chlorine injection for oxidation, two parallel reaction tanks, and two parallel greensand filters.

1. Chlorination – The sodium hypochlorite feed system includes a 44-gpd diaphragm feed pump and a 35-gallon polyethylene solution tank. The design feed rate is 3 ppm. The chlorine solution is injected just ahead of the in-line static mixer (max. flow: 25 gpm) which is upstream of the 96-gallon bladder tank.

2. Reaction Tanks – The two parallel fiberglass reaction tanks each have a volume of 26 gallons (12 inches in diameter, 53 inches in height). The 96-gallon bladder tank also provides reaction volume, making the total reaction volume 148 gallons. The reaction time is 11.4 minutes at the observed well pump capacity of 13 gpm.

3. Greensand Filters – The two parallel fiberglass greensand filters (16 inches in diameter, 65 inches in height) each include approximately 1 ft^3 (8.5 inches) of manganese greensand, underlain by 4 ft^3 of filter Ag (silicon dioxide) and 70 lbs of gravel. At the observed well pump capacity of 13 gpm, the filtration rate is 4.7 gpm/ft^2. Backwash operations are automatic, using untreated water. A flow control valve on each filter limits the backwash rate to 12 gpm (8.6 gpm/ft^2). The filter backwash wastes are conveyed by a 1-inch HDPE line to an 8-ft x 8-ft drainfield located just outside of the storage/treatment room. A 6-gpd diaphragm pump and a 15-gallon solution tank are provided for regeneration of the filters with potassium permanganate solution, when needed.

B. Softener

The softener (16 inches in diameter, 65 inches in height) includes 4 ft^3 of cationic resin underlain by 70 lbs of gravel. The loading rate is 9.3 gpm/ft^2 at the well pump output of 13 gpm. A flow control valve limits the backwash rate to 7 gpm or 5 gpm/ft^2. Untreated water is used for the backwash. The softener backwash wastes are conveyed to the same drainfield as the filter backwash wastes. The brine tank (24 inches in diameter, 50 inches in height) has a volume of approximately 95 gallons. Regeneration frequency is controlled by metered flow through the system.

Drainfield

The drainfield for the well blow-off, the filter backwash wastes, and the softener backwash wastes has an area of 8-ft x 8-ft and a depth of 1.5 feet. The drainfield is filled with #57 gravel. The void area is approximately 38.4 ft^3 or 287 gallons.

EVALUATION OF THE SYSTEM

1. Design Basis: Based on §12 VAC 5-590-670 of the *Waterworks Regulations*
   20 gpd/employee
   50 gpd/seat (restaurant)

2. Estimated Usage:

Offices: 20 employees @ 20 gpd/employee =	400 gpd
Restaurant: 50 seats @ 50 gpd/seat =	2,500 gpd
TOTAL:	2,900 gpd

3. Well Yield: 15 gpm – 24 hours of continuous pumping (5/24/03)
   (15 gpm)(1,440 minutes/day) = 21,600 gpd

4. Well Pump Capacity: 13 gpm (observed output on 11/3/03)
   (13 gpm)(1,440 minutes/day) = 18,720 gpd

5. Storage Capacity: (one-half of average daily demand)
   One 96-gallon bladder tank
   Effective Storage Volume: 1/3(96 gallons) = 32 gallons
   Effective Storage Capacity: 32 gallons / 0.5 day = 64 gpd

6. Capacity of Iron and Manganese Treatment System:

   A. Sodium Hypochlorite Feed System:
   A 44-gpd diaphragm solution feed pump and a 35-gallon solution tank. The feed system utilizes chlorine solution with a 5.25% chlorine concentration (52,500 ppm).

$$N_1V_1 = N_2V_2$$

V_1 = required output of chemical feed pump
N_1 = 5.25% = 52,500 ppm
V_2 = 13 gpm – well pump output
N_2 = 3 ppm = design dosage (oxidation only)

V_1 = (13 gpm)(3ppm)/ (52500 ppm) = 0.0007 gpm or 1.07 gpd

The 44-gpd solution feed pump is therefore adequate for the sodium hypochlorite feed system.

   B. Reaction Tanks:
   Two reaction tanks in parallel; 12-inch diameter, 53-inch height
   Volume of each tank: 26 gallons
   Total reaction volume (including the 96-gallon bladder tank): 148 gallons
   Total reaction time at well pump capacity (13 gpm): 11.4 minutes

C. Capacity of Filters:
Filter Units: Two filters in parallel; 16 inches in diameter, 65 inches in height
Area = 1.4 ft^2/filter
Flow rate: 13 gpm (well pump capacity) or 6.5 gpm/filter
Filtration rate: 6.5 gpm / 1.4 ft^2 = 4.6 gpm/ft^2 (<7 gpm/ft^2, per mfr)

7. Capacity of Cation Exchange Softener:

Raw Water characteristics:	Fe = 0.55 mg/L, Mn = 0.10 mg/L, Total Hardness = 70 mg/L
Resin Capacity provided:	10,000 gr removed / 5 lb salt added (min)
Resin Volume provided:	4 cf
Softener unit:	16 inches in diameter; area = 1.4 ft^2
Flow rate:	13 gpm (well pump capacity) = 18,720 gpd
Hydraulic Loading Rate:	13 gpm / 1.4 ft^2 = 9.3 gpm/ft^2 (< 14 gpm/ft^2, per mfr)
Resin Capacity:	(70 mg/L)(18,720 gpd) / (4 cf)(17.1 mg/L/gr/gal) 19,158 gr removed / cf resin (<20,000 gr/cf per Regulations)

The softener is therefore adequate for the water system.

8. Existing services:
Restaurant
Pizza (carry out)
Gift Shop
Construction Office
Cabinet Shop

This waterworks is limited by the total effective storage capacity. However, since it is a non-community waterworks with a direct delivery system, it is being permitted for the existing building with four businesses and a restaurant.

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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: April 30, 2003

WATERWORKS: Red Oak Café — CERTIFIED CLASS: VI

CITY/COUNTY: Goochland County — TYPE: Transient Non-Community

LOCATION: Take I-64 West from Richmond to Exit 173 (Manakin/Rockville exit). Turn left (south) onto Route 623. Go approximately 1.1 miles and turn right (west) onto U. S. Route 250. Go approximately 0.10 miles, and turn left (south) onto Route 623. The restaurant is on the southeast corner of the intersection of U. S. Route 250 and Route 623.

OWNER: Goochland Realty, Inc.
1601 Hockett Road
Manakin-Sabot, Virginia 23103-2330
Contact Ms. Vernell Burton
(804) 784-5288

OPERATOR: Cayuga, Ltd.
1601 Hockett Road
Manakin-Sabot, Virginia 23103-2330
Contact Mr. Paul Cruser
(804) 784-2330 FAX: (804) 784-1972

PERMIT NUMBER: 4075060

DATE ISSUED: May 8, 2003

TREATMENT: Iron and Manganese Treatment

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing building with two businesses (restaurant and realty office)

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, iron and manganese treatment facilities, and two 44-gallon bladder tanks.

Well

The well is located in the grassy area on the right (south) side of the restaurant. It is about 4 feet from the paved parking area, and about 30 feet from Route 623. No information is available on the well construction except that it includes steel casing that extends to a height approximately 3.5 inches below the ground surface. The well head is protected by a 30-inch concrete well curbing with a concrete cover. The top of the well curbing is approximately 6 inches above the ground surface. There is a concrete floor poured inside of the concrete curbing, approximately 20 inches below grade. A floor drain is provided. Appurtenances to the well at the well head include a sanitary seal, and a plugged tee that could be modified to provide a sample tap or a blow-off.

Water is pumped from the well by submersible pump (unknown rating and horsepower) through approximately 50 feet of pipe (diameter unknown) to the bladder tanks, then through the treatment facilities, and into the distribution system. A pressure switch on the well discharge line just upstream of the bladder tanks controls the operation of the well pump, but the settings are unknown.

The treatment facilities and the bladder tanks are housed in the mechanical room of the café. The mechanical room is equipped with lighting, heat, and a locked entrance.

Storage Facilities

Appurtenances to the two 44-gallon bladder tanks include a hose bib for draining the tanks, and a pressure gauge.

Treatment Facilities

The iron and manganese treatment facilities include:

- Air injection (inside of the well curbing),
- A fiberglass-reinforced plastic detention/air release tank (12-inch diameter; 36-inch height); and
- Two Kinetico ® filters in fiberglass-reinforced plastic housing (9-inch diameter, 54-inch height) installed in parallel, with Birm media.

The Birm media consists of a silica dioxide core with manganese dioxide bonded to the surface, and some calcium dioxide. It has an effective size of 0.48 mm and a uniformity coefficient of 2.7. Filter backwashing with untreated well water is automatic. The filter backwash water discharges to a concrete pad outside of the mechanical room where the treatment units are housed.

EVALUATION OF THE SYSTEM

1. Present Population: 10 employees and 93 customers
   *includes 1 employee for the realty office

2. Estimated Usage: 25 gpd/employee x 10 employees = 250 gpd
   5 gpd/customer x 93 customers = 465 gpd
   TOTAL: 715 gpd

3. Well Yield: Unknown

4. Well Pump Capacity: Unknown

5. Storage Capacity: (one-half of average daily demand)
   Two 44-gallon bladder tanks

   Effective Storage Volume: 1/3(44 + 44 gallons) = 29 gallons
   Effective Storage Capacity: $\frac{29 \text{ gallons}}{0.5 \text{ days}}$ = 58 gpd

6. Filtration Capacity: ($3\ gpm/ft^2$)
   Two 9-inch diameter filters installed in parallel
   Filtration Area: $2(3.14159)(0.375)^2 = 0.88\ ft^2$
   $0.88\ ft^2\ (3\ gpm/ft^2) = 2.65\ gpm$
   $2.65\ gpm \times 1{,}440\ minutes/day = 3{,}816\ gpd$

This waterworks is being permitted for the existing building with two businesses until information about the well yield and the well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: January 31, 2003

WATERWORKS: Royal Virginia Golf Club

CERTIFIED CLASS: N/A

CITY/COUNTY: Goochland County

TYPE: Transient Non-Community

LOCATION: I-64 West to the Hadensville exit (Route 629 - Exit #152). Go south (left) on Route 629 approximately 0.7 miles to U. S. Route 250. Go west (right) on U. S. Route 250 approximately 0.2 miles to Three Chopt Road (Route 606). Go south (left) on Three Chopt Road approximately 0.2 miles to Royal Virginia Parkway (Route 679). Turn right onto Royal Virginia Parkway, and go approximately 0.4 miles. The clubhouse will be on the right side of the road.

OWNER: Royal Virginia Golf Club L.L.C.
3016 Royal Virginia Parkway
Louisa, Virginia 23093

Ronnie Adams
457-2041

OPERATOR: Royal Virginia Golf Club
Attention: Mr. Chip Edwards, Manager
300 Lee Avenue
Highland Springs, Virginia 23075
(804) 737-0573 FAX: (804) 737-8202

PERMIT NUMBER: 4075701

DATE ISSUED: February 10, 2003

TREATMENT: None

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing clubhouse

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well and a 32-gallon bladder tank.

Well

The well is located in the grassy area on the right side of the clubhouse parking lot. It is constructed from a 9 7/8-inch hole drilled to a depth of 72 feet, with a 6-inch hole extended from 72 feet to 404 feet in depth. Bedrock was encountered at a depth of 71 feet. Six-inch steel casing was installed from +1 to 72 feet in depth, and the well was grouted with neat cement from ground level to 72 feet in depth. The well yielded 10 gpm after being pumped continuously for 8 hours, with 34 feet of drawdown, in a test conducted on September 27, 2000.

The well casing is protected by a 30-inch concrete well curbing with a concrete cover that is set directly on the ground surface around the well head. Fiberglass insulation is packed inside of the concrete curbing. Appurtenances to the well at the well head include a sanitary seal, a screened vent, a plugged tee that can be used as a blow-off, and a check valve.

Water from the well is pumped by a submersible pump of unknown capacity and horsepower to the bladder tank, and then to the distribution system. A pressure switch near the bladder tank on the well discharge line controls the operation of the well pump.

The bladder tank is housed in a basement area of the clubhouse, which is accessed through a trap door in the floor of the employees' restroom.

Storage

The 32-gallon bladder tank is equipped with a hose bib for sampling and for draining the tank, and a pressure gauge.

EVALUATION OF THE SYSTEM

Design Criteria: The system is evaluated on the basis of an equivalent residential connection (ERC). One ERC will utilize 400 gallons/day (gpd).

1. Present Population: 3 employees and about 100 customers

2. Estimated Usage:
   25 gpd/employee x 3 employees = 75 gpd
   5 gpd/customer x 100 customers = 500 gpd
   Total: 575 gpd

3. Well Yield:
   (0.5 gpm/ERC)
   10 gpm – continuous pumping for 8 hours (2000)
   10 gpm @ 0.5 gpm/ERC = 20 ERCs or 8,000 gpd

4. Well Pump Capacity: Unknown

5. Storage Capacity:
   (200 gallons/ERC)
   One 32-gallon bladder tank

Effective Storage Volume: 1/3(32 gallons) = 11 gallons
Effective Storage Capacity: 11 gallons @ 200 gallons/ERC
= 0.05 ERCs or 20 gpd
20 gpd @ 25 gpd/employee = 1 employee

Based on the above evaluation, this waterworks would be limited by the total effective storage capacity to a maximum population of 1 employee. However, it is being permitted for the existing clubhouse until information about the well pump capacity is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: December 29, 2004

WATERWORKS NAME:	St. Catherine's School Athletic Complex	CERTIFIED CLASS: N/A
COUNTY/CITY:	Goochland County	TYPE: Transient Non-Community
LOCATION:	West on River Road, approximately 0.5 miles beyond where it crosses over Route 288. The entrance to the athletic complex is on the right (north) side of River Road.	
OWNER:	St. Catherine's School 6001 Grove Avenue Richmond, Virginia 23226 Edward A. Hartman, of Finance and Operations (1/28/05) Contact Mr. ~~Shane W. Tippett~~, Assistant Head ~~for Financial Affairs~~ Phone: 804-288-2804	
OPERATOR:	Sydnor Hydro, Inc. P. O. Box 27186 Richmond, Virginia 23261 Contact Mr. W. S. Shaw, P.E., Senior Project Manager Phone: 804-643-2725 Ext. 226 Mr. Louis Edward Hanford (Class III)	
PERMIT NUMBER:	401203	4075703
EFFECTIVE DATE:	10/03/03	01/07/05
TYPE OF TREATMENT:	Iron and Manganese Treatment	
SOURCE:	Groundwater – one drilled well	
DESIGN CAPACITY:	Concession and Maintenance Building	

DESCRIPTION OF SYSTEM

This waterworks includes a drilled well, iron and manganese treatment, a 1,500-gallon gravity storage tank, two 1-HP booster pumps, a 119-gallon bladder tank, and approximately 180 feet of 1.5-inch PVC waterline, with appropriate appurtenances.

Well

The well is located in the vicinity of the Concession and Maintenance Building, which is approximately 1,800 feet (0.33 miles) from the entrance to the athletic complex. The well was constructed from a 10-inch hole drilled to a depth of 60 feet, with a 6-inch hole extended from 60 feet to 1,000 feet in depth. The well was cased with 6-inch steel casing from +2 feet to 60 feet in depth, and was grouted with benseal from ground level to 60 feet in depth. Bedrock was

encountered at a depth of 60 feet. The well yielded 1.3 gpm with 600 feet of drawdown after 24 hours of continuous pumping in a test conducted on August 26, 2003.

Appurtenances to the well at the well head include a pitless adapter unit, a sanitary well cap with a screened vent, an air line for determining the depth of water in the well, and a 6-ft x 6-ft x 6-inch concrete pad. A 3/4-HP submersible well pump, rated at 2.3 gpm @ 493 feet TDH, conveys the water through approximately 180 feet of 1.5-inch PVC waterline to the treatment and storage facilities. The operation of the well pump is controlled by electrodes in the gravity storage tank. The gate valve on the well discharge line is throttled to limit the output of the well pump to 2.7 gpm.

The well pump is set at a depth of 462 feet. A low water level electrode installed in the well will automatically shut off the well pump if the water level falls to that depth. Another electrode will allow the well pump to be reactivated if the water level in the well rises to a depth of 300 feet.

Concession and Maintenance Building

The iron and manganese treatment facilities, the storage tanks, and the booster pumps are housed in the 30-ft x 38-ft x 10-ft Athletic Storage Room in the Concession and Maintenance Building. A chain link fence separates the waterworks facilities from the main portion of the room. Within this room, the well discharge line is equipped with a pressure relief valve, a check valve, a discharge meter, a screened blow-off downstream of the meter, a pressure gauge, and a gate valve. An H-O-A switch for the well pump is also provided. The room includes lighting, heat, and a lockable entrance.

Treatment Facilities

A cartridge filter (4.5-inch diameter, 9¾-inch height) with activated carbon media is installed upstream of the iron and manganese treatment facilities.

The softener (7-inch diameter, 44-inch height) includes 0.5 ft^3 of high capacity resin, and has a manufacturer's rated hydraulic capacity of 7 gpm/ft^2. The actual hydraulic loading rate is 9.3 gpm/ft^2 at the well pump output of 2.5 gpm. The brine tank for regenerating the resin with sodium chloride is 18 inches in diameter and 33 inches in height. Water for backwashing and regenerating the resin is supplied by the 1,500-gallon gravity storage tank. The design flow rates are 1.9 gpm (7.1 gpm/ft^2) for the backwash, 0.4 gpm (1.5 gpm/ft^2) for the brine rinse, and 1.3 gpm (4.8 gpm/ft^2) for the rapid rinse. The backwash and regeneration water is discharged to an on-site septic tank-drainfield system.

The hypochlorination unit oxidizes the remaining iron and manganese ions. It includes a 50-gallon polyethylene solution tank and an 11-gpd diaphragm feeder. The injection point for the chlorine solution is downstream of the softener. Settling of the precipitated ions occurs in the 1,500-gallon gravity storage tank.

Storage Facilities

The 1,500-gallon (5.33-ft diameter, 10.08-ft height) polyethylene gravity storage tank has an effective storage volume of approximately 1,377 gallons. The "well pump on" and "well pump shut off" electrodes are set at 8.0 feet and 9.0 feet, respectively, above the tank bottom. The "booster pump shut off" and "booster pump restore" electrodes are set at 0.75 feet and

1.67 feet, respectively, above the tank bottom. Appurtenances to the gravity storage tank include a screened vent, a 16-inch diameter manway with a lever lock cover, a screened drain, and a screened overflow.

The 119-gallon bladder tank has a diameter of 23.5 inches and a standing height of 76.5 inches. The height of the pressure vessel is approximately 69 inches. Appurtenances to the bladder tank include a pressure gauge, a sample tap, a snifter valve for manual air addition, and a drain.

Booster Pumps

Two 1-HP booster pumps, installed in parallel, transfer water from the 1,500-gallon gravity storage tank to the 119-gallon bladder tank, and then into the distribution system. Each pump is rated at 25.5 gpm @ 140 feet TDH. When operating together, they have a rated capacity of 52 gpm @ 138 feet TDH. The booster pumps are controlled by pressure switches installed near the bladder tank. The lead pump operates at pressures of 50-70 psi, and the lag pump operates at pressures of 45-65 psi. Appurtenances to the booster pumps include gate valves on the suction and discharge lines for each pump, a check valve on the discharge line for each pump, an H-O-A switch for each pump, and automatic alternation after each pumping cycle.

Sample Taps

Sample taps are installed on the well discharge line near the pressure relief valve (untreated water), on the influent line to the gravity storage tank (treated water), and at the bladder tank.

Backflow Preventer

A reduced pressure zone (RPZ) backflow prevention device is installed on the waterline between the bladder tank and the plumbing fixtures in the Concession and Maintenance Building. The drainage pipe is connected to the drain line for the gravity storage tank.

EVALUATION OF THE SYSTEM

1. Design Water Usage: 455 gpd (average) on weekdays
   1,700 gpd (peak) on tournament days
   13 gpm – peak hour usage (based on actual water usage)
   (13 gpm)(60 minutes/hr) = 780 gallons

2. Well Yield: 1.3 gpm for 24 hours of continuous pumping
   (1.3 gpm)(1,440 minutes/day) = 1,872 gpd

3. Well Pump Capacity: 2.7 gpm @ 450 feet TDH (well pump is throttled)
   (2.7 gpm)(1,440 minutes/day) = 3,888 gpd

4. Booster Pump Capacity: Two 1-HP booster pumps installed in parallel
   Each pump is rated at 25.5 gpm @ 140 feet TDH
   They are rated at 52 gpm @ 138 feet TDH operating together
   (52 gpm)(1,440 minutes/day) = 74,880 gpd

5. Storage Capacity: One 1,500-gallon gravity storage tank
(Effective storage volume: 1,377 gallons)
One 119-gallon bladder tank

Effective Storage Volume: 1,377 + 1/3(119) = 1,417 gallons
Effective Storage Capacity: 1,417 gallons / 0.5 days = 2,834 gpd

6. Capacity of Iron and Manganese Treatment System:

A. Cation Exchange Softener

Raw Water characteristics: Fe = 0.77 mg/L, Mn = 0.054 mg/L,
Total Hardness = 32 mg/L
Resin Capacity provided: 10,000 gr removed / 3 lb salt added (min)
Resin Volume provided: 0.5 cf
Softener unit: 7 in diameter, 4 in height; area = 0.27 ft^2
Flow rate: 2.5 gpm (observed capacity of the well pump) = 3,600 gpd
Hydraulic Loading Rate = 2.5 gpm / 0.27 ft^2 = 9.3 gpm/ft^2
The softener exceeds the hydraulic loading rate recommended by the manufacturer.
Resin Capacity = (32 mg/L)(3,600 gpd) / (0.5 cf)(17.1 mg/L/gr/gal)
= 13,474 gr removed / cf resin (< 20,000 gr/cf per Regulations)

B. Sodium Hypochlorite Feed System:

One 11-gpd diaphragm solution feed pump and a 50-gallon solution tank. The feed system utilizes chlorine solution with a 12.5% chlorine concentration (125,000 ppm).

$N_1V_1 = N_2V_2$

V_1 = required output of chemical feed pump
N_1 = 12.5% = 125,000 ppm
V_2 = 2.5 gpm – maximum output of the well pump
N_2 = 7.5 ppm = max. dosage

V_1 = (7.5)(2.5) / 125,000 = 0.00015 gpm or 0.22 gpd

The 11-gpd solution feed pump is therefore adequate for the sodium hypochlorite feed system

7. Delivery Capacity: Well pump capacity + storage capacity
2.7 gpm (60 minutes/hour) + 1.417 gallons = 1,579 gph
The delivery capacity exceeds the peak hour demand of 780 gph.

This waterworks is adequate to serve the Concession and Maintenance Building.
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VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: February 19, 2003

WATERWORKS:	Satterwhite's Restaurant	CERTIFIED CLASS: N/A
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community

LOCATION: Take I-64 West from Richmond to Exit 173 (Manakin/Rockville exit). Turn left (south) onto Route 623. Go approximately 1.1 miles and turn right (west) onto U. S. Route 250. The restaurant is approximately 0.75 miles down U. S. Route 250, on the right hand side (northwest corner of the intersection of U. S. Route 250 and Route 621).

OWNER: Ms. Joan N. Satterwhite
2106 Rockville Road
Rockville, Virginia 23146
(804) 749-3315

OPERATOR: Bear Enterprises, Inc.
c/o Satterwhite's Restaurant
116 Broad Street Road
Manakin-Sabot, Virginia 23103
Contact Mr. Fred Snyder, President
(804) ~~784-5301~~ 784-1994 or 339-1324

PERMIT NUMBER: 4075714

DATE ISSUED: March 3, 2003

TREATMENT: None

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing restaurant

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well and 5-gallon bladder storage tank.

Well

The well is located in a grassy area about 6 feet north of the gravel parking lot on the west side of the restaurant, and about 120 feet west of the restaurant. No information is available on the construction of the well, except that it includes 4-inch steel casing. The well casing is protected by a 30-inch diameter concrete well curbing with a concrete cover. The top of the well curbing is about 20 inches above grade, and the top of the well casing is about 18 inches above grade. A small electrical heater is installed in the curbing. Appurtenances to the well include a sanitary seal and screened casing vent.

Water from the well is pumped by a submersible pump (unknown HP and rating) to the bladder storage tank and/or to the distribution system. A pressure switch on the well discharge piping just downstream of the connection to the bladder tank controls the operation of the well pump. The operating range is 28-48 psi. The well discharge piping includes a plugged blow-off and a gate valve prior to the connection to the distribution system. A 5-micron filter (3.5-inch diameter, 31-inch height) for particulate removal is installed in the well discharge piping in the utility room where the water supply piping enters the restaurant.

Storage Facility

The 5-gallon bladder tank is installed inside of the concrete well curbing. It is equipped with a pressure gauge.

EVALUATION OF THE SYSTEM

1. Present Population: 7 employees and about 200 customers

2. Estimated Usage:

25 gpd/employee x 7 employees	=	175 gpd
5 gpd/customer x 200 customers	=	1,000 gpd
TOTAL:		1,175 gpd

3. Well Yield: Unknown

4. Well Pump Capacity: Unknown

5. Storage Capacity: (one-half of average daily demand)
   One 5-gallon bladder tank

Effective Storage Volume: 1/3(5 gallons) = 1.7 gallons

Effective Storage Capacity: $\frac{1.7 \text{ gallons}}{0.5 \text{ days}}$ = 3.4 gpd

3.4 gpd @ 25 gpd/employee = 1 employee

Based on the above evaluation, this waterworks would be limited by the total effective storage capacity to a maximum population of 1 employee. However, it is being permitted for the existing restaurant until information about the well yield and well pump capacity are provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: February 13, 2003

WATERWORKS:	Seibert's Oilville BP	CERTIFIED CLASS: VI
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community

LOCATION: I-64 West to the Oilville exit (Route 617). Go south (left) on Route 617 approximately 0.5 miles to U. S. Route 250. The gas station/convenience store/fast food restaurant is on the left hand side, at the intersection of Route 617 and U. S. Route 250.

OWNER: Manchester Marketing
9327 Midlothian Turnpike, #2B
Richmond ~~Midlothian~~, Virginia 23235
Contact Mr. John Seibert, President
276-3728 (804) 276-3728

Richard Buchanan

AGENT: Aero Associates
3950 Monza Drive
Richmond, Virginia 23234-4222
Contact Mr. Jay Lowden
(804) 405-5200

OPERATOR: Sydnor Hydro, Inc.
Contact Mr. Clifton L. Parker, IV, P.E. – Class ~~II~~ III
(804) 643-2725, Ext. 226

PERMIT NUMBER: 4075600

DATE ISSUED: February 26, 2003

TREATMENT: Iron and Manganese Treatment

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing Service Station/Convenience Store/Fast Food Restaurant

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, iron and manganese treatment, and two bladder tanks.

Well

The well is located in the grassy area between the gas pumps and Route 617. It was constructed from a 10-inch hole drilled to a depth of 68 feet, and a hole (probably 6-inch) extending from 68 feet to 400 feet in depth. Bedrock was encountered at a depth of 58 feet. Six-inch steel casing was installed from +1 feet to a depth of 68 feet. The well was grouted with neat cement from ground level to 50 feet in

depth, and it is believed that the annular space around the casing was sealed with bentonite from 50 feet to 68 feet in depth. This well yielded 15 gpm after one hour of continuous pumping in May 1995.

The well is enclosed in a 30-inch concrete well curbing with a concrete cover. Appurtenances to the well at the well head include a sanitary seal, a screened casing vent, and a plugged tee that may be adapted for use as a blow-off. Fiberglass insulation has been placed in the well curbing for freeze protection.

Water is pumped from the well by a submersible pump (unknown HP and rating) through approximately 100 feet of pipe (diameter unknown) to the two bladder tanks, then through the treatment facilities, and into the distribution system. A pressure switch on the well discharge line near the bladder tanks controls the operation of the well pump. The well pump is set to operate at a pressure range of 40-60 psi at the pressure switch. The well pump had an output of 5.5 gpm during an instantaneous reading on January 16, 2003.

The treatment facilities and bladder tanks are housed in the office of the gas station/convenience store/fast food restaurant. The office is equipped with lighting, heat, and a locked entrance. Appurtenances to the well in this room include a discharge meter, a sample tap, a check valve, and a pressure gauge.

Storage Facilities

Appurtenances to the 34-gallon and 36-gallon bladder tanks include a hose bib for sampling and for draining the tanks, a liquid pressure relief valve, and a pressure gauge. A shutoff valve is installed on the waterline between the bladder tanks.

Treatment Facilities

The iron and manganese treatment facilities include air injection (upstream of the bladder tanks), two parallel detention/air release tanks (each 6 inches in diameter and 38 inches in height) and two parallel filters with calcite media. Each filter is 13 inches in diameter and 54 inches in height. Untreated well water is used to backwash the filters. The filter backwash water discharges to the floor drainage holding tank.

EVALUATION OF THE SYSTEM

1. Present Population: 18 employees, 1,450 customers at the convenience store, and 225 customers at the fast food restaurant

2. Estimated Usage:

25 gpd/employee x 18 employees =	450 gpd
5 gpd/fast food customer x 225 customers =	1,125 gpd
1 gpd/store customer x 1,450 customers =	1,450 gpd
Total:	3,025 gpd

3. Well Yield: 15 gpm – one hour of continuous pumping (1995)
   15 gpm x 1,440 minutes/day = 21,600 gpd

4. Well Pump Capacity: 5.5 gpm – instantaneous reading on 1/16/03
   5.5 gpm x 1,440 minutes/day = 7,920 gpd

5. Storage Capacity: (one-half of average daily demand)
One 36-gallon and one 34-gallon bladder tank

Effective Storage Volume: 1/3(36 + 34 gallons) = 23 gallons
Effective Storage Capacity: $\frac{23 \text{ gallons}}{0.5 \text{ days}}$ = 46 gpd

46 gpd @ 25 gpd/employee = 2 employees

6. Filtration Capacity: (3 gpm/ft^2)
Two 13-inch diameter filters
Filtration Area: (3.14159)(0.54)^2(2 filters) = 1.84 ft^2
1.84 ft^2 (3 gpm/ft^2) = 5.5 gpm
5.5 gpm x 1,440 minutes/day = 7,920 gpd

This waterworks would be limited by the total effective storage capacity to a maximum population of 2 employees. However, it is being permitted for the existing gas station/convenience store/fast food restaurant until the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: March 31, 2003

WATERWORKS:	Sycamore Creek Golf Course	CERTIFIED CLASS: IV
CITY/COUNTY:	Goochland County	TYPE: Transient Non-Community

LOCATION: Take I-64 West from Richmond to Exit 173 (Manakin/Rockville exit). Turn left (south) onto Route 623. Go approximately 1.1 miles and turn right (west) onto U. S. Route 250. Go approximately 0.70 miles, and turn right (north) onto Route 621. Go approximately 0.1 miles on Route 621. The entrance to the golf course club house is on the right side of the road.

OWNER: Mid-Atlantic Golf, Inc.
1991 Manakin Road
Manakin-Sabot, Virginia 23103
Contact Mr. Robert H. Pratt, Vice-President
(804) 784-3544 FAX: (804) 784-1204

OPERATOR: Mr. Robert H. Pratt
(804) 784-3544

PERMIT NUMBER: 4075780

DATE ISSUED: April 9, 2003

TREATMENT: Iron and Manganese Treatment

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing clubhouse

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well, iron and manganese treatment facilities, and a 20-gallon bladder tank.

Well

The well is located on the left side of the clubhouse, in a corner of the paved parking area. No information is available on the well construction except that it includes PVC well casing that extends approximately 5.25 inches above the pavement. Appurtenances to the well at the well head include a pitless adapter unit.

Water is pumped from the well by a ¾-HP submersible pump reportedly rated at 8 gpm through approximately 100 feet of pipe (diameter unknown) to the bladder tank, then through the treatment facilities, and into the distribution system. A pressure switch on the well discharge line near the bladder tank controls the operation of the well pump. The well pump is set to operate at a pressure range of 30-50 psi at the pressure switch.

The treatment facilities and the bladder tank are housed in the storage room for the snack bar in the clubhouse. The storage room is equipped with lighting, heat, and a locked entrance. Appurtenances to the well discharge line in this room include a valved blow-off and a shut-off valve, both located downstream of the bladder tank.

Storage Facilities

Appurtenances to the 20-gallon bladder tank include a hose bib for sampling and draining the tank, a liquid pressure relief valve, and a pressure gauge.

Treatment Facilities

The iron and manganese treatment facilities include:

- Air injection (upstream of the bladder tank),
- A fiberglass reinforced plastic detention/air release tank (7.5-inch diameter; 35-inch height);
- A fiberglass reinforced plastic filter (9-inch diameter, 55-inch height) with birm media; and
- A sodium ion exchange unit (9-inch diameter, 44-inch height).

The birm material consists of a silica dioxide core with manganese dioxide bonded to the surface, and some calcium dioxide. It has an effective size of 0.48 mm and a uniformity coefficient of 2.7. Untreated well water is used to backwash the filter. The filter backwash water and the ion exchange backwash water discharge to a septic tank/drainfield system. The ion exchange unit has a design flow of 6 gpm.

Bypass piping is provided for the air injection unit, and for the filter.

EVALUATION OF THE SYSTEM

1. Present Population: 20 employees and 200 golfers

2. Estimated Usage:
   25 gpd/employee x 20 employees = 500 gpd
   5 gpd/golfer x 200 golfers = 1,000 gpd
   TOTAL: 1,500 gpd

3. Well Yield: Unknown

4. Well Pump Capacity:
   8 gpm
   8 gpm x 1,440 minutes/day = 11,520 gpd

5. Storage Capacity:
   (one-half of average daily demand)
   One 20-gallon bladder tank

   Effective Storage Volume: 1/3(20 gallons) = 7 gallons
   Effective Storage Capacity: $\frac{7 \text{ gallons}}{0.5 \text{ days}}$ = 14 gpd

6. Filtration Capacity: (3 gpm/ft^2)
One 9-inch diameter filter
Filtration Area: $(3.14159)(0.375)^2 = 0.44 \text{ ft}^2$
0.44 ft^2 (3 gpm/ft^2) = 1.3 gpm
1.3 gpm x 1,440 minutes/day = 1,872 gpd

7. Ion Exchange Capacity: The unit is designed for a flow of 6 gpm
6 gpm x 1,440 minutes/day = 8,640 gpd

This waterworks is being permitted for the existing golf course clubhouse until information about the well yield is provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH
ENGINEERING DESCRIPTION SHEET

DATE: February 12, 2003

WATERWORKS: Tanglewood Ordinary

CERTIFIED CLASS: N/A

CITY/COUNTY: Goochland County

TYPE: Transient Non-Community

LOCATION: On Patterson Avenue (Route 6), approximately 10.2 miles west of its intersection with River Road (Route 650), and approximately 0.7 miles west of the elevated water storage tank at James River Correctional Center. The Tanglewood Ordinary restaurant is a big log cabin on the right side of the road.

OWNER: James River Ordinaries, Inc
2210 River Road West
Maidens, Virginia 23102
Contact Mr. Jim Hardwick
(804) 556-3284

OPERATOR: Same as above

Eric Gorrison
640-5964

PERMIT NUMBER: 4075790

DATE ISSUED: February 21, 2003

TREATMENT: None

SOURCE: Groundwater – one drilled well

DESIGN CAPACITY: Existing restaurant and restaurant office

DESCRIPTION OF SYSTEM:

This waterworks consists of a drilled well and an 86-gallon bladder tank.

Well

The well is located in the partially cleared area on the north (right) side of the auxiliary parking lot, which is located on the west side of the restaurant. It is enclosed in a 24-inch concrete well curbing with a 30-inch concrete cover. The top of the well casing is about 20 inches below the surface of the ground, and the top of the well curbing is about 1.5 inches above the ground surface. No information is known about the construction of the well, except that it is a drilled well with 6-inch PVC casing. The well is equipped with a sanitary seal.

Water from the well is pumped by a submersible pump (HP and rating unknown) approximately 200 feet (pipe material and diameter unknown) to the bladder tank, and then to the distribution system. A pressure switch on the well discharge line near the bladder tank controls the operation of the well pump, but the control settings are unknown.

Storage Facilities

The 86-gallon bladder tank is housed in the basement of the restaurant. Appurtenances to the bladder tank include a hose bib for sampling and for draining the tank, and a pressure gauge. The basement area is equipped with lighting, heat, and a locked entrance.

Treatment Facilities

A particulate filter (9-inch diameter, 48-inch height), that is located beside the bladder tank, is not in service.

EVALUATION OF THE SYSTEM

Design Criteria: The system is evaluated on the basis of an equivalent residential connection (ERC). One ERC will utilize 400 gallons/day (gpd).

1. Present Population: 12 employees and about 500 customers

2. Estimated Usage:
   25 gpd/employee x 12 employees = 300 gpd
   5 gpd/customer x 500 customers = 2,500 gpd
   Total: 2,800 gpd

3. Well Yield: Unknown

Well Pump Capacity: Unknown

4. Storage Capacity: (200 gallons/ERC)
   One 86-gallon bladder tank

Effective Storage Volume: 1/3(86 gallons) = 29 gallons
Effective Storage Capacity: 29 gallons @ 200 gallons/ERC
= 0.15 ERCs or 60 gpd
60 gpd @ 25 gpd/employee = 2 employees

This waterworks would be limited by the total effective storage capacity to a maximum population of 2 employees. However, it is being permitted for the existing restaurant and restaurant office until information about the well yield and the well pump capacity are provided, and the need for additional storage capacity is evaluated.

VIRGINIA DEPARTMENT OF HEALTH

ENGINEERING DESCRIPTION SHEET

DATE: August 15, 1005

WATERWORKS NAME:	Westview on the James	**CERTIFIED CLASS:**	N/A
COUNTY/CITY:	Goochland County	**TYPE:**	Transient Non-Community

LOCATION: Go west on Patterson Avenue (Route 6) to Route 600, which is approximately 17.6 miles west of its intersection with River Road (Route 650), and approximately 3.2 miles west of its intersection with U. S. Route 522 North at Goochland Courthouse. Turn south (left) on Route 600, and go approximately 4.9 miles to Route 643. Turn south (right) on Route 643 to reach the camp entrance and the camp office.

OWNER: Westview, Inc.
Contact: Mr. John A. Edwards, Camp Director
1231 Westview Road
Goochland, Virginia 23063
Phone: (804) 457-2410; **Fax:** (804) 457-2178

OPERATOR: Mr. Kenny Morris, Maintenance
Phone: (804) 457-2410; **Fax:** (804) 457-2178

PERMIT NUMBER:	4075920	401405	Amended
EFFECTIVE DATE:	02/26/05	04/07/05	08/24/05

TYPE OF TREATMENT: Chlorination

SOURCE: Groundwater – two drilled wells

DESIGN CAPACITY: Existing Camp Facilities

DESCRIPTION OF SYSTEM

The system consists of two drilled wells, chlorination facilities, and a 30,000-gallon standpipe.

Wells
To reach the wells, continue south on Route 600 approximately 1.0 miles beyond its intersection with Route 643. The wells are located on the right side of the road, in a fenced pasture belonging to the campground. No livestock utilize the pasture. The wells are approximately 300 feet apart.

Well No. 1

This well was constructed in 1975 from a 10-inch hole drilled to a depth of 183 feet, and a 6-inch hole extending from 183 feet to 485 feet in depth. Bedrock was encountered at a depth of 183 feet. Six-inch steel casing was installed from +1 feet to 183 feet in depth. It is believed that the well was sealed with bentonite from 50 feet to 183 feet in depth. The well was grouted with neat cement from ground level to a depth of 50 feet. The estimated yield of the well at the time of drilling was 10 gpm, but no yield and drawdown test was conducted.

Appurtenances to the well include a sanitary seal, a screened casing vent, a gate valve, a check valve, a sample tap, a meter, and a plugged tee that may be used as a blowoff. The well and its appurtenances are housed in a 6'2" x 6'2" x 8'0" frame and siding well house. The building is equipped with light, a locking entrance, and an overhead access for the well pump. Heat tape is used for freeze protection.

Well No. 2

This well was constructed in 1980 from an 11-inch hole drilled to a depth of 184 feet, and a 6-inch hole extending from 184 feet to 400 feet in depth. Bedrock was encountered at a depth of 181 feet. The water aquifer began at a depth of 260 feet. Six-inch steel casing was installed from +2 feet to 184 feet in depth. The well was sealed with bentonite from 50 feet to 184 feet in depth, and grouted with neat cement from ground level to 50 feet in depth. This well yielded 7 gpm after 48 hours of continuous pumping in a test completed on August 30, 1980.

Appurtenances to the well include a sanitary seal, a screened casing vent, a gate valve, a check valve, a sample tap, a meter, a drawdown gauge, and a valved blowoff. The well and its appurtenances are housed in a 7'2" x 7'2" x 8'0" frame and siding well house. The building is equipped with light,a locking entrance, and an overhead access for the well pump. Heat tape is used for freeze protection.

Operation of the Well Pumps

The 30,000-gallon steel standpipe is approximately equidistant from the two wells. The operator can manually select either Well No. 1 to operate or both wells to operate simultaneously. Water from each well is pumped by a submersible pump (HP and rating unknown) through approximately 150 feet of 2-inch PVC pipe to the elevated storage tank. Float switches in the 30,000-gallon standpipe set at 32.0 feet and 33.0 feet, respectively, above the bottom of the tank activate and cut off the well pump(s).

A pressure gauge on the waterline at the Camp Director's home enables him to know when there is low pressure in the distribution system, and possibly an operational problem with the well pumps.

Treatment Facilities

A sodium hypochlorite feed system is installed in each well house for disinfection. Each hypochlorination system includes a 35-gallon polyethylene solution tank and a diaphragm pump rated for 12 gpd at maximum feed rate setting and 100 psi discharge system pressure. The chemical feed pumps are controlled by the float switches in the 30,000-gallon standpipe which control the operation of the well pumps. Chlorine solution is injected into the well discharge lines just downstream of the water meters. Sample taps are provided upstream and downstream of the injection points.

Storage Facilities

The 30,000-gallon standpipe is 12 feet in diameter and 34 feet in height. The tank is equipped with a screened vent, a 2' x 2' framed access manhole with overlapping lid on top, a valved drain pipe, and a screened overflow pipe with a concrete splash block underneath. The inverts for the fill and discharge pipes are set 1.0 foot above the bottom of the tank. Thus, the total effective storage capacity is 27,070 gallons.

Distribution System

The water mains are 4-inch PVC pipe. The branch lines are 3-inch and 2-inch PVC pipe. The system has not been designed for fire protection, and fire hydrants are not provided. The waterlines were installed when the camp was constructed.

EVALUATION OF THE SYSTEM

1. Summer Population: 40 residential staff, 33 non-residential staff, 150 dormitory campers, 50 tent campers, and 40 pool members

2. Existing Connections: 12 - the Administration Building, the Maintenance Building, the Director's home, the Minister's Cabin, the Homestead Lodge, the Lakeside Lodge, the Lakeside Lodge Kitchen, the swimming pool, the two bathhouses, the activity shelter, and the Dining Hall

3. Estimated Usage:

40 residential staff @ 50 gpd/staff	=	2,000 gpd
33 non-residential staff @ 25 gpd/staff	=	825 gpd
150 dormitory campers @ 50 gpd/camper	=	7,500 gpd
50 tent campers @ 30 gpd/camper	=	1,500 gpd
40 pool members @ 5 gpd/member	=	200 gpd
TOTAL:		12,025 gpd

Use peak factor of 4 for peak hour
Peak Hour: (4)(12,025 gpd)/(24 hr/day) = 2,004 gallons/hr

4. Well Yield:

Well No. 1:	Unknown
Well No. 2:	7 gpm – 48 hours of continuous pumping in 1980
TOTAL:	7 gpm

7 gpm x 1,440 minutes/day = 10,080 gpd

5. Well Pump Capacity:

Well No. 1:	3.5 gpm (observed output on 6/29/05)
Well No. 2:	8 gpm (observed output on 6/30/05)
TOTAL:	11.5 gpm

11.5 gpm x 1,440 minutes/day = 16,560 gpd

6. Storage Capacity: One 30,000-gallon standpipe
Effective storage volume – 27,070 gallons

The recommended storage capacity is one-half day's usage.
(27,070 gallons)/(0.5 days) = 54,140 gpd

7. Peak Delivery Capacity: Transfer Capacity = well pump (lowest single well in operation) + effective storage
= (3.5 gpm)(60 min/hr) + 27,070 gallons
= 27,280 gallons-peak hour
27,280 gallons Peak Delivery Capacity > 2,004 gallons Peak Hour Demand

The previous permit was issued on February 26, 2003 for the existing camp facilities. Based on the above evaluation, the permitted capacity is limited to the existing camp facilities until information about the well yield for Well No. 1 is provided.

R:\15b\eds.opr/Westview on the James-2005

APPENDIX B
Water Agreement between the Commonwealth of Virginia Department of Corrections and the County of Goochland

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CORRECTIONS
AND
COUNTY OF GOOCHLAND, VIRGINIA

MEMORANDUM OF AGREEMENT

THIS AGREEMENT, made this 23rd of June 1989, by and between the County of Goochland, party of the first part, hereinafter referred to as "County," and the Department of Corrections, Commonwealth of Virginia, party of the second part, hereinafter referred to as "Department";

W I T N E S S E T H:

WHEREAS, "County" is the owner and operator of a water system serving the Goochland Courthouse and surrounding area in Goochland, including facilities owned by Goochland, the Department and the Commonwealth of Virginia;

WHEREAS, in order to correct existing difficulties with such system and to insure improved services in this area for its customers, "County" desires to construct additional water storage facilities in this area;

WHEREAS, to insure that the facilities operated by the Department, the Commonwealth of Virginia (J. Sargeant Reynolds Community College) and the "County" itself have adequate water service for the future, the "Department" and the "County" have determined that it is in their best interests to join in a cooperative effort;

WHEREAS, "County" has also determined that it would be in the best interests of the residents located in the Goochland Courthouse and surrounding area, including the facilities of the Department; and

WHEREAS, the parties desire to set forth herein their terms of an agreement for their mutual advantage;

IN CONSIDERATION OF the mutual covenants and promises contained herein, the parties agree as follows:

1. The Department hereby agrees to prepare a Deed of Easement to a site upon such terms and conditions as it may deem proper, for the purpose of the building of a 100,000 gallon elevated water storage tank and to connect same to the water distribution system serving the Virginia Correctional Center for Women. Any such site shall be of a dimension determined by "County" to be necessary for the construction and operation of a water storage tank based upon the requirements of the State Department of Health in their permitting process with such site not exceeding 300 feet by 400 feet in dimensions.

2. The Deed of Easement by the Department to "County" shall include a provision whereby the Department has the right to use any water from the tank located on any such site made available to "County" as a supply of water for the Department in the event of an emergency or during periods of low line pressure. This use by the Department would be subject to the condition that such use did not unduly hinder the ability of the "County" to serve its regular customers and shall be for the duration of the specific needs only.

3. "County" will be responsible for any and all construction and improvements necessary on such site for the operation of the storage tank including, but not limited to, a pump house and other facilities associated with the tank, as well as any measures required to assure proper drainage on or around any tank site.

4. "County" alone will be responsible for any liability incurred arising out of the testing, exploration, construction or operation of a tank on the site.

5. The Department will permit "County" to make a connection at their expense to the existing water supply lines from James River Correctional Center to serve the storage tank. This water will be metered and paid for by "County" at a rate to be found mutually agreeable.

6. "County" shall indemnify and save harmless the Department from and against any and all liability, damage, expense, causes of action, suits, claims or judgments, and attorney's fees and cost incurred in connection therewith, arising from injury to persons or property on or about any site or easement thereto caused by the negligence or omission or misconduct or breach of any such agreement by "County", its employees, subtenants, invitees or any other person on or about such sites or easements under express or implied invitation of "County", or arising by reason of the use of the site by "County".

7. "County" will keep in force at its own expense so long as this agreement remains in effect, broad form public liability insurance in the amount of $1,000,000.00 per occurrence and property damage of $100,000.00 per occurrence, protecting and indemnifying "County", Goochland, the Department and "County" agents, naming the Department as an additional insured, against all claims for damage to persons or property or for loss of life or property occurring on, in or about any sites or easements hereto. Such certificate of insurance and any endorsement thereto shall be furnished to the Department at or prior to commencement of this agreement and thereafter within thirty (30) days prior to the expiration of any such policy. Each such policy shall provide for at least thirty (30) days written notice to "County" and the Department of any change or cancellation thereof.

8. As part of such site availability to "County" the Department shall grant to "County" any construction easements as may be necessary for the construction of the tank on such site. The Department will also in such agreement grant to "County" a right of ingress and egress to any applicable site during exploration, construction and then following the Deed of Easement to the property for the purpose of maintaining such tank site.

9. The Department shall also grant to "County" Deeds of Easement for the construction of lines, pipes, pumping station and other facilities necessary for the use of the site. These Deeds of Easement and the construction of all facilities as contemplated by this agreement will be determined after considering the economic, technical and security considerations applicable to the Department and "County".

10. This agreement shall survive the execution of any documents or Deeds of Easement by the Department to "County" and the provisions of this agreement shall remain in full force and effect thus binding the parties following any such arrangements.

11. It is understood and agreed that all obligations of the Department herein are subject to all applicable laws of the 2.1-504.3 and 2.1-512, Code of Virginia (1950), as amended and all applicable directives and regulations of the Commonwealth of Virginia, including but not limited to those promulgated by the Department of General Services, Division of Engineering and Buildings. This Agreement has been approved by the Board of Supervisors at a duly called meeting after proper notice of the Board on May 2, 1989, and by the Department of Corrections.

IN AGREEMENT WHEREOF, the parties to this Agreement through their authorized agents hereby agree to the above terms.

DEPARTMENT OF CORRECTIONS

COMMONWEALTH OF VIRGINIA

By _____

Director,

Department of Corrections

COUNTY OF GOOCHLAND

By _____

Chairman, Board of Supervisors

By _____

Gregory K. Wolfrey

County Administrator

By _____

Clerk, Board of Supervisors

COMMONWEALTH OF VIRGINIA

CITY COUNTY OF Goochland, to wit:
The foregoing Agreement was acknowledged before me by Andrew W. Pryor on the day of May 2, 1989, in the jurisdiction aforesaid.

My Commission expires: May 10, 1991

Cynthia M. Clements
Notary Public

COMMONWEALTH OF VIRGINIA

CITY COUNTY OF Richmond, to wit:
The foregoing Agreement was acknowledged before me by E.W. Murray on the day of June 23, 1989, in the jurisdiction aforesaid.

My Commission expires July 22 1989

Notary Public

RECOMMEND APPROVAL:
DIVISION OF ENGINEERING AND BUILDINGS

BY: for DIRECTOR

RECOMMEND APPROVAL:
DEPARTMENT OF GENERAL SERVICES

BY: DIRECTOR

APPROVED BY THE GOVERNOR:

Pursuant to 2.1-504.2 of the Code of Virginia (1950), as amended, as the official designee of the Governor of Virginia, as authorized and designated by Executive Order 29(86), dated NOV. 15, 1986. I hereby approve this Agreement and the execution of this instrument for, on behalf of, and in the stead of the Governor of Virginia.

Carolyn J. Moss
Secretary of Administration

6/15/89
(Date)

COMMONWEALTH of VIRGINIA

EDWARD W. MURRAY
DIRECTOR

Department of Corrections

P.O. BOX 26963
RICHMOND, VIRGINIA 23261
(804) 674-3000

June 20, 1990

Darvin E. Satterwhite, Esq.
P. O. Box 325
Goochland, Virginia 23063

Re: Amended Memorandum of Understanding with Goochland County on water Supply

Dear Mr. Satterwhite:

Attached is a fully executed original of subject agreement as approved by the Secretary of Administration and signed by Director E. W. Murray of this Department.

Thank you for your valued assistance in working out this agreement which should have beneficial results for both the County and our Department.

Sincerely,

Marcellus Wright, Jr. FAIA
Consultant

Attachment: As Noted

cc: Messrs: E. W. Murray
J. W. McCluskey
E. C. Morris

MWjr/jc

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CORRECTIONS
AND
COUNTY OF GOOCHLAND, VIRGINIA

AMENDED MEMORANDUM OF UNDERSTANDING

THIS Amended Agreement, made this 19th day of June, 1990 by and between the County of Goochland, party of the first part, hereinafter referred to as "County", and the Department of Corrections, Commonwealth of Virginia, party of the second part, hereinafter referred to as "Department";

WHEREAS, the "County" and the Department entered into a Memorandum of Understanding dated June 23, 1989; and,

WHEREAS, the "County" and the Department desire to amend such agreement to reflect an increase in the size of the proposed elevated water storage tower and the costs of constructing such tower.

NOW THEREFORE, in consideration of the premises and the mutual promises and covenants contained herein the aforesaid Memorandum of Understanding is amended as follows:

1. Paragraph 1 of the Memorandum of Understanding is amended to read as follows:

> The Department hereby agrees to execute a Deed of Easement to a site upon such terms and conditions as it may deem proper, for the purpose of the building by the County of a 300,000 gallon elevated water storage tank and the connection by the County of same to the water distribution system serving the Virginia Correctional Center for Women. Any such site shall be of a dimension determined by "County" to be

necessary for the construction and operation of an elevated water storage tank based upon the requirements of the State Department of Health in their permitting process with such site not exceeding 300 feet by 400 feet in dimensions.

2. Paragraph 3 of the Memorandum of Understanding is amended to read as follows:

> "County" shall be responsible to the extent of any costs which would be incurred for the construction and improvements necessary on such site had a 100,000 gallon elevated water storage tank been constructed, including, but not limited to, a pump house and other facilities associated with the tank, as well as any measures required to assure proper drainage on or around any tank site.
>
> The Department shall be responsible for reimbursing the County in an amount not to exceed $230,000 for all properly documented and reasonably necessary costs incurred in connection with the construction of the 300,000 gallon elevated water storage tank over and above what it would have cost the "County" to construct a 100,000 gallon elevated water storage tank on the same site. This documentation shall consist of certified monthly invoices for accounting purposes.

3. In all other respects, the Memorandum of Understanding shall remain in full force and effect.

DEPARTMENT OF CORRECTIONS
COMMONWEALTH OF VIRGINIA

By: _____
Director, Department of Corrections

COUNTY OF GOOCHLAND

By: _____
Chairman, Board of Supervisors

By: _____
Gregory K. Wolfrey, County Administrator

By: _____
Clerk, Board of Supervisors

COMMONWEALTH OF VIRGINIA

COUNTY OF GOOCHLAND, to-wit:

The foregoing Amended Memorandum of Understanding was acknowledged before me by Andrew W. Pryor and Gregory K. Wolfrey, Chairman and Clerk, respectively, of the Board of Supervisors of Goochland County, Virginia, on the 19th day of April, 1990, in the jurisdiction aforesaid.

My Commission Expires: 3/7/92

Dawn E. Sattawhite
Notary Public

COMMONWEALTH OF VIRGINIA

COUNTY OF GOOCHLAND, to-wit:

The foregoing Amended Memorandum of Understanding was acknowledged before me by E. W. Murray on the 15th day of June, 1990, in the jurisdiction aforesaid.

My Commission Expires: March 31, 1992 RLS

Notary Public

RECOMMEND APPROVAL:
DIVISION OF ENGINEERING

By: _____
DIRECTOR

RECOMMEND APPROVAL:
DEPARTMENT OF GENERAL SERVICES

By: _____
DIRECTOR

APPROVED BY THE GOVERNOR:

Pursuant to 2.1-504.2 of the Code of Virginia (1950), as amended, as the official designee of the Governor of Virginia, as authorized and designated by Executive ~~Order 29(86)~~ Order #18(89), dated ~~November 15, 1986~~ Dec. 21, 1989. I hereby approve this Amended Memorandum of Understanding and the execution of this instrument for, on behalf of, and in the stead of the Governor of Virginia.

6-6-90
(Date)

Secretary of Administration

APPENDIX C
Department of Environmental Quality Water Usage Records

DEPARTMENT OF ENVIRONMENTAL QUALITY WATER USAGE RECORDS - GOOCHLAND COUNTY

OWNNAME	SYSTEM	SOURCE	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	DAILY	MAX DAY	CATEGORY	TYPE	SUBTYPE
MARTIN MARIETTA MATERIALS	ANDERSON CREEK QUARRY	QUARRY	2002	4.72	4.72	0.081	2.73	2.73	2.73	2.88	2.61	4.32	3.52	1.98	6.6	39.621	0.108550685	0.2	MIN	SW	RE
MARTIN MARIETTA MATERIALS	ANDERSON CREEK QUARRY	QUARRY	2003	1.92	4.35	4.35	4.29	5.04	5.37	9.6	4.91	12.27	1.95	1.05	1.65	56.75	0.155479452	0.41	MIN	SW	RE
MARTIN MARIETTA MATERIALS	ANDERSON CREEK QUARRY	QUARRY	2004	0.6	0.6	0.63	2.46	3.21	4.23	2.25	7.11	4.11	4.2	4.38	1.98	35.76	0.097972603	0.22	MIN	SW	RE
MARTIN MARIETTA MATERIALS	ANDERSON CREEK QUARRY	QUARRY	2005	2.04	4.38	1.92	2.43	1.57	3.42	3.45	2.13	1.2	3.06	3.39	3.93	32.92	0.090191781	0.18	MIN	SW	RE
MARTIN MARIETTA MATERIALS	ANDERSON CREEK QUARRY	QUARRY	2006	5.04	5.1	1.92	1.53	2.82	3.75	2.46	1.8	1.35	6.66	5.52	8.43	46.38	0.127068493	0.26	MIN	SW	RE
ALEXANDER M FISHER JR	BROOKVIEW FARM	JAMES RIVER	2004																IRR	SW	SR
ALEXANDER M FISHER JR	BROOKVIEW FARM	JAMES RIVER	2005																IRR	SW	SR
ALEXANDER M FISHER JR	BROOKVIEW FARM	JAMES RIVER	2006																IRR	SW	SR
JAMES P MASSIE JR	COPLEY FARMS	FARM POND FARM #405	2004																IRR	SW	RE
JAMES P MASSIE JR	COPLEY FARMS	FARM POND FARM #405	2005																IRR	SW	RE
JAMES P MASSIE JR	COPLEY FARMS	FARM POND FARM #405	2006																IRR	SW	RE
JAMES P MASSIE JR	COPLEY FARMS	FARM POND FARM #407	2002																IRR	SW	RE
JAMES P MASSIE JR	COPLEY FARMS	FARM POND FARM #407	2003																IRR	SW	RE
JAMES P MASSIE JR	COPLEY FARMS	FARM POND FARM #407	2004																IRR	SW	RE
JAMES P MASSIE JR	COPLEY FARMS	FARM POND FARM #407	2005																IRR	SW	RE
JAMES P MASSIE JR	COPLEY FARMS	FARM POND FARM #407	2006																IRR	SW	RE
GOOCHLAND, COUNTY OF	GOOCHLAND COURT HOUSE	FROM HENRICO	2004													79.9	0.2189		PWS	TW	
GOOCHLAND, COUNTY OF	GOOCHLAND COURT HOUSE	FROM HENRICO	2005																PWS	TW	
GOOCHLAND, COUNTY OF	GOOCHLAND COURT HOUSE	FROM HENRICO	2006	4.529	3.875	5.791	5.254	4.498	12.943	7.793	10.794	6.962	7.056	7.017	6.431	82.943	0.227241096	0.431	PWS	TW	
GOOCHLAND, COUNTY OF	GOOCHLAND COURT HOUSE	FROM VDOC-JAMES R CORRECTIONS	2002	3.0256	2.3504	1.4213	1.4293	1.6338	1.4207	1.6755	1.2198	1.335	1.2167	0.9989	0.9604	18.6874	0.051198356	0.0976	PWS	TW	
GOOCHLAND, COUNTY OF	GOOCHLAND COURT HOUSE	FROM VDOC-JAMES R CORRECTIONS	2003	1.094	0.912	1.109	1.123	1.436	1.615	1.436	1.455	2.16	1.681	1.158	1.242	16.421	0.044989041		PWS	TW	
GOOCHLAND, COUNTY OF	GOOCHLAND COURT HOUSE	FROM VDOC-JAMES R CORRECTIONS	2004													17.152	0.047		PWS	TW	
GOOCHLAND, COUNTY OF	GOOCHLAND COURT HOUSE	FROM VDOC-JAMES R CORRECTIONS	2005																PWS	TW	
GOOCHLAND, COUNTY OF	GOOCHLAND COURT HOUSE	FROM VDOC-JAMES R CORRECTIONS	2006	1.772	1.718	2.187	2.485	2.226	2.747	2.37	2.715	2.316	2.207	1.862	2.398	27.003	0.073980822	0.091	PWS	TW	
HERMITAGE COUNTRY CLUB	HERMITAGE COUNTRY CLUB	BROAD BRANCH PONDS #1, #2	2002	0	0	0.118	0.13	12	20	25	25	18.75	18.375	5	2.5	126.873	0.34759726		COM	SW	RE
HERMITAGE COUNTRY CLUB	HERMITAGE COUNTRY CLUB	BROAD BRANCH PONDS #1, #2	2003	0	0	0.565	0.765	0.985	1.4	9.3	5.4	3.2	5.8	0.319	0	27.734	0.075983562	0.96	COM	SW	RE
HERMITAGE COUNTRY CLUB	HERMITAGE COUNTRY CLUB	BROAD BRANCH PONDS #1, #2	2004	0	0	0	0	1.2	2.2	0.84	3.8	2.6	4.8	0.89	0.03	16.36	0.044821918	0.71	COM	SW	RE
HERMITAGE COUNTRY CLUB	HERMITAGE COUNTRY CLUB	BROAD BRANCH PONDS #1, #2	2005	0	0	0.238	5.9	7.3	16.4	11.6	12.5	20.1	3.4	4.6	0	82.038	0.224761644	1.2	COM	SW	RE
HERMITAGE COUNTRY CLUB	HERMITAGE COUNTRY CLUB	BROAD BRANCH PONDS #1, #2	2006	0	0	8.3	6.8	13.2	10.9	14.5	18.5	4.9	2.8	0.57	0	80.47	0.220465753	1.4	COM	SW	RE
HERMITAGE COUNTRY CLUB	HERMITAGE COUNTRY CLUB	WELL SYDNOR MAINTAINED	2004	0.118	0.202	0.302	0.233	0.633	0.373	0.371	0.374	0.256	0.185	0.149	0.153	3.349	0.009175342		COM	GW	WE
HERMITAGE COUNTRY CLUB	HERMITAGE COUNTRY CLUB	WELL SYDNOR MAINTAINED	2005	0.118	0.141	0.186	0.197	0.252	0.474	0.34	0.292	0.238	0.199	0.192	0.145	2.774	0.0076		COM	GW	WE
HERMITAGE COUNTRY CLUB	HERMITAGE COUNTRY CLUB	WELL SYDNOR MAINTAINED	2006	0.1407	0.1933	0.2219	0.2202	0.4372	0.4205	0.3951	0.4648	0.2848	0.3286	0.2324	0.2313	3.5708	0.009783014		COM	GW	WE
VIRGINIA, COMMONWEALTH OF	I-64 GOOCHLAND REST AREA	EAST BOUND WELL	2005	0.096	0.1003	0.1269	0.1573	0.175	0.1976	0.2177	0.1982	0.1761	0.1849	0.1529	0.1143	1.8972	0.005197808	0.0167	COM	GW	WE
VIRGINIA, COMMONWEALTH OF	I-64 GOOCHLAND REST AREA	WEST BOUND WELL	2005	0.1455	0.1464	0.1869	0.2182	0.2892	0.2882	0.3449	0.2844	0.2286	0.2328	0.1973	0.154	2.7164	0.007442192	0.018	COM	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1	2002	0.071	0.051	0.062	0.061	0.065	0.052	0.058	0.051	0.054	0.044	0.058	0.074	0.701	0.001920548		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1	2003	0.0626	0.1603	0.0673	0.0863	0.094	0.05	0.0468	0.0519	0.031	0.0256	0.055	0.0553	0.7861	0.002153699		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1	2004	0.07	0.077	0.101	0.1	0.0952	0.0778	0.0893	0.1769	0.049	0.0507	0.0295	0.0295	0.9459	0.002591507		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1	2006	0.0199	0.0173	0.0194	0.0171	0.0211	0.02	0.0059	0	0.0148	0.0136	0.0228	0.0204	0.1923	0.000526849		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1A	2002	0.048	0.036	0.041	0.039	0.04	0.034	0.035	0.032	0.032	0.027	0.036	0.053	0.453	0.001241096		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1A	2003	0.0492	0.0432	0.0359	0.0222	0.02	0.0751	0.0593	0.0647	0.0347	0.0549	0.0282	0.0391	0.5265	0.001442466		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1A	2004	0.0381	0.0228	0.008	0.0074	0.0058	0.0054	0.0066	0.0074	0.0049	0.0462	0.0712	0.0378	0.2616	0.000716712		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1A	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #1A	2006	0.0341	0.0276	0.0315	0.0274	0.0286	0.0223	0.0079	0	0.0242	0.0325	0.0467	0.0324	0.3152	0.000863562		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2	2002	0.158	0.122	0.145	0.187	0.159	0.162	0.14	0.157	0	0.027	0	0	1.257	0.003443836		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2	2003																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2	2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2	2006	0	0.0034	0	0	0	0	0.0019	0	0	0	0	0	0.0053	1.45205E-05		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2A	2002	0.09	0.034	0.01	0	0	0	0	0	0	0	0	0	0.134	0.000367123		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2A	2003																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2A	2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2A	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	JAMES RIVER ESTATES	WELL #2A	2006	0	0.0012	0	0	0	0	0	0	0	0	0	0	0.0012	3.28767E-06		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #10	2002	0	0	0	0	0.553	0.712	0.679	0.691	0.189	0.141	0.336	0.469	3.77	0.010328767		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #10	2003	1.1497	1.2848	0.5179	0.6667	0.8437	0.7414	2.6652	1.4608	0.2573	0.7688	0.414	0.4416	11.2119	0.030717534		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #10	2004	0.534	0.513	0.6	0.878	0.796	0.793	0.565	0.169	0.19	18	0.191	0.126	23.355	0.063986301		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #10	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #10	2006	0.034	0.168	0.479	0.703	0.463	0.808	0.871	0.785	0.583	0.37	0.308	0.43	6.002	0.016443836		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #11	2006	0.217	0.305	0.617	0.682	0.641	1.158	0.647	1.228	0.796	0.489	0.391	0.409	7.58	0.020767123		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #12	2006	0.555	0.328	0.672	1.029	0.703	1.271	1.399	1.33	0.868	0.533	0.427	0.445	9.56	0.026191781		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #4	2002	0.122	0.118	0.103	0.025	0.001	0	0	0	0	0	0	0	0.369	0.001010959		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #4	2003													0	0		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #4	2004																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #4	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #4	2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #6	2002	0.208	0.084	0.19	0.268	0.385	0.248	0.422	0.262	0.315	0.62	0.137	0	3.139	0.0086		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #6	2003	0	0.0011	0.0047	0.0005	0.0002	0.0012	0.004	0.0002	0.0001	0.0005	0.0002	0.0073	0.02	5.47945E-05		PWS	GW	WE

* See Legend for Abbreviation Definitions

AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #6	2004	0	0	0	0	0.16	0.0026	0.405	0.467	0.521	0.391	0.441	0.113	2.5006	0.006850959		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #6	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #6	2006	0.0122	0	0	0.0049	0	0	0	0	0	0	0	0	0.0171	4.68493E-05		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #7	2002	0.269	0.354	0.237	0.283	0.209	0.553	0.517	0.539	0.156	0.116	0.277	0.387	3.897	0.010676712		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #7	2003	0.4625	0.3513	0.3995	0.5568	0.5229	0.4695	0.6159	0.4796	0.5452	0.5653	0.4232	0.4953	5.887	0.016128767		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #7	2004	0.432	0.417	0.485	0.684	0.631	0.638	0.467	0.154	0.169	0.159	0.169	0.1112	4.5162	0.012373151		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #7	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #7	2006	0.3049	0.19	0.38	0.413	0.506	0.645	0.674	0.635	0.469	0.3008	0.249	0.259	5.0257	0.013769041		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #8	2002	0	0.133	0.0015	0.053	0	0	0	0	0	0	0.0202	0	0.2077	0.000569041		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #8	2003	0.0127	0.0005	0.0089	0.0001	0.0002	0	0.0008	0.0002	0.0001	0.007	0.0002	0.0053	0.036	9.86301E-05		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #8	2004																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #8	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #8	2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #9	2002	0.318	0.281	0.285	0.348	0.311	0.293	0.313	0.31	0.275	0.274	0	0	3.008	0.008241096		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #9	2003	0.5752	0.4336	0.4944	0.6969	0.6529	0.5835	0.7818	0.6026	0.6857	0.7196	0.5245	0.6128	7.3635	0.020173973		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #9	2004	0	0	0	0	0.025	0.001	0.001	0	0	0.001	0.001	0.001	0.03	8.21918E-05		PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #9	2005																PWS	GW	WE
AQUA VA - DIV OF AQUA AMERICA	MANAKIN FARMS	WELL #9	2006	0.0021	0.001	0.0063	0	0.001	0.002	0.01	0.0035	0	0	0	0	0.0259	7.09589E-05		PWS	GW	WE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	LITTLE TUCKAHOE CREEK TRIB	2002	0.5	0.6	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.4	6.6	0.018082192		MIN	SW	SR
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	LITTLE TUCKAHOE CREEK TRIB	2003																MIN	SW	SR
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	LITTLE TUCKAHOE CREEK TRIB	2004	0.5	0.5	0.5	0.6	0.5	0.6	0.7	0.7	0.5	0.4	0.5	0.4	6.4	0.017534247		MIN	SW	SR
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	LITTLE TUCKAHOE CREEK TRIB	2005	12.5	22.7	32.5	21.1	18	21.8	26.2	34.3	28.3	24	15.4	10.9	267.7	0.733424658	2.16	MIN	SW	SR
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	LITTLE TUCKAHOE CREEK TRIB	2006	20.6	18	22.6	19.2	21.7	16.3	14.2	20.6	16.2	22	15.9	12.7	220	0.602739726	1.05	MIN	SW	SR
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	PIT SUMP	2002	8.5	11.9	8.8	9.2	14.7	16.4	16.5	18.3	25.6	23.1	33.7	10.6	197.3	0.540547945	1.6	MIN	SW	RE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	PIT SUMP	2003																MIN	SW	RE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	PIT SUMP	2004	14.6	13	13.2	23.2	14.2	29.5	14	26	37.6	15.9	18.1	14.9	234.2	0.641643836	1.6	MIN	SW	RE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	PIT SUMP	2005	17.2	29.7	23	21.7	24.7	23.2	13.1	29.3	22.9	17.8	14.1	4.4	241.1	0.660547945	1.6	MIN	SW	RE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	PIT SUMP	2006	14.8	24.8	16.4	17.1	16.5	20.5	14.1	24.4	17.3	22.2	44.3	26.4	258.8	0.709041096	1.6	MIN	SW	RE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	WELL #1	2002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.024	6.57534E-05		MIN	GW	WE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	WELL #1	2003																MIN	GW	WE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	WELL #1	2004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.024	6.57534E-05		MIN	GW	WE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	WELL #1	2005	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	5.6	0.015342466		MIN	GW	WE
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	WELL #1	2006	0.4	0.4	0.5	0.3	0.5	0.5	0.5	0.5	0.5	0.4	0.5	0.4	5.4	0.014794521		MIN	GW	WE
VIRGINIA, COMMONWEALTH OF	STATE FARM	BEAVERDAM CREEK	2002	23.57	21.34	21.85	19.46	19.58	26.47	0	0	0	0	22.4	23.64	178.31	0.488520548	1.12	COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	BEAVERDAM CREEK	2003	25.39	23.64	24.52	22.68	23.33	23.34	23.96	24.31	25.45	24.31	22.72	24.03	287.68	0.788164384	1.11	COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	BEAVERDAM CREEK	2004	25.16	22.824	24.092	24.601	26.127	25.928	26.396	25.168	26.094	23.191	22.118	23.519	295.218	0.808816438	1.292	COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	BEAVERDAM CREEK	2005	25.3	23.8	25	23.9	25.8	25	25.9	27.5	26.3	25.3	23.6	24.5	301.9	0.827123288	1.1	COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	BEAVERDAM CREEK	2006	23.7	21.9	25.3	25.3	25.5	26	27.3	26.7	26.3	27.8	25.8	25	306.6	0.84	1.2	COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	JAMES RIVER	2002	0	0	0	0	0	0	27.72	27.6	26.41	25.71	0	0	107.44	0.294356164		COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	JAMES RIVER	2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0		COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	JAMES RIVER	2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0		COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	JAMES RIVER	2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0		COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	JAMES RIVER	2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0		COM	SW	SR
VIRGINIA, COMMONWEALTH OF	STATE FARM	TO GOOCHLAND COUNTY	2002	3.025	2.351	1.421	1.429	1.634	1.42	1.675	1.219	1.373	1.216	1.001	0.99	18.754	0.051380822		COM	TW	
VIRGINIA, COMMONWEALTH OF	STATE FARM	TO GOOCHLAND COUNTY	2003	1.11	0.923	1.11	1.12	1.44	1.62	1.43	1.45	2.19	1.68	1.15	1.24	16.463	0.04510411		COM	TW	
VIRGINIA, COMMONWEALTH OF	STATE FARM	TO GOOCHLAND COUNTY	2004	1.943	0.442	1.386	1.327	1.528	1.841	1.629	1.377	1.322	1.417	1.264	1.676	17.152	0.046991781		COM	TW	
VIRGINIA, COMMONWEALTH OF	STATE FARM	TO GOOCHLAND COUNTY	2005	2.39	2.4	1.95	2.05	2.27	2.61	2.63	2.69	2.26	1.96	1.88	1.88	26.97	0.073890411		COM	TW	
VIRGINIA, COMMONWEALTH OF	STATE FARM	TO GOOCHLAND COUNTY	2006													27.003	0.074		COM	TW	

Legend
Monthly amounts are in million gallons (MG).
Annual is total in MG.
Daily is in million gallons per day(MGD).
Agr =Agriculture
Com = commercial
Irr = irrigation
Man = manufacturing
Min = mining
Pws = public water supply
Pf = power fossil
Ph = hydropower
Pn = power nuclear
WL = withdrawal
RL = sold water……town sells water to an outside system
DL = water bought from outside source
SR = system release……water released by wtp to be used locally
SD = system delivery……water from wtp
RE = return……water returned to source….water from STP to river or from well to a pond

* See Legend for Abbreviation Definitions

APPENDIX D
Water Agreement between the County of Henrico and the County of Goochland

WATER AGREEMENT
between
COUNTY OF GOOCHLAND, VIRGINIA
and
COUNTY OF HENRICO, VIRGINIA

THIS AGREEMENT is made this 11th day of June, 2002, by and between the COUNTY OF GOOCHLAND, VIRGINIA, hereinafter referred to as "Goochland," party of the first part, and the COUNTY OF HENRICO, VIRGINIA, hereinafter referred to as "Henrico," party of the second part, to set forth the terms and conditions under which Henrico will provide treated water to Goochland during the term of the agreement.

WHEREAS, Henrico provides water service to Goochland under terms of the water agreement dated December 14, 1994, as amended on July 12, 1995, and both parties desire to continue such service and to provide for increased service in the future; and,

WHEREAS, Goochland wishes to construct at its sole expense a water system within Goochland to provide water to residential, commercial and industrial customers in Goochland; and,

WHEREAS, Henrico desires and plans to construct a water treatment plant within Henrico initially capable of treating up to 55 million gallons per day ("mgd") and both parties desire that Goochland obtain water treatment capacity from this plant; and,

WHEREAS, the parties desire to provide for the aforementioned water treatment capacity to be made available to Goochland and to set forth the terms and conditions under which Henrico will provide water to Goochland and Goochland will obtain water from Henrico.

NOW, THEREFORE, in consideration of the promises and the mutual covenants and undertakings of the parties to this Agreement, the parties hereto mutually agree each with the other as follows:

Section 1. Earlier agreements to be canceled. The Water Agreement between the parties dated December 14, 1994 (the "Water Agreement") and the Amendment to December 14, 1994 Water Agreement dated July 12, 1995 (the "Amendment") shall be canceled and of no further effect as of the date of this agreement. At such time, the provisions of this Agreement shall take effect and shall provide the terms, conditions and quantities of water to be provided by Henrico to Goochland.

Section 2. Henrico to provide treated water. Henrico shall provide water to Goochland for resale by Goochland to water customers located within Goochland through water meters at the Henrico-Goochland boundary. Henrico or Goochland may provide water service directly to customers located within the other jurisdiction along the Henrico-Goochland boundary if mutually agreed in writing by Henrico and Goochland.

Section 3. Goochland to provide public drinking water. Goochland agrees to operate said water supply system according to requirements of the Virginia Department of Health ("VDH") as a public drinking water supply for its residential, commercial and industrial users, and shall obtain and maintain a valid operation permit prior to commencement of providing service.

Section 4. Annual Projections. Subject to the continuation of water service in the amount of 35 mgd to Henrico from the City of Richmond, which Henrico agrees to use its best efforts to continue, Henrico agrees to supply Goochland after the opening of the Henrico Water Treatment Plant ("WTP") up to a maximum of 25 mgd of water through mutually agreed metered connections between the Goochland and Henrico water systems, as provided in the requirements schedule provided by Goochland to Henrico. The initial requirements schedule is attached hereto as Exhibit A. By March 1 of each year, Goochland shall provide an amended requirements schedule meeting the requirements of this Agreement which shall automatically become a part of this Agreement, indicating the projected maximum-day and peak hour water requirements at each metering point for the next ten (10) fiscal years. The schedule shall indicate future requirements beginning on the first day of the fiscal year following submission of the amended requirements schedule. Additional connections and metering points may be established by written agreement of the parties, and the requirements schedule shall be adjusted accordingly in such case. The currently desired capacity as shown in the most recent requirements schedule, as amended, shall be known as the "contractual capacity." In the event that Goochland's projected requirements increase overall, or at any delivery point, and as a result exceed the maximum capacity of Henrico's facilities to deliver Goochland's projected requirements, Henrico will, within one hundred eighty (180) days of receipt of the projected requirements, advise Goochland of this condition in writing, including the facility involved, the date on which the capacity of such facility will be exceeded, and the alternatives available to meet the projected Goochland requirements. Henrico shall be under no obligation to enlarge or modify its distribution system beyond the improvements or for greater quantities than described in this Agreement to meet increases in Goochland's requirements unless mutually agreed in writing. Notwithstanding the foregoing, and subject to the continuation of water service from the City of Richmond described above, which Henrico agrees to use its best efforts to continue, the maximum quantity of water to be supplied to Goochland shall not exceed the following:

a. 786,000 gallons per day ("gpd") (0.786 mgd) upon the effective date of this agreement;

b. 5.25 mgd when the 55 mgd WTP begins operation, currently expected to be January 1, 2003;

c. 11.54 mgd when the WTP begins operation at 80 mgd (estimated to be in 2010 or later);

d. 25 mgd when the WTP begins operation 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 WTP. Henrico agrees to use its best efforts to acquire a permit for a 120 mgd WTP as needed.

Section 5. Annual payment. Goochland agrees to pay Henrico for the water service provided by Henrico to Goochland during the term of this Agreement. The charges for the sale of water to Goochland under this Agreement shall be determined annually on a fiscal year basis. For purposes of this Agreement, each fiscal year shall be from July 1st through June 30.

Section 6. Basis of Charges. The charges for water sold to Goochland during the term of this Agreement shall be based on the actual cost to Henrico for the fiscal year in which the sale of water occurred. The billing to Goochland shall consist of a Capacity Charge based on contractual capacity or maximum day demands, whichever is greater, and a Commodity Charge based on metered use. The amounts of the Capacity Charge and the Commodity Charge shall be determined through a formula determined through an annual cost allocation study of the components set forth in Section 7, Commodity Charges, and Section 8, Capacity

Charges. The cost allocation study's formula shall be used to determine the pro rata costs of serving Goochland in each of the enumerated cost categories and shall allocate the actual portions of the total cost in each category incurred by Henrico to serve Goochland for each fiscal year under this Agreement. The methods, parameters, procedures, and principles used in the cost allocation study's formula shall be reviewed by the parties in detail upon the request of either party to ensure that the billing is on a pro rata basis, except that such review shall be no more frequently than once every five (5) years unless agreed to by both parties. The most recent allocation study is attached hereto as Exhibit B.

Section 7. Commodity Charges. The Commodity Charge shall include the following categories of operating expenses, to the extent such costs are not capitalized under generally accepted accounting principles: Administrative, Accounting, Construction Inspection, Engineering, Customer Service-Billing and Collection, Customer Service-Meter Reading, Operations Administration and General, Warehouse, Transmission and Distribution, Meter Repair, Water Source of Supply, Water Treatment, Water Pumping, and Laboratory Expense. In each category, the actual expense directly attributable to Goochland shall be determined, and the total annual Commodity Charge to Goochland shall be the sum of such expenses in each category directly attributable to Goochland.

Section 8. Capacity Charges. Capacity charges shall be the sum of the amounts determined for depreciation, payments in lieu of taxes and return on investment on the plant and facilities for intake, treatment, pumping and distribution allocated to serve Goochland. The allocation of plant and facilities costs partially allocable to Goochland shall be based on the ratio of Goochland's actual maximum day demand to the system maximum day demand or the ratio of contract maximum day demand to the system maximum day demand, whichever is higher during the fiscal year of the cost allocation study/formula. The cost of facilities or plant serving only Goochland (direct) shall be allocated directly to Goochland. The rate used to determine the Rate of Return on Investment shall be Henrico's average cost of outstanding debt during the period of the cost allocation study plus 2%, and the charge shall be based on the book value of joint and direct plant allocated to serve Goochland at the end of the fiscal year. The rate used to determine the Payment in Lieu of Taxes shall be Henrico's rates in effect during the period of the cost allocation study, and the charges shall be calculated on the book value of joint and direct plant allocated to serve Goochland at the end of the fiscal year. Facilities paid for by Goochland shall not be depreciated for purposes of calculation of Capacity Charges, nor shall return on investment be paid on such facilities. Henrico's costs for necessary capitalized repairs or necessary upgrades to the plant or facilities used to serve Goochland may be added to the calculations of Capacity Charges upon completion and placement into service of such repairs or upgrades. Prior to undertaking any such repairs or upgrades, Henrico shall advise Goochland of its plans and the effect upon Capacity Charges.

Section 9. Prepayment of Capacity Charges. Prior to completion of construction or expansion of any plant serving Goochland, Goochland may elect to prepay intake, treatment or distribution capacity charges in whole or in part. If Goochland so elects, the Goochland Engineer and the Director of the Henrico Department of Public Utilities shall agree upon the portion of treatment plant or distribution capacity to be allocated to Goochland expressed as a percentage of treatment or distribution plant capacity. The parties agree that Goochland's prepayment of capacity charges for 5.25 mgd of the 55 mgd water treatment plant shall be $13,389,920.00, subject to adjustment for change orders, refunds, and offsets upon completion of all construction activities. Upon billing by Henrico, Goochland shall pay to Henrico the Goochland portion of all expenses paid by Henrico in connection with the design and construction of the treatment plant and distribution plant which Henrico capitalizes as a project cost and upon completion, Goochland shall have the

right to receive from Henrico the quantity of water for which capacity charges are paid for by Goochland during the term of the contract. Goochland shall be entitled to pro rata refunds or offsets in the event that Henrico receives a refund or offset of any payment. After Goochland has prepaid for any capacity of the treatment or distribution plant, depreciation for that portion of the plant shall be considered to be zero for purposes of calculation of any capacity charge for that capacity. Goochland shall not pay return on investment for such portion of the plant. Goochland also may elect at any time after plant is placed in service to prepay capacity charges for intake, treatment or distribution in whole or in part. In such case, the prepayment amount by Goochland shall be the undepreciated amount which is the basis for the Capacity Charge for which prepayment is made as set forth in Section 8. The effect of such prepayment shall be that depreciation and return on investment components of Capacity Charges are eliminated for all items of plant for which prepayments are made. If the actual maximum day use by Goochland in any fiscal year exceeds the maximum day capacity purchased, then a capacity charge on the difference between the maximum day use and the maximum day capacity purchased will be billed to Goochland at the time the annual cost allocation study/formula is prepared and will be calculated according to Section 8.

Section 10. Henrico to Use Allocated Capacity. In the event that capacity allocated to Goochland pursuant to this Agreement is in excess of the capacity which Goochland reasonably anticipates using, Goochland shall notify Henrico by revising its estimates to reflect decreases in its anticipated usage. Goochland may revise its future capacity projections downward without cost or penalty at any time, provided that Henrico has not commenced design or construction of a capacity expansion to accommodate the Goochland projections of use. If Goochland desires to reduce future capacity projections following commencement of design or construction but prior to the placement of the plant or facilities into service, Henrico shall advise Goochland of the costs it has incurred attributed to the plant or facilities being designed or installed to meet Goochland's projections, and Goochland may pay that amount to Henrico as a cancellation fee. Following payment of such a fee, Goochland shall have no further obligations to use or pay for such capacity. If Goochland has already paid for the design or installation of capacity which has been placed into service and which it later determines it may not use, it shall so advise Henrico. In such a case, Henrico shall undertake to use such capacity for system purposes, including use by its customers or by any other local government or regional entity which may utilize water treatment by the Henrico treatment plant, at the first opportunity for such use. Upon the use of such capacity to serve other customers, Goochland shall no longer pay capacity charges for such plant, and Henrico shall refund to Goochland the depreciated value of such treatment capacity.

Section 11. Cost Allocation Formula. Because the actual cost of service for any fiscal year cannot be determined until the close of the accounting books for that period, Henrico shall bill estimated charges each month until a cost allocation formula is calculated and Henrico has determined the actual cost of service. The cost allocation formula shall determine the allocation of operating costs in accordance with Section 7 and capacity costs in accordance with Section 8. After the cost allocation formula has been prepared each year, the cost of service for the fiscal year shall be determined by multiplying the total amount of water sold to Goochland by the rate per hundred cubic feet (CCF) determined in the cost allocation formula to determine the Commodity Charge and adding that amount to the Capacity Charge, if any. For the first partial fiscal year of service, estimated costs shall be billed, and Goochland and Henrico shall confer prior to any billing in order to develop the best possible good faith estimates of such costs. Following the end of the first partial fiscal year, and each subsequent fiscal year, adjustments will be made pursuant to this Section for the following year, and reimbursements shall be made pursuant to Section 12. For each year following the first partial fiscal year, if applicable, the estimated monthly Capacity Charge to be billed shall be one twelfth (1/12) of the annual

Capacity Charge estimated by calculating the anticipated Capacity Charge for the fiscal year. The estimated Commodity Charge to be billed shall be the rate for the immediately preceding fiscal year, plus the average percentage increase in water rates for service to Henrico County retail water customers authorized by the Henrico County Board of Supervisors for the current year, multiplied by the usage incurred by Goochland, as metered or estimated pursuant to Section 16. Henrico shall complete the cost allocation study within sixty (60) days of the completion of Henrico's annual audit by its external auditors and provide a copy of the study and formula to Goochland. Bills will be rendered monthly and payment shall be due within thirty (30) days of receipt.

Section 12. Annual Reimbursement. In the event that payments made by Goochland exceed the computed cost of service for the fiscal year for which the cost allocation formula is prepared, then Goochland shall be reimbursed for the excess within thirty (30) days of completion of the cost allocation formula. If the payments made by Goochland are less than the computed cost of service, then Goochland shall pay the difference within thirty (30) days of billing.

Section 13. Quality of Service. Henrico shall provide the same quality of water to Goochland that it furnishes Henrico customers from the main or mains from which the water is taken by Goochland. Water pressure at each delivery point to Goochland shall be the same as provided to customers in Henrico at the metering point when Goochland's demand does not exceed the maximum-day flow rate at that meter.

Section 14. Construction of Mains. At the request of Goochland, Henrico shall construct water mains and connections in Henrico as necessary for Goochland to obtain water under this Agreement. Where the mains are solely for the benefit of Goochland, they shall be constructed at no cost to Henrico. All construction shall be in accordance with plans and specifications approved by the Henrico Director of Public Utilities. Upon completion and acceptance of such mains and connections, ownership shall be vested in Henrico for that portion of the water system up to and including the meter installation, and Henrico shall be responsible for operation and maintenance of such mains and connections.

Section 15. Construction and Operation in Goochland. Goochland shall construct, maintain, repair and operate water mains and connections in Goochland as are necessary to provide water service in Goochland under this Agreement. The design, construction, maintenance, repair and operation shall comply with applicable local, state and federal regulations. Goochland shall provide water storage and pumping facilities as required by VDH regulations and as necessary to meet Goochland's peak-hour demand, including needed fire flows. At the time this Agreement is executed, Goochland warrants that Goochland's plans and water pressure modeling for its proposed water storage and pumping facilities indicate that Goochland's existing and proposed facilities will be able to handle up to 5.25 mgd of water capacity. Prior to Goochland using water capacities greater than 5.25 mgd, Goochland's plans and water pressure modeling shall show that the proposed water storage and pumping facilities can handle the additional capacities. Henrico shall be entitled to review Goochland's plans and water system models. Should Henrico have any reasonable concerns about Goochland's plans or water system models, Goochland and Henrico shall discuss Henrico's concerns and work together to resolve them before additional capacities are used. Goochland shall have title to all water facilities in Goochland constructed or provided by Goochland. Should Goochland's operation cause Henrico's water system to be in noncompliance with VDH and other applicable rules and regulations, then Goochland will take immediate steps necessary to alleviate the situation, including necessary capital improvements as soon as reasonably practicable.

Section 16. Metering. Henrico shall provide, install and maintain the meter at each point of delivery of water to Goochland under this Agreement and the quantity of all water delivered to Goochland shall be measured through these meter(s). Henrico shall read all meters monthly. Goochland shall have the right to read such meters simultaneously with Henrico for the purpose of verifying the accuracy of such meters. Goochland shall not have access to meter vaults unless Henrico personnel are present but access by Goochland personnel or agents shall be neither denied nor unreasonably delayed. In the event of a meter failing to register properly for any cause, the quantity of water delivered shall be estimated based upon the average quantity delivered for the preceding twelve months, if available, or using another reasonable period of time or methodology as mutually agreed by the parties. Upon request, Henrico will provide Goochland with flow information which is available from the Henrico SCADA System, or some successor system providing the same type of information. Goochland may connect to the Henrico SCADA system, or a successor system, at its cost, and receive information directly from meters serving Goochland. However, actual meter readings will be used for billing purposes, except as otherwise provided herein.

Section 17. Limitation of Liability. Neither Henrico nor Goochland shall be liable in damages to the other for any act, omission, or circumstances occasioned by or in consequence of any acts of God, acts of the public enemy, wars, epidemics, landslides, lightning, earthquakes, fires, storms, floods, washouts, civil disturbances, explosions, breakage or accident to machinery or lines of pipe, or any other cause, not reasonably within the control of the party claiming suspension and which by the exercise of due diligence such party is unable to prevent or overcome. Such causes or contingencies affecting the performance hereunder by either Henrico or Goochland shall not relieve it of liability in the event of its concurring negligence or in the event of its failure to use due diligence to remedy the situation and to remove the cause in an adequate manner and with all reasonable dispatch, nor shall such causes or contingencies affecting such performance relieve either party from its obligations to make payment of amounts then due hereunder in respect of water theretofore delivered. Nothing contained in this section shall be construed as waiving any immunity which either County may possess.

Section 18. Interruption. Henrico shall have the obligation at all times to provide the maximum quantities of water to be delivered under this Agreement, and may interrupt such supply only in the event of emergencies beyond the control of Henrico, or by mutual consent if required for system maintenance or construction.

Section 19. Suspension/Limitation. Whenever in the reasonable judgment of Henrico an actual, bona fide emergency exists which requires the suspension or limitation of water services, service to Goochland customers hereunder may be suspended or limited as long as such emergency exists, but only if and to the extent that Henrico suspends or limits service to all similarly affected Henrico customers. Henrico will notify Goochland as soon as possible that services are to be or have been suspended or limited under this Section and, thereafter will keep Goochland advised as to when such services may be restored. In the event an emergency is declared, pursuant to the Code of Henrico, restrictions imposed on citizens of Henrico shall also be imposed on citizens of Goochland if supplied or supplemented from the affected water supply. Henrico shall act in good faith when declaring the existence of any such emergency, and shall take any and all reasonable measures to continue to supply all or part of Goochland's water supply needs despite the existence of any such emergency. The term "emergency" as used in this section shall include mandatory compliance with water conservation restrictions as required by the withdrawal permit conditions for a water conservation plan approved by the Virginia Department of Environmental Quality ("DEQ"), including any restrictions

placed upon the Henrico water system by DEQ upon renewal of Henrico's DEQ Virginia Water Protection Permit. The term "emergency" shall also include the voluntary conservation of water when conditions warrant; *e.g.*, when peak or maximum flows cause the Henrico water system to function improperly (*i.e.*, pressure below state regulations), or when requested by the City of Richmond. All voluntary measures shall be applied equally to Henrico and Goochland. In addition, Goochland agrees to pro rata flow reductions when future federal, state or local limitations or flow reductions are applied system-wide to all other users of the Henrico water system.

Section 20. Term. This agreement shall be in full force and effect from its date through and including June 30, 2032, and shall continue in force thereafter until terminated by either the County Manager of Henrico or County Administrator of Goochland giving to the other party hereto ten (10) years written notice to that effect. In the event this Agreement is canceled by Goochland and not replaced by a new agreement, Goochland shall pay Henrico an amount equal to the book value of plant directly allocated to Goochland and not paid for by Goochland whether through direct payments for capacity, monthly or annual capacity charges, or in another manner, including direct installation and payment therefor by Goochland. In the event this Agreement is canceled by Henrico and not replaced by a new agreement before the end of its term, Henrico shall pay Goochland an amount equal to the book value of plant directly allocated to Goochland and paid for by Goochland whether through direct payments for capacity, monthly or annual capacity charges, or in another manner, including direct installation and payment by Goochland. For purposes of calculation of any payments due from Goochland to Henrico under this section, book value shall be deemed to be zero for any item of plant that no longer decreases in value each year on Henrico's schedule of depreciation. This agreement shall be binding upon and inure to the benefit of the parties hereto and their successors or assigns. The parties specifically agree that their respective rights under this Agreement shall be assignable, provided that the assignor remains responsible for the performance of all contractual obligations set forth herein.

Section 21. Adoption of Henrico water conservation plan by Goochland. Within 30 days of execution of this agreement, or Henrico's final adoption of a water conservation plan, whichever is later, Goochland shall adopt the water conservation plan adopted by Henrico. Furthermore, within 30 days of adoption of water conservation plan amendments by Henrico, Goochland shall adopt all amendments to the Henrico water conservation plan.

IN WITNESS WHEREOF, Henrico and Goochland have caused this Agreement to be executed by their duly authorized officers.

[SIGNATURES FOLLOW ON NEXT PAGE]

COUNTY OF GOOCHLAND, VIRGINIA

By: _____
Chairman, Board of Supervisors

ATTEST:

_____
Clerk

Approved as to form:

_____
Goochland County Attorney

COUNTY OF HENRICO, VIRGINIA

By: _____
Chairman, Board of Supervisors

ATTEST:

_____
Clerk

Approved as to form:

_____
Assistant Henrico County Attorney

Water Projections

Average and Peak day Figures in MGD Peak hour figures in Million Gallons

Location		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030	2035	2040
Route 250	Average Day	0.014	0.018	0.024	0.150	0.195	0.254	0.330	0.428	0.557	0.724	1.030	1.465	2.084	2.965	4.217	5.999
	Peak Day	0.028	0.036	0.047	0.300	0.390	0.507	0.659	0.857	1.114	1.448	2.060	2.930	4.168	5.929	8.434	11.998
	Peak Hour	0.001	0.002	0.002	0.013	0.016	0.021	0.027	0.036	0.046	0.060	0.086	0.122	0.174	0.247	0.351	0.500
Ridgefield Parkway	Average Day	0.000	0.103	0.129	0.161	0.201	0.251	0.314	0.393	0.491	0.614	0.747	0.909	1.107	1.347	1.639	1.995
	Peak Day	0.000	0.206	0.258	0.322	0.402	0.503	0.629	0.786	0.982	1.228	1.494	1.819	2.213	2.693	3.278	3.989
	Peak Hour	0.000	0.009	0.011	0.013	0.017	0.021	0.026	0.033	0.041	0.051	0.062	0.076	0.092	0.112	0.137	0.166
Patterson Avenue	Average Day	0.076	0.099	0.128	0.167	0.217	0.282	0.367	0.477	0.620	0.806	1.067	1.414	1.873	2.480	3.285	4.351
	Peak Day	0.152	0.198	0.257	0.334	0.434	0.564	0.734	0.954	1.240	1.612	2.135	2.828	3.745	4.961	6.570	8.703
	Peak Hour	0.006	0.008	0.011	0.014	0.018	0.024	0.031	0.040	0.052	0.067	0.089	0.118	0.156	0.207	0.274	0.363
River Road	Average Day	0.101	0.104	0.107	0.110	0.114	0.117	0.121	0.124	0.128	0.132	0.136	0.140	0.144	0.148	0.153	0.157
	Peak Day	0.202	0.208	0.214	0.221	0.227	0.234	0.241	0.248	0.256	0.264	0.271	0.280	0.288	0.297	0.306	0.315
	Peak Hour	0.008	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.013
Totals	Average Day	0.191	0.324	0.388	0.588	0.727	0.904	1.131	1.422	1.796	2.276	2.980	3.928	5.207	6.940	9.294	12.502
	Peak Day	0.382	0.648	0.776	1.177	1.454	1.808	2.263	2.845	3.592	4.551	5.961	7.856	10.415	13.880	18.588	25.004
	Peak Hour	0.016	0.027	0.032	0.049	0.061	0.075	0.094	0.119	0.150	0.190	0.248	0.327	0.434	0.578	0.775	1.042

EXHIBIT A
Water Agreement

GOOCHLAND WATER COST OF SERVICE
2000-01 WATER RATE

VOLUME PURCHASED (CCF)		76,320
CAPACITY CHARGE	$0.878	$66,976
COMMODITY COSTS	$1.008	$77,002
ACTUAL COST	$1.886	$143,978
ACTUAL AMOUNT BILLED	$1.623	$123,853
AMOUNT (OVER) UNDER COST	$0.263	$20,125

EXHIBIT B
Water Agreement

JOCHLAND WATER COST OF SERVICE
,000-01 OPERATING EXPENSE ALLOCATION

INDEX #	INDEX	2001 ACTUAL	% WATER	2001 WATER	GOOCHLAND SHARE (%)	GOOCHLAND SHARE ($)	GOOCHLAND RATE/CCF
J10	ADMINISTRATIVE	2,016,601	60.2200%	1,214,397	0.4439%	5,391	$0.071
J11	ACCOUNTING	325,511	60.2200%	196,023	0.4439%	870	$0.011
J12	ENGINEERING	383,318	60.2200%	230,834	0.4439%	1,025	$0.013
J13	TV INSPECTION	116,192	60.2200%	69,971	0.0000%	0	$0.000
J14	CONSTRUCTION INSP	328,523	60.2200%	190,133	0.0000%	0	$0.000
J15	CUST SERV-BILL/COLL	1,045,454	51.0700%	533,913	0.0025%	13	$0.000
J16	CUST SERV-READING	471,836	51.0700%	240,967	0.0037%	9	$0.000
J17	OPERATIONS A & G	540,039	60.2200%	325,211	0.4439%	1,444	$0.019
J18	WAREHOUSE	133,226	60.2200%	80,229	0.4439%	356	$0.005
J19	UTILITY SUPPORT SYSTEMS	948,146	60.2200%	570,974	0.4439%	2,535	$0.033
J20	TRANSMISSION & DIST	2,047,879	100.0000%	2,047,879	0.4439%	9,091	$0.119
J21	METER REPAIR	213,933	100.0000%	213,933	0.0037%	8	$0.000
J30	COLLECTION	1,392,545	0.0000%	0	0.0000%	0	$0.000
J40	WATER PUMPING	640,333	100.0000%	640,333	0.4439%	2,842	$0.037
J45	WATER SOURCE OF SUPPLY (WELLS)	296,650	100.0000%	296,650	0.0000%	0	$0.000
JXX	WATER TREATMENT PLANT	0	100.0000%	0	0.4439%	0	$0.000
J50	WASTEWATER PUMPING	2,639,443	0.0000%	0	0.0000%	0	$0.000
J51	TRI COUNTY REGIONAL JAIL FARM	0	100.0000%	0	0.0000%	0	$0.000
J55	WASTEWATER TREATMENT	555,431	0.0000%	0	0.0000%	0	$0.000
J70	WW TREATMENT FACILITY	3,681,711	0.0000%	0	0.0000%	0	$0.000
J71	W/W BIOSOLID DISPOSAL	0	0.0000%	0	0.0000%	0	$0.000
J77	WWTP - MAINTENANCE	1,321,937	0.0000%	0	0.0000%	0	$0.000
J78	MONITORING & COMPLIANCE	359,696	0.0000%	0	0.0000%	0	$0.000
J79	LABORATORY	608,984	60.2200%	366,730	0.4439%	1,628	$0.021
	WATER SOURCE OF SUPPLY (PURCH FR CITY)	11,666,998	100.0000%	11,666,998	0.4439%	51,790	$0.679
	TOTAL OPERATING COST	31,734,386		18,885,175		77,002	$1.008
	PAYMENT IN LIEU OF TAXES	3,768,197		1,271,052			
	INTEREST EXPENSE	8,064,757					
	DEBT SERVICE	5,720,000		20,156,227			
	DEPRECIATION	15,611,885					
	TOTAL COST	64,899,225					
	WATER PURCHASES FROM CITY (CCF)			17,192,170			
	GOOCHLAND PURCHASES FROM HENRICO (CCF)			76,320			

$\frac{13,389,920.00}{5.25} - \frac{16,042,400.00}{6.27}$

GOOCHLAND WATER COST OF SERVICE

2000-01 ALLOCATION BASIS:	GOOCHLAND	OTHER	SYSTEM TOTAL
AVG CONSUMPTION (CCF)	76,320	17,115,850	17,192,170
	0.4439%	99.5561%	100.0000%
# OF METERS	3	81,394	81,397
	0.0037%	99.9963%	100.0000%
BILLS PRODUCED	12	472,467	472,479
	0.0025%	99.9975%	100.0000%
NON COINCIDENT PEAK DAY FOR FISCAL 1992-93 (MGD)	1.195	59.259	60.454
	1.9767%	98.0233%	100.0000%

2000-01 PLANT ALLOCATION:		COST	ACCUM DEPR	BOOK VALUE
LAND		266,967	0	266,967
BUILDINGS		2,707,289	881,333	1,825,957
IMPROVEMENTS		247,151,571	62,996,402	184,155,169
EQUIPMENT		5,733,017	3,622,006	2,111,011
TOTAL PLANT		255,858,845	67,499,740	188,359,104
LESS: HENRICO DIRECT PLANT		(212,286,523)	(55,318,234)	(156,968,289)
JOINT PLANT		43,572,322	12,181,506	31,390,815
GOOCHLAND PORTION OF JOINT PLANT	1.977%	861,294	240,792	620,502
GOOCHLAND DIRECT PLANT		0	0	0
GOOCHLAND PORTION OF JOINT PLANT		861,294	240,792	620,502
LUMP SUM CAPACITY PAYMENTS		0		
TOTAL PLANT AFTER LUMP SUM PAYMENTS		861,294	240,792	620,502
TOTAL PLANT (DEPRECIATION BASE)		255,858,845		
DEPRECIATION		5,177,152		
COMPOSITE RATE		2.02%		
DEPRECIATION	2.02%	17,398	BASED ON COST AFTER LUMP SUM PAYMENTS	
RETURN	7.05%	43,745	BASED ON BOOK VALUE AFTER LUMP SUM PAYMENTS	
REAL ESTATE TAX	0.94%	5,833	BASED ON BOOK VALUE	
TOTAL CAPACITY CHARGE		66,976		

PIPE SIZE ADJUSTMENT:		COST	ACCUM	NET
30"		78,463	30,469	47,994
24"		2,145,538	642,866	1,502,672
16"		14,306,422	3,630,765	10,675,656
12"		25,558,077	7,383,692	18,174,385
		42,088,499	11,687,793	30,400,707
TOTAL WATER MAINS		240,822,692	62,855,060	177,967,631
ADJUSTMENT FOR MAINS UNDER 12"		198,734,192	51,167,268	147,566,925
SOURCE OF SUPPLY-WELLS (J45)		773,292	459,120	314,172
12" MAINS NOT USED FOR TRANSMISSION	50.00%	12,779,039	3,691,846	9,087,192
ADJUSTMENT FOR HENRICO DIRECT PLANT		212,286,523	55,318,234	156,968,289

APPENDIX E
Residential Well Survey

GOOCHLAND COUNTY GROUND WATER SURVEY DATA

RESIDENTIAL WELLS

DAA PROJECT NO. R07246-01

TAX MAP #1																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 1 - Autumn Ridge	D	99-157-0212	1 (1) 4	3	2/25/2000	170	120	50	6 ¼	0	120	160	165	-	-	-	-	5	Swift
R	5370 Martin Road	D	05-137-9405	1 (1) 29	3	1/27/2005	500	58	20	6 ¼	1+	62	-	-	-	-	-	-	5	Curtis
R	LOT 7 - Deer Run	D	00-137-0269	1 (6) 7	3	12/6/2000	120	100	60	6 ¼	1+	99	110	113	-	-	-	-	20	Curtis
TAX MAP #2																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	5012 Fleming Crossroads	D	02-137-0099	2 (5) 1	3	8/6/2002	200	94	42	6 ¼	1+	94	280	300	-	-	-	-	40	Royall
R	5008 Fleming Crossroads	D	03-137-0048	2 (5) 2	3	4/14/2003	200	104	30	6 ¼	1+	103	180	200	-	-	-	-	25	Curtis
R	5000 Fleming Crossroads	D	04-137-0208T	2 (5) 3	3	1/20/2005	140	104	30	6 ¼	0	106	114	115	-	-	-	-	25	Curtis
R	LOT 4 - Fleming Crossroads	D	02-137-0292	2 (5) 4	3	1/9/2003	260	NA	28	4 ½	0	130	-	-	-	-	-	-	25	Curtis
R	5011 Fleming Crossroads	D	02-137-0410	2 (5) 6	3	9/11/2002	120	48	NA	6 ¼	0	50	108	109	-	-	-	-	10	Curtis
R	LOT 12 - Shannon Hill	D	05-137-0203	2 (3) 12	3	3/3/2006	115	85	25	6 ¼	0	85	90	100	-	-	-	-	20	Curtis
R	4070 County Line Road - Church	D	03-137-0208	2 (1) 30	3	7/21/2006	600	58	30	6 ¼	0	60	369	370	-	-	-	-	1	Curtis
R	LOT 4 - Chestnut Hills	D	NA	2 (1) 21	3	6/30/2001	105	53	25	6 ¼	0	55	80	90	-	-	-	-	10	Curtis
TAX MAP #3																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	4486 Shannon Hill Rd	D	98-137-0046	3 (2) 1	3	5/10/1998	130	60	25	6 ¼	0	60	120	125	-	-	-	-	5	Swift
R	Route 605 - Shannon Hill	D	97-137-0242	3 (2) 3	3	11/2/1997	115	77	20	6 ¼	0	77	82	85	-	-	-	-	10	Curtis
R	LOT 5 - Caledonia Pines	D	NA	3 (1) 8	3	11/9/2005	350	62	NA	6 ¼	1+	65	260	270	-	-	-	-	½	Curtis
R	4220 Shannon Hill Rd	D	04-137-0328	3 (5) 0	3	1/12/2005	200	85	30	6 ¼	1+	84	180	200	-	-	-	-	15	Curtis
TAX MAP #4																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 10 - Shannon Hill	B	95-137-0009	4 (2) 10	3	2/12/1996	45	45	30	30	0	45	30	45	-	-	-	-	4	Ashland Well
R	5051 Shannon Hill Rd	B	01-137-0254	4 (1) 35	3	9/24/2001	30	30	20	30	1	30	20	30	-	-	-	-	5	Ashland Well
R	4421 Tabscott Rd	B	95-137-0136	4 (6) 1	3	4/5/1996	54	NA	25	30	1	54	25	40	-	-	-	-	5	Ashland Well
R	4700 Shannon Station Ln	D	95-137-0030	4 (7) 10	3	04/13/1997	105	60	10	6 ¼	0	60	75	80	-	-	-	-	20	Swift
R	4900 Tabscott Rd	B	NA	4 (8) C	3	2/13/1998	58 ½	57	NA	24	0	58 ½	-	-	-	-	-	-	NA	Fred Jones
R	LOT 4 - Shannon Hill	D	NA	4 (6) 4	3	10/7/1990	305	48	23	6	1+	59	-	-	-	-	-	-	8	Appletree
R	4618 Slippery Rock Ln	D	1390-427	4 (3) 12	3	6/12/1991	165	NA	21	6 ¼	1+	50	-	-	-	-	-	-	5	Curtis
TAX MAP #5																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	4231 Rollins Dr	D	48-137-0065	5 (1) 36	3	11/14/1998	125	29	18	6 ¼	1+	29	100	125	-	-	-	-	20	Curtis
R	5616 Broad Street Rd	D	99-137-0258	5 (3) 31	3	1/5/2000	400	40	50	6 ¼	1+	40	260	280	-	-	-	-	1 ½	Curtis
R	LOT 2B Countyline Estates	D	07-137-0036	5 (19) B2	3	2/3/2007	240	68	30	6 ¼	1+	67	180	240	-	-	-	-	6	Curtis
R	Parcel A Route 720	D	98-137-0190	5 (1) 37	3	12/8/1998	180	79	19	6 ¼	1+	79	140	180	-	-	-	-	10	Curtis
R	LOT 49 - Hidden Acres	D	98-137-0530	5 (1) 49	3	11/11/1999	205	88	40	6 ¼	0	88	-	-	-	-	-	-	6	Curtis
R	LOT 76 - Hidden Acres	B	85-137-0016	5 (1) 76	3	4/11/1986	39	NA	NA	24	0	39	-	-	-	-	-	-	NA	Gentry
R	5050 Three Chopt Road	D	97-137-0042	5 (5) E	3	10/23/1997	405	89	NA	6 ¼	2+	89	-	-	-	-	-	-	3 ¼	Royall
R	LOT A - Countyline Estates	B	87-137-0055	5 (8) A	3	05/15/1987	21	NA	11	30	0	21	11	21	-	-	-	-	4	Ashland Well
R	4628 Peters Creek Rd	B	98-137-0182	5 (13) 12	3	1/14/1999	57	56	NA	24	0	57	-	-	-	-	-	-	NA	Fred Jones
R	LOT 20 - Shannon Hill Farms	D	88-137-0062	5 (13) 20	3	8/13/1988	200	87	25	6	0	87	140	145	180	185	-	-	13	Swift
R	LOT 21 - Shannon Hill Farms	D	99-137-0240	5 (13) 21	3	3/8/2000	140	71	15	6¼	1+	75	-	-	-	-	-	-	25	Anderson
R	LOT 1 - Royal Oak Estates	D	92-137-0105	5 (18) 1	3	6/30/1992	145	90	30	6¼	0	90	130	135	-	-	-	-	10	Curtis
R	LOT 3 - Royal Oak Estates	D	94-137-0013	5 (3) 1	3	3/8/1995	160	65	NA	6¼	1+	69	-	-	-	-	-	-	15	Anderson
R	LOT 6 - County Line Estates	D	95-137-0198	5 (19) B6	3	11/17/1997	125	78	NA	6¼	0	80	91	92	112	113	-	-	10	Curtis
R	LOT 11 - Shelton Ridge	D	99-137-0036	5 (20) 11	3	7/25/1999	185	77	70	6¼	0	77	-	-	-	-	-	-	8	Curtis
R	LOT 6 - Broad Pines	D	98-137-0160	5 (22) 6	3	2/24/1999	125	78	22	6 ¼	1+	79	100	120	-	-	-	-	20	Curtis
R	LOT 9 - Shelton Ridge	D	98-137-0079	5 (20) 9	3	7/14/1998	300	50	18	6 ¼	1+	50	230	290	-	-	-	-	6	Curtis
R	LOT 35 - Royal Oak Estates	D	03-137-0281	5 (27) 35	3	11/25/2003	300	50	NA	6 ¼	1+	52	286	300	-	-	-	-	8	Curtis
R	LOT 34 - Royal Oak Estates	D	01-137-0427	5 (27) 34	3	4/12/2002	125	44	NA	6 ¼	1+	44	100	125	-	-	-	-	15	Curtis
R	4985 Double Eagle Dr	D	NA	5 (27) 32	3	11/4/2005	110	52	30	6 ¼	0	52	100	105	-	-	-	-	20	Curtis
R	LOT 6 - Royal Oak Estates	D	99-137-0360	5 (25) 6	3	3/17/2000	304	NA	NA	6 ¼	0	115	144	164	164	184	-	-	25	Gammon
R	LOT 2 - Royal Oak Estates	D	99-137-0364	5 (25) 2	3	3/24/2000	304	NA	NA	6 ¼	0	76	110	115	150	160	280	284	15	Gammon
R	LOT 3 - Royal Oak Estates	D	02-137-0065	5 (25) 3	3	08/20/2002	300	75	45	6 ¼	1+	75	105	107	-	-	-	-	3	Curtis
R	LOT 3 - Shelton Ridge	D	00-137-0274	5 (21) 3	3	1/30/2002	300	50	40	6 ¼	1+	50	281	285	-	-	-	-	4	Curtis
R	LOT 36C - Hidden Acres	D	01-137-0436	5 (1) 36C	3	3/3/2002	260	93	20	6 ¼	1+	93	180	240	-	-	-	-	7	Curtis
R	LOT 51 - Royal Virginia	D	99-137-0051	5 (1) 55	3	9/1/1999	400	24	11	6 ¼	1+	24	360	400	-	-	-	-	2	Curtis
R	5423 Three Chopt Rd	D	06-137-0009	5 (1) 24	3	06/17/2006	220	104	30	6 ¼	1+	103	180	200	-	-	-	-	7	Curtis
R	LOT 6 - Broad Pines	D	98-137-0157	5 (22) 6	3	2/24/1999	125	78	22	6 ¼	1+	78	100	120	-	-	-	-	20	Curtis

GOOCHLAND COUNTY GROUND WATER SURVEY DATA

RESIDENTIAL WELLS

DAA PROJECT NO. R07246-01

TAX MAP #6																					
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	Broad Street Road	D	88-137-1047	6 (1) 10C	3	9/1/1988	255	150	30	6 ¼	1+	150	-	-	-	-	-	-	3	Curtis
R	Broad Street Road	B	96-137-0059	6 (1) 12A	3	5/20/1997	45	NA	20	30	0	45	20	45	-	-	-	-	4	Ashland Well
R	LOT 2 - Quarter Mill	D	99-137-0099	6 (1) 53	3	11/1/1999	100	55	20	6 ¼	0	55	60	65	-	-	-	-	10	Swift
R	LOT 15 - Hadensville Farms	D	94-137-0166	6 (4) 15	3	3/15/1995	225	70	14	6 ¼	1+	69	180	190	215	220	-	-	8	Curtis
R	LOT 3 - Hadensville Farms	D	99-137-0033	6 (4) 3	3	7/21/1999	160	88	22	6 ¼	1+	87	140	160	-	-	-	-	10	Curtis
R	4151 Broad Street Road	D	00-137-0008	6 (1) 4B	3	7/19/2000	85	30	NA	6 ¼	0	85	49	50	-	-	-	-	100	Curtis
R	LOT 10 - Lake Killarney	D	01-137-0455	6 (3) 10	3	6/6/2002	125	85	40	6 ¼	1+	85	110	115	-	-	-	-	10	Curtis
R	4650 Old Fredericksburg Rd	D	01-137-0367	6 (6) 4	3	10/11/2001	140	90	NA	6 ¼	0	92	126	127	-	-	-	-	20	Curtis
R	LOT 7 - Hadensville Farms	D	99-137-0218	6 (4) 7	3	6/9/2000	120	50	20	6 ¼	0	50	110	115	-	-	-	-	10	Curtis
R	Route 609 & I-64 - Hadensville	D	05-137-0215	6 (1) 57	3	7/13/2005	300	96	12	6 ¼	1+	96	280	300	-	-	-	-	2	Curtis
R	LOT 20 Hadensville Farms	D	98-137-0297	6 (4) 20	3	6/3/1999	260	117	30	6 ¼	1+	117	240	260	-	-	-	-	6	Curtis
TAX MAP # 9																					
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	3981 Wildflower Creek Lane	D	99-137-0091	9 (9) 2	3	10/27/1999	400	55	50	6 ¼	1+	55	350	400	-	-	-	-	½	Curtis
R	Off Route 605/Shannon Hill Road	D	05-137-0050T	9 (7) C	3	12/3/2005	300	80	30	6 ¼	1+	79	-	-	-	-	-	-	7	Curtis
R	3930 Fourcee Farms Lane	D	05-137-0416	9 (13) 2	3	3/28/2006	200	70	30	6 ¼	1+	69	180	200	-	-	-	-	20	Curtis
R	3091 Three Chopt Road	B	94-137-0114	9 (1) 770	3	10/17/1994	42	41	NA	24	0	42	-	-	-	-	-	-	1	Fred Jones
R	3951 Wildflower Creek Lane	D	98-137-0281	9 (9) 6	3	2/10/1999	305	50	40	6 ⅝	0	50	-	-	-	-	-	-	1	Fred Jones
R	6005 Community House Road	D	01-137-0158	9 (11) 7D	3	9/21/2001	200	95	30	6 ¼	0	95	110	115	197	199	-	-	5	Curtis
R	LOT 4 - Lantana South	D	01-137-0245	9 (12) 4	3	5/16/2002	145	87	93	6 ¼	0	87	-	-	-	-	-	-	15	Hall Well
R	3500 Lowry Road	D	NA	9 (11) 6	3	8/10/2002	165	95	30	6 ¼	0	95	150	160	-	-	-	-	10	Curtis
R	3746 Shannon Hill Road	D	05-137-0118	9 (1) 40A	3	4/18/2005	160	52	30	6 ¼	1+	51	100	160	-	-	-	-	20	Curtis
R	3933 Fourcee Farms Lane	D	06-137-0347	9 (13) 3	3	2/3/2007	520	52	30	6 ¼	1+	51	400	520	-	-	-	-	6	Curtis
R	LOT 5 -Fourcee Farms	D	05-137-0079	9 (13) 5	3	3/24/2005	440	100	30	6 ¼	1+	99	400	440	-	-	-	-	2	Curtis
R	Caldonia Subdivision	D	00-137-0159	9 (9) 8	3	9/21/2000	260	115	30	6 ¼	1+	115	160	165	-	-	-	-	5	Curtis
R	Wildflower Lane	D	99-137-0124	9 (9) 7	3	10/28/1999	260	95	30	6 ¼	1+	45	160	170	-	-	-	-	6	Curtis
R	3980 Wildflower Circle Lane	D	05-137-0353	9 (9) 1	3	5/13/2006	365	58	30	6 ¼	1+	57	200	365	-	-	-	-	100+	Curtis
R	LOT 2 - Lanana South	D	02-137-0561	9 (12) 2	3	2/27/2006	200	58	25	6 ¼	1+	57	62	200	-	-	-	-	12	Curtis
R	3926 Fourcee Farms Lane	D	05-137-0405	9 (13) 1	3	3/29/2006	240	70	25	6 ¼	1+	69	200	240	-	-	-	-	12	Curtis
TAX MAP #10																					
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 2 - Shannon Hill	B	98-137-0140	10 (1) 2	3	7/1/1999	53	NA	26	30	0 & 20	20 & 53	26	53	-	-	-	-	4	Ashland Well
R	3475 Tabscott Road	D	93-137-0141	10 (1) 25B	3	11/16/1994	125	66	NA	6 ¼	0	68	74	75	111	112	-	-	25	Curtis
R	LOT 32 - Shannon Hill	D	99-137-0064	10 (1) 32	3	7/6/1999	400	39	15	6 ¼	1+	39	380	385	-	-	-	-	2 ½	Curtis
R	Route 603	B	92-137-0067	10 (6) A5	3	5/18/1992	73	NA	NA	30	1+	73	40	73	-	-	-	-	1	Curtis
R	Route 688	D	99-137-0326	10 (1) 37	3	11/18/1999	165	42	52	6 ¼	0	42	-	-	-	-	-	-	10	Curtis
TAX MAP #11																					
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	4221 Hickory Hill Road	D	98-137-0081	11 (1) 53E	3	8/14/1998	180	42	18	6 ¼	1+	42	160	180	-	-	-	-	30	Curtis
R	Pace Road	D	98-137-0213	11 (1) 47	3	11/12/1999	105	77	NA	6 ¼	0	79	88	89	-	-	-	-	15	Curtis
R	3810 Hadensville Fife Road	D	05-137-0313	11 (1) 5	3	9/15/2005	500	52	30	6 ¼	1+	51	460	500	-	-	-	-	20	Curtis
R	3944 Pace Road	D	97-137-0029	11 (1) 29	3	9/15/1997	105	20	10	6 ¼	0	20	40	45	-	-	-	-	10	Swift
R	Route 606	B	90-137-0229	11 (1) 23	3	4/8/1991	34	NA	NA	30	1+	34	15	34	-	-	-	-	5	Amelia Well
R	Fleischman Road	D	94-137-0249	11 (1) 5	3	4/20/1995	105	53	NA	6 ¼	0	55	71	72	89	90	-	-	30	Curtis
R	4233 Hickory Hill Road	D	99-137-0074	11 (1) 53	3	1/12/2000	100	20	15	6 ¼	0	20	90	95	-	-	-	-	10	Curtis
R	LOT 3 - Royal Virginia	D	04-137-0083	11 (16) 30	3	07/10/2004	400	101	30	6 ¼	1+	60	160	400	-	-	-	-	10	Curtis
R	4980 Double Eagle Drive	D	03-137-0170	11 (15) 19	3	11/25/2003	302	NA	NA	6 ⅝	0	65	-	-	-	-	-	-	8	Gammon
R	LOT 16 - Royal Virginia	D	02-137-0142	11 (15) 16	3	6/21/2002	320	24	10	6 ¼	1+	28	-	-	-	-	-	-	7	Curtis
R	3043 Putting Green Way (Well # 2)	D	06-137-0136	11 (15) 17	3	10/27/2006	145	5	5	6 ¼	0	50	40	65	80	85	120	125	15	Curtis
Ag	3043 Putting Green Way (Well # 1)	D	06-137-0136	11 (15) 17	3	10/27/2006	325	69	10	6 ¼	0	69	145	150	-	-	-	-	1	Curtis
R	LOT 53 - Royal Virginia Golf Club	D	99-137-0377	11 (13) 53	3	4/11/2000	200	52	70	6 ¼	1+	52	165	170	183	185	-	-	15	Curtis
R	LOT 29 - Royal Virginia	D	05-137-0367	11 (16) 29	3	06/16/2006	400	90	30	6 ¼	1+	89	260	400	-	-	-	-	13	Curtis
TAX MAP #12																					
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	Route 609	B	94-137-0254	12 (18) C	2	3/13/1995	37	37	20	30	1+	37	20	32	-	-	-	-	5	Ashland Well
R	LOT 1 - Beachtree Springs	D	97-137-0148	12 (26) 1	3	8/18/1998	186	32	24	6 ¼	1+	32	160	186	-	-	-	-	7	Curtis
R	3512 Pacetown Road	D	04-137-0142	12 (29) 7	3	9/16/2005	500	53	30	6 ¼	1+	52	400	500	-	-	-	-	1	Curtis
R	Route 615	B	98-137-0020	12 (2) 1C	3	7/17/1998	36	NA	20	30	0	36	20	36	-	-	-	-	4	Ashland Well

R	3967 Cedar Plains Road	B	88-137-0057	12 (1) 71	2	5/20/1997	30	30	18	30	1+	30	18	30	-	-	-	-	4	Ashland Well
R	Broad Street Road	D	99-137-0007	12 (1) 55	3	5/18/1999	190	23	20	6 ¼	0	23	180	185	-	-	-	-	4	Curtis
R	Cedar Plains Road	D	98-137-0175	12 (1) 39	3	10/31/1998	250	50	30	6 ¼	0	50	240	245	-	-	-	-	40	Swift
R	Route 611	B	99-137-0142	12 (1) 37	3	6/28/1999	34	34	20	30	1	34	20	28	-	-	-	-	5	Ashland Well
R	4640 Three Chopt Road	D	96-137-0165	12 (1) 16A	3	1/9/1997	145	85	35	6 ¼	0	85	125	138	-	-	-	-	5	Swift
R	LOT 14 - Hadensville Farms	D	01-137-0160	12 (8) 14		11/5/2001	420	75	10	6 ¼	1+	79	-	-	-	-	-	-	3	Curtis
R	LOT 14A - Lake Killarney	D	NA	12 (6) 14A		5/11/2000	130	35	25	6 ¼	0	35	120	125	-	-	-	-	5	Curtis

GOOCHLAND COUNTY GROUND WATER SURVEY DATA

RESIDENTIAL WELLS

DAA PROJECT NO. R07246-01

R	Cedar Plains Road	D	00-137-0107	12 (1) 7IG		6/6/2000	200	69	22	6 ¼	1+	69	150	200	-	-	-	-	8	Curtis
R	Route 609	D	01-137-0400	12 (1) 61D		5/30/2002	440	50	46	6 ¼	1+	50	210	213	-	-	-	-	½	Curtis
R	Route 609	B	01-137-0149	12 (1) 46E		12/7/2001	55	NA	35	30	0	54 ½	-	-	-	-	-	-	3	Dowdy's Well
R	3640 Forest Grove Road	D	99-137-0054	12 (1) 26	3	7/25/2000	215	48	NA	6 ¼	0	50	81	82	207	208	-	-	8	Curtis
R	4525 Three Chopt Road	D	01-137-0423	12 (1) 7		1/15/2002	300	65	20	6 ¼	1+	65	280	290	-	-	-	-	2	Curtis
R	4146 Broad Street Road	D	05-137-0430	12 (30) 3	2	2/28/2007	400	52	30	6 ¼	1+	51	320	400	-	-	-	-	3	Curtis
R	4150 Broad Street Road	D	06-137-0279	12 (30) 2	2	3/1/2007	300	80	30	6 ¼	1+	79	100	300	-	-	-	-	50	Curtis
R	Hamlin Oaks	D	00-137-0057	12 (13) 7		4/13/2000	220	43	20	6 ¼	1+	43	-	-	-	-	-	-	6	Curtis
R	LOT 19 - Lake Killarney	D	99-137-0119	12 (6) 19		9/4/1999	165	49	14	6 ¼	1+	49	150	165	-	-	-	-	10	Curtis
TAX MAP #13																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 25 - Countryside West	D	95-137-0023	13 (13) 25	2	7/17/1995	200	85	NA	6 ¼	0	87	92	93	-	-	-	-	3 ½	Curtis
R	3908 Broad Street Road	D	98-137-0318	13 (1) 16A	2	5/6/1999	200	50	20	6 ¼	1+	50	185	200	-	-	-	-	15	Curtis
R	3725 Broad Street Road	B	90-137-0172	13 (9) 4	2	8/6/1990	30	30	15	30	1	30	15	30	-	-	-	-	4	Ashland Well
R	4924 Penny Lane	D	96-137-0233	13 (3) 5A	2	4/12/1997	200	52	20	6 ¼	0	52	95	100	-	-	-	-	3	Swift
R	4039 Broad Street Road	D	99-137-0293	13 (1) 57	2	11/19/1999	240	89	34	6 ¼	1+	89	220	240	-	-	-	-	8	Curtis
R	LOT 1 - Knibb-Blanford Tact	D	95-137-0130	13 (1) 52A	2	10/10/1995	225	51	25	6 ¼	1+	55	165	166	200	201	-	-	4	Curtis
R	LOT 4 - Oak Forest	B	94-137-0226	13 (1) 40	2	4/10/1995	52	NA	NA	30	1+	52	37	52	-	-	-	-	2	Curtis
R	3843 Broad Street Road	D	93-137-0183	13 (1) 20E	2	4/11/1994	125	61	30	6 ¼	0	61	110	115	-	-	-	-	5	NA
R	3855 Three Chopt Road	D	98-137-0196	13 (1) 18	2	12/30/1998	145	62	NA	6 ¼	0	64	93	94	129	130	-	-	8	Curtis
R	3872 Cabin Road	B	96-137-0110	13 (1) 12A	2	10/11/1996	63	NA	45	30	0	63	45	63	-	-	-	-	4	Ashland Well
R	3747 Broad Street Road	D	04-137-0478	13 (9) 2	2	4/5/2005	300	67	30	6 ¼	1+	66	210	300	-	-	-	-	10	Curtis
R	LOT 7 - Leake's Mill	D	02-137-0009	13 (22) 7	2	2/4/2002	200	25	25	6 ¼	0	25	35	50	125	130	165	170	3	Swift
R	4424 New Line Road	D	00-137-0204	13 (18) 4	2	3/8/2001	200	65	30	6 ¼	0	65	80	85	165	170	-	-	4	Swift
R	3769 Three Chopt Road	B	99-137-0356	13 (1) 42A	2	10/17/2000	54	NA	25	30	20	54	25	54	-	-	-	-	4	Curtis
R	612 Three Chopt Road	D	01-137-0233	13 (1) 1	2	8/3/2001	125	75	25	6 ¼	1+	75	90	100	-	-	-	-	15	Curtis
R	4048 Broad Street Road	D	99-137-0187	13 (1) 54	2	5/18/2000	570	72	18	6 ¼	1+	72	400	570	-	-	-	-	8	Curtis
R	3843 Broad Street Road	D	94-137-0143	13 (1) 20E	2	10/18/1994	165	36	26	6 ¼	1+	50	140	160	-	-	-	-	30	Curtis
R	3815 Three Chopt Road	D	99-137-0335	13 (1) 20A	2	3/23/2000	185	90	15	6 ¼	1+	90	175	180	-	-	-	-	8	Curtis
R	4039 Broad Street Road	D	99-137-0293	13 (1) 57	2	11/19/1999	240	89	34	6 ¼	1+	89	220	240	-	-	-	-	8	Curtis
R	3745 Broad Street Road	D	04-137-0477	13 (9) 1	2	4/4/2005	200	87	30	6 ¼	1+	86	140	200	-	-	-	-	15	Curtis
TAX MAP #14																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	4862 West Grey Fox Circle	D	05-137-0375	14 (2) 16	2	10/31/2005	420	170	30	6 ¼	1+	169	280	420	-	-	-	-	9	Curtis
TAX MAP #15																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 32 - Ravenwood Road	D	98-137-0234	15 (5) 32	3	6/21/1999	320	75	NA	6 ¼	1+	79	-	-	-	-	-	-	6	Anderson
R	6412 River Road West	D	02-137-0114	15 (5) 5	3	6/13/2002	380	20	60	6 ¼	1+	20	370	375	-	-	-	-	10	Curtis
R	LOT 26 - James River Farms	D	99-137-0116	15 (5) 26	3	9/11/1999	500	55	34	6 ¼	1+	55	450	500	-	-	-	-	1	Curtis
R	LOT 16 - James River Farms	D	06-137-0005	15 (5) 16	3	3/24/2006	400	109	30	6 ¼	1+	108	260	400	-	-	-	-	5	Curtis
TAX MAP #17																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	5514 Old Columbia Road	D	99-137-0379	17 (1) 10	3	11/16/2000	125	40	20	6 ¼	1+	40	110	120	-	-	-	-	30	Curtis
R	5282 Chimney Springs Drive	D	05-137-0062	17 (11) A	3	10/31/2005	160	60	30	6 ¼	1+	59	140	160	-	-	-	-	30	Curtis
TAX MAP #18																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	3062 Davis Mill Road	D	NA	18 (4) 4D	3	2/3/1990	205	51	28	6 ½	1+	50	-	-	-	-	-	-	5	Curtis
R	Georges Landing - Davis Mill Road	D	99-137-0288	18 (9) 13	3	9/6/1999	240	20	31	6 ¼	1+	20	210	240	-	-	-	-	8	Curtis
R	2890 Georges Landing Road	D	99-137-0275	18 (9) 3	3	9/27/1999	260	40	35	6 ¼	1+	40	220	260	-	-	-	-	7	Curtis
R	3551 Davis Mill Road	D	99-137-0309	18 (1) 49B	3	10/19/1999	300	50	30	6 ¼	1+	50	160	170	-	-	-	-	3	Curtis
R	2600 Danieltown Road	D	04-137-0021	18 (1) 26 B1	3	1/6/2005	400	51	30	6 ¼	1+	50	300	400	-	-	-	-	1 ½	Curtis

GOOCHLAND COUNTY GROUND WATER SURVEY DATA

RESIDENTIAL WELLS

DAA PROJECT NO. R07246-01

FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
TAX MAP #19																				
R	4523 Hewitt Lane	D	99-137-0276	19 (10) A	2	9/26/1999	140	54	32	6 ¼	1+	54	120	140	-	-	-	-	8	Curtis
R	3344 Forest Grove Road	D	98-137-0245	19 (12) C	2	11/30/1999	340	85	50	6 ¼	1+	85	180	200	300	320	-	-	10	Curtis
R	4243 Whitehall Road	D	97-137-0262	19 (1) 64	2	5/3/1998	300	103	20	6 ¼	1+	103	275	285	-	-	-	-	6	Curtis
TAX MAP #20																				
R	LOT 6 - Red Eye Bluff	D	07-137-0017	20 (25) 6	2	3/9/2007	300	52	30	6 ¼	1+	51	210	300	-	-	-	-	5	Curtis
R	LOT 19 - Bolling Layne Place	D	99-137-0386	20 (20) 19	2	2/9/2000	400	50	15	6 ¼	1+	50	260	270	-	-	-	-	2	Curtis
R	LOT 10 - Bolling Layne Place	D	99-137-0351	20 (20) 10	2	3/14/2000	320	90	50	6 ¼	1+	90	160	170	300	310	-	-	3	Curtis
R	LOT 4 - Bolling Layne Place	D	00-137-0085	20 (20) 4	2	4/16/2000	145	80	60	6 ¼	1+	80	120	125	-	-	-	-	7	Curtis
R	3653 Whitehall Road	D	99-137-0110	20 (1) 90	2	5/2/2000	300	130	50	6 ¼	1+	130	271	275	-	-	-	-	6	Curtis
R	3004 Rocky Creek Lane	D	99-137-0337	20 (1) 69	2	4/24/2000	600	40	30	6 ¼	1+	40	400	500	-	-	-	-	2	Curtis
R	LOT 30 - Bolling Layne Place	D	00-137-0025	20 (20) 30	2	5/30/2000	500	60	100	6 ¼	1+	60	360	365	493	497	-	-	3	Curtis
R	LOT 7 - Mill's Forest	D	99-137-0365	20 (19) 7	2	6/19/2000	200	71	11	6 ¼	1+	71	150	200	-	-	-	-	8	Curtis
R	3080 Woodlin Drive	D	99-137-0163	20 (13) 9	2	8/16/1999	500	80	27	6 ¼	1+	80	400	500	-	-	-	-	2	Curtis
R	3026 Running Still Lane	D	04-137-0424	20 (1) 68C	2	8/25/2005	240	51	30	6 ¼	1+	50	200	240	-	-	-	-	10	Curtis
R	LOT 59 - Mill's Forest	D	04-137-0430	20 (22) 59	2	3/2/2005	200	80	30	6 ¼	1+	79	180	200	-	-	-	-	15	Curtis
R	LOT 63 - Mill's Forest	D	04-137-0342	20 (22) 63	2	3/2/2005	260	88	30	6 ¼	1+	87	200	260	-	-	-	-	10	Curtis
R	3057 Rocky Creek Lane	D	98-137-0208	20 (13) 4	2	1/22/1999	320	64	31	6 ¼	1+	64	280	320	-	-	-	-	5	Curtis
R	3464 Cedar Plains Road	D	94-137-0058	20 (1) 15	2	6/18/1998	300	50	30	6 ¼	1+	50	280	300	-	-	-	-	2	Curtis
TAX MAP #21																				
R	2541 Old Dam Road	D	91-137-0058	21 (4) 3	2	6/29/1992	165	52	25	6 ¼	1+	52	-	-	-	-	-	-	10	Curtis
R	LOT 20 - High Grove	D	94-137-0184	21 (9) 20	2	11/23/1994	285	94	32	6 ¼	1+	93	230	245	-	-	-	-	8	Curtis
R	LOT 53 - High Grove	D	99-137-0278	21 (9) 53	2	12/9/1999	320	140	30	6 ¼	1+	140	150	160	280	290	-	-	5	Curtis
R	LOT 58 - High Grove	D	99-137-0257	21 (9) 58	2	12/8/1999	200	69	22	6 ¼	1+	69	180	200	-	-	-	-	7	Curtis
R	LOT 23 - Mill Forest	D	99-137-0260	21 (10) 23	2	10/10/1995	280	45	18	6 ¼	1+	44	240	280	-	-	-	-	5	Curtis
R	2755 Hillhouse Lane	D	06-137-0215	21 (9) 22	2	7/15/2006	380	115	30	6 ¼	1+	114	240	380	-	-	-	-	15	Curtis
R	LOT 2 - Sandy Hills	D	04-137-0387	21 (12) 2	2	4/4/2005	300	125	30	6 ¼	1+	124	280	300	-	-	-	-	5	Curtis
TAX MAP #21																				
R	LOT 3 - Sandy Hills	D	04-137-0301	21 (12) 3	2	1/11/2005	460	104	30	6 ¼	1+	103	-	-	-	-	-	-	1	Curtis
R	LOT 18 - Mill Forest	D	98-157-0091	21 (10) 18	2	2/11/1999	160	82	12	6 ¼	1+	82	150	155	-	-	-	-	12	Curtis
R	LOT 31 - Mill Forest	D	98-137-0081	21 (10) 31	2	12/3/1998	300	53	41	6 ¼	1+	53	280	300	-	-	-	-	10	Curtis
R	LOT 57 - High Grove	D	98-137-0110	21 (9) 57	2	9/29/1998	400	69	32	6 ¼	1+	69	300	400	-	-	-	-	3	Curtis
R	LOT 16 - High Grove	D	98-137-0010	21 (9) 16	2	7/1/1998	180	123	24	6 ¼	1+	123	160	180	-	-	-	-	15	Curtis
R	LOT 1 - Sandy Hill	D	05-137-0129	21 (12) 1	2	9/1/2005	220	141	30	6 ¼	1+	140	180	220	-	-	-	-	15	Curtis
R	LOT 7 - High Grove	D	97-137-0058	21 (9) 7	2	3/2/1998	420	93	27	6 ¼	1+	93	340	420	-	-	-	-	3	Curtis
TAX MAP #26																				
R	LOT 5 - Hickory Ridge	D	05-137-0415	26 (12) 5	3	3/23/2006	200	82	15	6 ¼	1+	81	100	200	-	-	-	-	15	Curtis
TAX MAP #27																				
R	Danieltown Road	D	92-137-0100	27 (1) 3	3	10/12/1992	300	50	15	6 ¼	1+	50	-	-	-	-	-	-	2	Curtis
R	LOT 4 - Whittle Branch Estates	D	92-137-0123	27 (1) 4	3	12/3/1992	225	50	34	6 ¼	1+	51	-	-	-	-	-	-	10	Curtis
R	2170 Haskins Road	D	94-137-0102	27 (1) 34	2	6/25/1994	245	30	27	6 ¼	1+	30	230	240	-	-	-	-	2	Curtis
TAX MAP #28																				
R	LOT 13 - Bexley Wood Run	D	02-137-0044	28 (14) 13	2	5/8/2002	303	NA	NA	6 ⅝	0	50	-	-	-	-	-	-	20	Gammon
R	LOT 16 - West Cliff	D	02-137-0226	28 (14) 16	2	6/24/2002	120	50	20	6 ¼	0	50	115	120	-	-	-	-	20	Curtis
R	LOT 1 - West Cliff	D	01-137-0088	28 (14) 1	2	7/30/2001	200	65	25	6 ¼	0	65	70	75	160	165	-	-	3	Curtis
R	LOT 5 - West Cliff	D	02-137-0107	28 (14) 5	2	11/1/2002	130	30	30	6 ⅝	0	30	-	-	-	-	-	-	NA	Fred Jones
R	LOT 10 - West Cliff	D	02-137-0071	28 (14) 10	2	7/29/2002	125	55	20	6 ¼	0	55	65	70	115	120	-	-	15	Curtis
R	2428 Chapel Hill-Habitat for Hum.	D	00-137-0082	28 (12) 1	2	7/15/2000	220	60	100	6 ¼	1+	60	203	207	-	-	-	-	7	Curtis
R	2428 Chapel Hill-Habitat for Hum.	D	99-137-0182	28 (12) 2	2	9/5/1999	400	79	20	6 ¼	1+	79	360	400	-	-	-	-	2	Curtis
R	LOT 7 - West Cliff	D	05-137-0063	28 (14) 7	2	10/5/2005	600	59	30	6 ¼	1+	58	580	600	-	-	-	-	2	Curtis
R	4353 Riddles Ridge Road	D	04-137-0417	28 (1) 87H1	2	12/28/2004	200	51	30	6 ¼	1+	50	140	200	-	-	-	-	25	Curtis

GOOCHLAND COUNTY GROUND WATER SURVEY DATA

RESIDENTIAL WELLS

DAA PROJECT NO. R07246-01

FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE	CASING DEPTH (FT)		WATER ZONE 1 (FT)		WATER ZONE 2 (FT)		WATER ZONE 3 (FT)		YIELD	WELL DRILLER
										IN	FROM	TO	FROM	TO	FROM	TO	FROM	TO	GPM	
TAX MAP #29																				
R	3676 Springfield Road	D	07-137-0020	29 (9) 5	2	3/29/2007	500	60	30	6 ¼	1+	59	460	500	-	-	-	-	3 ½	Curtis
R	3765 Bell Road	D	99-137-0238	29 (20) 4	2	8/26/1999	320	109	32	6 ¼	1+	109	280	320	-	-	-	-	4	Curtis
R	3664 Springfield Road	D	98-137-0237	29 (9) 7B	2	1/21/1999	200	54	24	6 ¼	1+	54	180	200	-	-	-	-	5	Curtis
TAX MAP #30																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE	CASING DEPTH (FT)		WATER ZONE 1 (FT)		WATER ZONE 2 (FT)		WATER ZONE 3 (FT)		YIELD	WELL DRILLER
										IN	FROM	TO	FROM	TO	FROM	TO	FROM	TO	GPM	
R	LOT 6 - Aldwyck	D	88-137-0268	30 (13) B6	2	3/25/1992	165	80	12	6 ¼	1+	79	-	-	-	-	-	-	10	Curtis
R	2375 Jackson Shop Road	D	98-137-0072	30 (1) 49	2	8/13/1998	160	60	18	6 ¼	1+	60	140	160	-	-	-	-	18	Curtis
R	LOT 2 - Courthouse Circle	D	89-137-0296	30 (16) 2	2	12/16/1992	125	60	30	6 ¼	1+	59	-	-	-	-	-	-	10	Curtis
R	2167 Sandy Hook Road	D	99-137-0037	30 (1) 100	2	10/21/1999	200	45	40	6 ¼	1+	45	160	170	-	-	-	-	8	Curtis
R	LOT 2 - Walnut Ridge	D	97-137-0300	30 (14) 2	2	10/5/1998	440	55	22	6 ¼	1+	55	360	440	-	-	-	-	5	Curtis
R	LOT 3 - Aldwyck	D	96-137-0199	30 (13) B3	2	3/23/1998	300	100	17	6 ¼	1+	100	250	300	-	-	-	-	8	Curtis
TAX MAP #31																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE	CASING DEPTH (FT)		WATER ZONE 1 (FT)		WATER ZONE 2 (FT)		WATER ZONE 3 (FT)		YIELD	WELL DRILLER
										IN	FROM	TO	FROM	TO	FROM	TO	FROM	TO	GPM	
R	2141 Broad Street Road	D	00-137-0298	31 (1) 79	2	11/10/2000	185	104	15	6 ¼	1+	104	170	175	-	-	-	-	12	Curtis
R	2760 Maidens Road	D	NA	31 (1) 45	2	11/8/1999	160	109	22	6 ¼	1+	108	140	160	-	-	-	-	10	Curtis
R	2855 Poorhouse Road	D	NA	31 (2) 20	2	6/26/1990	230	135	48	6 ¼	1+	134	-	-	-	-	-	-	8	Curtis
R	Pony Farm Road	D	99-137-0174	31 (28) 1	2	7/24/1999	260	125	22	6 ¼	1+	125	240	260	-	-	-	-	15	Curtis
R	LOT 10 - Maidens Forest	D	91-137-0070	31 (23) 10	2	3/2/1991	330	54	18	6 ¼	1+	53	-	-	-	-	-	-	3	Curtis
R	2575 Maidens Road	D	92-137-0034	31 (1) 73	2	3/6/1992	305	58	33	6 ¼	1+	57	-	-	-	-	-	-	5	Curtis
R	2060 Hawktown Road	D	92-137-0098	31 (1) 87	2	6/24/1992	205	71	28	6 ¼	1+	71	-	-	-	-	-	-	6	Curtis
R	228 Camel Back Road	D	92-137-0166	31 (1) 88D	2	11/21/1992	305	23	18	6 ¼	1+	23	-	-	-	-	-	-	18	Curtis
R	2675 Turner Road	D	97-137-0183	31 (1) 13	2	7/21/1999	240	99	27	6 ¼	1+	99	200	240	-	-	-	-	20	Curtis
R	2110 Hawktown Road	D	99-137-0069	31 (1) 86	2	5/25/1999	260	44	50	6 ¼	1+	44	240	260	-	-	-	-	50	Curtis
R	2681 Turner Road	D	99-137-0185	31 (1) 13	2	7/21/1999	260	92	27	6 ¼	1+	92	220	260	-	-	-	-	20	Curtis
R	2585 Elpis Church Road	D	98-137-0253	31 (24) 5	2	3/25/1999	180	129	30	6 ¼	1+	129	160	180	-	-	-	-	20	Curtis
R	LOT 3 - Pony Farm Road	D	97-137-0265	31 (28) 3	2	2/11/1998	285	145	25	6 ¼	1+	145	250	275	-	-	-	-	7	Curtis
TAX MAP #32																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE	CASING DEPTH (FT)		WATER ZONE 1 (FT)		WATER ZONE 2 (FT)		WATER ZONE 3 (FT)		YIELD	WELL DRILLER
										IN	FROM	TO	FROM	TO	FROM	TO	FROM	TO	GPM	
R	1867 Spruce Lane	D	00-137-0104	32 (6) A	2	5/11/2000	125	50	20	6 ¼	1+	50	100	110	-	-	-	-	30	Curtis
R	2716 Perkinsville Road	D	99-137-0181	32 (1) 16	2	11/11/1999	200	150	24	6 ¼	1+	150	160	200	-	-	-	-	15	Curtis
R	200 Maidens Road	D	87-137-0063	32 (10) 13	2	9/20/1989	130	80	100	6 ¼	1+	79	-	-	-	-	-	-	NA	Curtis
R	1887 West Broad Street	D	05-137-0190	32 (1) 48	2	11/23/2005	400	51	30	6 ¼	1+	50	320	380	-	-	-	-	4	Curtis
R	2390 Camel Back Road	D	98-137-0096	32 (1) 33P	2	9/29/1998	160	68	15	6 ¼	1+	68	140	160	-	-	-	-	10	Curtis
TAX MAP #33																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE	CASING DEPTH (FT)		WATER ZONE 1 (FT)		WATER ZONE 2 (FT)		WATER ZONE 3 (FT)		YIELD	WELL DRILLER
										IN	FROM	TO	FROM	TO	FROM	TO	FROM	TO	GPM	
R	2589 Hanover Road	D	06-137-0018	33 (4) 2	1	2/23/2006	300	51	10	6 ¼	1+	50	220	300	-	-	-	-	100	Curtis
R	2313 Temple Heights	D	05-137-0451	33 (9) 7	1	12/23/2005	200	66	30	6 ¼	1+	65	160	200	-	-	-	-	20	Curtis
R	LOT 3 - Temple Heights	D	05-137-0330	33 (9) 3	1	12/1/2005	200	89	30	6 ¼	1+	88	-	-	-	-	-	-	25	Curtis
R	708 Baldwin Road	D	04-137-0457	33 (1) 18A1	1	2/23/2005	220	73	30	6 ¼	1+	72	200	220	-	-	-	-	15	Curtis
TAX MAP #38																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE	CASING DEPTH (FT)		WATER ZONE 1 (FT)		WATER ZONE 2 (FT)		WATER ZONE 3 (FT)		YIELD	WELL DRILLER
										IN	FROM	TO	FROM	TO	FROM	TO	FROM	TO	GPM	
R	Cartersville Road	D	07-137-0096	38 (1) 22	3	4/18/2007	540	78	30	6 ¼	1+	77	300	540	-	-	-	-	1	Curtis
R	1834 Brookstone Drive	D	06-137-0112	38 (11) 2	3	8/2/2006	420	80	30	6 ¼	1+	79	200	420	-	-	-	-	3	Curtis
TAX MAP #39																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE	CASING DEPTH (FT)		WATER ZONE 1 (FT)		WATER ZONE 2 (FT)		WATER ZONE 3 (FT)		YIELD	WELL DRILLER
										IN	FROM	TO	FROM	TO	FROM	TO	FROM	TO	GPM	
R	1899 Haskins Road	D	00-137-0002	39 (1) 94B	2	3/10/2000	320	70	18	6 ¼	1+	70	290	295	-	-	-	-	1	Curtis
R	4791 St. Pauls Church Road	D	00-137-0297	39 (1) 43	3	11/15/2000	200	100	60	6 ¼	1+	99	180	184	-	-	-	-	8	Curtis
R	4901 St. Pauls Church Road	D	98-137-0021	39 (1) 52	3	6/10/1998	300	90	22	6 ¼	1+	90	260	290	-	-	-	-	3	Curtis
R	1405 Marlin Road	D	98-137-0163	39 (10) 1	2	7/9/1998	160	50	21	6 ¼	1+	50	140	160	-	-	-	-	20	Curtis
TAX MAP #41																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE	CASING DEPTH (FT)		WATER ZONE 1 (FT)		WATER ZONE 2 (FT)		WATER ZONE 3 (FT)		YIELD	WELL DRILLER
										IN	FROM	TO	FROM	TO	FROM	TO	FROM	TO	GPM	
R	3884 Big Hickory Drive	D	05-137-0084	41 (3) 3	2	10/4/2005	300	58	30	6 ¼	1+	57	260	300	-	-	-	-	12	Curtis

GOOCHLAND COUNTY GROUND WATER SURVEY DATA

RESIDENTIAL WELLS

DAA PROJECT NO. R07246-01

TAX MAP #42																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	1507 Point Meadows Court	D	00-137-0090	42 (1) 118B	2	8/9/2000	400	51	80	6 ¼	1+	51	322	327	-	-	-	-	2	Curtis
R	2425 Dorothea Lane	D	92-137-0102	42 (23) 9	2	7/2/1992	325	50	30	6 ¼	1+	50	-	-	-	-	-	-	5	Curtis
R	2644 River Road West	D	99-137-0131	42 (1) 118	2	8/12/1999	300	83	18	6 ¼	1+	83	250	255	-	-	-	-	5	Curtis
R	2034 Sandy Hook road	D	99-137-0259	42 (1) 74	2	8/20/1999	500	84	27	6 ¼	1+	84	400	500	-	-	-	-	1	Curtis
R	LOT 34 - Holland Hills	D	05-137-0389	42 (35) G34	2	6/7/2006	200	63	30	6 ¼	1+	62	160	200	-	-	-	-	15	NA
R	LOT 32 - Holland Hills	D	05-137-0387	42 (35) G32	2	2/2/2006	600	51	20	6 ¼	1+	50	400	600	-	-	-	-	4½	NA
R	LOT 31 - Holland Hills	D	05-137-0386	42 (35) G31	2	3/2/2006	240	51	15	6 ¼	1+	50	200	220	-	-	-	-	15	NA
R	LOT 30 - Holland Hills	D	05-137-0385	42 (35) G30	2	3/1/2006	240	51	15	6 ¼	1+	50	180	240	-	-	-	-	30	NA
R	LOT 33 - Holland Hills	D	05-137-0388	42 (35) G33	2	2/3/2006	240	51	25	6 ¼	1+	50	140	240	-	-	-	-	40	NA
R	LOT 28 - Holland Hills	D	05-137-0383	42 (35) G28	2	2/8/2006	420	51	30	6 ¼	1+	50	400	420	-	-	-	-	3	NA
R	LOT 42 - Holland Hills	D	04-137-0489	42 (32) F42	2	4/19/2005	340	51	30	6 ¼	1+	50	300	340	-	-	-	-	12	NA
R	LOT 41 - Holland Hills	D	04-137-0488	42 (32) F41	2	4/19/2005	300	51	30	6 ¼	1+	50	280	300	-	-	-	-	10	NA
R	LOT 39 - Holland Hills	D	04-137-0487	42 (32) F39	2	4/21/2005	400	71	30	6 ¼	1+	70	320	400	-	-	-	-	4	NA
R	LOT 40 - Holland Hills	D	04-137-0492	42 (32) F40	2	4/20/2005	400	55	30	6 ¼	1+	54	320	400	-	-	-	-	8	NA
R	LOT 47 - Holland Hills	D	04-137-0491	42 (32) F47	2	4/22/2005	320	51	30	6 ¼	1+	50	280	320	-	-	-	-	10	NA
R	LOT 48 - Holland Hills	D	04-137-0490	42 (32) F48	2	4/21/2005	260	55	30	6 ¼	1+	54	200	260	-	-	-	-	30	NA
R	LOT 27 - Holland Hills	D	05-137-0382	42 (35) G27	2	2/1/2006	420	55	15	6 ¼	1+	54	360	420	-	-	-	-	3	NA
R	LOT 9 - Holland Hills	D	05-137-0270	42 (30) A9	2	8/15/2005	640	51	19	6 ¼	1+	50	80	160	-	-	-	-	12	NA
TAX MAP #43																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 21 - The Preserve @ Parker Hill	D	04-137-0003	43 (35) 21	2	11/9/2004	165	79	NA	6 ¼	0	79	80	85	119	121	137	165	60	NA
R	LOT 1 -The Preserve @ Parker Hill	D	04-137-0010	43 (35) 1	2	3/3/2005	200	125	30	6 ¼	1+	124	180	200	-	-	-	-	25	Curtis
R	LOT 6 - The Preserve @ Parker Hill	D	04-137-0009	43 (35) 6	2	3/4/2005	200	51	30	6 ¼	1+	50	120	200	-	-	-	-	40	Curtis
R	LOT 13 - The Preserve @ Parker Hill	D	04-137-0259	43 (35) 13	2	9/3/2004	185	109	20	6 ¼	2+	109	125	145	145	165	-	-	15	Royall
R	LOT 17 - The Preserve @ Parker Hill	D	04-137-0410	43 (35) 17	2	3/24/2004	180	53	4	6 ¼	1+	53	165	168	-	-	-	-	12	Clearwater
R	LOT 23 - Crossroads West	D	NA	43 (20) 23	2	4/6/2000	200	55	50	6 ¼	1+	55	160	164	186	190	-	-	8	NA
R	1871 Wickerwoods Drive	D	95-137-0002	43 (28) 10	2	5/22/1995	205	80	26	6 ¼	1+	79	175	185	-	-	-	-	10	Curtis
R	LOT 16 - Longwood	D	98-137-0281	43 (33) 16	2	2/26/1999	300	51	34	6 ¼	1+	51	260	300	-	-	-	-	5	Curtis
R	2406 Aspen Woods Road	D	98-137-0324	43 (29) 4	2	12/9/1999	500	70	20	6 ¼	1+	70	480	485	-	-	-	-	1	Curtis
R	LOT 22 - The Preserve @ Parker Hill	D	06-137-0041	43 (35) 22	2	6/8/2006	160	104	30	6 ¼	1+	103	120	160	-	-	-	-	50	Curtis
R	2588 Sheppard Town Road	D	06-137-0117	43 (32) 2	2	4/19/2006	200	76	30	6 ¼	1+	75	120	200	-	-	-	-	20	Curtis
R	2134 Whistle Lane	D	05-137-0038	43 (1) 64	2	8/3/2005	200	51	30	6 ¼	1+	50	120	200	-	-	-	-	15	Curtis
R	1790 Hawktown Road	D	04-137-0462	43 (1) 65	2	8/31/2005	400	51	30	6 ¼	1+	50	320	400	-	-	-	-	4	Curtis
TAX MAP #44																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 5 - Somerset	D	03-137-0109	44 (27) 5	1	7/17/2003	120	90	20	6 ¼	0	90	105	115	-	-	-	-	20	NA
R	LOT 12 - Somerset	D	03-137-0082	44 (27) 12	1	7/10/2003	300	61	20	6 ¼	0	61	190	195	270	280	-	-	6	NA
R	LOT 18 - Somerset	D	02-137-0408	44 (27) 18	1	2/20/2003	300	60	30	6 ¼	0	60	160	170	280	290	-	-	3	NA
R	LOT 23 - Somerset	D	05-137-0281	44 (27) 23	1	3/21/2003	110	68	20	6 ¼	0	68	100	105	-	-	-	-	20	NA
R	LOT 32 - Somerset	D	04-137-0223	44 (27) 32	1	11/27/204	100	40	20	6 ¼	0	50	60	65	-	-	-	-	20	NA
R	2235 Anmar Drive	D	99-137-0129	44 (1) 37D	1	4/7/2000	500	70	60	6 ¼	1+	70	450	500	-	-	-	-	2	NA
R	1605 Sheppard Town Road	D	00-137-0185	44 (1) 76	1	10/5/2000	300	119	31	6 ¼	1+	119	150	300	-	-	-	-	4	Curtis
R	1905 Soldiers Lane	D	99-137-0318	44 (1) 49B	1	12/16/1999	200	60	50	6 ¼	1+	60	170	180	-	-	-	-	20	Curtis
R	LOT F - Covington	D	98-137-0076	44 (21) F	1	6/23/1998	280	110	27	6 ¼	1+	110	160	180	-	-	-	-	20	Curtis
R	1852 Taylor Road	D	98-137-0071	44 (21) E	1	6/26/1998	340	70	34	6 ¼	1+	70	320	340	-	-	-	-	10	NA
TAX MAP #45																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 40 - Fox Downs	D	NA	45 (18) 40	1	11/28/1990	130	87	33	6 ¼	1+	86	-	-	-	-	-	-	8	Curtis
R	LOT 28 - Autumn Breeze	D	05-137-0315	45 (23) 28	1	12/9/2005	600	70	30	6 ¼	1+	68	400	600	-	-	-	-	5	Curtis
R	1707 Shallow Well Road	D	97-137-0266	45 (1) 78	1	2/10/1998	300	100	10	6 ¼	1+	100	275	280	-	-	-	-	6	Curtis
R	LOT 6 - Autumn Breeze	D	05-137-0183	45 (23) 9	1	12/12/2005	240	51	30	6 ¼	1+	50	200	240	-	-	-	-	12	Curtis
R	LOT 32 - Autumn Breeze	D	05-137-0095	45 (23) 32	1	12/13/2005	300	58	30	6 ¼	1+	57	160	200	280	300	-	-	8	Curtis
R	1177 Tri County Drive	D	04-137-0378	45 (19) 9	1	12/20/2005	240	58	NA	6 ¼	0	58	170	240	-	-	-	-	25	Curtis
R	LOT 31 Fox Downs	D	94-137-0101	45 (18) 31	1	9/1/1994	165	54	30	6 ¼	1+	53	145	165	-	-	-	-	30	Curtis
R	941 Broad Street Road	D	06-137-0137	45 (11) 1	1	7/14/2006	300	61	30	6 ¼	1+	60	200	300	-	-	-	-	15	Curtis
R	2039 Valpark Drive	D	98-137-0102	45 (1) 129	1	10/22/1998	160	46	14	6 ¼	1+	46	140	160	-	-	-	-	30	Curtis
R	LOT 35 - Autumn Breeze	D	05-137-0003	45 (23) 35	1	6/8/2006	300	51	30	6 ¼	1+	50	200	300	-	-	-	-	50	Curtis
R	1885 Shallow Well Road	D	06-137-0113	45 (1) 86	1	5/17/2006	200	70	30	6 ¼	1+	69	100	200	-	-	-	-	30	Curtis

GOOCHLAND COUNTY GROUND WATER SURVEY DATA

RESIDENTIAL WELLS

DAA PROJECT NO. R07246-01

R	LOT 4 - Autumn Breeze	D	06-137-0068	45 (23) 4	1	4/20/2006	320	51	NA	6 ¼	1+	50	160	320	-	-	-	-	12	Curtis
R	2047 Shallow Well Road	D	04-137-0283	45 (21) 1	1	3/20/2006	200	60	25	6 ¼	1+	59	120	200	-	-	-	-	50	Curtis
R	LOT 17 - Covington	D	05-137-0209	45 (15) 218	1	8/4/2005	200	60	30	6 ¼	1+	59	180	200	-	-	-	-	10	Curtis
R	Genito Road	D	97-137-0150	45 (1) 45	1	5/26/1998	100	50	13	6 ¼	0	50	70	75	-	-	-	-	12	Curtis
R	1715 Shallow Well Road	D	97-137-0281	45 (1) 78B	1	2/11/1998	185	80	10	6 ¼	1+	80	165	170	-	-	-	-	10	Curtis
TAX MAP #46																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 2 - Proffitts Knoll	D	00-137-0011	46 (1) 117	1	5/16/2000	400	55	70	6 ¼	1+	55	-	-	-	-	-	-	2	Curtis
R	LOT 6 - Windy Run	D	05-137-0092	46 (26) 6	1	5/2/2001	160	52	30	6 ¼	1+	51	60	160	-	-	-	-	30	Curtis
R	690 Seay Road	D	04-137-0383	46 (1) 79E	1	8/26/2005	160	51	30	6 ¼	1+	50	120	160	-	-	-	-	15	Curtis
R	1670 Manakin Road	D	99-137-0063	46 (1) 58	1	4/20/1999	200	110	15	6 ¼	1+	110	180	185	-	-	-	-	30	Curtis
R	2581 Manakin Road	D	99-137-0363	46 (35) B1	1	5/26/2000	300	80	30	6 ¼	1+	80	195	200	-	-	-	-	4½	Curtis
R	606 Newood Road	D	00-137-0156	46 (21) A1	1	6/5/2000	200	59	31	6 ¼	1+	59	150	200	-	-	-	-	8	Curtis
R	1664 Curtis Fleming Drive	D	00-137-0128	46 (1) 53 A3	1	10/29/2000	165	80	60	6 ¼	1+	80	120	125	145	155	-	-	12	Curtis
R	836 Seay Road	D	NA	46 (25) 1B	1	11/21/1989	180	107	42	6 ¼	1+	106	-	-	-	-	-	-	8	Curtis
R	LOT 15 - Wheatlands	D	NA	46 (27) B15	1	2/4/1992	125	80	22	6 ¼	1+	79	-	-	-	-	-	-	12	Curtis
R	LOT 24 - Wheatlands	D	NA	46 (1) 113	1	3/10/1992	145	NA	25	6 ¼	1+	91	-	-	-	-	-	-	10	Curtis
R	LOT 23 - Wheatlands	D	92-137-0168	46 (27) 23A	1	9/3/1992	150	53	15	6 ¼	1+	52	-	-	-	-	-	-	28	Curtis
R	LOT 9B - Wheatlands	D	94-137-0028	46 (27) B9	1	5/9/1994	125	90	9	6 ¼	1+	89	110	120	-	-	-	-	19	Curtis
R	LOT 25A - Wheatlands	D	NA	46 (27) A25	1	10/20/1992	165	92	32	6 ¼	1+	92	-	-	-	-	-	-	8	Curtis
R	Three Chopt Road	D	99-137-0135	46 (1) 5	1	10/20/1999	340	50	27	6 ¼	1+	50	300	340	-	-	-	-	3	Curtis
R	LOT 16 - Wheatlands	D	93-137-0175	46 (27) B16	1	3/9/1994	205	54	20	6 ¼	0	54	-	-	-	-	-	-	10	Curtis
R	496 Three Chopt Road	D	93-137-0080	46 (29) 4	1	8/4/1993	205	72	76	6 ¼	0	72	140	143	172	173	-	-	10	Curtis
R	2205 Denver Lane	D	99-137-0220	46 (16) K2	1	2/15/1999	400	35	37	6 ¼	1+	33	360	400	-	-	-	-	4	Curtis
R	LOT 1 - Nuckols Forest	D	05-137-0274	46 (39) 1	1	5/9/2006	540	124	30	6 ¼	1+	123	530	540	-	-	-	-	5	Curtis
R	LOT 2 - Rabbit Glen	D	98-137-0051	46 (33) 2	1	4/28/1998	340	55	30	6 ¼	1+	55	300	340	-	-	-	-	5	Curtis
TAX MAP #47																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	LOT 22 - Lanier Industrial Park	D	00-137-0196	47 (32) 22	TC	8/25/2000	200	68	40	6 ¼	1+	68	115	120	191	195	-	-	35	Curtis
R	LOT 7 - Lanier Industrial Park	D	99-137-0178	47 (1) 112A	TC	6/22/1999	200	89	22	6 ¼	1+	89	140	200	-	-	-	-	20	Curtis
R	Sycamore Creek Golf	D	NA	47 (1) 35	TC	4/11/1992	345	55	45	6 ¼	1+	54	-	-	-	-	-	-	4	Curtis
R	LOT 7 - Lanier Industrial Park #2	D	99-137-0146	47 (1) 112	TC	6/22/1999	480	60	24	6 ¼	1+	60	300	480	-	-	-	-	8	Curtis
R	Shell Mart off 250	D	95-137-0002	47 (27) 8	TC	5/17/1995	600	55	22	6 ¼	1+	54	540	565	-	-	-	-	4	Curtis
R	12927 Plaza Drive	D	99-137-0132	47 (21) 13	TC	5/26/1999	400	50	22	6 ¼	1+	50	360	400	-	-	-	-	7	Curtis
R	LOT 3 - Manakin Trace	D	97-137-0186	47 (30) 3	1	12/12/1997	300	52	10	6 ¼	1+	52	290	300	-	-	-	-	10	Curtis
TAX MAP #48																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	1793 Three Chopt Road	D	99-137-0013	48 (4) B	TC	2/10/2000	600	50	50	6 ¼	1+	50	550	560	-	-	-	-	2	Curtis
R	LOT 11 - Lanier Park	D	00-137-0068	48 (9) 11	TC	3/24/2000	500	130	24	6 ¼	1+	130	300	440	-	-	-	-	8	Curtis
R	1785 Three Chopt Road	D	00-137-0129	48 (13) A	TC	9/14/2000	400	39	15	6 ¼	1+	39	350	400	-	-	-	-	3	Curtis
R	2369 Lanier Road	D	95-137-0072	48 (9) APT	TC	7/12/1995	200	70	20	6 ¼	1+	69	145	185	-	-	-	-	18	Curtis
R	LOT 1 - Lanier Park	D	00-137-0030	48 (14) 1	TC	10/19/1999	200	105	30	6 ¼	1+	105	150	155	170	173	-	-	35	Curtis
R	2226 Ashland Road	D	06-137-0083	48 (1) 7	TC	5/15/2006	480	51	30	6 ¼	1+	50	320	480	-	-	-	-	3	Curtis
TAX MAP #50																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	1193 Lickinghole Road	D	02-137-0571	50 (5) 10	2	4/26/2004	330	35	30	6 ¼	1+	50	120	130	-	-	-	-	4	Curtis
R	LOT 12 - James River Landing	D	NA	50 (5) 12	2	9/28/2005	700	51	30	6 ¼	1+	50	680	700	-	-	-	-	1	Curtis
R	LOT 23 - James River Landing	D	05-137-0196	50 (5) 23	2	10/3/2005	900	51	30	6 ¼	1+	50	800	900	-	-	-	-	3	Royall
R	LOT 13 - James River Landing	D	04-137-0144	50 (5) 13	2	9/17/2004	265	65	20	6 ¼	1+	65	65	85	225	245	-	-	12	Royall
R	LOT 26 - James River Landing	D	02-137-0224	50 (5) 26	2	12/30/2002	205	44	20	6 ¼	1+	44	-	-	-	-	-	-	25	Royall
R	LOT 6 - Castle View	D	99-137-0242	50 (9) 6	2	3/29/2000	240	50	20	6 ¼	1+	50	230	235	-	-	-	-	8	Curtis
R	Lot 25 - James River Landing	D	06-137-0087	50 (5) 25	2	7/13/2006	800	51	25	6 ¼	1+	50	420	800	-	-	-	-	5	Curtis
R	LOT 8 - Castle View	D	05-137-0199T	50 (9) 8	2	8/11/2005	525	30	30	6 ¼	1+	29	520	525	-	-	-	-	100	Curtis
TAX MAP #51																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	1442 New Town Road	D	05-137-0276	51 (2) 5A	2	6/5/2006	260	104	30	6 ¼	1+	103	200	260	-	-	-	-	7	Curtis
TAX MAP #54																				
FACILITY R, Ag, Com, Ind, CW, M	LOCATION/ADDRESS	WELL TYPE B or D	ID/VDH PERMIT #	TAX MAP NUMBER	DISTRICT ID	DATE INSTALLED	WELL DEPTH FT.	DEPTH TO BEDROCK (FT)	STATIC WATER LEVEL (FT)	CASING SIZE IN	CASING DEPTH (FT) FROM	CASING DEPTH (FT) TO	WATER ZONE 1 (FT) FROM	WATER ZONE 1 (FT) TO	WATER ZONE 2 (FT) FROM	WATER ZONE 2 (FT) TO	WATER ZONE 3 (FT) FROM	WATER ZONE 3 (FT) TO	YIELD GPM	WELL DRILLER
R	2210 Denver Lane	D	99-137-0202	54 (3) K	2	8/13/1999	340	139	32	6 ¼	1+	139	300	340	-	-	-	-	4	Curtis

APPENDIX F

Virginia Department of Health Sanitary Survey Reports

Community Water Systems

- Crozier
- Goochland Courthouse
- Eastern Goochland Central Water System
- Elk Hill Farm
- James River Correctional Center
- James River Estates
- Jenkins Trailer Park
- Manakin Farms
- Meadows Nursing Center
- Pagebrook

Non-Transient Non-Community Systems

- Broadview Shopping Center
- Byrd Elementary School
- Goochland Middle School
- Hermitage Country Club
- Randolph Elementary School
- Richmond County Club
- Sabot Hill Farm
- Salem Baptist Church
- Veterinary Referral and Critical Care

VIRGINIA DEPARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Crozier
PWSID No. 4075100

PART I – GENERAL INFORMATION

Owner: Aqua Virginia, Inc.

Telephone: (804) 204-1611, ext. 12

Type Waterworks: (X) C ( ) NTNC ( ) NC

Waterworks Class: IV

Operator's License Class: III (Mr. Clifton Parker, License No. 19002236, exp. 02/28/2007)

Inspection By: Winston C. Marshall

Inspection Date: 02/07/2006

Time Spent On-site: 2 hours

Last Inspection Date: 02/19/2004

Reviewed By / Date: RLM 2/21/06

Reviewed By / Date: BWR 3/23/2006

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Matt Rogers, Aqua Virginia Operator

Facilities Inspected: well, well lot, well house, hydropneumatic storage tank, hypochlorination and corrosion control equipment.

Permit Effective Date: 10/07/1997

Permit/EDS Up-to-Date: ( ) Yes (X) No
If "No", explain: Chlorination facility installed.

No. Connections: 24 **Pop. Served:** 72 **Avg. Daily Usage:** 7,981 gallons

Permit Capacity: 24 connections

Operating Within Permit Capacity: (X) Yes ( ) No

Average GPD/Connection: 333

Average GPD/Person: 111

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 07/08/1993

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 01/04/2006
Records Inspected This Visit: ( ) Yes (X) No[1] **Satisfactory:** ( ) Yes (X) No[1]
Date Records Last Checked: 01/04/2006 **Program Active:** ( ) Yes (X) No[1]

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 09/01/1992

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 12/20/1993

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 01/08/2002

CCR Requirements Met: (X) Yes ( ) No **Date Distributed:** 06/14/2005

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

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[1] Cross connection questionnaires were mailed to 20% of Aqua VA customers in December 2005. We cannot verify that questionnaires were mailed to Crozier customers. Cross connection questionnaires are required to be mailed to all customers at least once every three years.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	04/20/04	04/2007	Satisfactory Results!
Metals	04/20/04	04/2007	Sodium = 28.8 mg/l (recommended level <20 mg/l)
Radiological	05/28/02	04/2010	Satisfactory Results!
Nitrates/Nitrites	05/11/05	**05/2006**	Combined Nitrate = 1.55 mg/l
Pb & Cu	09/28/04	09/2007	Satisfactory Results! On Ultimate Reduced (triennial) monitoring.
VOCs	04/20/04	04/2007	Satisfactory Results!
SOCs	04/20/00	*	Waived through 12/31/2007.
Cyanide**	02/14/00	02/2009	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2007.
Raw water MPN	03/23/05	**05/2006**	Satisfactory Results!
HAA5	08/02/04	08/2007	Satisfactory Results!
TTHM	08/02/04	08/2007	Satisfactory Results!

Waiver Status: *All provisional waivers for the compliance period of 01/01/05 to 12/31/07 have been granted.
**The cyanide waiver granted is for the compliance cycle of 01/01/02 to 12/31/10. One cyanide sample must be collected during this compliance cycle.

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

Date	Well No. 1
02/07/06	13,926,560
02/19/04	08,188,300
719 days	5,738,260 gallons

GPD: 7,981

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Goochland Courthouse
PWSID No. 4075280

PART I – GENERAL INFORMATION

Owner: County of Goochland – Mr. W. Douglas Harvey, P. E., Goochland County Engineer

Telephone: (804) 556-5369

Type Waterworks: (X) C ( ) NTNC ( ) NC

Waterworks Class: V[1]

Operator's License Class: I (Mr. Gerry A. Langfi
License No. 1901001101, exp. 02/28/20(

Inspection By: Winston C. Marshall

Inspection Date: 04/21/2006

Time Spent On-site: 1.5 hours

Last Inspection Date: 03/09/2004

Reviewed By / Date: [illegible] 5/5/06

Reviewed By / Date: Monte Waugh / 0

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Mark Wilds, Goochland County Engineer

Facilities Inspected: Elevated storage tank

Permit/EDS Up-to-Date: ( ) Yes (X) No **Permit Effective Date:** 05/04/1995
If "No", explain: The waterworks class needs to be revised to Class V on the EDS.

No. Connections: 175 **Pop. Served:** 1418 **Avg. Daily Usage:** 73,445 gpd[2]
(plus the students at a community college, a high school, and an elementary school)

Permit Capacity: 250 ERCs or 0.1 MGD **Operating Within Permit Capacity:** (X) Yes ( ) No

Average GPD/Connection: N/A **Average GPD/Person:** N/A

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 07/14/1993

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 09/19/1990
Records Inspected This Visit: ( ) Yes (X) No **Satisfactory:** ( ) Yes ( ) No
Date Records Last Checked: 04/21/2006[3] **Program Active:** (X) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 05/03/2005

Surface Water Influenced: N/A

Source Water Assessment Performed: N/A

CCR Requirements Met: (X) Yes ( ) No **Date Distributed:** 06/09/2005

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:**

---

[1] See letter dated 10/19/01
[2] Water usage based on bills from the Department of Corrections for 2005. Goochland County's usage shown on JRCC's monthly operation reports for 2005 was 73,445 gpd.
[3] Goochland County is experimenting with a self-surveillance cross-connection control program for the residential customers. Information, surveillance forms, and contact information for County personnel are available on the Department of Public Works web site. There are no records or RPZ type backflow devices to inspect at the elevated tank facility.

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Eastern Goochland Central Water System
PWSID No. 4075283

PART I - GENERAL INFORMATION

Owner: County of Goochland – Mr. W. Douglas Harvey, P. E., County Engineer

Telephone: (804) 556-5369

Type Waterworks: (X) C ( ) NTNC ( ) NC

Waterworks Class: V

Operator's License Class: I (Mr. Gerry A. Langfitt, License No. 1901001101, exp. 02/28/2007)

Inspection By: Winston C. Marshall

Inspection Date: 01/17/2007

Time Spent On-site: 2 hours

Last Inspection Date: 02/09/2005

Reviewed By / Date: RLM 2/8/07

Reviewed By / Date: MS 2-15-07

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Gerry A. Langfitt, System Operator

Facilities Inspected: West Creek elevated tank, Centerville elevated tank, Centerville booster pump station

Permit/EDS Up-to-Date: (X) Yes ( ) No

Permit Effective Date: 05/17/2006

If "No", explain:

No. Connections: 637[1]

Pop. Served: 3,231 (estimated)

Avg. Daily Usage: 240,931 gallons[2]

Permit Capacity: 3.2 MGD

Operating Within Permit Capacity: (X) Yes ( ) No

Average GPD/Connection: 378

Average GPD/Person: 74.5

Pb & Cu Materials Survey Approved: (X) Yes ( ) No

Date: 07/14/1993

Cross-Connection Program Approved: (X) Yes ( ) No

Date: 09/19/1990

Records Inspected This Visit: (X) Yes ( ) No

Satisfactory: (X) Yes[3] ( ) No

Date Records Last Checked: 01/17/2007

Program Active: (X) Yes[4] ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No

Date: 05/04/2005

Surface Water Influenced: N/A

Source Water Assessment Performed: N/A

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[1] 577 residential connections, 60 commercial connections

[2] Mr. Langfitt indicated that additional flushing is being implemented for the Centerville distribution system due to low water usage within the distribution system.

[3] Many commercial businesses have RPZ backflow devices for protection against cross connections. Mr. Wilds indicated that all businesses are inspecting these devices once per year; however there is no specific schedule. He anticipates the initial inspections will begin in March – April 2007.

[4] Mr. Mark Wilds indicated that customers are educated on cross connections through mass mailings once per year. The most recent mailing occurred in April 2006, which consisted of a brochure included in the monthly water bill. Also, the brochure and cross connection information is included on the County website. Sending questionnaires has become futile, because most customers do not complete and return them. All existing reduced pressure zone (RPZ) and double-gate double-check valves are to be tested annually, and the testing records are to be maintained by the County for at least 10 years.

CCR Requirements Met: (X) Yes ( ) No **Date Distributed:** 06/26/2006

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Pb & Cu	10/06/04	**09/2007**	Satisfactory Results! The water system is on Ultimate Reduced Monitoring, which requires one set of 10 distribution tap samples to be collected every 3 years.
TTHM/HAA5	09/25/06	**09/2007**	Satisfactory Results! The water system is on Reduced (Annual) Monitoring.

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	October 2006
	Monitoring violation issued [month(s)]	November 2006
	Owner issued Public Notice as required?	No[5]

Water Usage (2006):

Meter	Gallons
Purchased Water From Henrico	
TOTAL	87.94 million gallons
Average	240,931 gal/day

[5] Verification of public notification has not been submitted to this Office for either violation.

VIRGINIA DEPARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Elk Hill Farm
PWSID No. 4075200

PART I – GENERAL INFORMATION

Owner: Elk Hill Farm, Inc. – Mr. Michael C. Farley, Executive Director

Telephone: (804) 457-4866

Type Waterworks: (X) C ( ) NTNC ( ) NC

Waterworks Class: VI

Operator's License Class: I (Mr. Michael L. Cook, TetraOps, License No. 1901000555, exp. 02/28/2007)

Inspection By: Winston C. Marshall

Inspection Date: 02/07/2006

Time Spent On-site: 1.5 hours

Last Inspection Date: 02/20/2004

Reviewed By / Date: RLM 2/13/06

Reviewed By / Date: BMR 2/15/06

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Mike L. Cook, Operator in Responsible Charge

Facilities Inspected: well, well lot, well house, storage tanks, and booster pumps

Permit Effective Date: 02/04/2000

Permit/EDS Up-to-Date: (X) Yes ( ) No
If "No", explain:

No. Connections: 10
Pop. Served: 125[1]

Permit Capacity: 12,800 gpd

Operating Within Permit Capacity: (X) Yes ( ) No

Average GPD/Connection: 548 **Average GPD/Person:** 44 **Avg. Daily Usage:** 5,480 gallons

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 07/14/1993

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 10/08/1985
Records Inspected This Visit: ( ) Yes (X) No **Satisfactory:** (X) Yes ( ) No
Date Records Last Checked: N/A[2] **Program Active:** (X) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 07/16/2001

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 12/20/1993

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 01/08/2002

CCR Requirements Met: (X) Yes ( ) No **Date Distributed:** 06/17/2005

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

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[1] 50 residential students, 20 non-residential students, 55 staff (non-residential). These are conservative population figures.
[2] There are no known RPZ type backflow devices to inspect. Mr. Bob Browning or Mr. Mike Cook (operator) needs to submit a list of existing cross-connection and backflow prevention devices provided for the water system. The water system needs to be re-surveyed annually to determine if any new cross-connections exist needing proper protection, and to inspect and maintain all installed backflow prevention devices. Maintaining records of the annual surveys and inspections of the installed devices is required.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	09/14/04	09/2007	Satisfactory Results!
Metals	09/14/04	09/2007	Sodium = 72.4 mg/l (recommended level <20 mg/l)
Radiological	12/16/02	10/2013	Satisfactory Results!
Nitrates/Nitrites	03/31/05	**03/2006**	Satisfactory Results!
Pb & Cu	09/11/04	09/2007	Satisfactory Results!
VOCs	03/31/05	03/2008	Satisfactory Results!
SOCs	N/A	*	Waived through 12/31/2007.
Cyanide**	01/15/98	01/2007	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2007.

Waiver Status: *All provisional waivers for the compliance period of 01/01/05 to 12/31/07 have been granted.
**The cyanide waiver granted is for the compliance cycle of 01/01/02 to 12/31/10. One cyanide sample must be collected during this compliance cycle.

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

Date	Meter Reading, gallons
02/07/06	12,706,860
02/20/04	08,772,040
718 days	03,934,820 gallons

GPD: 5,480

PWSID No. 4075735

SUBJECT: GOOCHLAND COUNTY
Water - James River Correctional Center WTP

To: Mr. Randy A. Wilson
Water Systems Treatment Plant Supervisor
James River Correctional Center
State Farm, Virginia 23160

WATERWORKS SANITARY SURVEY REPORT

GENERAL

1. Facility name: James River Correctional Center WTP

2. Facility owner: Commonwealth of Virginia, Department of Corrections

3. Address: State Farm, Virginia 23160
   Contact: Mr. Randy A. Wilson, Water Systems Treatment Plant Supervisor
   Telephone: (804) 221-7997
   FAX: (804) 556-6328

4. Survey by: Randall L. Morrissette RLM Time on Site: 4.5 hours

5. Survey type: Routine Waterworks Type: Class II

6. Survey Date: 06/19/07 Report Date: 07/20/07

7. Last Survey: 11/28/06

8. Reviewed by: _____ Date: 8/1/2007
   _____ Date: _____

9. Present at inspection: Mr. Lee Puett, Chief Operator

10. Operation Permit No. 4075735 Effective Date: 07/27/98

11. Permit/Engineering Description Sheet Date: 07/16/98 Complete and Accurate? No
    The information on the replacement flocculator drives and mixers needs to be included.

12. Permitted capacity: 1.5 MGD Limited by: Filtration rate maximum of 2.0 gpm/ft^2

13. Number of facilities and sequential systems being served: 9 Population served: 8,073
    (8 DOC facilities + Goochland Courthouse) (June 2007)

14. Inventory Records Up-to-date? Yes

VIRGINIA DEPARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - James River Estates
PWSID No. 4075400

PART I – GENERAL INFORMATION

Owner: Aqua Virginia, Inc.

Telephone: (804) 749-8868 **Type Waterworks:** (X) C ( ) NTNC ( ) NC

Waterworks Class: IV **Operator's License Class:** III (Clifton L. Parker, P.E., License No. 19002236, exp. 02/28/2009)

Inspection By: Winston C. Marshall **Inspection Date:** 05/08/2007

Time Spent On-site: 2 hours **Last Inspection Date:** 02/09/2005

Reviewed By / Date: RLM 6/14/07 **Reviewed By / Date:** MS 6-14-07

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present at Inspection: Mr. Matthew Rogers, Aqua Virginia Operator

Facilities Inspected: Four wells, two well houses, one well enclosure, one gravity storage tank, two booster pumps, two hydropneumatic tanks, and treatment equipment

Permit Effective Date: 09/04/2001 **Permit/EDS Up-to-Date:** ( ) Yes (X) No
If "No", explain: Additional connections allowed based on availability of water from Goochland County

No. Connections: 77 **Pop. Served:** 231 **Avg. Daily Usage:** 16,307 gallons

Permit Capacity: 68 connections **Operating Within Permit Capacity:** (X) Yes[1] ( ) No

Average GPD/Connection: 212 **Average GPD/Person:** 70.5

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 07/08/1993

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 01/04/2006
Records Inspected This Visit: ( ) Yes (X) No[2] **Satisfactory:** ( ) Yes ( ) No
Date Records Last Checked: 01/04/2006 **Program Active:** ( ) Yes (X) No[3]

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 09/01/1992

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 05/18/1994

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 01/09/2002

CCR Requirements Met: (X) Yes ( ) No **Date Distributed:** 06/08/2006

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: Failure to collect the required number of lead and copper samples during the monitoring period of June-September 2004; Issued on 02/28/2005.

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[1] Additional capacity is provided through Henrico County; Aqua Virginia purchases the water.
[2] There are no RPZ type backflow devices to inspect. A cross connection update request was sent via email from this Office to Aqua Virginia, however no response was provided.
[3] This Office does not know the status of the cross connection control program for this water system.

Water Production Calculations (gallons)

Date	Well No. 1	Well 1A	Well No. 2	Well 2A
05/08/07	4,255,300	638,070	6,297,600	4,605,600
02/09/05	4,108,730	5,900[4]	6,290,290	4,519,950
818 days	146,570[5]	632,170	7,310	85,650

Purchased water from 02/09/2005 through 05/08/2007 = 12,080,600 gallons. Average gpd = 14,768
Average gpd from four wells: 1,539

GPD Total: 16,307

There is a 1-1/2 inch Sensus (SN 54917959) meter installed in the well house for Well No. 1 that measures the water purchased from Goochland County. The meter reading was 25,401,300 gallons.

PART III – INSPECTION OF FACILITES

SOURCE: Well No. 1 (inside)	Satisfactory? Yes	Satisfactory? No	Comments Located on West Brook Run Drive near the main entrance.
All-weather access Rd	X		Gravel access road from West Brook Run Drive.
Well lot condition		X	A significant amount of brush and logs from downed trees are stored on the well lot.
Protected from surface runoff	X		The well is located inside a concrete block building.
Screened/downward-facing casing vent	X		
12" Casing extension		X	The well casing extends approximately 6 inches above the floor.
Sanitary casing seal/well cap	X		
Drawdown gauge			Not provided
Raw water sample tap	X		This sample tap is installed on the well head.
Valved blow-off	X		The sample tap upstream of the meter can be used.
Discharge shutoff valve	X		The well shutoff valve is downstream of the meter.
Discharge check valve	X		
Operable water meter	X		A 5/8" Neptune
Meter serial number			SN 80524056
Meter reading			387,150 gallons
Pump cycle time	X		The pump ran for the entire inspection (due to low output).
Pump controlled by	X		Electrodes in the gravity storage tank.
Pumping rate (gpm)	X		0.5 gpm
Discharge head (psi)	X		20 psi

[4] This is the first reading from the new meter for Well No. 1A on 02/14/2005.
[5] An additional 387,150 gallons of water (new meter reading) was used after a meter replacement on 07/12/2005.

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Jenkins Trailer Park
PWSID No. 4075420

PART I – GENERAL INFORMATION

Owner: Mr. Frederick P. Jenkins and Mrs. Essie Jenkins

Telephone: (804) 556-4568

Type Waterworks: (X) C ( ) NTNC ( ) NC

Waterworks Class: VI

Operator's License Class: I (Mr. Michael L. Cook, License No. 1901000555, exp. 02/28/2007)

Inspection By: Winston C. Marshall

Inspection Date: 01/31/2007

Time Spent On-site: 2 hours

Last Inspection Date: 02/09/2005

Reviewed By / Date: RLM 2/8/07

Reviewed By / Date: MS 2-15-07

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present at Inspection: Mr. Michael L. Cook, Operator

Facilities Inspected: Two wells, well house, four bladder-type storage tanks, chlorination facility, and corrosion control treatment equipment

Permit/EDS Up-to-Date: (X) Yes ( ) No
If "No", explain:

Permit Effective Date: 07/07/1999

No. Connections: 49 trailer connections

Pop. Served: 100

Avg. Daily Usage: 2,923 gallons[1]

Permit Capacity: 52 trailer connections

Operating Within Permit Capacity: (X) Yes ( ) No

Average GPD/Connection: 60

Average GPD/Person: 29

Pb & Cu Materials Survey Approved: (X) Yes ( ) No

Date: 02/13/1997

Cross-Connection Program Approved: (X) Yes ( ) No

Date: 07/21/1987

Records Inspected This Visit: ( ) Yes (X) No[2]

Satisfactory: ( ) Yes (X) No

Date Records Last Checked: 01/31/2007

Program Active: ( ) Yes (X) No[3]

Bacteriological SSR Approved: (X) Yes ( ) No

Date: 12/21/1992

Surface Water Influenced: ( ) Yes (X) No

Date Determined: 06/29/1994

Source Water Assessment Performed: (X) Yes ( ) No

Date of Report: 1/09/2002

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[1] The meter was frozen during my inspection; however Mr. Mike Cook was able to revive the meter. The indicated usage may be lower than the actual amount of water used, because the meter was not working at times.

[2] There are no RPZ type backflow devices to inspect. Mr. Jenkins indicated that all trailers are equipped with a check valve on the connection piping. Also, he indicated that the residential cross connection questionnaires have not been distributed recently, and he has no previous records on file.

[3] The residential questionnaires are due to be distributed; complete this as soon as possible. A copy of a questionnaire is attached for your convenience.

Water Production Calculations (gallons)

Date	Combined Meter (Well Nos. 1 & 2)
01/31/07	(1)1,106,760
02/09/05	8,999,270
721 days	2,107,490

GPD: 2,923

PART III – INSPECTION OF FACILITIES

SOURCE: Well No. 1 (Inside)	Satisfactory? Yes	Satisfactory? No	Comments (36-inch diameter bored well)
All-weather access Rd	X		A graveled area extending from the paved entrance road.
Well lot condition	X		Approximately 25 feet from a trailer and a similar distance from Route 6.
Protected from surface runoff	X		
Screened/downward-facing casing vent		X	Bored well – N/A (has two plastic tubes that extend through the side of the casing – **screen the ends of the tubes**)
12" Casing extension	X		
Concrete pad (6'x6')		X	The well house floor does not extend three feet from the well head in all directions.
Sanitary casing seal/well cap	X		The concrete cover is in good condition.
Drawdown gauge			Not provided
Raw water sample tap	X		
Valved blow-off	X		The raw water sample tap could be used for this purpose.
Discharge shutoff valve	X		One shutoff valve serves both wells.
Discharge check valve	X		
Operable water meter	X		A 1" Neptune
Meter serial number			SN 22890976
Meter reading			1,106,760 gallons
Pump cycle time	X		The pump cycled satisfactorily numerous times.
Pump controlled by	X		Pressure switch connected to the common well discharge piping.
Pumping rate (gpm)	X		20 gpm
Discharge head (psi)			No gauge is provided to measure the head pressure.

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Manakin Farms
PWSID No. 4075500

PART I – GENERAL INFORMATION

Owner: James River Service Corporation, an Aqua Virginia, Inc. company
Telephone: (804) 204-1611 **Type Waterworks:** (X) C ( ) NTNC ( ) NC

Waterworks Class: IV **Operator's License Class:** III – Mr. Cliff Parker, IV (License No. 19002236, Exp. 02/28/2007)

Inspection By: Winston C. Marshall **Inspection Date:** 12/13/2005

Time Spent On-site: 4 hours **Last Inspection Date:** 01/30/2004

Reviewed By / Date: RLM 1/6/06 **Reviewed By / Date:** MR 1/17/2006

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Matt Rogers, Aqua Virginia Waterworks Operator

Facilities Inspected: Wells Nos. 6, 7, 9, 10, 11, and 12, three well houses, corrosion control equipment, chlorination equipment, iron/manganese filtration system, and gravity and hydropneumatic storage tanks

Permit/EDS Up-to-Date: ( ) Yes (X) No **Permit Effective Date:** 07/26/1999
If "No", explain: Have installed a calcite filter at Well No. 6. Have installed hypochlorination for Well Nos. 6, and 7 & 10. Have completed addition of Well No. 10 and associated 125,000-gallon gravity storage tank. Have completed addition of Well Nos. 11 and 12. Have switched from use of Aqua Mag ortho-polyphosphate blend to the AquaMag F-35 ortho-polyphosphate blend for sequestering and corrosion control. Well Nos.4 and 8 have been permanently abandoned.

No. Connections: 195 **Pop. Served:** 585 **Avg. Daily Usage:** 70,190 gallons

Permit Capacity: 147,600 gpd (369 ERCs)[1] **Operating Within Permit Capacity:** (X) Yes ( ) No

Average GPD/Connection: 360 **Average GPD/Person:** 120

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 07/08/1993

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 10/13/1994
Records Inspected This Visit: ( ) Yes (X) No[2] **Satisfactory:** ( ) Yes (X) No[2]
Date Records Last Checked: 10/13/1994 **Program Active:** ( ) Yes (X) No[2]

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 09/01/1992

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 11/24/1993 and 02/26/2004

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 01/09/2002 and 02/26/2004

CCR Requirements Met: (X) Yes ( ) No **Date Distributed:** 06/14/2005

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[1] The waterworks permit needs to be updated to reflect the improvements.
[2] Cross connection questionnaires were mailed to 20% of Aqua VA customers in December 2004. We cannot verify that questionnaires were mailed to Manakin Farms customers. Cross connection questionnaires are required to be mailed to all customers at least once every three years.

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

Date	Well No. 6	Well No. 7	Well No. 9	Well No. 10	Well No. 11[4]	Well No. 12[5]
12/13/05	8,522,730	34,834,600	2,803,200	22,068,500	8,019,600	8,982,800
01/30/04	5,514,970	25,589,500	2,755,000	11,706,200	312,700	269,800
683 days	3,007,760	9,245,100	48,200	10,362,300	7,706,900	8,713,000
Avg. Daily Use:	4,404	13,536	71	15,172	18,350	18,657

Total Avg. Daily Use = 70,190

[4] The first available well meter reading was on 09/02/2004; also the last available well meter reading was on 10/27/2005 due to a well pump failure.

[5] The first available well meter reading was on 09/02/2004.

VIRGINIA DEPARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - The Meadows Nursing Center
PWSID No. 4075520

PART I – GENERAL INFORMATION

Owner: Life Care Centers of America, Inc. c/o The Meadows Nursing Center

Telephone: (804) 556-4418

Type Waterworks: (X) C ( ) NTNC ( ) NC

Waterworks Class: IV

Operator's License Class: I (Mr. Michael L. Cook, TetraOps, License No. 1901000555, exp. 02/28/2007)

Inspection By: Winston C. Marshall

Inspection Date: 02/07/2006

Time Spent On-site: 1.5 hours

Last Inspection Date: 02/19/2004

Reviewed By / Date: RLM 2/23/06

Reviewed By / Date: BLH 2/24/2006

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Mike L. Cook, Licensed Operator

Facilities Inspected: well, well lot, pump house, treatment facilities, storage tanks, and booster pumps

Permit Effective Date: 09/07/2000

Permit/EDS Up-to-Date: (X) Yes ( ) No
If "No", explain:

No. Connections: 1 **Pop. Served:** 168 (79 residents, 89 staff) **Avg. Daily Usage:** 9,849 gallons

Permit Capacity: 14,400 gpd

Operating Within Permit Capacity: (X) Yes ( ) No

Average GPD/Connection: N/A

Average GPD/Person: 59

Pb & Cu Materials Survey Approved: (X) Yes ( ) No

Date: 09/20/1993

Cross-Connection Program Approved: (X) Yes ( ) No
Records Inspected This Visit: ( ) Yes (X) No[1]
Date Records Last Checked: N/A – no records

Date: 03/28/1991
Satisfactory: (X) Yes ( ) No
Program Active: (X) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No

Date: 06/04/1992

Surface Water Influenced: ( ) Yes (X) No

Date Determined: 01/03/1994

Source Water Assessment Performed: (X) Yes ( ) No

Date of Report: 01/09/2002

CCR Requirements Met: (X) Yes ( ) No

Date Distributed: 06/17/2005

Any Complaints Since Last Inspection: ( ) Yes (X) No

If "Yes", explain: N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

[1] There are no records or RPZ type backflow devices to inspect. Mike Cook indicated that all outside hose bibs are equipped with atmospheric vacuum breakers.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	12/22/03	**03/2006**	Satisfactory Results!
Metals	12/22/03	**03/2006**	Iron = 0.53 mg/l (SMCL – 0.30 mg/l), Manganese = 0.062 mg/l (SMCL – 0.05 mg/l)
Radiological	12/16/02	10/2012	Satisfactory Results!
Nitrates/Nitrites	03/31/05	**03/2006**	Satisfactory Results!
Pb & Cu	08/26/03	**08/2006**	Satisfactory Results! On Ultimate Reduced (triennial) monitoring
VOCs	12/22/03	**03/2006**	Satisfactory Results!
SOCs	N/A	*	Waived through 12/31/2007.
Cyanide**	03/30/99	03/2008	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2007.
Raw water MPN	07/25/05	**08/2006**	Satisfactory Results!

Waiver Status: *All provisional waivers for the compliance period of 01/01/05 to 12/31/07 have been granted.
**The cyanide waiver granted is for the compliance cycle of 01/01/02 to 12/31/10. One cyanide sample must be collected during this compliance cycle.

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations

Date	Meter Reading (gallons)
02/07/06	54,590,000
02/19/04	47,508,400
719 days	7,081,600

GPD: 9,849

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Pagebrook
PWSID No. 4075630

PART I – GENERAL INFORMATION

Owner: Aqua Virginia, Inc., Mr. Gregory K. Odell, Division Manager-Virginia

Telephone: (804) 204-1611

Type Waterworks: (X) C ( ) NTNC ( ) NC

Waterworks Class: IV

Operator's License Class: Class III (Mr. Cliff Parker - License No. 19002236, exp. 02/28/2007)

Inspection By: Winston C. Marshall

Inspection Date: 12/13/2005

Time Spent On-site: 2 hours

Last Inspection Date: 01/23/2004

Reviewed By / Date: RLM 12/27/05

Reviewed By / Date: SLEO/12-28-05

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Alone

Facilities Inspected: Three wells, two well houses, one gravity storage tank, one booster pump, two hydropneumatic tanks, and treatment equipment

Permit/EDS Up-to-Date: ( ) Yes (X) No **Permit Effective Date:** 10/02/2000
If "No", explain: Ortho-polyphosphate treatment for sequestration of Fe and Mn and chlorination equipment have been added at Well No. 4. Also, requires update due to purchase of AquaSource by Aqua Virginia, Inc. and change operator status from Sydnor Hydro, Inc. to Aqua Virginia, Inc.

No. Connections: 20 **Pop. Served:** 60 (Est.) **Avg. Daily Usage:** 3,585 gallons

Permit Capacity: 20 residential connections **Operating Within Permit Capacity:** (X) Yes ( ) No

Average GPD/Connection: 179 **Average GPD/Person:** 60

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 07/08/1993

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 10/13/1994
Records Inspected This Visit: ( ) Yes (X) No[1] **Satisfactory:** ( ) Yes (X) No[1]
Date Records Last Checked: 10/13/1994 **Program Active:** ( ) Yes (X) No[1]

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 09/01/1992

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 12/20/1993

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 01/09/2002

CCR Requirements Met: (X) Yes ( ) No **Date Distributed:** 06/14/2005

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

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[1] Cross connection questionnaires were mailed to 20% of Aqua VA customers in December 2004. We cannot verify that questionnaires were mailed to Pagebrook customers. Cross connection questionnaires are required to be mailed to all customers at least once every three years.

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

Date	Well No. 1	Well No. 3	Well No. 4
12/13/05	528,360	5,946,790	7,315,110
01/23/04	528,360	3,909,280	6,878,920
690 days	0	2,037,510	436,190
GPD:	0	2,953	632

GPD Total: 3,585

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Broadview Shopping Center
PWSID No. 4075036

PART I - GENERAL INFORMATION

Owner: Broadview Associates - Mr. W. Douglas Elliott, Jr., President

Telephone: (804) 784-0407 (pager: 759-3266) **Type Waterworks:** ( ) C (X) NTNC ( ) NC

Waterworks Class: IV **Operator's License Class:** I (Mr. Michael L. Cook, License No. 1901000555, exp. 02/28/2009)

Inspection By: Winston C. Marshall **Inspection Date:** 04/25/2007

Time Spent On-site: 2½ hours **Last Inspection Date:** 04/22/2005

Reviewed By / Date: **Reviewed By / Date:**

Inspection Type: (X) Routine ( ) Complaint ( ) Other

Present At Inspection: Mr. Michael L. Cook, TetraOps Environmental Services

Facilities Inspected: two wells, two well lots, a pump house, a pressure tank, two gravity storage tanks, two booster pumps, an iron and manganese treatment system, a corrosion control treatment system, and a chlorination system (oxidation)

Permit/EDS Up-to-Date: (X) Yes ( ) No **Permit Effective Date:** 05/31/2005

If "No", explain:

No. Connections: 18 **Pop. Served:** 200 (variable) **Avg. Daily Usage:** 6,599 gallons

Permit Capacity: 61,056 gpd - limited by the filtration capacity

Operating Within Permit Capacity: (X) Yes ( ) No

Average GPD/Connection: 367 **Average GPD/Person:** 33

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 05/26/1993

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 02/20/1986
Records Inspected This Visit: ( ) Yes (X) No[1] **Satisfactory:** (X) Yes ( ) No
Date Records Last Checked: N/A – no records **Program Active:** (X) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 09/20/1992

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 05/02/2005

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 02/23/2005

Any Complaints Since Last Inspection: (X) Yes ( ) No **If "Yes", explain:** A complaint of dirty water at the Food Lion was investigated on 07/27/2006 by Mr. Sean Hejja of the Department of Agriculture and Consumer Services. Winston C. Marshall and Mike Cook of TetraOps investigated the complaint on 08/03/2006. The water was clear, and a bacteriological sample collected from the Food Lion by Mike Cook tested negative for total coliform bacteria. There had been some repair work in the pump house, which affected the effectiveness of the treatment facilities.

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[1] There are no records or RPZ type backflow devices to inspect. Mr. Cook indicated that no major repairs have been done to the water system since the previous inspection.

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	01/24/07	01/2010	Satisfactory Results!
Metals	01/24/07	01/2010	**Iron = 1.24 mg/l; Manganese = 0.37 mg/l** (SMCL: Iron – 0.30 mg/l; Manganese – 0.05 mg/l) Sodium = 16.1 mg/l (satisfactory level)
Nitrates/Nitrites	01/24/07	07/2008	Combined nitrates = 0.14 mg/l. Sample annually.
Pb & Cu	08/22/06	08/2009	On Ultimate Reduced (triennial) monitoring. The next samples are scheduled to be collected between 6/1/09 and 9/30/09.
VOCs	03/27/07	01/2010	Satisfactory Results!
SOCs	N/A	*	Waived through 12/31/2010.
Cyanide**	07/02/99	07/2008	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2010.
HAA5	09/21/04	**09/2007**	On Reduced (triennial) monitoring. The next samples are scheduled to be collected between 7/1/07 and 9/30/07.
TTHM	09/21/04	**09/2007**	On Ultimate Reduced (triennial) monitoring. The next samples are scheduled to be collected between 7/1/07 and 9/30/07.

Waiver Status: *A waiver application has been approved for this waterworks owner for the compliance period of 01/01/08 to 12/31/10. **Sampling for cyanide will be required once during each of the next three three-year compliance periods during the 01/01/02 to 12/31/10 compliance cycle. This sampling will be done prior to the possible reduction in cyanide sampling to only once during each nine-year compliance cycle.

Operational Reports	Submitted for the Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over the past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

Date	Well No. 1 & 3
04/25/07	8,179,000
04/22/05	3,342,000
733 days	4,837,000

GPD: 6,599

VIRGINIA DEPARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Byrd Elementary School
PWSID No. 4075040

PART I - GENERAL INFORMATION

Owner: Goochland County Public Schools – Mr. Sonny Turner, Maintenance Supervisor

Telephone: (804) 556-5316 **Type Waterworks:** ( ) C (X) NTNC ( ) NC

Waterworks Class: IV **Operator's License Class:** IV

Inspection By: Winston C. Marshall **Inspection Date:** 12/07/2006

Time Spent On-site: 1½ hours **Last Inspection Date:** 12/14/2004

Reviewed By / Date: **Reviewed By / Date:**

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Robert Lawrence, Operator

Facilities Inspected: well, well house, treatment facilities, pressure tank, gravity storage tank, and booster pumps

Permit Effective Date: 09/24/1997 **Permit/EDS Up-to-Date:** (X) Yes ( ) No
If "No", explain:

No. Connections: 1 **Pop. Served:** 323[1] **Avg. Daily Usage:** 2,039 gallons/school day

Permit Capacity: 4,400 gpd **Operating Within Permit Capacity:** (X) Yes ( ) No

Average GPD/Connection: 2,039 **Average GPD/Person:** 6.3

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 12/05/1991
Records Inspected This Visit: ( ) Yes (X) No[2] **Satisfactory:** (X) Yes ( ) No
Date Records Last Checked: N/A – no records **Program Active:** (X) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 12/28/2000 (revised)

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 11/12/1993

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 04/25/1997

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 01/09/2002

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti)/Enforcement Actions Since Last Inspection: None

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[1] This water system serves approximately 288 students and 35 staff members.
[2] There are no records, RPZ backflow devices, or double gate/double check valves to inspect. Mr. Lawrence indicated that no major plumbing work has been done to the well or distribution system since the last inspection. Also, there are atmospheric vacuum breakers installed on the hose bibs used for chemical make-up and spray nozzles.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	10/04/05	10/2008	Satisfactory Results!
Metals	10/04/05	10/2008	Sodium = 30.9 mg/l (recommended < 20 mg/l)
Nitrates/Nitrites	10/04/06	10/2007	Combined Nitrate = 0.38 mg/l – Satisfactory!
Pb & Cu	09/21/04	09/2007	The lead and copper tap samples must be collected between 06/01/2007 and 09/30/2007.
VOCs	11/04/04	11/2007	Satisfactory Results!
SOCs	N/A	*	Waived through 12/31/2007
Cyanide	02/03/99	**	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2007
Asbestos	N/A	*	Waived through 12/31/2007
Raw water MPN	09/27/06	09/2007	<1.0 colonies/100 ml
HAA5	09/02/04	09/2007	Satisfactory Results!
TTHM	09/02/04	09/2007	Satisfactory Results!

Waiver Status: : *All provisional waivers for the compliance period of 01/01/05 to 12/31/07 have been granted.
**The cyanide waiver granted is for the compliance cycle of 01/01/02 to 12/31/10. One cyanide sample must be collected during this compliance cycle.

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

TOTAL PRODUCTION		SUMMER PRODUCTION			
Date	Meter Reading	Date	Meter Reading	Date	Meter Reading
12/07/06	7,702,600	06/22/05	7,140,200	06/20/06	7,520,900
12/14/04	6,916,600	08/31/05	7,158,750	08/31/06	7,546,100
723 days	786,000	70 days	18,550	72 days	25,200

GPD: (786,000 – (18,550 + 25,200)) / (182*2) = 742,250 / 364 school days = 2,039 gallons/school day

VIRGINIA DEPARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Goochland Middle School
PWSID No. 4075285

PART I – GENERAL INFORMATION

Owner: Goochland County Public Schools – Mr. Sonny Turner, Maintenance Supervisor

Telephone: (804) 556-5316 **Type Waterworks:** ( ) C (X) NTNC ( ) NC

Waterworks Class: IV **Operator's License Class:** IV

Inspection By: Winston C. Marshall **Inspection Date:** 12/07/2006

Time Spent On-site: 1½ hours **Last Inspection Date:** 12/14/2004

Reviewed By / Date: **Reviewed By / Date:**

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Robert Lawrence, Operator

Facilities Inspected: well, well house, treatment facilities, pressure tank, gravity storage tank, and booster pumps

Permit Effective Date: 12/21/2000 **Permit/EDS Up-to-Date:** (X) Yes ( ) No
If "No", explain:

No. Connections: 1 **Pop. Served:** 445[1] **Avg. Daily Usage:** 3,034 gallons/school day

Permit Capacity: 5,600 gpd **Operating Within Permit Capacity:** (X) Yes ( ) No

Average GPD/Connection: 3,034 **Average GPD/Person:** 6.8

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 12/05/1991
Records Inspected This Visit: ( ) Yes (X) No[2] **Satisfactory:** (X) Yes ( ) No
Date Records Last Checked: N/A – no records **Program Active:** (X) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 09/30/1992

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 11/12/1993

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 04/25/1997

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 01/09/2002

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti)/Enforcement Actions Since Last Inspection: None

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[1] This water system serves approximately 392 students and 53 staff members.

[2] There are no records, RPZ backflow devices, or double gate/double check valves to inspect. Mr. Lawrence indicated that no major plumbing work has been done to the well or distribution system since the last inspection. Also, there is an atmospheric vacuum breaker installed on the hose bib used for chemical make-up water.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	10/05/05	10/2008	Satisfactory Results!
Metals	10/05/05	10/2008	Manganese = 0.19 mg/l (SMCL – 0.05 mg/l); Sodium = 29.2 mg/l (recommended < 20 mg/l)
Nitrates/Nitrites	10/04/06	10/2007	Satisfactory Results!
Pb & Cu	09/27/06	09/2009	On Ultimate Reduced Monitoring. The lead and copper tap samples must be collected between 06/01/09 and 09/30/09.
VOCs	03/01/06	03/2007	**Sample Annually!**
SOCs	N/A	*	Waived through 12/31/2007
Cyanide	01/12/00	**	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2007
Asbestos	N/A	*	Waived through 12/31/2007
Raw water MPN	09/27/06	09/2007	<1.0 colonies/100 ml
HAA5	09/02/04	09/2007	Satisfactory Results!
TTHM	09/02/04	09/2007	Satisfactory Results!

Waiver Status:

*All provisional waivers for the period of 01/01/05 to 12/31/07 have been granted.

**The cyanide waiver is for the compliance cycle of 01/01/02 to 12/31/10. One cyanide sample must be collected during this compliance cycle.

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

TOTAL PRODUCTION			SUMMER PRODUCTION		
Date	Meter Reading	Date	Meter Reading	Date	Meter Reading
12/07/06	4,000,500	06/22/05	3,082,660	06/21/06	3,722,780
12/14/04	2,770,510	08/31/05	3,130,140	08/31/06	3,800,790
723 days	1,229,990	70 days	47,480	71 days	78,010

GPD: (1,229,990 – (47,480 + 78,010)) = 1,104,500 / 364 school days = 3,034 gallons/school day

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Hermitage Country Club
PWSID No. 4075350

PART I – GENERAL INFORMATION

Owner: Hermitage Country Club, Inc. - Mr. Ted Bartlett, General Manager

Telephone: (804) 784-5234

Type Waterworks: ( ) C (X) NTNC ( ) NC

Waterworks Class: IV

Operator's License Class: III (Mr. Eddie Hanford, License No. 1903002506, exp. 02/28/2007)

Inspection By: Winston C. Marshall

Inspection Date: 06/13/2006

Time Spent On-site: 2 hours

Last Inspection Date: 04/15/2004

Reviewed By / Date:

Reviewed By / Date:

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Eddie Hanford, Sydnor Hydro, Inc., and Mr. Tim Hume

Facilities Inspected: well, well enclosure, pressure tank, and hypochlorite and caustic soda feed equipment

Permit/EDS Up-to-Date: ( ) Yes (X) No **Permit Effective Date:** 09/20/96 (EDS revised 04/24/97.)
If "No", explain: The EDS needs to be updated to reflect a change in the Clubhouse Maintenance Supervisor and the contract operator, the switch from the use of soda ash to caustic soda for pH adjustment for corrosion control, and the use of 24-gpd chemical feed pumps for both the hypochlorite and caustic soda solutions. A larger well pump has been installed and a well blow-off line has been installed.
No. Connections: 1 **Pop. Served:** 100 (variable) **Avg. Daily Usage:** 8,654 gallons

Permit Capacity: 48,000 gpd (50 gpm @ 16 hrs/day) **Operating Within Permit Capacity:** (X) Yes ( ) No

Average GPD/Connection: N/A **Average GPD/Person:** N/A

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 07/14/1993

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 05/21/2004
Records Inspected This Visit: (X) Yes ( ) No **Satisfactory:** ( ) Yes (X) No[1]
Date Records Last Checked: 06/13/2006 **Program Active:** ( ) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 08/20/1992

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 04/25/1997

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 01/09/2002

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

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[1] There is an RPZ device located in the pool building; however a current inspection tag was not attached to the device. Also, there was a garden hose attached to an outside hose bib on the pool building, however an atmospheric vacuum breaker was not provided.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	05/13/03	**05/2006**	**Sample is due!**
Metals	05/16/06	05/2009	Sodium = 52.9 mg/l (recommended level <20 mg/l) Iron = 0.37 mg/l; Barium = 0.03 mg/l; Nickel = 0.02 mg/l; Zinc = 0.02 mg/l
Nitrates/Nitrites	06/16/05	**06/2006**	Combined Nitrate = 0.18 mg/l; **Annual sample is due by June 30!**
Pb & Cu	09/22/04	No later than 09/30/07	Satisfactory Results! 90th % Pb = 3 ppb; Cu = 0.815 mg/l
VOCs	05/16/06	05/2009	Satisfactory Results!
SOCs	N/A	*	Waived through 12/31/2007.
Cyanide**	10/21/98	09/2007	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2007.
Raw water MPN	05/16/06	09/2007	MPN <1.0 colonies/100 ml
HAA5	08/24/04	09/2007	Satisfactory Results!
TTHM	08/24/04	09/2007	Satisfactory Results!

Waiver Status:

* All provisional waivers for the compliance period of 01/01/05 to 12/31/07 have been granted.

**The cyanide waiver granted is for the compliance cycle of 01/01/02 to 12/31/10. One cyanide sample must be collected during this compliance cycle.

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

Date	Well No. 1
06/13/06	4,465,200
04/15/04[2]	48,685,800
784 days	6,784,900[3]

GPD: 8,654

[2] The meter failed on October 21, 2004 with a reading of 51,005,500 gallons. A new meter was installed on October 26, 2004. A total of 2,319,700 gallons was used from the date of the previous inspection until the meter failed.

[3] This number represents the total amount of water (gallons) used since the previous inspection.

VIRGINIA DEPARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Randolph Elementary School
PWSID No. 4075660

PART I - GENERAL INFORMATION

Owner: Goochland County Public Schools – Mr. Sonny Turner, Maintenance Supervisor

Telephone: (804) 556-5316 **Type Waterworks:** ( ) C (X) NTNC ( ) NC

Waterworks Class: IV **Operator's License Class:** IV

Inspection By: Winston C. Marshall **Inspection Date:** 12/07/2006

Time Spent On-site: 1½ hours **Last Inspection Date:** 12/14/2004

Reviewed By / Date: **Reviewed By / Date:**

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Robert Lawrence, Operator

Facilities Inspected: well, well house, treatment facilities, pressure tank, gravity storage tank, and booster pumps

Permit Effective Date: 09/15/1997 **Permit/EDS Up-to-Date:** (X) Yes ( ) No
If "No", explain:

No. Connections: 1 **Pop. Served:** 439[1] **Avg. Daily Usage:** 3,271 gallons/school day

Permit Capacity: 4,400 gpd **Operating Within Permit Capacity:** (X) Yes ( ) No

Average GPD/Connection: 3,271 **Average GPD/Person:** 7.5

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 12/05/1991
Records Inspected This Visit: ( ) Yes (X) No[2] **Satisfactory:** (X) Yes ( ) No
Date Records Last Checked: N/A – no records **Program Active:** (X) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 12/28/2000 (revised)

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 11/12/1993

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 04/25/1997

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 01/08/2002

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti)/Enforcement Actions Since Last Inspection: None

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[1] This water system serves approximately 389 students and 50 staff members.
[2] There are no records, RPZ backflow devices, or double gate/double check valves to inspect. Mr. Lawrence indicated that no major plumbing work has been done to the well or distribution system since the last inspection. Also, there is an atmospheric vacuum breaker installed on the hose bib used for chemical make-up.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	10/04/06	10/2009	Satisfactory Results!
Metals	10/04/06	10/2009	Sodium = 38.4 mg/l (recommended level <20 mg/l)
Nitrates/Nitrites	10/04/06	10/2007	Satisfactory Results!
Pb & Cu	09/08/05	09/2008	The lead and copper tap samples must be collected between 06/01/08 and 09/30/08.
VOCs	11/01/06	11/2009	Satisfactory Results!
SOCs	N/A	*	Waived through 12/31/2007
Cyanide	01/12/00	**	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2007
Asbestos	N/A	*	Waived through 12/31/2007
Raw water MPN	09/27/06	09/2007	<1.0 colonies/100 ml
HAA5	09/02/04	09/2007	Satisfactory Results!
TTHM	09/02/04	09/2007	Satisfactory Results!

Waiver Status:

*All provisional waivers for the compliance period of 01/01/05 to 12/31/07 have been granted.

**The cyanide waiver granted is for the compliance cycle of 01/01/02 to 12/31/10. One cyanide sample must be collected during this compliance cycle.

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

TOTAL PRODUCTION			SUMMER PRODUCTION		
Date	Meter Reading	Date	Meter Reading	Date	Meter Reading
12/07/06	8,746,500	06/22/05	7,810,200	06/20/06	8,484,600
12/14/04	7,473,600	08/31/05	7,851,800	08/31/06	8,525,200
723 days	1,272,900	70 days	41,600	72 days	40,600

GPD: (1,272,900 – (41,600 + 40,600)) / (182*2) = 1,190,700 / 364 school days = 3,271 gallons/school day

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Richmond Country Club
PWSID No. 4075670

PART I – GENERAL INFORMATION

Owner: Richmond Country Club, Inc. - Mr. Toby Tomko, Clubhouse Manager

Telephone: (804) 784-5272

Type Waterworks: ( ) C (X) NTNC ( ) NC

Waterworks Class: VI

Operator's License Class: III (Eddie Hanford, Sydnor License No. 1903002506, exp. 02/28/2009)

Inspection By: Winston C. Marshall

Inspection Date: 09/25/2007

Time Spent On-site:

Last Inspection Date: 08/25/2006

Reviewed By / Date:

Reviewed By / Date:

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Eddie Hanford, Sydnor Hydro, Inc.

Facilities Inspected: well, well house, pressure storage tank, and treatment facilities

Permit/EDS Up-to-Date: (X) Yes ( ) No
If "No", explain:

Permit Effective Date: 10/31/2005

No. Connections: Clubhouse and Pro shop

Avg. Daily Usage:

Pop. Served: 112[1]

Permit Capacity: Limited to existing connections

Operating Within Permit Capacity: (X) Yes ( ) No

Cross-Connection Program Approved: (X) Yes ( ) No
Records Inspected This Visit: ( ) Yes ( ) No
Date Records Last Checked:

Date: 11/18/2002
Satisfactory: ( ) Yes ( ) No
Program Active: ( ) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No

Date: 12/16/2002

Surface Water Influenced: ( ) Yes (X) No

Date Determined: 06/13/1997

Source Water Assessment Performed: (X) Yes ( ) No

Date of Report: 08/26/2002

Any Complaints Since Last Inspection: ( ) Yes (X) No

If "Yes", explain: N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

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[1] This water system serves 32 employees/day and approximately 80 customers/day. However, the club hosts events twice per month on average. Approximately 300 people attend these events.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	06/13/06	02/2009	Satisfactory Results!
Metals	02/07/06	02/2009	Satisfactory Results! (Sodium = 30.1 mg/l)
Nitrates/Nitrites	02/27/07	02/2008	Satisfactory Results! Sample annually.
Pb & Cu	09/26/05	No later than 09/2008	On Ultimate Reduced (once every 3 years) monitoring 90th% = Pb <0.001 mg/l; Cu = 0.090 mg/l
VOCs	02/27/07	02/2010	Satisfactory Results!
SOCs	N/A	*	Waived through 12/31/2010!
Cyanide	06/13/06*	02/2009	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2010!
MPN	08/29/06	**09/2007**	Satisfactory results in 2006! Sample annually.
HAA5	08/24/04	**09/2007**	Compliance sample due!
TTHM	08/24/04	**09/2007**	Compliance sample due!

Waiver Status: *A waiver was issued for the compliance period of 01/01/08 to 12/31/10. **If the analysis of the 2009 compliance sample for cyanide indicates satisfactory results, the sampling frequency will be reduced to once every 9 years.**

Bacteriological (checked since previous inspection)	BSSR Up To Date	Yes
	Sampling locations in accordance with BSSR	Yes
	PMCL violation issued [quarter/year]	None
	Monitoring violation issued [quarter/year]	None
	Owner issued Public Notice as required?	N/A

Operational Reports	Reporting Frequency	Monthly
	Submitted since previous inspection	Yes
	Reports Accurate and Complete	Yes

Water Production Calculations (gallons)

Date	Meter Reading
09/24/07	
08/25/06	2,343,910

GPD:

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Sabot Hill Farm
PWSID No. 4075705

PART I – GENERAL INFORMATION

Owner: Sabot Hill Farm, Inc. – Mr. Hunter McGuire III, President

Telephone: 784-3413-Hunter McGuire III
784-5024-W. L. Branch, Jr.

Type Waterworks: ( ) C (X) NTNC ( ) NC

Waterworks Class: VI

Operator's License Class: VI (W.L. Branch, Jr., License No. 1918000217, Expires 02/28/2009)

Inspection By: Winston C. Marshall

Inspection Date: 04/18/2007

Time Spent On-site: 1½ hours

Last Inspection Date: 04/12/2005

Reviewed By / Date:

Reviewed By / Date:

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. W. L. Branch, Jr. (Farm Manager)

Facilities Inspected: well, well house, hydropneumatic tank, and corrosion control treatment

Permit/EDS Up-to-Date: (X) Yes ( ) No **Permit Effective Date:** 04/09/2004
If "No", explain:

No. Connections: Nine[1] **Avg. Daily Usage:** 2,584 gallons **Average GPD/Connection:** 287

Pop. Served: 14 residents and 24 non-transients

Permit Capacity: Limited to existing connections **Operating Within Permit Capacity:** (X) Yes ( ) No

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 09/03/2004

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 05/16/2005
Records Inspected This Visit: ( ) Yes (X) No **Satisfactory:** ( ) Yes (X) No
Date Records Last Checked: N/A – no records **Program Active:** ( ) Yes (X) No[2]

Bacteriological SSR Approved: (X) Yes ( )No **Date:** 09/03/2004

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 04/22/2005

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 02/23/2005

Any Complaints Since Last Inspection: ( ) Yes (X) No. **If "Yes", explain:** N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

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[1] The nine connections consist of 7 residential houses, a church, and a church out-building (former parish house).
[2] Atmospheric vacuum breakers need to be installed on exterior hose bibs and frost-free yard hydrants to help prevent a cross connection through a garden hose. Homeowners and the church administration need to be educated on cross connections through a questionnaire form.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	05/07/04	**07/2007**	Satisfactory Results!
Metals	08/12/05	08/2008	Manganese = 0.032 mg/l; Sodium = 11.4 mg/l
Nitrates/Nitrites	03/16/07	08/2008	Combined nitrates = 1.78 mg/l
Pb & Cu	11/30/05	06/30/08	EPA Action Level for lead exceeded. Owner notified of need to modify corrosion control treatment. Phosphate addition recommended. Treatment must be installed by 1/1/08, after plans and specifications are approved by this Office.
VOCs	01/16/06	**07/2007**	Satisfactory Results!
SOCs	N/A	*	Waived through 12/31/2007.
Cyanide**	07/12/05	08/2008	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2007.

Waiver Status: *A waiver application for the compliance period of 01/01/08 to 12/31/10 was mailed to Mr. Hunter H. McGuire on 02/05/2007. ****Sampling for cyanide will be required once during each of the next three three-year compliance periods during the 01/01/02 to 12/31/10 compliance cycle. This sampling will be done prior to the possible reduction in cyanide sampling to only once during each nine-year compliance cycle.**

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	Yes

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	August 2006
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	Yes

Water Production Calculations (gallons)

Date	Well
04/18/07	13,226,500
04/12/05	11,325,000
736 days	1,901,500

GPD: 2,584

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Salem Baptist Church
PWSID No. 4075708

PART I – GENERAL INFORMATION

Owner: Salem Baptist Church[1] – Mr. Zachery Zbinden, Pastor

Telephone: (804) 784-4171

Type Waterworks: ( ) C (X) NTNC ( ) NC

Waterworks Class: VI

Operator's License Class: III (Eddie Hanford, License No. 1903002506, exp. 02/28/2009)

Inspection By: Winston C. Marshall

Inspection Date: 04/18/2007

Time Spent On-site: 1.5 hours

Last Inspection Date: 04/11/2005

Reviewed By / Date:

Reviewed By / Date:

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Ms. Kim Bunge, Church Secretary

Facilities Inspected: well, well lot, a bladder tank, and a neutralizer filter

Permit/EDS Up-to-Date: ( ) Yes (X) No **Permit Effective Date:** 05/16/2003
If "No", explain: A trailer used for extra school rooms has been connected to the water system.[2] The operator information needs to be updated. Also, the church is planning to move to another locality.
No. Connections: Two[3] **Avg. Daily Usage:** N/A – no meter provided

Pop. Served: 480 weekly[4]

Permit Capacity: Limited to existing church and school building. **Operating Within Permit Capacity:** ( ) Yes (X) No

Pb & Cu Materials Survey Approved: (X) Yes ( ) No **Date:** 09/02/2004

Cross-Connection Program Approved: (X) Yes ( ) No **Date:** 09/02/2004
Records Inspected This Visit: ( ) Yes (X) No[5] **Satisfactory:** (X) Yes ( ) No
Date Records Last Checked: N/A – no records **Program Active:** (X) Yes ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No **Date:** 09/02/2004

Surface Water Influenced: ( ) Yes (X) No **Date Determined:** 04/22/2005

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[1] The church owns a property adjacent to nearby U. S. Route 250. The church plans to build a new church and school facility on this property in the near future.
[2] This office first became aware of the trailer on January 7, 2004. It houses two grades for the school. In 2004, Pastor Zbinden stated that no additional grades would be added at the school until the new church building was completed.
[3] The two connections consist of the church/school building and a trailer used for extra school rooms. An additional trailer has been installed on the property, however no water is provided.
[4] This water system serves approximately 130 students for the school, 20 staff, and 350 people for Sunday services.
[5] There are no records or RPZ type backflow devices to inspect. Also, there have been no major repairs done to the water system since the initial inspection.

Source Water Assessment Performed: (X) Yes ( ) No **Date of Report:** 02/23/2005

Any Complaints Since Last Inspection: ( ) Yes (X) No **If "Yes", explain:** N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: Failure to provide a licensed waterworks operator from 2004 until January 2007; Failure to provide a totalizing water meter to the present date; a notice of violation was issued with this routine inspection report.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	06/04/04	**06/2007**	Satisfactory Results!
Metals	06/30/05	**06/2007**	Collect this sample by June 30!
Nitrates/Nitrites	06/28/06	**06/2007**	Combined Nitrate/Nitrite = 2.47 mg/l. A sample collected on 6/10/06 indicated that nitrite concentration is <0.05 mg/l. *(Nitrate-nitrogen: PMCL = 10 mg/l; Nitrite-nitrogen: PMCL = 1 mg/l)*
Pb & Cu	11/03/04	**06/2007**	EPA Action Level for lead was exceeded. The owner has been notified to modify corrosion control treatment. The treatment must be installed by 1/1/2008; however plans and specifications must be approved by this Office. This Office requests a set of samples be collected by June 30 to verify lead and copper levels in the distribution system.
VOCs	03/24/06	**06/2007**	Satisfactory Results!
SOCs	N/A	*	Waived through 12/31/2010.
Cyanide**	05/24/04	**06/2007**	Satisfactory Results!
Diquat	N/A	*	Waived through 12/31/2010.

Waiver Status: *A waiver was issued for the compliance period of 01/01/08 to 12/31/10. ****Sampling for cyanide will be required once during each of the next three three-year compliance periods during the 01/01/02 to 12/31/10 compliance cycle. This sampling will be done prior to the possible reduction in cyanide sampling to only once during each nine-year compliance cycle.**

Bacteriological (checked since previous inspection)	BSSR Up To Date	Yes
	Sampling locations in accordance with BSSR	Yes
	PMCL violation issued [quarter/year]	None
	Monitoring violation issued [quarter/year]	January 2006
	Owner issued Public Notice as required?	Yes

Water Production Calculations (gallons)
Operational Reports are required; the reports must include weekly meter readings. **Install a totalizing water meter immediately!**

VIRGINIA DEPTARTMENT OF HEALTH
OFFICE OF DRINKING WATER
GROUNDWATER SYSTEM SANITARY SURVEY REPORT

SUBJECT: Goochland County
Water - Veterinary Referral & Critical Care
PWSID No. 4075880

PART I – GENERAL INFORMATION

Owner: Veterinary Referral & Critical Care, Inc. – Mrs. Brenda Hubbard, Administrator[1]

Telephone: (804) 784-8722

Type Waterworks: ( ) C (X) NTNC ( ) NC

Waterworks Class: IV

Operator's License Class: I (Mr. Michael L. Cook, License No. 1901000555, exp. 02/28/2007)

Inspection By: Winston C. Marshall

Inspection Date: 10/05/2006

Time Spent On-site: 2 hours

Last Inspection Date: 03/10/2005

Reviewed By / Date:

Reviewed By / Date:

Inspection Type: (X) Routine ( ) Complaint ( ) Other:

Present At Inspection: Mr. Michael L. Cook, TetraOps, and Mrs. Brenda Hubbard

Facilities Inspected: two wells, two chlorinators, a bladder tank, a neutralizer filter, and two carbon filters

Permit/EDS Up-to-Date: (X) Yes ( ) No

Permit Effective Date: 03/13/2006

If "No", explain:

No. Connections: Existing Building **Pop. Served:** 62[2] **Avg. Daily Usage:** 2,153 gallons

Permit Capacity: 7,200 GPD

Operating Within Permit Capacity: (X) Yes ( ) No

Average GPD/Connection: N/A

Average GPD/Person: 35

Pb & Cu Materials Survey Approved: (X) Yes ( ) No

Date: 09/12/2005

Cross-Connection Program Approved: (X) Yes ( ) No

Date: 09/12/2005

Records Inspected This Visit: ( ) Yes (X) No[3]

Satisfactory: (X) Yes ( ) No

Date Records Last Checked: N/A – no records

Program Active: (X) Yes[4] ( ) No

Bacteriological SSR Approved: (X) Yes ( ) No

Date: 09/12/2005

Surface Water Influenced: ( ) Yes (X) No

Date Determined: 10/13/2006

Source Water Assessment Performed: ( ) Yes (X) No

Date of Report: N/A

Any Complaints Since Last Inspection: ( ) Yes (X) No

If "Yes", explain: N/A

Violations (non-bacti) / Enforcement Actions Since Last Inspection: None

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[1] The veterinary center administration is considering a connection to the Eastern Goochland Central Water System as soon as a waterline is extended along Route 623 to their property. An exact plan is questionable since Mrs. Hubbard did not know the County's plan or timeline for extension. She plans to connect to County water and sewer lines at the same time.

[2] 62 employees; also there is a Diamond Springs water cooler in the waiting area for visitors.

[3] There are no records or RPZ backflow devices to inspect.

[4] The exterior hose bibs are equipped with an atmospheric vacuum breaker. No vacuum breakers are provided for the frost free hydrants at each well, however no hoses are connected.

PART II – MONITORING HISTORY

Sample Type	Last Sample Date	Next Sample Date	Comments
Inorganics	06/29/05	06/2008	Fluoride = 0.22 mg/l (SMCL – 2.00 mg/l)
Metals	06/29/05	06/2008	Manganese = 0.41 mg/l (SMCL – 0.05 mg/l)
Nitrates/Nitrites	06/27/06	06/2007	Combined nitrate = 1.89 mg/l
Pb & Cu	06/23/06	06/2007	Annual reduced monitoring!
VOCs	06/27/06	06/2007	Annual monitoring for 3 years!
Cyanide	06/29/05	06/2008	Satisfactory Results!
TTHM/HAA5	N/A	N/A	**Disinfectants/Disinfection By-Products Monitoring Plan needs to be submitted.**
Diquat	N/A	N/A	Waived through 12/31/2007!
Asbestos	N/A	N/A	Waived through 12/31/2007!
SOC	N/A	N/A	Waived through 12/31/2007!
Raw water MPN	08/23/06	08/2007	Both wells <1.0 col.

Waiver Status:

Operational Reports	Submitted for Past 12 Months	Yes
	Reports Accurate and Complete	No[5]

Bacteriological (checked over past 12 months)	BSSR Up To Date	Yes
	Sampling locations in Accordance with BSSR	Yes
	PMCL violation issued [month(s)]	None
	Monitoring violation issued [month(s)]	None
	Owner issued Public Notice as required?	N/A

Water Production Calculations (gallons)

Date	Meter Reading
10/05/06	972,230
04/15/06	599,720
173 days	372,510

GPD: 2,153

[5] The operational reports need to include iron and manganese levels, pH levels, and chlorine residuals for raw water and finished water on a weekly basis.

APPENDIX G
Virginia Department of Health Source Water Assessment Reports

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Alley's Motel **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075010

OWNER: Mr. Forest Alley **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area. Potential sources of contamination are also located in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on the attached Form F.

There are Potential Sources of Contamination known to be located in Zone 2 for the source. The Potential Sources of Contamination shown on the Zone 2 map are inventoried on the attached Form D and ranked in order of greatest public health risk on the attached Form E..

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Bogey's Sports Park **DATE:** August 23, 2002

CITY/COUNTY: New Kent County **PWSID NO.:** 4075025

OWNER: F.G. Pruitt, Inc. **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area. Potential sources of contamination are located in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on the attached Form F.

There are Potential Sources of Contamination known to be located in Zone 2 for the source. The Potential Sources of Contamination shown on the Zone 2 map are inventoried on the attached Form D and ranked in order of greatest public health risk on the attached Form E..

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Brother's Italian Restaurant **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075720

OWNER: Mr. Billy Smith **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area. Potential sources of contamination are located in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on the attached Form F.

There are Potential Sources of Contamination known to be located in Zone 2 for the source. The Potential Sources of Contamination shown on the Zone 2 map are inventoried on the attached Form D and ranked in order of greatest public health risk on the attached Form E.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Byrd Elementary School **DATE**: December 28, 2001

CITY/COUNTY: Goochland County **PWSID NO.**: 4075040

OWNER: Goochland County School Board **TYPE**: Non-Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 1	High	The well is located in an area that promotes the migration of contaminants. There are land use activities of concern and potential conduits to groundwater in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for Well No. 1. The Land Use Activities are shown on the Zone 1 map and inventoried on the attached Form E, ranked in order of greatest public health risk. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on Form F.

There are no Potential Sources of Contamination known to be located in Zone 2.

During the past 5 years of monitoring, we have not found any contaminants associated with the well.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Camp Hilbert **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075049

OWNER: Jewish Community Center of Richmond **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. A land use activity of concern and a potential conduit to groundwater are located in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are a Land Use Activity of Concern and a Potential Conduit to Groundwater located in Zone 1 for the source. The Land Use Activity shown on the Zone 1 map is inventoried on the attached Form E. The Potential Conduit to Groundwater is shown in Zone 1 and inventoried on the attached Form F.

The Best Management Practices utilized at Land Use Activity sites in Zone 2 for Well No. 1 are documented on the attached Form G.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Camp Little Hawk **DATE:** July 26, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075055

OWNER: Boys & Girls Club of Metro Richmond **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and a potential conduit to groundwater are located in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and a Potential Conduits to Groundwater located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduit to Groundwater is shown in Zone 1 and inventoried on the attached Form F.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

The Best Management Practices utilized at Land Use Activity sites in Zone 2 are documented on the attached Form G.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Camp T. Brady Saunders **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075045

OWNER: Boy Scouts of America - Robert E. Lee Council **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. A land use activity of concern is located in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There is a Land Use Activity of Concern located in Zone 1 for the source. The Land Use Activity shown on the Zone 1 map is inventoried on the attached Form E.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

The following attachments are part of this report:
[X] Assessment Area Map(s)
[X] Source Water Susceptibility Determination Form (Form A)
[X] Ranking of Land Use Activity and Potential Sources of Contamination in Zone 1 Form (Form E)
[X] Key Definitions

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Collegiate Athletic Complex **DATE**: 27 February 2004

CITY/COUNTY: Goochland County **PWSID NO.**: 4075085

OWNER: Collegiate School **TYPE**: Transient Non-community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 1	High	Groundwater source constructed in an area that promotes migration of contaminants. A contaminant has been detected in the last 5 years. Land use activities of concern are located in the Zone 1 assessment area. Potential sources of contamination are located in the Zone 2 assessment area.

Assessment Area

The source waters for this waterworks have been categorized as groundwater. Based on the source type, the following assessment area delineation has been assigned. They are shown on the attached maps prepared for each source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern located in Zone 1 for the well. The Land Use Activities are shown on the Zone 1 map and inventoried on Form E for this source, ranked in order of greatest public health risk.

Contaminants identified within the past 5 years of monitoring are listed on Form B.

Attachments

The following attachments are part of this report:

1. Assessment Area Maps
2. Source Water Susceptibility Determination (Form A)
3. Known Contamination Form (Form B)
4. Potential Sources of Contamination in Zone 1 (Form D)
5 Ranking of Land Use Activity and Potential Sources of Contamination in Zone 1 (Form E)
6. Definitions of Key Terms

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Elk Hill Farm **DATE**: December 28, 2001

CITY/COUNTY: Goochland County **PWSID NO.**: 4075200

OWNER: Elk Hill Farm, Inc. **TYPE**: Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 1	High	The well is located in an area that promotes the migration of contaminants. There are land use activities of concern in the Zone 1 assessment area, and a potential source of contamination in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern located in Zone 1 for Well No. 1. The Land Use Activities are shown on the Zone 1 map and inventoried on the attached Form E, ranked in order of greatest public health risk.

There is a Potential Source of Contamination known to be located in Zone 2. It is shown on the Zone 2 map and inventoried on Form D.

During the past 5 years of monitoring, we have not found any contaminants associated with the well.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Henrico County Water System **DATE**: July 15, 2004

CITY/COUNTY: Henrico County **PWSID NO.**: 4087125

OWNER: Henrico County DPU **TYPE**: Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Surface Water Treatment Plant	High	Surface Water is exposed to an inconsistent array of contaminants at varying concentrations due to changing hydrologic, hydraulic, and atmospheric conditions. Land use activities of concern and Potential sources of contamination are located in the Zones 1 and 2 assessment areas.

Assessment Area

The source waters for this waterworks have been categorized as surface water with non-tidal intake. Based on the source type, the following assessment area delineation has been assigned. They are shown on the attached maps.

Groundwater Assessment Area

- Zone 1 = Watershed area upgradient and within a 5-mile fixed radius of the raw water intake.
- Zone 2 = Total watershed area upgradient of the raw water intake and outside of Zone 1.

Findings

There are Land Use Activities of Concern, and Potential sources of contamination to the surface water supply located in Zone 1 for the Water treatment plant. The Land Use Activities and Potential Sources of Contamination sites are shown on the Zones 1and 2 maps and inventoried on the attached Form E for this source, ranked in order of greatest public health risk. There are Potential Sources of Contamination known to be located in Zones 1 and 2 for the water treatment plant. The Potential Source of Contamination are shown on the Zones 1 and 2 maps and inventoried on the attached Form D completed for this source.

Best Management Practices utilized at Land Use Activity sites In Zones 1 and 2 for Henrico Water Treatment Plant is documented on the attached Form G.

The Henrico Water Treatment Plant has just started operating, therefore, during the past 5 years of monitoring, we have not found any contaminants associated with its treated water.

Attachments

The following attachments are part of this report:

1. Assessment Area Maps
2. Source Water Susceptibility Determination Form (Form A)
4. Potential Sources of Contamination in Zones 1 and 2 Form (Form D)
5. Ranking of Land Use Activity and Potential Sources of Contamination in Zone 1 Form (Form E)
7. Best Management Practice Documentation Form (Form G)
8. Definitions of Key Terms

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Hermitage Country Club **DATE:** December 28, 2001

CITY/COUNTY: Goochland County **PWSID NO.:** 4075350

OWNER: Hermitage Country Club, Inc. **TYPE:** Non-Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 1	High	The well is located in an area that promotes the migration of contaminants. There are land use activities of concern and a potential conduit to groundwater in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for Well No. 1. The Land Use Activities are shown on the Zone 1 map and inventoried on the attached Form E, ranked in order of greatest public health risk. The Potential Conduit to Groundwater is shown in Zone 1 and inventoried on Form F.

There are no Potential Sources of Contamination known to be located in Zone 2.

During the past 5 years of monitoring, we have not found any contaminants associated with the well.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Hickory Notch Grill **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075368

OWNER: Hickory Notch Grill, Inc. **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. A contaminant (benzene) was detected within the last 5 years. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on the attached Form F.

The contaminant (benzene) identified within the last 5 years is inventoried on Form B.

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: I-64 Rest Area – Eastbound Lanes **DATE:** December 28, 2001

CITY/COUNTY: Goochland County **PWSID NO.:** 4075390

OWNER: Virginia Department of Transportation **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 1	High	The well is located in an area that promotes the migration of contaminants. There are land use activities of concern and potential conduits to groundwater in the Zone 1 assessment area, and potential sources of contamination in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for Well No. 1. The Land Use Activities are shown on the Zone 1 map and inventoried on the attached Form E, ranked in order of greatest public health risk. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on Form F.

There are Potential Sources of Contamination known to be located in Zone 2. They are shown on the Zone 2 map and inventoried on Form D.

During the past 5 years of monitoring, we have not found any contaminants associated with the well.

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: I-64 Rest Area – Westbound Lanes **DATE:** December 28, 2001

CITY/COUNTY: Goochland County **PWSID NO.:** 4075391

OWNER: Virginia Department of Transportation **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 1	High	The well is located in an area that promotes the migration of contaminants. Contaminants have been detected in the past five years. There are land use activities of concern and potential conduits to groundwater in the Zone 1 assessment area, and potential sources of contamination in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for Well No. 1. The Land Use Activities are shown on the Zone 1 map and inventoried on the attached Form E, ranked in order of greatest public health risk. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on Form F.

There are Potential Sources of Contamination known to be located in Zone 2. They are shown on the Zone 2 map and inventoried on Form D.

During the past 5 years of monitoring, we have found small concentrations of toluene associated with the well. See the attached Form B for more details.

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: James River Correctional Center WTP **DATE:** January 7, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075735

OWNER: Virginia Department of Corrections **TYPE:** Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Beaverdam Creek	High	Surface water exposed to an inconsistent array of contaminants at varying concentrations due to changing hydrologic, hydraulic and atmospheric conditions. There are land use activities of concern in the Zone 1 assessment area.
James River	High	Surface water exposed to an inconsistent array of contaminants at varying concentrations due to changing hydrologic, hydraulic and atmospheric conditions. There are land use activities of concern in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks has been categorized as surface water with an impoundment source intake. Based on the source type, the following assessment area delineation has been assigned. They are shown on the attached maps prepared for each source:

Surface Water Assessment Area

-

For an impoundment source intake:

- Zone 1 = Watershed area within a 5-mile fixed radius of the raw water intake
- Zone 2 = Total watershed area outside of Zone 1

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Jenkins Mobile Home Park **DATE**: 28 December 2001

CITY/COUNTY: Goochland County **PWSID NO.**: 4075420

OWNER: Mr. Frederick P. Jenkins **TYPE**: Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and a potential conduit to groundwater are located in the Zone 1 assessment area.
Well No. 2	High	Same as above.

Assessment Area

The source waters for this waterworks have been categorized as groundwater. Based on the source type, the following assessment area delineation has been assigned. They are shown on the attached maps prepared for each source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern located in Zone 1 for both wells. The Land Use Activities and the Potential Sources of Contamination sites are shown on the Zone 1 map and inventoried on Form E for these sources, ranked in order of greatest public health risk. Potential Conduits to Groundwater located in Zone 1 are also shown on the Zone 1 map for each well, and are inventoried on Form F.

During the past 5 years of monitoring, we have not found any contaminants associated with these two wells.

Attachments

The following attachments are part of this report:

1. Assessment Area Maps
2. Source Water Susceptibility Determination (Form A)
3. Ranking of Land Use Activity and Potential Sources of Contamination (Form E)
4. Potential Conduits to Groundwater Inventory (Form F)
5. Definitions of Key Terms

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Manakin Farms **DATE**: 26 February 2004

CITY/COUNTY: Goochland County **PWSID NO.**: 4075500

OWNER: James River Service Corporation, An Aqua Virginia, Inc. Company **TYPE**: Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 10	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern are located in the Zone 1 assessment area. Potential sources of contamination are located in the Zone 2 assessment area.
Well No. 11	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern are located in the Zone 1 assessment area. Potential sources of contamination are located in the Zone 2 assessment area.
Well No. 12	High	The well is constructed in an area that promotes the migration of contaminants. Potential sources of contamination are located in the Zone 2 assessment area.

Assessment Area

The source waters for this waterworks have been categorized as groundwater. Based on the source type, the following assessment area delineation has been assigned. They are shown on the attached maps prepared for each source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern located in Zone 1 for Well Nos. 10 and 11. Potential Sources of Contamination exist in Zones 1 and 2 for all wells. The Land Use Activities and Potential Sources of Contamination sites are shown on the Zone 1 map and inventoried on the Form E for these sources, ranked in order of greatest public health risk.

Contaminants identified within the past 5 years of monitoring are listed on Form B for Well Nos. 11 and 12.

Attachments

The following attachments are part of this report:

1. Assessment Area Maps

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Manakin Grill **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075030

OWNER: Witten Enterprises **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Old Well	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area. Potential sources of contamination are located in the Zone 2 assessment area.
Drilled (New) Well	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area. Potential sources of contamination are located in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for each source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E's. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on the attached Form F's.

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Oilville Exxon & Convenience **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075610

OWNER: Mr. William Carter **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern are located in the Zone 1 assessment area. There are Potential Sources of Contamination located in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E.

There are Potential Sources of Contamination known to be located in Zone 2 for the source. The Potential Sources of Contamination shown on the Zone 2 map are inventoried on the attached Form D and ranked in order of greatest public health risk on Form E.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

DATE: February 22, 2005
PWSID: 4075615
WATER: Oilville Office Park
OWNER: DES, LLC
SUBJECT: Goochland County
TYPE: Transient Non-community

For the source serving the subject waterworks this report includes maps showing the source water assessment area (divided into Zones 1 and 2 with Zone 1 having greater influence on the source), an inventory of known Land Use Activities of Concern and Potential Conduits to Ground Water within the assessment area, a rudimentary determination of its relative susceptibility to contamination. Information in this report is provided to aid in efforts toward Source Water Protection.

The Source Water Assessment of the subject waterworks has yielded the following results:

Source Name	Relative Susceptibility to Contamination	Explanation
Well No. 1	High	The well is properly constructed, but is located in an area that promotes the migration of contaminants. No contamination has been detected in the last 5 years. There are land use activities of concern and potential conduits to groundwater in the Zone 1 assessment area. There are also land use activities of concern in the Zone 2 assessment area.

The criteria utilized for placement into a particular susceptibility class is included on the attached Source Water Susceptibility Determination Form (Form A). Explanations for selection of a susceptibility class are included on Chart A. The susceptibility class is not intended to be a definitive determination. A list of definitions of key terms used in this report is included on Chart B.

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1. The Land Use Activities are shown on the Zone 1 map and inventoried on Form E, ranked in order of greatest public health risk. The Potential Conduits to Ground Water are shown in Zone 1 and inventoried on the "Potential Conduits to Ground Water Inventory Form (Form F) for this source. Many of the properties in Zone 1 with on-site sewage systems also have on-site wells, which are Potential Conduits to Groundwater.

During the past 5 years of monitoring, we have not found any contaminants associated with the well.

The source water for this waterworks has been categorized in accordance with the following table:

Source Name	Source Water Type
Well No. 1	Ground Water

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

Based on the source type, the following assessment area delineation has been assigned in accordance with the guidance of the Virginia Source Water Assessment Program and is shown on the attached map(s) prepared for each source:

Ground Water Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

The following attachments are part of this report (one for each source):

[X] Assessment Area Map(s)
[X] Source Water Susceptibility Determination Form (Form A)
[ ] Ground Water Coastal Plain Source Water Susceptibility Determination Form (Form A2)
[ ] Known Contamination Documentation Form (Form B)
[X] Potential Sources of Contamination in Zones 1 and 2 Form (Form D)
[X] Ranking of Land Use Activity and Potential Sources of Contamination Form (Form E)
[ ] Area Features Documentation Form (Form E2)
[X] Potential Conduits to Ground Water Inventory Form (Form F)
[ ] Best Management Practice Documentation Form (Form G)
[X] Chart A (Susceptibility Explanations)
[X] Chart B (Key Definitions)

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Randolph Elementary School **DATE:** December 28, 2001

CITY/COUNTY: Goochland County **PWSID NO.:** 4075660

OWNER: Goochland County School Board **TYPE:** Non-Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 1	High	The well is located in an area that promotes the migration of contaminants. Contaminants have been detected in the past five years. There are land use activities of concern and potential conduits to groundwater in the Zone 1 assessment area, and potential sources of contamination in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for Well No. 1. The Land Use Activities are shown on the Zone 1 map and inventoried on the attached Form E, ranked in order of greatest public health risk. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on Form F.

There are Potential Sources of Contamination known to be located in Zone 2. They are shown on the Zone 2 map and inventoried on Form D.

During the past 5 years of monitoring, we have found concentrations of nitrate associated with the well. See the attached Form B for more details.

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Richmond Country Club **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075670

OWNER: Richmond Country Club, Inc. **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. A land use activity of concern is located in the Zone 1 assessment area. Other Potential Sources of Contamination are located in the Zone 1 and Zone 2 assessment areas.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Sources of Contamination located in Zone 1 for the source. The Land Use Activities and Potential Sources of Contamination sites shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E.

There is a Potential Source of Contamination known to be located in Zone 2 for the source. The Potential Source of Contamination shown on the Zone 2 map is inventoried on the attached Form D and ranked on Form E.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Royal Virginia Golf Club (#2) **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075701

OWNER: Royal Virginia Golf Club L.L.C. **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and a potential conduit to groundwater are located in the Zone 1 assessment area. A Potential Source of contamination is located in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and a Potential Conduit to Groundwater located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduit to Groundwater is shown in Zone 1 and inventoried on the attached Form F.

There is a Potential Source of Contamination known to be located in Zone 2 for the source. The Potential Source of Contamination shown on the Zone 2 map is inventoried on the attached Form D and ranked on Form E.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

DATE: February 22, 2005
PWSID: 4075705
WATER: Sabot Hill Farm
OWNER: Sabot Hill Farm, Inc.
SUBJECT: Goochland County
TYPE: Non-Transient Non-community

For the source serving the subject waterworks this report includes maps showing the source water assessment area (divided into Zones 1 and 2 with Zone 1 having greater influence on the source), an inventory of known Land Use Activities of Concern and Potential Conduits to Ground Water within the assessment area, a rudimentary determination of its relative susceptibility to contamination. Also included is documentation of Best Management Practices utilized at Land Use Activity sites. Information in this report is provided to aid in efforts toward Source Water Protection.

The Source Water Assessment of the subject waterworks has yielded the following results:

Source Name	Relative Susceptibility to Contamination	Explanation
Well No. 1	High	The well appears to be properly constructed, but is located in an area that promotes the migration of contaminants. No contamination has been detected in the last 5 years. There are land use activities of concern in the Zone 1 assessment area.

The criteria utilized for placement into a particular susceptibility class is included on the attached Source Water Susceptibility Determination Form (Form A). Explanations for selection of a susceptibility class are included on Chart A. The susceptibility class is not intended to be a definitive determination. A list of definitions of key terms used in this report is included on Chart B.

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1. The Land Use Activities are shown on the Zone 1 map and inventoried on Form E, ranked in order of greatest public health risk. The Potential Conduits to Ground Water are shown in Zone 1 and inventoried on the "Potential Conduits to Ground Water Inventory Form (Form F) for this source. Many of the properties in Zone 1 with on-site sewage systems also have on-site wells, which are Potential Conduits to Groundwater.

During the past 5 years of monitoring, we have not found any contaminants associated with the well.

The source water for this waterworks has been categorized in accordance with the following table:

Source Name	Source Water Type
Well No. 1	Ground Water

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

Based on the source type, the following assessment area delineation has been assigned in accordance with the guidance of the Virginia Source Water Assessment Program and is shown on the attached map(s) prepared for each source:

Ground Water Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

The following attachments are part of this report (one for each source):

[X] Assessment Area Map(s)
[X] Source Water Susceptibility Determination Form (Form A)
[ ] Ground Water Coastal Plain Source Water Susceptibility Determination Form (Form A2)
[ ] Known Contamination Documentation Form (Form B)
[X] Potential Sources of Contamination in Zones 1 and 2 Form (Form D)
[X] Ranking of Land Use Activity and Potential Sources of Contamination Form (Form E)
[ ] Area Features Documentation Form (Form E2)
[X] Potential Conduits to Ground Water Inventory Form (Form F)
[X] Best Management Practice Documentation Form (Form G)
[X] Chart A (Susceptibility Explanations)
[X] Chart B (Key Definitions)

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

DATE: February 22, 2005
PWSID: 4075708
WATER: Salem Baptist Church
OWNER: Salem Baptist Church
SUBJECT: Goochland County
TYPE: Non-Transient Non-community

For the source serving the subject waterworks this report includes maps showing the source water assessment area (divided into Zones 1 and 2 with Zone 1 having greater influence on the source), an inventory of known Land Use Activities of Concern and Potential Conduits to Ground Water within the assessment area, a rudimentary determination of its relative susceptibility to contamination. Also included is documentation of Best Management Practices utilized at Land Use Activity sites. Information in this report is provided to aid in efforts toward Source Water Protection.

The Source Water Assessment of the subject waterworks has yielded the following results:

Source Name	Relative Susceptibility to Contamination	Explanation
Well No. 1	High	No information is available on the construction of the well, and it is located in an area that promotes the migration of contaminants. However, no contamination has been detected in the last 5 years. There are land use activities of concern and potential conduits to groundwater in the Zone 1 assessment area.

The criteria utilized for placement into a particular susceptibility class is included on the attached Source Water Susceptibility Determination Form (Form A). Explanations for selection of a susceptibility class are included on Chart A. The susceptibility class is not intended to be a definitive determination. A list of definitions of key terms used in this report is included on Chart B.

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1. The Land Use Activities are shown on the Zone 1 map and inventoried on Form E, ranked in order of greatest public health risk. The Potential Conduits to Ground Water are shown in Zone 1 and inventoried on the "Potential Conduits to Ground Water Inventory Form (Form F) for this source. Many of the properties in Zone 1 with on-site sewage systems also have on-site wells, which are Potential Conduits to Groundwater.

Best Management Practices Used at Land Use Activity sites in Zone 2 are documented on the attached "Best Management Practice Documentation Form" for this source.

During the past 5 years of monitoring, we have not found any contaminants associated with the well.

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

The source water for this waterworks has been categorized in accordance with the following table:

Source Name	Source Water Type
Well No. 1	Ground Water

Based on the source type, the following assessment area delineation has been assigned in accordance with the guidance of the Virginia Source Water Assessment Program and is shown on the attached map(s) prepared for each source:

Ground Water Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

The following attachments are part of this report (one for each source):

[X] Assessment Area Map(s)
[X] Source Water Susceptibility Determination Form (Form A)
[ ] Ground Water Coastal Plain Source Water Susceptibility Determination Form (Form A2)
[ ] Known Contamination Documentation Form (Form B)
[ ] Potential Sources of Contamination in Zones 1 and 2 Form (Form D)
[X] Ranking of Land Use Activity and Potential Sources of Contamination Form (Form E)
[ ] Area Features Documentation Form (Form E2)
[X] Potential Conduits to Ground Water Inventory Form (Form F)
[X] Best Management Practice Documentation Form (Form G)
[X] Chart A (Susceptibility Explanations)
[X] Chart B (Key Definitions)

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Seiberts' Oilville BP **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075600

OWNER: Mr. John Seiberts **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area. A Potential Source of contamination is located in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on the attached Form F.

There is a Potential Source of Contamination known to be located in Zone 2 for the source. The Potential Source of Contamination shown on the Zone 2 map is inventoried on the attached Form D and ranked on Form E.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

DATE: March 18, 2005
PWSID: 4075703
WATER: St. Catherine's School Athletic Complex
OWNER: St. Catherine's School
SUBJECT: Goochland County
TYPE: Transient Non-community

For the source serving the subject waterworks this report includes maps showing the source water assessment area (divided into Zones 1 and 2 with Zone 1 having greater influence on the source), an inventory of known Land Use Activities of Concern and Potential Conduits to Ground Water within the assessment area, a rudimentary determination of its relative susceptibility to contamination. Also included is documentation of Best Management Practices utilized at Land Use Activity sites. Information in this report is provided to aid in efforts toward Source Water Protection.

The Source Water Assessment of the subject waterworks has yielded the following results:

Source Name	Relative Susceptibility to Contamination	Explanation
Well No. 1	Low	The well is properly constructed, and is protected with an appropriate aquitard. No contamination has been detected in the last 5 years. There are land use activities of concern in the Zone 1 assessment area.

The criteria utilized for placement into a particular susceptibility class is included on the attached Source Water Susceptibility Determination Form (Form A). Explanations for selection of a susceptibility class are included on Chart A. The susceptibility class is not intended to be a definitive determination. A list of definitions of key terms used in this report is included on Chart B.

Findings

There are Land Use Activities of Concern located in Zone 1. The Land Use Activities are shown on the Zone 1 map and inventoried on Form E, ranked in order of greatest public health risk.

During the past 5 years of monitoring, we have not found any contaminants associated with the well.

The source water for this waterworks has been categorized in accordance with the following table:

Source Name	Source Water Type
Well No. 1	Ground Water

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

Based on the source type, the following assessment area delineation has been assigned in accordance with the guidance of the Virginia Source Water Assessment Program and is shown on the attached map(s) prepared for each source:

Ground Water Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

The following attachments are part of this report (one for each source):

[X] Assessment Area Map(s)
[X] Source Water Susceptibility Determination Form (Form A)
[ ] Ground Water Coastal Plain Source Water Susceptibility Determination Form (Form A2)
[ ] Known Contamination Documentation Form (Form B)
[ ] Potential Sources of Contamination in Zones 1 and 2 Form (Form D)
[X] Ranking of Land Use Activity and Potential Sources of Contamination Form (Form E)
[ ] Area Features Documentation Form (Form E2)
[ ] Potential Conduits to Ground Water Inventory Form (Form F)
[ ] Best Management Practice Documentation Form (Form G)
[X] Chart A (Susceptibility Explanations)
[X] Chart B (Key Definitions)

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Stewart's Café **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075465

OWNER: Ms. Brenda Kiser **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area. A Potential Source of Contamination is located in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on the attached Form F.

There is a Potential Source of Contamination known to be located in Zone 2 for the source. The Potential Source of Contamination shown on the Zone 2 map is inventoried on the attached Form D and ranked on the attached Form E..

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Sycamore Creek Golf Course **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075780

OWNER: Mid Atlantic Golf **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area. Potential Sources of Contamination are located in the Zone 2 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for the source. The Land Use Activities shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on the attached Form F.

There are Potential Sources of Contamination known to be located in Zone 2 for the source. The Potential Sources of Contamination shown on the Zone 2 map are inventoried on the attached Form D and ranked in order of greatest public health risk on the attached Form E.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Tanglewood Ordinary **DATE**: August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.**: 4075790

OWNER: James River Ordinaries, Inc. **TYPE**: Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	High	The well is constructed in an area that promotes the migration of contaminants. Land use activities of concern and potential conduits to groundwater are located in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for the source. The Land Use Activities sites shown on the Zone 1 map are inventoried and ranked in order of greatest public health risk on the attached Form E. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on the attached Form F.

The Best Management Practices utilized at Land Use Activity sites in Zone 2 are documented on the attached Form G.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: The Meadows Nursing Center **DATE**: December 28, 2001

CITY/COUNTY: Goochland County **PWSID NO.**: 4075520

OWNER: Capstone of Virginia Limited Partnership **TYPE**: Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water source. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well No. 1	High	The well is located in an area that promotes the migration of contaminants. There are land use activities of concern and potential conduits to groundwater in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

There are Land Use Activities of Concern and Potential Conduits to Groundwater located in Zone 1 for Well No. 1. The Land Use Activities are shown on the Zone 1 map and inventoried on the attached Form E, ranked in order of greatest public health risk. The Potential Conduits to Groundwater are shown in Zone 1 and inventoried on Form F.

There are no Potential Sources of Contamination known to be located in Zone 2.

During the past 5 years of monitoring, we have not found any contaminants associated with the well.

Attachments

VIRGINIA DEPARTMENT OF HEALTH
SOURCE WATER ASSESSMENT REPORT

WATERWORKS: Westview on the James **DATE:** August 23, 2002

CITY/COUNTY: Goochland County **PWSID NO.:** 4075920

OWNER: Westview Inc. **TYPE:** Transient Non-Community

The purpose of this report is to assess the susceptibility of this public water supply to contaminants regulated by the Safe Drinking Water Act. This was accomplished by identifying the origins of contaminants within a specific area surrounding the water sources. The goal of this assessment is to assist with Source Water Protection efforts. Data was gathered using the most reliable sources available, and by visual observations in the field. Despite these efforts to ensure accuracy, some errors and/or omissions may have occurred.

The Source Water Assessment of the waterworks yielded the following results:

Source Name	Susceptibility to Contamination	Explanation
Well #1	Moderate	The well is constructed in an area that promotes the migration of contaminants. However, no land use activities of concern or potential conduits to groundwater are located in the Zone 1 assessment area.
Well #2	Moderate	The well is constructed in an area that promotes the migration of contaminants. However, no land use activities of concern or potential conduits to groundwater are located in the Zone 1 assessment area.

Assessment Area

The source water for this waterworks is groundwater. Based on the source type, the following assessment area delineation has been assigned. It is shown on the attached maps prepared for the source:

Groundwater Assessment Area

- Zone 1 = 1000-foot fixed radius surrounding source
- Zone 2 = 1-mile fixed radius surrounding source and outside of Zone 1

Findings

No Land Use Activities of Concern, Potential Sources of Contamination, or Potential Conduits to Groundwater are known to exist in Zone 1 for the source.

During the past 5 years of monitoring, we have not found any contaminants associated with the source.

Attachments