HAMPTON ROADS REGIONAL WATER SUPPLY PLAN

HAMPTON ROADS PDC
PLANNING DISTRICT COMMISSION

July 2011

PEP11-06

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HAMPTON ROADS
REGIONAL WATER SUPPLY PLAN

The Hampton Roads Regional Water Supply Plan was prepared pursuant to the State Water Control Law Section 62.1-44.15 and 62.1-44.38:1 of the Code of Virginia and the State Water Control Board implementing regulations, 9 VAC 25-780, which establishes the planning process and criteria that local governments must use in the development of local or regional water supply plans.

The Hampton Roads Regional Water Supply Plan includes the Cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg, the Counties of Gloucester, Isle of Wight, James City, Southampton, Surry, and York, and the Towns of Boykins, Branchville, Capron, Claremont, Courtland, Dendron, Ivor, Newsoms, Smithfield, Surry, and Windsor.

The plan includes the following elements: description of existing water sources; description of existing water use; assessment of projected water demand; statement of need; alternatives analysis to address projected deficits in water supplies; and descriptions of water management and drought response actions.

Information in the plan is organized by sub-regions as follows:

Peninsula sub-region: Cities of Hampton, Newport News, Poquoson, and Williamsburg; and Counties of Gloucester, James City, and York.

Southside sub-region: Cities of Norfolk, Portsmouth, Virginia Beach, Chesapeake, and Suffolk.

Western Tidewater sub-region: City of Franklin; Counties of Isle of Wight, Southampton, and Surry; and Towns of Boykins, Branchville, Capron, Claremont, Courtland, Dendron, Ivor, Newsoms, Smithfield, Surry, and Windsor.

The March 7, 2007 "Memorandum of Agreement (MOA) Guiding the Hampton Roads Regional Water Supply Planning Process" established the administrative framework for the regional plan, developed under the direction of the Hampton Roads Planning District Commission, Directors of Utilities Committee. The Virginia Department of Environmental Quality contributed funding toward the MOA development.

Preparation of this report was included in the Hampton Roads Planning District Commission
Unified Planning Work Program for Fiscal Years 2008, 2009, 2010, and 2011.

Prepared by the staff of the
Hampton Roads Planning District Commission
PEP-11-06

JULY 2011

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ABSTRACT:

This document was prepared pursuant to the State Water Control Law Section 62.1-44.15 and 62.1-44.38:1 of the Code of Virginia and the State Water Control Board implementing regulations, 9 VAC 25-780, which establishes the planning process and criteria for local governments to use in the development of local or regional water supply plans. The Hampton Roads Regional Water Supply Plan includes the Cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg, the Counties of Gloucester, Isle of Wight, James City, Southampton, Surry, and York, and the Towns of Boykins, Branchville, Capron, Claremont, Courtland, Dendron, Ivor, Newsoms, Smithfield, Surry, and Windsor. The plan includes the following elements: description of existing water sources; description of existing water use; assessment of projected water demand; statement of need; alternatives analysis to address projected deficits in water supplies; and water management and drought response actions.

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Funding for this document was provided by the Hampton Roads localities through the Regional Water Program. The Virginia Department of Environmental Quality contributed funding toward the development of the March 7, 2007 “Memorandum of Agreement (MOA) Guiding the Hampton Roads Regional Water Supply Planning Process.”

This document was prepared by the Hampton Roads Planning District Commission in cooperation with the localities. Preparation of this report was included in the Hampton Roads Planning District Commission Unified Planning Work Program for Fiscal Years 2008, 2009, 2010, and 2011.

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TABLE OF CONTENTS

Section 1 | Existing Sources

TABLE OF CONTENTS

Section 1 | Existing Sources (continued)

TABLE OF CONTENTS

Section 1 | Existing Sources (continued)

Section 2 | Existing Water Use

TABLE OF CONTENTS

Section 2 | Existing Water Use (continued)

TABLE OF CONTENTS

Section 2 | Existing Water Use (continued)

Section 3 | Existing Resources

TABLE OF CONTENTS

Section 3 | Existing Resources (continued)

Section 4 | Projected Water Demands

TABLE OF CONTENTS

Section 5 | Water Demand Management

TABLE OF CONTENTS

Section 6 | Statement of Need

Section 7 | Alternatives

Section 8 | References

TABLE OF CONTENTS

Appendix

Attachment (DVD in Pocket)

TABLE OF CONTENTS

(This page intentionally left blank.)

LIST OF MAPS

Section 1 | Existing Sources

LIST OF MAPS

Section 1 | Existing Sources (continued)

Section 3 | Existing Resources

LIST OF MAPS

Section 3 | Existing Resources (continued)

LIST OF FIGURES

Section 2 | Existing Water Use

LIST OF FIGURES

Section 2 | Existing Water Use (continued)

Section 3 | Existing Resources

Section 4 | Projected Water Demands

LIST OF FIGURES

Section 4 | Projected Water Demands (continued)

Section 5 | Water Demand Management

Section 6 | Statement of Need

Section 7 | Alternatives

LIST OF TABLES

Section 1 | Existing Sources

LIST OF TABLES

Section 1 | Existing Sources (continued)

Section 2 | Existing Water Use

Section 3 | Existing Resources

LIST OF TABLES

Section 3 | Existing Resources (continued)

Section 4 | Projected Water Demands

LIST OF TABLES

Section 4 | Projected Water Demands (continued)

Section 5 | Water Demand Management

Section 7 | Alternatives

LIST OF ABBREVIATIONS

Abbreviation	Name
305(b)/303(d) Report	Virginia Water Quality Assessment Integrated Report
ASR	aquifer storage and recovery
AWWA	American Water Works Association
Bay Act	Chesapeake Bay Preservation Act
CBPA	Chesapeake Bay Preservation Areas
CIL	commercial, institutional, and light industrial
CIP	Capital Improvement Plan
Corps	U.S. Army Corps of Engineers
CPC	Climate Prediction Center
CWS	community water system
DCR	Department of Conservation and Recreation
DEQ	Department of Environmental Quality
DSD	development service district
EPA	Environmental Protection Agency
GIS	Geographic Information System
gpm	gallon per minute
GWMA	Groundwater Management Area
HRPDC	Hampton Roads Planning District Commission
HRSD	Hampton Roads Sanitation District
HR WET	Hampton Roads Water Efficiency Team
HUC	Hydrologic Unit Code
JCSA	James City Service Authority
kgal	thousand gallons
MCL	maximum contaminant level
mgd	million gallons per day
MS4s	Municipal Separate Storm Sewer Systems
NAWQA	National Water Quality Assessment
NDMC	National Drought Mitigation Center
NCDC	National Climatic Data Center
NCEP	National Centers for Environmental Prediction
NNWW	Newport News Waterworks
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRI	Nationwide Rivers Inventory
NWS	National Weather Service
psi	pounds per square inch
PCBs	polychlorinated biphenyls
PCG	Public Clamming Ground
PMP	Probable Maximum Precipitation
REMI	Regional Economic Models, Inc.
SPSA	Southeastern Public Service Authority
STP	sewage treatment plant
SWAP	Source Water Assessment Program
TMDL	Total Maximum Daily Load
UAW	unaccounted-for water
UIC	underground injection control
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VA USBC	Virginia Uniform Statewide Building Code
VAC	Virginia Administrative Code
VDH	Virginia Department of Health
VPDES	Virginia Pollutant Discharge Elimination System
VDOT	Virginia Department of Transportation
VFWIS	Virginia Fish and Wildlife Information Service
VPDES	Virginia Pollutant Discharge Elimination System
VPPSA	Virginia Peninsulas Public Services Authority
WAOB	World Agricultural Outlook Board
WTP	water treatment plant
WTWA	Western Tidewater Water Authority
WWTP	wastewater treatment plant

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Section 1 | **Existing Sources**

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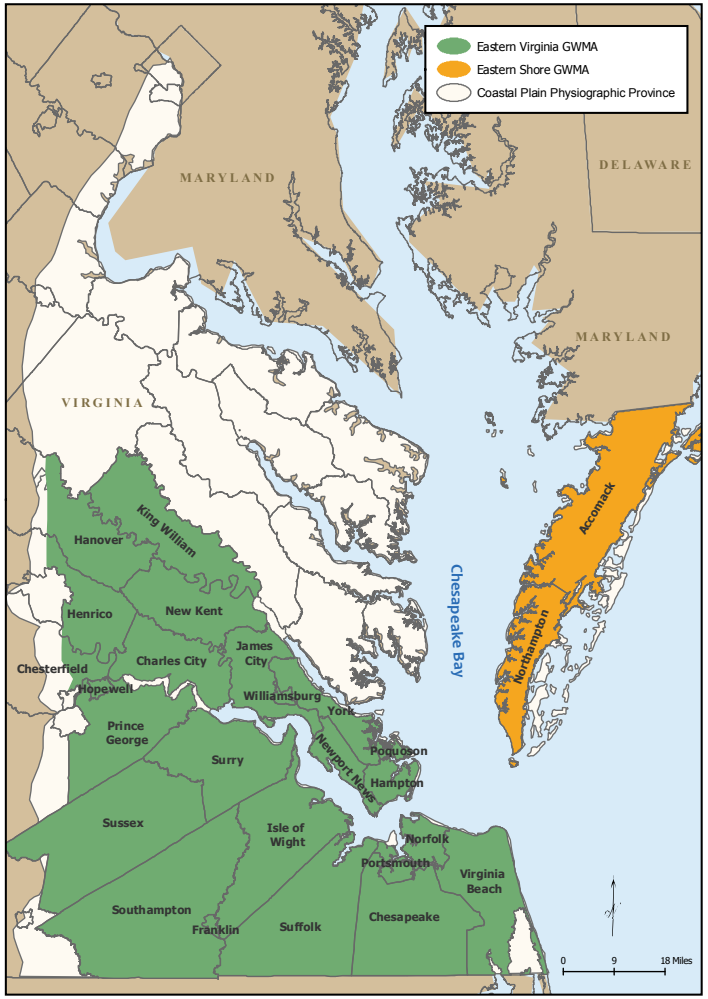
Existing Sources - Introduction

The Local and Regional Water Supply Planning Regulation (9 VAC 25-780-70) requires information regarding the water source(s) that support current water use. The sources can be groundwater, surface water reservoirs, or stream intakes, and in some cases, water is supplied from a combination of sources. This chapter provides information about the water sources and water systems serving the Hampton Roads Region.

The Virginia Department of Health (VDH) and the Virginia Department of Environmental Quality (DEQ) both track water use in the State of Virginia. DEQ's regulations address (1) management of surface water and groundwater resources, (2) impacts on other beneficial uses of streams such as recreation, habitat, fish, etc., (3) water quality issues, and (4) avoiding conflicts between water users. VDH's regulations are focused on protecting public health.

Under the Groundwater Management Act of 1992, ground water resources are managed through a DEQ program regulating groundwater withdrawals from designated Groundwater Management Areas (GWMAs). Virginia has two GWMAs: the Eastern Virginia GWMA and the Eastern Shore GWMA. All of the localities in the Hampton Roads Region, with the exception of Gloucester County, are within the Eastern Virginia GWMA (see Map 1-1). Any groundwater withdrawal in a GWMA greater than 300,000 gallons per month must obtain a Ground Water Withdrawal Permit from DEQ. The permit limits the maximum monthly and yearly withdrawal amounts for the respective well. The monthly amount is an operating constraint that is important for evaluating the system's ability to meet peak demands, which typically occur during summer months. The yearly amount is considered the available supply in the following sections of the report and in evaluations of long-term supply verses demand.

DEQ requires a Virginia Water Protection Permit for surface water withdrawals of more than 300,000 gallons per month. Permittees must report withdrawal information to DEQ. Most surface water withdrawals in the sub-region were established prior to 1989 and are, therefore, exempt from the VWP Permit program. Permits from the VDH are required for the establishment, construction, or operation of any community water system (CWS) or water supply. CWSs are defined as water systems that serve at least 15 residential connections or at least 25 residential consumers for at least 60 days out of the year.



Map 1-1: Virginia Groundwater Management Areas

Existing Sources – Peninsula Sub-Region

The Peninsula sub-region includes the Cities of Hampton, Newport News, Poquoson, and Williamsburg, and the Counties of Gloucester, James City, and York. All localities in the sub-region are located on the York-James Peninsula, with the exception of the County of Gloucester. Gloucester County is located on the Middle Peninsula and is geographically separated from the other sub-region localities by the York River. Gloucester County is unique in that it is a member of the Hampton Roads Planning District as well as the Middle Peninsula Planning District. The total population of the Peninsula sub-region was 512,000 people in 2007. The majority of residents are served by publicly-owned CWSs. However, portions of Gloucester County, James City County, and York County do not have public water service.

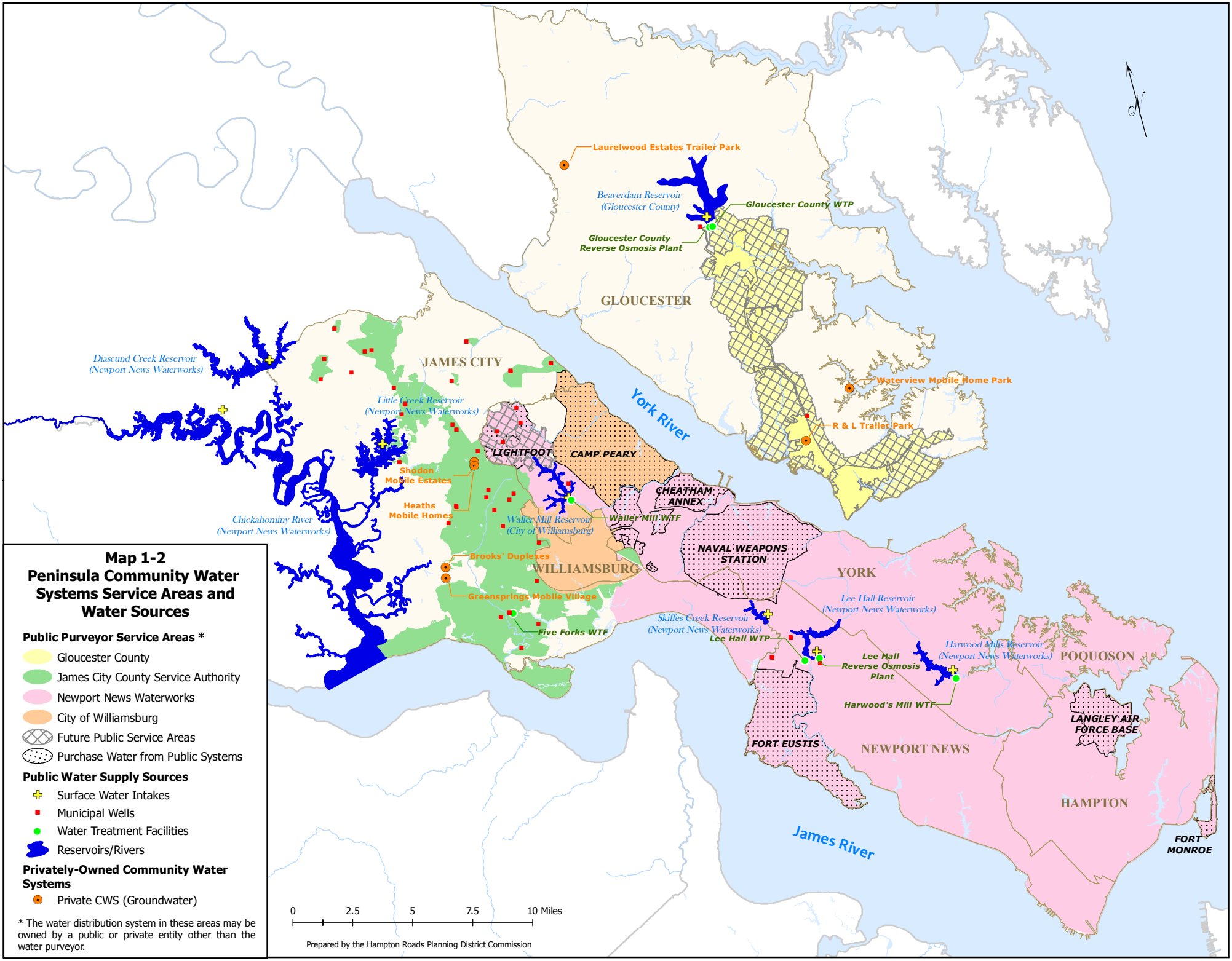
The sub-region is served by 26 CWSs: 11 systems are owned by the municipalities (publicly-owned systems), 8 systems are military base systems or privately-owned systems that are customers of Newport News Waterworks, and the remaining 7 systems are small, privately-owned systems that each serve less than 200 people from groundwater sources. Eight of the publicly-owned CWSs rely solely on groundwater, including seven systems in James City County and one in York County. Three systems, Gloucester County, Newport News Waterworks, and City of Williamsburg, are conjunctive use systems that use both surface water and groundwater. Surface water sources include seven reservoirs and the Chickahominy River. Map 1-2 identifies CWS in the sub-region and their sources and service areas. Map 1-3 shows all of the self-supplied users that withdraw more than 300,000 gallons per month.

In 2001, the Hampton Roads Planning District Commission (HRPDC) conducted a detailed Source Water Assessment Program (SWAP) (August 2002). The HRPDC SWAP assessment found that all surface water sources in the Peninsula sub-region have a high susceptibility to contamination. Most of the groundwater wells in the sub-region were found to have a low susceptibility to contamination.

Per the 1996 Safe Drinking Water Act Amendments, the VDH SWAP Program inventoried drinking water sources and nearby land uses that may impact water quality, including common activities related to residential, industrial, commercial, and agricultural land uses and waste management and transportation facilities. VDH SWAP evaluations (February 15, 2006), which included private systems, identified five private CWSs with wells with a high susceptibility to contamination. Unlike other parts of Hampton Roads, wells in the Peninsula sub-region do not produce water exhibiting elevated concentrations of fluoride.

2007 Peninsula Overview

- 26 publicly-owned CWSs served 478,155 people.
- All surface water sources have a high susceptibility to contamination.
- 7 privately-owned CWSs served 435 people.
- 5 privately-owned CWSs have wells with high susceptibility to contamination.
- 23 active Groundwater Withdrawal Permits.
- 33,384 people were served by private residential wells.
- 54 businesses were served by private business wells withdrawing less than 300,000 gallons per month.
- 7 self-supplied users withdrew more than 300,000 gallons per month of surface water for non-agricultural use.
- 13 self-supplied users withdrew more than 300,000 gallons per month of groundwater for non-agricultural use.
- No agricultural users reported withdrawals of more than 300,000 gallons per month.



Map 1-2
Peninsula Community Water Systems Service Areas and Water Sources

Public Purveyor Service Areas *

- Gloucester County
- James City County Service Authority
- Newport News Waterworks
- City of Williamsburg
- Future Public Service Areas
- Purchase Water from Public Systems

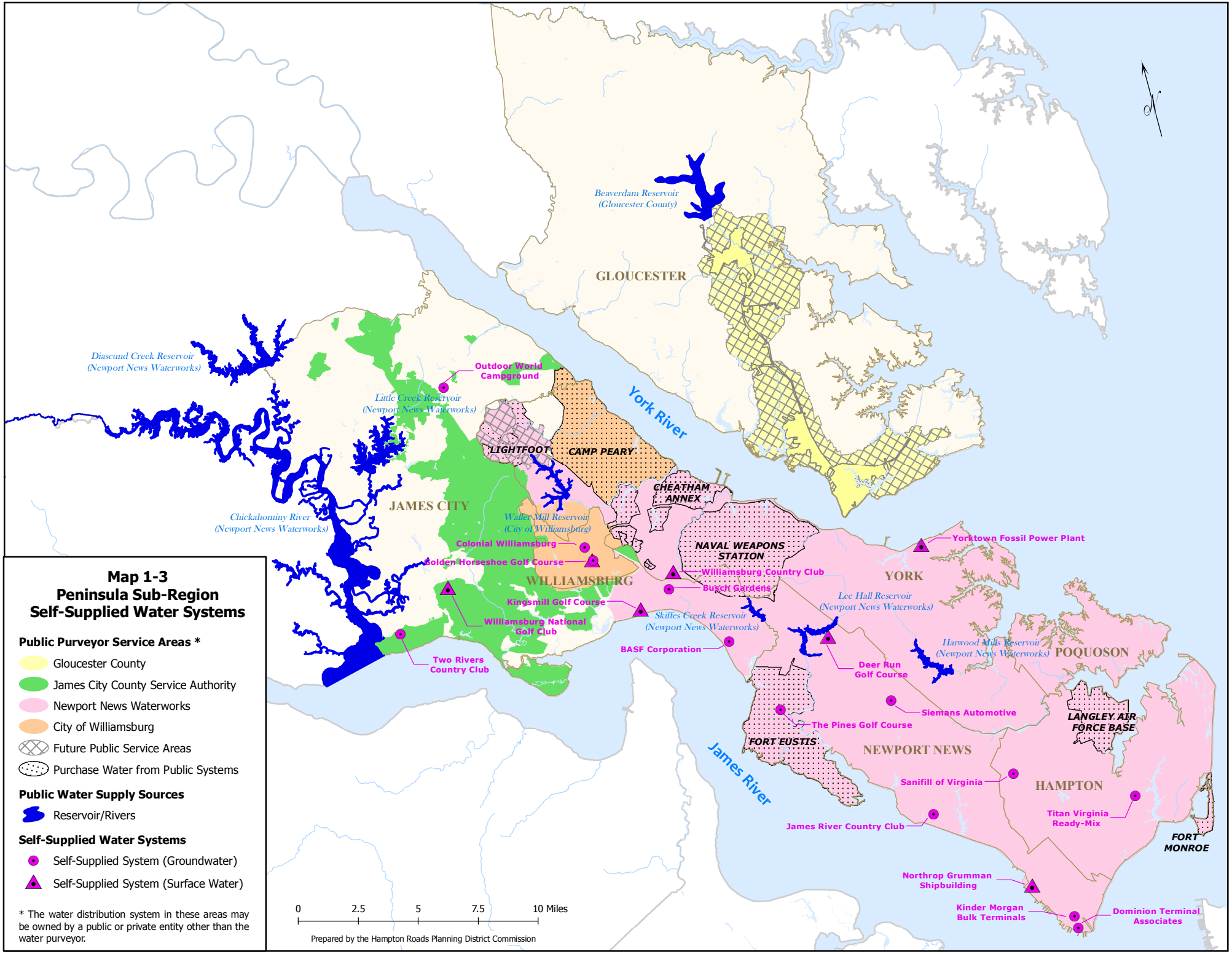
Public Water Supply Sources

- Surface Water Intakes
- Municipal Wells
- Water Treatment Facilities
- Reservoirs/Rivers

Privately-Owned Community Water Systems

- Private CWS (Groundwater)

* The water distribution system in these areas may be owned by a public or private entity other than the water purveyor.


Map 1-3
Peninsula Sub-Region
Self-Supplied Water Systems
Public Purveyor Service Areas *
Gloucester County
James City County Service Authority
Newport News Waterworks
City of Williamsburg
Future Public Service Areas
Purchase Water from Public Systems
Public Water Supply Sources
Reservoir/Rivers
Self-Supplied Water Systems
Self-Supplied System (Groundwater)
Self-Supplied System (Surface Water)
* The water distribution system in these areas may be owned by a public or private entity other than the water purveyor.
Beaverdam Reservoir (Gloucester County)
GLOUCESTER
Diascund Creek Reservoir (Newport News Waterworks)
Outdoor World Campground
Little Creek Reservoir (Newport News Waterworks)
York River
LIGHTFOOT
CAMP PEARY
CHEATHAM ANNEX
JAMES CITY
Chickahominy River (Newport News Waterworks)
Waller Mill Reservoir (City of Williamsburg)
Colonial Williamsburg
Golden Horseshoe Golf Course
WILLIAMSBURG
Kingsmill Golf Course
Williamsburg National Golf Club
Two Rivers Country Club
NAVAL WEAPONS STATION
Williamsburg Country Club
Busch Gardens
Yorktown Fossil Power Plant
YORK
Lee Hall Reservoir (Newport News Waterworks)
Skiffes Creek Reservoir (Newport News Waterworks)
BASF Corporation
Harwood Mills Reservoir (Newport News Waterworks)
POQUOSON
Deer Run Golf Course
Siemans Automotive
LANGLEY AIR FORCE BASE
The Pines Golf Course
FORT EUSTIS
NEWPORT NEWS
James River
Sanifill of Virginia
HAMPTON
Titan Virginia Ready-Mix
James River Country Club
FORT MONROE
Northrop Grumman Shipbuilding
Kinder Morgan Bulk Terminals
Dominion Terminal Associates
0
2.5
5
7.5
10 Miles
Prepared by the Hampton Roads Planning District Commission

York-James Peninsula

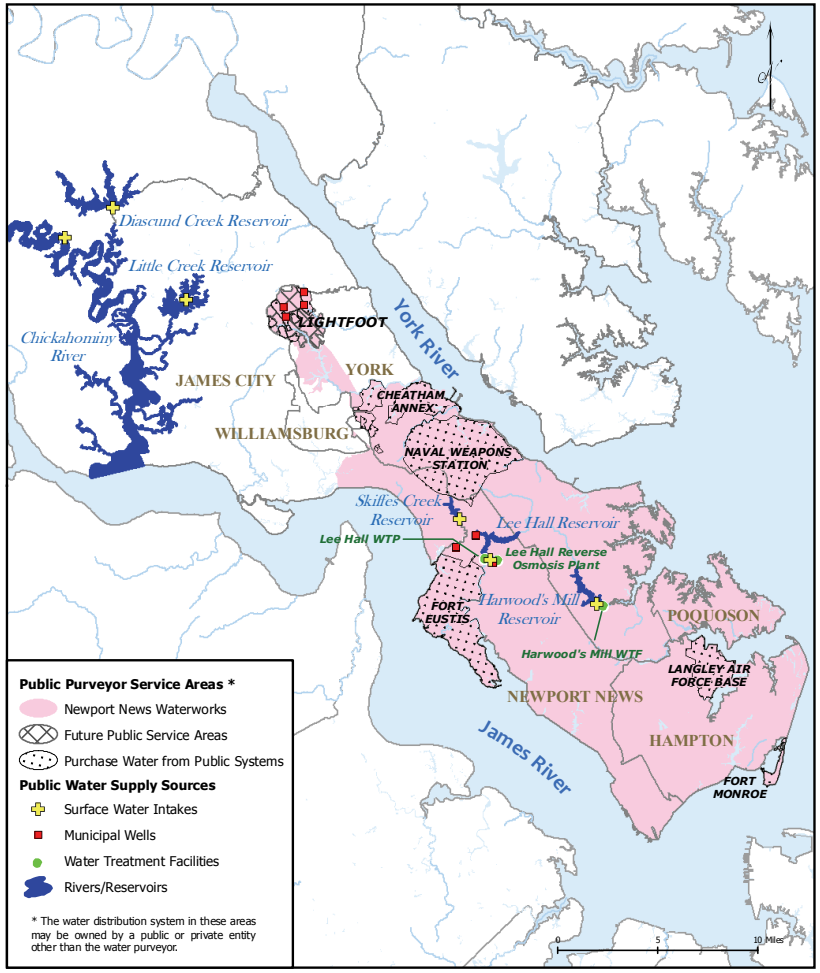
Cities of Hampton, Newport News, Poquoson, and York County: Publicly-Owned Community Water Systems

Newport News Waterworks (NNWW) provides water service to approximately 400,000 people in the Peninsula sub-region with a combination of withdrawals from the Chickahominy River, five reservoirs, and groundwater resources. The NNWW service area includes the entire cities of Newport News, Hampton, and Poquoson. NNWW also serves a small portion of James City County and most of York County, including several military installations (Yorktown Naval Weapons Station and Cheatham Annex).

NNWW has agreements to also sell bulk water to the James City Service Authority (JCSA) and the City of Williamsburg. JCSA can obtain an annual average of 4 million gallons per day (mgd) of treated water from NNWW and may receive up to 5 mgd of treated water in a calendar year, if available, upon written notice to NNWW based on specific criteria in their contract (see Attachment 1). The contract term is from 2009 to 2050 with automatic renewals. Williamsburg can purchase a combined total of 2 mgd of raw water and/or treated water measured as a yearly average. Williamsburg may purchase up to 2.5 mgd in a calendar year if the useable reservoir capacity of the NNWW system is at or above the typical drawdown cycle. Additional details are described in their contract.

The primary source of drinking water for the NNWW system is surface water. NNWW operates two water treatment plants (WTP): Lee Hall WTP and Harwood's Mill WTP. When available, water is pumped from the Chickahominy River above Walker's Dam and transferred to reservoirs for storage. NNWW has five reservoirs: Lee Hall Reservoir, Harwood's Mill Reservoir, Skiffe's Creek Reservoir, Little Creek Reservoir, and Diascund Creek Reservoir. NNWW uses groundwater as the secondary source of water. Wells withdraw brackish groundwater that is treated at the Lee Hall Reverse Osmosis Plant. Surface water and groundwater are treated separately, then blended together at the Lee Hall WTP before distribution. NNWW also operates the Harwood's Mill WTP, which only treats surface water. Map 1-4 shows the locations of NNWW's treatment plants, sources, and service areas.

Map 1-4: Newport News Waterworks Service Area and Water Sources



The Chickahominy River is in the James River Basin. The drainage area of the intake is 301 square miles and the average river flow is 180 mgd. The surface water withdrawal permit restricts NNWW from pumping when the river stage at Walker's Dam is below elevation 3.00 feet. NNWW withdrawals from the Chickahominy River may be suspended when tidal influences occur and downstream chlorides are elevated, as during drought conditions, to avoid drawing high chloride water into the intake.

The five NNWW reservoirs are geographically spread out across the sub-region. The following list describes the reservoirs from north to south:

- Diascund Reservoir, at the border of James City County and New Kent County, has a drainage area of 45 square miles and the available storage for 3.5 billion gallons of raw water.
- Little Creek Reservoir is located in James City County. The drainage area is 4.6 square miles and the storage available for water supply is 7.5 billion gallons of raw water.
- Skiffe's Creek Reservoir is located at the border of James City County and Newport News. The drainage area is approximately 6 square miles and the storage available for water supply is 230 million gallons of raw water.
- Harwood's Mill Reservoir is located in the southern portion of York County. The drainage area is 8.6 square miles and the storage available for water supply is 850 million gallons of raw water.
- Lee Hall Reservoir is located in the northern portion of Newport News. The drainage area is 14.5 square miles and the storage available for water supply is 880 million gallons of raw water.

The NNWW Lee Hall well field is located in the northern portion of Newport News just west of the Lee Hall Reservoir. The well field includes six deep wells in the Potomac Aquifer. The shallowest screen interval is from 505 to 530 feet below ground surface and the deepest is 1126 to 1131 feet below ground surface. The well field is

Photo: Skiffe's Creek Reservoir, HRPDC

permitted to withdraw 7 mgd, which produces 5.7 mgd of drinking water after losses during the reverse osmosis treatment process.

The water available from the NNWW surface water sources was evaluated by a private consultant in 2000. The yield of the wells is based on the total permitted annual withdrawal minus the losses associated with the reverse osmosis treatment process. See Table 1-1 for additional details.

Table 1-1: Newport News Waterworks Water Supply

Source Description	Raw Water (mgd)	Water Loss Description	Water Losses (mgd)	Finished Water (mgd)
Five reservoirs, Chickahominy River intake	54.8	1% loss to production processes	0.4	54.4
Brackish wells	7.0	20% loss to reverse osmosis	1.4	5.7
Total Supply	61.8		1.8	60.0

The HRPDC SWAP (August 2002) determined that the Chickahominy River and NNWW reservoir system have high susceptibility to contamination. However, NNWW has purchased land around the reservoirs and the conservation of those buffer areas reduces the likelihood of water quality problems in the reservoirs. Section 3: Existing Resources has additional information and maps of these buffers. All of the groundwater wells were determined to have a low susceptibility to contamination.

York County transferred ownership of the Lightfoot/Skimino and Banbury Water System (Lightfoot System) to NNWW in 2009. The water system is located in the northwest portion of York County. The system has 275 residential connections and significant commercial water users such as the Williamsburg Community Hospital and Great Wolf Lodge (indoor water park).

Photo: Lee Hall Reservoir, HRPDC

The Lightfoot System has four wells ranging from 280 to 320 feet deep. The system has a DEQ Ground Water Withdrawal Permit for 0.63 mgd. It is still operated as a stand-alone system but the distribution system will eventually be connected to NNWW's main system.

Newport News Waterworks Service Area: Privately-Owned Community Water Systems

Five CWSs within the NNWW service area serve military installations: Yorktown Naval Weapons Station, Cheatham Annex, Fort Monroe, Langley Air Force Base, and Fort Eustis. None of these systems has a raw water source or treatment facilities. Each of these systems has a retail service account with NNWW and is not obligated by minimum or maximum contract purchases.

There are six privately-owned CWSs in York County that own distribution systems but do not have any raw water sources (see Map 1-5). York County purchases the water from NNWW for these six systems. Aqua Virginia owns the three CWSs that serve the neighborhoods of Carver Gardens, Nelson Park, and York Terrace. Mountain Lake owns York Public Utilities. Two systems, Hubbards Lane and Queens Lake, formerly purchased water from the City of Williamsburg Waller Mill WTP; in August 2009, these systems began purchasing water from NNWW.

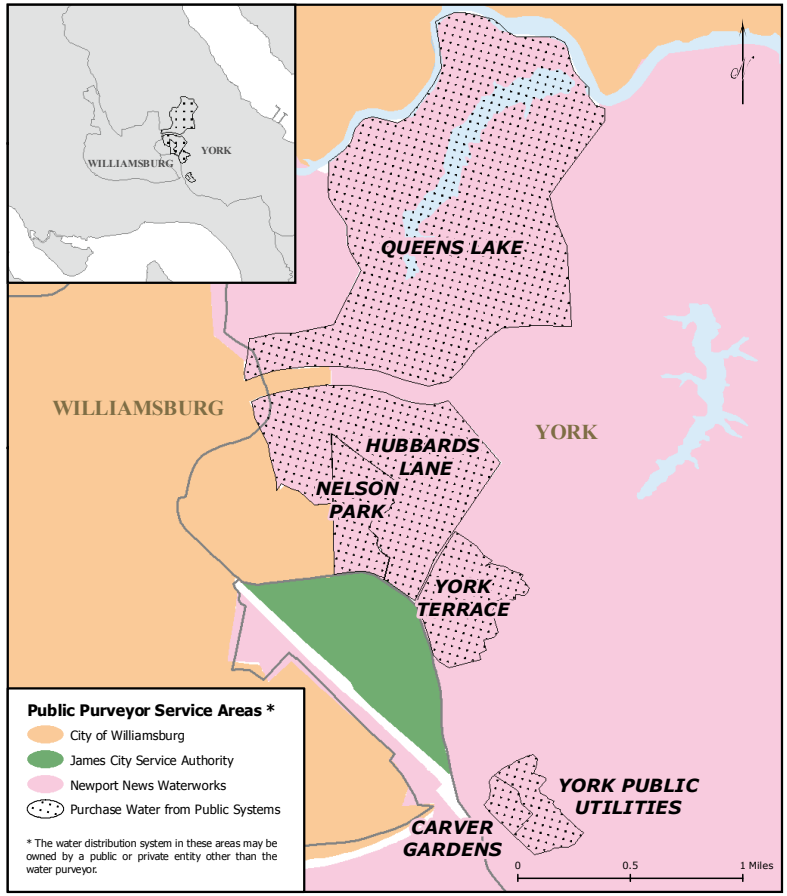
Newport News Waterworks Service Area: Self-Supplied Water Systems

There are approximately 3,200 people in York County that have domestic wells that provide water for their individual residences. Domestic well withdrawals in York County are from shallow aquifers: Yorktown-Eastover Aquifer (74%) and Piney Point Aquifer (26%) (Pope, USGS, 2007). A list of businesses with wells withdrawing less than 300,000 gallons per month is included in Appendix A. All of the domestic wells are located outside the CWS service areas.

In 2007, 11 self-supplied water systems withdrew more than 300,000 gallons per month of either surface water or groundwater in the NNWW service area. Four additional users, James River Country Club (surface water), Thomas Jefferson National Accelerator Lab (groundwater), and Williamsburg Pottery Factory A & B Systems (groundwater), have reported water use exceeding the permitting threshold for at least one year between 2002-2009 but did not exceed the threshold in 2007.

The Yorktown Fossil Power Plant is the largest self-supplied system in the NNWW service area. The facility withdraws water from the York River. The Yorktown Refinery uses reclaimed water from Hampton Roads Sanitation District (HRSD). In August 2010, Western Refining Inc. announced the refinery would be closing.

Map 1-5: Privately-Owned CWS, Newport News Waterworks Service Area



The following list describes each self-supplied water user (see Map 1-6 and Table 1-2):

- **Deer Run Golf Course:** Withdraws surface water for irrigation.
- **Dominion Terminal Associates-Pier 11:** Withdraws groundwater for dust suppression; 2 wells are approximately 730 feet deep.

- **James River Country Club:** Withdraws groundwater for irrigation; 6 wells are shallow, 2 wells are 700 and 720 feet deep.
- **Kinder Morgan Bulk Terminal – Pier IX:** Withdraws groundwater for dust suppression; 7 wells are approximately 30 feet deep, 1 well is 900 feet deep.
- **Northrop Grumman Shipbuilding:** Withdraws surface water for industrial cooling water.
- **Sanifill of Virginia – Big Bethel Landfill**: Withdraws groundwater for dewatering under the landfill liner; 7 wells are between 10 and 50 feet deep.
- **Siemens Automotive – Newport News:** Withdraws ground-water for industrial cooling water for automotive electronic/electrical systems; 7 wells are between 30 and 70 feet deep.
- **The Pines Golf Course – Fort Eustis:** Withdraws groundwater for irrigation; 1 well is 510 feet deep.
- **Titan Ready Mix Plant – Rip Rap Road:** Withdraws groundwater for concrete production; 3 wells are between 105 and 175 feet deep.
- **Williamsburg Country Club:** Withdraws surface water from a private lake for irrigation.
- **Yorktown Fossil Power Plant:** Withdraws surface water from the York River for cooling water.

Map 1-6: Self-Supplied Water Users in the Newport News Waterworks Service Area

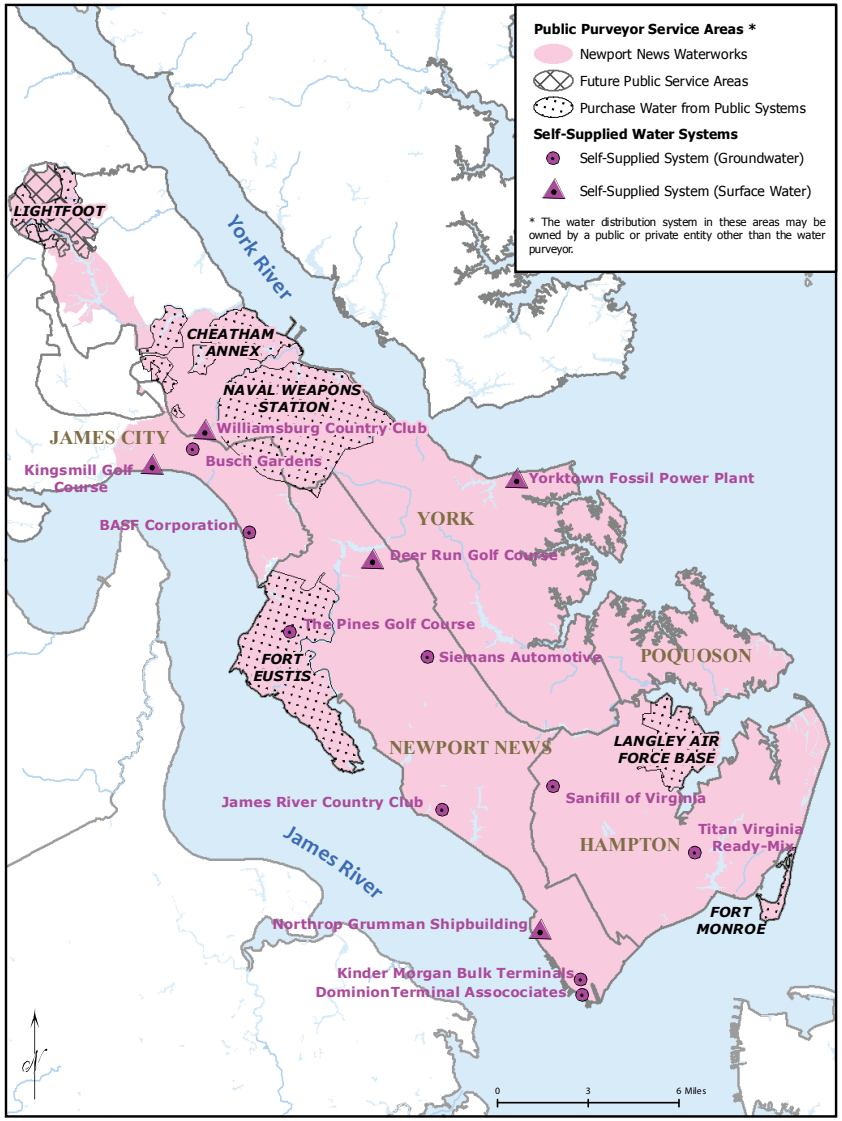


Table 1-2: 2007 Non-Agricultural Self-Supplied Use > 300,000 gallons/month in the Newport News Waterworks Service Area

Water User Name	Source Water	Type of Use	Within CWS Service Area	Groundwater Withdrawal Permit* (mgd)
Deer Run Golf Course[1]	Lee Hall Reservoir	Commercial	Yes	NA
Dominion Terminal Associates – Pier 11[1]	Groundwater	Manufacturing	Yes	0.15
James River Country Club[1]	Groundwater	Commercial	Yes	0.03*
Kinder Morgan Bulk Terminal – Pier IX Terminal Company[1]	Groundwater	Manufacturing	Yes	0.12
Northrop Grumman Shipbuilding[1]	James River	Industrial	Yes	NA
Sanifill of Virginia – Big Bethel Landfill[2]	Groundwater	Commercial	Yes	0.19**
Siemens Automotive – Newport News[1]	Groundwater	Manufacturing	Yes	0.11
The Pines Golf Course – Fort Eustis[1]	Groundwater	Commercial	Yes	0.33*
Titan Ready Mix Plant – Rip Rap Road[2]	Groundwater	Manufacturing	Yes	0.02
Williamsburg Country Club[3]	Golf Course Lake	Commercial	Yes	NA
Yorktown Fossil Power Plant[3]	York River	Power	Yes	Virginia Water Protection Permit (2007 use estimate = 817 mgd)

NA = Not applicable
*Permitted annual withdrawal
**Permit application submitted but not issued as of July 2010
[1] Located in the City of Newport News.
[1] Located in the City of Newport News.
[2] Located in the City of Hampton
[3] Located in York County

James City County: Publicly-Owned Community Water Systems

James City Service Authority (JCSA) operates 7 CWSs that provide water to approximately 46,000 people. All seven systems rely on groundwater. The service areas are shown on Map 1-7. JCSA's Central System is the largest system serving almost 45,000 people. Newport News Waterworks provides water to about 8,000 people in James City County.

In 2007, JCSA's Central System had 24 wells ranging from a depth of 241 to 1277 feet. In 2010, 5 of the 24 wells were no longer in use. Deep wells in the Central System withdraw brackish water that is treated by reverse osmosis at the Five Forks Water Treatment Facility. Other wells withdraw fresh water, which does not require treatment to reduce salinity.

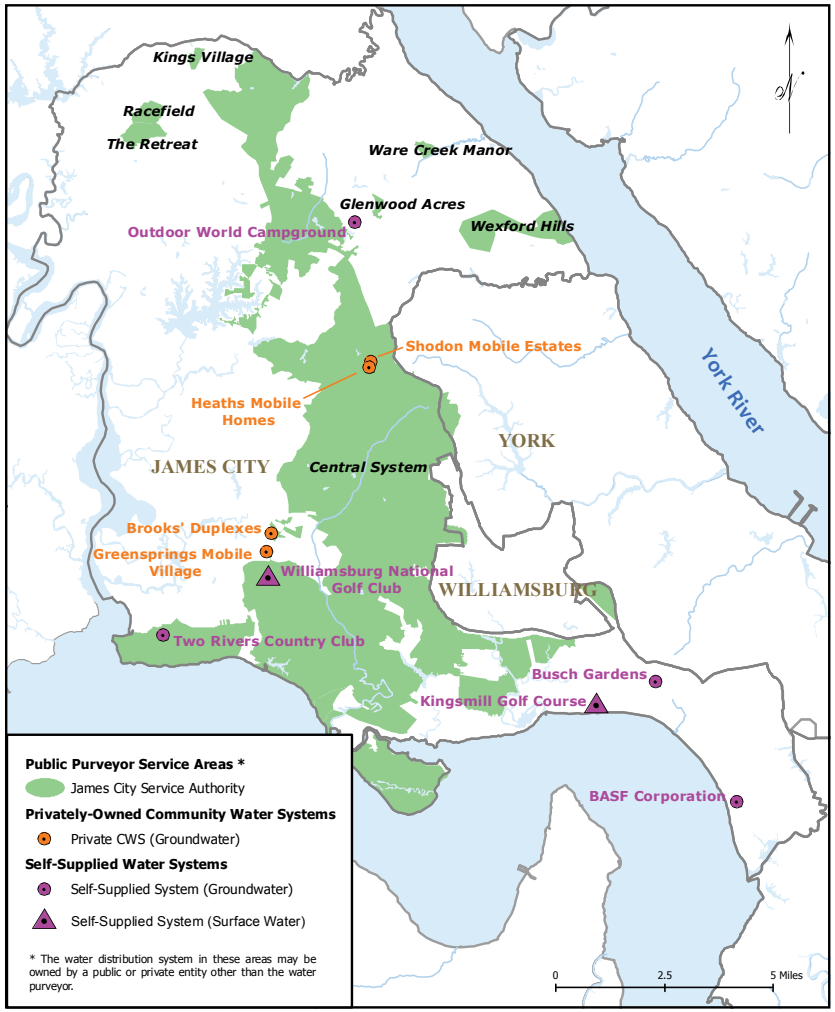
JCSA operates six additional CWSs. These systems are much smaller than the Central System in terms of population served and number of wells. The wells withdraw fresh water from the Chickahominy-Piney Point Aquifer, which is 200 to 300 feet below ground surface. A disinfectant is added to the groundwater before it enters the distribution systems. These six CWSs are described below:

- **Glenwood Acres System**: The system has 33 connections, with approximately 82 people served. There is 1 well with a depth of 272 feet.

- **Kings Village System:** The system has 49 connections, with approximately 121 people served. There are 2 wells with depths of 250 and 268 feet.

- **Racefield System:** The system has 36 connections, with approximately 89 people served. There are 2 wells with depths of 228 and 300 feet.

Map 1-7: James City Service Authority Service Area, Privately-Owned Community Water Systems, and Self-Supplied Users



- **Retreat System**: The system has 47 connections, with approximately 116 people served. There is 1 well at a depth of 230 feet.

- **Ware Creek Manor System**: The system has 64 connections, with approximately 158 people served. There are 2 wells with depths of 275 and 280 feet.

- **Wexford Hills System**: The system has 135 connections, with approximately 333 people served. There are 2 wells with depths of 306 and 315 feet.

JCSA holds DEQ Ground Water Withdrawal Permits for each of its seven CWSs, which are not interconnected. The permitted amount by system is listed in Table 1-3. The total permitted withdrawal amount is 8.9 mgd, and approximately 0.96 mgd is consumed during production processes. Additionally, JCSA may obtain an annual average of 4 to 5 mgd of treated water from NNWW. Beyond 2010, JCSA plans to expand its service area with the construction of an eighth CWS to be supplied by two new wells.

Table 1-3: 2007 James City Service Authority Publicly-Owned Community Water Systems

Water System	Total Permitted Withdrawal (mgd)	Production Losses	Finished Water
Central System	8.830	0.960	7.870
Glenwood Acres	0.010	0.00	0.010
Kings Village	0.015	0.00	0.015
Racefield	0.019	0.00	0.019
The Retreat	0.023 (draft permit)	0.00	0.023
Ware Creek Manor	0.013	0.00	0.013
Wexford Hills	0.032	0.00	0.032
JCSA Systems Total	**8.942**	**0.960**	**7.982**
NNWW Contract			**4.0 to 5.0**

James City County: Privately-Owned Community Water Systems

There are four privately-owned CWSs in James City County. The smallest system serves 35 people; the largest serves 200 people. Three of the four private systems are located within the service area of the JCSA's public CWSs (see Map 1-7). Only one system, Greensprings Mobile Village, is outside JCSA's service area. Shodon Mobile Estates is the only system that has a DEQ Ground Water Withdrawal Permit. The VDH has limited information about the other three systems. All of the wells in the privately-owned systems were determined to have a high susceptibility to contamination by the VDH SWAP evaluations (February 15, 2006).

- **Shodon Mobile Estates**: The system serves about 150 people. There are 2 wells at depths of 283 and 298 feet, which correspond to the Chickahominy-Piney Point aquifer. The total permitted withdrawal is 10,000 gallons per day (0.010 mgd).

- **Brooks Duplexes**: The system serves 35 people. There is 1 well with a depth of 463 ft. The VDH system capacity is 3,333 gallons per day (0.003 mgd).

- **Greensprings Mobile Village**: The system serves about 200 people. There are two wells but the depths are not known. The VDH system capacity is 34,400 gallons per day (0.034 mgd). The system capacity is three times higher than the threshold requiring a DEQ Ground Water Withdrawal Permit (0.1 mgd). The system does not have a permit and may not require one if actual withdrawals are less than 0.01 mgd.

- **Heath Mobile Homes**: The system serves approximately 40 people. There is 1 well with a depth of 290 feet. The VDH system capacity is 15,000 gallons per day (0.015 mgd). The system capacity is higher than the threshold requiring a DEQ Ground Water Withdrawal Permit (0.1 mgd). The system does not have a permit and may not require one if actual withdrawals are less than 0.01 mgd.

James City County: Self-Supplied Water Systems

There are approximately 7,224 people in James City County that are served by private wells at their residence. Private well withdrawals from various aquifers are estimated to be as follows (Pope, USGS, 2007): 11% Yorktown-Eastover Aquifer, Piney Point Aquifer (28%), Aquia Aquifer (47%), and Potomac Aquifer (14%).

A list of businesses with wells withdrawing less than 300,000 gallons per month is included in Appendix A. Most of the residential use is located outside a publicly-owned CWS.

In 2007, 6 self-supplied users in James City County reported withdrawals of more than 300,000 gallons of water per month for non-agricultural purposes (see Table 1-4). Two of the users withdraw surface water, and four users withdraw groundwater. The following list describes the six large self-supplied users.

- **BASF Corporation:** Facility has been closed as of July 2010, however, the DEQ Ground Water Withdrawal Permit remains active. Water was formerly used in manufacturing of acrylic fibers. The 5 wells are between 510 and 545 feet deep, corresponding to the Potomac aquifer.
- **Busch Gardens Williamsburg:** Withdraws groundwater for water rides and irrigation. The system's 2 wells are approximately 530 feet deep, corresponding to the Potomac aquifer.
- **Outdoor World Campground:** Withdraws groundwater to provide potable water to campers.
- **Kingsmill Golf Course**: Withdraws surface water for irrigation from three private ponds.
- **Two Rivers Country Club**: Withdraws groundwater for irrigation.
- **Williamsburg National Golf Courses**: Withdraw surface water for irrigation from Powhatan Creek.

Busch Gardens Williamsburg, Colonial Golf Course, and Williamsburg Pottery Factory have reported withdrawals over

Table 1-4: 2007 Non-Agricultural Self-Supplied Use > 300,000 gallons/month in James City County

Water User Name	Source Water	Type of Use	Within PWS Service Area	Groundwater Withdrawal Permit* (mgd)
BASF Corporation[1]	Groundwater	Manufacturing	Yes	3.55
Busch Gardens Williamsburg[1]	Groundwater	Commercial	Yes	0.13
Outdoor World Campground	Groundwater	Commercial	No	Application submitted
Kingsmill Golf Course[1]	Busch Gardens Lake, Wareham's Pond, Kingsmill Pond	Commercial	Yes	NA
Two Rivers Country Club	Groundwater	Commercial	Yes	0.20
Williamsburg National Golf Course	Powhatan Creek	Commercial	Yes	NA

*Total Permitted Withdrawal
[1] System is physically located within the portion of James City County served by Newport News Waterworks, not James City Service Authority.
NA =Not Applicable

300,000 gallons per month for at least one year from 2002-2009, but did not exceed the threshold in 2007. The Williamsburg Pottery Factory has a DEQ Ground Water Withdrawal Permit for 0.018 mgd. All of the systems are located within the JCSA's service areas except the Colonial Golf Course.

There are no reported withdrawals of more than 300,000 gallons of water per month for agricultural purposes.

City of Williamsburg: Publicly-Owned Community Water Systems

The City of Williamsburg operates a CWS which provides water to approximately 13,800 people. The service area includes the city and the Camp Peary military installation (see Map 1-8). Williamsburg's source water includes Waller Mill Reservoir, a deep well, and raw or treated water purchases from Newport News Waterworks.

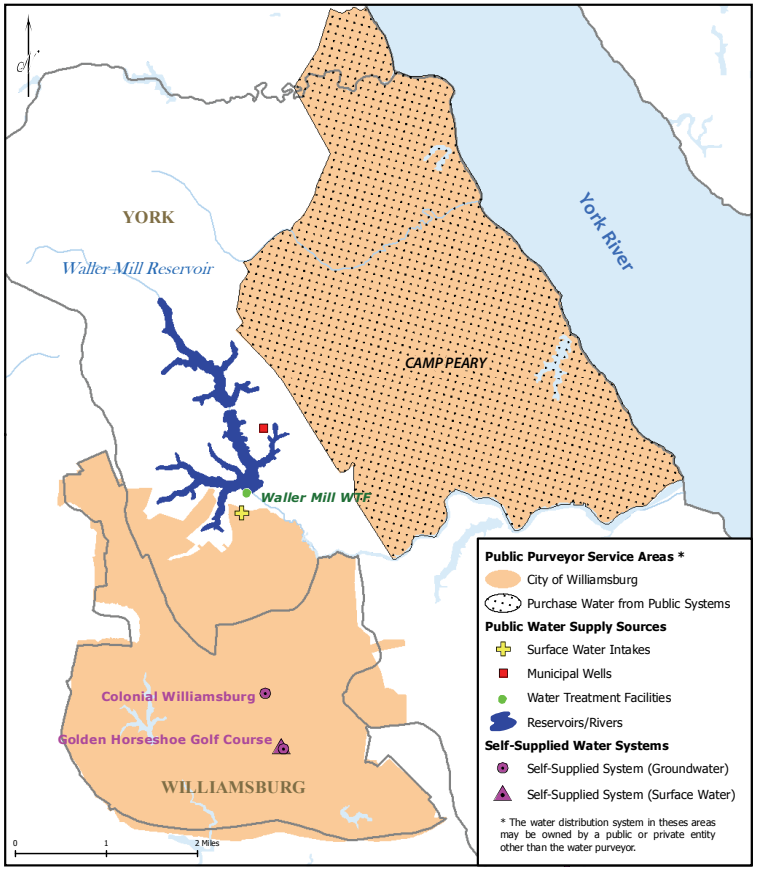
Waller Mill Reservoir is located at the border of Williamsburg and York County. The drainage area is approximately seven square miles and the available storage is 1,500 million gallons of raw water. The City's 500-ft deep well is located adjacent to the reservoir. Williamsburg has a DEQ Ground Water Withdrawal Permit for 707,000 gallons per day (0.71 mgd). The City's permit renewal application, submitted prior to 2005, is being processed by DEQ.

The HRPDC SWAP (August 2002) found that Waller Mill Reservoir has a high susceptibility to contamination and that Williamsburg's well has a low susceptibility to contamination. The available water supply of the Williamsburg conjunctive system was evaluated by a private consultant in 2007. The system yield is 5.14 mgd of raw water. The analysis included the reservoir, permitted groundwater withdrawals, and a maximum purchase of 2 mgd of raw water from Newport News Waterworks.

City of Williamsburg: Privately-Owned Community Water Systems

No privately-owned CWSs are located in the City of Williamsburg. The city formerly provided treated water to two privately-owned CWSs located in York County. In August 2009, the residential subdivisions of Hubbards Lane and Queens Lake began purchasing water from Newport News Waterworks.

Map 1-8: Williamsburg Service Area and Self-Supplied Users



City of Williamsburg: Self-Supplied Water Systems

There are no self-supplied residences in the City of Williamsburg. All residential water use is supplied by the publicly-owned CWS. Some commercial uses have private wells. A list of businesses with wells withdrawing less than 300,000 gallons per month is included in Appendix A.

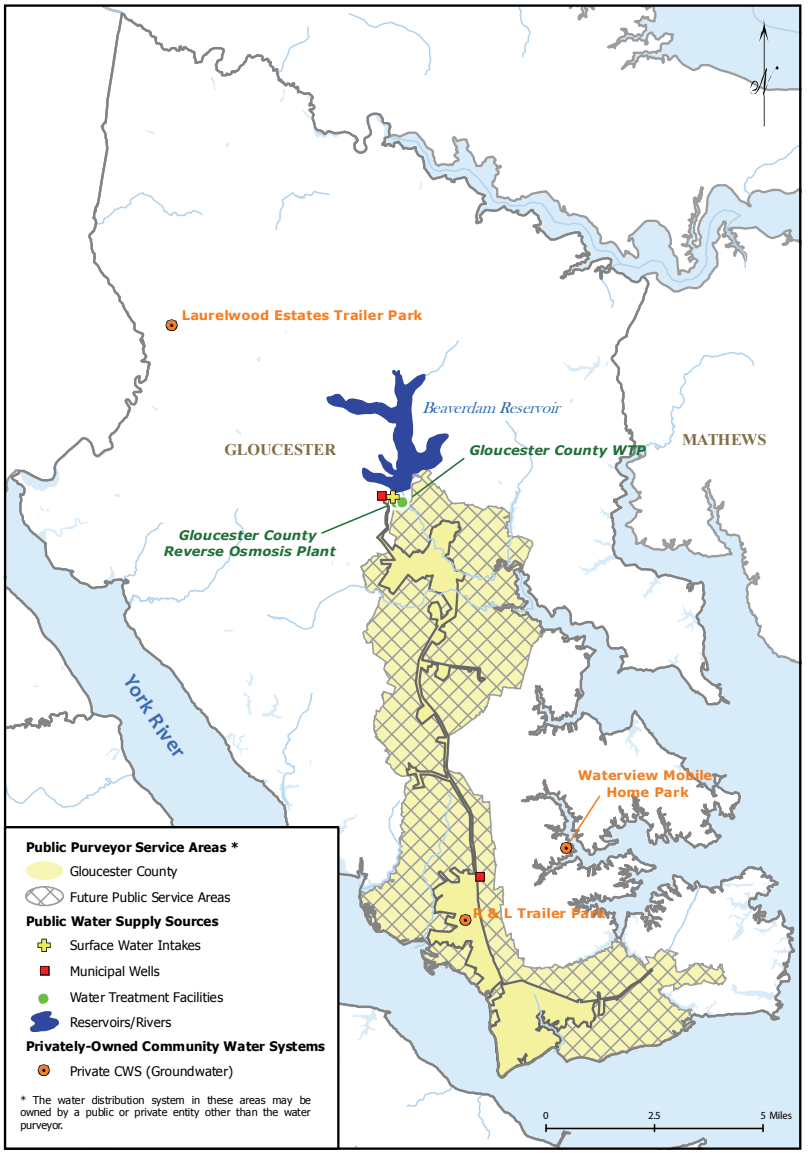
In 2007, 2 self-supplied users in Williamsburg reported withdrawing more than 300,000 gallons of water per month for non-agricultural purposes. The Golden Horseshoe Golf Course withdraws irrigation water from a well screened in the Potomac aquifer and two on-site ponds. Colonial Williamsburg has a DEQ Ground Water Withdrawal Permit to withdraw 1.844 mgd from the Potomac aquifer. Colonial Williamsburg uses the groundwater as cooling water for chillers and heat pumps. All of these self-supplied users are located within the service area of the Williamsburg water system. There are no reported withdrawals of more than 300,000 gallons of water per month for agricultural purposes.

Middle Peninsula

Gloucester County: Publicly-Owned Community Water Systems

Gloucester County operates a CWS which provides water to approximately 12,700 people. The service area primarily runs along Route 17 with many customers in the center of the county and a few neighborhoods in the southern portion of the county. The county has identified expansion areas that would significantly increase the service area of the publicly-owned CWS. The expansion area is shown on Map 1-9 as the hatched area.

Map 1-9: Gloucester County Service Area and Privately-Owned Community Water Systems



Gloucester's source water includes Beaverdam Reservoir and two deep wells which yield brackish water that must be treated by reverse osmosis to reduce salinity. Beaverdam Reservoir is located in the central portion of Gloucester County. The drainage area is approximately 24 square miles and the storage available for water supply is 5 million gallons of raw water. The 2 wells are between 1500 and 1600 feet deep. Gloucester County is not within the Eastern Virginia GWMA, so a DEQ Ground Water Withdrawal Permit is not required for the wells.

The HRPDC SWAP (August 2002) found that Beaverdam Reservoir has a high susceptibility to contamination and that Gloucester's wells have a low susceptibility to contamination.

The water system's yield is 4.0 mgd of raw water and 3.5 mgd of treated water. The analysis of the available water supply included the reservoir, groundwater withdrawals, and limitations of the reverse osmosis treatment plant.

Gloucester County: Privately-Owned Community Water Systems

There are three privately-owned CWSs in Gloucester County. The systems are not located within the service area of the public CWS. All of the wells in the privately-owned systems were determined to have a high susceptibility to contamination by the VDH SWAP evaluations (February 16, 2006).

- **Laurelwood Estates Trailer Park:** The system serves about 175 people. There are two wells at depths of 619 and 670 feet, which corresponds to the Potomac aquifer. The VDH permitted system capacity is 30,000 gpd (0.030 mgd).
- **R&L Trailer Park:** The system serves 45 people. There are two wells at depths of 109 and 119 feet, which corresponds to the Yorktown-Eastover aquifer. The VDH system capacity is 6,300 gallons per day (0.006 mgd).
- **Waterview Mobile Home Park:** The system serves about 80 people. There are three wells but only two in service. The depths of the active wells are 88 and 80 feet, corresponding to the Yorktown-Eastover aquifer. The VDH system capacity is 10,400 gallons per day (0.010 mgd).

Gloucester County: Self-Supplied Water Systems

There are approximately 23,000 people in Gloucester County that rely on private wells at their residences to provide potable water. Withdrawals in the county are primarily from shallow aquifers: Yorktown-Eastover Aquifer (94%) and the Piney Point Aquifer (6%) (Pope, USGS, 2007). A list of businesses with wells withdrawing less than 300,000 gallons per month is included in Appendix A. There are no reported withdrawals of more than 300,000 gallons of water per month for non-agricultural or agricultural purposes.

Photo: Beaverdam Reservoir, HRPDC

Existing Sources - Southside Sub-Region

The Southside sub-region includes the Cities of Chesapeake, Norfolk, Portsmouth, Suffolk, and Virginia Beach. Each of the cities have dense population centers, yet the Cities of Chesapeake, Suffolk, and Virginia Beach also have rural areas. The sub-region is served by 15 publicly-owned CWSs, which provided water to a total of 974,450 people in 2007. The majority of the sub-region's population is served by publicly-owned CWSs with raw water sources that include aquifers, reservoirs, Lake Gaston, and the Northwest, Blackwater and Nottoway Rivers.

Most of the publicly-owned water systems in the sub-region are conjunctive systems that use both surface water and groundwater. The raw water safe yields of these systems have been analyzed in previous technical reports and permit applications. These studies are typically based on the VDH's definition of safe yield for a complex reservoir system. Safe yield is the minimum withdrawal rate available to withstand the worst drought of record in Virginia since 1930. Safe yield defines the available water supply for these systems.

There are small systems in the sub-region that only use groundwater. For those systems, the available water supply is assumed to be the total permitted, annual average withdrawal based on their DEQ Ground Water Withdrawal Permits. If the system is very small and does not require a DEQ Ground Water Withdrawal Permit, the safe yield is assumed to be equal to the VDH permitted system capacity. The total available raw water supply for publicly-owned CWSs in the sub-region is 199 mgd. For further discussion about yield and demand, see the Statement of Need section.

In 2001, HRPDC conducted a detailed Source Water Assessment Program (SWAP). The HRPDC SWAP (August 2002), found that all surface water sources in the Southside sub-region have a high susceptibility to contamination. All groundwater wells serving publicly-owned CWSs were determined to have a low susceptibility to contamination. The only significant water quality problem in the sub-region is naturally occurring elevated levels of fluoride in groundwater. As of 2010, the City of Suffolk's Holland CWS is under a Fluoride Consent Order by VDH due to elevated levels of fluoride (see Section 3, Existing Resources for more information). A plan is underway to reduce fluoride in the Holland CWS to a level below the regulatory limit.

Nine privately-owned CWSs also operate in the sub-region. The systems all rely on groundwater. The combined available water supply of these systems is 1.2 mgd. In 2007, the systems served a total of 7,490 people. Per the 1996 Safe Drinking Water Act Amendments, the VDH SWAP Program inventoried drinking water sources and nearby land uses that may impact water quality, including common activities related to residential, industrial, commercial, and agricultural land uses and waste management and transportation facilities. According to the VDH SWAP evaluations (February 15, 2006), seven privately-owned CWSs have a well or wells with a high susceptibility to contamination. As of 2010, three privately-owned CWSs in Suffolk and two systems in Chesapeake were under a Fluoride Consent Order by VDH. Map 1-10 shows the Southside sub-region's CWS service areas and sources.

2007 Southside Overview

- 15 publicly-owned CWS served 974,450 people.
- 9 privately-owned CWS served 7,490 people.
- Private residential wells served approximately 57,000 people.
- 12 self-supplied users withdrew more than 300,000 gallons per month of surface water for non-agricultural purposes.
- 26 self-supplied users withdrew more than 300,000 gallons per month of groundwater for non-agricultural purposes.
- 3 self-supplied users withdrew more than 300,000 gallons per month of groundwater and/or surface water for agricultural purposes.

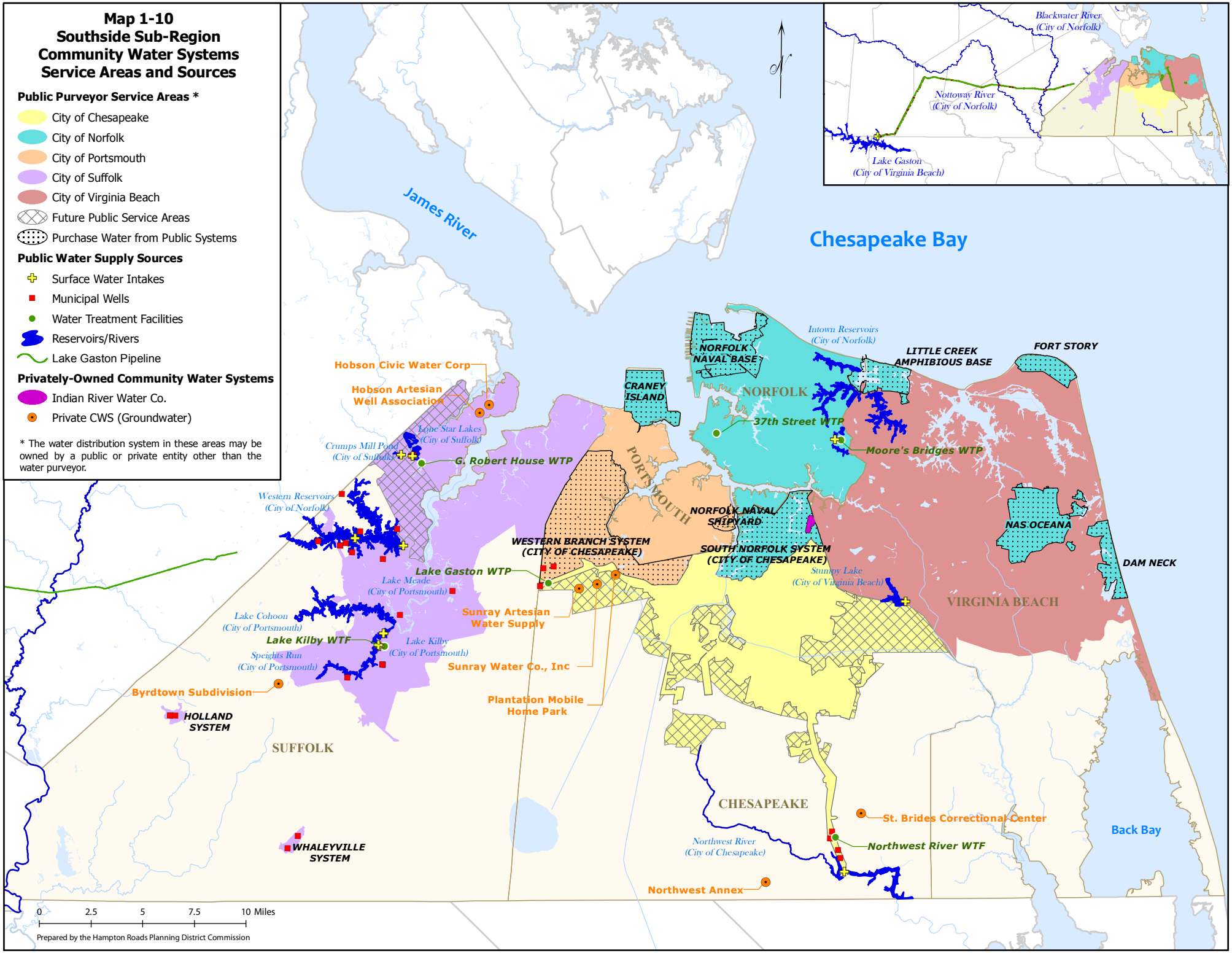
Photo: Stumpy Lake, HRPDC

The Southside sub-region has many self-supplied water users. These users range from residences with private wells to large commercial or agricultural operations with large withdrawals from wells or surface water sources. An estimated 57,000 people were served by private residential wells and 78 businesses were served by private wells in 2007. Map 1-11 shows the sub-regions' self-supplied water users.

DEQ requires users that withdraw more than 300,000 gallons per month of surface water or groundwater to report withdrawal information. The threshold for a Ground Water Withdrawal Permit and a Virginia Water Protection Permit for surface water withdrawal is 300,000 gallons per month. Most surface water withdrawals in the sub-region were established prior to 1989 and are, therefore, exempt from the permit program.

Southside Sub-Region: Water Contracts

Several publicly-owned CWSs in the Hampton Roads region purchase water from other systems in the region. The purchases are explained in more detail in the sections that follow. Table 1-5 summarizes the contract terms.


Map 1-10
Southside Sub-Region
Community Water Systems
Service Areas and Sources
Public Purveyor Service Areas *
City of Chesapeake
City of Norfolk
City of Portsmouth
City of Suffolk
City of Virginia Beach
Future Public Service Areas
Purchase Water from Public Systems
Public Water Supply Sources
Surface Water Intakes
Municipal Wells
Water Treatment Facilities
Reservoirs/Rivers
Lake Gaston Pipeline
Privately-Owned Community Water Systems
Indian River Water Co.
Private CWS (Groundwater)
* The water distribution system in these areas may be owned by a public or private entity other than the water purveyor.
Blackwater River (City of Norfolk)
Nottoway River (City of Norfolk)
Lake Gaston (City of Virginia Beach)
James River
Chesapeake Bay
Intown Reservoirs (City of Norfolk)
NORFOLK NAVAL BASE
LITTLE CREEK AMPHIBIOUS BASE
FORT STORY
CRANEY ISLAND
NORFOLK
37th Street WTP
Moore's Bridges WTP
Hobson Civic Water Corp
Hobson Artesian Well Association
Lone Star Lakes (City of Suffolk)
Crumps Mill Pond (City of Suffolk)
G. Robert House WTP
PORTSMOUTH
Western Reservoirs (City of Norfolk)
NORFOLK NAVAL SHIPYARD
NAS OCEANA
DAM NECK
WESTERN BRANCH SYSTEM (CITY OF CHESAPEAKE)
SOUTH NORFOLK SYSTEM (CITY OF CHESAPEAKE)
Stumpy Lake (City of Virginia Beach)
Lake Gaston WTP
Lake Meade (City of Portsmouth)
VIRGINIA BEACH
Sunray Artesian Water Supply
Lake Cohoon (City of Portsmouth)
Lake Kilby WTF
Lake Kilby (City of Portsmouth)
Speights Run (City of Portsmouth)
Sunray Water Co., Inc
Byrdtown Subdivision
Plantation Mobile Home Park
HOLLAND SYSTEM
SUFFOLK
CHESAPEAKE
St. Brides Correctional Center
Back Bay
Northwest River (City of Chesapeake)
Northwest River WTF
WHALEYVILLE SYSTEM
Northwest Annex
0 2.5 5 7.5 10 Miles
Prepared by the Hampton Roads Planning District Commission

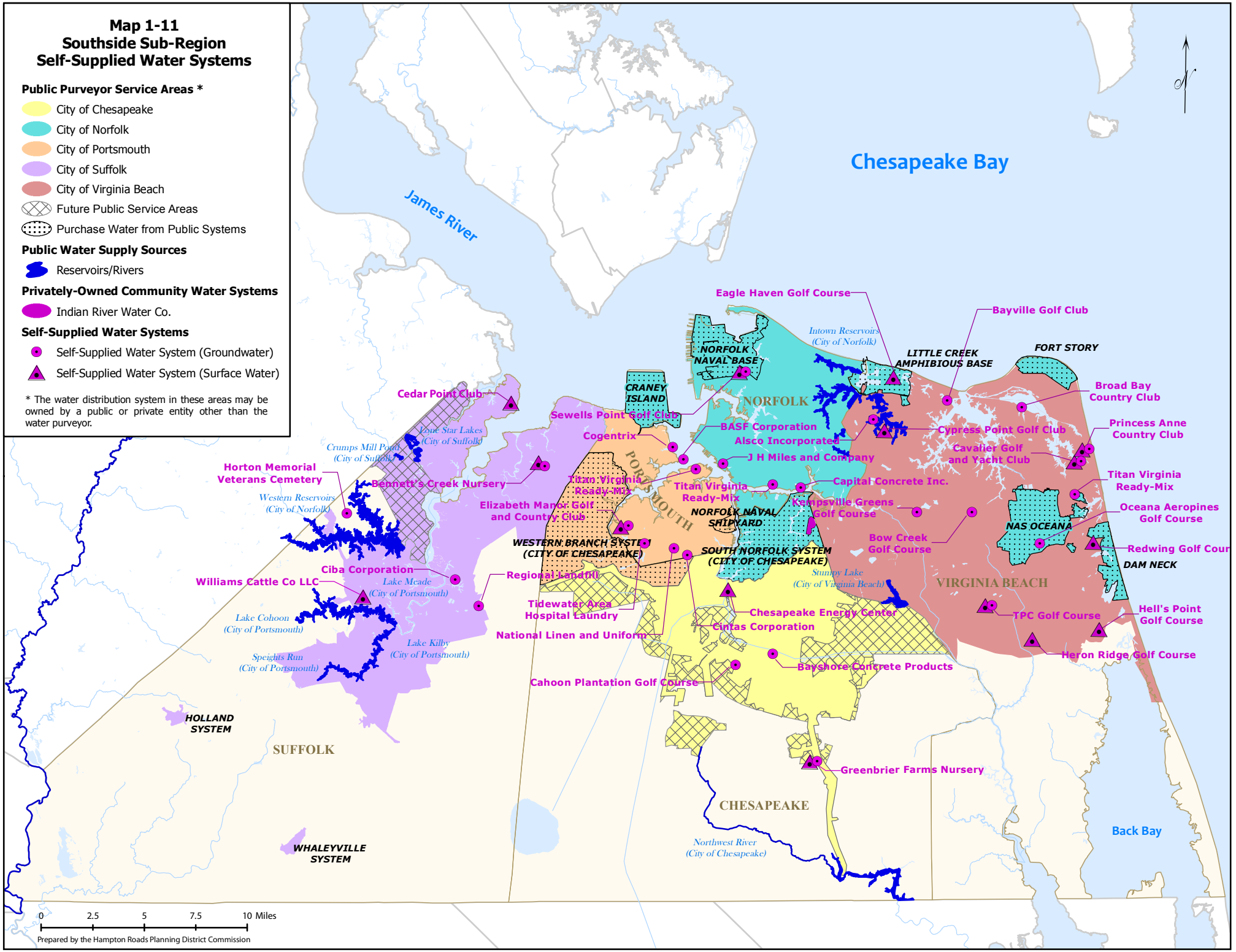

Map 1-11
Southside Sub-Region
Self-Supplied Water Systems
Public Purveyor Service Areas *
City of Chesapeake
City of Norfolk
City of Portsmouth
City of Suffolk
City of Virginia Beach
Future Public Service Areas
Purchase Water from Public Systems
Public Water Supply Sources
Reservoirs/Rivers
Privately-Owned Community Water Systems
Indian River Water Co.
Self-Supplied Water Systems
Self-Supplied Water System (Groundwater)
Self-Supplied Water System (Surface Water)
* The water distribution system in these areas may be owned by a public or private entity other than the water purveyor.
Chesapeake Bay
James River
Eagle Haven Golf Course
Bayville Golf Club
Intown Reservoirs (City of Norfolk)
NORFOLK NAVAL BASE
LITTLE CREEK AMPHIBIOUS BASE
FORT STORY
CRANEY ISLAND
NORFOLK
Broad Bay Country Club
Cedar Point Club
Sewells Point Golf Club
Lone Star Lakes (City of Suffolk)
Cogentrix
BASF Corporation
Alsco Incorporated
Cypress Point Golf Club
Princess Anne Country Club
Crumps Mill Pond (City of Suffolk)
J H Miles and Company
Cavalier Golf and Yacht Club
Horton Memorial Veterans Cemetery
Bennett's Creek Nursery
Titan Virginia Ready-Mix
PORTSMOUTH
Titan Virginia Ready-Mix
Capital Concrete Inc.
Titan Virginia Ready-Mix
Western Reservoirs (City of Norfolk)
Elizabeth Manor Golf and Country Club
Kempsville Greens Golf Course
Oceana Aeropines Golf Course
NORFOLK NAVAL SHIPYARD
NAS OCEANA
WESTERN BRANCH SYSTEM (CITY OF CHESAPEAKE)
Bow Creek Golf Course
Redwing Golf Course
SOUTH NORFOLK SYSTEM (CITY OF CHESAPEAKE)
DAM NECK
Ciba Corporation
Regional Landfill
Stumpy Lake (City of Virginia Beach)
Williams Cattle Co LLC
Lake Meade (City of Portsmouth)
VIRGINIA BEACH
Tidewater Area Hospital Laundry
Chesapeake Energy Center
TPC Golf Course
Hell's Point Golf Course
Lake Cohoon (City of Portsmouth)
Cintas Corporation
National Linen and Uniform
Lake Kilby (City of Portsmouth)
Heron Ridge Golf Course
Speights Run (City of Portsmouth)
Bayshore Concrete Products
Cahoon Plantation Golf Course
HOLLAND SYSTEM
SUFFOLK
Greenbrier Farms Nursery
CHESAPEAKE
Back Bay
Northwest River (City of Chesapeake)
WHALEYVILLE SYSTEM
0
2.5
5
7.5
10 Miles
Prepared by the Hampton Roads Planning District Commission

Table 1-5: Southside Sub-Region Water Sales

Water Seller	Water Buyer	Community Water System Name	Contract or Agreement Terms	Raw or Finished
Norfolk	Chesapeake	Northwest River System	Contractually obligated to purchase minimum 7 mgd	Raw
Norfolk	Chesapeake	South Norfolk System	Minimum purchase is 2 mgd	Finished
Norfolk	Norfolk Navy Installations	Norfolk Naval Base	Unrestricted volume by contract	Finished
Norfolk	Virginia Beach	City of Virginia Beach	Norfolk treats and wheels Lake Gaston water in accordance with a cost of service contract	Finished
Norfolk	Virginia Beach Military Installations (wheeled by Virginia Beach)	Fort Story – US Army Little Creek – US Navy Oceana – US Navy Dam Neck – US Navy	Unrestricted volume by contract	Finished
Norfolk	Portsmouth Navy Installation	Craney Island (fire suppression)	Unrestricted amount Rate by ordinance	Raw
Norfolk	Western Tidewater Water Authority: Suffolk – 75%, Isle of Wight – 25%	Suffolk Main System, Newport Development Service District, Windsor Development Service District	2014 – 3mgd Increases 1 mgd every other year (15 mgd max)	Raw
Norfolk	Portsmouth	City of Portsmouth	Pre-negotiated rate for up to 10 mgd, if available during droughts	Raw
Portsmouth	Chesapeake	Western Branch System	Contractually obligated to purchase 4.0 mgd, 5 mgd in 2020	Finished
Portsmouth	Norfolk Naval Ship Yard	Norfolk Naval Ship Yard – US Navy	Unrestricted/commercial account	Finished
Portsmouth	City of Suffolk	Suffolk Main System	2.54 mgd	Finished
WTWA	Isle of Wight County	Suffolk Main System	6.76 mgd	Finished

City of Chesapeake: Publicly-Owned Community Water Systems

The City of Chesapeake operates three publicly-owned CWSs and two WTPs. See Map 1-12 for a visual of the service areas. The 3 systems served a total population of 174,590 people in 2007. Table 1-6 further summarizes the sources for the three systems. They rely on groundwater, surface water, and purchases of raw and treated water. The systems' raw water safe yield is 21 mgd. The safe yield includes the Northwest River withdrawals and groundwater withdrawals. Purchased water is not included. The HRPDC SWAP (August 2002) found that all surface water sources had a high susceptibility to contamination. All of the groundwater wells were determined to have a low susceptibility to contamination.

Northwest River System

The Northwest River System is the City's largest system, serving approximately 102,430 people in 2007. The system uses water from several sources: an intake on the Northwest River, groundwater, and raw water purchased from the City of Norfolk. Two WTPs serve the system: Northwest River WTP and the Lake Gaston WTP.

The intake on the Northwest River is permitted by the U.S. Army Corps of Engineers (Corps), which allows the City to withdraw up to 10 mgd from the river. The permit requires stringent water quality control monitoring when the daily average withdrawal reaches 6 mgd, and the withdrawals must be reduced as necessary to avoid violation of water quality standards. The Northwest River is slightly affected by tidal action and at times saltwater may reach the intake site. The permit states that the City must cease withdrawing water if (1) the chloride content of the raw water exceeds 250 parts per million (ppm), (2) the monitoring near the mouth of the North Landing River indicates salinities over 7.5% seawater equivalency, or (3) sufficient environmental degradation is evident as determined by state agencies or the Corps. This permit is subject to permanent cancellation or modification at any time if it is determined that the withdrawal of water has resulted in environmental degradation. Prior to receiving the permit, the City had to provide the Corps with a contingency plan that assures a continued supply of water to its customers in the event the permit is cancelled.

Map 1-12: City of Chesapeake Sources and Service Area, Privately-Owned Water Systems, and Self-Supplied Water Systems

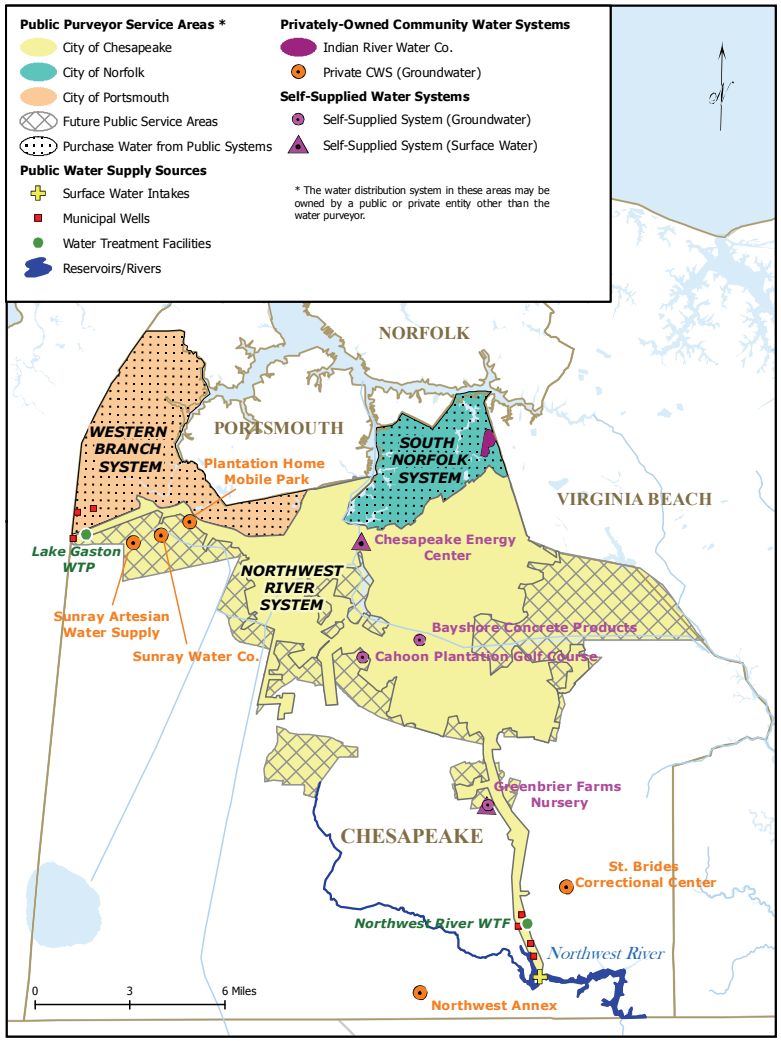


Table 1-6: 2007 Chesapeake Publicly-Owned CWSs

System	Population Served	Source	Limitations	Available Water Supply
Northwest River	102,434	Northwest River	Army Corps of Engineers: Maximum 10 mgd	28 mgd raw water + 6 mgd treated water
		4 Northwest River Wells	DEQ Ground Water Withdrawal Permit: 11.0 mgd	
		3 Western Branch Wells		
		Raw water purchase from Norfolk	Contract: 7 mgd	
South Norfolk	33,512	Finished water purchase from Norfolk	Contract: Minimum 2 mgd	
Western Branch	38,640	Finished water purchase from Portsmouth	Contract Minimum 4 mgd	

The second source for the Northwest River System is four Northwest River wells and three Western Branch wells. All of the wells are under one DEQ Ground Water Withdrawal Permit. The wells are screened in the Potomac Aquifer, which is the deepest aquifer in the Virginia Coastal Plain. The Northwest River wells are adjacent to the river and are permitted to withdraw 5 mgd. The water is brackish and must be treated by reverse osmosis to remove the salinity. The Western Branch wells are located across the City. The permitted withdrawals for the Western Branch wells are 3 mgd for Western Branch Well #1, and 3 mgd for Western Branch Well #3 and Well #4 combined. Water withdrawn from the Western Branch wells is pumped to the Lake Gaston WTP and provides natural fluoridation. Western Branch Well #4 is also called the Aquifer Storage and Recovery (ASR) well. The ASR well began operating in 1989. Treated water from the Northwest River WTP is injected into the ASR well for storage to meet peak demands. Only the "bubble" of injected water is withdrawn from the ASR well.

The Northwest River System also purchases raw water from the City of Norfolk. Currently, the City of Chesapeake purchases 7 mgd of raw water from the City of Norfolk's Western Reservoirs (located in the City of Suffolk). The City of Chesapeake treats the water at its Lake Gaston WTP. The In-Town Lakes, located in the Deep Creek area of western Chesapeake, are operated to provide emergency, short-term backup supply of water for the Lake Gaston WTP. The In-Town Lakes store a 30-day supply of water for the system and are primarily used to store water while the membranes at the treatment plant are cleaned and repaired.

The City of Chesapeake will have an additional water source for the Northwest River System within the next five years. The City has a contract with Virginia Beach for one-sixth (10 mgd) of the Lake Gaston permitted withdrawal. Additional infrastructure including a raw water pipeline from the Western Branch pump station to Chesapeake's treatment plant must be constructed to allow the City to use the 10 mgd from Lake Gaston. The City estimates the finished water yield for this project will be 8.5 mgd. Approximately 15% of the raw water yield is lost in the production processes at the Lake Gaston WTP. See Table 1-6 for a summary of the Northwest River System.

South Norfolk System

The South Norfolk System, owned by the City of Chesapeake, serves the portion of the City north of Military Highway and east of the Southern Branch of the Elizabeth River. The system served approximately 33,512 people in 2007. The only water source for this system is finished water purchased from the City of Norfolk's Moores Bridges WTP. The contract with the City of Norfolk

stipulates that the City of Chesapeake must "take or pay" for 2 mgd monthly, which means the City must pay for a minimum of 2 mgd even if total use is less than 2 mgd. The contract term is from January 1, 2003 to December 31, 2042. Norfolk has the ability to supply the system with 4 mgd. The average annual amount of water purchased for the South Norfolk System was 2.69 mgd in 2007.

Western Branch System

The Western Branch System, owned by the City of Chesapeake, serves the portion of the City north of Military Highway and west of the Southern Branch of the Elizabeth River. The system served 38,640 people in 2007. Finished water is purchased for the system from the City of Portsmouth's Lake Kilby WTP. The term of the contract is from January 1, 1990 to December 31, 2026 and stipulates that the City of Chesapeake must take or pay for 4 mgd in 2010. The take or pay amount increases to 5 mgd in 2020. Approximately 474 Chesapeake residents also buy water directly from the City of Portsmouth.

City of Chesapeake: Privately-Owned Community Water Systems

Six privately-owned CWSs operate in the City of Chesapeake. In 2007, the systems served a total of 7,250 people. All of the systems use groundwater. The Indian River System is located within the City's South Norfolk System service area. The other privately-owned systems are outside of the City's service area. The Plantation Mobile Home Park and two Sunray Systems are in the City's Franchise Area, where city service may be offered in the future. The St. Bride's Correctional Center and U.S. Navy's Northwest Annex are in the southern portion of the City and will not be incorporated into the City's service area within the foreseeable future. The total available water supply of these systems equals 1.16 mgd.

The Indian River Co. and St. Bride's Correctional Center are the only systems that hold DEQ Ground Water Withdrawal Permits. The Navy owns and operates a system of nine active wells and two treatment plants to supply water to the Northwest Annex Naval Support Activity. The system capacity is permitted at 0.35 mgd by VDH. The withdrawals exceed the threshold for a DEQ groundwater permit; however, the Navy has claimed sovereign immunity from the Ground Water Management Act and has not applied for a permit.

As of 2010, the Indian River Co., Plantation Mobile Home Park and Sunray Artesian Water Supply systems were under a Fluoride Consent Order from VDH. Four of the six privately-owned systems in Chesapeake have a well or wells with a high susceptibility to contamination. See Table 1-7 for a summary of Chesapeake's privately–owned systems.

City of Chesapeake: Self-Supplied Water Systems

In 2007, an estimated 33,600 people were served by private residential wells and 11 businesses had their own well. Seven businesses use less water than the DEQ reporting threshold. All of the residential use and four of the businesses are located outside a CWS service area.

Non-Agricultural: The Chesapeake Energy Center is the only non-agricultural, self-supplied user that reported withdrawing more than 300,000 gallons of surface water in 2007. The Energy Center withdraws from the Southern Branch of the Elizabeth River. The system's maximum intake capacity is 633.6 mgd. The Energy Center does not hold a DEQ Virginia Water Protection Permit. The water is used in the cooling tower of the coal plant. See Map 1-12 for the location of the Energy Center, and Table 1-8 for a summary.

In 2007, 2 non-agricultural self-supplied systems reported withdrawing more than 300,000 gallons per month of groundwater: Bayshore Concrete Products and Cahoon Plantation Golf Course. Both systems hold DEQ Ground Water Withdrawal Permits and their respective sources and uses are described as follows:

- **Bayshore Concrete Products:** Uses groundwater for concrete production. The 4 wells are between 45 and 95 feet deep and withdraw water from the Yorktown-Eastover Aquifer.

- **Cahoon Plantation Golf Course:** Uses groundwater for irrigation. The 4 wells are between 110 and 118 feet deep and withdraw water from the Yorktown-Eastover Aquifer.

The three non-agricultural, self-supplied systems are located within the City of Chesapeake's publicly-owned CWS service area. See Map 1-12 for the locations and Table 1-8 for a summary.

Agricultural: Greenbrier Farms Nursery (see Map 1-12) is the only self-supplied agricultural user that reported withdrawing more than 300,000 gallons per month of groundwater or surface water. The farm holds a DEQ Ground Water Withdrawal Permit.

Table 1-7: 2007 Privately–Owned CWSs in Chesapeake

System	Population Served	Well Depth	Groundwater Withdrawal Permit (mgd)	VDH System Capacity (mgd)	VDH SWAP Evaluated Susceptibility to Contamination
Indian River Co.	1,500	5 wells: 65 – 94 (ft)	0.24	0.16	High Under Fluoride Consent Order
Naval Support Activity NW Annex	2,200	9 wells: 90 – 124 (ft)	No	0.35	Low
Plantation Mobile Home Park	95	NI	No	0.02	No wellhead assessment Under Fluoride Consent Order
Sunray Artesian Water Supply	100	NI	No	0.01	High
Sunray Water Co	60	NI	No	0.01	High Under Fluoride Consent Order
VDOC – Saint Brides Correctional Center	3,291	4 wells: 105 – 160 (ft)	0.53	0.32	2 wells high 1 well low 1 well unknown

NI = no information

Table 1-8: 2007 Self-Supplied Use > 300,000 gallons/month in Chesapeake

Business	Source Water	Type of Use	Within CWS Service Area	Groundwater Withdrawal Permit (mgd)
Bayshore Concrete Products	Groundwater	Manufacturing	Yes	0.023
Cahoon Plantation Golf Course	Groundwater	Commercial	Yes	0.17
Chesapeake Energy Center	Southern Branch Elizabeth River	Fossil Power	Yes	Not applicable
Greenbrier Farms Nursery	Groundwater	Agriculture	No	0.24

Photo: Northwest River, www.kayakvb.com, Paul Perusse

Photo: Northwest River Park, courtesy of the City of Chesapeake Parks and Recreation

City of Norfolk: Publicly-Owned Community Water System

The City of Norfolk operates one CWS that serves the entire City (see Map 1-13). The system includes two WTPs: 37th Street WTP and Moores Bridges WTP. The city has multiple sources of raw water: Western Reservoirs (Western Branch Reservoir, Lake Prince, and Lake Burnt Mills), Intown Reservoirs (Lake Smith, Lake Lawson, Little Creek Reservoir, Lake Whitehurst, and Lake Wright), Blackwater River, Nottoway River, and four deep wells. The VDH operating permit for the City of Norfolk includes both WTPs and the raw water sources listed above. The VDH permitted system capacity for the entire Norfolk system is 136 mgd. The raw water safe yield, or available water supply, for the system is 92.5 mgd. The HRPDC SWAP (August 2002) found that Norfolk's surface water reservoirs have a high susceptibility to contamination, and the wells were determined to have a low susceptibility to contamination.

Norfolk sells water to several CWSs within the Hampton Roads region. By 2038, these contracts obligate approximately 24 mgd of Norfolk's safe yield to other systems in the region. See Table 1-9 for more details. Water sales are summarized below:

- Norfolk sells finished and raw water to the City of Chesapeake.
- Norfolk sells finished water to the Navy installations in Norfolk and Virginia Beach.
- Norfolk sells raw water to the Navy for fire suppression at Craney Island in Portsmouth.
- Contracts are in place to sell water to the Cities of Portsmouth and Virginia Beach during drought conditions.
- Norfolk will begin selling water to the Western Tidewater Water Authority in 2014.

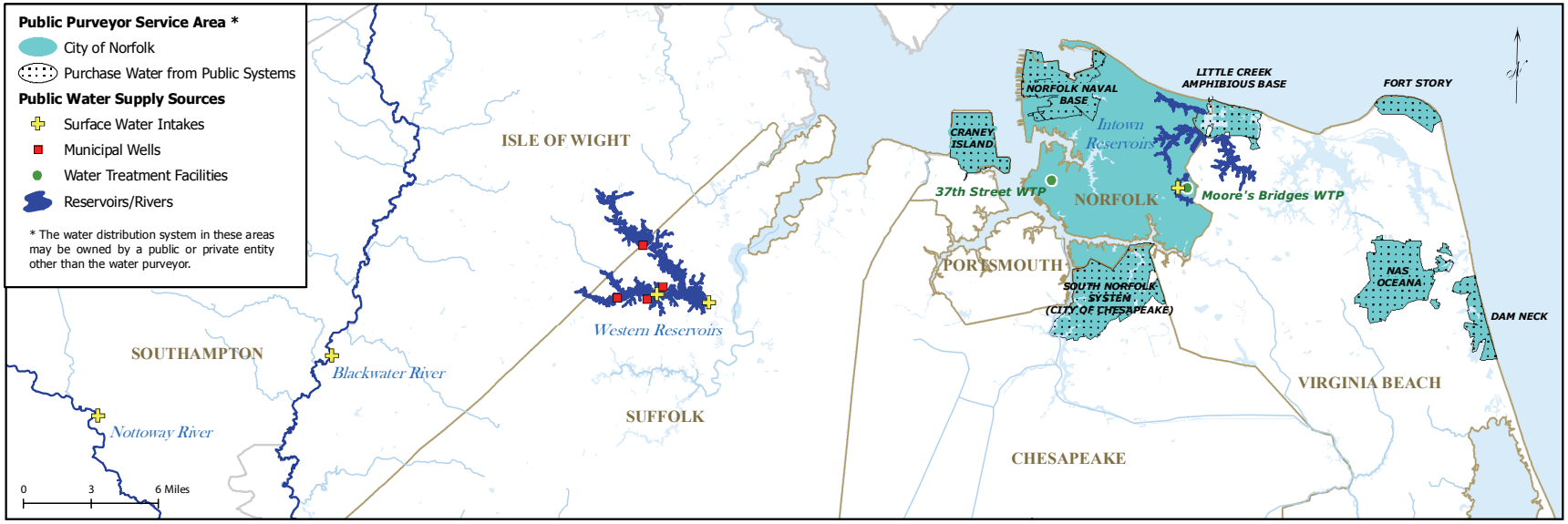
Norfolk and Virginia Beach have a unique agreement; Norfolk wheels and treats the entire water supply for Virginia Beach. The Lake Gaston water owned by Virginia Beach is discharged from the Lake Gaston pipeline into Lake Prince (located in the City of Suffolk) which is part of Norfolk's Western Reservoirs. The Lake Gaston water blends with the City of Norfolk's water sources and is treated at Norfolk's WTP.

No privately–owned water systems operate in Norfolk.

Table 1-9: 2007 City of Norfolk - Contracts for Water Sales

(All figures in mgd)

Buyer	Raw Water	Finished Water	Contract Period	Contract Terms
City of Chesapeake – Northwest River System	7.0	0.0	1/1/2003 - 12/31/2042	Norfolk provides minimum of 7 mgd which Chesapeake must take or pay for.
City of Chesapeake – South Norfolk System	0.0	2.0	1/1/2003 - 12/31/2042	Norfolk provides minimum of 2 mgd monthly, which Chesapeake must take or pay for.
Western Tidewater Water Authority (City of Suffolk and Isle of Wight County)	15.0	0.0	7/1/2009 - 6/30/2048	In 2014, Norfolk provides 3 mgd. Amount increases by 1 mgd every other year (maximum contracted amount of 15 mgd).
Total Contract Obligations for Norfolk	**22.0**	**2.0**		



Map 1-13: City of Norfolk Sources and Service Area

Western Reservoirs

The Western Reservoirs are comprised of three interconnected reservoirs: Lake Prince, Lake Burnt Mills, and Western Branch Reservoir. The bodies of water are located mainly within the City of Suffolk, but also extend into Isle of Wight County. The combined drainage area is approximately 66 square miles and the storage available for water supply is 13.2 billion gallons of raw water. The City of Norfolk Department of Utilities recently completed a $13 million rehabilitation project for Lake Burnt Mills Dam, including reconstruction of the spillway and embankments and installation of a new intake structure and outlet pipe to the Western Branch Reservoir.

Water from the Blackwater and Nottoway Rivers also supply the Western Reservoirs. Raw water pumped from the rivers is discharged into the headwaters of Lake Prince. There are no permit limits for withdrawing water from the Blackwater and Nottoway Rivers.

Additionally, Norfolk has four deep wells that also supplement the Western Reservoirs. Three wells discharge directly into Lake Prince and one discharges into Lake Burnt Mills. The four wells are permitted under one DEQ Ground Water Withdrawal Permit for 15.94 mgd.

Virginia Beach's water from the Lake Gaston pipeline, which is discharged into Lake Prince, and Norfolk's water from the Western Reservoirs is pumped to the Moores Bridges WTP and the 37th Street WTP (see Table 1-10). The Moores Bridges WTP has served the Norfolk system since construction in 1899. The 37th Street WTP, located on the west side of Norfolk, was constructed in 1920 and provides water to the western half of the City as well as to Norfolk Naval Base. The Moores Bridges and 37th Street WTPs have a combined rated capacity of 136 mgd.

Table 1-10: 2007 Norfolk Publicly-Owned CWSs

System	Reservoir	Reservoir sources	Safe Yield
Norfolk	Western Reservoirs	Lake Prince	92.5 mgd
		Lake Burnt Mills	
		Western Branch Reservoir	
		Blackwater River	
		Nottoway River	
		4 wells	
	Intown Reservoirs	Lake Lawson	
		Lake Smith	
		Little Creek Reservoir	
		Lake Whitehurst	
		Lake Wright	

Intown Reservoirs

The Intown Reservoirs are comprised of five interconnected bodies of water: Lake Lawson, Lake Smith, Little Creek Reservoir, Lake Whitehurst, and Lake Wright. The bodies of water are located in the Cities of Norfolk and Virginia Beach. Lake Wright is the terminal reservoir, where water is withdrawn for treatment at the Moores Bridges WTP. The combined drainage area is approximately 14 square miles and the storage available for water supply is 1.9 billion gallons of raw water.

The other CWS in the City is the Norfolk Naval Base System, which purchases water from the City of Norfolk. The Naval Base is a commercial customer and does not have a contract with minimum or maximum purchase amounts.

Photo: Nottoway River, www.dcr.virginia.gov

Photo: Lake Whitehurst, HRPDC

City of Norfolk: Self-Supplied Water Systems

Non-Agricultural: In 2007, 2 golf-courses reported withdrawing more than 300,000 gallons per month of surface water. Both use the water for irrigation and both are located within Norfolk's publicly-owned CWS service area. Map 1-14 and Table 1-11 summarize the self-supplied water systems in Norfolk.

There are 5 self-supplied, non-agricultural users who reported withdrawing more than 300,000 gallons per month of groundwater in 2007. The systems all hold DEQ Ground Water Withdrawal Permits and are all located within Norfolk's public water system service area.

- **JH Miles and Company – Norfolk Processing Plant:** Groundwater is used for seafood processing. The well is 900 feet deep, corresponding to the Potomac aquifer.
- **Capital Concrete Incorporated – Stapleton Street Plant:** Groundwater is used for concrete production. The 2 wells are 104 and 105 feet deep, corresponding to the Yorktown-Eastover aquifer.
- **Titan Virginia Ready-Mix LLC:** Groundwater is used for concrete production. The 3 wells are between 42 and 95 feet deep, corresponding to the Yorktown-Eastover aquifer.
- **US Navy-Norfolk Naval Base, Sewells Point Golf Course:** Groundwater is used for irrigation. The 5 wells are 40 feet deep, corresponding to the water table aquifer. Surface water from an irrigation pond is also used.
- **Eagle Haven Golf Course:** Surface water is used for irrigation. Course is located on Little Creek Amphibious Base, Virginia Beach. Base is served by Norfolk's water supply.

Agricultural: There are no agricultural users that withdraw more than 300,000 gallons per month of water, nor are there residences or businesses served by private wells.

Map 1-14: Self-Supplied Water Systems in Norfolk

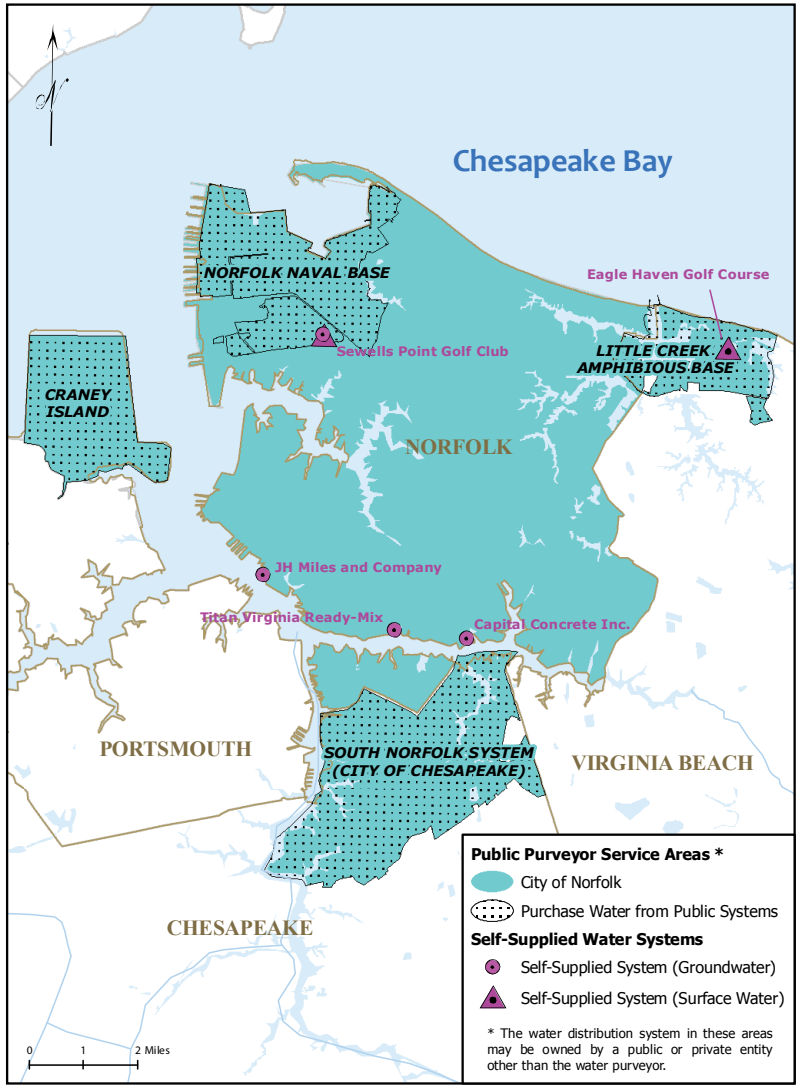


Table 1-11: 2007 Self-Supplied Use > 300,000 gallons per month in Norfolk

Business	Source Water	Type of Use	Within CWS Service Area	Groundwater Withdrawal Permit (mgd)
Capital Concrete Incorporated	Groundwater	Manufacturing	Yes	0.027
Eagle Haven Golf Course, NAB Little Creek	Lake	Commercial	Yes	Not applicable
J.H. Miles and Company	Groundwater	Manufacturing	Yes	0.225
Sewells Point Golf Course	Groundwater& Ponds	Commercial	Yes	0.038
Titan Virginia Ready-Mix, LLC	Groundwater	Commercial	Yes	0.025

City of Portsmouth: Publicly-Owned Community Water System

The City of Portsmouth operates one CWS that serves the entire City (see Map 1-15). Portsmouth's system has multiple sources of raw water: Lake Meade, Lake Cahoon, Speights Run, Lake Kilby, and five deep wells. The four surface water reservoirs are interconnected and located in the City of Suffolk. The combined drainage area of the reservoirs is 64.2 square miles and the total storage available for water supply is approximately 4.1 billion gallons. Additionally, there is an emergency pumpover from Norfolk's Lake Prince into Lake Cahoon and Lake Meade. The VDH permitted treatment capacity for the entire Portsmouth System is 38.5 mgd. The four interconnected reservoirs have a raw water safe yield of 19.1 mgd.

Of the City's five wells, two are production wells and three are drought relief wells. Production well #1 is pumped into Lake Kilby and the Lake Kilby Treatment Plant. Production well #2 is also pumped to the treatment plant. The production wells are utilized to supplement the surface water supply. The raw water is blended to maintain a ratio of 25% groundwater to 75% surface water. The addition of groundwater adds natural fluoride and alkalinity and reduces the creation of disinfection byproducts. All five wells are screened in the Potomac Aquifer. As of 2009, the City had submitted a DEQ Ground Water Withdrawal Permit application for the five wells. The draft withdrawal permit requests 5.4 mgd for the production wells and 6.22 mgd for the drought wells. The city is currently withdrawing groundwater based on a historic use certificate.

Surface water and groundwater are treated at the Lake Kilby WTP located near the reservoirs in the City of Suffolk. The system's raw water safe yield, or available water supply, is 24.7 mgd. The drought wells and pumpover from Norfolk's Lake Prince are not considered in the estimate of yield.

The HRPDC SWAP (August 2002) found that Portsmouth's surface water reservoirs have a high susceptibility to contamination. All of the groundwater wells were determined to have a low susceptibility to contamination.

The City of Portsmouth sells water to Chesapeake's Western Branch System, the City of Suffolk's Main System, and approximately 474 residents in the City of Chesapeake. These contracts obligate Portsmouth to provide a minimum of 6.5 mgd of treated water in 2010. Table 1-12 summarizes the contract terms.

Map 1-15: City of Portsmouth Sources and Service Area

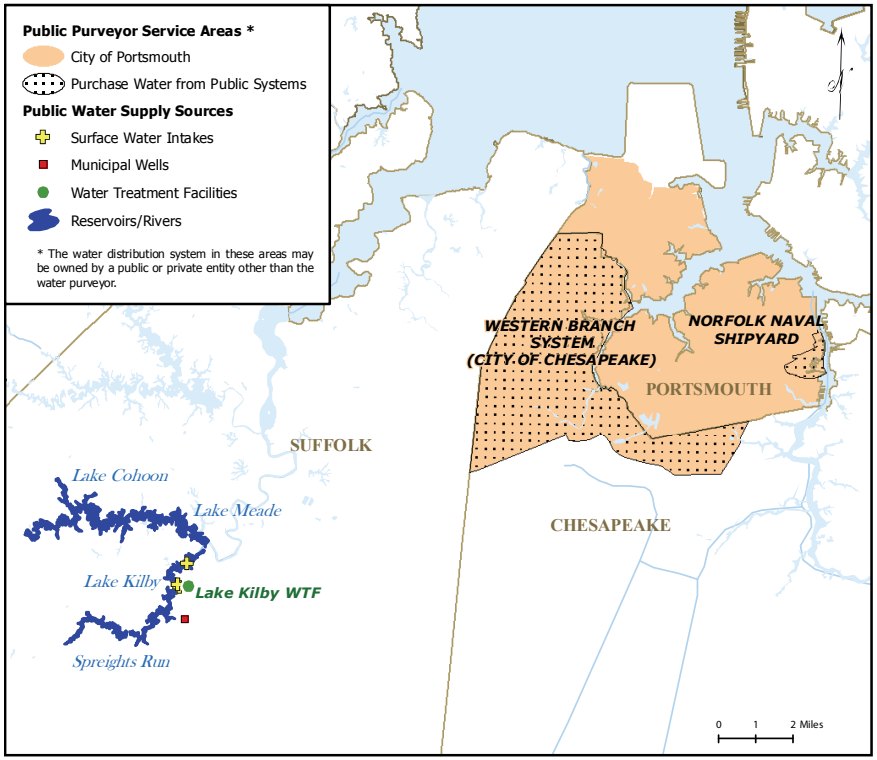


Table 1-12: 2007 City of Portsmouth – Contracts for Water Sales

Buyer	Finished Water (mgd)	Contract Period	Contract Terms
Chesapeake Western Branch System	3.0	1/1/1990 – 12/31/2026	2007 Minimum 3 mgd 2010 increase to 4 mgd 2020 increase to 5 mgd
City of Suffolk	2.54	8/27/1997 – 12/31/2040	2.54 mgd

The only other CWS in Portsmouth is the Norfolk Naval Shipyard. The system is served by the City of Portsmouth and does not have its own source water or treatment facility. The system has a typical commercial account with the City of Portsmouth and does not have a minimum or maximum contracted purchase. The population served by this system is included in Portsmouth's population served. No privately-owned CWSs operate in the City.

City of Portsmouth: Self-Supplied Water Systems

Non-Agricultural: The Elizabeth Manor Golf Course is the only non-agricultural user that reported withdrawing more than 300,000 gallons of surface water per month in 2007. The golf course withdraws from a pond and also holds a DEQ Ground Water Withdrawal Permit.

Six non-agricultural users reported withdrawing more than 300,000 gallons per month of groundwater in 2007. The surface water and groundwater users are all located within Portsmouth's public water system service area.

- **BASF:** The business is closed but is providing steam to neighboring business. Groundwater is withdrawn from 2 wells that are approximately 700 feet deep, corresponding to the Potomac aquifer.
- **Cintas Corporation:** Groundwater is used for washing textiles. The well is 700 feet deep, corresponding to the Potomac aquifer.
- **Cogentrix Virginia Leasing Corporation:** Water is used for boiler feed. Groundwater is withdrawn from 7 wells that are between 600 and 1300 feet deep, corresponding to the Potomac aquifer.
- **Elizabeth Manor Golf and Country Club:** Groundwater is used for irrigation. The 3 wells are between 40 and 45 feet deep, corresponding to the Yorktown-Eastover aquifer. Surface water from a pond is also used for irrigation.

Photo: Lake Meade, HRPDC

- **Tidewater Area Central Hospital Laundry:** Water is used for washing textiles. The well is 660 feet deep, corresponding to the Potomac aquifer.
- **Titan Virginia Ready-Mix:** Groundwater is used for concrete production. The well is 697 feet deep, corresponding to the Potomac aquifer.

Agricultural: No agricultural users reported withdrawing more than 300,000 gallons per month in 2007.

Map 1-16 and Table 1-13 summarize self-supplied CWS in Portsmouth.

Map 1-16: Self-Supplied Water Systems in Portsmouth

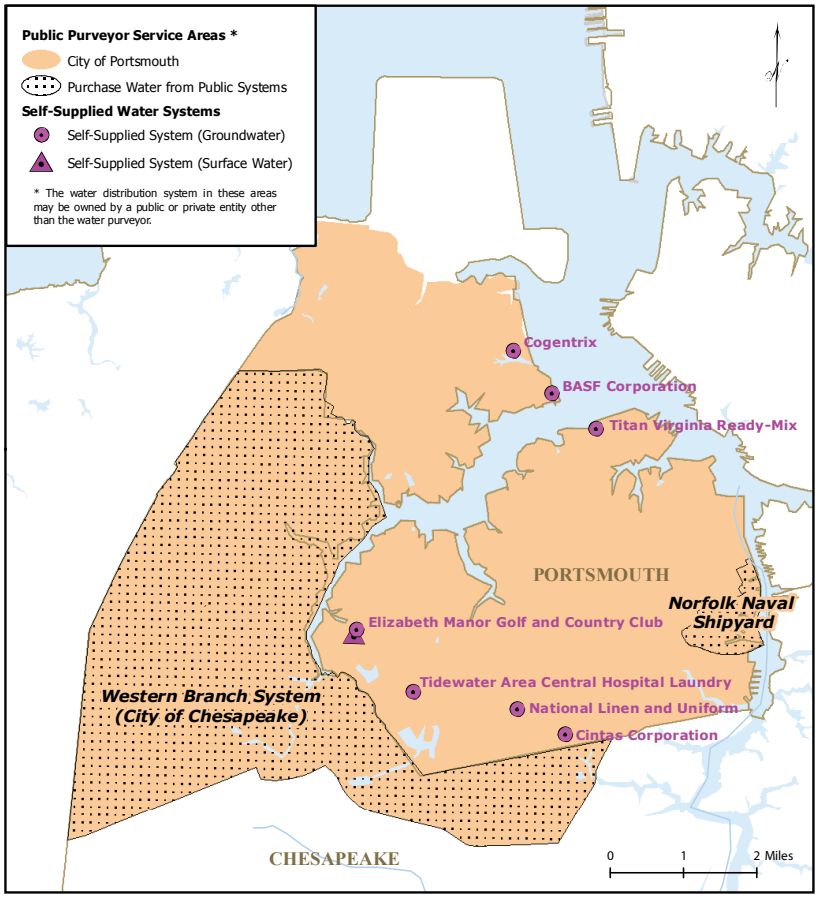


Table 1-13: 2007 Self-Supplied Use > 300,000 gallons/month in Portsmouth

Business	Source Water	Type of Use	Within PWS Service Area	Groundwater Withdrawal Permit (mgd)
BASF	Groundwater	Manufacturing	Yes	0.42
Cintas Corporation	Groundwater	Manufacturing	Yes	0.06
Congentrix Virginia Leasing Corporation	Groundwater	Fossil Power	Yes	2.6
Elizabeth Manor Golf Course	Groundwater & Ponds	Commercial	Yes	0.05
Tidewater Area Central Hospital Laundry Inc.	Groundwater	Commercial	Yes	0.12
Titan Virginia Ready-Mix, LLC	Groundwater	Manufacturing	Yes	0.01

City of Suffolk: Publicly-Owned Community Water System

The City of Suffolk operates three CWSs. The Main System has the largest service area. In 2007, the system provided water for 64,600 people. The Whaleyville System and Holland System are much smaller in comparison, and both serve about 500 people each. Suffolk's safe yield, or available water supply, is 9.68 mgd, which includes the Main, Whaleyville and Holland systems, but does not include the treated water purchased from Portsmouth. Table 1-14 summarizes the systems.

The HRPDC SWAP (August 2002) indicates that the Main System's surface water sources have a high susceptible to contamination. The VDH SWAP evaluation (February 15, 2006) indicates the wells have a low susceptibility to contamination. As of 2010, the Holland system is under a Fluoride Consent Order by VDH. The City has been working with VDH to address the fluoride levels.

In April 1998, the City of Suffolk and the County of Isle of Wight formed the Western Tidewater Water Authority (WTWA) for the purpose of "acquiring, financing, constructing, leasing, operating and maintaining facilities for the production, impoundment, treatment and transmission of water on a cooperative, regional basis" (Western Tidewater Regional Water Agreement, 2009).

The Authority's water supply, which is distributed through Suffolk's Main System, comes from multiple sources:

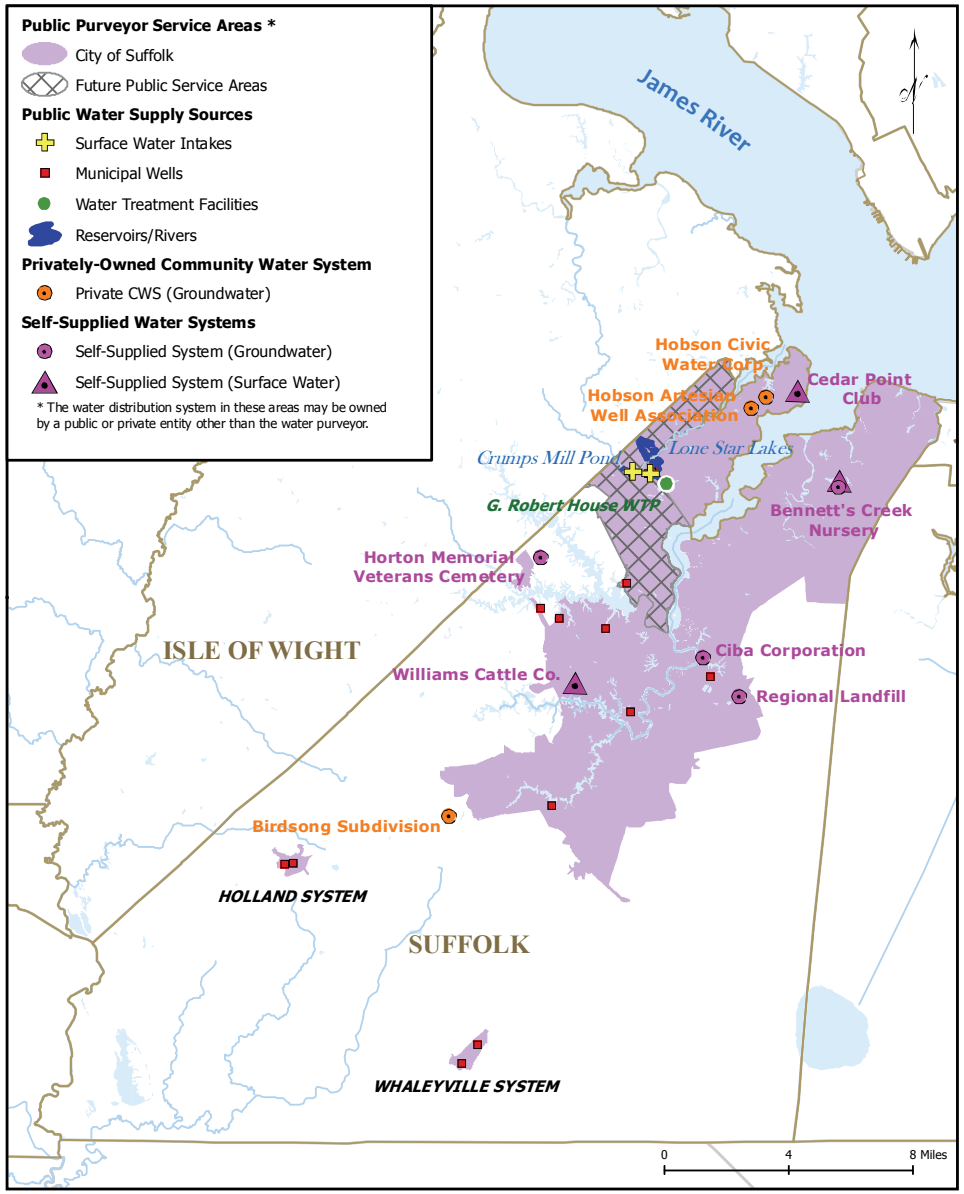
- Suffolk's contract with the City of Portsmouth for 2.54 mgd of treated water;
- Suffolk's 1.20 mgd safe yield of raw surface water from Lone Star Lakes and Crumps Mill Pond;
- Suffolk's 3 production wells and the Authority's production well that are all permitted under one DEQ Ground Water Withdrawal Permit for 8.30 mgd held by the WTWA; and
- WTWA's contract with Norfolk (begins 2014- 2048) for 3 mgd and increasing to 15 mgd over time.

The surface water and groundwater listed above is treated at the G. Robert House WTP. The finished water purchased from Portsmouth is connected to the distribution system at Portsmouth's Lake Kilby WTP, which is located in the City of Suffolk. The location of the reservoirs, wells and treatment plant are shown on Map 1-17. The WTWA reserves 25% of the available water supply for Isle of Wight County (3.01 mgd in 2007) and 75% for Suffolk (9.03 mgd in 2007).

Table 1-14: 2007 Suffolk Publicly-Owned Community Water System

System	Population Served	Source	Permit or Contract
Main	64,600	4 production wells	DEQ Ground Water Withdrawal Permit = 8.3 mgd
		Lone Star Reservoir	VDH permitted capacity/ safe yield = 1.2 mgd
		Crumps Mill Pond Reservoir	
		Finished water purchased from Portsmouth	2.54 mgd of treated water
		6 emergency wells	DEQ Ground Water Withdrawal Permit = 0.045 mgd
Holland	500	Groundwater	DEQ Ground Water Withdrawal Permit = 0.044 mgd
Whaleyville	500	Groundwater	DEQ Ground Water Withdrawal Permit = 0.097 mgd

Map 1-17: City of Suffolk Sources and Service Area, Privately-Owned Water Systems, and Self-Supplied Water Systems



Main System

The City of Suffolk's Main System is currently supplied by the sources listed above: four production wells that are permitted under one DEQ Ground Water Withdrawal Permit held by the WTWA; two reservoirs; and finished water purchased from the City of Portsmouth.

Suffolk owns Lone Star Lakes Reservoir and Crumps Mill Pond Reservoir, which are located in the northwest portion of the City. The two bodies of water have a combined drainage area of 7.75 square miles in the James River watershed and on-stream storage of 375 million gallons. The combined raw water safe yield of the two reservoirs is 1.2 mgd.

Photo: Lone Star Lakes, Suffolk Parks and Recreation

Four production wells supply the Main System: EDR, Reids Ferry, Crittenden, and Fluoride well. All the wells withdraw groundwater from the Potomac aquifer, which is the deepest aquifer. The total permitted withdrawal from the four wells is 8.3 mgd. The Main system is also has six emergency wells. The additional annual permitted withdrawal for the emergency wells is 0.045 mgd to allow the wells to be maintained.

The surface water and groundwater for Suffolk's Main System are treated at the G. Robert House WTP. Withdrawals from the EDR, Reids Ferry, and Crittenden wells are processed in treatment systems to reduce fluoride levels, then blended with withdrawals from the Fluoride well and Suffolk's treated surface water and finished water purchased from Portsmouth. The current capacity for Suffolk's Main System is 9.5 mgd. The combined capacity of Suffolk's Main System and the water purchased from Portsmouth is 12.04 mgd. Based on the WTWA agreement, Suffolk's portion of the available water supply is 9.03 mgd.

Holland System

The City of Suffolk's Holland System relies on groundwater. The system has a DEQ Ground Water Withdrawal Permit for 44,000 gallons per day (0.044 mgd), which is the system's available water supply. The two wells withdraw groundwater from the Potomac aquifer, which is the deepest aquifer. As of 2010, the Holland System was under a Fluoride Consent Order by VDH.

Whaleyville System

The City of Suffolk's Whaleyville System also relies on groundwater. The DEQ Ground Water Withdrawal Permit is for 97,000 gallons per day (0.097 mgd) from Robertson School Well #3 and Tower Well #4. Both wells withdraw groundwater from the Aquia aquifer. The VDH SWAP evaluations (February 15, 2006) indicates that the wells have a low susceptibility to contamination.

City of Suffolk: Privately-Owned Community Water Systems

Three privately-owned CWSs operate in Suffolk (see Table 1-15). The systems all use groundwater. The Hobson Village and Hobson Mt. Lebanon systems are located in the northern portion of Suffolk's Main System service area. Each of these systems has one deep well (over 500 feet below ground surface). The third privately-owned CWS, Birdsong (formerly Byrdtown), is located outside of the City of Suffolk's service area. It is a small system with one deep well. None of these privately-owned systems require a DEQ Ground Water Withdrawal Permit. The systems' available water supply is 41,600 gpd (0.042 mgd). In 2007, the systems each served between 70 and 100 people. As of 2010, the Hobson Village and Hobson Mt. Lebanon systems were under a VDH Fluoride Consent Order.

Table 1-15: Privately-owned CWS in Suffolk

System	VDH Permitted Capacity
Hobson Village	11,200 gpd
Hobson Mt. Lebanon	13,600 gpd
Birdsong	16,800 gpd

City of Suffolk: Self-Supplied Water Systems

In 2007, an estimated 20,164 people were served by private residential wells and 11 businesses were served approximately 1,600 people from their own source wells. All of the residences and four businesses are located outside a publicly-owned CWS service area.

Non-Agricultural: Cedar Point Golf Course was the only self-supplied, non-agricultural user in 2007 that reported withdrawing more than 300,000 gallons per month of surface water. Cedar Point Golf Course withdraws from a lake and does not hold a DEQ Virginia Water Protection Permit. The golf course is located within the City of Suffolk's CWS service area.

Three self-supplied, non-agricultural users reported withdrawing more than 300,000 gallons per day of groundwater in 2007. All the systems hold a DEQ Ground Water Withdrawal Permit. Two of the users are located within the City of Suffolk's CWS service area.

- **Albert G. Horton, Jr. Veterans Cemetery:** Groundwater is used for irrigation. The 3 wells are between 475 and 520 feet deep, corresponding to the Potomac aquifer.
- **Ciba Specialty Chemicals:** Groundwater is used in the industrial process. The well is 884 feet deep, corresponding to the Potomac aquifer.
- **SPSA Regional Landfill:** Groundwater is withdrawn to dewater under the landfill liner. Water must be pumped out from under the liner until there is enough weight on the liner to keep it from being pushed up by the groundwater. 4 wells are about 20 feet deep and 1 well is 650 feet deep. The deep well withdraws groundwater from the Potomac aquifer.

Agricultural: In 2007, 2 agricultural users reported withdrawing more than 300,000 gallons of water per month. Williams Cattle Company relies on farm ponds and Bennetts Creek Nursery has both ponds and wells. Table 1-16 summarizes the self-supplied use in Suffolk.

City of Virginia Beach: Publicly-Owned Community Water System

The City of Virginia Beach operates one CWS. In 2007, the system provided water to 403,000 people. The city does not own any water treatment facilities. Instead, the City of Norfolk treats and wheels all of Virginia Beach's source water in accordance with a cost of service contract between the two localities. There are no privately-owned CWSs in the City.

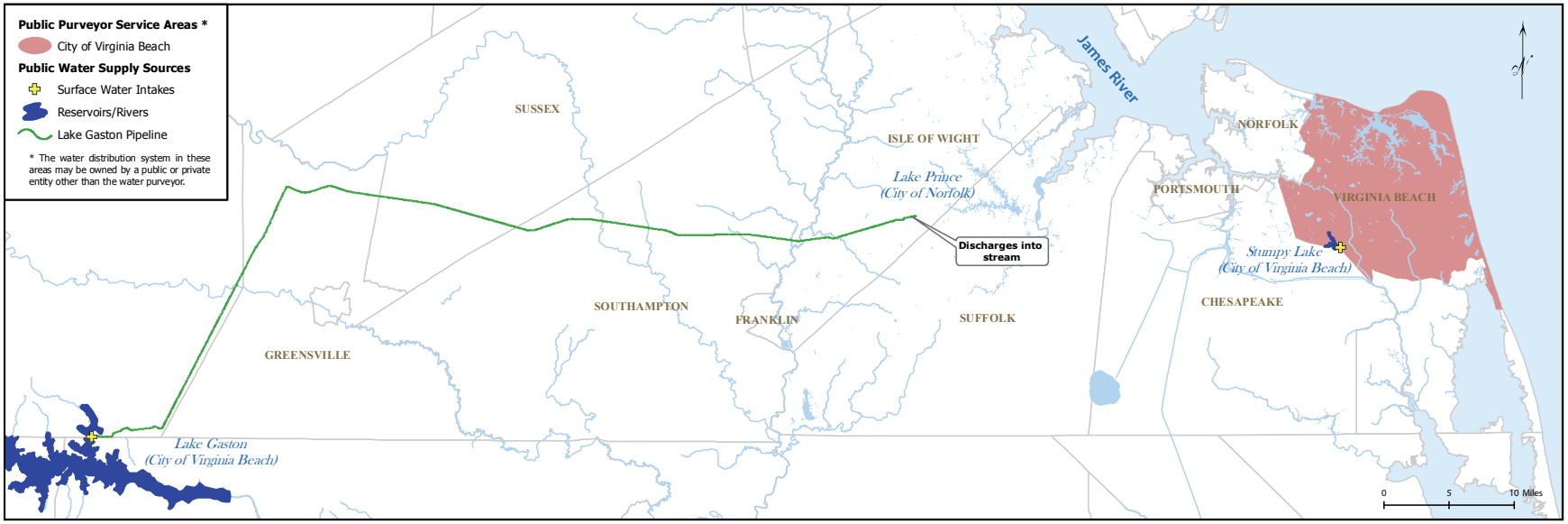
The City of Virginia Beach holds a permit from the U.S. Army Corps of Engineers to withdraw 60 mgd from Lake Gaston, located along the Virginia border with North Carolina (see Map 1-18). The Lake Gaston pipeline transports the water from Lake Gaston to Norfolk's Lake Prince, which is located in Isle of Wight County. The City of Chesapeake is a partner in the project and will receive 10 mgd of the 60 mgd in the future.

The HRPDC SWAP (August 2002) found that Lake Gaston and the City of Norfolk's reservoir systems have a high susceptibility to contamination. Norfolk's groundwater wells, which are pumped into Lake Prince, have a low susceptibility to contamination.

Virginia Beach also owns Stumpy Lake, located along the border with Virginia Beach and Chesapeake. The lake serves as an emergency water source. The City of Norfolk provides treatment if withdrawals from Stumpy Lake are needed. The total available raw water supply for Virginia Beach is 51.3 mgd.

There are four CWSs within Virginia Beach that serve military installations: Dam Neck, Little Creek Amphibious Base, NAS Oceana, and Fort Story. These systems do not have their own source water or treatment facilities; water service is contracted with the City of Norfolk. The Navy is not obligated to minimum or maximum contracted purchases.

Map 1-18: City of Virginia Beach Sources and Service Area



City of Virginia Beach: Self-Supplied Water Systems

In 2007, approximately 5,000 people were served by private residential wells and 42 businesses had their own water source. Twenty-four businesses were identified by VDH and do not use enough water to exceed the DEQ reporting threshold. Nearly all of the residential use is located outside a publicly-owned CWS service area. Approximately half of the businesses are located within a publicly-owned CWS service area.

Non-Agricultural: In 2007, 7 self-supplied, non-agricultural users reported withdrawing more than 300,000 gallons per month of surface water. All of the users are golf courses that are located within the City of Virginia Beach's CWS service area.

As for non-agricultural groundwater withdrawals, 9 self-supplied users reported withdrawing more than 300,000 gallons per month in 2007. These users all hold DEQ Ground Water Withdrawal Permits. All nine users are located within Virginia Beach's CWS service area. Seven of the nine users are golf courses, three of which also withdraw surface water. There are two commercial and manufacturing groundwater users:

- **Servitex Division of Alsco:** Groundwater is used for washing textiles. The company has three wells. The depth of only one well is known. It is 75 feet deep, corresponding to the Yorktown-Eastover aquifer.
- **Titan Ready Mix Oceana Plant:** Groundwater is used for concrete production. The one well is 142 feet deep, corresponding to the Yorktown-Eastover aquifer.

Map 1-19 shows the locations of self-supplied CWS in Virginia Beach and Table 1-17 contains the permitted amounts by user.

Agricultural: No agricultural users reported withdrawing more than 300,000 gallons per month of groundwater or surface water in 2007.

Map 1-19: Self-Supplied Water Systems in Virginia Beach

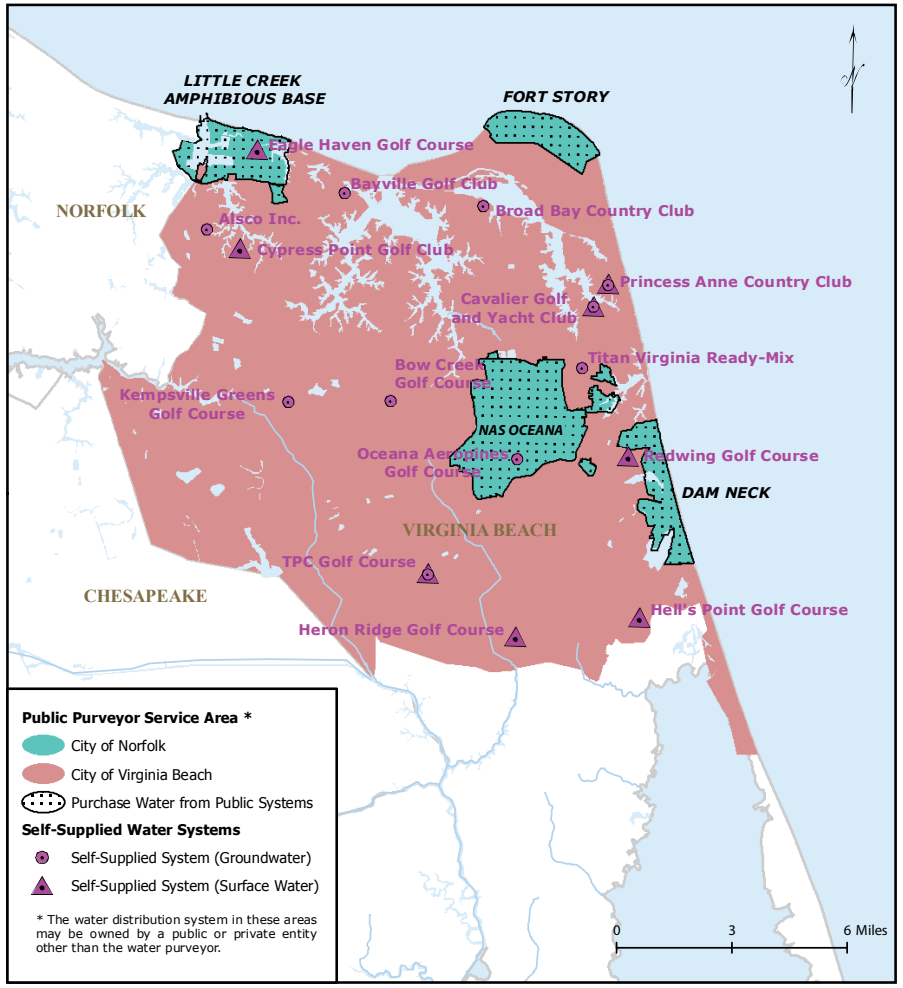


Table 1-17: 2007 Self-Supplied Use > 300,000 gallons/month in Virginia Beach

User	Source Water	Type of Use	Within PWS Service Area	Groundwater Withdrawal Permit (mgd)
Bayville Golf Club	Groundwater	Commercial	Yes	0.04
Bow Creek Golf Course	Groundwater	Commercial	Yes	Applied for permit
Broad Bay Country Club	Groundwater	Commercial	Yes	0.05
Cavalier Golf & Yacht Club	Lake & Groundwater	Commercial	Yes	0.06
Cypress Point Golf Course	Pond	Commercial	Yes	Not applicable
Hell's Point Golf Course	Lake	Commercial	Yes	Not applicable
Heron Ridge Golf Course	Lake	Commercial	Yes	Not applicable
Kempsville Greens Golf Course	Groundwater	Commercial	Yes	0.03
Oceana Golf Course	Groundwater	Commercial	Yes	0.30
Princess Anne Country Club	Pond & Groundwater	Commercial	Yes	0.07
Redwing Golf Course	Lake	Commercial	Yes	Not applicable
Servitex Division of Alsco	Groundwater	Commercial	Yes	0.05
Titan Ready Mix Oceana Plant	Groundwater	Manufacturing	Yes	0.01
TPC Golf Course	Lakes & Groundwater	Commercial	Yes	0.22

Existing Sources - Western Tidewater Sub-Region

The Western Tidewater sub-region includes the City of Franklin; Counties of Isle of Wight, Southampton, and Surry; and Towns of Boykins, Branchville, Capron, Claremont, Courtland, Dendron, Ivor, Newsoms, Smithfield, Surry, and Windsor. The largest population center is the City of Franklin. The sub-region is mostly rural with scattered, small population centers. The majority of the population is served by private residential wells.

In 2007, the USGS completed the report *Private Domestic-Well Characteristics and the Distribution of Domestic Withdrawals among Aquifers in the Virginia Coastal Plain* (Pope, McFarland, and Banks, 2008). This report examines groundwater use by private residential wells. The study estimates the number of wells and the number of people served in each locality. Aquifer depths are identified by locality and there are estimates of the number of wells that withdraw groundwater from each aquifer.

The sub-region is served by 24 CWSs. The systems served a total of 28,000 people in 2007. All but one of the systems relies on groundwater. The combined available water supply of the publicly-owned CWSs is 9.81 mgd. The available water supply is calculated by taking the sum of all the total permitted annual withdrawals set by DEQ Ground Water Withdrawal Permits, or if a system does not have a withdrawal permit, the permitted system capacity determined by VDH. The available surface water is determined by the terms of the contracts. For further discussion about the available water supply and demands, see "Section 4, Projected Water Demands" and "Section 6, Statement of Need."

Per the 1996 Safe Drinking Water Act Amendments, the VDH SWAP Program inventoried drinking water sources and nearby land uses that may impact water quality, including common activities related to residential, industrial, commercial, and agricultural land uses and waste management and transportation facilities. According to the VDH SWAP evaluations (February 15, 2006), 11 of the publicly-owned systems have a well or wells with a high susceptibility to contamination. In 2010, 4 publicly-owned CWSs were under a Fluoride Consent Order by VDH due to elevated levels of fluoride: Town of Smithfield, Carrsville, Smithfield Heights, and Gatling Pointe (which receives water from the Town of Smithfield). As of December 2010, the Carrsville and Smithfield Heights systems were no longer under the consent order. At low levels, fluoride can help prevent tooth decay, but children drinking water containing more than 2 milligrams per liter (mg/l) of fluoride may develop cosmetic discoloration of their permanent teeth (dental fluorosis). The four systems have been working with VDH to find alternatives to address the high fluoride levels.

In 2007, 40 privately-owned CWSs in the sub-region served a total population of 7,221 people. Most of these systems are located outside a publicly-owned CWS service area and serve less than 100 residences. The systems all rely on groundwater. The combined available water supply of the 40 privately-owned CWSs is 1.22 mgd. According to the VDH SWAP evaluations (February 15, 2006), 30 of the systems have a well or wells with a high susceptibility to contamination. As of 2010, 13 privately-owned CWSs were under a Fluoride Consent Order by VDH. Map 1-20 shows the location and service areas of CWSs in the sub-region.

Photo: Isle of Wight County Farm, HRPDC

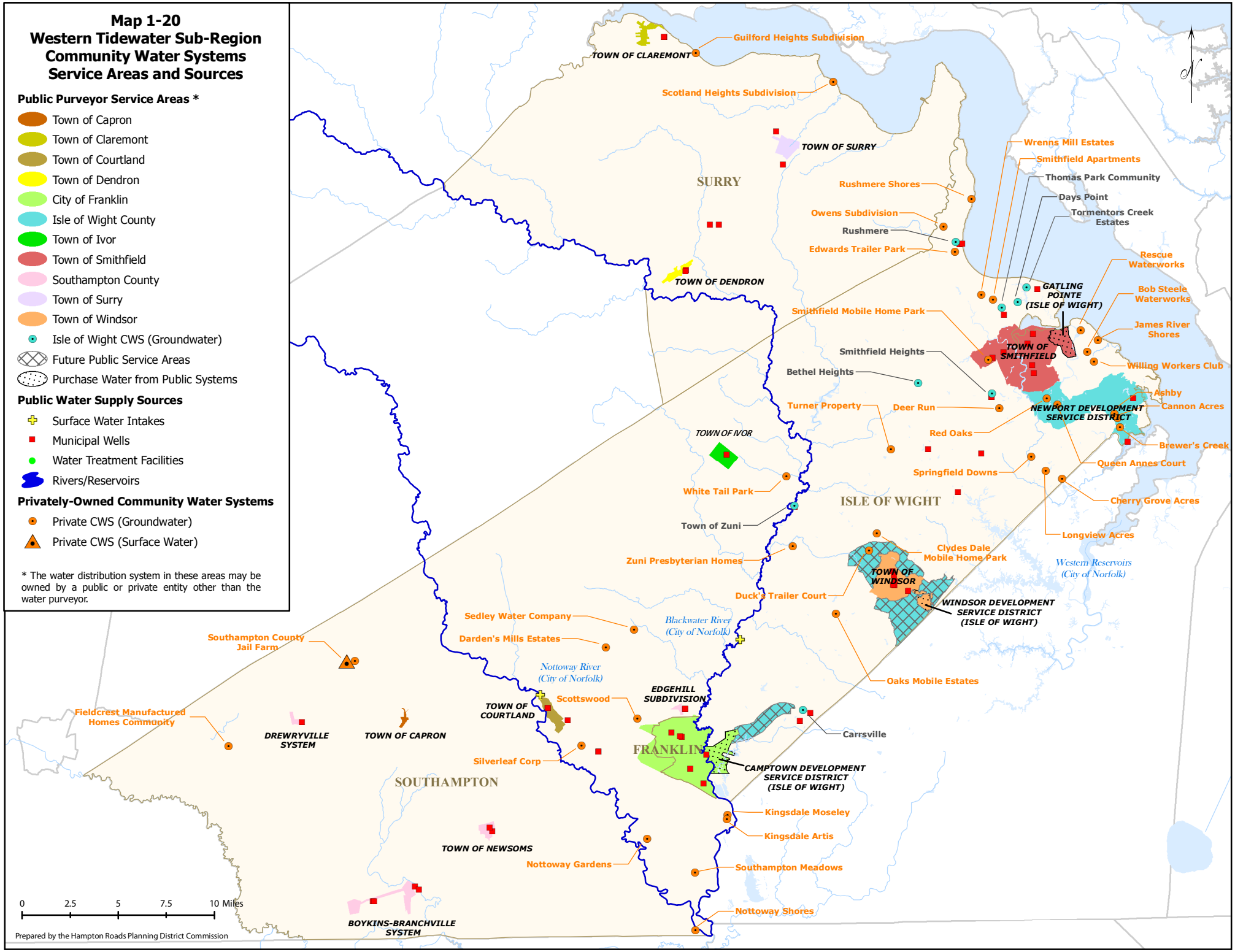
The Western Tidewater sub-region has many self-supplied water users. These users range from residences with private wells to commercial or agricultural operations with large monthly withdrawals from wells or ponds. Virginia Water Withdrawal Regulation (9 VAC 25-200-10, et seq.) requires reporting for any withdrawal whose daily average withdrawal exceeds 300,000 gallons per month (10,000 gpd), with the exception of crop irrigation. Reporting of crop irrigation applies to withdrawals exceeding one million gallons in any single month. The accuracy of withdrawal reporting to DEQ and VDH is not known, and therefore it cannot be assumed that water use included in this report is a complete account of all water use in the Western Tidewater Sub-Region.

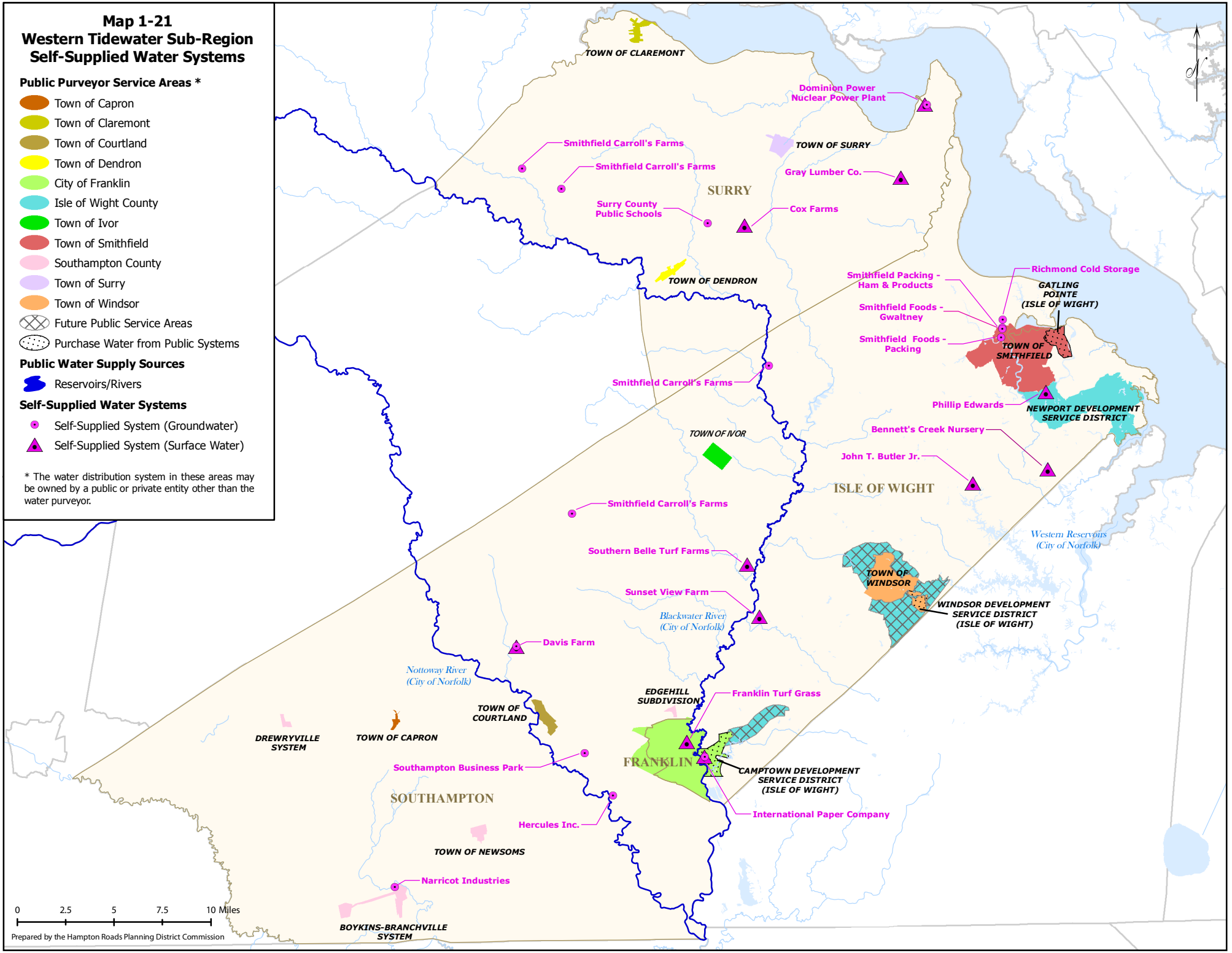
The regulatory threshold for applicability of the DEQ Ground Water Withdrawal Permit Program and Virginia Water Protection Permit Program for surface water withdrawals is also 300,000 gallons per month. Many of the surface water users in the Hampton Roads Region are exempt from the Virginia Water Protection Permit Program because withdrawals were established prior to 1989.

Map 1-21 shows the locations of the self-supplied users that withdraw more than 300,000 gallons per month.

2007 Western Tidewater Overview

- 24 publicly-owned CWS served 28,000 people.
- All but one of the publicly-owned CWS relies on groundwater.
- 11 publicly-owned CWS have wells with high susceptibility to contamination.
- 4 publicly-owned CWS were under Fluoride Consent Orders.
- 40 privately-owned CWS served 7,220 people.
- 13 privately-owned CWS were under Fluoride Consent Orders.
- 34,160 people were served by private residential wells.
- 58 businesses are self-supplied with wells or surface water sources.
- 2 self-supplied users reported withdrawing more than 300,000 gallons per month of surface water for non-agricultural use.
- 10 self-supplied users reported withdrawing more than 300,000 gallons per month of groundwater for non-agricultural use.
- 13 self-supplied users reported withdrawals of more than 300,000 gallons per month of groundwater and/or surface water for agricultural use.


Map 1-20
Western Tidewater Sub-Region
Community Water Systems
Service Areas and Sources
Public Purveyor Service Areas *
Town of Capron
Town of Claremont
Town of Courtland
Town of Dendron
City of Franklin
Isle of Wight County
Town of Ivor
Town of Smithfield
Southampton County
Town of Surry
Town of Windsor
Isle of Wight CWS (Groundwater)
Future Public Service Areas
Purchase Water from Public Systems
Public Water Supply Sources
Surface Water Intakes
Municipal Wells
Water Treatment Facilities
Rivers/Reservoirs
Privately-Owned Community Water Systems
Private CWS (Groundwater)
Private CWS (Surface Water)
* The water distribution system in these areas may be owned by a public or private entity other than the water purveyor.
Guilford Heights Subdivision
TOWN OF CLAREMONT
Scotland Heights Subdivision
TOWN OF SURRY
SURRY
Rushmere Shores
Owens Subdivision
Rushmere
Edwards Trailer Park
TOWN OF DENDRON
Wrenns Mill Estates
Smithfield Apartments
Thomas Park Community
Days Point
Tormentors Creek Estates
Rescue Waterworks
GATLING POINTE (ISLE OF WIGHT)
Bob Steele Waterworks
James River Shores
Smithfield Mobile Home Park
TOWN OF SMITHFIELD
Smithfield Heights
Bethel Heights
Willing Workers Club
Ashby
Cannon Acres
Turner Property
Deer Run
NEWPORT DEVELOPMENT SERVICE DISTRICT
TOWN OF IVOR
Red Oaks
Brewer's Creek
Queen Annes Court
Springfield Downs
White Tail Park
ISLE OF WIGHT
Cherry Grove Acres
Town of Zuni
Longview Acres
Clydes Dale Mobile Home Park
Zuni Presbyterian Homes
Western Reservoirs (City of Norfolk)
TOWN OF WINDSOR
Duck's Trailer Court
WINDSOR DEVELOPMENT SERVICE DISTRICT (ISLE OF WIGHT)
Sedley Water Company
Blackwater River (City of Norfolk)
Southampton County Jail Farm
Darden's Mills Estates
Oaks Mobile Estates
Nottoway River (City of Norfolk)
EDGEHILL SUBDIVISION
Scottswood
TOWN OF COURTLAND
Fieldcrest Manufactured Homes Community
DREWRYVILLE SYSTEM
TOWN OF CAPRON
Carrsville
FRANKLIN
Silverleaf Corp
CAMPTOWN DEVELOPMENT SERVICE DISTRICT (ISLE OF WIGHT)
SOUTHAMPTON
Kingsdale Moseley
Kingsdale Artis
TOWN OF NEWSOMS
Nottoway Gardens
Southampton Meadows
Nottoway Shores
BOYKINS-BRANCHVILLE SYSTEM
0
2.5
5
7.5
10 Miles
Prepared by the Hampton Roads Planning District Commission


Map 1-21
Western Tidewater Sub-Region
Self-Supplied Water Systems
Public Purveyor Service Areas *
Town of Capron
Town of Claremont
Town of Courtland
Town of Dendron
City of Franklin
Isle of Wight County
Town of Ivor
Town of Smithfield
Southampton County
Town of Surry
Town of Windsor
Future Public Service Areas
Purchase Water from Public Systems
Public Water Supply Sources
Reservoirs/Rivers
Self-Supplied Water Systems
Self-Supplied System (Groundwater)
Self-Supplied System (Surface Water)
* The water distribution system in these areas may be owned by a public or private entity other than the water purveyor.
TOWN OF CLAREMONT
Dominion Power Nuclear Power Plant
TOWN OF SURRY
Smithfield Carroll's Farms
Smithfield Carroll's Farms
Gray Lumber Co.
SURRY
Surry County Public Schools
Cox Farms
TOWN OF DENDRON
Smithfield Packing - Ham & Products
Richmond Cold Storage
GATLING POINTE (ISLE OF WIGHT)
Smithfield Foods - Gwaltney
Smithfield Foods - Packing
TOWN OF SMITHFIELD
Smithfield Carroll's Farms
Phillip Edwards
NEWPORT DEVELOPMENT SERVICE DISTRICT
TOWN OF IVOR
Bennett's Creek Nursery
John T. Butler Jr.
ISLE OF WIGHT
Smithfield Carroll's Farms
Western Reservoirs (City of Norfolk)
Southern Belle Turf Farms
TOWN OF WINDSOR
Sunset View Farm
WINDSOR DEVELOPMENT SERVICE DISTRICT (ISLE OF WIGHT)
Blackwater River (City of Norfolk)
Davis Farm
Nottoway River (City of Norfolk)
EDGEHILL SUBDIVISION
Franklin Turf Grass
TOWN OF COURTLAND
DREWRYVILLE SYSTEM
TOWN OF CAPRON
FRANKLIN
CAMPTOWN DEVELOPMENT SERVICE DISTRICT (ISLE OF WIGHT)
Southampton Business Park
SOUTHAMPTON
International Paper Company
Hercules Inc.
TOWN OF NEWSOMS
Narricot Industries
BOYKINS-BRANCHVILLE SYSTEM
0 2.5 5 7.5 10 Miles
Prepared by the Hampton Roads Planning District Commission

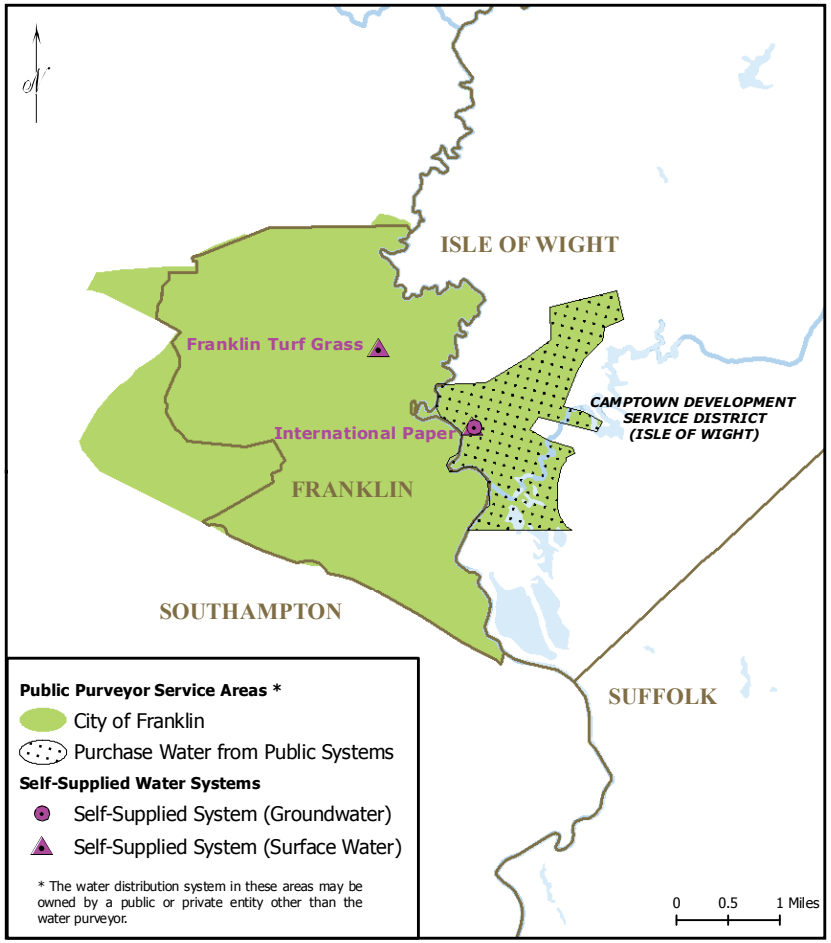
City of Franklin

The City of Franklin operates one publicly-owned CWS that served 9,000 people in 2007 (see Map 1-22). The population served includes the City's total population, two neighborhoods in Southampton County, and Isle of Wight County's Camptown Development Service District. The City of Franklin has an agreement with Isle of Wight County to supply the Camptown Development Service District with 0.20 mgd of treated water. The contract was signed in 1998 and has a one year automatic renewal until Isle of Wight County or the City of Franklin gives notice of termination.

Franklin's four wells are permitted under one DEQ Ground Water Withdrawal Permit for 2.88 mgd, which equals the City's available water supply. All 4 wells are over 400 feet deep and withdraw from the Potomac aquifer. The VDH SWAP evaluations (February 15, 2006) indicate that all the wells have a low susceptibility to contamination. There are no privately-owned CWSs or private residential wells in the City of Franklin.

Franklin Turfgrass Inc, a sod turf farm, is the only large self-supplied user in the City of Franklin. The farm withdraws approximately 0.6 mgd of water annually from the Blackwater River and the Nottoway River for irrigation. The International Paper mill and Hercules Incorporated are located in Franklin's service area but outside the city limits. Both facilities have very large groundwater withdrawals.

Map 1-22: City Of Franklin Service Area and Self-Supplied Water Systems



Isle of Wight County: Publicly-Owned Community Water Systems

In 2007, Isle of Wight County operated 12 water systems, 11 of which are publicly-owned CWSs that served a total population of 4,625 people. The remaining system provides water to an industrial park and does not supply any residences; therefore, it is not considered a CWS. The County systems are geographically separate and none of the distribution systems are connected. The VDH SWAP evaluations (February 15, 2006) indicate that six of the publicly-owned CWSs have a well or wells that are highly susceptible to contamination. The Gatling Pointe system, which receives water from Smithfield, is under a Fluoride Consent Order from VDH.

The 2007 available water supply for Isle of Wight County's 11 publicly-owned CWSs was approximately 3.40 mgd plus the water available to the Gatling Pointe subdivision, which is limited by the amount of water available from Smithfield and not by a DEQ Ground Water Withdrawal Permit or contract agreement.

The County has established three development service districts (DSD): Camptown DSD, Windsor DSD, and the Newport DSD (see Map 1-23). The County's long range land use plan is for the three designated Districts to host the majority of new residential, commercial and industrial growth. All three of the Districts purchase water from outside the County through water agreements (see Table 1-18).

The Camptown DSD is located along the eastern border of the City of Franklin. The County has an agreement with the City of Franklin to purchase up to 225,565 gallons per day (0.23 mgd) of treated water for the Camptown DSD. The contract between the City of Franklin and Isle of Wight County is a three year contract that started in 1998 and is automatically renewed each year until one of the parties gives notice of termination. The County has a plan to build a reverse osmosis WTP to serve the Camptown DSD. The county acquired a DEQ Ground Water Withdrawal Permit in 2002 for 0.98 mgd which would be treated at the proposed reverse osmosis plant.

Map 1-23: Isle of Wight County Development Service Districts

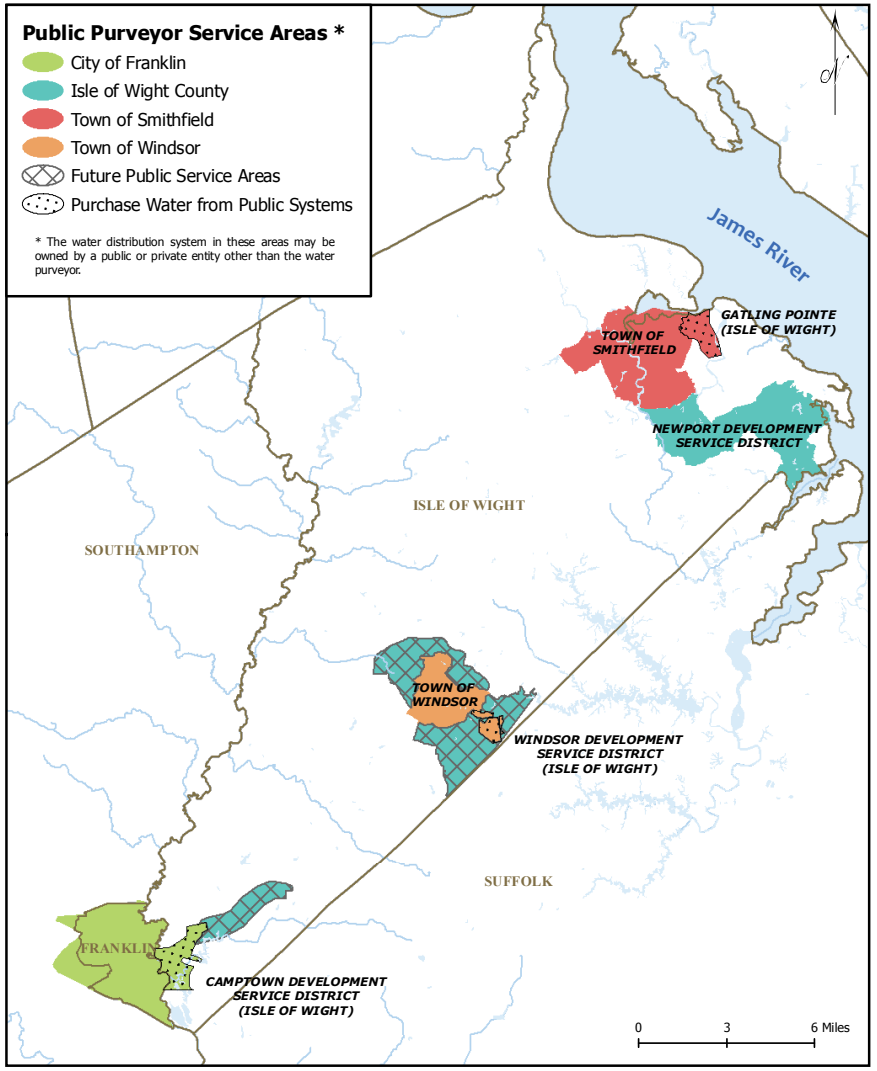


Table 1-18: 2007 Isle of Wight County Water Agreements*

Seller/ Source	Purchaser	System	Contract or Agreement Terms	Raw or Treated Water
Windsor	Isle of Wight County	Windsor DSD	0.204 mgd	Treated
Franklin	Isle of Wight County	Camptown DSD	0.20 mgd	Treated
Suffolk Portsmouth	Western Tidewater Water Authority*	Newport DSD	3.01 mgd maximum reserved for Isle of Wight County (on-going contract)	Treated
Smithfield	Gatling Pointe Subdivision	Gatling Pointe Subdivision	Residents billed by Isle of Wight County	Treated
Western Tidewater Authority	Isle of Wight County	Suffolk Main System	6.76 mgd	Finished

* Western Tidewater Water Authority has a contract with the City of Norfolk to purchase 3 mgd starting in 2014. The amount increases 1 mgd every other year until the contract ends in 2048. Max purchase is 15 mgd, split between Isle of Wight and Suffolk.

DSD = Development Service District

However, the county has not obtained approval to discharge the reverse osmosis concentrate to the City of Franklin's wastewater treatment plant. As of July 2010, the County has not withdrawn any groundwater under the Camptown permit.

The Windsor DSD is located around the Town of Windsor. The DSD water system is currently not a CWS because it only serves the industrial park. The population residing within the DSD area is either served by the Town of Windsor or private residential wells. In 1996, the County signed an agreement with the Town of Windsor to provide water for the Windsor DSD. In 2004, the agreement was amended such that the Town provides 224,400 gallons per day (0.224 mgd) of treated water. Until the DSD service area is expanded, the purchased water only serves the industrial park. The contract between the Town of Windsor and Isle of Wight County does not have an expiration date. The County plans to terminate the contract with the Town of Windsor and connect the Windsor DSD to Suffolk's Main System. This would allow the County to save money by using more of the water it paid to reserve in the Western Tidewater Water Authority agreement. There is also some uncertainty about whether the Town of Windsor would have enough water to serve the Windsor DSD if the town's industrial parks continue to build out.

The Newport DSD is located along the southeast border of the Town of Smithfield, and receives 1.0 mgd of treated water from the City of Suffolk WTP. Isle of Wight County has an agreement with the City of Suffolk through the Western Tidewater Water Authority (WTWA) which ensures that the Newport DSD will have adequate water supplies through 2048.

In April 1998, the WTWA was formed between the City of Suffolk and Isle of Wight County for the purpose of "acquiring, financing, constructing, leasing, operating and maintaining facilities for the production, impoundment, treatment and transmission of water on a cooperative, regional basis" (see Attachment 1). WTWA's supply is comprised of four wells, a contract between the City of Suffolk and the City of Portsmouth for 2.54 mgd of treated water, and 1.20 mgd of raw surface water from the City of Suffolk reservoirs. WTWA holds a DEQ Ground Water Withdrawal Permit for 8.30 mgd, which includes three of Suffolk's production wells and one WTWA well. The surface water and groundwater for Suffolk's Main System is treated at the G. Robert House WTP. The finished water purchased from Portsmouth enters the distribution system at Portsmouth's Lake Kilby WTP, which is located in the City of Suffolk.

The WTWA reserves 25% of the current safe yield for Isle of Wight County (3.01 mgd) and 75% for Suffolk (9.03 mgd). In 2007, Isle of Wight County used approximately 0.3 mgd. WTWA signed a contract to purchase additional water from the City of Norfolk in

2009. See "Existing Sources – Southside Sub-Region, City of Suffolk: Publicly-Owned Community Water Systems" for more information.

In 2007, Isle of Wight County owned 11 CWSs. The Newport and Camptown DSDs were discussed previously. The remaining nine systems are relatively small water systems (see Map 1-24 and Table 1-19). In late 2010, the County purchased the infrastructure for the Queen Anne's Court system (shown on Map 1-24 as a private CWS) and connected the system to the WTWA source.

The Gatling Pointe subdivision is the only system that purchases water from the Town of Smithfield instead of pumping water from neighborhood wells. The Gatling Pointe system is under a Fluoride Consent Order from VDH. Water use in Gatling Pointe is metered by Smithfield and the residents are billed by Isle of Wight County. The subdivision is connected to Smithfield's water distribution system. New infrastructure would have to be built for the County to provide water service to Gatling Pointe.

Each of the other eight publicly-owned systems serves a neighborhood or a few subdivisions that are clustered together. Each system has one to three wells. The wells and distribution systems are not connected to each other. The smallest system, Bethel Heights, served 23 people in 2007. The largest system, Smithfield Heights, served 572 people that year. Most of the wells are over 400 feet deep and withdraw groundwater from the Potomac aquifer. In 2007, two systems held DEQ Ground Water Withdrawal Permits. The most significant water quality issue for these systems is the natural occurrence of high concentrations of fluoride.

Map 1-24: Isle of Wight County Community Water Systems

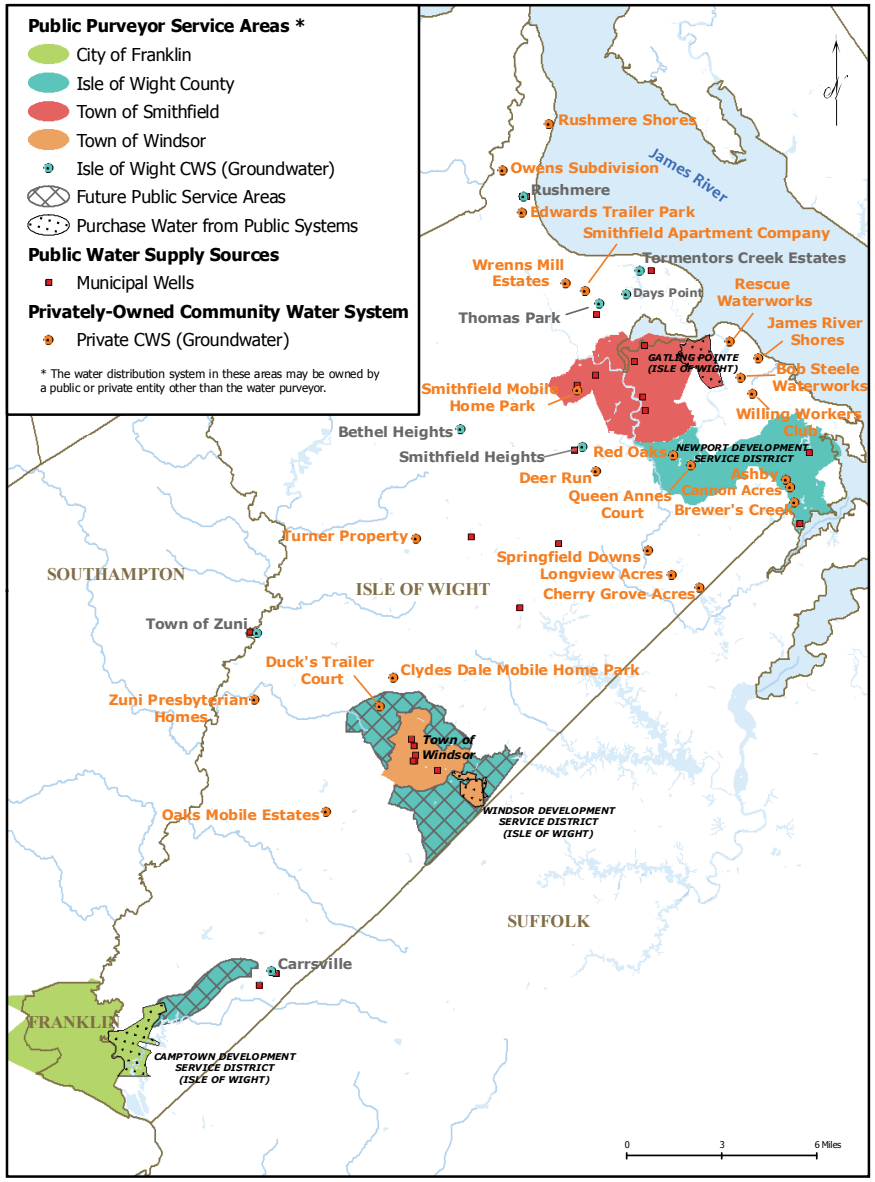


Table 1-19: 2007 Isle of Wight County Publicly-Owned Water Systems

System	Population Served	Well Depth	Groundwater Withdrawal Permit* (mgd)	VDH System Capacity (mgd)	VDH SWAP Evaluated Susceptibility to Contamination
Camptown DSD CWS	900	NA	Held by City of Franklin	NA	NA
Newport DSD CWS	1,284	NA	Held by WTWA	NA	NA
Windsor DSD	No residential use	NA	Held by Town of Windsor	NA	NA
Bethel Heights CWS	23	450	No	0.01	Low
Carrsville CWS	500	2 wells 240 (ft) & NI	0.02*	0.05	High
Days Pointe Subdivision CWS	268	446 (ft)	0.02*	0.03	High
Gatling Pointe Subdivision CWS	480	NA	Held by Town of Smithfield	NA	Smithfield under Fluoride Consent Order
Rushmere – Burwell's Bay CWS	276	3 wells – 440 (ft)	0.04	0.04	Low - 2 wells NI - 1 well
Smithfield Heights – Sandy Mount Manor CWS	572	3 wells 400 – 495 (ft)	0.03**	0.07	High - 2 wells NI - 1 well
Thomas Park CWS	150	490 (ft)	No	0.02	Low
Tormentor Creek Estates CWS	72	460 (ft)	No	0.01	High
Zuni CWS	100	NI	NA	0.01	High

Note: In late 2010, Isle of Wight County purchased the Queen Anne's Court CWS (formerly a private system) and connected the system to the WTWA source.
* Total Permitted Annual Amount
** Permits were issued in 2008.
NA = not applicable
NI = no information
mgd = million gallons per day

Isle of Wight County: Privately-Owned Community Water Systems

There are 25 privately-owned CWSs operating within Isle of Wight County (see Table 1-20). The systems served approximately 4,275 people in 2007. Only six of the systems are located within a publicly-owned CWS service area. Map 1-24 shows the five private CWS located within the Newport DSD service area: Red Oaks Mobile Home Community, Ashby Subdivision, Cannon Acres, Brewer's Creek Subdivision, and Queen Anne's Court. The sixth system is located in the Town of Smithfield. In 2010, the Queen Anne's Court system was acquired by Isle of Wight County.

The Ducks Trailer Court system is located within the Windsor DSD's future service area. The remaining 18 privately-owned CWSs serve populations located in Isle of Wight County's rural areas.

All of the privately-owned systems rely on groundwater. Four of the systems hold DEQ Ground Water Withdrawal Permits to withdraw more than 300,000 gallons per month. The SWAP evaluations (February 15, 2006) indicate that 21 of the systems have a well or wells with a high susceptibility to contamination; 13 of the systems are under a Fluoride Consent Order from VDH (see Table 1-20).

Lawne's Point is a privately owned subdivision under construction as of 2010. The subdivision has the capacity to include 155 homes. In 2007, four homes were served by one well. Because of the small number of customers, Lawne's Point was not permitted by VDH as a publicly-owned CWS in 2007. It is expected that by 2020 the system will be permitted to serve as a publicly-owned CWS. In 2010 Lawne's Point applied for a DEQ Ground Water Withdrawal Permit for an average of 44,932 gallons per day (0.045 mgd).

The available water supply from privately-owned CWSs in Isle of Wight County is approximately 0.52 mgd. The estimate does not include the available capacity of three systems for which the VDH permitted capacity is not known. The available water supply is the sum of the DEQ Ground Water Withdrawal Permit limits, or if under DEQ's permit threshold, the VDH permitted system capacity.

Photo: Lawne's Point, www.loopnet.com

Table 1-20: 2007 Privately-Owned Community Water Systems in Isle of Wight County

System	Population Served	Well Depth	Groundwater Withdrawal Permit (mgd)	VDH Permitted Capacity (mgd)	VDH SWAP Evaluated Susceptibility to Contamination
Ashby Subdivision	470	3 wells 483 – 830 (ft)	0.06	0.04	Low
Bob Steele Waterworks	62	450 (ft)	No	0.007	High, Fluoride Consent Order
Brewer's Creek	125	2 wells 923 – 430 (ft)	0.03	0.03	High
Cannon's Acres	52	500 (ft)	No	0.021	High, Fluoride Consent Order
Cherry Grove Acres	108	589 (ft)	No	0.02	High, Fluoride Consent Order
Clydes Dale Mobile Home Park	600	2 wells 400 (ft)	0.04	0.04	High
Deer Run	104	440 (ft)	No	0.02	High, Fluoride Consent Order
Duck's Trailer Court	83	440 (ft)	No	NI	High
Edwards Trailer Park	140	NI	No	NI	High
James River Shores	132	450 (ft)	No	0.012	High, Fluoride Consent Order
Lawne's Point[1]	10	NI	No	NA	NI
Longview Acres	120	420 (ft)	No	0.02	High Fluoride Consent Order
Oaks Mobile Estates Trailer Court	150	550 (ft)	No	NI	High
Owen's Subdivision	116	465 (ft)	No	0.02	Low
Queen Anne's Court[2]	125	2 wells 420-470 (ft)	No	0.03	High, Fluoride Consent Order
Red Oaks Mobile	386	NI	No	0.05	High for all
Rescue Waterworks	203	2 wells 515 (ft) & NI	0.01	0.03	High, Fluoride Consent Order
Rushmere Shores	276	2 wells 410-440 (ft)	No	0.02	High for all
Smithfield Apartment Company	138	412 (ft)	No	0.014	High, Fluoride Consent Order
Smithfield Mobile Home Park	107	450 (ft)	No	0.014	High, Fluoride Consent Order
Springfield Downs Subdivision	120	450 (ft)	No	0.02	High, Fluoride Consent Order
Turner Property	60	440 (ft)	No	0.01	High
Willing Workers Club	29	NI - 1 well (ft)	No	0.01	High, Fluoride Consent Order
Wrenn's Mill Estates	372	2 wells 406-440 (ft)	No	0.08	Low
Zuni Presbyterian	70	NI	No	0.01	Low

1. System was not a community water system in 2007 but is expected to be permitted as a CWS in the next ten years.
2. System was purchased by Isle of Wight County in late 2010 and connected to the WTWA source.

NA = Not applicable | NI = No information | GWWP = Groundwater Withdrawal Permit (annual amount) | mgd = million gallons per day

Isle of Wight County: Self-Supplied Water Systems

In 2007, an estimated 16,420 people, which does not include the Towns of Windsor and Smithfield, were served by private residential wells. In Isle of Wight County, domestic wells withdraw groundwater from the following aquifers: water table (6%), Yorktown-Eastover (20%), Aquia (7%), and Potomac (66%) (Pope, 2007). Of the 15 businesses with their own wells, 9 businesses were identified by VDH and do not use enough water to exceed the DEQ reporting threshold. Six of the businesses are located within a publicly-owned CWS service area. Map 1-25 shows the location of self-supplied water systems in the County.

Non-Agricultural: The International Paper Franklin Mill Plant is the only self-supplied, non-agricultural surface water user that reported withdrawing more than 300,000 gallons per month in 2007 (see Table 1-21). The 2007 estimated annual withdrawal by the mill from the Blackwater River for paper processing is 4.2 mgd. The withdrawal is exempt from the DEQ Virginia Water Protection Permit Program. The plant closed in June 2010.

Two self-supplied non-agricultural users reported withdrawing more than 300,000 gallons per month of groundwater in 2007: International Paper Franklin Mill Plant and Richmond Cold Storage Incorporated. All of the businesses hold DEQ Ground Water Withdrawal Permits and withdraw groundwater from the Potomac aquifer. The following list describes each user. Table 1-21 provides additional information.

- **International Paper:** Formerly withdrew groundwater and surface water for paper processing (plant closed in June 2010). The system's 16 wells are between 515 and 910 feet deep.
- **Richmond Cold Storage:** Withdraws groundwater for evaporative cooling, fire protection, and public water supply. The system's well is 500 feet deep.

Map 1-25: Self-Supplied Water Systems in Isle of Wight County

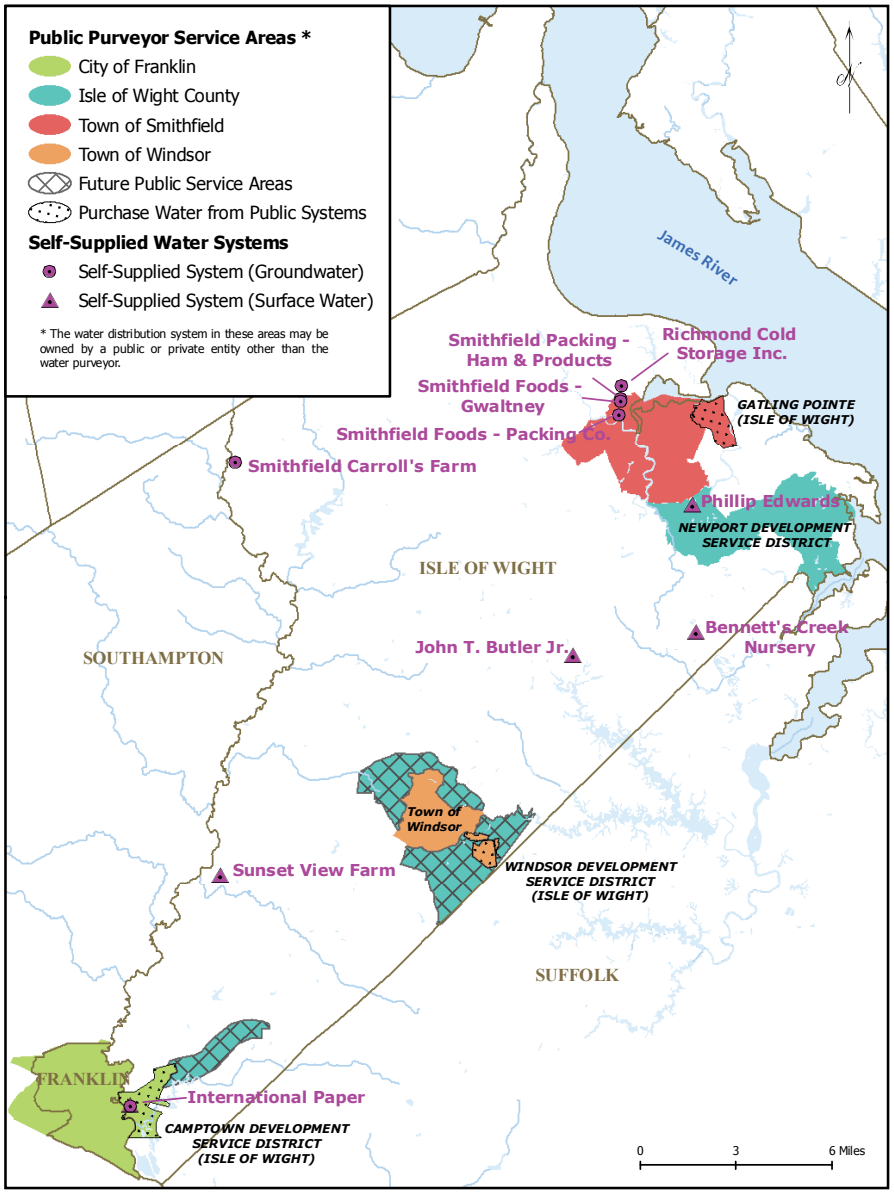


Table 1-21: 2007 Non-Agricultural Self-Supplied Use > 300,000 gallons/month in Isle of Wight County

Business	Source Water	CWS Service Area	# of Wells	GWWP (mgd)
International Paper Franklin Mill Plant	Blackwater River	Camptown DSD	NA	NA
International Paper Franklin Mill Plant	Groundwater	Camptown DSD	16	36.68
Richmond Cold Storage Incorporated	Groundwater	No	1	0.03

NA = Not applicable
GWWP = Groundwater Withdrawal Permit (annual amount)
mgd = million gallons per day

Table 1-22: 2007 Agricultural Self-Supplied Use > 300,000 gallons/month in Isle of Wight County

Business	Source Water	Within CWS Service Area
Bennett's Creek Wholesale Nursery	Pond	No
Murphy Brown LLC – Smithfield Carroll's Farms 1-5	Groundwater	No
John T Butler, Jr	Pond	No
Philip Edwards	Pond	Newport DSD
Sunset View Farm	Blackwater River	No
Southern Belle Turf	Blackwater River	No

Agricultural: Six self-supplied agricultural users reported withdrawing more than 300,000 gallons per month of surface water in 2007 (see Table 1-22). Many of the surface water users withdraw from private farm ponds while two users withdraw from the Blackwater River. Isle of Wight Farms is the only groundwater user that reported exceeding the threshold. The farm holds a DEQ Ground Water Withdrawal Permit to withdraw a total of 0.15 mgd from 10 wells.

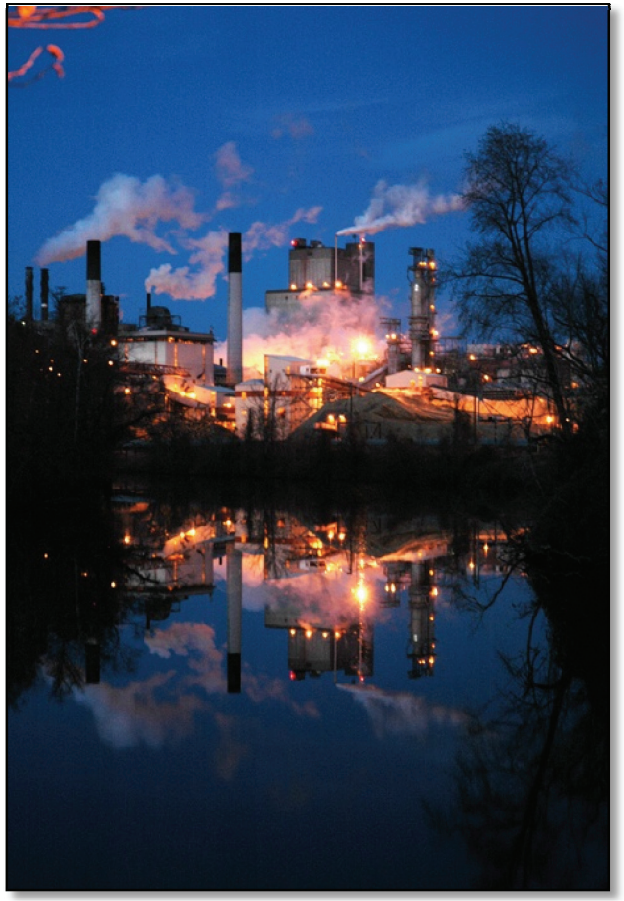
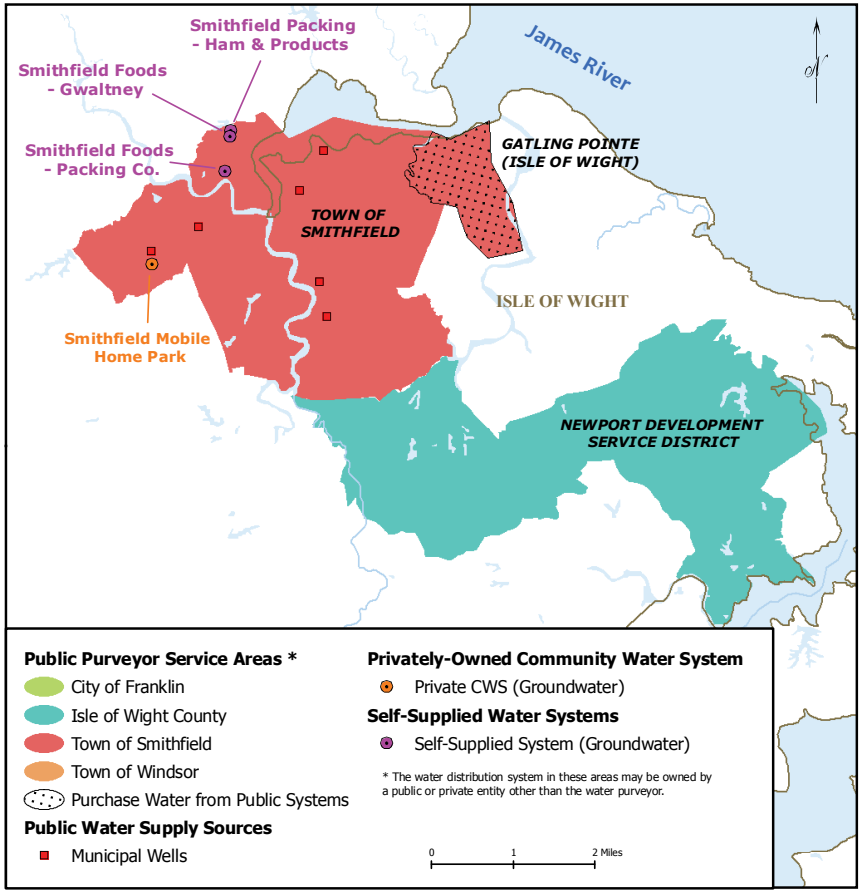


Photo: International Paper Franklin Mill Plant, HRPDC

Town of Smithfield: Publicly-Owned Community Water System

The Town of Smithfield operates one publicly-owned CWS that served approximately 7,200 people in 2007 (see Map 1-26), which includes the population served in the Gatling Pointe CWS. Gatling Pointe is located in Isle of Wight County, not the Town of Smithfield.

Map 1-26: Town of Smithfield Publicly-Owned Community Water System Service Area and Self-Supplied Water Systems



The town's seven permitted wells are between 400 and 1010 feet deep and withdraw from the Potomac Aquifer. The VDH SWAP evaluations (February 15, 2006) indicate that five of the town's wells are highly susceptible to contamination (see page 1-43 for discussion of VDH SWAP program). All wells are permitted under one DEQ Ground Water Withdrawal Permit for 1.40 mgd, which is the Town's available water supply. The Town also has an observation well in addition to the permitted production wells.

The Town is gradually phasing out the regular use of all but one of its wells. The remaining six wells will be used for emergency purposes. As of 2007, two of the permitted wells were not in use through 2010.

As of 2010, the Town has been under a Fluoride Consent Order from VDH. Smithfield is constructing a reverse osmosis water treatment plant that will remove fluoride from the groundwater. Construction of the plant is expected to be completed in October 2011.

Town of Smithfield: Privately-Owned Community Water Systems

One privately-owned CWS operates in the Town of Smithfield (see Map 1-26). The system is located within the service area of the Town's publicly-owned CWS and, in 2007, served a total population of 107 people. The system relies on groundwater, and it is also connected to the Town's publicly-owned CWS. The connection to the Town's publicly-owned CWS provides the Smithfield Mobile Home Park CWS with an alternate source of water in the event of an emergency. A valve must be manually actuated in the field to initiate flow through the system connection. The system is not required to have a DEQ Ground Water Withdrawal Permit. The VDH SWAP evaluations (February 15, 2006) indicate that the well serving the system has a high susceptibility to contamination. In 2007, the available water supply for the system was approximately 0.01 mgd.

Town of Smithfield: Self-Supplied Water Systems

In 2007, 237 people were served by private residential wells, and one business owned its own well. Three self-supplied non-agricultural users reported withdrawing more than 300,000 gallons per month of groundwater in 2007: Smithfield Foods Incorporated - Gwaltney, Smithfield Foods Incorporated - Packing Company, Smithfield Packing Co. Incorporated - Ham and Products Division (see Table 1-23). All of the businesses hold DEQ Ground Water Withdrawal Permits and withdraw groundwater from the Potomac aquifer. The system's 8 wells are between 400 and 565 feet deep. They are all located within Smithfield's CWS service area (see Map 1-26).

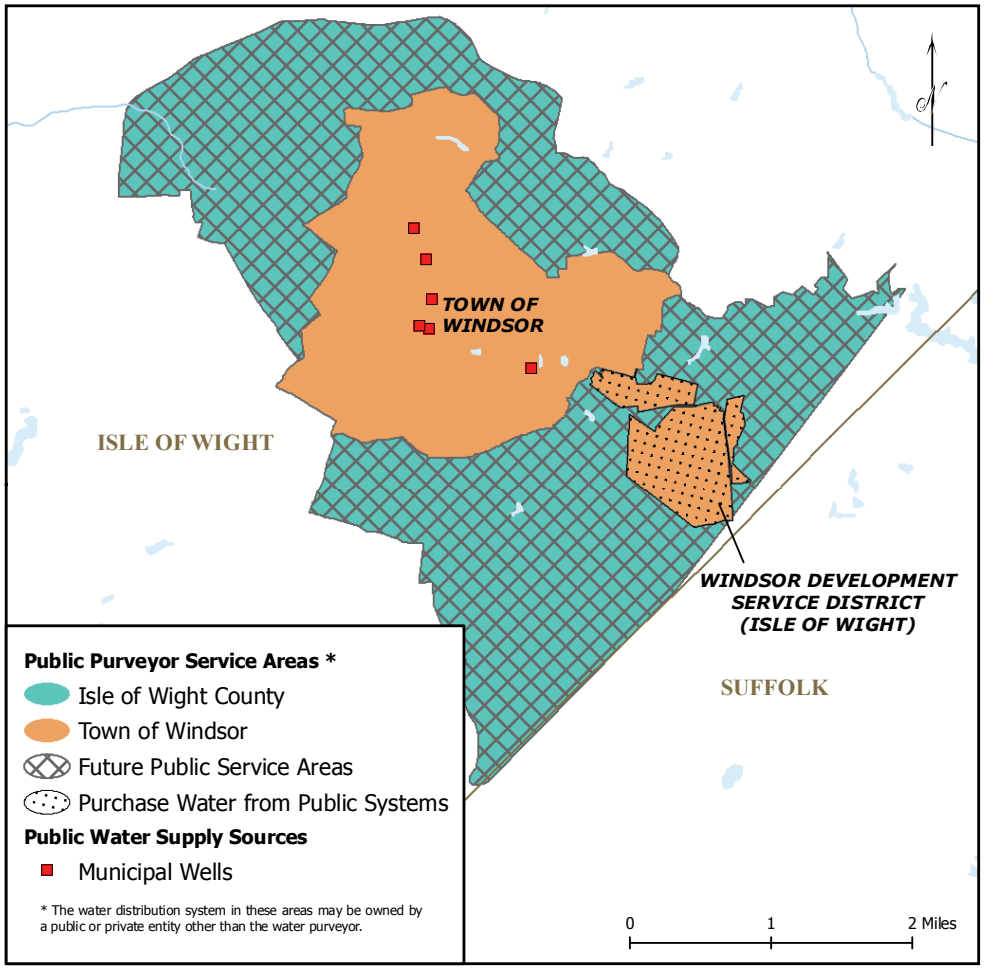
Table 1-23: 2007 Non-Agricultural Self-Supplied Use > 300,000 gallons/month in the Town of Smithfield

Business	Source Water	CWS Service Area	# of Wells	Groundwater Withdrawal Permit(mgd)
Smithfield Foods Incorporated – Gwaltney	Groundwater	Town of Smithfield	3	1.56
Smithfield Foods Incorporated – Packing Company	Groundwater	Town of Smithfield	4	2.45
Smithfield Foods Packing Co. Inc – Ham and Products Division	Groundwater	Town of Smithfield	1	0.03

Town of Windsor: Publicly-Owned Community Water System

The Town of Windsor operates one publicly-owned CWS that served 2,300 people in 2007 (see Map 1-27). The town also sells water to Isle of Wight County to serve the County's Windsor DSD system.

Map 1-27: Town of Windsor Publicly-Owned Community Water System Service Area

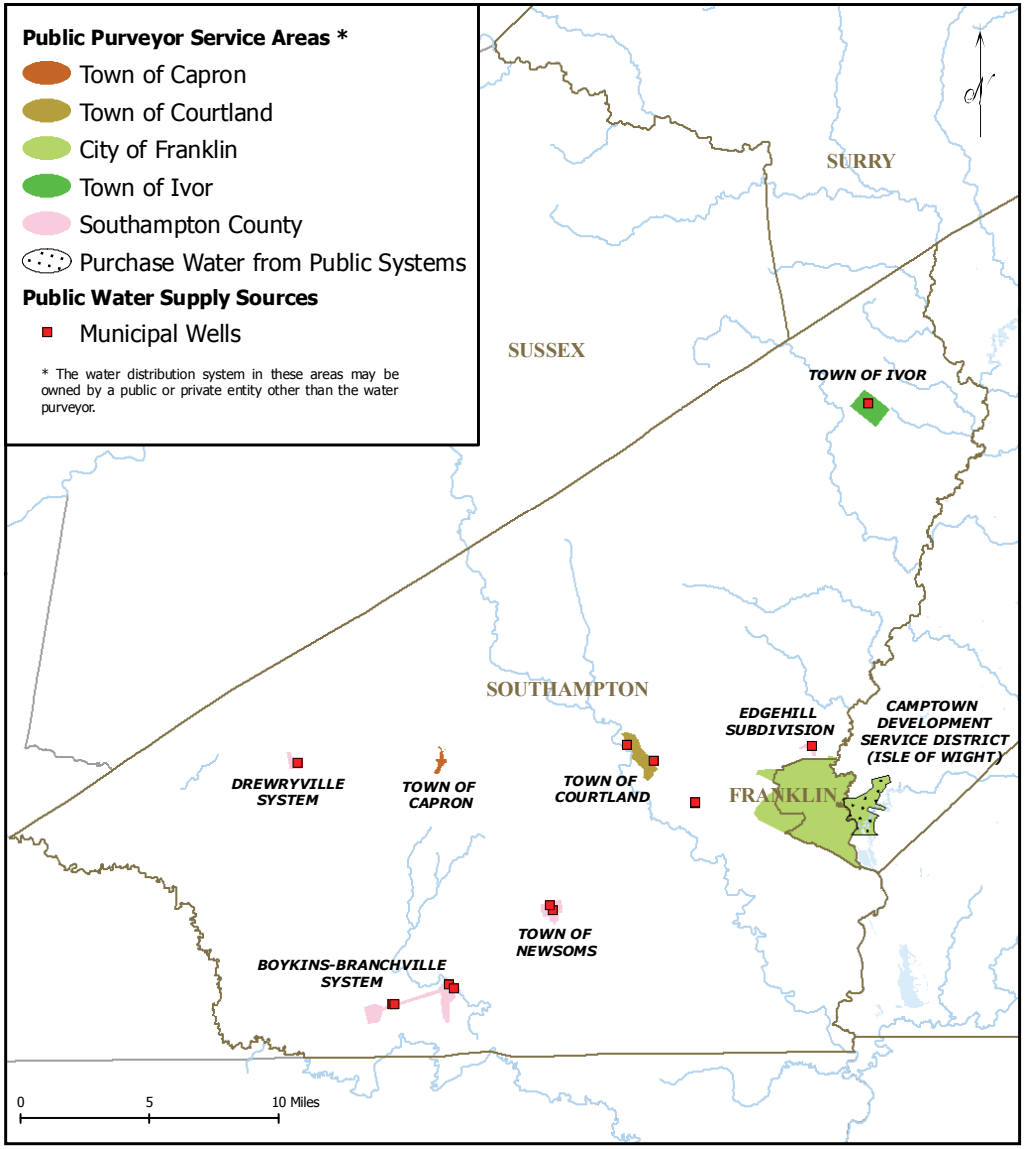


Per the 1996 agreement, amended in 2004, the Town of Windsor provides 224,400 gallons per day (0.224 mgd) of treated water to the County's Windsor DSD (see Table 1-18). All water use within the Windsor DSD is attributed to the existing industrial park. The contract between the Town of Windsor and Isle of Wight County does not have an expiration date. The County may eventually terminate the contract with the Town of Windsor and connect the Windsor DSD to Suffolk's Main System.

The Town of Windsor's six wells are permitted under one DEQ Ground Water Withdrawal Permit for 0.54 mgd, which is the Town's available water supply. The wells are around 400 feet deep and withdraw from the Potomac Aquifer. The VDH SWAP evaluations (February 15, 2006) indicate that four of the town's six wells have a high susceptibility to contamination. As of June 2011, 2 wells are in use and 4 have been abandoned.

There are no privately-owned CWSs in the town. In 2007, 188 people were served by private residential wells and one school had its own well. The wells are all located outside the Town's publicly-owned CWS service area. The Town of Windsor does not have any self-supplied water systems using more than 300,000 gallons per month of water.

Map 1-28: Southampton County, Capron, Courtland, Ivor Publicly-Owned Community Water Systems



Southampton County: Publicly-Owned Community Water Systems

Most of Southampton County is sparsely populated which makes CWSs impractical. Only 45% of the county residents are served by CWSs. Southampton County operates four publicly-owned CWSs that served a total population of 2,330 people in 2007. The four systems serve Newsoms, Boykins-Branchville, Drewryville, and Edgehill (see Map 1-28 and Table 1-24).

Three of the systems hold DEQ Ground Water Withdrawal Permits. The County operates 10 wells that are between 240 and 358 feet deep and withdraw groundwater from the Potomac aquifer. The available water supply for Southampton County's publicly-owned CWSs is 0.4 mgd. The available water supply is the sum of the DEQ Ground Water Withdrawal Permit limits, or if under the permit threshold, the VDH permitted system capacity.

The Incorporated Towns of Capron, Courtland and Ivor each operate publicly-owned CWSs. The three systems served a total of 1,830 people in 2007. The systems are geographically spread out and serve small population centers. All of the systems either have a Groundwater Permit or have requested a permit. See Map 1-28 and Table 1-24 for a summary of the public systems.

Town of Capron

The Town of Capron's publicly-owned CWS served 144 people in 2007. The system serves the town's residents and three areas outside of the town limits: Rockspring Road, Cary's Bridge Road, and Meadow Street. The system's VDH permitted system capacity is

60,000 gallons per day (0.06 mgd). The 2 wells are between 200 and 300 feet deep and withdraw groundwater from the Potomac aquifer. The VDH SWAP evaluations (February 15, 2006) indicate that the system's two wells have a high susceptibility to contamination. In 2007, the Town of Capron applied for a DEQ Ground Water Withdrawal Permit for 0.03 mgd.

Town of Courtland

The Town of Courtland's publicly-owned CWS served 1,270 people in 2007. The system's three wells are between 200 and 250 feet deep and withdraw groundwater from the upper portion of the Potomac aquifer. The system's VDH permitted system capacity is 0.35 mgd.

In 2003, the Town began the application process to renew and expand its permit. However, in 2005, the Town entered into a Consent Order with VDH to reduce fluoride in the Town's drinking water system. Courtland requested that DEQ suspend the application process while the Town prepared to study alternatives for fluoride abatement. In 2007, a test well was drilled, and low-fluoride water was found several hundred feet deeper than current withdrawals.

Later in 2007, VDH approved a preliminary engineering report that outlined the proposal for a new well facility to replace the Town's existing facilities. The new facility proposed includes two new production wells, and the abandonment of the existing wells. The Town submitted a groundwater withdrawal application for 0.17 mgd in February 2009. In 2010, the Town was still monitoring the fluoride levels of the existing wells and had seen a decrease in fluoride levels over time. The Town is in a transition period while it monitors the fluoride level and determines whether new wells need to be drilled. The VDH SWAP evaluations (February 15, 2006) do not include susceptibly ratings for the system's three wells.

Town of Ivor

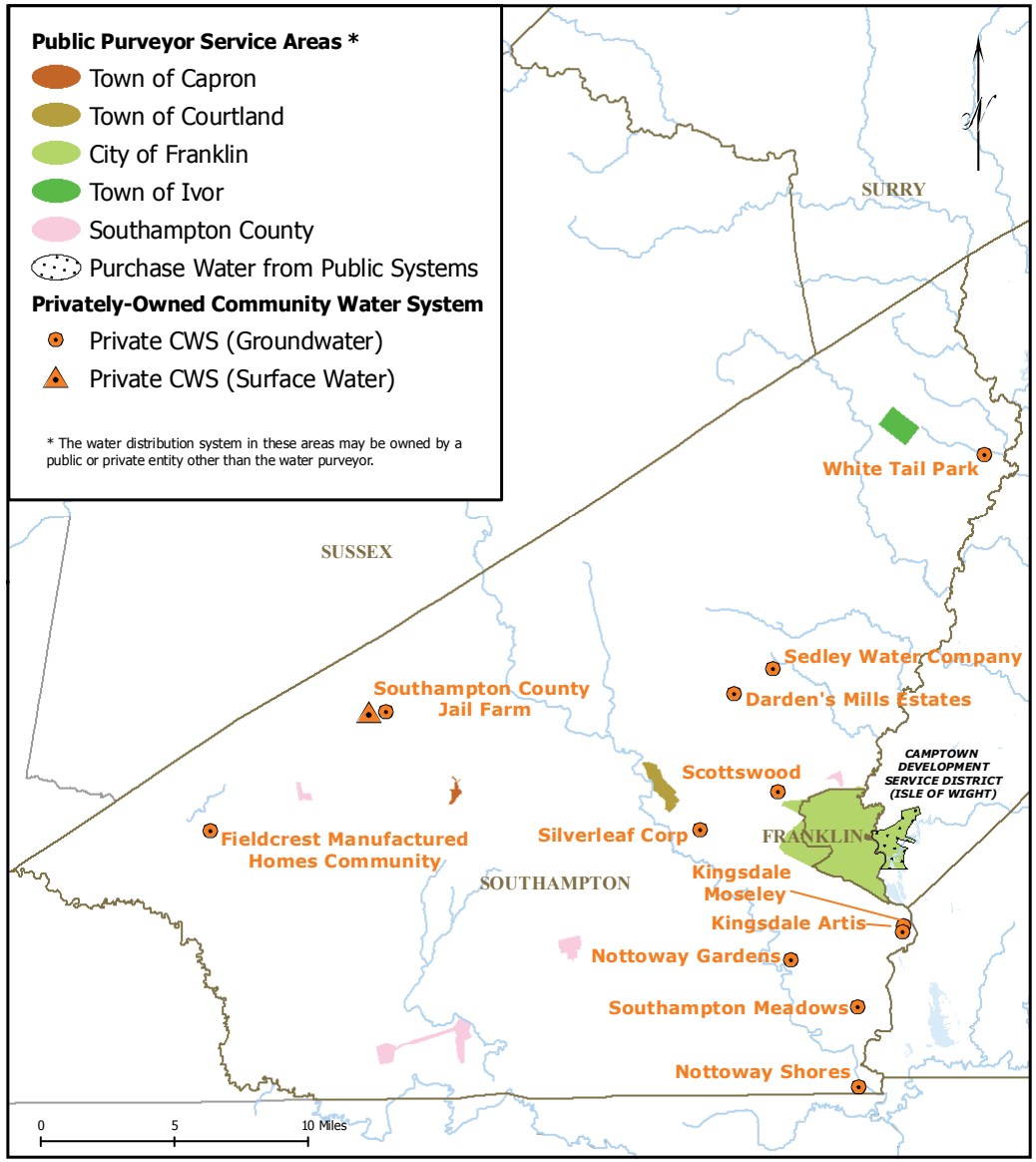
The Town of Ivor's publicly-owned CWS served 395 people in 2007, which included 325 people within the town limits and 70 people with residences along adjacent roadways in Southampton County. The system's VDH permitted system capacity is 0.28 mgd.

Table 1-24: 2007 Publicly-Owned Community Water Systems in Southampton County

System	Population Served	Well Depth	Groundwater Withdrawal Permit* (mgd)	VDH System Capacity (mgd)	VDH SWAP Evaluated Susceptibility to Contamination
Southampton County- Boykins-Branchville	1,405	3 wells 280-305 (ft)	0.24	0.46	NI
Southampton County- Drewryville	155	240 (ft)	0.02	0.02	High
Southampton County- Edgehill	230	3 wells 320-360 (ft)	No	0.03	Low
Town of Newsoms	538	2 wells 331-358 (ft)	0.19	0.09	NI
Town of Capron	144	2 wells 221-290 (ft)	No*	0.06	High
Town of Courtland	1,270	3 wells 228-242 (ft)	No*	0.35	High, Fluoride Consent Order
Town of Ivor	395	3 wells 318-516 (ft)	No*	0.28	Low - 2 wells, High - 1 well

* Total Permit Annual Amount
NI = no information
mgd = million gallons per day

Map 1-29: Privately-Owned Community Water Systems in Southampton County



Ivor did not apply for a groundwater permit until 2007. The Town was granted a historic based DEQ Ground Water Withdrawal Permit for 0.054 mgd in November 2008. The system's three wells are 300 to 500 feet deep and withdraw groundwater from the Potomac aquifer. The VDH SWAP evaluations (February 15, 2006) determined that two of the system's three wells have a low susceptibility to contamination. The third well has a high susceptibility to contamination.

Southampton County: Privately-Owned Community Water Systems

Thirteen privately-owned CWSs operate in Southampton County (see Map 1-29 and Table 1-25). These systems are all located outside public water systems service areas. The systems served a total population of 2,630 people in 2007. All the systems rely on groundwater. Five of the systems hold DEQ Ground Water Withdrawal Permits. Eight of the systems have a well or wells with a high susceptibility to contamination. The available water supply from the 13 privately-owned CWSs in Southampton County was approximately 0.65 mgd in 2007.

Table 1-25: 2007 Privately-Owned Community Water Systems in Southampton County

System	Population Served	Well Depth	Groundwater Withdrawal Permit* (mgd)	VDH System Capacity (mgd)	VDH SWAP Evaluated Susceptibility to Contamination
Darden's Mill Estates	100	2 wells314 (ft)	No	0.04	High
Fieldcrest Manufactured Home Community	130	NI	No	0.01	High
Kingsdale Subdivision (Artis)	80	180 (ft)	No	0.01	High
Kingsdale Subdivision (Mosely)	40	188 (ft)	No	0.02	High
Nottoway Gardens	200	160 (ft)	No	0.03	Low
Nottoway Shores	104	250 (ft)	No	0.01	Low
Scottswood Subdivision	400	3 wells 380-388 (ft)	0.05	0.07	High
Sedley	486	2 wells 305-306 (ft)	0.03	0.08	Low
Silverleaf Mobile Home Park	134	2 wells 333-363 (ft)	No	0.04	High
Southampton Correctional Complex	1,500	5 wells 155 – 230 (ft)	0.30	0.37	Low - 1 High - 2
Southampton County Jail Farm	100	146 (ft)	No	NI	Low
Southampton Meadows Mobile Home Park	500	2 wells 182-195 (ft)	0.09	0.14	Low – 1 High - 1
White Tail Park	356	320 (ft)	0.01	0.04	Low

*Total Permited Annual Amount
NI = No information
mgd = million gallons per day

Southampton County: Self-Supplied Water Systems

In 2007, approximately 11,500 people were served by private residential wells. In Southampton County, domestic wells withdraw groundwater from the following aquifers: water table (20%), Yorktown-Eastover (4%), Aquia (2%), and Potomac (74%) (Pope, 2007). Twenty-two businesses had their own wells in 2007, six of which were located inside the service area of a publicly-owned CWS. Sixteen businesses were identified by VDH as not using enough water to exceed the DEQ reporting threshold.

Non-Agricultural: Three non-agricultural self-supplied users reported withdrawing more than 300,000 gallons per month of groundwater in 2007: Hercules Incorporated, Narricot Industries Incorporated, and Agri-Business Industrial Park. Valley Proteins Incorporated's water use was below the reporting threshold in 2007 but the company holds a DEQ Ground Water Withdrawal Permit for 0.04 mgd. There are no reported withdrawals greater than 300,000 gallons per month of surface water. The locations of these water users are on Map 1-30, and Table 1-26 provides more details.

- **Agri-Business Industrial Park:** The Park withdraws groundwater for predominantly potable commercial use. As of 2010 the commercial space was mostly unoccupied. The system's 2 wells are between 350 and 400 feet deep and withdraw from the Potomac Aquifer.
- **Hercules Incorporated:** Hercules withdraws groundwater for the production of paper chemicals and resins. Most of the water is used for non-contact cooling; the remaining water is used for processing and wastewater treatment. The system's 4 wells are between 540 and 715 feet deep and withdraw from the Potomac Aquifer.
- **Narricot Industries Incorporated:** Narricot withdraws groundwater for the production process of dye and automotive seatbelt webbing. The system's 2 wells are between 290 and 320 feet deep and withdraw from the Potomac Aquifer.
- **Valley Proteins Incorporated:** Valley Proteins withdraws groundwater for the production of animal feed and pet food ingredients. The system's well is 190 feet deep and withdraws from the Potomac Aquifer.

Table 1-26: 2007 Non-Agricultural Self-Supplied Use > 300,000 gallons/month in Southampton County

Business	Source Water	Type of Use	Within CWS Service Area	# of Wells	Groundwater Withdrawal Permit* (mgd)
Agri Business Industrial Park	Groundwater	Commercial	No	2	0.3
Hercules Incorporated	Groundwater	Manufacturing	Yes	4	6.67
Narricot Industries Incorporated	Groundwater	Manufacturing	Yes	2	0.15

* Total Permitted Annual Amount
mgd = million gallons per day

Agricultural: In Southampton County, two agricultural self-supplied users reported withdrawing more than 300,000 gallons per month of groundwater and/or surface water in 2007. See Map 1-30 and Table 1-27 for more details.

Map 1-30: Self-Supplied Water Systems in Southampton County

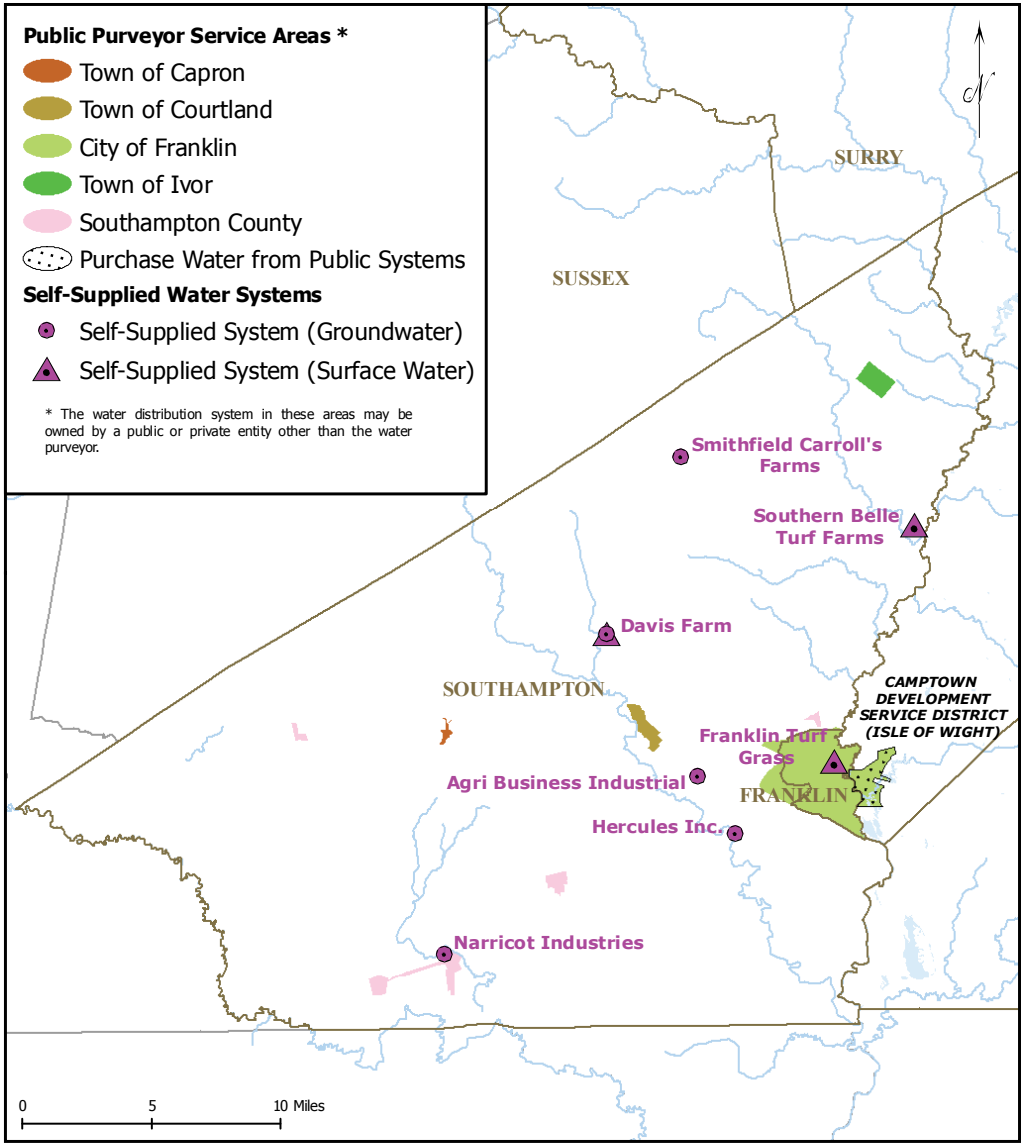


Table 1-27: 2007 Agricultural Self-Supplied Use > 300,000 gallons/month in Southampton County

Business	Source Water	Within CWS Service Area	Groundwater Withdrawal Permit* (mgd)
Davis Farm	Groundwater	No	No Permit
Davis Farm	Nottoway River 4 ponds	No	NA
Smithfield Carroll's Farm	Groundwater	No	0.08

* Total Permitted Annual Amount
NA = Not applicable
mgd = million gallons per day

Surry County: Publicly-Owned Community Water Systems

Surry County is a rural, sparsely populated community. The County does not operate any CWSs. The County owns two wells that serve the County's schools. The wells are permitted under a DEQ Ground Water Withdrawal Permit for 0.01 mgd. The incorporated towns of Claremont, Dendron and Surry are the population centers in the county. Each town owns and operates a CWS that relies solely on groundwater. The towns are all geographically isolated, and none of the distribution systems are connected. See Map 1-31 and Table 1-28 for more details on the publicly-owned CWSs in Surry County.

Town of Claremont

The Town of Claremont's publicly-owned CWS served 343 people in 2007, which includes the Town's population and some areas in the county along the James River. The Town holds a DEQ Ground Water Withdrawal Permit for 46,800 gallons per day (0.047 mgd) which also defines the system's available water supply. The Town's two wells are both 400 feet deep and withdraw groundwater from the Potomac aquifer. The VDH SWAP evaluations (February 15, 2006) indicate that one of the wells has a high susceptibility to contamination while the second well has a low susceptibility.

Town of Dendron

The Town of Dendron's publicly-owned CWS served 375 people in 2007, which included the Town's population and some areas immediately adjacent to the Town. The existing water system was constructed in the 1970's and upgraded in the 1980's. Based on a 2008 survey, there are a total of approximately 180 residences, commercial customers, government buildings, and churches in the service area. Approximately 50 of these residences have chosen to use their existing private wells and not connect to the community system. The well depth is only known for one of the two wells. The well is 510 feet deep and withdraws groundwater from the Potomac aquifer. The Town of Dendron did not request a historic use DEQ Ground Water Withdrawal Permit until recently. In 2008, the Dendron system received a permit for 24,400 gallons per day (0.02 mgd) which also defines the system's available water supply. The VDH SWAP evaluations (February 15, 2006) indicate that the wells have a high susceptibility to contamination.

Town of Surry

The Town of Surry's publicly-owned CWS served approximately 400 people in 2007, which included surrounding businesses and residences in the County (see Map 1-31). The system has two active wells at 475 and 495 feet deep which withdraw groundwater from the Potomac aquifer. The system's VDH permitted system capacity is 0.12 mgd. The Town submitted a DEQ Ground Water Withdrawal Permit application in 2007 for 97,000 gallons per day (0.097 mgd), but subsequently decided to request a historic use based permit for 59,000 gallons per day (0.059 mgd). The historic use permit was approved in 2010 and defines the system's safe yield of 0.059 mgd. The VDH SWAP evaluations (February 15, 2006) indicate that the wells have a high susceptibility to contamination.

Map 1-31: Publicly and Privately-Owned Community Water Systems in Surry County

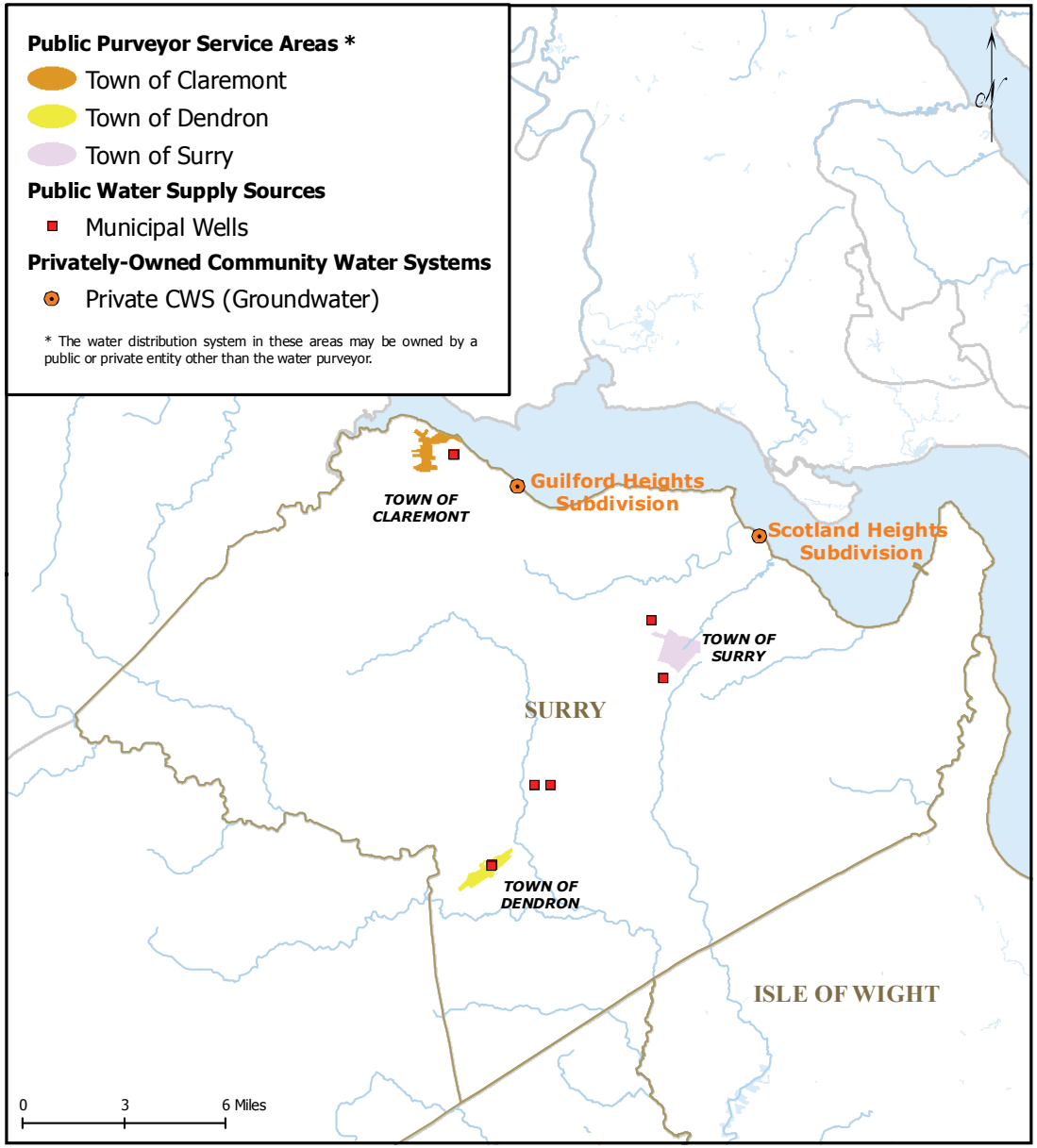


Table 1- 28: 2007 Publicly-Owned Community Water Systems in Surry County

System	Population Served	Well Depth	Groundwater Withdrawal Permit* (mgd)	VDH Permitted Capacity (mgd)	VDH SWAP Evaluated Susceptibility to Contamination
Town of Claremont	343	2 wells 400-403 (ft)	0.047	0.05	High – 1 Low - 1
Town of Dendron	375	2 wells 510 (ft),NI	0.024	0.02	High
Town of Surry	400	2 wells 479-495 (ft)	0.059	0.12	High

* Total Permitted Annual Amount
NI = no information
mgd = million gallons per day

Table 1-29: 2007 Privately-Owned Community Water Systems in Surry County

System	Population Served	Well Depth	Groundwater Withdrawal Permit* (mgd)	VDH Permitted Capacity (mgd)	VDH SWAP Evaluated Susceptibility to Contamination
Guilford Heights	150	600 (ft)	No	0.03	High
Scotland Heights	168	332 (ft)	No	0.02	High

* Total Permitted Annual Amount
mgd = million gallons per day

Surry County: Privately-Owned Community Water System

Two privately-owned CWSs operate in Surry County. Both the Guilford Heights and the Scotland Heights systems are located in rural areas along the James River (see Map 1-32). Each system serves less than 200 people. The systems rely on groundwater and withdraw from the Potomac aquifer. The available water supply from the two systems is 0.05 mgd. The VDH SWAP evaluations (February 15, 2006) determined that the wells are highly susceptible to contamination.

Surry County: Self-Supplied Water Systems

In 2007, approximately 5,800 people in the county were served by private residential wells. Based on the USGS study of domestic wells, the private wells in Surry County withdraw from the following aquifers: Yorktown-Eastover (61%), Aquia (5%), and Potomac (34%). Eleven businesses were served by private wells. Seven businesses do not use enough water to exceed the DEQ reporting threshold but they were identified by VDH. The residences and businesses are located outside a publicly-owned CWS service area.

Non-Agricultural Surface Water Use: The Dominion Power Nuclear Power Plant in Surry is the only non-agricultural self-supplied user in Surry County that reported withdrawing more than 300,000 gallons per month of surface water in 2007 (see Map 1-32 and Table 1-30). The plant withdraws water from the James River. The system's design capacity is a maximum daily withdrawal of 2,535 mgd, and the system's 2007 annual water use is estimated at 1,774 mgd. The plant is exempt from the Virginia Water Protection Permit Program Regulation since the withdrawal began before July 1, 1989.

Non-Agricultural Groundwater Use: In addition to the surface water withdrawals by the Dominion Power Nuclear Power Plant, the plant holds a DEQ Ground Water Withdrawal Permit to withdraw 0.42 mgd from nine wells. Surry County Public Schools is the only other groundwater user that reported withdrawals exceeding the threshold. Surry County holds a DEQ Ground Water Withdrawal Permit to withdraw 0.01 mgd from two wells. See Map 1-32 and Table 1-30 for more information.

- **Dominion Power Nuclear Power Plant:** Dominion Power withdraws water from the James River for use as cooling water. Most of the water is discharged back into the James River. The system also withdraws groundwater from nine wells that are between 380-480 feet deep and withdraw groundwater from the Potomac Aquifer. Some of the groundwater is for potable use, but the majority of the plant's groundwater withdrawals are demineralized and used to produce steam-generated electricity. As much as possible, this process reuses and recycles water, but some volume is lost during the industrial process. Water is also consumed by appurtenant activities including air emissions control and fire control.
- **Surry County:** The County holds a DEQ Ground Water Withdrawal Permit for 0.01 mgd for the County's public schools. The system's two wells are 380 feet and 481 feet deep and withdraw water from the Potomac Aquifer.

Agricultural: Four self-supplied agricultural users reported withdrawals of more than 300,000 gallons per month of surface/groundwater in 2007. Two of the users hold DEQ Ground Water Withdrawal Permits (see Table 1-31).

Map 1-32: Self-Supplied Water Systems in Surry County

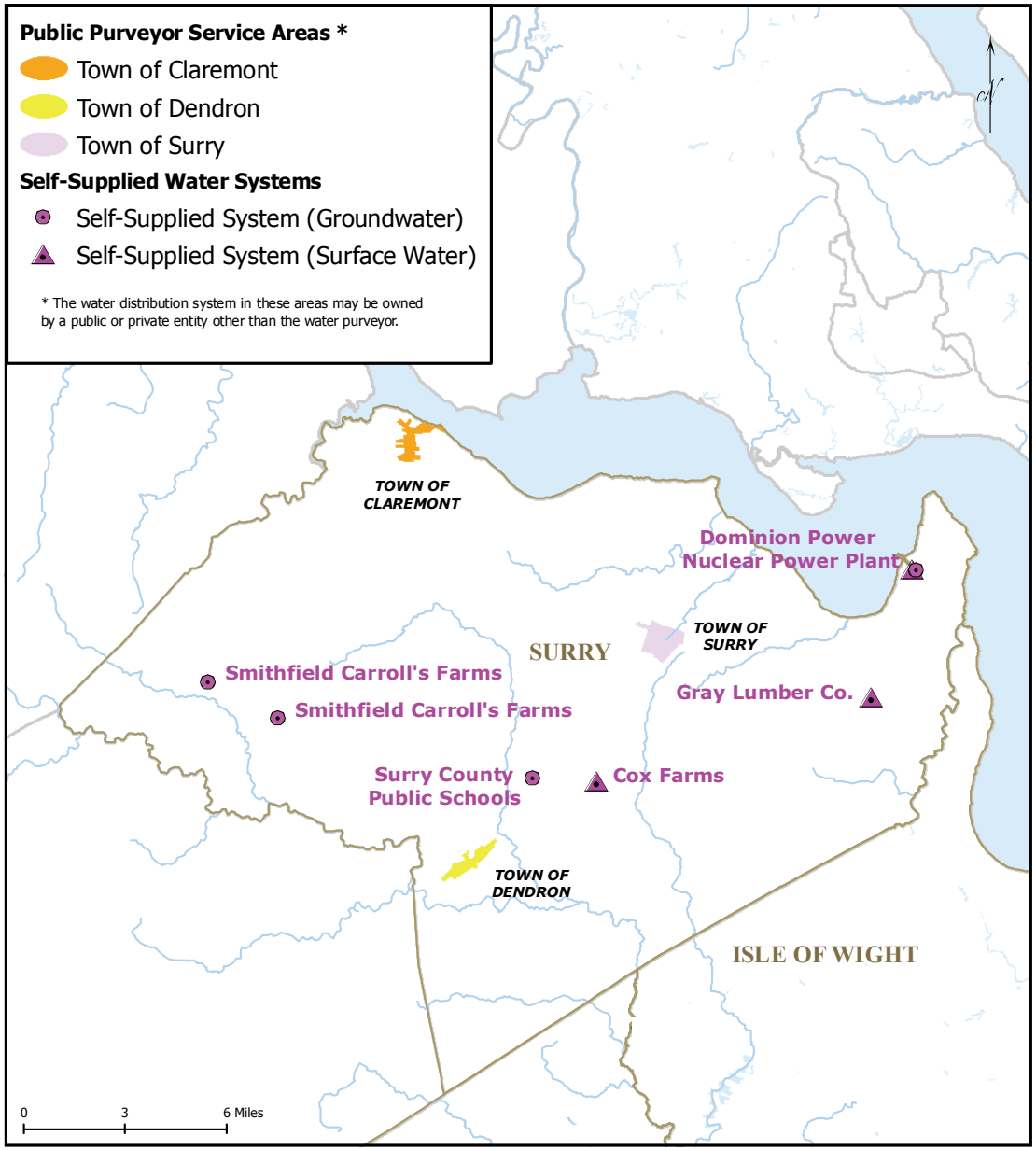


Table 1-30: 2007 Non-Agricultural Self-Supplied Use > 300,000 gallons/month in Surry County

Business	Source Water	Type of Use	Within CWS Service Area	# of Wells	Groundwater Withdrawal Permit* (mgd)
Dominion Power Nuclear Power Plant	James River	Nuclear Power	No	NA	NA
Dominion Power Nuclear Power Plant	Groundwater	Nuclear Power	No	9	0.42
Surry County Public Schools	Groundwater	Commercial	No	2	0.01

* Total Permitted Annual Amount
NA = not applicable
mgd = million gallons per day

Table 1-31: 2007 Self-Supplied Agricultural Use > 300,000 gallons/month in Surry County

User	Source Water	Within CWS Service Area	Groundwater Withdrawal Permit* (mgd)
Cox Farm	5 Ponds	No	NA
Gray Lumber Company – Bacons Castle Farm	Lake	No	NA
Smithfield Carroll's Surry Farms 9, 10, 21	Groundwater	No	0.1
Smithfield Carroll's Surry Farms 16-17	Groundwater	No	0.06

* Total Permitted Annual Amount
NA = not applicable
mgd = million gallons per day

Section 2 | **Existing Water Use**

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Existing Water Use

The Local and Regional Water Supply Planning Regulation (9 VAC 25-780-70) requires information about existing water use. Water use information was obtained from VDH, DEQ, and local water utility departments. The Regulation requires the following information for each CWS in the planning area: the number of people served; the number of connections; the average and maximum daily withdrawal; the amount of water used; the peak day water use; and the disaggregated water use.

Additionally, the Regulation requires that, to the extent that information is available, for each CWS using stream intakes, the Regional Water Supply Plan shall include a qualitative description of existing in-stream beneficial uses within the planning area or outside the planning area that may be affected by the point of stream withdrawal.

The plan must include the amount of water used by self-supplied users that withdraw more than 300,000 gallons per month of surface water and groundwater for non-agricultural and agricultural use. The plan must also identify whether self-supplied users are located within the service area of a CWS.

Private residential wells and private business wells do not have to report their water withdrawals to DEQ unless they withdraw more than 300,000 gallons per month. The plan is required to include an estimate of water used by these self-supplied users. Domestic water use was assumed to be 75 gallons per person and household size was based on the 2000 census estimates. The per capita use was based on the USGS study "Private Domestic–Well Characteristics and the Distribution of Domestic Withdrawals among Aquifers in the Virginia Coastal Plain". Annual use by small businesses was estimated based on the "Commonwealth of Virginia Guidance for Conducting a Comprehensive Public Drinking Water Supply Needs Assessment".

This chapter summarizes the portion of the required regulatory data that most impacts water supply planning in the Hampton Roads region. A complete set of data addressing all of the regulatory requirements is included in Appendix A.

Publicly-owned CWS served 94% of the Peninsula sub-region's population in 2007. The systems used a combined average of 57.93 mgd, not including water consumed during production processes. Newport News Waterworks, the largest publicly-owned CWS in the sub-region, used 48.16 mgd of water in 2007.

Privately-owned CWSs only operate in Gloucester, James City, and York Counties. The private systems used 0.045 mgd in 2007. That figure does not include the water used by the privately-owned CWSs in York County since water for those systems is purchased from Newport News Waterworks and the Williamsburg publicly-owned CWS.

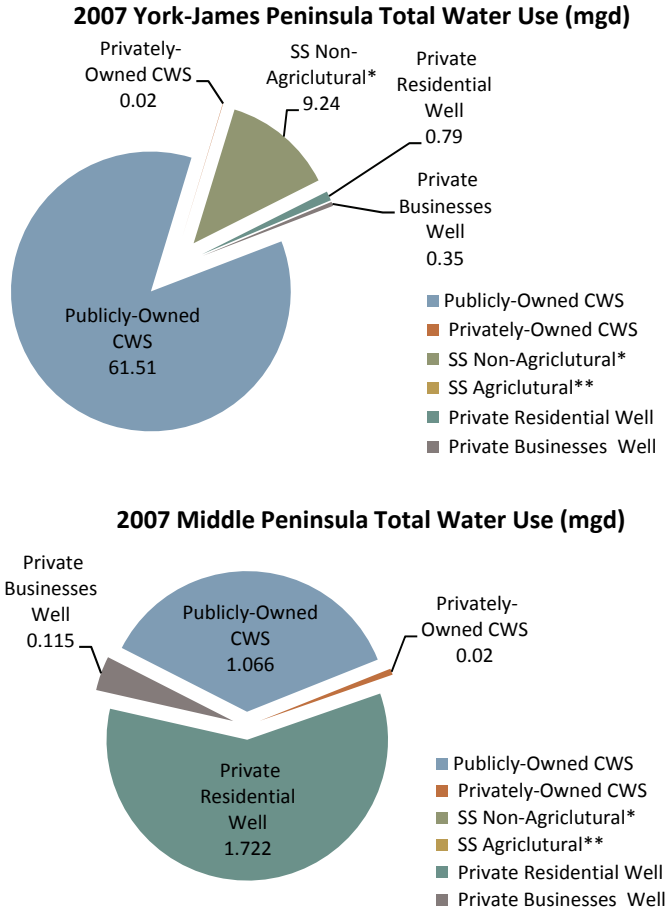
Private residential wells served approximately 33,384 people in 2007 in the Counties of Gloucester, James City and York. In 2007 private residential use required approximately 2.50 mgd, and all users lived outside a publicly-owned CWS service area.

An estimated 54 businesses were served by private wells in 2007; 36 businesses were located outside a publicly-owned CWS. The businesses served by private wells used a total of approximately 0.47 mgd in 2007.

In 2007, seven self-supplied non-agricultural users reported withdrawing more than 300,000 gallons per month of surface water; the systems used an average of 825 mgd. The largest user was the Yorktown Fossil Power Plant, which withdrew an estimated 817 mgd of surface water in 2007. The majority of the water was returned to the York River.

There were 13 self-supplied non-agricultural users who reported withdrawing more than 300,000 gallons per month of groundwater in 2007; these businesses used an average of 0.86 mgd. All the use occurred within a publicly-owned CWS service area. The largest user was Colonial Williamsburg Inn, which used 0.48 mgd.

Figure 2-1
2007 Peninsula Sub-Region Total Water Use (mgd)



*SS Non-Ag = Self-Supplied Non-Agricultural withdrawals > 300,000 gallons/month
**Self-supplied does not include Yorktown Fossil Power Plant. Plant used 817 mgd in 2007. Most of the water was returned to the York River.

Publicly-Owned Community Water Systems

There are 23 publicly-owned CWSs operating in the Peninsula sub-region. Newport News Waterworks provides water to twelve of the systems in addition to the main Newport News Waterworks system. The majority of the sub-region's population relies on a publicly-owned CWS. As a whole, the systems served approximately 477,855 people (94% of the total population) in 2007 (see Figure 2-2).

The total 2007 water use by Peninsula sub-region publicly-owned CWSs was 57.93 mgd. An additional 4.65 mgd of water was consumed during production processes. Water use by usage type is summarized below:

- **Residential use:** 29.45 mgd
- **Commercial, institutional, and light industrial (CIL) use:** 12.45 mgd
- **Heavy industrial use:** 9.69 mgd
- **Military use:** 3.11 mgd
- **Other:** 0.13 mgd
- **Unaccounted for water:** 3.11 mgd

Figure 2-3 and Table 2-1 provide detailed 2007 water use information for York-James Peninsula and Middle Peninsula publicly-owned CWSs.

Figure 2-2
2007 Peninsula Sub-Region Locality Populations Served by Publicly-Owned Community Water Systems

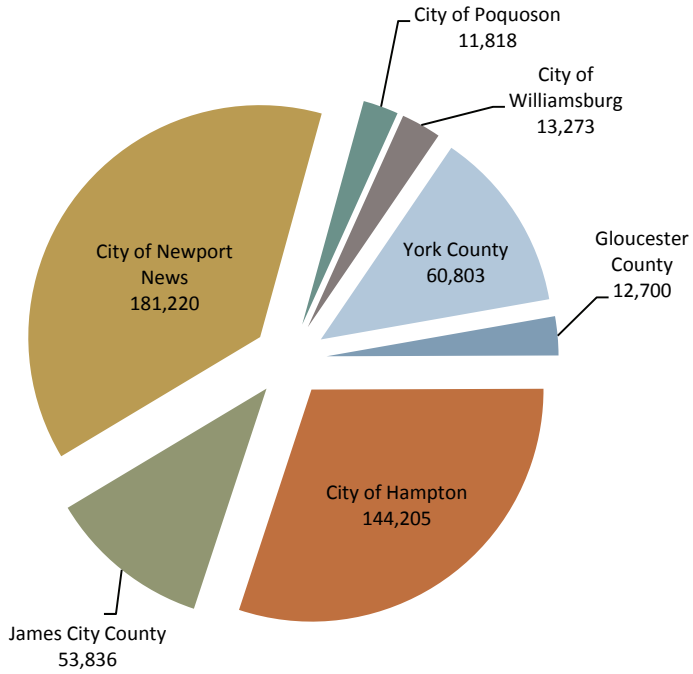
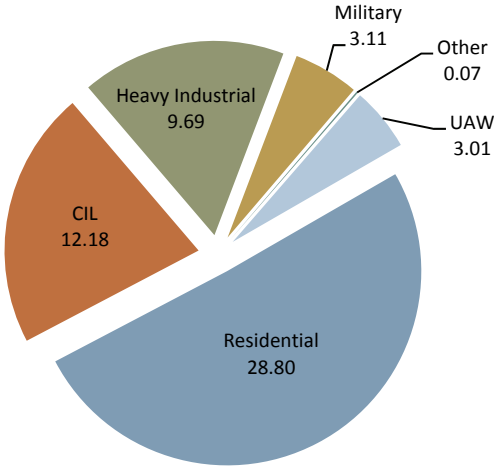


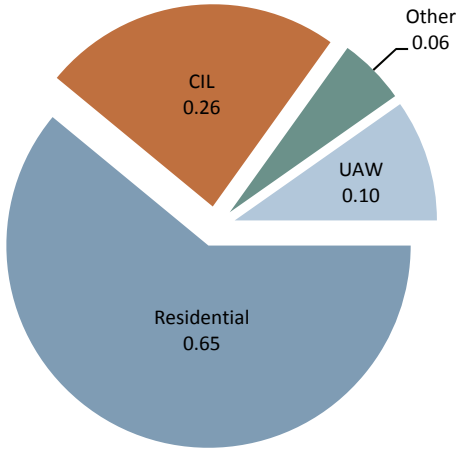
Figure 2-3
2007 Peninsula Sub-Region Publicly-Owned Community Water System Use by Type (mgd)

2007 York-James Peninsula Publicly-Owned Community Water System Use by Type (mgd)



CIL = Commercial, Institutional, Light Industrial
UAW = Unaccounted for water

2007 Middle Peninsula Publicly-Owned Community Water System Use by Type (mgd)



CIL = Commercial, Institutional, Light Industrial
UAW = Unaccounted for water

Table 2-1: Categories of Use for Peninsula Publicly-Owned Community Water Systems

(2007 data, all figures in mgd)

Water System Name	Residential	Commercial Institutional Light Industrial (CIL)	Heavy Industrial	Military	Other	Unaccounted for Losses	Total Water Use	Additional Production Losses
York-James Peninsula								
James City Service Authority - Glenwood Acres	0.006	0.000	0.000	0.000	0.000	0.000	**0.006**	0.000
James City Service Authority - Central System	3.107	1.673	0.000	0.000	0.000	0.251	**5.031**	0.790
James City Service Authority - Kings Village	0.010	0.000	0.000	0.000	0.000	0.000	**0.010**	0.000
James City Service Authority - Racefield	0.011	0.000	0.000	0.000	0.000	0.000	**0.011**	0.000
James City Service Authority – The Retreat	0.014	0.000	0.000	0.000	0.000	0.000	**0.014**	0.000
James City Service Authority - Ware Creek Manor	0.012	0.000	0.000	0.000	0.000	0.000	**0.012**	0.000
James City Service Authority - Wexford Hills	0.038	0.000	0.000	0.000	0.000	0.000	**0.028**	0.000
Newport News Waterworks	25.000	8.100	9.690	3.010	0.070	2.290	**48.160**	3.470
Newport News Waterworks - Lightfoot [1]	0.056	0.249	0.000	0.000	0.000	0.023	**0.328**	0.000
City of Williamsburg	0.560	2.168	0.000	0.097	0.000	0.440	**3.265**	0.071
Middle Peninsula								
Gloucester County WTP	0.650	0.255	0.000	0.000	0.057	0.104	**1.066**	0.314
Peninsula Sub-Region Total	**29.454**	**12.445**	**9.690**	**3.107**	**0.127**	**3.108**	**57.931**	**4.645**

1. In 2007, the Lightfoot System was operated by York County.

York-James Peninsula

Newport News Waterworks: Publicly-Owned Community Water System

Waterworks provided water service to approximately 410,000 people in the Peninsula sub-region in 2007. The service area includes the entire City of Newport News, Hampton, and Poquoson. Waterworks also serves a small portion of James City County and most of York County. The reported water use for Waterworks includes the following ten CWSs: Fort Monroe, Langley Air Force Base, Langley Family Housing, Fort Eustis, Yorktown Naval Weapons Station, Cheatham Annex, Carver Gardens, Nelson Park, York Terrace, and York Public Utilities. Waterworks' use was 48.16 mgd of finished water; an additional 3.47 mgd of raw water was consumed by production processes (e.g., backwashing filters, concentrate from the brackish groundwater treatment system) (see Table 2-1). The Lightfoot system was operated by York County in 2007. The system's use was 0.33 mgd.

Waterworks is the only CWS in the Peninsula sub-region that has a stream intake. In addition to groundwater withdrawals and reservoir withdrawals, Waterworks withdraws from the Chickahominy River. The River's existing in-stream beneficial uses include anadromous fish use areas or reaches of alewife, blueback herring, striped bass, and yellow perch. The Chickahominy is listed on National Rivers Inventory for extensive, well developed cypress-gum swamp forest and bottomland hardwood forest which includes three rare, endemic and possibly endangered species of plants. The River is also sacred to the Chickahominy Indian tribe. The College of William and Mary rowing club practices on the river. Sections of the Chickahominy do not support recreation, aquatic life (estuary) or fish consumption. See "Section 3, Existing Resources" for more information.

Photo: Chickahominy River, HRPDC

Photo: Harwoods Mill, HRPDC

JCSA: Publicly-Owned Community Water Systems

JCSA operates seven CWSs that all rely on groundwater. The systems provided water to approximately 46,000 people with a total use of 5.11 mgd in 2007. An additional 0.79 mgd of raw water was consumed during the brackish groundwater treatment process (see Table 2-1).

The City of Williamsburg: Publicly-Owned Community Water System

Williamsburg operates one CWS that relies on groundwater and surface water. The system provided water to approximately 13,273 people in 2007 with a total use of 3.27 mgd (see Table 2-1). An additional 0.07 mgd of raw water was consumed during the production process.

Middle Peninsula

Gloucester County: Publicly-Owned Community Water System

Gloucester County operates one CWS that relies on groundwater and surface water. The system provided water to approximately 12,700 people in 2007, with a total use of 1.07 mgd. An additional 0.31 mgd of raw water was consumed in production processes (see Table 2-1).

Privately-Owned Community Water Systems

There are are 12 privately-owned CWSs operating in the Peninsula sub-region. The five systems that operate in York County purchase water from Newport News Waterworks or the City of Williamsburg (see Map 2-1). The water use for those residential systems is reported under the Waterworks and the City of Williamsburg systems.

Three privately-owned systems operate in Gloucester County and four operate in James City County. In 2007, the systems served a total of 835 people and used 0.03 mgd for residential use. The systems all rely on groundwater (see Table 2-2).

Table 2-2: 2007 Peninsula Privately-Owned Community Water System Use

System	Population Served	Use (mgd)
York-James Peninsula:		
James City County		
Brooks' Duplexes	35	0.002
Greensprings Mobile Village	208	0.011
Heaths Mobile Homes	42	0.003
Shodon Mobile Estates	150	0.002
Middle Peninsula:		
Gloucester County		
Laurelwood Estates Trailer Park	175	0.001
R&L Trailer Park	45	0.004
Waterview Mobile Home Park	80	0.008

Self-Supplied Users Served by Private Residential or Private Business Wells

In 2007, the Peninsula sub-region was estimated to have approximately 33,384 people served by private residential wells (see Figure 2-4 and 2-5). Residential wells used an estimated 2.50 mgd in 2007. All of the residents served by a private well live outside a publicly-owned CWS service area. Residential wells use less than 300,000 gallons per month and serve less people than a CWS. Therefore, residential well owners are not required to report their withdrawals to DEQ or VDH. Water use was estimated based on 75 gallons per person per day.

The Cities of Hampton, Newport News, Poquoson, and Williamsburg do not have any population served by private residential wells. The following list is a summary of the self-supplied residential use in the Peninsula sub-region.

York-James Peninsula:

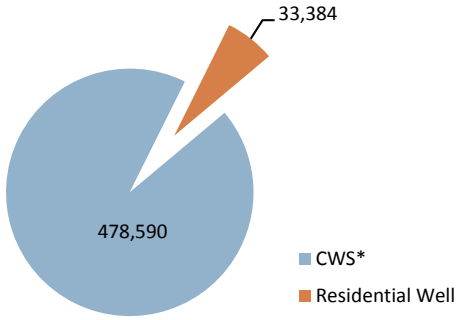
- James City County: 7,224 people. Use = 0.54 mgd.
- York County: 3,200 people. Use = 0.24 mgd.

Middle Peninsula:

- Gloucester County: 22,960 people. Use = 1.72 mgd.

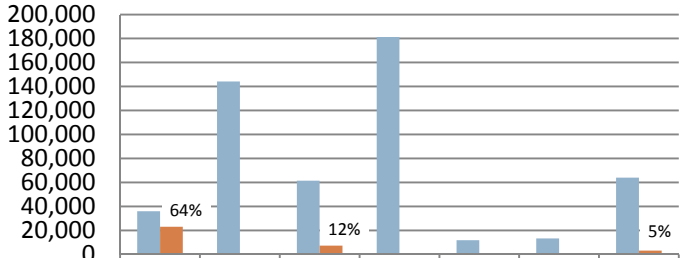
In 2007, 54 businesses used private wells; 18 of these businesses were located within a CWS service area. Like private residential wells, businesses that withdraw less than 300,000 gallons per day are not required to report their withdrawals to a state agency. Therefore, the use was calculated by following the VDH guidelines for calculating use by type of businesses. The estimated 2007 total demand for all 54 sub-region businesses using private wells was 0.47 mgd.

Figure 2-4
Peninsula Population Served by Private Residential Wells vs. CWSs



*CWS include publicly- and privately-owned systems.

Figure 2-5
Percent of Peninsula Population on Private Residential Wells



	GL	HA	JCC	NN	PQ	WM	YK
Total Population	35,960	144,205	61,495	181,220	11,818	13,273	64,003
Population served by private residential well	22,960	0	7,224	0	0	0	3,200

GL = Gloucester County | HA = City of Hampton | NN = City of Newport News
JCC = James City County| PQ= City of Poquoson| YK = York | WM = Williamsburg

Self-Supplied Users Withdrawing More Than 300,000 Gallons per Month

Non-Agricultural Users: Surface Water Use

Photo: Golden Horseshoe Golf Club, HRPDC

Seven self-supplied non-agricultural users reported withdrawing more than 300,000 gallons per month of surface water in 2007 (see Figure 2-6 and Table 2-3). Surface water was withdrawn from ponds, lakes, creeks, and the York River. All of the users are located within a publicly-owned CWS service area. The total average surface water use was 825 mgd in 2007, with the largest withdrawal of 817 mgd coming from the Yorktown Fossil Power Plant. The majority of the water withdrawn by the power plant is returned to the river.

Non-Agricultural Users: Groundwater Use

Photo: Dominion Terminal Associates, HRPDC

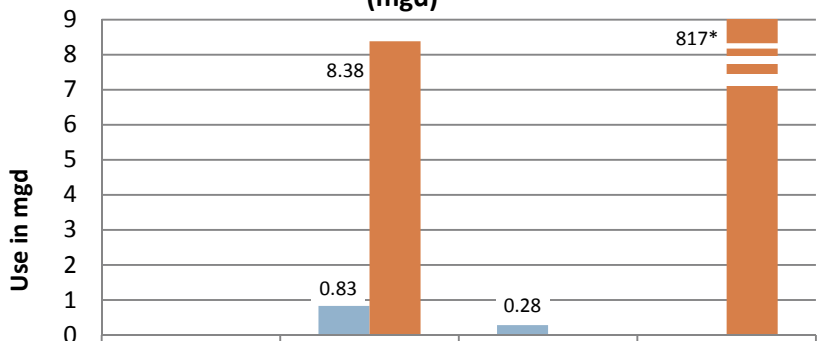
In 2007, 13 self-supplied users reported withdrawing more than 300,000 gallons per month of groundwater (see Figure 2-6 and Table 2-3). All of the users are located within a publicly-owned CWS service area. The total average groundwater use was 0.86 mgd in 2007. The largest groundwater withdrawal was from Colonial Williamsburg Inn, 0.48 mgd.

In 2007, 54 businesses withdrew less than 300,000 gallons per day; 18 of these businesses are located within a CWS service area. The businesses are not required to report their withdrawals to DEQ. Therefore, the use was estimated based on the VDH guidelines for demands for types of businesses. The estimated total demand in 2007 was 0.47 mgd.

Agricultural Users

No self-supplied agricultural users reported withdrawals that were more than 300,000 gallons per month to DEQ in 2007, nor did any agricultural users hold DEQ Ground Water Withdrawal Permits in 2007.

Figure 2-6
Peninsula Self-Supplied Use > 300,000 Gallons per Month (mgd)



	Agriculture	Commercial	Manufacturing	Power
Groundwater	0	0.83	0.28	0
Surface water	0	8.38	0	817

*Yorktown Fossil Power Plant withdrew 817 mgd. Majority of water is returned to the York River.

Table 2-3: 2007 Peninsula Self-Supplied Non-Agricultural Users > 300,000 Gallons per Month
(all figures in mgd)

Water User Name	Source	Use	Estimated Annual Average Use
BASF Corporation Williamsburg	GW	Man	0.02
Busch Gardens Williamsburg	GW	Com	0.07
Colonial Williamsburg Inn	GW	Com	0.48
Deer Run Golf Course	SW	Com	0.08
Dominion Terminal Associates - Pier 11	GW	Man	0.12
Golden Horseshoe Golf Course	GW	Com	0.04
Golden Horseshoe Golf Course	SW	Com	0.18
James River Country Club	GW	Com	0.03
Kinder Morgan Bulk Terminal - Pier IX	GW	Man	0.09
Kingsmill Golf Course	SW	Com	0.28
Northrup Grumman Shipbuilding	SW	Com	8.15
Outdoor World Campground	GW	Com	0.01
Sanifill of Virginia - Big Bethel Landfill	GW	Com	0.08
Siemens Automotive - Newport News	GW	Man	0.04
The Pines Golf Course - Fort Eustis	GW	Com	0.06
Titan Ready Mix Plant - Rip Rap Road	GW	Man	0.02
Two Rivers Country Club	GW	Com	0.07
Williamsburg Country Club	SW	Com	0.05
Williamsburg National Golf Course	SW	Com	0.05
Yorktown Fossil Power Plant	SW	Pf	817.00

Com = Commercial | Man = Manufacturing | Pf = Fossil Power
GW = Groundwater | SW = Surface water

*All of the businesses listed are located within the service area of a publicly-owned community water system.

Publicly-owned CWSs served 92% of the Southside sub-region's population in 2007. The entire populations of the Cities of Norfolk and Portsmouth are served by publicly-owned CWS. The publicly-owned CWSs in Chesapeake, Suffolk and Virginia Beach serve the dense population centers within each respective city, but do not cover the entire city. The areas not served by the publicly–owned CWSs are served by either private residential wells or privately–owned CWSs. In 2007, the sub-region's publicly-owned CWSs used approximately 100.00 mgd, not including water consumed during production processes.

The Cities of Chesapeake and Suffolk are the only localities in the sub-region with privately-owned CWSs. Nine privately-owned CWSs served 7,500 people in 2007, 1% of the sub-region's population. The systems used a combined average of 0.49 mgd.

Private residential wells are found in the southern and western portions of Chesapeake, Suffolk, and Virginia Beach. The majority of the private residential wells are in the City of Chesapeake. A total of 58,618 people, about 5% of the sub-region's total population, were served by a private residential well in 2007. Private residential wells used approximately 4.40 mgd. Irrigation wells are not included. The majority of the wells are located outside publicly-owned CWS service areas.

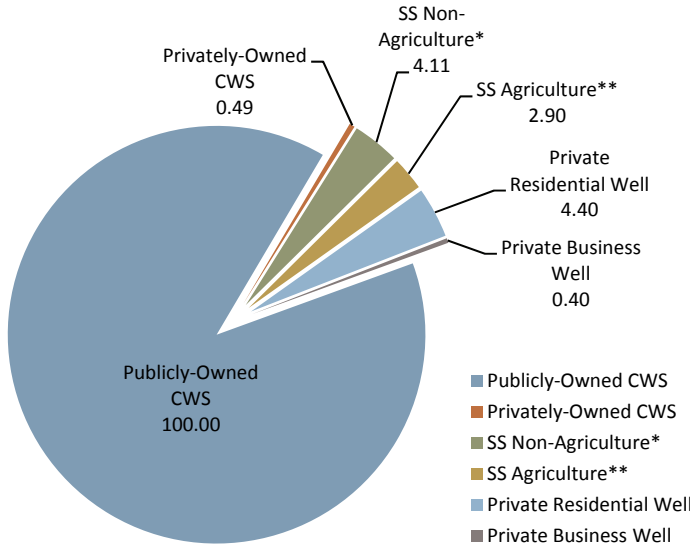
In 2007, 49 businesses were served by private wells. These businesses used an estimated total of 0.40 mgd of water.

As for self-supplied non-agricultural users, 12 users reported withdrawing more than 300,000 gallons per month of surface water in 2007, with an average use of 522 mgd. The Chesapeake Energy Center had the largest withdrawal of surface water of 521 mgd. The majority of this withdrawal is returned to the Elizabeth River.

Additionally, the sub-region had 26 non-agricultural users that reported withdrawing more than 300,000 gallons per day of groundwater in 2007, with an average use of 3.11 mgd. Cogentrix Virginia Leasing Company, a fossil power plant, had the largest withdrawal of 1.66 mgd.

The Southside sub-region is also home to many self-supplied agricultural users that reported withdrawing more than 300,000 gallons per month of surface water and/or groundwater. The reported use was 2.63 mgd of surface water and 0.26 mgd of groundwater. Figure 2-7 summarizes the total water use in the sub-region for 2007.

Figure 2-7
2007 Southside Total Water Use (mgd)



* SS Non-Agriculture = Self-Supplied Non-Agricultural withdrawals > 300,000 gallons/month. Does not include 521 mgd withdrawn by the Chesapeake Energy center; most of the water is returned to the Elizabeth River.
**SS Agriculture = Self-Supplied Agricultural withdrawals >300,000 gallons/month.

Publicly-Owned Community Water Systems

Nine publicly-owned CWSs operate in the Southside sub-region: three in Chesapeake, three in Suffolk, one in Norfolk, one in Portsmouth, and one in Virginia Beach. The majority of the sub-region's population relies on publicly-owned CWSs. As a whole, the systems served a total of 977,626 people in 2007 (see Figure 2-8).

In addition to residential use, which had the highest use in 2007, publicly-owned systems served a variety of uses (see Figure 2-9):

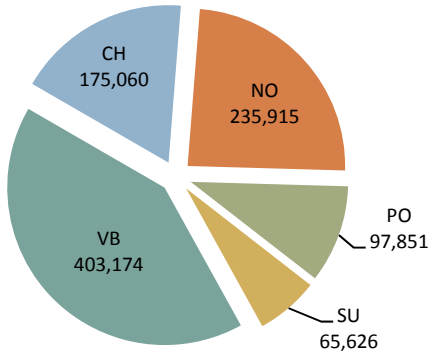
- **Residential use:** 59.65 mgd
- **CIL use:** 19.21 mgd
- **Heavy industrial use:** 2.04 mgd
- **Military:** 5.77 mgd
- **Other:** 1.86 mgd
- **Unaccounted for water:** 11.46 mgd

The total 2007 water use by publicly-owned CWSs was approximately 100.00 mgd; an additional 6.62 mgd was consumed during production processes.

The Cities of Norfolk and Portsmouth sell water to various CWSs within the Southside sub-region. Figure 2-9 reflects the sub-region's water use as determined by the CWS that purchased the water and provided water service to the customer. See subsequent discussions on Norfolk and Portsmouth publicly-owned CWSs for details on water sales.

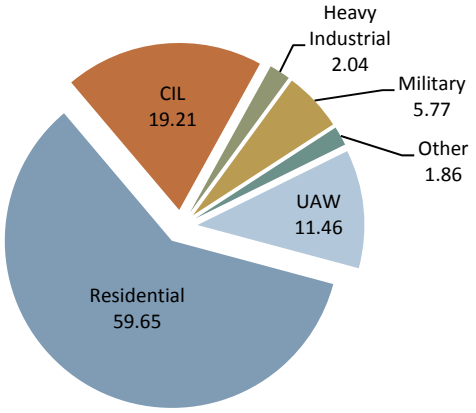
Figure 2-9 does not reflect 0.357 mgd of water sold by the City of Suffolk to the Western Tidewater Authority to serve uses located outside the sub-region. Use of this water is discussed in Section 2, "Existing Water Use – Western Tidewater."

Figure 2-8
2007 Southside Population Served by Publicly-Owned Community Water Systems



CH = Chesapeake | NO = Norfolk | PO = Portsmouth| SU = Suffolk | VB = Virginia Beach

Figure 2-9
2007 Southside Publicly-Owned Community Water System Use by Type (mgd)



CIL = Commercial, Institutional, Light Industrial
UAW = Unaccounted for water

City of Chesapeake: Publicly-Owned Community Water Systems

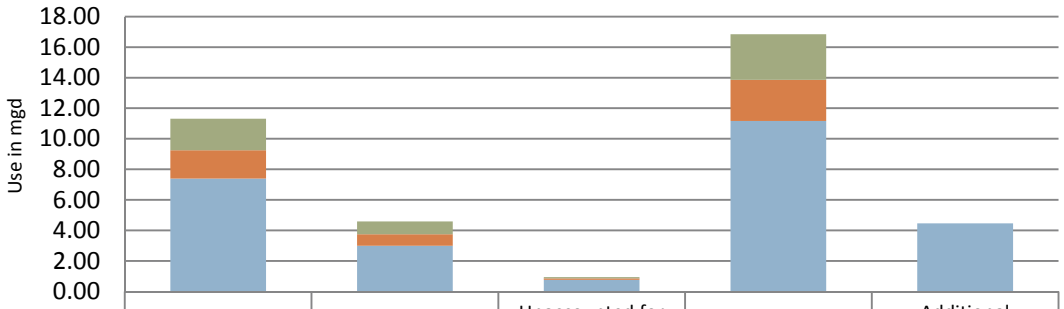
The City of Chesapeake owns and operates three CWSs. The systems served 174,586 people in 2007. Residential use required 11.31 mgd; CIL use required 4.59 mgd; and the unaccounted water losses were 0.94 mgd in 2007 (see Figure 2-10).

The Northwest River System is the largest system, and served approximately 102,434 people in 2007. The City of Chesapeake purchased 6.45 mgd of raw water from the City of Norfolk to supplement supply for this system. The system's 2007 use was 11.17 mgd. An additional 4.46 mgd was consumed in the production process. Residential use was 7.40 mgd and CIL use was 3.00 mgd. The Northwest River System withdraws water from the Northwest River. The River's existing in-stream beneficial uses include designation on the National Rivers Inventory list. The river is also an estuarine system that consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed or sporadic access to the open ocean. The water quality of the river is impaired, and there are sections that do not support recreation and aquatic life. See "Section 3, Existing Resources" for more information about in-stream beneficial uses.

The South Norfolk System served 33,512 people in 2007. The City of Chesapeake purchased 2.69 mgd of finished water from the City of Norfolk to supply this system. Residential use was 1.85 mgd, and CIL use was 0.75 mgd.

The Western Branch System served 38,640 people in 2007. The City of Chesapeake purchased 2.98 mgd of finished water from the City of Portsmouth to supply this system. Approximately 474 Chesapeake residents buy water directly from the City of Portsmouth. Residential use of approximately 0.14 mgd attributed to these customers is included in the City of Portsmouth's use information.

Figure 2-10
2007 City of Chesapeake Publicly-Owned CWS Use by Type (mgd)



	Residential	CIL	Unaccounted for Water	Average Daily Use	Additional Production Loss
Western Branch	2.06	0.84	0.08	2.98	0.00
South Norfolk	1.85	0.75	0.09	2.69	0.00
Northwest River	7.40	3.00	0.77	11.17	4.46

City of Norfolk: Publicly-Owned Community Water System

The City of Norfolk owns and operates one CWS that serves the city's entire population, which was 235,915 people in 2007.

The City of Norfolk system's total use in 2007 was 28.73 mgd (see Figure 2-11). An additional 1.86 mgd was used in the production process. Residential use was 11.10 mgd, CIL use was 5.20 mgd, heavy industrial use was 2.04 mgd, military use was 4.79 mgd, other use was 0.55 mgd, and unaccounted for losses were 5.05 mgd. The 2007 total system use does not include the additional 43.36 mgd sold by Norfolk to other CWSs. The 2007 unaccounted for losses of 5.05 mgd include losses associated with the delivery of water sold to other CWSs.

In Figure 2-11, military water use of 4.79 mgd includes 0.09 mgd sold to the Navy at Craney Island, 3.52 mgd sold to the Navy installations located in the City of Norfolk (Norfolk Naval Base), and 1.18 mgd sold to military installations in Virginia Beach (Dam Neck, Little Creek Amphibious Base, NAS Oceana, Fort Story, and Camp Pendleton).

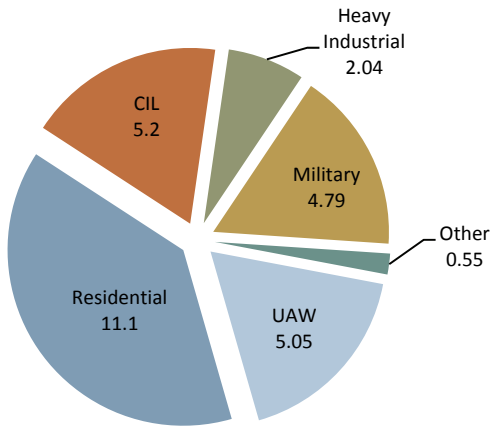
Norfolk's water sales include:

- 2.69 mgd of finished water to the City of Chesapeake's South Norfolk CWS;
- 6.45 mgd of raw water to the City of Chesapeake's Northwest River CWS; and
- 3.0 mgd of raw water for drought relief to the City of Portsmouth's CWS (existing contract for up to 10 mgd).

The City of Norfolk has a cost of service contract with the City of Virginia Beach to treat and wheel water supplied from Lake Gaston. In 2007, Norfolk provided Virginia Beach with 36.26 mgd of finished water under this contract.

A portion of Norfolk's supply comes from stream intakes of the Blackwater River and the Nottoway River. The in-stream beneficial uses of these rivers include anadromous fish reaches, trout and other significant fisheries. Additionally, a segment of the Nottoway River that is upstream from the Norfolk intake has been designated into Virginia's Scenic River Program. A segment of the Blackwater River upstream from the Norfolk intake has been designated a Blueway trail. Segments of both rivers are listed on the Nationwide Rivers Inventory. Both rivers are palustrine systems. A palustrine system includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, farmed wetlands, and similar wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand. The Blackwater River has water quality use impairments according to the VDH SWAP evaluation. Aquatic life, fish consumption, and recreation are not supported in large sections of the river. See "Section 3, Existing Resources" for more information on in-stream beneficial use.

Figure 2-11
2007 City of Norfolk Publicly-Owned CWS Use by Type (mgd)



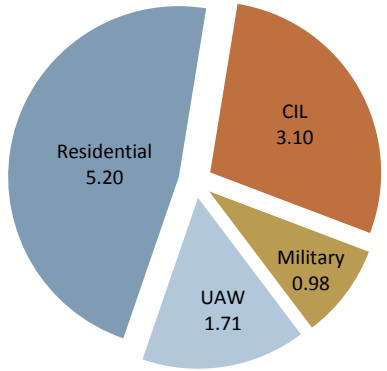
CIL = Commercial, Institutional, Light Industrial
UAW = Unaccounted for Water

City of Portsmouth: Publicly-Owned Community Water System

The City of Portsmouth owns and operates one CWS that serves the entire city's population. In 2007, the system served 97,851 people. The system's total use was 10.99 mgd in 2007 (see Figure 2-12). An additional 0.30 mgd was used in the production process. In Figure 2-12, residential use in Portsmouth includes 0.14 mgd purchased directly by 474 Chesapeake residents that are not within the City of Chesapeake's Western Branch CWS service area. Military use of 0.98 consists of water used by Norfolk Naval Shipyard.

Portsmouth's 2007 water sales of 5.56 mgd include 2.98 mgd to the City of Chesapeake for the Western Branch System (the Cities' contractual agreement is for 3.0 mgd) and 2.58 mgd to the City of Suffolk.

Figure 2-12
2007 City of Portsmouth Publicly-Owned CWS Use by Type (mgd)



CIL = Commercial, Institutional, Light Industrial
UAW = Unaccounted for water

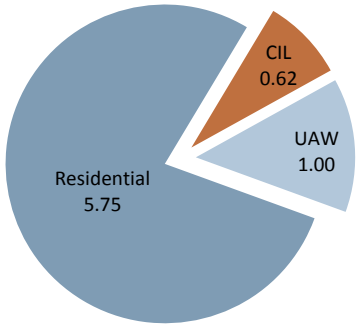
City of Suffolk: Publicly-Owned Community Water Systems

The City of Suffolk owns and operates three CWSs. The systems served 65,626 people in 2007. Figure 2-13 describes the 7.37 mgd total water use across Suffolk's publicly-owned CWSs. System use does not include water sold to other CWSs.

The Main System has the largest service area and provides water for approximately 64,600 people. In 2007, the City of Suffolk purchased 2.58 mgd from the City of Porstmouth for this system and the 2007 use was 7.29 mgd. Residential use was 5.67 mgd; CIL use was 0.62 mgd; unaccounted for losses totaled 1.00 mgd. The city also operates the Whaleyville System and Holland System. Both systems served about 500 people each and used an average of 0.04 mgd each in 2007. Both systems only serve residential customers (see Figure 2-13).

Suffolk sold 0.36 mgd from the Main System through the Western Tidewater Water Authority (WTWA) to Isle of Wight County to supply the Newport Development Service District. Use of this water is described in Section 2, "Existing Water Use – Western Tidewater." See Section 1, "Existing Sources - Southside Sub-Region" for more information on the WTWA.

Figure 2-13
2007 City of Suffolk Publicly-Owned CWS Use by Type (mgd)



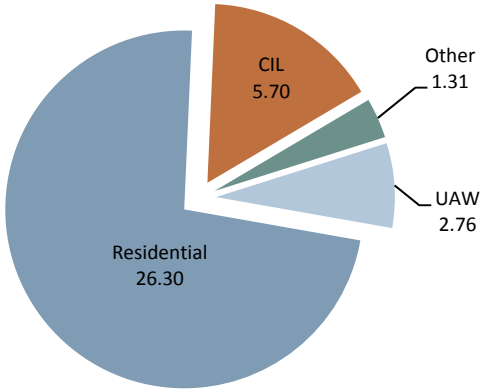
CIL = Commercial, Institutional, Light Industrial
UAW = Unaccounted for Water

City of Virginia Beach: Publicly-Owned Community Water System

The City of Virginia Beach operates one CWS. The system provided water to 403,174 people in 2007. Residential use required 26.3 mgd; CIL use required 5.7 mgd; other use was 1.31 mgd; and unaccounted for losses totaled 2.76 mgd (see Figure 2-14).

The City of Virginia Beach has a cost of service contract with the City of Norfolk to treat and wheel water supplied from Lake Gaston. In 2007, Norfolk provided Virginia Beach with 36.26 mgd of finished water under this contract.

Figure 2-14
2007 City of Virginia Beach Publicly-Owned CWS Use by Type (mgd)



CIL = Commercial, Institutional, Light Industrial
UAW = Unaccounted for Water

There are several CWSs within Virginia Beach that serve military installations: Dam Neck, Little Creek Amphibious Base, NAS Oceana, Fort Story, and Camp Pendleton. Each of these systems are served by the City of Norfolk and do not have their own source water or treatment facilities. The water demands for these systems are not reflected in Figure 2-14 (refer to Figure 2-11 for more information).

Photo: Lake Gaston, www.city-data.com

Privately-Owned Community Water Systems

Nine privately-owned CWSs, located in the Cities of Chesapeake and Suffolk, served approximately 1% of the total south-side population in 2007. The systems served 7,490 people and used a total of 0.49 mgd. Residential demand was 0.38 mgd and military demand was 0.11 mgd.

Chesapeake: Privately-Owned Community Water Systems

Six privately-owned CWSs operate in Chesapeake. Together the systems served 7,250 people and used a total of 0.47 mgd. The Naval Support Activity – NW Annex system is the only system that serves military use rather than residential use (see Table 2-4).

Suffolk: Privately-Owned Community Water Systems

Within the City of Suffolk, privately-owned CWSs served 243 people in 2007. The use for Hobson Village Waterworks and Hobson Mt. Lebanon Waterworks was not available from VDH or DEQ. The total use for the three privately-owned CWSs in Suffolk was estimated to be 0.02 mgd, based on 75 gallons per person (see Table 2-5).

Table 2-4: 2007 Chesapeake Privately-Owned CWS Use

(all figures in mgd)

System	Avg. Use
Indian River Water Co.	0.116
VDOC – Saint Brides Correctional Center	0.228
Plantation Mobile Home Park	0.007
Sunray Artesian Water Supple	0.004
Sunray Water Co.	0.005
Naval Support Activity – NW Annex	0.109
TOTAL	**0.470**

Table 2-5: 2007 Suffolk Privately-Owned CWS Use

(all figures in mgd)

System	Avg. Use
Birdsong	0.007
Hobson Village Waterworks	0.005
Hobson Village Mt. Lebanon Waterworks	0.008
TOTAL	**0.020**

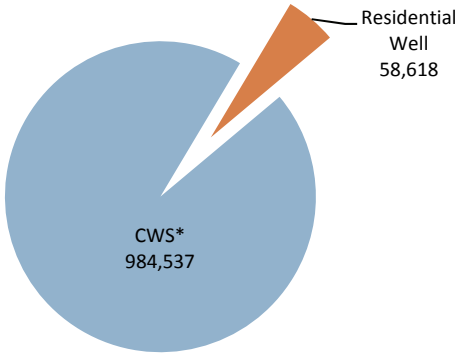
Self-Supplied Users Served by Private Residential or Private Business Wells

The Southside sub-region was estimated to have 58,618 people served by private residential wells in 2007 (see Figures 2-15 and 2-16). Residential wells used an estimated 4.40 mgd in 2007. Residential wells are located outside CWS service areas. Residential well owners are not required to report their withdrawals to DEQ or VDH. Water use for the systems was estimated assuming 75 gallons per person per day. The City of Norfolk and Portsmouth do not have any population served by self-supplied water systems.

- **City of Chesapeake:** 33,600 people. Use = 2.52 mgd
- **City of Suffolk:** 20,164 people, Use = 1.51 mgd
- **City of Virginia Beach:** 4,851 people. Use = 0.36 mgd

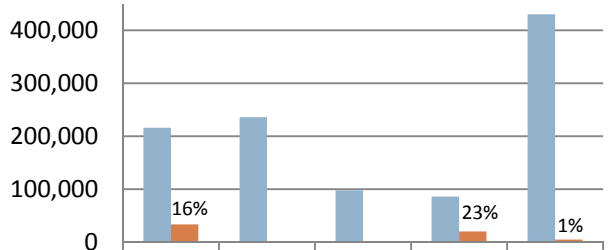
Businesses using private wells totaled 49 in 2007; 29 of these businesses were located within a CWS service area. These businesses withdraw less than 300,000 gallons per day are not required to report their withdrawals to a state agency. Therefore, the use was calculated by following the VDH guidelines for calculating use by type of businesses. The estimated total demand in 2007 was 0.40 mgd.

Figure 2-15
Southside Population Served by Private Residential Well vs. CWS



*CWSs include publicly- and privately-owned systems.

Figure 2-16
Percent of Southside Population on Private Residential Wells



	CH	NO	PO	SU	VB
Total Population	215,906	235,915	97,851	86,033	430,349
Population with private residential well	33,600	0	0	20,164	4,851

CH = Chesapeake | NO = Norfolk | PO = Portsmouth | SU = Suffolk | VB = Virginia Beach

Self-Supplied Users Withdrawing More Than 300,000 Gallons per Month

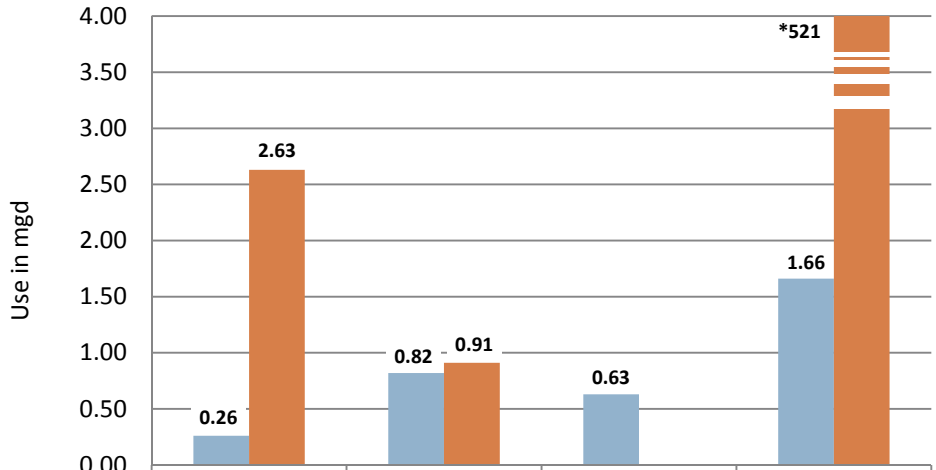
Non-Agricultural Users: Surface Water Use

Twelve self-supplied non-agricultural users reported withdrawing more than 300,000 gallons per month of surface water in 2007 (see Figure 2-17 and Table 2-6). Four of the users also withdrew groundwater. The total average water use was 522 mgd. The Chesapeake Energy Center used the largest amount of surface water, 521 mgd. The majority of the water was returned to the Elizabeth River. All of the users are located within a publicly-owned CWS service areas.

Non-Agricultural Users: Groundwater Use

Twenty-six self-supplied non-agricultural users reported withdrawing more than 300,000 gallons per month of groundwater in 2007 (see Figure 2-17 and Table 2-6). The total average use was 3.11 mgd in 2007. All but one of the systems are located within a CWS service area. In 2007, Cogentrix Virginia Leasing Corporation used the largest amount of groundwater per day at 1.66 mgd.

Figure 2-17
2007 Southside Self-Supplied Use > 300,000 gallons per month (mgd)



	Agriculture	Commercial	Manufacturing	Power
Groundwater	0.26	0.82	0.63	1.66
Surface water	2.63	0.91	0.00	521.00

*Chesapeake Energy Center withdraws 521 mgd; majority of this water is returned to the Elizabeth River.

Table 2-6: 2007 Southside Self-Supplied Non-Agricultural Users >300,000 Gallons Per Month

(all figures in mgd)

System or Business	Source	Use	Estimated Annual Average Use	System or Business	Source	Use	Estimated Annual Average Use
Albert G Horton, Jr Veterans Cemetery	GW	Com	0.01	Elizabeth Manor Golf and Country Club	SW	Com	0.04
BASF	GW	Man	0.24	Hell's Point Golf Club	SW	Com	0.10
Bayshore Concrete Products	GW	Man	0.01	Heron Ridge Golf Course	SW	Com	0.15
Bayville Golf Club	GW	Com	0.04	J H Miles and Company - Norfolk Processing Plant	GW	Man	0.15
Bow Creek Golf Course	GW	Com	0.02	National Linen & Uniform Service	GW	Com	0.02
Broad Bay Country Club	GW	Com	0.03	Oceana Golf Course	GW	Com	0.07
Cahoon Plantation Golf Course	GW	Com	0.05	Princess Anne Country Club	GW	Com	0.13
Capital Concrete Incorporated - Stapleton Street Plant	GW	Man	0.02	Princess Anne Country Club	SW	Com	0.06
Cavalier Golf & Yacht Club	SW	Com	0.05	Redwing Golf Course	SW	Com	0.12
Cavalier Golf and Yacht Club	GW	Com	0.09	Servitex Division of Alsco	GW	Man	0.03
Cedar Point Golf Course	SW	Com	0.07	Sewells Point Golf Club	SW	Com	0.05
Chesapeake Energy Center	SW	Pf	521	SPSA Regional Landfill	GW	Man	0.03
BASF (Ciba Specialty Chemicals) - Suffolk Plant	GW	Man	0.07	Tidewater Area Central Hospital Laundry, Inc	GW	Com	0.06
Cintas Corporation / Omni Services, Inc.	GW	Man	0.06	Titan Virginia Ready-Mix LLC Campostella Ready Mix Plant	GW	Man	0.02
City of Virginia Beach - Kempsville Greens Golf Course	GW	Com	0.01	Titan Virginia Ready-Mix LLC Oceana Plant	GW	Man	0.01
Cogentrix Virginia Leasing Corporation	GW	Man	1.66	Titan Virginia Ready-Mix LLC Port Norfolk Plant	GW	Man	0.01
Cypress Point Golf Course	SW	Com	0.07	TPC Golf Course (Virginia Beach National Golf Course)	GW	Com	0.08
Eagle Haven Golf Course, NAB Little Creek	SW	Com	0.03	TPC of Virginia Beach LLC	SW	Com	0.17
Elizabeth Manor Golf and Country Club	GW	Com	0.10	US Navy - Norfolk Naval Base, Sewells Point Golf Course	GW	Com	0.08

GW = Groundwater | SW = Surface water | Com = Commercial | Man = Manufacturing | Pf = Fossil Power

Agricultural Users

In 2007, three agricultural users reported withdrawing more than 300,000 gallons per month of surface water and/or groundwater in 2007 (see Table 2-7).

The annual average use of surface water by agricultural users was 2.63 mgd in 2007. The annual average use of groundwater was 0.26 mgd. The majority of this use occurs outside existing CWS service areas. In 2007, the largest groundwater and surface water user was the Greenbrier Farms Nursery in Chesapeake which withdrew 0.11 mgd of groundwater and 2.44 mgd ofsurface water.

Two users did not report withdrawals in 2007, but hold DEQ Ground Water Withdrawal Permits: Lancaster Farms, located in Suffolk, holds a permit for 0.03 mgd; and Norfolk City Nursery, located in Chesapeake, holds a permit for 0.007 mgd.

The amount of water needed to support livestock was estimated based on data from the USDA National Agricultural Statistics Service. Water use for cows was estimated to be 0.13 mgd in 2007. Water use by horses was 0.09 mgd. The calculation is based on 12 gallons per day per cow and per horse.

Table 2-7: 2007 Southside Self-Supplied Agricultural Users >300,000 gallons per month

(all figures in mgd)

System or Business	Source	Estimated Annual Average Use
Bennetts Creek Nursery	GW	0.04
Bennetts Creek Nursery	SW	0.03
Greenbrier Farms Nursery	SW	2.44
Greenbrier Farms Nursery	GW	0.11
Williams Cattle Co LLC	SW	0.06

GW = Groundwater | SW = Surface water

Photo: Farm, HRPDC

Unlike the other two sub-regions in Hampton Roads, a significant portion of the Western Tidewater sub-region's population relies on private residential wells. The City of Franklin and the Towns of Smithfield and Windsor are the only localities in the sub-region where the majority of the population is served by publicly-owned CWSs. In 2007, 49% of the population was served by private residential wells, with a total estimated annual average use of 2.59 mgd. Approximately 35 businesses were served by private wells that used an estimated annual average of 0.26 mgd.

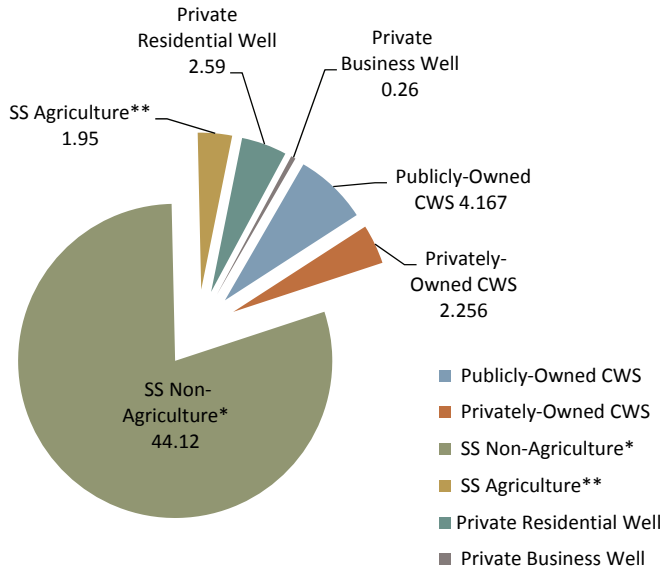
In 2007, 24 publicly-owned CWSs served 41% of the sub-region's population and used an average of 4.17 mgd. The remaining population is served by one of 40 privately-owned CWSs that used an average of 2.26 mgd for all uses. The majority of the privately-owned CWSs are located in Isle of Wight County and Southampton County.

Two self-supplied users reported to DEQ withdrawing more than 300,000 gallons per month of surface water for non-agricultural use in 2007; one user is located within a CWS service area. These systems used an average of 4.22 mgd. This amount does not include 1,774 mgd of surface water withdrawals from the James River by the Surry Nuclear Power Plant, which returns almost all of the water to the river.

Additionally, the sub-region had 10 self-supplied non-agricultural users that reported withdrawing more than 300,000 gallons per month of groundwater. The majority of the users are within a CWS service area. In 2007, the systems used an average of 39.9 mgd; the largest use totaled 32.37 mgd by the International Paper Franklin Mill Plant.

There were 13 self-supplied agricultural users who reported withdrawing more than 300,000 gallons per month of surface water or groundwater in 2007. Groundwater use was 0.38 mgd, and surface water use was 1.57 mgd.

Figure 2-18
2007 Western Tidewater Total Water Use (mgd)



* SS Non-Agriculture = Self-Supplied Non-Agricultural withdrawals > 300,000 gallons/month. Does not include Surry Nuclear Power Plant surface water withdrawals of 1,774 mgd, as most of the water is returned to the James River.

** SS Agriculture = Self-Supplied Agricultural withdrawals > 300,000 gallons/month.

Publicly-Owned Community Water Systems

Photo: Windsor, HRPDC

Twenty-four publicly-owned CWSs served 41% of the sub-region's population and used an average of 4.17 mgd in 2007 (see Figure 2-19 and Figure 2-20). The City of Franklin and the Towns of Smithfield and Windsor serve nearly their entire populations, while the Counties of Isle of Wight, Southampton, and Surry provide public water service to less than 25% of their residents.

The Towns of Smithfield and Windsor sell water from their publicly-owned systems to areas of Isle of Wight County. The City of Franklin sells water from its system to areas of Southampton County and Isle of Wight County. Service agreements and usage are further described in the locality-specific discussions.

Figure 2-19
2007 Western Tidewater Population Served by Publicly-Owned Community Water Systems

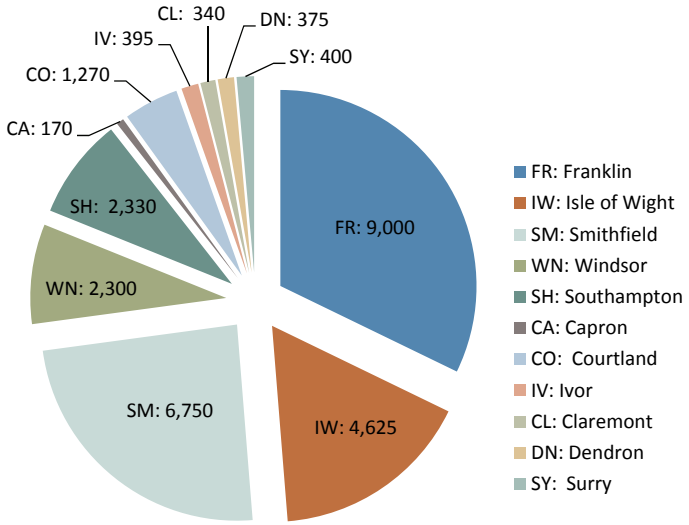
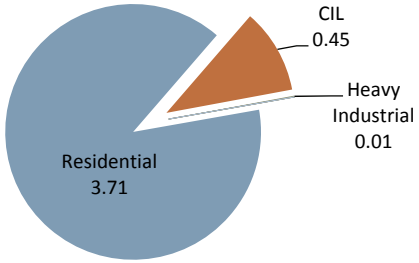


Figure 2-20
2007 Western Tidewater Publicly-Owned Community Water System Use by Type (mgd)



CIL = Commercial, Institutional, Light Industrial

Isle of Wight County: Publicly Owned Community Water Systems

Isle of Wight County has delineated three Development Service Districts (DSD): Newport DSD, located along the southeast border of the Town of Smithfield; Windsor DSD, located around the town line of Windsor; and Camptown DSD, located along the east border of the City of Franklin. The County's long range land use plan is to direct the majority of new residential, commercial and industrial growth to the development service districts.

The Newport DSD publicly-owned CWS receives surface water from the Western Tidewater Water Authority (WTWA). Isle of Wight County purchased 0.36 mgd from the Western Tidewater Water Authority for the Newport DSD in 2007. At that time, the DSD served 1,280 people. Residential demand was 0.232 mgd and CIL demand was 0.125 mgd. Five privately-owned CWSs are located within the Newport DSD. Over time it is expected that two to three of the systems will switch to the Newport DSD publicly-owned CWS.

The Windsor DSD purchases groundwater from the Town of Windsor. As of 2007, the Windsor DSD supplied CIL uses in the Shirley T. Holland Industrial Park, located within the DSD, and did not serve any residential customers. Isle of Wight County's agreement with the Town of Windsor is for up to 0.224 mgd. The 2007 CIL use was 0.01 mgd.

The Camptown DSD purchases water from the City of Franklin for residential and CIL use. However, the Camptown DSD did not serve any CIL use customers in 2007. The 2007 water use was an average of 0.090 mgd for approximately 900 people.

In 2007, Isle of Wight County owned and operated nine publicly-owned CWSs that served only residential customers in small neighborhoods. These non-DSD systems provided water to 2,441 people in 2007. In 2010, the County purchased the infrastructure for the Queen Anne's Court system and connected it to the WTWA source.

Table 2-8 summarizes the publicly-owned CWSs in Isle of Wight County.

Table 2-8: 2007 Isle of Wight County Publicly-Owned CWS Use

(all figures in mgd)

System	Residential Use	CIL Use
Bethel Heights	0.004	0.000
Days Point Subdivision	0.011	0.000
Gatling Pointe[1]	0.500	0.000
Rushmere - Burwell's Bay	0.011	0.000
Smithfield Heights -Sandy Mount Manor	0.029	0.000
Tormentor Creek Estates	0.005	0.000
Carrsville	0.016	0.000
Thomas Park Community	0.005	0.000
Zuni	0.005	0.000
Camptown Development Service District[2]	0.090	0.000
Newport Development Service District[3]	0.232	0.125
Windsor Development Service District[4]	0.000	0.005
TOTAL	**0.908**	**0.130**

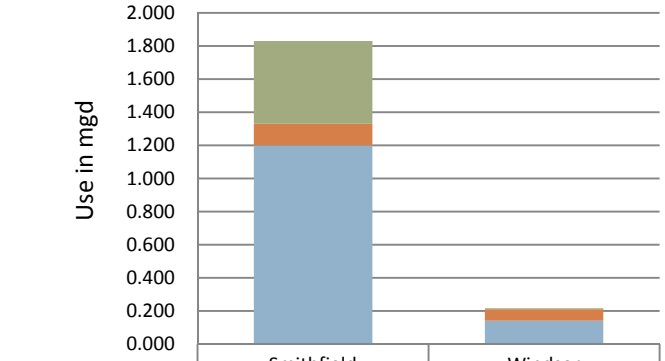
1. Gatling Pointe receives water from Town of Smithfield
2. Camptown DSD receives water from City of Franklin.
3. Newport DSD receives water from Western Tidewater Water Authority
4. Windsor DSD received water from the Town of Windsor

Towns of Smithfield and Windsor: Publicly-Owned Community Water System

The Town of Smithfield's system served 6,750 people in 2007. The total demand for residential use and CIL use was 1.330 mgd. An additional 0.500 mgd was sold to the Gatling Pointe CWS in Isle of Wight County (see Figure 2-21). Smithfield's 2007 water demand was significantly greater than the average annual water demand of 0.83 mgd for 2004 to 2006 and 2008 to 2010. The 2007 annual demand reflects increased water use for extensive construction activity, including frequent water tank draining and water main flushing.

The Town of Windsor's system served 2,300 people, and the total demand for residential and CIL use was 0.211 mgd in 2007. An additional 0.005 mgd was sold to the Windsor DSD in Isle of Wight County. The water service agreement enables the provision of up to 0.224 mgd to the Windsor DSD. The Town holds a DEQ Ground Water Withdrawal Permit for 0.540 mgd (see Figure 2-21).

Figure 2-21
2007 Isle of Wight County: Smithfield and Windsor Publicly-Owned CWS Use by Type (mgd)



	Smithfield	Windsor
Sold to other CWS	0.500	0.005
CIL	0.130	0.070
Residential	1.200	0.141

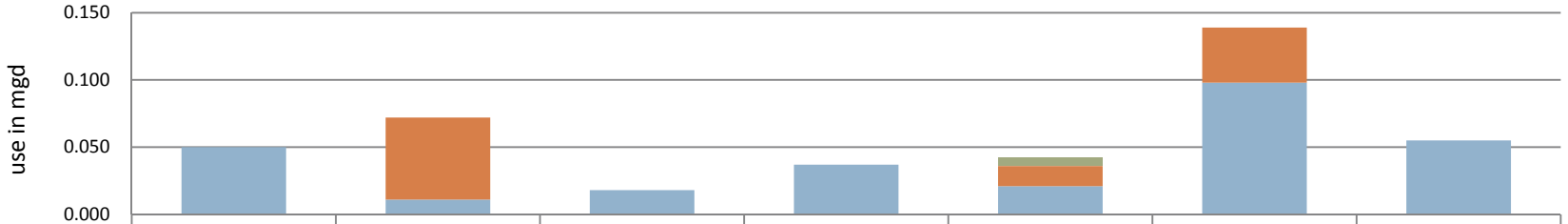
Southampton County: Publicly-Owned Community Water Systems

Southampton County owns and operates four publicly-owned CWSs. The systems served 2,330 people in 2007. Residential demand was 0.12 mgd and CIL demand was 0.06 mgd (see Figure 2-22).

The Incorporated Towns of Capron, Courtland and Ivor each own and operate a publicly-owned CWS. Capron's system served 167 people. Residential demand was 0.21 mgd, CIL demand was 0.02 mgd and heavy industrial demand was less than 0.01 mgd in 2007.

Courtland's system served 1,270 people, and used 0.10 mgd for residential demand and 0.04 mgd for CIL demand in 2007. Ivor's system served 395 people and used 0.06 mgd for residential demand in 2007 (see Figure 2-22).

Figure 2-22
2007 Southampton County, Towns of Capron, Courtland, and Ivor Publicly-Owned CWS Use by Type (mgd)



	SH County: Boykins-Branchville	SH County: Drewryville	SH County: Edgehill	SH County: Town of Newsoms	Capron	Courtland	Ivor
Heavy Industrial	0.000	0.000	0.000	0.000	0.006	0.000	0.000
CIL	0.000	0.061	0.000	0.000	0.015	0.041	0.000
Residential	0.050	0.011	0.018	0.037	0.021	0.098	0.055

City of Franklin: Publicly-Owned Community Water System

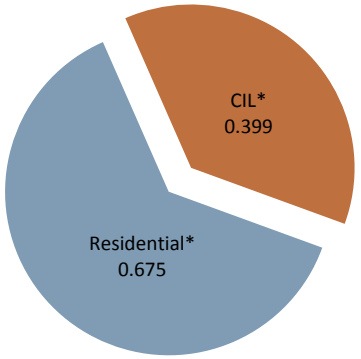
The City of Franklin's publicly-owned CWS served 9,000 people in 2007 and includes two residential areas in Southampton County: Cypress Manor subdivision and a portion of Regency Estates subdivision. The system's total water use in 2007 was 1.074 mgd, which includes residential and CIL use.

Actual 2007 use information does not differentiate between residential and CIL water use. It is possible to estimate 2007 residential use as 0.675 mgd, based on the population served by the CWS and the VDH guidelines of 75 gallons per person per day for domestic use (see Figure 2-23). Given the total water use information for the system, CIL use can then be assumed to be approximately 0.399 mgd. CIL customers include the Pretlow Industrial Park in Franklin and three industrial/commercial sites in Southampton County.

An additional 0.090 mgd of water was sold to the Camptown Development Service District in Isle of Wight County.

Photo: Downtown Franklin, www.wsws.org

Figure 2-23
2007 City of Franklin Publicly-Owned CWS Use by Type (mgd)



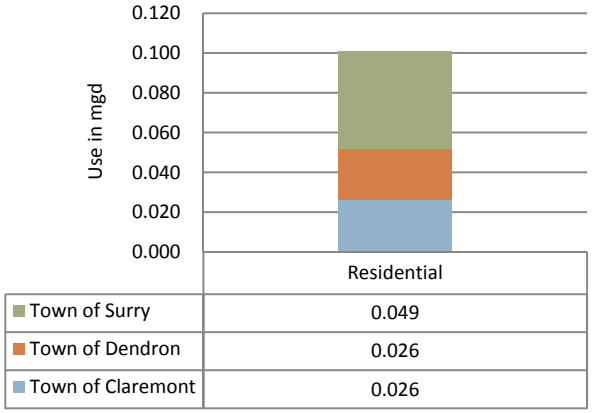
CIL = Commercial, Institutional, Light Industrial
UAW = Unaccounted for Water
*Estimated use

Surry County: Publicly-Owned Community Water Systems

In Surry County, the Incorporated Towns of Claremont, Dendron and Surry each own and operate a publicly-owned CWS that serves only residential use (see Figure 2-24). The Town of Claremont's system served 343 people, and used 0.026 mgd in 2007. Dendron's system served 375 people, and used 0.026 mgd in 2007. Surry's system served 400 people, and used 0.049 mgd in 2007.

Photo: Claremont, VA – James River www.city-data.com

Figure 2-24
2007 Surry County Publicly-Owned CWS Use by Type (mgd)



Privately-Owned Community Water Systems

Forty privately-owned CWS operate in the Western Tidewater sub-region. Together the systems served 7,096 people and used 2.256 mgd in 2007 (see Table 2-9). The City of Franklin and the Towns of Smithfield and Windsor do not have any privately-owned CWSs. Isle of Wight County has the largest population served by privately-owned CWSs.

Isle of Wight County: Privately-Owned Community Water Systems

In Isle of Wight County, 25 privately-owned CWS served 4,148 people and used 1.762 mgd of groundwater in 2007. All water use was residential, with the exception of the Zuni Presbyterian Training Center which hosts CIL uses. Although 13 systems have withdrawals that meet the threshold for a DEQ Ground Water Withdrawal Permit, only 3 of the systems held a permit in 2007.

In 2007, five privately-owned systems are located within the Newport Development Service District's service area: Red Oaks Mobile Home Community, Queen Anne's Court, Ashby Subdivision, Cannon Acres, and Brewer's Creek Subdivision. In 2010, the infrastructure for the Queen Anne's Court system was purchased by the County and connected to the WTWA source.

One privately-owned system is located within the Windsor Development Service District. It can be expected that over time, half those systems will switch to the service district's publicly-owned CWS. These six systems are the only systems that are located within a publicly-owned CWS service area in the County.

Southampton County: Privately-Owned Community Water Systems

In 2007, 13 privately-owned CWS operate in Southampton County. The systems served a total of 2,630 people and used an average of 0.473 mgd in 2007. All water use was residential with the exception of the Southampton Correctional Complex, which hosts CIL uses. Seven systems had withdrawals that met the threshold for a DEQ Ground Water Withdrawal Permit, yet only four systems held permits in 2007. All of the privately-owned CWS in Southampton County are located outside the publicly-owned CWS service areas.

Surry County: Privately-Owned Community Water Systems

Surry County has two privately-owned CWSs that serve only residential demand. Guilford Heights served 150 people and used 0.009 mgd in 2007. Scotland Heights served 170 people and used 0.012 mgd in 2007. The Scotland Heights system meets the threshold for a DEW Ground Water Withdrawal Permit, yet did not hold a permit in 2007. Both of the systems are located outside the publicly-owned CWS service areas.

Table 2-9: 2007 Western Tidewater Privately-Owned Community Water System Use

County	System Name	Use	System Name	Use
Isle of Wight	Ashby Subdivision	0.062	Owen's Subdivision	0.008
	Brewer's Creek	0.029	Queen Anne's Court[1]	0.009
	Cannon Acres	0.015	Red Oaks Mobile Community	0.039
	Bob Steele Waterworks	0.004	Rescue Waterworks	0.011
	Cherry Grove Acres	0.015	Rushmere Shores	0.006
	Clydes Dale Mobile Home Park	0.027	Smithfield Apts	0.009
	Deer Run	0.007	Smithfield MHP	0.008
	Duck's Trailer Court	0.001	Springfield Downs Subdivision	0.012
	Edwards Trailer Park	0.011	Turner Property	0.007
	James River Shores	0.012	Willing Workers Club	0.003
	Lawne's Point	0.001	Wrenn's Mill Estates	1.437
	Longview Acres	0.014	Zuni Presbytarian Training Center[2]	0.004
	The Oaks Mobile Estates Trailer Court	0.011		
			ISLE OF WIGHT COUNTY TOTAL USE	**1.762**
Southampton	Sedley	0.028	Scottswood Subdivision	0.030
	Darden's Mill Estates	0.012	Silverleaf Mobile Home Park	0.010
	Kingsdale Subdivision (Artis)	0.006	Southampton Correctional Complex[2]	0.268
	Kingsdale Subdivision (Moseley)	0.003	Southampton Meadows Mobile Home Park	0.067
	Nottoway Gardens	0.020	Fieldcrest Manufactured Home Community	0.008
	Nottoway Shores	0.008	White Tail Park	0.007
	Southampton County Jail Farm[2]	0.006		
			SOUTHAMPTON COUNTY TOTAL USE	**0.473**
Surry	Guilford Heights	0.009	Scotland Heights	0.012
			SURRY COUNTY TOTAL USE	**0.021**

1. The Queen Anne's Court system was purchased by Isle of Wight County in 2010 and connected to the Western Tidewater Water Authority source.
2. Water use in these systems is for CIL uses (no residential use).

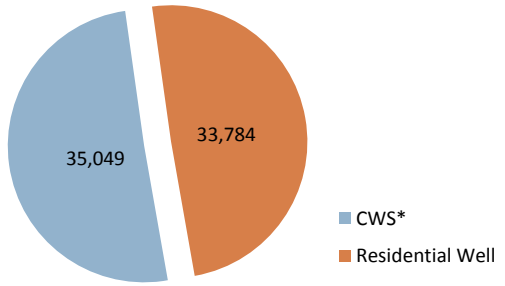
Self-Supplied Users Served by Private Residential or Private Business Wells

An estimated 33,780 people, 49% of the Western Tidewater sub-region population, were served by private residential wells in 2007 (see Figures 2-25 and 2-26). The majority of the wells are located outside a publicly-owned CWS. The estimated total private residential well demand in 2007 was 2.59 mgd. Residential wells use less than 300,000 gallons per month and serve less people than a CWS. Therefore, residential well owners are not required to report their withdrawals to DEQ or VDH. Water use for these systems was calculated using the VDH guideline of 75 gallons per person per day for homes, locality-specific population per household factors, and estimates of the number of households served by residential wells.

- **Isle of Wight County:** 16,093 people. Use = 1.26 mgd.
- **Southampton County:** 12,152 people. Use = 0.91 mgd.
- **Surry County:** 5,534 people. Use = 0.42 mgd.

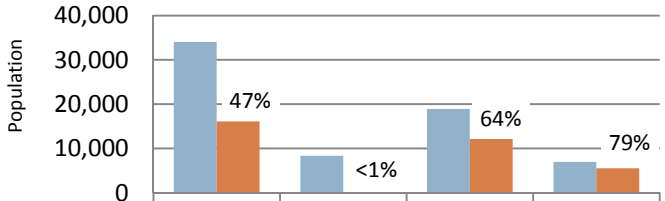
There were 35 businesses served by private wells in 2007, with an estimated total demand of 0.27 mgd. Like private residential wells, businesses that withdraw less than 300,000 gallons per day are not required to report their withdrawals to a state agency. Therefore the use was calculated by following the VDH guidelines for calculating use by type of businesses.

Figure 2-25
2007 Western Tidewater Population Served by Private Residential Wells vs. CWS



*CWS includes publicly- and privately-owned systems

Figure 2-26
2007 Percent of Western Tidewater on Private Residential Wells (mgd)



	IW	FR	SH	SY
Total Population	34,041	8,357	18,942	6,970
Population with private residential well	16,093	5	12,152	5,534

Self-Supplied Users Withdrawing More Than 300,000 Gallons per Month

Non-Agricultural Users: Surface Water Use

In 2007, two self-supplied users withdrawing more than 300,000 gallons per month of surface water for non-agricultural use: International Paper Franklin Mill Plant and the Dominion Surry Nuclear Power Plant (see Table 2-10 and Figure 2-27). International Paper withdrew an average of 4.22 mgd from the Blackwater River in 2007 for manufacturing paper. The Power Plant withdrew an average of 1,774 mgd from the James River in 2007. The water is used for cooling and is largely a non-consumptive use. The Plant discharges close to 100% of the withdrawal back to the James River.

Photo: Blackwater River, www.virginiatrailguide.com

Non-Agricultural Users: Groundwater Use

Ten self-supplied users reported withdrawals of greater than 300,000 gallons per month of groundwater for non-agricultural use (see Table 2-10). The systems used a combined average of 39.9 mgd in 2007. At the time, the largest self-supplied user of groundwater was the International Paper Franklin Mill Plant, which used 32.4 mgd.

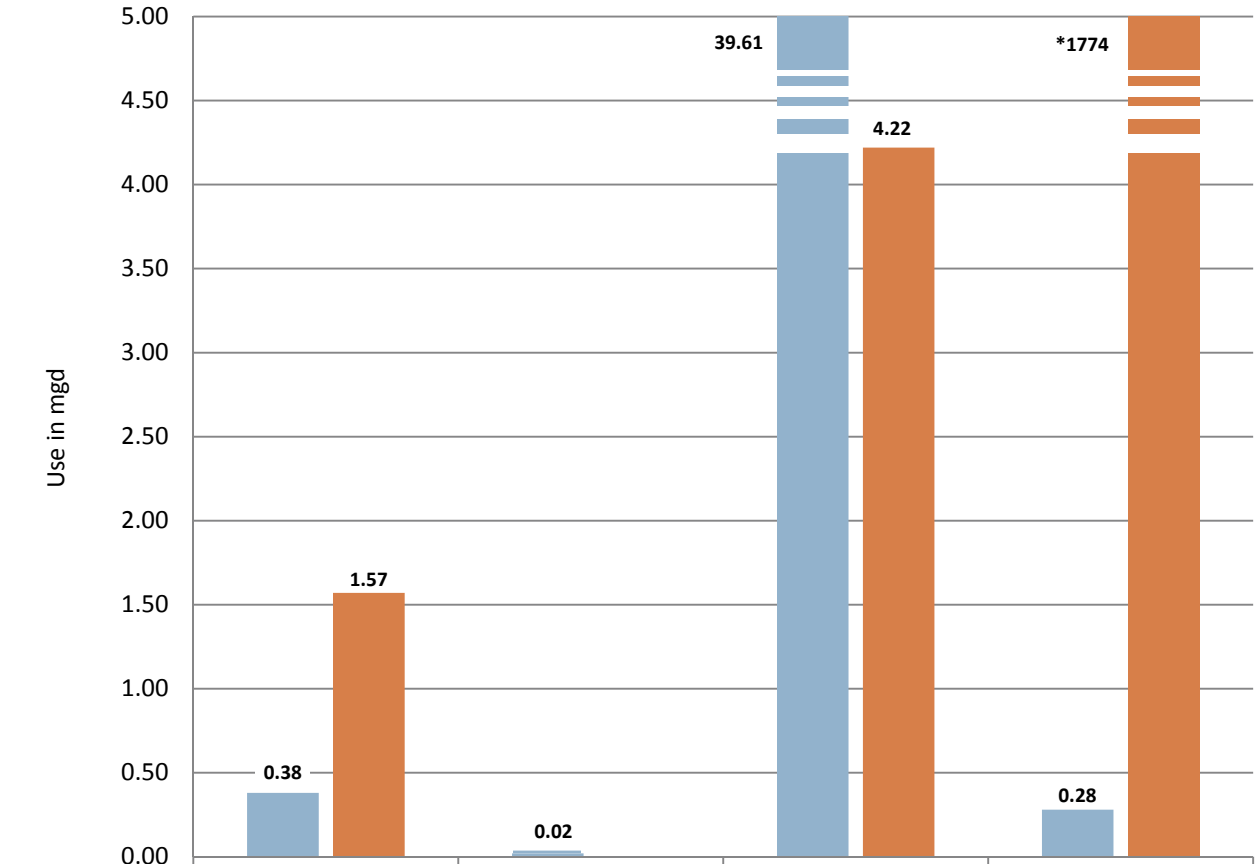
Table 2-10: 2007 Western Tidewater Self-Supplied Non-Agricultural Users >300,000 gallons per month

(all figures in mgd)

System or Business	Source	Use	Estimated Annual Average Use
Hercules Incorporated	GW	Man	5.26
International Paper Franklin Mill Plant	SW	Man	4.22
International Paper Franklin Mill Plant	GW	Man	32.37
Narricot Industries Incorporated	GW	Man	0.09
Richmond Cold Storage Incorporated	GW	Man	0.02
Smithfield Foods Incorporated - Gwaltney	GW	Man	1.35
Smithfield Foods Incorporated - Packing Company	GW	Man	0.50
Smithfield Packing Co. Inc - Ham and Products Division	GW	Man	0.02
Southampton County Agribusiness Industrial Park	GW	Com	0.01
Surry County Public Schools	GW	Com	0.01
Surry Nuclear Power Plant	SW	Pn	1,774.00
Surry Nuclear Power Plant	GW	Pn	0.28

Com = Commercial | Man = Manufacturing | Pn = Nuclear Power
GW = Groundwater | SW = Surface water

Figure 2-27
2007 Western Tidewater Self-Supplied Use > 300,000 gallons per month (mgd)



	Agriculture	Commercial	Manufacturing	Power
Groundwater	0.38	0.02	39.61	0.28
Surface water	1.57	0.00	4.22	1774.00

Agricultural Users

Photo: Farm, HRPDC

In 2007, 13 supplied agricultural users reported withdrawing more than 300,000 gallons per month of surface water and/or groundwater. Groundwater use was 0.38 mgd, and surface water use was 1.57 mgd in 2007. The largest agricultural use of surface water was by the Franklin Turfgrass Inc. - River Road Farm with 0.60 mgd. Murphy Brown LLC Isle of Wight Farms - Carrolls 1-5 had the largest groundwater use in 2007 with 0.12 mgd (see Table 2-11).

Based on the U.S. Department of Agriculture National Agricultural Statistics Service data for the Western Tidewater sub-region, cattle used an average of 0.05 mgd of surface water and the same amount of groundwater in 2007. Horses used an average of 0.01 mgd of surface water and the same amount of groundwater in 2007. The calculation is based on 12 gallons per day per cow and per horse. The number of cattle and horses in Isle of Wight County estimated by the USDA National Agricultural Statistics Service was used to calculate the water needs of these livestock. Based on 7,900 cattle and 1,900 horses, livestock water use was approximately 60,000 gallons per day (0.06 mgd).

Table 2-11: 2007 Western Tidewater Self-Supplied - Agricultural Users >300,000 gallons per month

(all figures in mgd)

System or Business	Source	Estimated Annual Average Use
Phillip Edwards	SW	0.01
Bennett Creek Wholesale Nursery	SW	0.40
Cox Farm	SW	0.02
Davis Farm	SW	0.05
Davis Farm	GW	0.03
Franklin Turfgrass Inc.-River Road Farm	SW	0.60
Gray Lumber Company - Bacons Castle Farm	SW	0.09
John T Butler, Jr	SW	0.05
Murphy Brown LLC Isle of Wight Farms - Carrolls 1-5	GW	0.12
Murphy Brown LLC Smithfield Carrolls Farm 16-17	GW	0.04
Murphy Brown LLC Smithfield Carrolls Farm 6-8	GW	0.06
Murphy Brown LLC Smithfield Carrols Farm 9, 10, 21	GW	0.07
Southern Belle Turf Farms	SW	0.02
Sunset View Farm	SW	0.29

GW = Groundwater | SW = Surface water

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Section 3 | **Existing Resources**

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Geological Conditions

The Hampton Roads region relies on groundwater to support many community water systems and self-supplied commercial and industrial users. The entire region is located in the Virginia Coastal Plain physiographic province.

The Coastal Plain is underlain by a seaward-thickening wedge of eastward-dipping layers of aquifers and confining units. The sediment wedge in Virginia ranges from zero feet at its western margin near Richmond to more than 6,000 feet along the Atlantic coast. Coastal Plain sediments in Virginia were further affected by the impact of an asteroid or comet that crashed near the mouth of the Chesapeake Bay (Powars and Bruce, 1999). The Chesapeake Bay impact crater is greater than 50 miles in diameter and extends across a large part of the southeastern Virginia Coastal Plain.

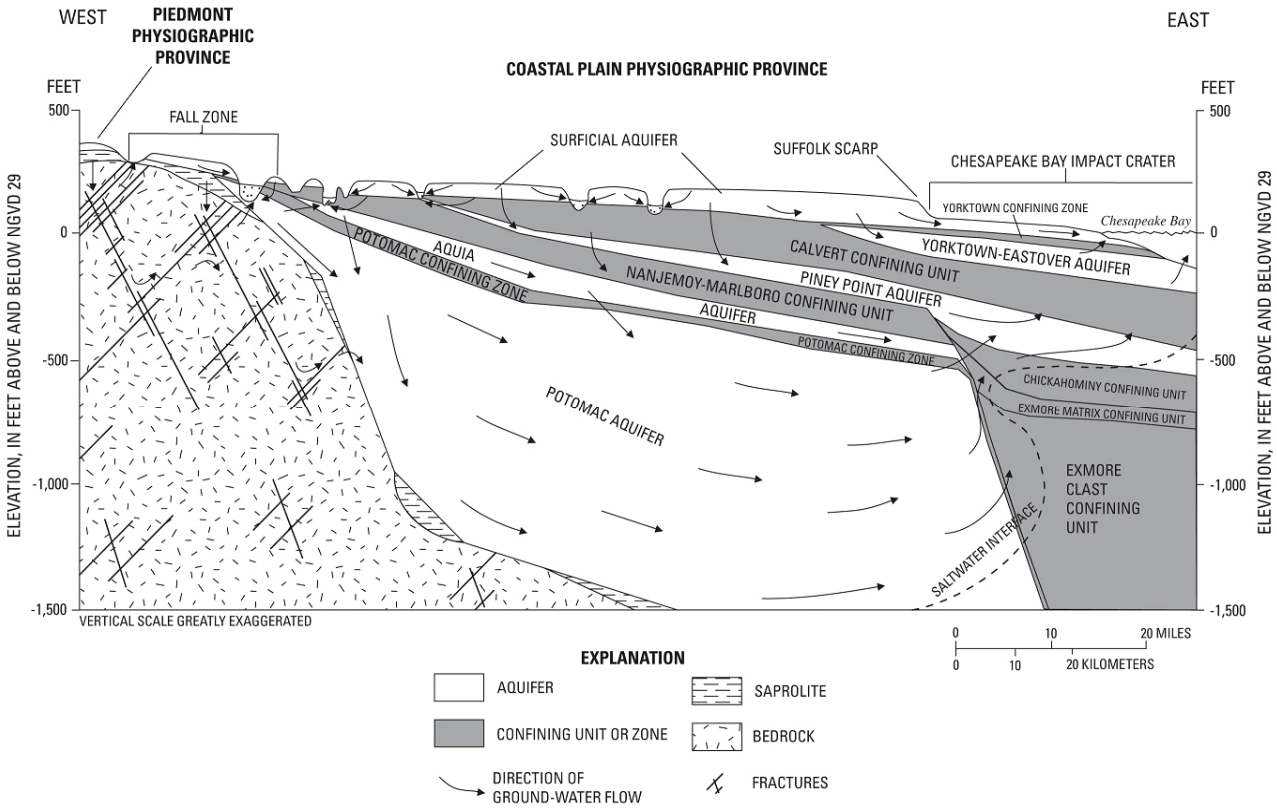
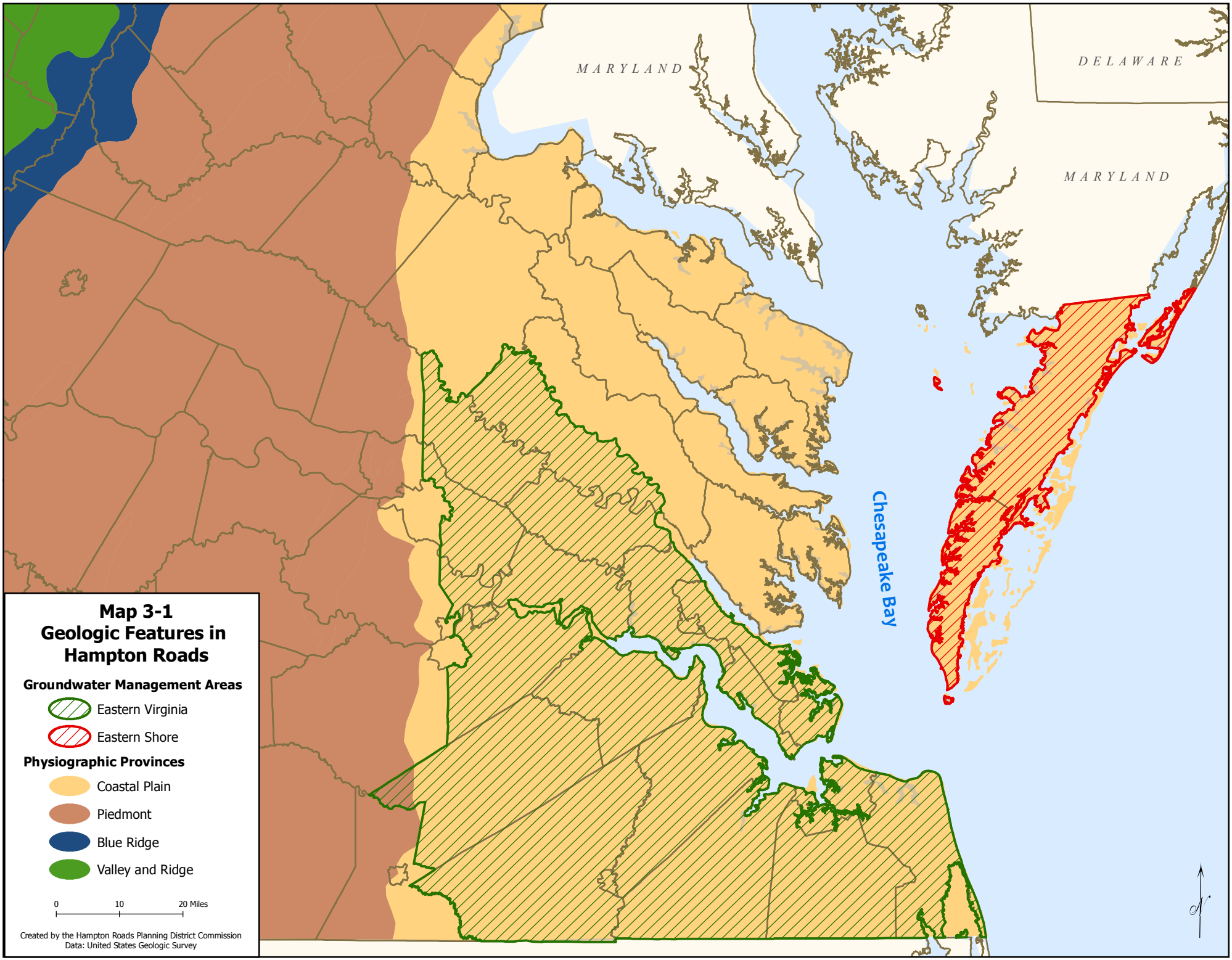


Figure 3-1: Cross-section of Coastal Plain aquifer system (McFarland & Bruce, 2006).

The crater was formed over 35 million years ago and has impacted the groundwater quality and flow pattern within the region. Additional information on the Chesapeake Bay impact crater is discussed in the "Unusual Geologic Formations" section of this chapter.

The permitted groundwater users in the Coastal Plain have reported withdrawal rates totaling approximately 100 mgd for the last decade. Additionally, the unregulated withdrawal rates are estimated to be 20-30 mgd. As a result of long-term withdrawals, groundwater levels in the Coastal Plain aquifers have declined by as much as 200 feet near large withdrawal centers. Flow gradients have been altered from a previously seaward direction to a landward direction (Harsh and Laczniak, 1990), creating the potential for saltwater intrusion.

All localities in the Hampton Roads region except Gloucester County are in the Eastern Virginia Ground Water Management Area (see Map 3-1). All users in the management area that withdraw over 300,000 gallons per month must receive a permit from DEQ.


MARYLAND
DELAWARE
MARYLAND
Chesapeake Bay
Map 3-1
Geologic Features in
Hampton Roads
Groundwater Management Areas
Eastern Virginia
Eastern Shore
Physiographic Provinces
Coastal Plain
Piedmont
Blue Ridge
Valley and Ridge
0
10
20 Miles
Created by the Hampton Roads Planning District Commission
Data: United States Geologic Survey

Groundwater withdrawal permits continue to receive a lot of scrutiny due to concerns that the groundwater resource might not support all the requested withdrawals. The overall yield of the aquifer system cannot be determined because of the complexity of the system.

The USGS report "The Virginia Coastal Plain Hydrogeologic Framework" by McFarland and Bruce provides a comprehensive description of the aquifer system in the Hampton Roads region.

Hydrologic Conditions

Hydrologic Units

Hydrologic units are drainage areas delineated within a multi-level hierarchical drainage system. Hydrologic units may accept water from one or more points outside of the unit's boundary or have multiple outlet points in addition to the surface waters collected within the boundary.

A numeric code is used to identify hydrologic units. Regions are the largest hydrological units and are designated by two-digit codes. The hydrologic conditions of Hampton Roads can best be visualized through the U.S. Geological Survey Hydrologic Unit Code (HUC) at the eight-digit level (HUC 8). HUC 8 codes are used to designate sub-basins or major watersheds. Map 3-2 shows the HUC 8 sub-basins that are located entirely or partially within the Hampton Roads region. A short description of the Hydrologic Unit Region, Subregion, Basin and Sub-basin or watersheds of Hampton Roads follows below.

Map 3-2 was created with a U.S. Department of Agriculture, National Cartography & Geospatial Center dataset compiled to provide the National Water Quality Assessment (NAWQA) study units with intermediate-scale river basin boundaries. The data set is designed for use as a reference source and not as a regulatory tool.

Mid-Atlantic Region (02)

Part of the Hampton Roads Planning District lies within the Mid-Atlantic Region of the United States. This region contains all drainage within the United States that ultimately discharges into the Atlantic Ocean (between the states of New York and Virginia), Long Island Sound (south of the New York-Connecticut State Line), and the Riviere Richelieu (tributary of the St. Lawrence River). This region includes all of Delaware, New Jersey, and the District of Columbia, and parts of Connecticut, Maryland, Massachusetts, New York, Pennsylvania, Vermont, Virginia, and West Virginia.

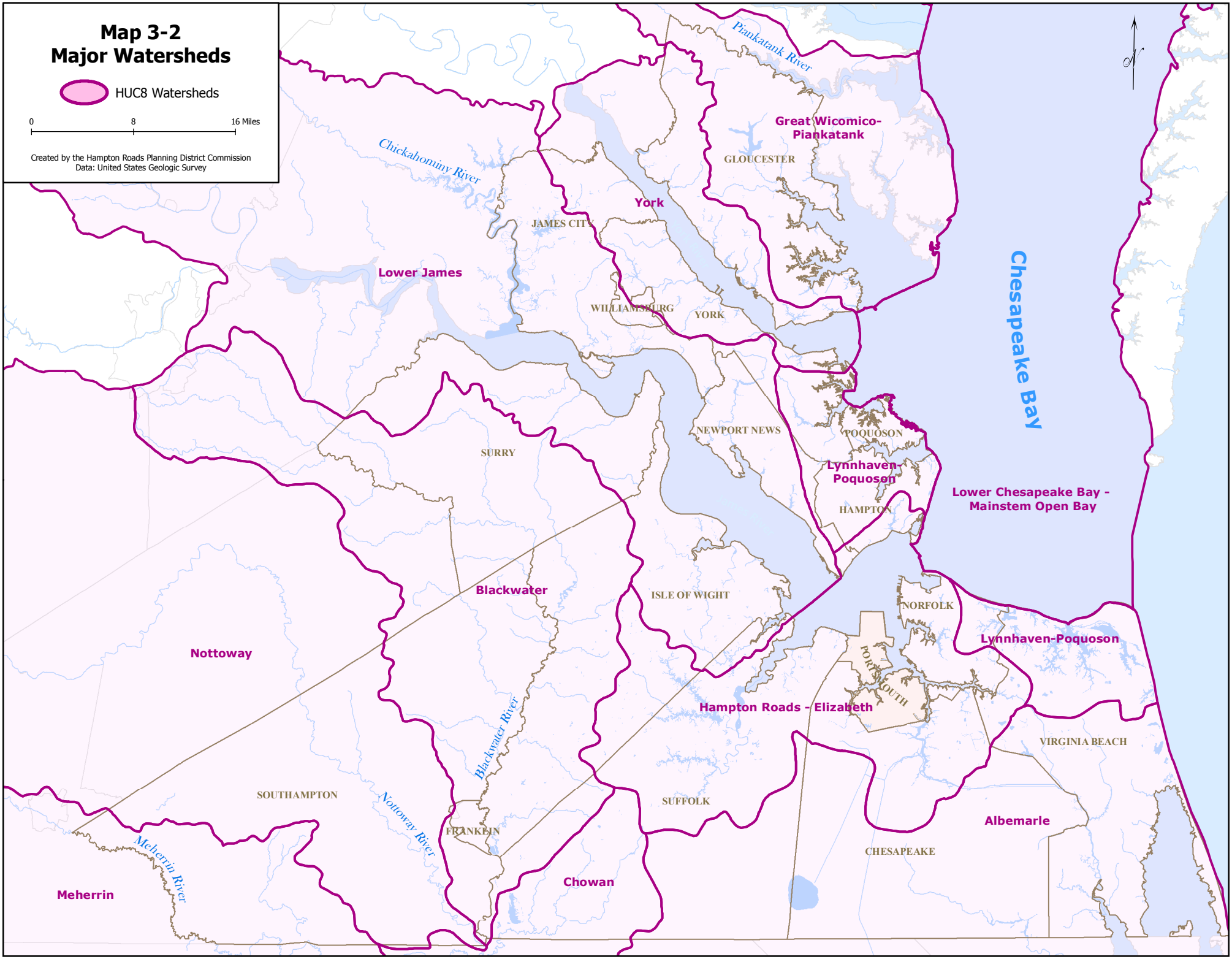
The Mid-Atlantic Region is further divided into subregions, identified by a four-digit hydrological unit code. The Lower Chesapeake subregion (0208) is contained within Virginia and West Virginia and includes drainage to the Chesapeake Bay and its tributaries south of the Maryland-Virginia state line, excluding the Pocomoke River drainage, and the Coastal drainage from the Chincoteague Inlet on the Delmarva Peninsula to the Back Bay drainage boundary. The total area of the Lower Chesapeake Region is 18,500 square miles.

Lower Chesapeake Subregion (0208)

The Lower Chesapeake subregion is split into several major river basins. Hampton Roads contains portions of three of those basins: the James River Basin, the York River Basin and the Chesapeake Bay and Small Coastal Basin.

James River Basin

The James River Basin occupies the central portion of Virginia and covers 10,200 square miles or approximately 25 percent of the Commonwealth's total land area as Virginia's largest river basin. The James River headwaters originate along the Virginia and West Virginia state line. The James River Basin begins in the Alleghany Mountains and flows in a southeasterly direction to Hampton Roads where it enters the Chesapeake Bay.


Map 3-2
Major Watersheds
HUC8 Watersheds
0
8
16 Miles
Created by the Hampton Roads Planning District Commission
Data: United States Geologic Survey
Pamunkey River
Chickahominy River
Great Wicomico-Piankatank
GLOUCESTER
York
JAMES CITY
Lower James
WILLIAMSBURG
YORK
Chesapeake Bay
NEWPORT NEWS
POQUOSON
SURRY
Lynnhaven-Poquoson
Lower Chesapeake Bay - Mainstem Open Bay
HAMPTON
Blackwater
ISLE OF WIGHT
NORFOLK
Lynnhaven-Poquoson
Nottoway
PORTSMOUTH
Hampton Roads - Elizabeth
Blackwater River
VIRGINIA BEACH
SOUTHAMPTON
Nottoway River
SUFFOLK
Albemarle
Meherrin River
FRANKLIN
CHESAPEAKE
Chowan
Meherrin

The James River is formed by the confluence of the Jackson and Cowpasture Rivers, and flows 228 miles to the Fall Line at Richmond and another 111 miles to the Chesapeake Bay. Major tributaries to the James River include the Jackson River, Cowpasture River, Craig Creek, Maury River, Tye River, Rockfish River, Slate River, Rivanna River, Willis River, Appomattox River, Chichahominy River, Pagan River, Chuckatuck Creek, Nansemond River, and the Elizabeth River.

The James River Basin is divided into seven smaller sub-basins identified by HUC 8 codes (see Table 3-1).

Table 3-1: James River Basin USGS HUC 8 Sub-Basins

Sub-Basin Name	Area (square miles)	HUC 8 Code
Upper James (Beginning in West Virginia)	2,210	02080201
Maury	818	02080202
Upper Middle James - Buffalo	1,990	02080203
Rivanna	758	02080204
Middle James - Willis	948	02080205
Lower James	1,440	02080206
Appomattox	1,590	02080207
Hampton Roads - Elizabeth	425	02080208

Portions of the Lower James and Hampton Roads - Elizabeth sub-basins are located in Hampton Roads. The James River Basin is divided into 92 different watersheds.

York River Basin

The York River Basin lies in the central and eastern section of Virginia and covers 2,626 square miles or 7 percent of the Commonwealth's total area. The headwaters of the York River begin in Orange County and flow in a southeasterly direction for approximately 220 miles to its mouth at the Chesapeake Bay. The basin is comprised of the York River and its two major tributaries, the Pamunkey and the Mattaponi Rivers. The York River itself is only about 30 miles in length.

The York River Basin is divided into USGS HUC 8 sub-basins as listed in Table 3-2. Portions of the York sub-basin are located within Hampton Roads. The York River Basin is divided into 23 watersheds.

Table 3-2: York River Basin USGS HUC 8 Sub-Basins

Sub-Basin Name	Area (square miles)	HUC 8 Code
Mattaponi	901	02080105
Pamunkey	1,450	02080106
York	275	02080107

Chesapeake Bay and Small Coastal Basin

The Chesapeake Bay and Small Coastal Basin is located in the eastern part of Virginia and covers 3,003 square miles. The basin encompasses the small bays, river inlets, islands and shoreline immediately surrounding the Chesapeake Bay and the southern tip of the Delmarva Peninsula. This basin also includes the Chesapeake Bay.

Major tributaries flowing into the Chesapeake Bay from the western shore are the Great Wicomico River, Piankatank River, Fleets Bay, Mobjack Bay including the East, North, Ware, and Severn Rivers, Poquoson River, Back River and Lynnhaven River. Tributaries in the

Eastern Shore portion that drain into the Bay include Pocomoke, Onancock, Pungoteague, Occohannock, and Nassawadox Creeks. The Machipongo River, Assawoman Creek, Parker Creek, Folly Creek, and Finney Creek drain east directly into the Atlantic Ocean.

The Chesapeake Bay and Small Coastal Basin is divided into HUC 8 sub-basins as listed in Table 3-3.

Table 3-3: Chesapeake Bay and Small Coastal Basin USGS HUC 8 Sub-Basins

Sub-Basin Name	Area (square miles)	HUC 8 Code
Lower Chesapeake Bay - Mainstem Open Bay	1,390	02080101
Great Wicomico-Piankatank	605	02080102
Lynnhaven - Poquoson (Lower Western Shore)	213	02080108
Western Lower Delmarva	338	02080109
Eastern Lower Delmarva	457	02080110

Portions of the Lower Chesapeake Bay - Mainstem Open Bay, Great Wicomico - Piankatank, and Lynnhaven - Poquoson sub-basins are located within Hampton Roads. The Chesapeake Bay and Small Coastal Basin is divided into 31 watersheds.

South Atlantic-Gulf Region (03)

A portion of Hampton Roads is within the South Atlantic-Gulf Region of the United States which contains all areas where the drainage ultimately discharges into:

- the Atlantic Ocean between the states of Virginia and Florida; and
- the Gulf of Mexico between the states of Florida and Louisiana and associated waters.

This region includes all of Florida and South Carolina, and parts of Alabama, Georgia, Louisiana, Mississippi, North Carolina, Tennessee, and Virginia.

The South Atlantic - Gulf Region is further divided into subregions. The Chowan - Roanoke subregion is contained within Virginia and North Carolina and includes the coastal drainage and associated waters from and including the Back Bay drainage to Oregon Inlet. The total area of the Chowan-Roanoke subregion is 18,300 square miles.

Chowan - Roanoke Subregion (0301)

The Chowan - Roanoke subregion is split into several major river basins. Hampton Roads contains portions of one basin, the Albemarle - Chowan Basin.

Albemarle - Chowan Basin

The Albemarle - Chowan River Basin is located in southeastern Virginia and northeastern North Carolina and covers 8,651 square miles. The total land area within the Commonwealth is 4,061 miles or approximately 10 percent of the Commonwealth's total area. The Basin extends eastward from Charlotte County to the Chesapeake Bay. The basin is approximately 145 miles in length and varies from 10 to 50 miles in width.

Major tributaries of the Chowan River are the Meherrin, the Nottoway and the Blackwater. The Nottoway and the Blackwater join at the Virginia/North Carolina state line to form the Chowan River. The Dismal Swamp portion is mostly flat with many swamp and marshland areas. The Chowan and Roanoke rivers are the largest of many streams flowing into Albemarle Sound. The Chowan River-Dismal Swamp Basin is divided into five sub-basins as listed in Table 3-4. The Albemarle - Chowan Basin is divided into 44 watersheds.

Table 3-4: Albemarle - Chowan Basin USGS HUC 8 Sub-Basins

Name	Area (square miles)	HUC 8 Code
Nottoway (North Carolina and Virginia)	1,700	03010201
Blackwater (North Carolina and Virginia)	744	03010202
Chowan (North Carolina and Virginia)	857	03010203
Meherrin (North Carolina and Virginia)	1,600	03010204
Albemarle (North Carolina and Virginia)	3,750	03010205

Meteorological Conditions

The entire Hampton Roads region enjoys mild winters with warm, humid summers. In addition to summer thunderstorms, Nor'easters and tropical storms bring significant rainfall to the region. According to the National Climatic Data Center (NCDC), the most frequently reported weather events in the region are thunderstorms, severe lightning, high winds, and flash flooding. Hurricanes occasionally bring heavy rain, high winds, and tidal flooding. The most significant weather events in recent years were the 2009 Nor'easter, Hurricane Isabel, which struck on September 18, 2003, and Hurricane Floyd, which struck on September 16, 1999. All three storms caused flooding and extensive damage throughout the Hampton Roads region.

The average annual rainfall and temperature data for the region were gathered from the Southeast Regional Climate Center, a national climate services program supported by the National Climatic Data Center (NCDC). For the purposes of this report, NCDC data from four selected weather stations, listed in Table 3-5, is presented as representative of the Hampton Roads region. The weather station locations are depicted on Map 3-3.

Throughout Hampton Roads January is the coldest month on average, while July is the hottest. More than 40 inches of annual rainfall is well distributed throughout the year, with the wettest months typically being July and August. The Hampton Roads coastal communities are subject to onshore winds that moderate temperature extremes. Table 3-6 provides a regional climate summary.

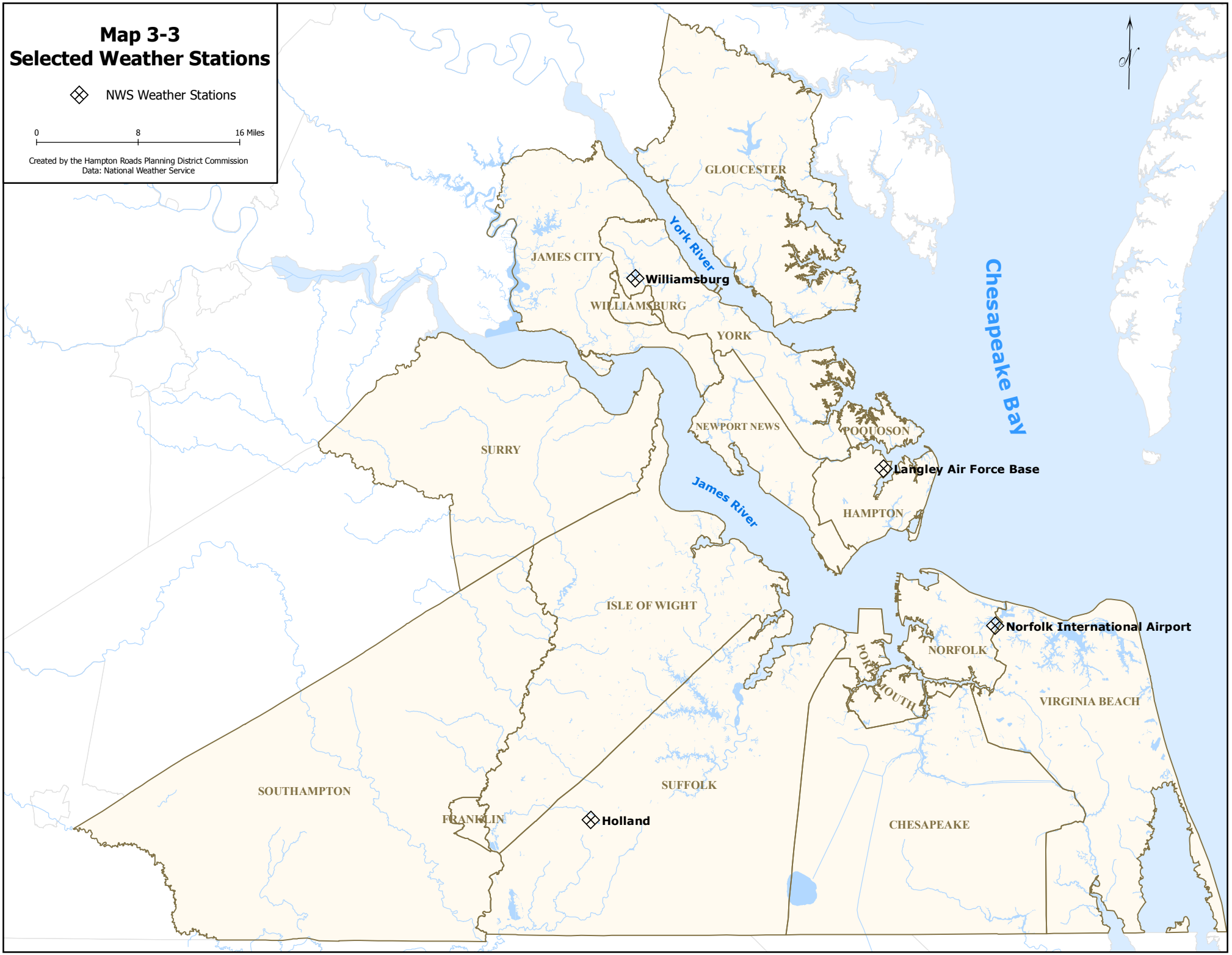
Figures 3-2 to 3-5 depict monthly Historic Climate Data for the four selected Hampton Roads Weather Stations.

Table 3-5: Selected Weather Stations

Name	Location	Subregion	Period of Record
Langley Air Force Base	Hampton	Peninsula	1918 – 2007
Williamsburg	Williamsburg	Peninsula	1948 – 2008
Holland	Suffolk	Southside and Western Tidewater	1933 – 2008
Norfolk Weather Service Office (WSO) Airport	Norfolk	Southside	1946 – 2008

Table 3-6: Annual Meteorological Averages

Weather Station	Maximum Temperature (Fahrenheit)	Minimum Temperature (Fahrenheit)	Mean Temperature (Fahrenheit)	Total Precipitation (Inches)
Langley Air Force Base	67.5	51.3	59.4	43.59
Williamsburg	69.9	47.6	58.7	47.46
Holland	70.2	47.4	58.8	48.36
Norfolk Weather Service Office (WSO) Airport	68.5	51.4	59.9	45.26


Map 3-3
Selected Weather Stations
NWS Weather Stations
0
8
16 Miles
Created by the Hampton Roads Planning District Commission
Data: National Weather Service
GLOUCESTER
JAMES CITY
Williamsburg
WILLIAMSBURG
YORK
York River
Chesapeake Bay
NEWPORT NEWS
POQUOSON
SURRY
Langley Air Force Base
James River
HAMPTON
ISLE OF WIGHT
Norfolk International Airport
NORFOLK
PORTSMOUTH
VIRGINIA BEACH
SOUTHAMPTON
SUFFOLK
FRANKLIN
Holland
CHESAPEAKE

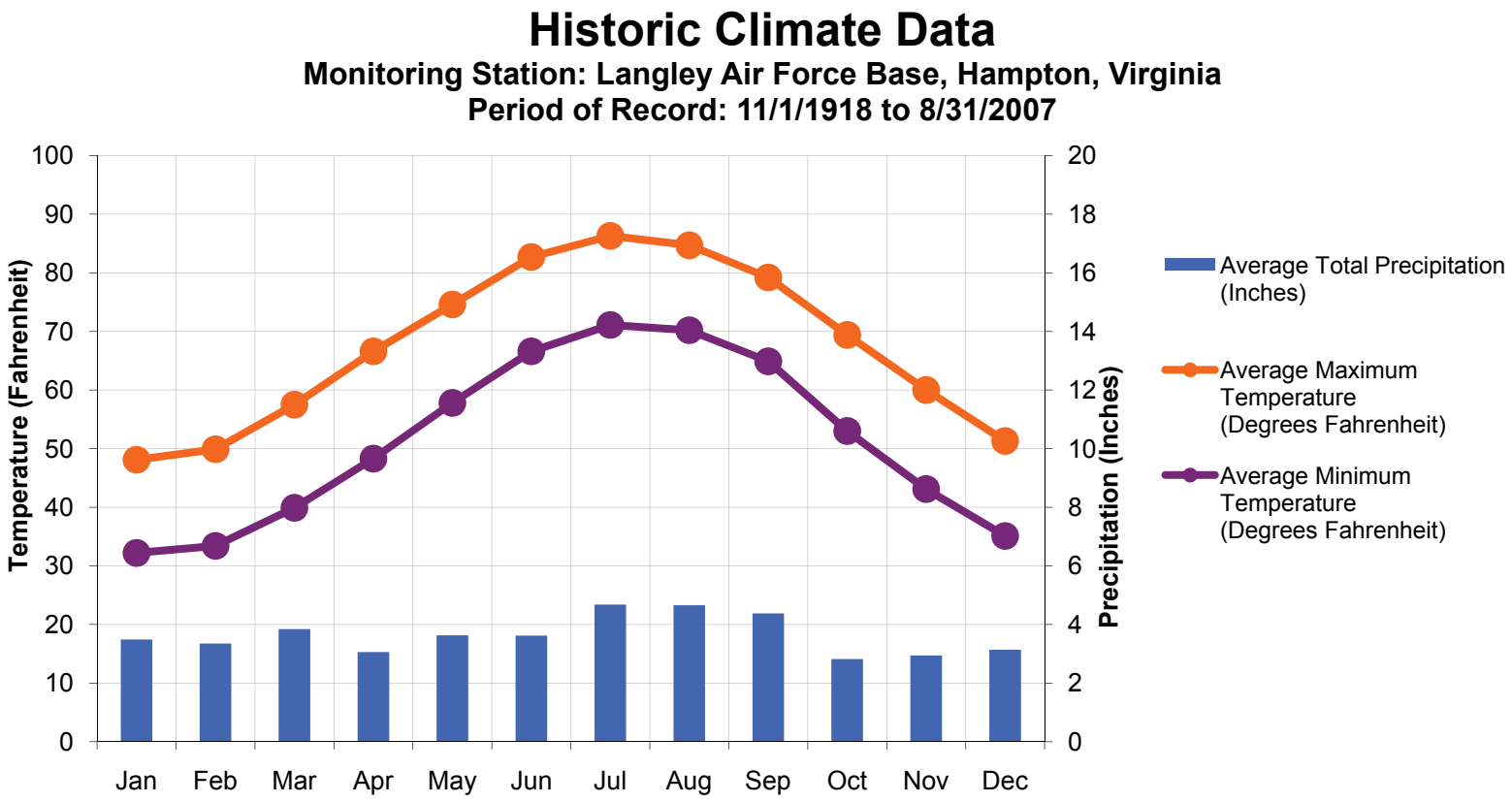


Figure 3-2: Historic climate data from monitoring station in Hampton, Virginia.

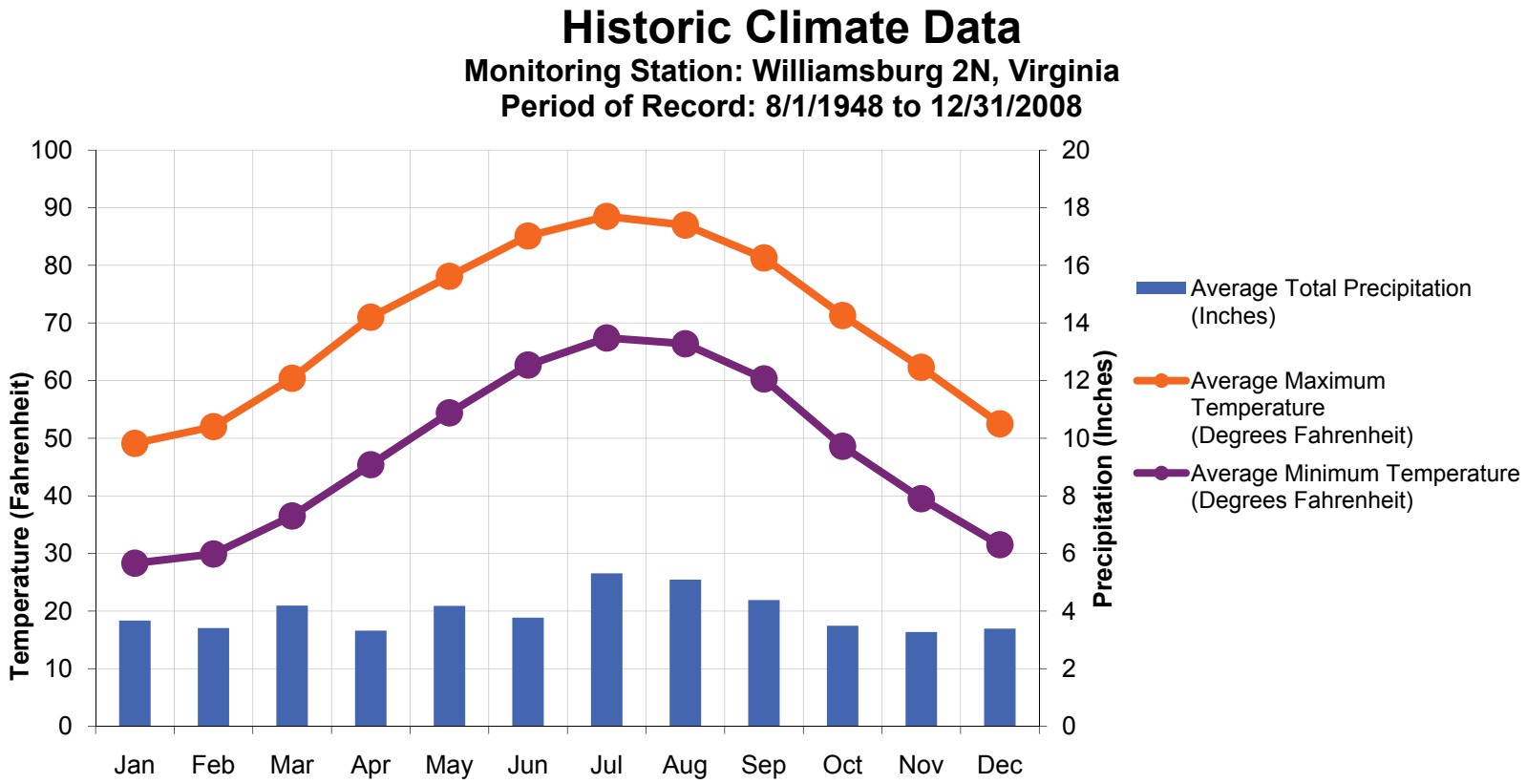


Figure 3-3: Historic climate data from monitoring station in Williamsburg, Virginia.

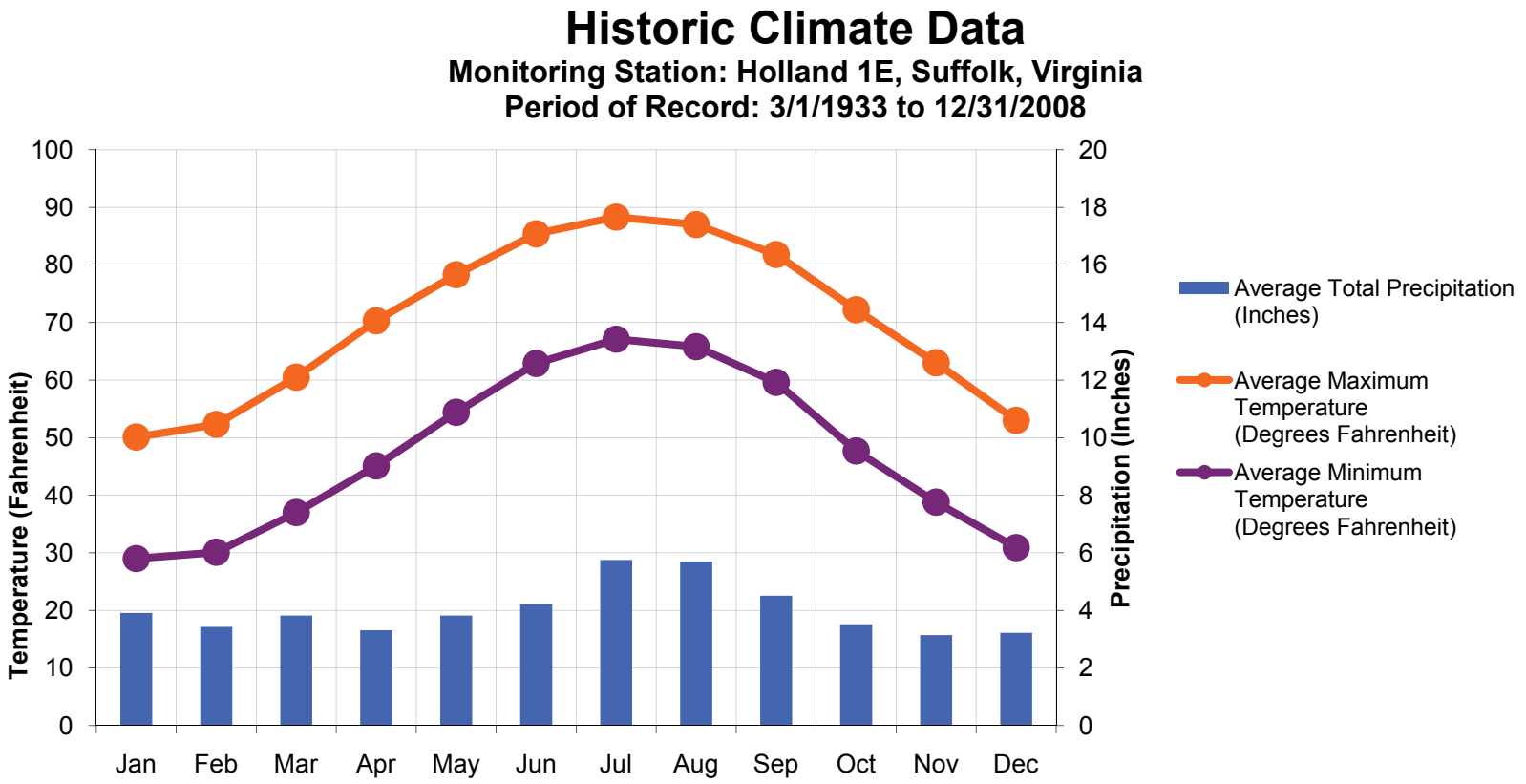


Figure 3-4: Historic climate data from monitoring station in Suffolk, Virginia.

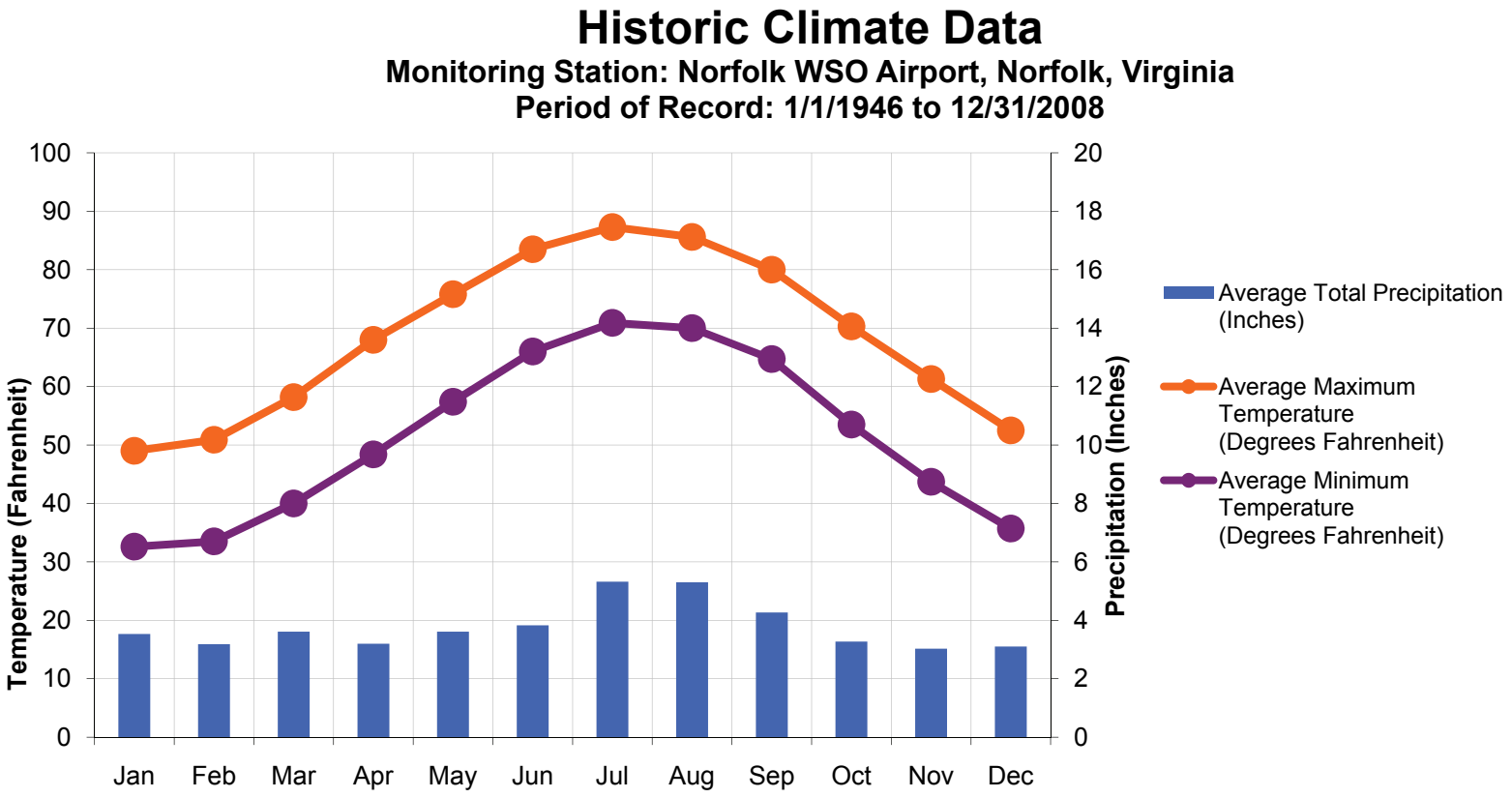


Figure 3-5: Historic climate data from monitoring station in Norfolk, Virginia.

State and Federal Listed Threatened or Endangered Species and Habitats of Concern

The Virginia Fish and Wildlife Information Service (VFWIS) online database contains a list of species known or likely to occur within defined administrative units. The dataset identifies those species that are listed as state or federal threatened or endangered species or habitats of concern and includes the species' common name, the species' scientific name, the species' code, and the protective status of the species. The list of species from the Hampton Roads region is extensive. The list can be accessed by becoming a registered subscriber at http://vafwis.org/fwis/.

The Virginia Department of Conservation and Recreation (DCR) maintains a natural heritage inventory that is the most comprehensive statewide inventory documenting the location and ecological status of Virginia's natural heritage resources, which are defined as the "habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest" (DCR). Habitats are classified by DCR according to ecological community groups. Ecological community groups that pertain to, or may affect, in-stream flow, in-stream uses, and water resources that currently provide water sources to Hampton Roads communities are as follows:

- **Pine/Scrub Oak Sandhills:** Suitable habitats for pine / scrub oak sandhills are mainly the slightly elevated sand deposits stretching along the eastern sides of the Blackwater and Nottoway Rivers in Sussex, Southampton, and Isle of Wight Counties and the City of Suffolk (DCR). Figure 3-6 shows longleaf pine, giant cane, and huckleberries at Blackwater Ecological Preserve, Isle of Wight County (photo by Gary P. Fleming / © DCR Natural Heritage).

Figure 3-6: Blackwater Ecological Preserve

- **Fluvial Terrace Woodlands:** Occurrences have been documented along the Nottoway River, Chickahominy River, Dragon Swamp, and Mattaponi River. The first two sites are current water supplies for localities in Hampton Roads (DCR).
- **Bald Cypress – Tupelo Swamps:** Valuable wildlife habitat and resources exist in this ecological community. Old-growth stands of bald cypress-dominated swamps, with trees up to 800 years old, occur along the Blackwater River in Surry and Isle of Wight Counties. The largest bald cypress and water tupelo trees grow in swamps along the Nottoway River in Southampton County (DCR). Figure 3-7 shows a bald cypress forest in Carbell Swamp, Isle of Wight County (photo by Gary P. Fleming / © DCR Natural Heritage).

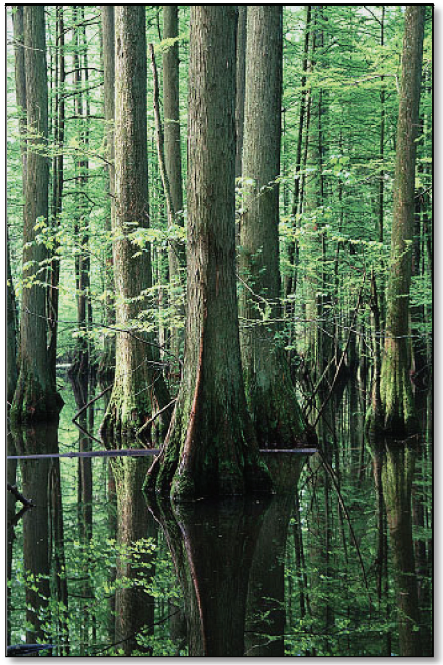


Figure 3-7: Carbell Swamp

- **Coastal Plain / Piedmont Swamp Forests:** This group includes forested, seasonally and semi-permanently flooded bottomland Coastal Plain sites and outer Piedmont sites that are not occupied by Bald Cypress - Tupelo Forests (DCR), including the Chickahominy River. Figure 3-8 shows a seasonally flooded swamp forest with green ash and lizard's-tail at Beaverdam Creek, Colonial National Historical Park, York County (photo by Gary P. Fleming / © DCR Natural Heritage).

Figure 3-8: Beaverdam Creek swamp forest

- **Coastal Plain / Piedmont Floodplain Forests:** This forest group is located in temporarily flooded, well-drained floodplains and bottomland terraces of the Coastal Plain and outer Piedmont, which includes the Nottoway River (DCR). Figure 3-9 shows a small-stream floodplain forest along Beaverdam Creek, Colonial National Historical Park, York County. Dominant trees include sweetgum, tulip-poplar, and sycamore (photo by Gary P. Fleming / © DCR Natural Heritage).

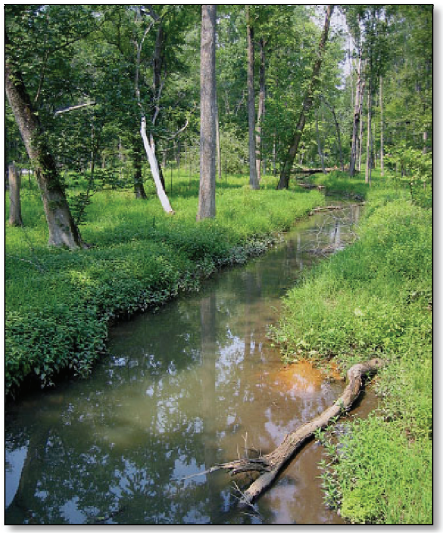


Figure 3-9: Beaverdam Creek floodplain forest

- **Tidal Bald Cypress Forests and Woodlands:** Examples of this coniferous or mixed swamp forest and woodlands dominated by bald cypress are documented in the Chickahominy River (DCR). Figure 3-10 shows a tidal bald cypress forest along the James River near Swanns Point, Surry County. Floating and submersed aquatics such as common duckweed and common hornwort dominate the herbaceous flora (photo by Gary P. Fleming / © DCR Natural Heritage).

Figure 3-10: James River near Swanns Point

- **Tidal Freshwater and Oligohaline Aquatic Beds:** Examples of this vegetation are found along the Northwest River and the Chickahominy River (DCR). Figure 3-11 shows a large aquatic bed along a tributary of the wind-tidal Northwest River in the City of Chesapeake. American water-lily, common hornwort, and greater bladderwort are abundant here (photo by William H. Moorhead III / © DCR Natural Heritage).

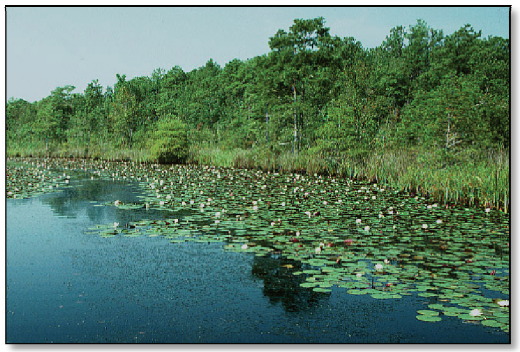


Figure 3-11: Northwest River tributary

Anadromous, Trout and Other Significant Fisheries

Anadromous Fish

Anadromous fish are those that spend all or part of their adult life in salt water and return to freshwater streams and rivers to spawn. Several common anadromous fish found in Virginia include alewife (Alosa pseudoharengus), blueback herring (Alosa aestivalis), American shad (Alosa sapidissima), hickory shad (Alosa mediocris), striped bass (Morone americana), and some populations of yellow perch (Perca flavescens).

Several anadromous fish use areas have been identified within or adjacent to the Hampton Roads regional water supply planning area. Areas with anadromous fish presence are indicated on Map 3-4 and are described in additional detail in the Virginia Department of Game and Inland Fisheries Fish and Wildlife Information service website (http://vafwis.org/fwis/). Information for the map was acquired from the Virginia Department of Game and Inland Fisheries. The Chickahominy, Blackwater, and Nottoway Rivers are used as sources for community water system supply and confirmed anadromous fish reaches are located along each river.

Trout

Several species of trout are found within the Commonwealth of Virginia (brook trout, brown trout and rainbow trout), yet few species are present in the Southeast portion of the State. According to the Virginia Fish and Wildlife Information Service, rainbow trout have been reported in James City County.

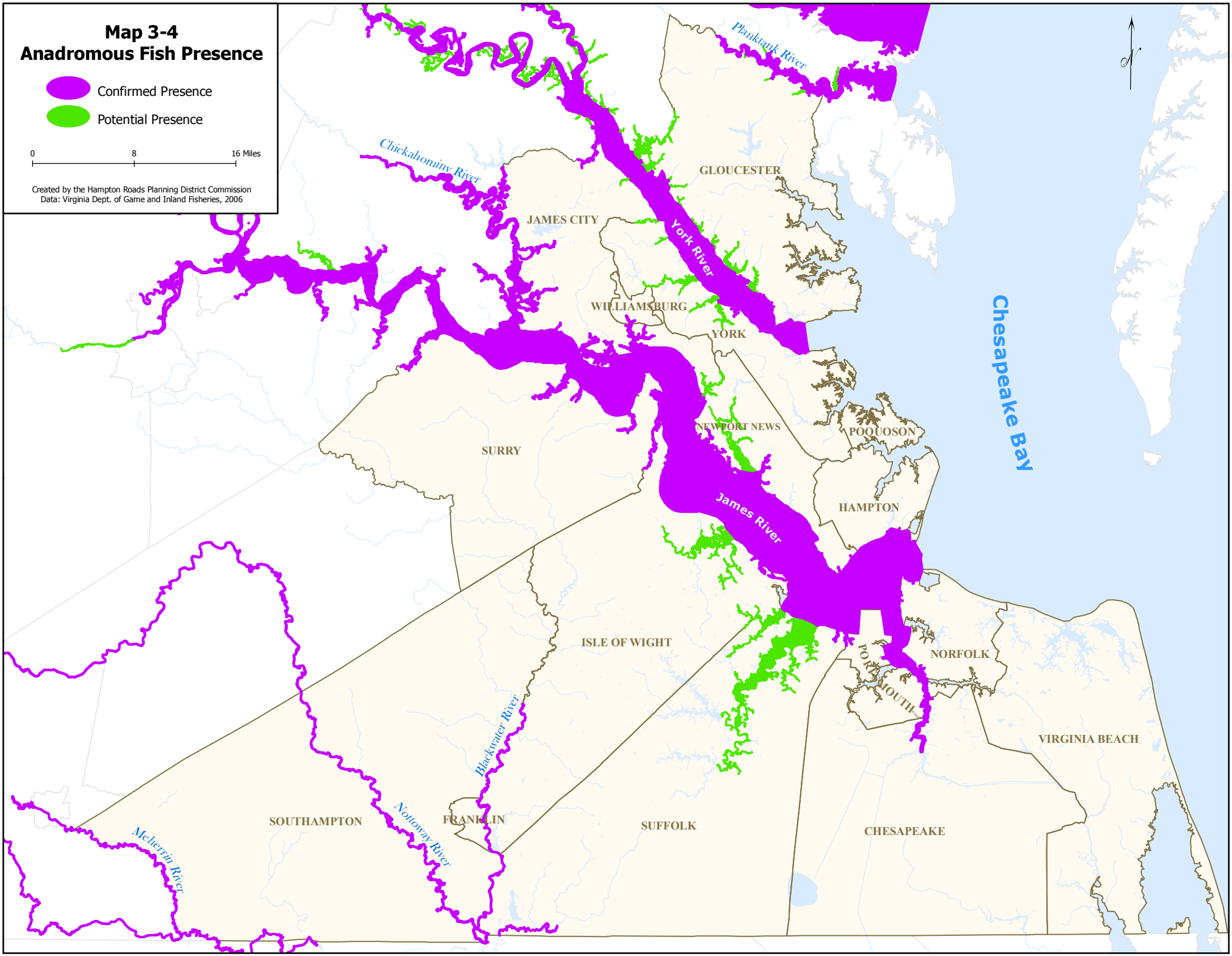
Fish Hatcheries

Based on data from the Virginia Fish and Wildlife Information Service, no fish hatcheries are located within the regional water supply planning area.

Shellfish Management Areas

The purpose of establishing shellfish management areas is to protect and promote the shellfish in the designated areas. Per the Virginia Marine Resources Commission regulation pertaining to shellfish management areas (4 VAC 20-560), the following shellfish management areas are located within the regional water supply planning area:

- **York River shellfish management area, along the York River.** This area consists of all public grounds located inshore of a line beginning at the entrance to the Virginia Institute of Marine Science boat basin at Gloucester Point, running Northwesterly to Buoy #30, thence Northwesterly to Buoy #32, thence Northwesterly to Buoy #34, then Northwesterly to Pages Rock Buoy, thence Northwesterly and ending at Clay Bank Wharf.
- **Poquoson River shellfish management area, along the Poquoson River.** This area consists of all public grounds bounded by a line beginning at Hunts Point Survey Taylor and running Northwesterly to Survey Station Spit, thence Northeasterly to Survey Station Cabin North, thence East to Survey Station Cabin South, thence Southeasterly following the general shoreline (not to include any creeks or canals) to the flag pole near Survey Station 80 at York Point, thence 175 degrees to Day Marker #14 and returning to Hunts Point Survey Taylor.
- **Back River shellfish management area, along the Back River.** This area consists of all current public clamming grounds bounded by a line from, corner 3 on Shell Plant 115 through corner 17, a daymarker, on Shell Plant 115, 237.42 feet to a point being the point of beginning; thence Southeasterly to corner number 1 Public Clamming Ground (PCG#12); thence Southeasterly to corner number 3A Public Clamming Ground (PCG#12); thence Northeasterly to corner number 3 Public Clamming Ground (PCG#12); thence Northwesterly to corner number 2 Public Clamming Ground (PCG#12); thence Southwesterly to the point of beginning (POB).


Map 3-4
Anadromous Fish Presence
Confirmed Presence
Potential Presence
0
8
16 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Dept. of Game and Inland Fisheries, 2006
Planktank River
Chickahominy River
GLOUCESTER
JAMES CITY
York River
WILLIAMSBURG
YORK
Chesapeake Bay
NEWPORT NEWS
POQUOSON
SURRY
James River
HAMPTON
ISLE OF WIGHT
NORFOLK
PORTSMOUTH
Blackwater River
VIRGINIA BEACH
SOUTHAMPTON
Nottoway River
FRANKLIN
SUFFOLK
CHESAPEAKE
Meherrin River

River Segments with Recreational Significance

Virginia Scenic Rivers

The Virginia Scenic Rivers program began in 1970 with passage by the General Assembly of the Virginia State Scenic River Act. Since then, 20 river segments totaling approximately 474 miles have been designated state scenic rivers. The Virginia Department of Conservation and Recreation (DCR) administers the program, and the Virginia Scenic Rivers Board, which was created by the enabling legislation, discusses issues and make recommendations on the stewardship of existing scenic rivers and expansion of the program with other eligible river segments.

The intent of the Virginia Scenic Rivers program is to identify, recognize, and provide a level of protection to those rivers whose scenic beauty, historic importance, recreational value, and natural characteristics make them resources of particular importance. Table 3-7 identifies the state designated scenic rivers located within the regional water supply planning area.

Map 3-5 describes the river segments and bodies of water in and around the regional water supply planning area that have been designated into the scenic rivers program. The map also indicates segments that qualify after evaluation for program acceptance but have not yet joined the program, or are worthy of further study to determine suitability. Future water development projects or significant proposed withdrawals from such rivers should be evaluated with respect to impacts on scenic river program significance criteria.

Table 3-7: Designated Scenic Rivers in the Hampton Roads

River	Designated Reach		Total Miles	Date Approved
	From	Downstream to		
Blackwater	Proctor's Bridge (Route 621	Confluence with Nottoway River at VA/NC state line	56	2010
James (lower)	1.2 miles east of Trees Point	Lawnes Creek (James City / Surry County)	25	1988
North Landing	NC/VA state line	North Landing Road (Route 165)	26.7	1988
Nottoway	Route 40 Bridge at Stoney Creek	Route 653 (Carey's bridge)	39.5	1979

Source: Virginia Department of Conservation and Recreation

One of Hampton Roads finest resources is its coastal location. Additional recreational and economical opportunities are afforded through public access to waterways. Map 3-5 also depicts public beaches, fishing piers and selected boat ramps throughout the region.

Nationwide Rivers Inventory

The Nationwide Rivers Inventory (NRI) was compiled by the National Park Service in partial fulfillment of federal requirements of the 1968 National Wild and Scenic Rivers Act. The NRI is a register of river segments that potentially qualify as national wild, scenic or recreational river areas. In order to be listed on the NRI, a river must be free-flowing and possess one or more Outstandingly Remarkable Values (ORV).

The eligibility analysis for ORV consists of an examination of the river's hydrology, including any man-made alterations, and an inventory of its natural, cultural, and recreational resources. In order to be assessed as outstandingly remarkable, a river-related value must be a unique, rare, or exemplary feature that is significant at a comparative regional or national scale

While the spectrum of resources that may be considered is broad, all values should be directly river-related. That is, they should:

- Be located in the river or on its immediate shore lands, within 1/4 mile;
- Contribute substantially to the functioning of the river ecosystem; and/or
- Owe their location or existence to the presence of the river.

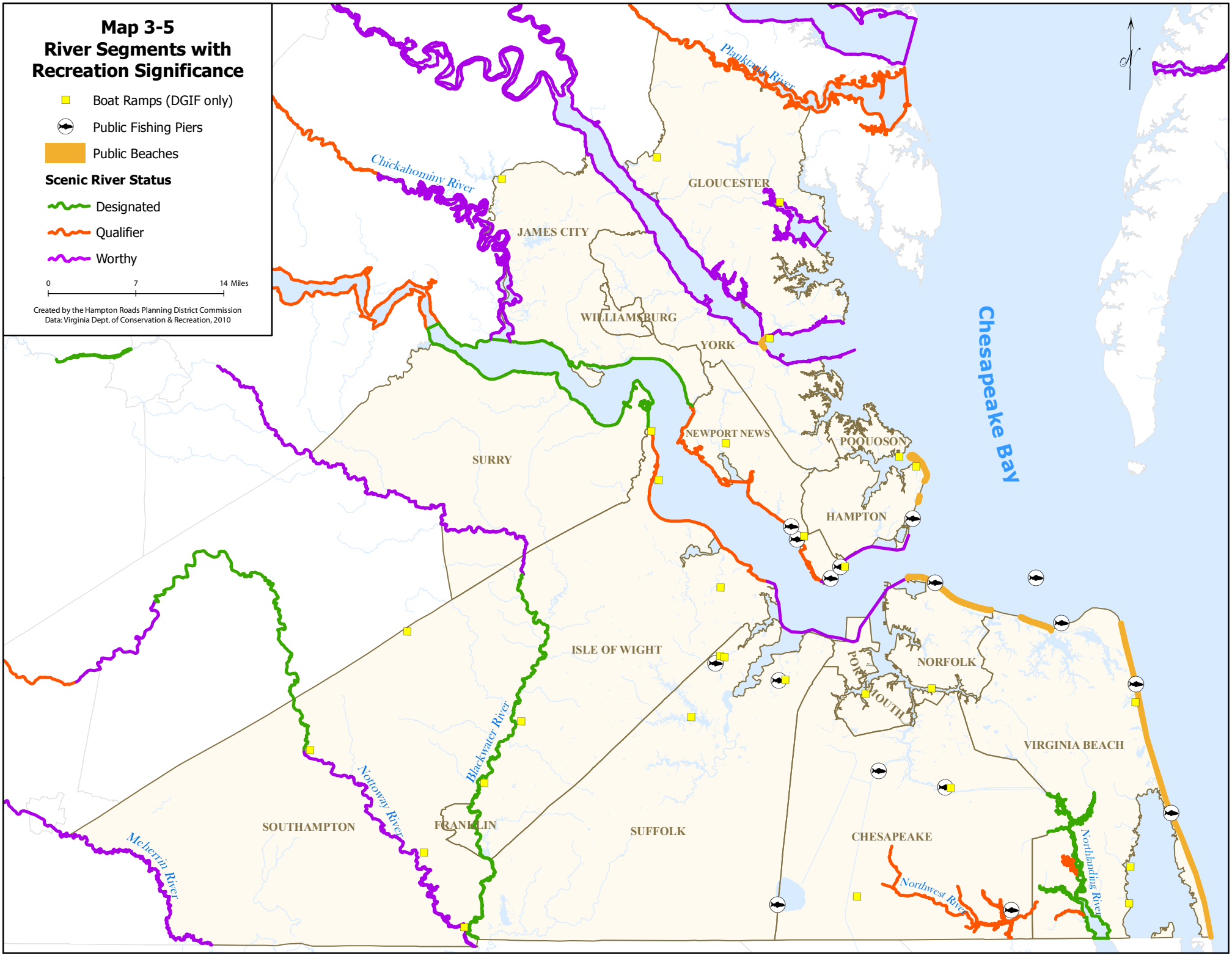

Map 3-5
River Segments with
Recreation Significance
Boat Ramps (DGIF only)
Public Fishing Piers
Public Beaches
Scenic River Status
Designated
Qualifier
Worthy
0
7
14 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Dept. of Conservation & Recreation, 2010
Chickahominy River
Plankatank River
GLOUCESTER
JAMES CITY
WILLIAMSBURG
YORK
NEWPORT NEWS
POQUOSON
SURRY
HAMPTON
Chesapeake Bay
ISLE OF WIGHT
PORTSMOUTH
NORFOLK
VIRGINIA BEACH
Blackwater River
Nottoway River
Meherrin River
SOUTHAMPTON
FRANKLIN
SUFFOLK
CHESAPEAKE
Northwest River
Northlanding River

Table 3-8: National Rivers Inventory Outstandingly Remarkable Values Threshold Criteria

Category	Code	Criteria Description
Scenery	S	The landscape elements of landform, vegetation, water, color, and related factors result in notable or exemplary visual features and/or attractions.
Recreation	R	Recreational opportunities are, or have the potential to be, popular enough to attract visitors from throughout or beyond the region of comparison or are unique or rare within the region.
Geology	G	The river, or the area within the river corridor, contains one or more example of a geologic feature, process or phenomenon that is unique or rare within the region of comparison.
Fish	F	Fish values may be judged on the relative merits of fish population, habitat, or a combination of these river-related conditions.
Wildlife	W	Wildlife values may be judged on the relative merits of either terrestrial or aquatic wildlife populations or habitat or a combination of these conditions.
Prehistory	P	The river, or area within the river corridor, contains a site(s) where there is evidence of occupation or use by Native Americans.
History	H	The river or area within the river corridor contains a site(s) or feature(s) associated with a significant event, an important person, or a cultural activity of the past that was rare or one-of-a-kind in the region.
Cultural	C	The river or area within the river corridor contains archaeological sites or areas significant to traditional cultures.
Other Values	O	While no specific national evaluation guidelines have been developed for the "other similar values" category, assessments of additional river-related values consistent with the foregoing guidance may be developed -- including, but not limited to, hydrology, paleontology and botany resources.

Source: National Park Service, National Rivers Inventory

Table 3-8 lists the eligibility criteria offered to foster greater consistency within the federal river-administering agencies. They are intended to set minimum thresholds to establish ORVs and are illustrative but not all-inclusive. Table 3-9 lists the rivers within the regional water supply planning area that have been listed with the National Park Service in the National Rivers Inventory.

Table 3-9: National Rivers Inventory Segments in Hampton Roads

River	County	Reach	Length (miles)	ORV Code	Description
Blackwater River	Southampton, Nansemond	Confluence with Nottoway and Chowan Rivers to George Bend	7	O	Botanic - Part of 10,000 acres of bogs and pine barrens with rare plants including northern and southern relicts.
Blackwater River	Prince George, Southampton, Sussex, Isle of Wight, Surry	Franklin to headwaters	62	O	Botanic - Rare bog plants, extensive stands of cypress, northern and southern vegetation relicts. Also near Virgin Cypress-Gum Swamp presently adjacent near Dendron.
Chickahominy River	James City, Charles City, New Kent	James River to Providence Forge	30	O	Botanic - An extensive, well developed cypress-gum swamp forest and bottomland hardwood forest which includes three rare, endemic and possibly endangered species of plants.
				G	Geologic - Extreme topographic diversity including cliffs up to 100 feet high at Fish Hole Landing.
Dragon Swamp River	King & Queen, Middlesex, Gloucester, Essex	Piankatank River to Powcan	38	O	Botanic - A wild freshwater Cypress-Gum swamp forest.
				H	Historic - Deer Chase is a nearby National Historic Register Site.
James River	York, Isle of Wight, Surry, James City, Charles City, Prince George	Mogarts Beach to Hopewell	62	H	Historic - One of the most significant historic, relatively undeveloped rivers in the entire northeast region. Within or adjacent to the corridor are 4 National Historic Register Sites and one National Historic Park.
Northwest River	Chesapeake	Virginia/North Carolina State line to headwaters at Cornland	12	O	Ecologic - The last remaining complete and representative example of a free flowing, undeveloped river within the Great Dismal Swamp area. The Swamp is a National Natural Landmark.
				W	Wild - Corridor and surrounding watershed is essentially undeveloped.

Table 3-9: National Rivers Inventory Segments in Hampton Roads (continued)

River	County	Reach	Length (miles)	ORV Code	Description
Nottoway River	Southampton, Sussex	North Carolina border to Fort Nottoway	82	O	Botanic - 5 to 10,000 acres of cypress forest; longest river swamp in the entire northeast region. Corridor and surrounding area include significant amounts of cypress.
Poropotank River	King and Queen, Gloucester	Confluence with the York River to headwaters	12	O	See York River comments.
Ware River	New Kent, James City	Confluence with the York River to Richardson Millpond	5	O	See York River comments.
Yarmouth Creek	James City	Chickahominy River to headwaters	7	O G	See Chickahominy River comments. (segment from James River to Providence Forge)
York River	James City, Gloucester	Almondsville to Plum Point	12	O	Hydrologic - A unique segment of sparsely developed, high order tidal river.

Source: National Park Service, National Rivers Inventory

Sites of Historic or Archaeological Significance

The Virginia Department of Historic Resources

The Virginia Landmarks Register is the state's official list of properties important to its history and is housed at the Virginia Department of Historic Resources (DHR), which functions as the State Historic Preservation Office under the National Historic Preservation Act of 1966. DHR also administers the National Register of Historic Places in Virginia. The National Park Service manages the Register, which serves as the official list of structures, sites, objects, and districts that embody the historical and cultural foundations of the nation.

The Hampton Roads region contains an abundance of historic sites, both archaeological and architectural. With a built environment that dates to the earliest permanent English settlement in the United States, there are few locations in the region where no historic resources exist. The list of historic resources can be accessed through the Virginia Landmarks Register, National Register of Historic Places, http://www.dhr.virginia.gov/. Town resources are included with the county in which they are located. The resource list includes the name of the structure or site, the date it was identified by the Virginia Landmarks Register, and the date of acceptance to the National Register of Historic Places. There are no known conflicts between historic resources and existing or proposed water supply sources. Future water development projects should be evaluated with respect to potential impacts to sites of historic or archaeological significance.

Other Information Sources

The Code of Virginia provides local governments with a number of tools that support the preservation of historic sites and structures. Included among them are the ability to designate historic districts and the authority to adopt local ordinances that govern the treatment of historic resources. Thus, some local governments have their own lists of historic sites and structures that they considered to be important to local history. Locally designated historic sites and structures were not gathered as a part of this planning effort.

Unusual Geologic Formations

Chesapeake Bay Impact Crater

In the 1990s, a large impact crater beneath the Chesapeake Bay was discovered. The discovery prompted a revision of the hydrogeologic framework in the Virginia Coastal Plain. The 56-mile-wide Chesapeake Bay impact crater is located beneath the lower Chesapeake Bay, its surrounding peninsulas, and a small part of the Atlantic Ocean (see Map 3-6). The approximate center of the crater is beneath the Town of Cape Charles on the eastern shore of Virginia.

The Chesapeake Bay impact crater was formed when a large comet or meteorite crashed into the mouth of the Chesapeake Bay approximately 35 million years ago. The impact produced an inverted, sombrero-shaped crater that was immediately filled with chaotically mixed sediments and seawater. Subsequent sediment deposition has buried the crater approximately 1,000 ft below the present-day land surface.

The low permeability of the sediments along the crater's rim created an unusual distribution of salinity in the groundwater around the crater (see Figure 3-12). The ocean level has risen and fallen many times since the crater was created. When the ocean moved inland or receded, the fresh groundwater moved around the crater rim rather than through the crater sediments. The exact location, as well as the geometry, of the outer rim of the crater beneath the lower York-James Peninsula and beneath the area between Norfolk and Virginia Beach is poorly defined. The outer rim coincides with an increase in concentrations of total dissolved solids and chlorides; therefore, groundwater in these areas is typically brackish and requires additional treatment for potable use.


Map 3-6
Chesapeake Bay Impact Crater
Crater Rim
0
8
16 Miles
Created by the Hampton Roads Planning District Commission
Data: United States Geologic Survey
GLOUCESTER
JAMES CITY
WILLIAMSBURG
York River
YORK
NEWPORT NEWS
POQUOSON
HAMPTON
SURRY
James River
Chesapeake Bay
Inner Crater
Outer Crater
ISLE OF WIGHT
PORTSMOUTH
NORFOLK
VIRGINIA BEACH
SOUTHAMPTON
FRANKLIN
SUFFOLK
CHESAPEAKE

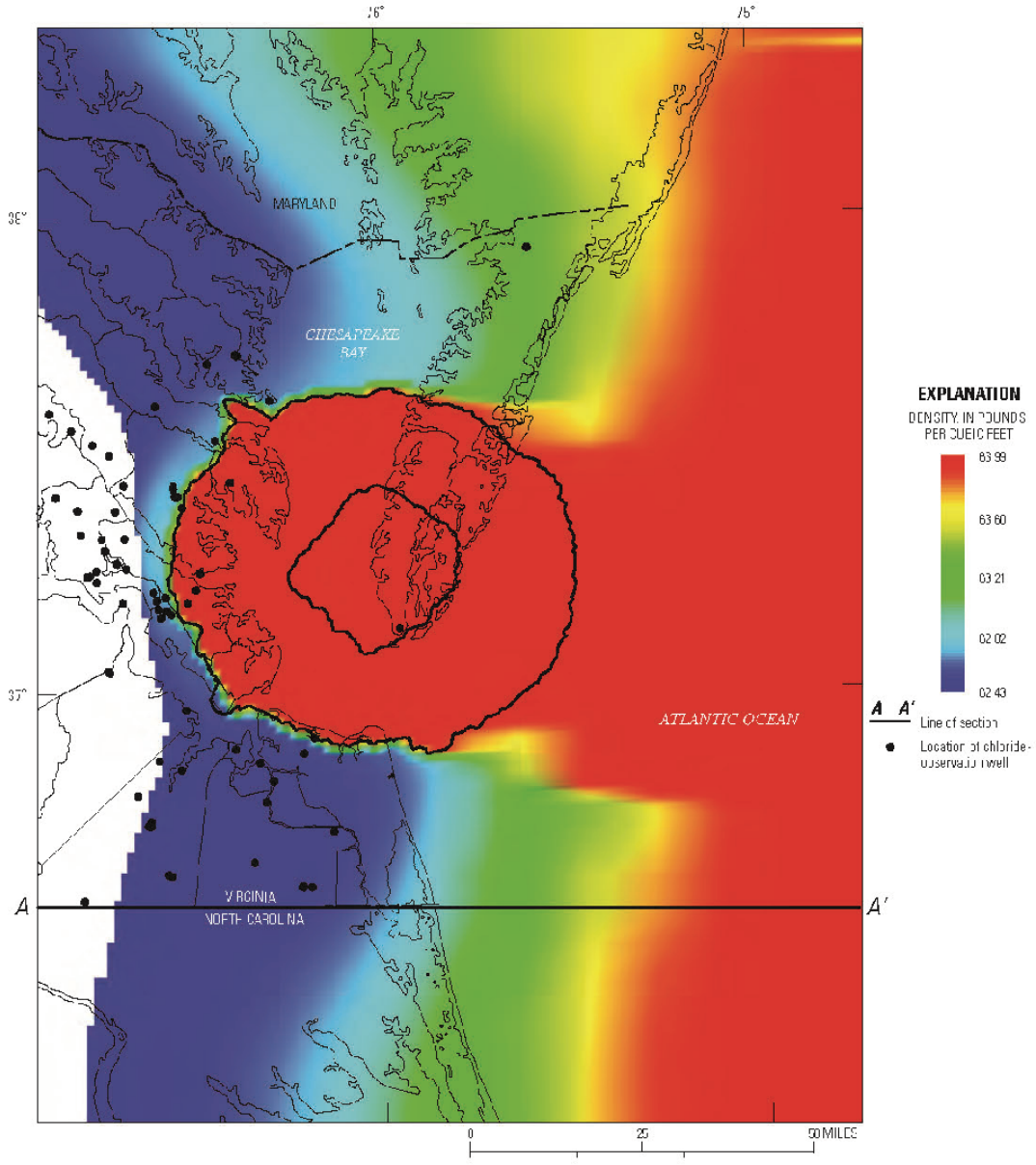


Figure 3-12: Simulated water density near the saltwater transition zone, Chesapeake Bay Impact Crater (adapted from Heywood, C.E., and Pope, J.P., 2009).

Wetlands

Wetlands are semi-aquatic lands that are either inundated or saturated by water for some period of time during the growing season. Wetlands, which include swamps, bogs, and marshes, are found along streams and rivers, in flood plains, depressions, and on the fringes of lakes and ponds. Saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in and on the soil in wetlands. The single feature most wetlands share is soil or substrate that is at least periodically saturated with or covered by water.

Wetlands provide a multitude of ecological, economic and social benefits. They provide habitat for fish, wildlife and a variety of plants. Wetlands are nurseries for many saltwater and freshwater fishes and shellfish of commercial and recreational importance. Wetlands are also important landscape features because they hold and slowly release flood water and snow melt, recharge groundwater, act as filters to cleanse water of impurities, recycle nutrients, and provide recreation areas and wildlife viewing opportunities for people.

The U.S. Fish and Wildlife Service provides information to the public on the nation's wetlands. Through the National Wetlands Inventory, the agency has developed a series of topographic maps to show the extent, approximate location and type of wetlands and deepwater habitats across the country. The data were developed in conjunction with the Cowardin et al. Classification of Wetlands and Deepwater Habitats of the United States (1979). The National Wetlands Inventory should only be used as a general reference and the mapping does not constitute all of the wetland areas in Virginia, nor does it replace on-the-ground assessments or delineations of wetland areas.

Each wetland area is classified based on a hierarchy that includes systems, subsystems, classes, and subclasses. For purposes of the Hampton Roads Regional Water Supply Plan, the wetland maps are classified by type of wetland system (see Table 3-10).

Table 3-10: Wetlands Systems

System	Description
Marine	Open ocean and its associated high energy coastline
Estuarine	Deepwater tidal habitats and adjacent tidal wetlands semi-enclosed by land
Riverine	Deepwater habitats with flowing water such as rivers and streams
Lacustrine	Deepwater habitats such as lakes, reservoirs, and large ponds
Palustrine	All non-tidal wetlands such as marsh, swamp, bog, prairie, and small ponds

Each system represents wetland and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors. Descriptions of each wetlands system are provided below.

Marine System. The marine system consists of the open ocean overlying the continental shelf and its associated high energy coastline. Marine habitats are exposed to the waves and currents of the open ocean. Salinity exceeds 30 parts per thousand, with little or no dilution except outside the mouths of estuaries. Shallow coastal inlets or bays without appreciable freshwater inflow, and coasts with exposed rocky islands that provide the mainland with little or no shelter from wind and waves are also considered part of the marine system because they generally support a typical marine biota.

The marine system extends from the outer edge of the continental shelf shoreward to one of three lines:

(1) The landward limit of tidal inundation (extreme high water of spring tides), including the splash zone from breaking waves;

(2) The seaward limit of wetland emergents, trees, or shrubs; or

(3) The seaward limit of the estuarine system, where this limit is determined by factors other than vegetation.

Deepwater habitats lying beyond the seaward limit of the marine system are outside the scope of this classification system.

Estuarine System. The estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi enclosed by land but have open, partly obstructed or sporadic access to the open ocean and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low energy coastlines there is appreciable dilution of sea water. Offshore areas with typical estuarine plants and animals, such as red mangroves (Rhizophora mangle) and eastern oysters (Crassostrea virginica) are also included in the estuarine system.

The estuarine system extends:

(1) Upstream and landward to where ocean-derived salts measure less than 0.5 parts per thousand during the period of average annual low flow;

(2) To an imaginary line closing the mouth of a river, bay, or sound; and

(3) To the seaward limit of wetland emergents, shrubs, or trees where they are not included in (2).

The Estuarine System also includes offshore areas of continuously diluted sea water.

Riverine System. The riverine system includes deepwater habitats contained in a channel. Water is usually, but not always, flowing in the riverine system.

The riverine system is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetland dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. In braided streams, the system is bounded by the banks forming the outer limits of the depression within which the braiding occurs. The riverine system terminates at the downstream end where the concentration of ocean-derived salts in the water exceeds 0.5 parts per thousand during the period of annual average low flow, or where the channel enters a lake. It terminates at the upstream end where tributary streams originate, or where the channel leaves a lake. Springs discharging into a channel are considered part of the riverine system.

Lacustrine System. The lacustrine system includes deepwater habitats with all of the following characteristics:

(1) Situated in a topographic depression or a dammed river channel;

(2) Lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent coverage;

(3) Total area exceeds 20 acres.

The lacustrine system is bounded by upland or by wetland dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. Lacustrine systems formed by damming a river channel are bounded by a contour approximating the normal spillway elevation or normal pool elevation, except where palustrine wetlands extend lakeward of that boundary. Where a river enters a lake, the extension of the shoreline forms the riverine-lacustrine boundary.

The lacustrine system includes permanently flooded lakes and reservoirs, intermittent lakes, and tidal lakes with salinity levels below 0.5 parts per thousand. Typically, there are extensive areas of deep water and there is considerable wave action. Islands of palustrine wetland may lie within the boundaries of the lacustrine system.

Palustrine System. The palustrine system includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, farmed wetlands, and similar wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand. It also includes wetlands lacking such vegetation, but with all of the following four characteristics:

(1) Area less than 20 acres;

(2) An active wave formed or bedrock shoreline features are lacking;

(3) Water depth in the deepest part of a basin less than 6.6 feet at low water; and

(4) Salinity due to ocean derived salts less than 0.5 parts per thousand.

The palustrine system is bounded by upland or by any of the other four systems. The palustrine system was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie, which are found throughout the United States. It also includes the small, shallow, permanent or intermittent water bodies often called ponds. Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries; on river floodplains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers. The erosive forces of wind and water are of minor importance except during severe floods.

Hampton Roads Wetlands

The following data for Hampton Roads wetlands comes from the U.S. Fish and Wildlife Service National Wetlands Inventory. Measurements and percentages shown in Tables 3-11 are estimates found through analysis of the NWI GIS Data. Wetlands in each sub-region of the planning area are shown in Maps 3-7, 3-8, and 3-9.

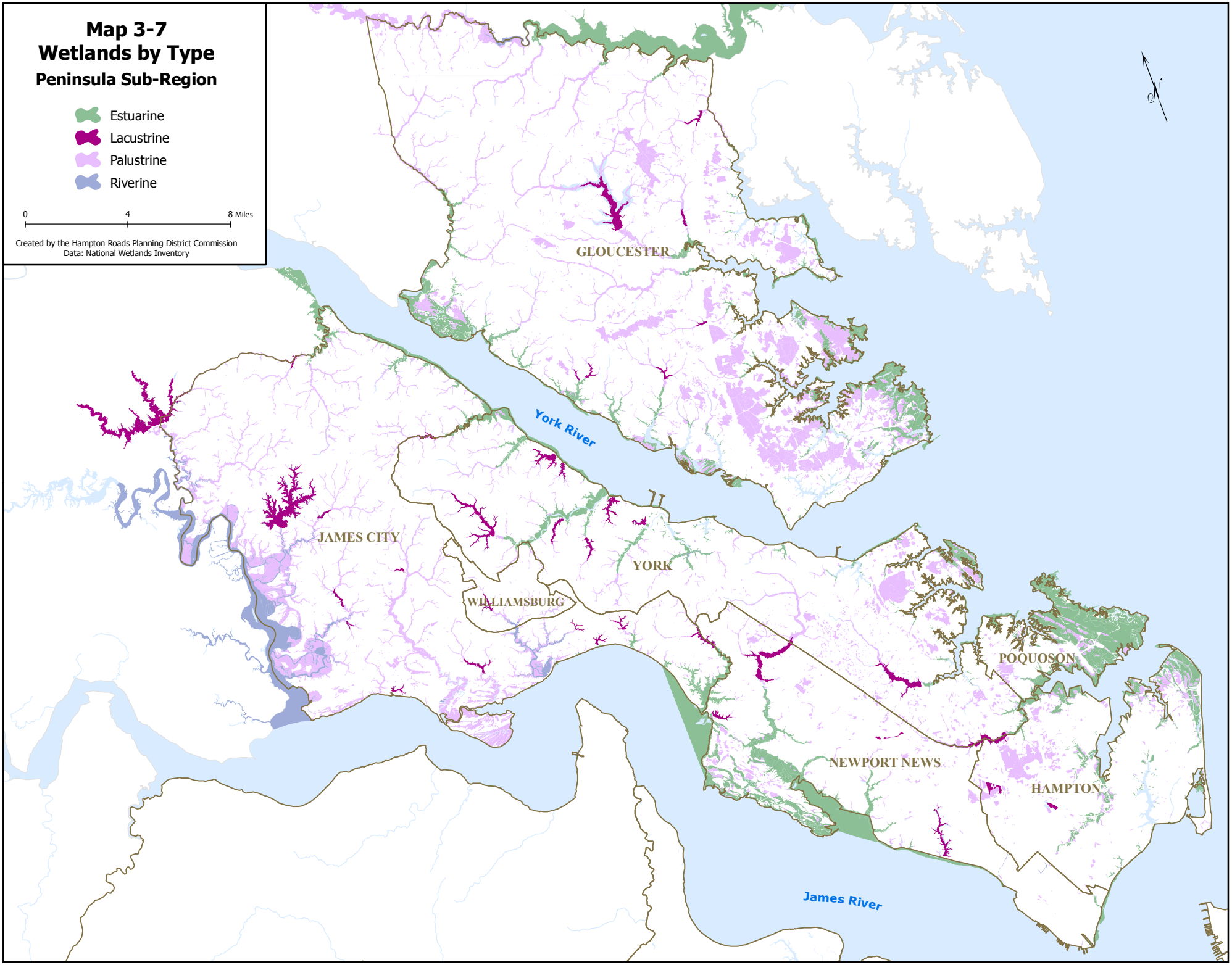
Tidal and non-tidal wetlands are a dominant physical feature in the Hampton Roads region of Virginia. The total area of the Hampton Roads region is 1,884,733 acres. Wetlands comprise 459,320 acres, or 24.4% of the total area of the region. Table 3-11 summarizes the estimated wetland area by type of wetlands system. Tidal wetlands, which encompass both vegetated marshes and nonvegetated beaches, sandflats, and mudflats, are dominated by tidal action and are flooded regularly. Vegetated marshes are categorized by salt marsh grasses such as smooth cordgrass, salt meadow grass, giant cordgrass, black needlerush, and others. Shrubs such as buttonbush and saltbush are found along their upper edges, which are not flooded on each tide. The non-tidal wetlands in Hampton Roads are generally forested and do not always have surface evidence of water. Common trees found in these areas include red and silver maple, black and sweet gum, pin and willow oak, cedar, and bald cypress. The majority of the wetlands found in Hampton Roads – about 80% – are non-tidal wetlands classified as palustrine systems. Estuarine systems account for approximately 14% of the remaining wetlands in the region, with a small percentage of riverine and lacustrine systems accounting for the rest. By definition, all man-made lakes and reservoirs are considered lacustrine wetlands. Marine wetlands have not been calculated for the Hampton Roads region.

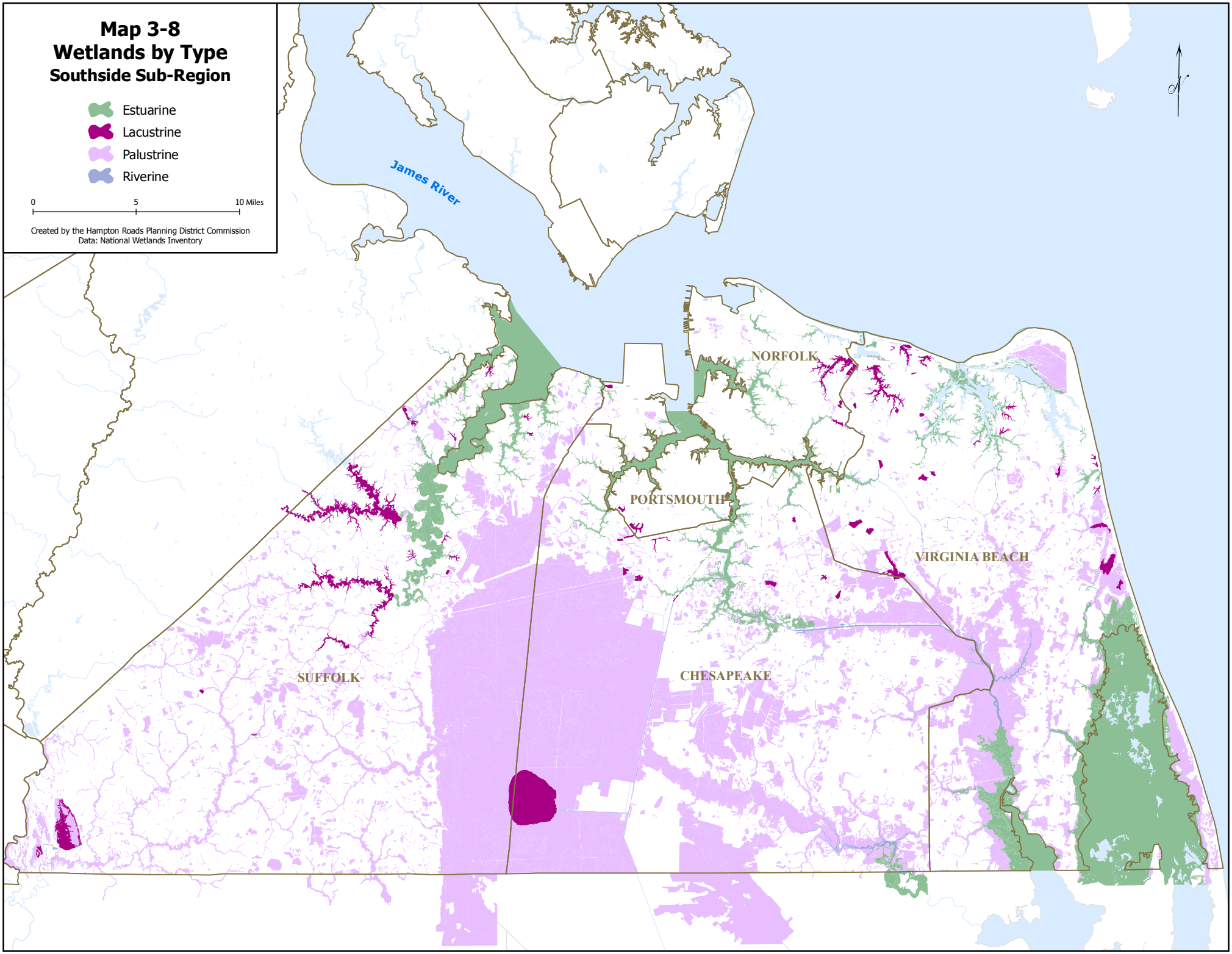
Table 3-11: Hampton Roads Wetlands Acreage Summary

Wetlands System	Acreage	Percent of Wetlands Acreage
Estuarine	65,353	14%
Riverine	7,600	2%
Lacustrine	17,245	4%
Palustrine	369,121	80%
Total Wetlands	**459,320**	**100%**

U.S. Fish and Wildlife Service. National Wetlands Inventory. NWIDBA.CONUS_wet_poly: Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31. 200605

Table 3-12 lists the current water supply sources for Hampton Roads and the types of wetlands they pertain to, or may affect. Future water development projects should be evaluated with respect to potential impacts to wetland resources.


Map 3-7
Wetlands by Type
Peninsula Sub-Region
Estuarine
Lacustrine
Palustrine
Riverine
0
4
8 Miles
Created by the Hampton Roads Planning District Commission
Data: National Wetlands Inventory
GLOUCESTER
York River
JAMES CITY
YORK
WILLIAMSBURG
POQUOSON
NEWPORT NEWS
HAMPTON
James River


Map 3-8
Wetlands by Type
Southside Sub-Region
Estuarine
Lacustrine
Palustrine
Riverine
0
5
10 Miles
Created by the Hampton Roads Planning District Commission
Data: National Wetlands Inventory
James River
NORFOLK
PORTSMOUTH
VIRGINIA BEACH
SUFFOLK
CHESAPEAKE

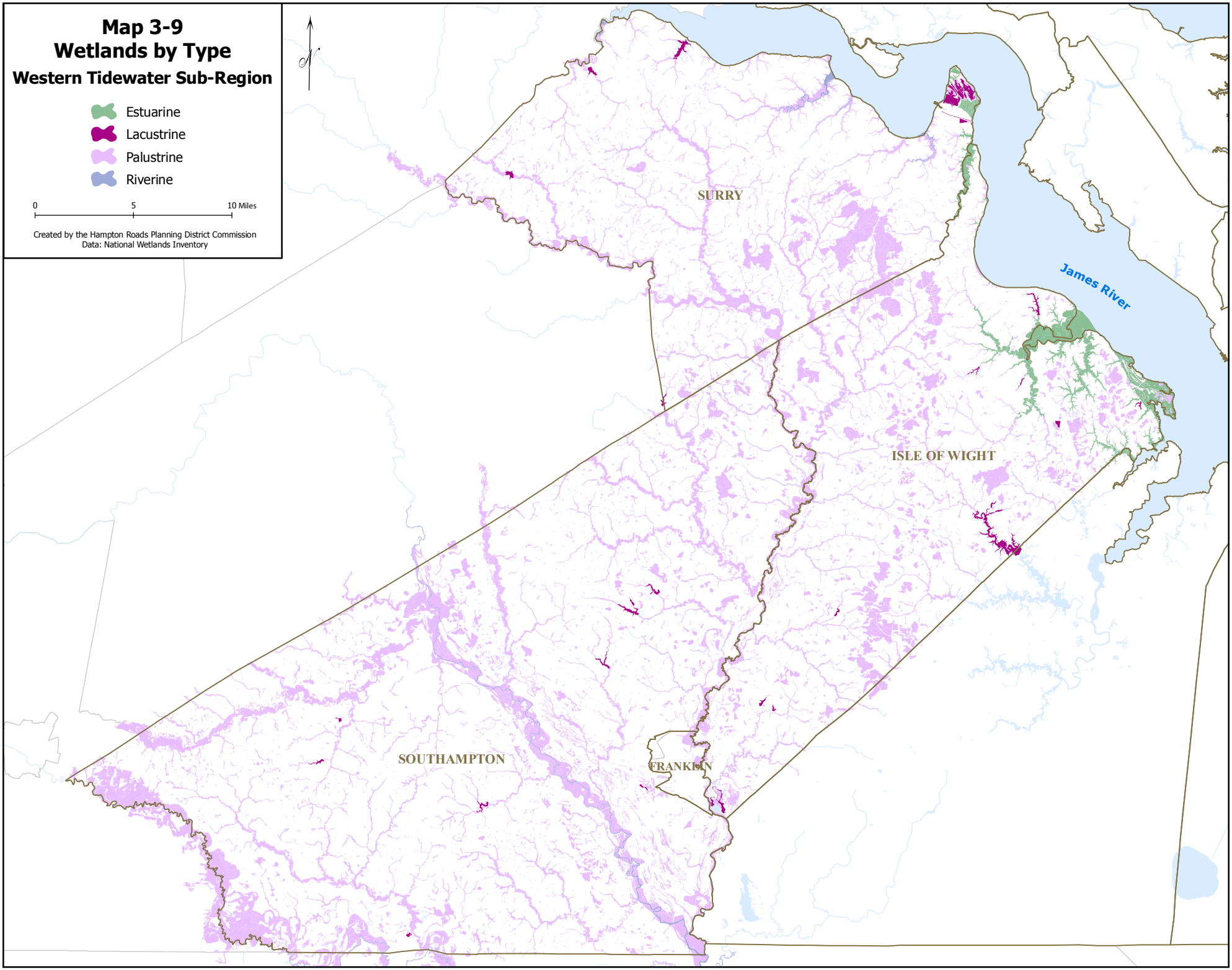

Map 3-9
Wetlands by Type
Western Tidewater Sub-Region
Estuarine
Lacustrine
Palustrine
Riverine
0
5
10 Miles
Created by the Hampton Roads Planning District Commission
Data: National Wetlands Inventory
SURRY
James River
ISLE OF WIGHT
SOUTHAMPTON
FRANKLIN

Table 3-12: Hampton Roads Surface Water Supply Sources and Wetlands Summary

Surface Water Supply Source	Type of Wetlands System	Surface Water Supply Source	Type of Wetlands System
Peninsula Sub-Region		**Southside and Western Tidewater Sub-Regions**	
Chickahominy River	Riverine	Northwest River	Riverine
Diascund Creek Reservoir	Lacustrine	Lake Lawson (Intown Reservoirs)	Lacustrine
Little Creek Reservoir	Lacustrine	Lake Smith (Intown Reservoirs)	Lacustrine
Skiffe's Creek Reservoir	Lacustrine	Lake Whitehurst (Intown Reservoirs)	Lacustrine
Lee Hall Reservoir	Lacustrine	Lake Wright (Intown Reservoirs)	Lacustrine
Harwoods Mill Reservoir	Lacustrine	Little Creek Reservoir (Intown Reservoirs)	Lacustrine
Waller Mill Reservoir	Lacustrine	Lake Burnt Mills (Western Reservoirs)	Lacustrine
Beaver Dam Reservoir	Lacustrine	Lake Prince (Western Reservoirs)	Lacustrine
		Western Branch Reservoir (Western Reservoirs)	Lacustrine
		Blackwater River	Riverine
		Nottoway River	Riverine
		Lake Kilby	Lacustrine
		Speight's Run	Lacustrine
		Lake Meade	Lacustrine
		Lake Cahoon	Lacustrine
		Lone Star Lakes	Lacustrine
		Crumps Mill Pond	Lacustrine
		Lake Gaston	Lacustrine
		Stumpy Lake	Lacustrine

Riparian Buffers and Conservation Easements

Riparian Buffers

Riparian buffers are transitional zones between surface water bodies and surrounding areas, and typically include areas of trees, shrubs, and vegetation. Riparian buffers are valued for their ability to moderate erosion and sedimentation, stabilize shorelines, improve water quality in ground water and surface water runoff, increase the base flow of streams, and provide a biologically diverse habitat for aquatic species and wildlife.

In 1988, the Virginia General Assembly passed the Chesapeake Bay Preservation Act (Bay Act) to protect and improve the water quality of the Chesapeake Bay and its tributaries. The Bay Act applies to all 84 cities, counties, and towns in Tidewater Virginia, which encompasses some portion of all localities in the Hampton Roads regional water supply planning area, with the exception of Southampton County and the City of Franklin. Each of the localities, excluding Southampton County and the City of Franklin, has implemented a Chesapeake Bay Preservation Act Ordinance. While ordinances differ between localities, the underlying objective is to improve water quality by protecting environmentally sensitive areas from the negative effects of development.

The Bay Act requires all counties, cities, and towns in Tidewater Virginia to define and protect Chesapeake Bay Preservation Areas (CBPA), which are determined by the ecological and geographic criteria laid out in the Bay Act. According to the DCR Local CBPA Ordinances, in general, no development, land disturbance, or vegetation removal is allowed within 100-feet of water. CBPAs within Hampton Roads are shown on Maps 3-10, 3-11, and 3-12.

CBPAs are divided into Resource Protection Areas (RPA) and Resource Management Areas (RMA). RPAs are the shoreward components of CBPAs. RPAs are comprised of:

- tidal wetlands;
- non-tidal wetlands connected by surface flow and contiguous to tidal wetlands or water bodies with perennial flow;
- tidal shores;
- such lands considered necessary by the locality to protect the quality of state waters; and
- 100-foot wide vegetated buffer adjacent to, and landward of, these features.

RMAs are described by the DCR Chesapeake Bay Local Assistance Programs to "include land types that, if improperly used or developed, have a potential for causing significant water quality degradation or for diminishing the functional value of the Resource Protection Area. An RMA shall be provided contiguous to the entire inland boundary of the RPA and, where mapping resources indicate the presence of these land types as contiguous to the Resource Protection Area, should be included in designation of RMAs: floodplains; highly erodible soils; including steep slopes; highly permeable soils; and nontidal wetlands not included in the RPA."

All affected localities in Hampton Roads have designated RPA areas in accordance with state regulations. Despite protective regulations, many of these buffer areas are being impacted by shoreline development and improper management of buffer vegetation. At greatest risk are buffers in parts of the state that have rapidly growing urban and suburban areas. The following is a discussion by locality of drinking water sources that are within CBPAs.

Chesapeake: The City of Chesapeake established the Northwest River Watershed Protection District to promote public health, safety and welfare through the protection of a major public drinking water source. The District allows the City of Chesapeake to study and analyze land use within the district and identify critical resources that need protection, and implement measures to minimize disruption of the natural systems that maintain the water quality in the Northwest

River Watershed. Additionally, Chesapeake is able to acquire real property and real property interests, which includes conservation and drainage easements. Chesapeake's surface water source is not located near a CBPA.

Gloucester: Gloucester County requires the protection of buffers as necessary within CBPAs. Portions of Gloucester's Beaverdam Reservoir are located within the CBPA.

Newport News: Newport News Waterworks owns and operates the five reservoirs and more than 12,000 acres of watershed property that encompasses the reservoirs. The City has a watershed management program that promotes the health of the forests within the watershed owned by the City to protect water quality. For the portions of watersheds lying within the City of Newport News that are privately held, the City's Reservoir Protection Ordinance requires a permit for earth disturbing activities and provides for a 200 foot protective buffer along perennial streams and the reservoirs' edge. For intermittent streams, the buffer is 100 feet. York County has imposed a reservoir protection overlay district for the portions of the watersheds that lie within that County. The specific protective provisions are similar to those in Newport News. The remaining reservoir watersheds in James City and New Kent Counties receive protection as prescribed by locally approved Chesapeake Bay Preservation Act Ordinances that have also been approved by VDCR.

Norfolk: The City of Norfolk has a long-standing Watershed Protection Program, which includes a basic watershed model to evaluate the effect of land use on the reservoirs and a source water assessment to identify potential sources of contamination. The Norfolk Watershed Protection Program Framework serves as a guide for future efforts to protect Norfolk's surface water resources.

The City of Norfolk has established reservoir protection buffers around the Western Reservoirs and the Intown Reservoirs (located within the City of Suffolk). These buffer areas are owned by the City of Norfolk and the amount of land included in buffer areas varies by reservoir, depending on when the reservoir was constructed and how the property was acquired. A permit is required for the removal of trees of any size, brush, or any other material from the City's property.

Portsmouth: The City of Portsmouth's four reservoirs are located in the City of Suffolk. The City of Portsmouth owns approximately 3,100 acres including Lake Meade, Lake Kilby, Lake Cohoon, and Speights Run Reservoir and surrounding lands. Portsmouth also owns easements and right of ways for water transmission lines.

The buffer areas owned by the City of Portsmouth along the reservoir shorelines vary in area and width, encompassing an approximate area of 1,500 total acres. Large tracts of forested property are maintained under a forestry management plan; best management practices are employed and occasional timber sales are allowed. The buffer properties are also managed by a watershed protection ordinance, Chapter 38 of the Portsmouth City Code. Additionally, the City of Suffolk also recognizes the buffer properties within their zoning regulations as covered by the Chesapeake Bay Preservation Act and CBPAs.

Suffolk: Lone Star Lakes Reservoir is within a City owned park; the surrounding park provides a buffer from development. Suffolk's City and Unified Development Ordinance requires the protection of water quality stream buffers in order to minimize erosion and sedimentation, loss of habitat, and loss of vegetation and tree cover by prohibiting any activity which disrupts the soil of a site. The reservoir is located within the CBPA.

Virginia Beach: The City of Virginia Beach owns property and easements for the In-Town Lakes surface water intake, pump station facilities, and the pipelines at the Lake Gaston Reservoir. The City owns Stumpy Lake and some of the lands along the lake's perimeter; the lake is not located within a CBPA.

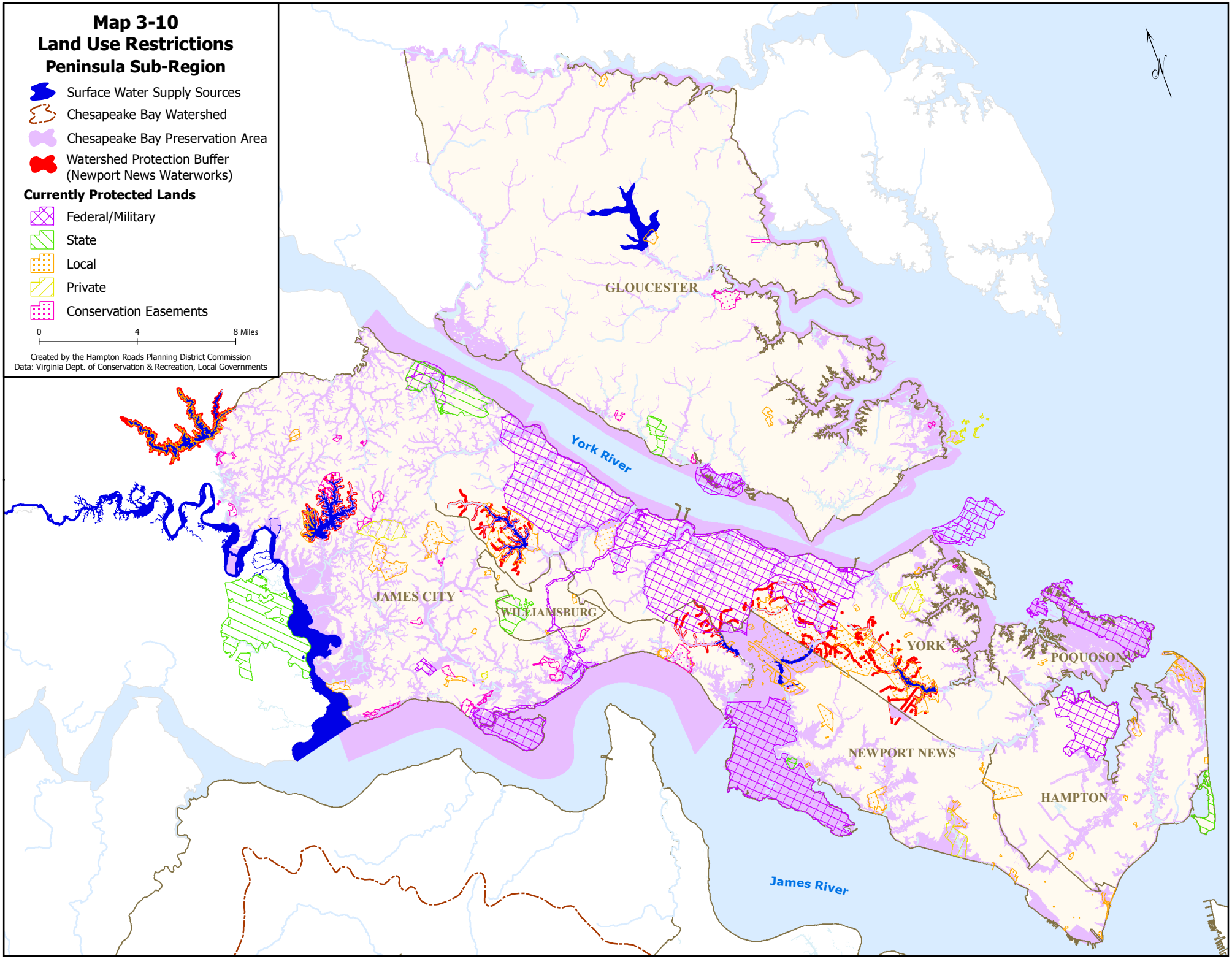
Williamsburg: Williamsburg requires the protection of buffers as necessary within Chesapeake Bay Preservation Areas. Williamsburg

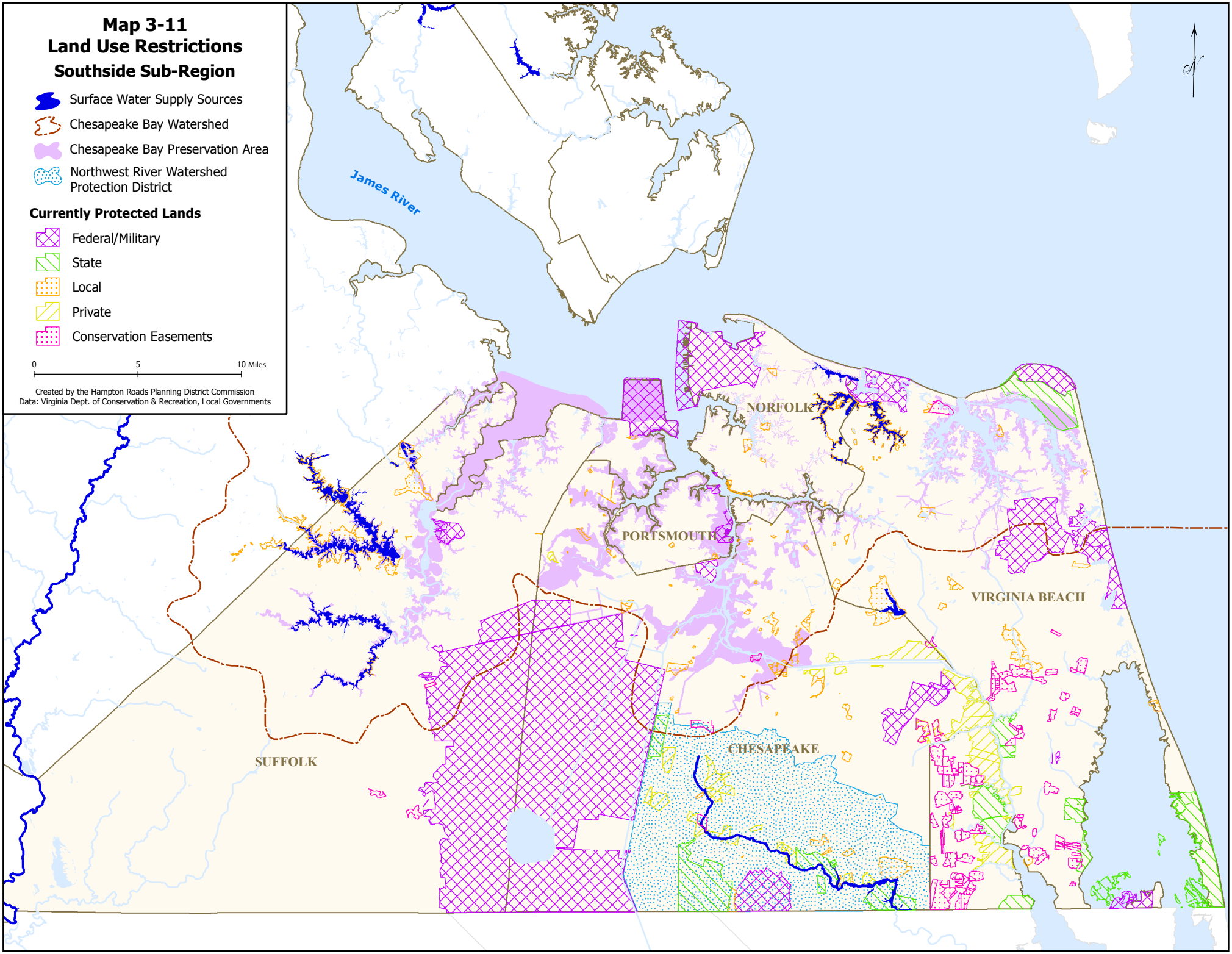
owns the land designated for conservation surrounding the Waller Mill reservoir, which is located within the CBPA.

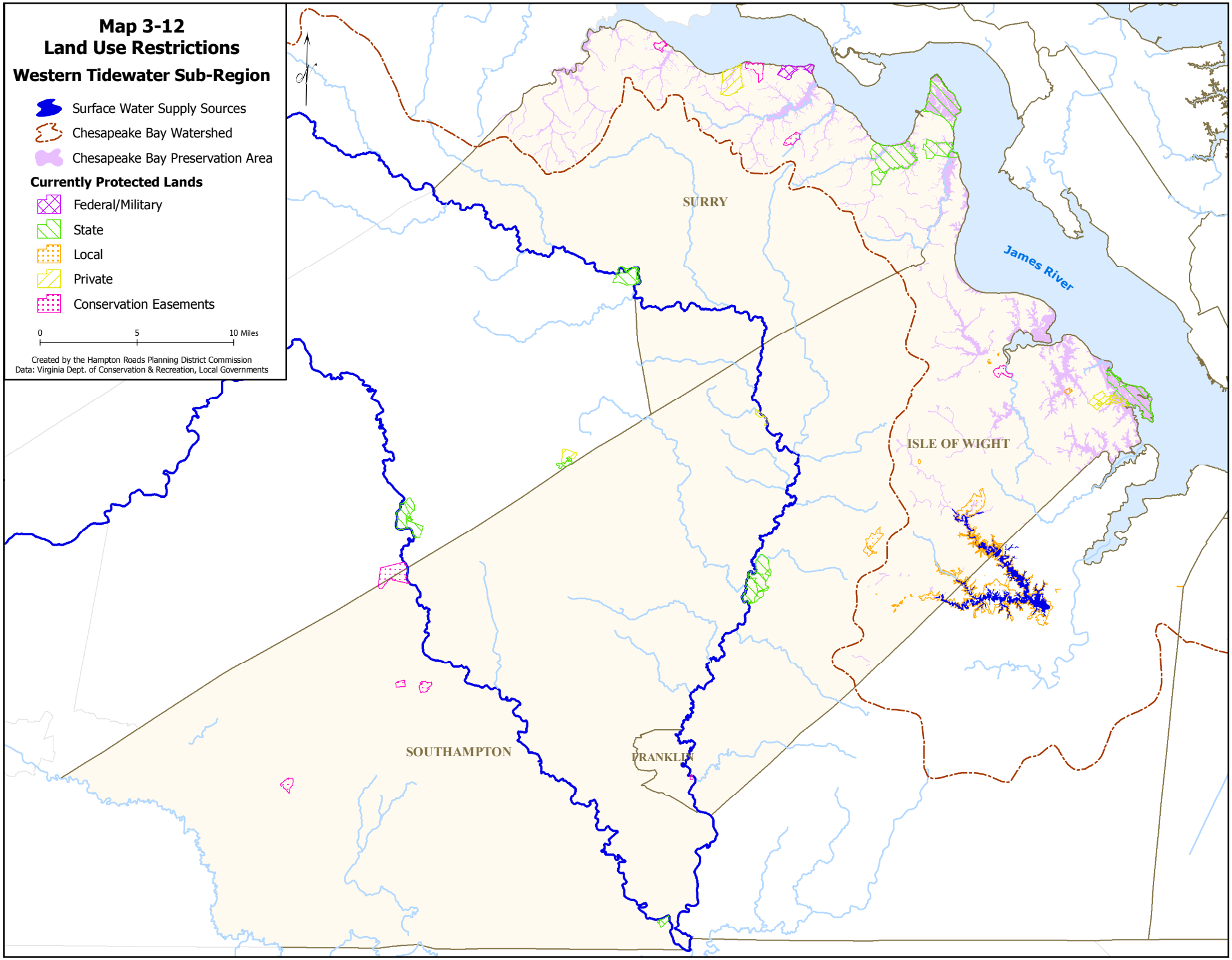
Conservation Easements

A conservation easement is an agreement between a landowner and a government agency or non-profit conservation organization that places permanent limits on the future development of the property in order to protect the conservation values of the land. Each easement is unique and permanent. Maps 3-10, 3-11, and 3-12 illustrate the Conservation Easements within Hampton Roads.

Chesapeake, Franklin, Gloucester, Isle of Wight County, James City County, Newport News, Southampton County, Suffolk, Surry County, Virginia Beach, Williamsburg, and York County have conservation easements within their borders. Virginia Beach has the highest number of conservation easements totaling 149. Many of the easements are held by the Virginia Department of Historic Resources, Virginia Outdoors Foundation, and by the localities themselves.


Map 3-10
Land Use Restrictions
Peninsula Sub-Region
Surface Water Supply Sources
Chesapeake Bay Watershed
Chesapeake Bay Preservation Area
Watershed Protection Buffer
(Newport News Waterworks)
Currently Protected Lands
Federal/Military
State
Local
Private
Conservation Easements
0
4
8 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Dept. of Conservation & Recreation, Local Governments
GLOUCESTER
York River
JAMES CITY
WILLIAMSBURG
YORK
POQUOSON
NEWPORT NEWS
HAMPTON
James River


Map 3-11
Land Use Restrictions
Southside Sub-Region
Surface Water Supply Sources
Chesapeake Bay Watershed
Chesapeake Bay Preservation Area
Northwest River Watershed Protection District
Currently Protected Lands
Federal/Military
State
Local
Private
Conservation Easements
0
5
10 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Dept. of Conservation & Recreation, Local Governments
James River
NORFOLK
PORTSMOUTH
VIRGINIA BEACH
CHESAPEAKE
SUFFOLK


Map 3-12
Land Use Restrictions
Western Tidewater Sub-Region
Surface Water Supply Sources
Chesapeake Bay Watershed
Chesapeake Bay Preservation Area
Currently Protected Lands
Federal/Military
State
Local
Private
Conservation Easements
0
5
10 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Dept. of Conservation & Recreation, Local Governments
SURRY
James River
ISLE OF WIGHT
SOUTHAMPTON
FRANKLIN

Land Use & Land Cover

The National Oceanic & Atmospheric Administration (NOAA) Coastal Services Center administers the Coastal Change Analysis Program (C-CAP). C-CAP produces a nationally standardized database of land cover and land change information for the coastal regions of the U.S. based on remotely-sensed imagery. The program inventories of coastal intertidal areas, wetlands, and adjacent uplands and updates land cover maps every five years. The C-CAP program is part of the Multi-Resolution Land Characteristics (MRLC) Consortium. Other federal agencies that are a part of the MRLC include the U.S. Environmental Protection Agency (EPA), the U.S. Forest Service (USFS), the U.S. Geological Survey (USGS), the Landscape Fire and Resource Management Planning Tools Project (LANDFIRE), the Bureau of Land Management (BLM), the Natural Resources Conservation Service (NRCS), the National Park Service (NPS), the National Aeronautics and Space Administration (NASA), the U.S. Fish and Wildlife Service (USFWS), and the Office of Surface Mining (OSM).

Maps 3-13, 3-14, and 3-15 show the land cover for each Hampton Roads sub-region based on the 2005 C-CAP data. Table 3-13 shows the percentage of land in the planning area that can be classified into general land cover categories. For the purposes of this report, some C-CAP land cover categories were consolidated as appropriate for the region. Forests, wetlands, grassland, and agricultural lands accounted for about 81% of the land cover in the Hampton Roads Region, while developed land, which includes commercial, industrial and residential land uses and developed open space, accounted for about 14% of the land cover. Surface water features, unconsolidated shore (tidal flats, shoals, and intertidal areas), and bare land (bare exposed rock, sand, and soil) total approximately 4% of land cover.

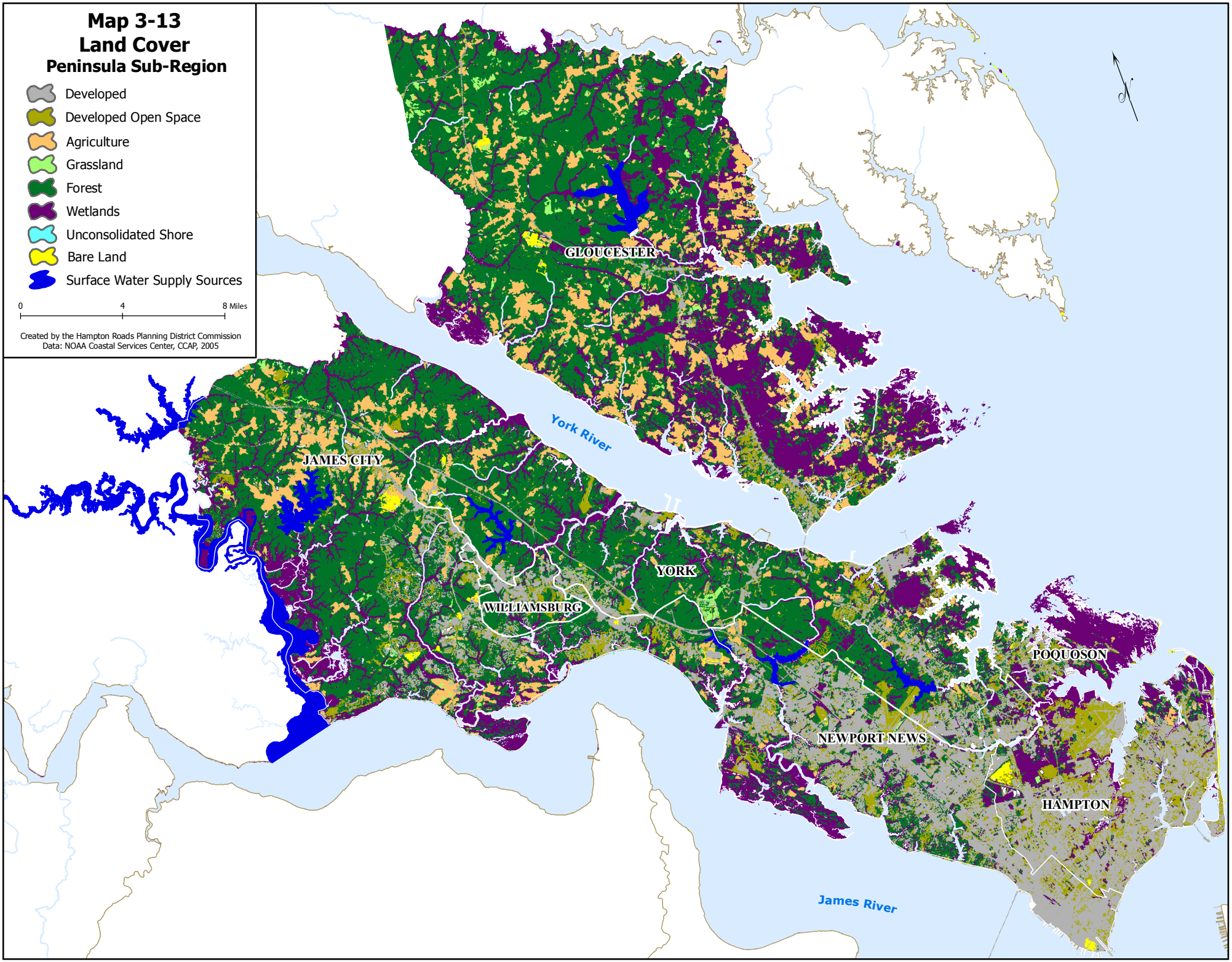
Table 3-13: Hampton Roads Land Cover Type

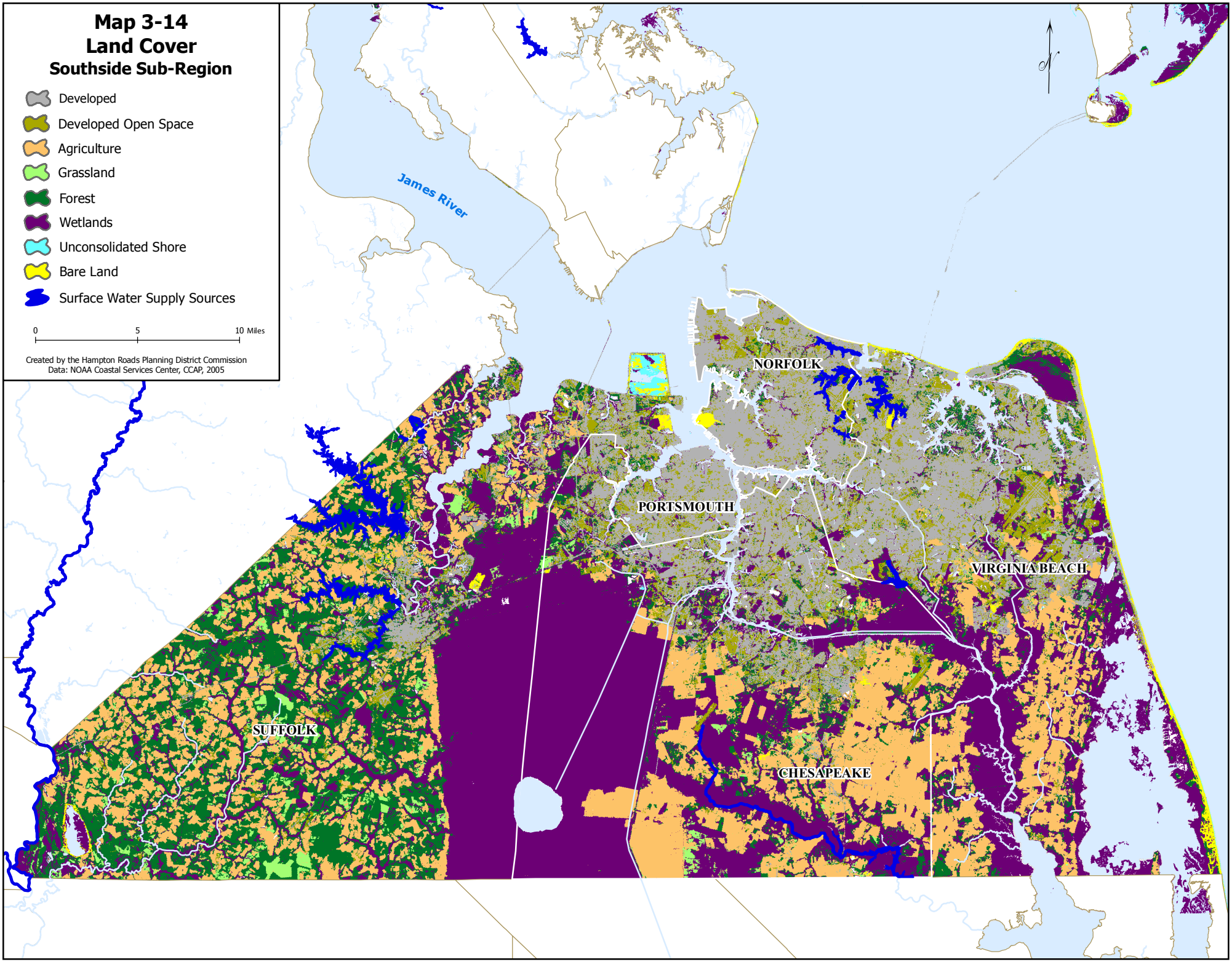
Land Cover Type	Percent of Total
Developed	10%
Developed Open Space	4%
Agriculture	22%
Grassland	2%
Forest	33%
Wetlands	25%
Unconsolidated Shore/Bare Land	1%
Water	3%
Total	**100%**

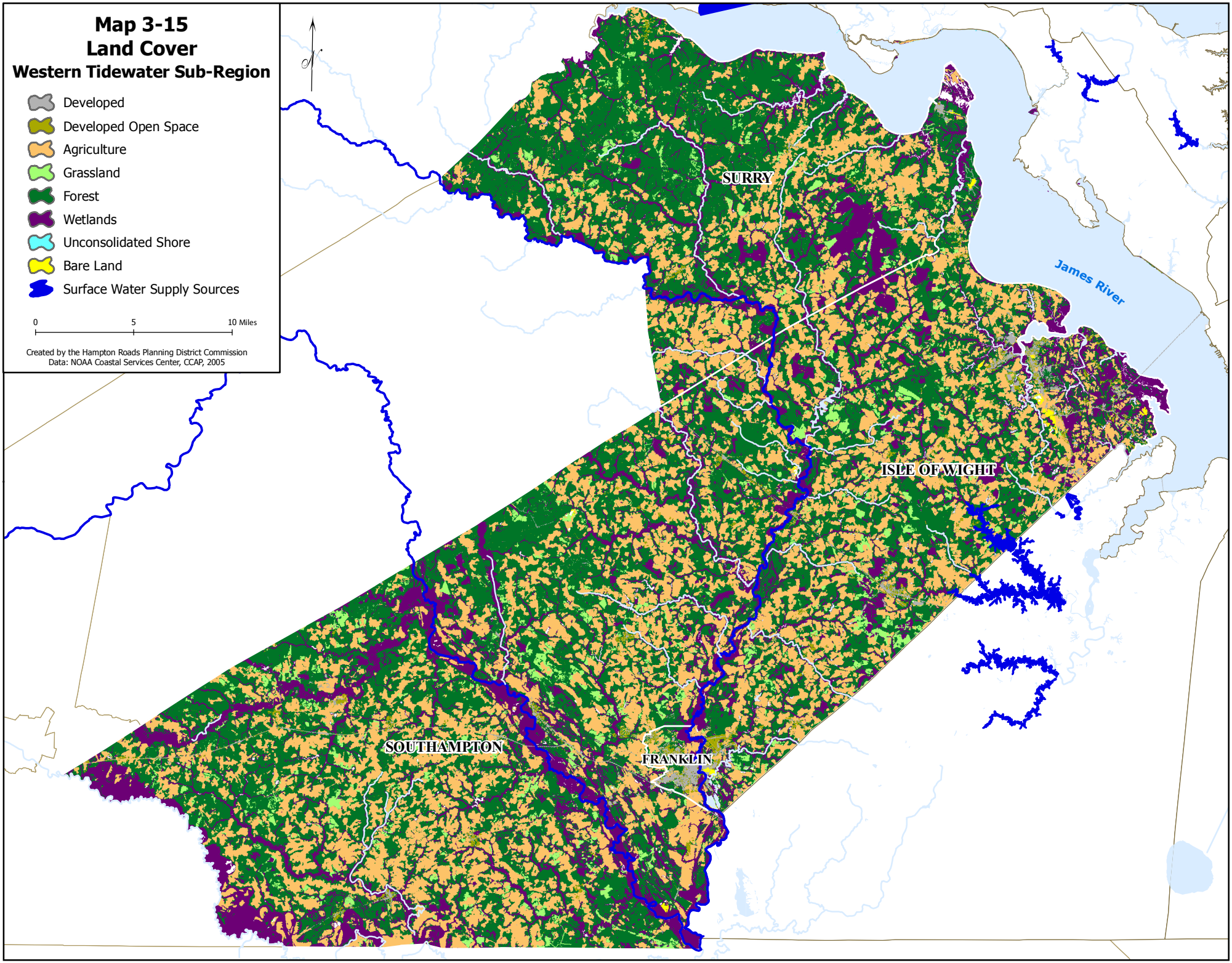
The percent of impervious cover within each jurisdiction in Hampton Roads varies greatly and is difficult to calculate accurately. The more developed central cities report imperviousness figures that range from 28 to 53 percent, while the rural localities report figures ranging from 6 to 16 percent.

Other Sources

Typically, each jurisdiction within the Hampton Roads regional water supply planning area has its own set of land use, land coverage, and/or zoning maps and ordinances. This information can generally be found in local comprehensive plans. Local land use, land cover and zoning information was not included as a part of the regional water supply plan due to the inconsistency in land use classifications between localities and the varying dates and timeframes reflected by the available local land use data.


Map 3-13
Land Cover
Peninsula Sub-Region
Developed
Developed Open Space
Agriculture
Grassland
Forest
Wetlands
Unconsolidated Shore
Bare Land
Surface Water Supply Sources
0
4
8 Miles
Created by the Hampton Roads Planning District Commission
Data: NOAA Coastal Services Center, CCAP, 2005
GLOUCESTER
JAMES CITY
York River
YORK
WILLIAMSBURG
POQUOSON
NEWPORT NEWS
HAMPTON
James River


Map 3-14
Land Cover
Southside Sub-Region
Developed
Developed Open Space
Agriculture
Grassland
Forest
Wetlands
Unconsolidated Shore
Bare Land
Surface Water Supply Sources
0
5
10 Miles
Created by the Hampton Roads Planning District Commission
Data: NOAA Coastal Services Center, CCAP, 2005
James River
NORFOLK
PORTSMOUTH
VIRGINIA BEACH
SUFFOLK
CHESAPEAKE


Map 3-15
Land Cover
Western Tidewater Sub-Region
Developed
Developed Open Space
Agriculture
Grassland
Forest
Wetlands
Unconsolidated Shore
Bare Land
Surface Water Supply Sources
0
5
10 Miles
Created by the Hampton Roads Planning District Commission
Data: NOAA Coastal Services Center, CCAP, 2005
SURRY
James River
ISLE OF WIGHT
SOUTHAMPTON
FRANKLIN

Although the National Land Cover Database data was produced in 2001, it does provide a fairly accurate picture of the land use composition of the local jurisdictions. The NLCD data was found to be the most consistent source of data for land coverage and impervious surface for the purposes of the Hampton Roads Regional Water Supply Plan. However, more current information may be available from individual jurisdictions within the planning area.

Impaired Waters & Type of Impairment

Every even-numbered year, DEQ publishes the Virginia Water Quality Assessment Integrated Report (305(b)/303(d) Report). The report satisfies the requirements of the U.S. Clean Water Act sections 305(b) and 303(d) and the Virginia Water Quality Monitoring, Information and Restoration Act. The 305(b)/303(d) Report summarizes the water quality conditions of the Commonwealth's waters during the reporting period.

The most recent and archived 305(b)/303(d) Reports are available on DEQ's Water Quality Assessments program website (see http://www.deq.state.va.us/wqa/homepage.html). Information presented in below is summarized from the 2008 305(b)/303(d) Report. Water quality conditions for the Regional water supply planning area per the report findings are discussed below.

Impaired Waterbodies

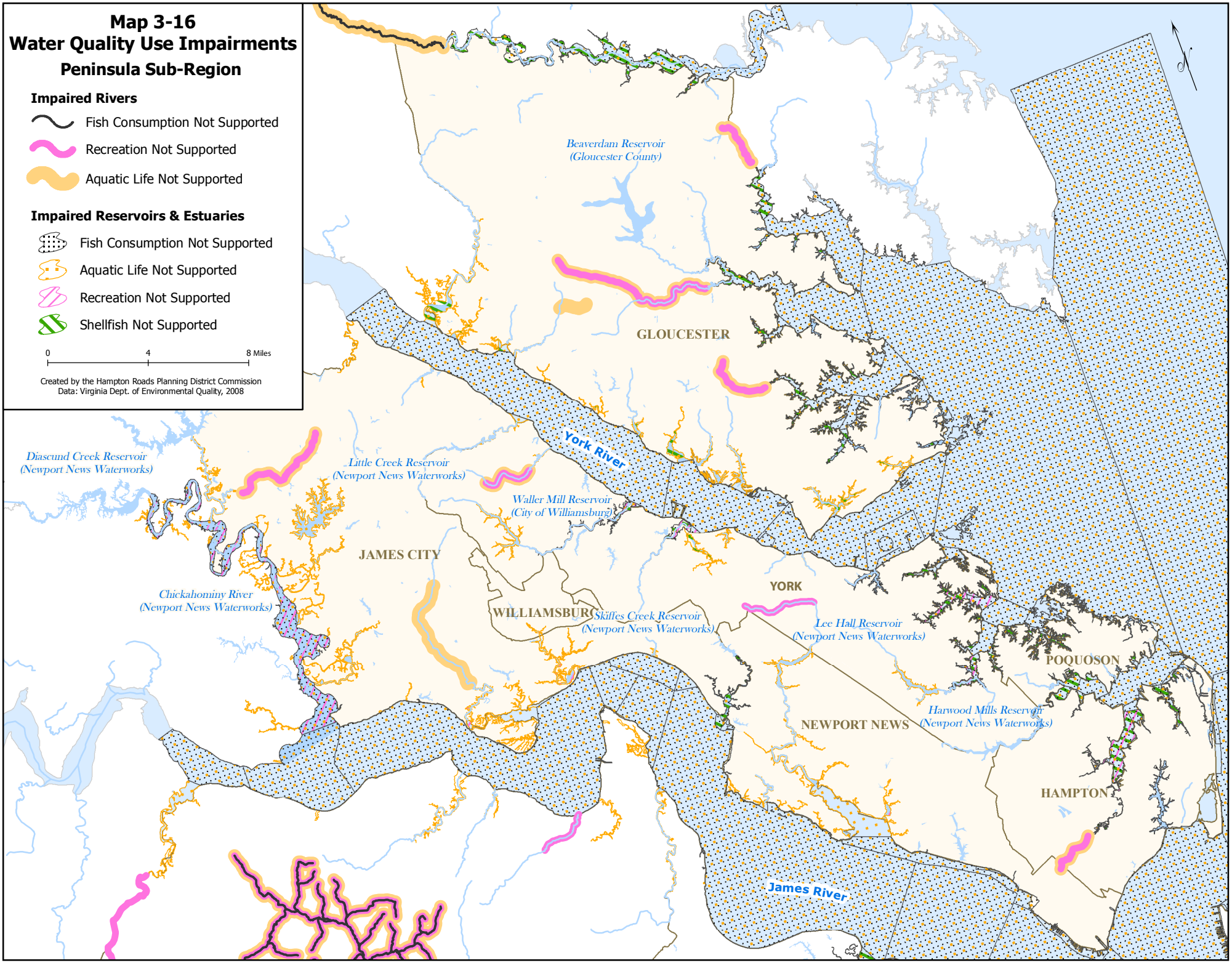
The 2008 Virginia Water Quality Assessment designates a significant portion of the Commonwealth's rivers, lakes and bays as impaired because they do not meet water quality standards. The water quality standards are established to protect drinking water supplies, aquatic life, production of edible and marketable fish and shellfish, wildlife and recreational uses of state waters, including swimming, boating, fishing and shellfish harvesting.

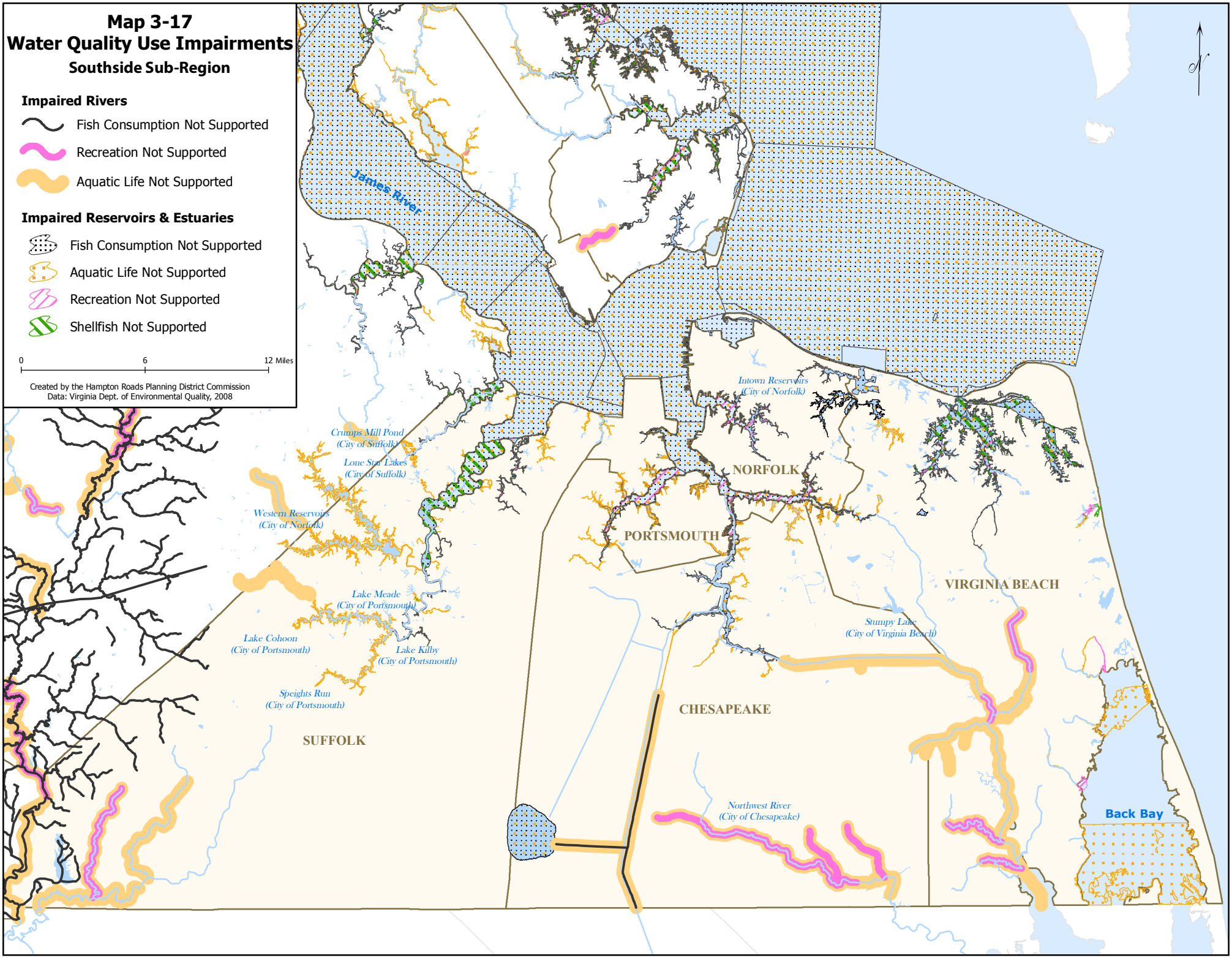
As a whole, the leading cause of impairment of designated uses in Virginia's rivers and streams is violation of the bacteria standards. In 2003, Virginia adopted three new bacteria criteria for primary recreation (swimming) use including fecal coliform, E.coli, and enterococci. (9 VAC 25-260-170). According to the Executive Summary, "Agricultural practices appear to be one of the primary sources contributing to the bacteria standards violations. However, urban runoff, leaking sanitary sewers, failing septic tanks, domestic animals and even wildlife can be significant contributing sources."

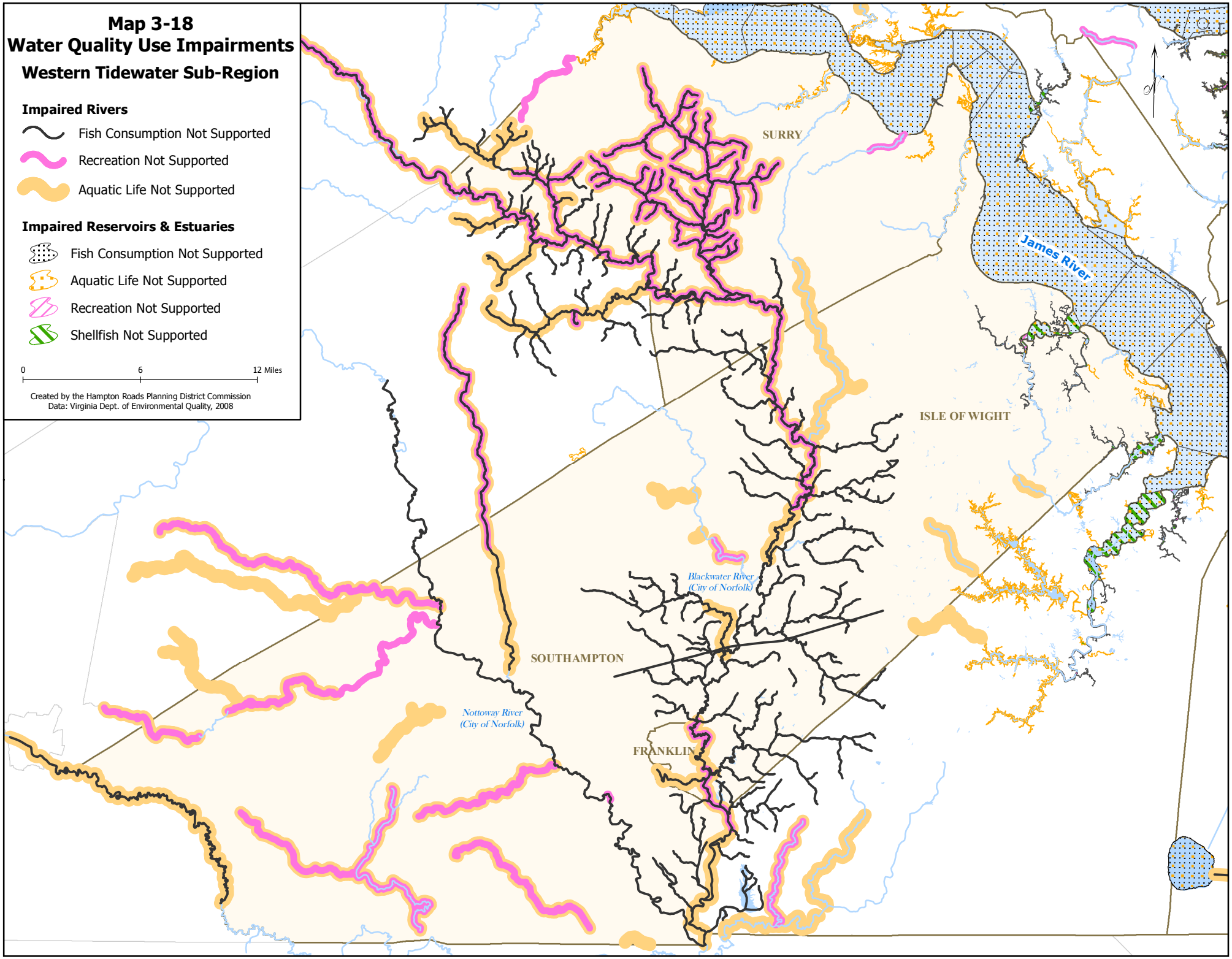
The leading cause of impairment in Virginia's estuarine waters is also dissolved oxygen and PCBs in fish tissue.

Maps 3-16, 3-17, and 3-18 show the impaired waters (Category 5 waters) identified in the 2008 305(b)/303(d) Report that are in and adjacent to the regional water supply planning area. Impaired waters are further classified as follows:

- 5A waters: The Water Quality Standard is not attained. The assessment unit is impaired for one or more designated uses by a pollutant(s) and requires a TMDL (303d list)
- 5B waters: The Water Quality Standard for shellfish use is not attained. One or more pollutants remain requiring TMDL development.
- 5C waters: The Water Quality Standard is not attained due to suspected natural conditions. The assessment unit is impaired for one or more designated uses by a pollutant(s) and may require a TMDL (303d list). Water Quality Standards for these waters may be re-evaluated due to the effects of natural conditions.
- 5D waters: The Water Quality Standard is not attained where TMDLs have been developed, but one or more pollutants remain requiring TMDL development.


Map 3-16
Water Quality Use Impairments
Peninsula Sub-Region
Impaired Rivers
Fish Consumption Not Supported
Recreation Not Supported
Aquatic Life Not Supported
Impaired Reservoirs & Estuaries
Fish Consumption Not Supported
Aquatic Life Not Supported
Recreation Not Supported
Shellfish Not Supported
0
4
8 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Dept. of Environmental Quality, 2008
N
Beaverdam Reservoir
(Gloucester County)
GLOUCESTER
York River
Diascund Creek Reservoir
(Newport News Waterworks)
Little Creek Reservoir
(Newport News Waterworks)
Waller Mill Reservoir
(City of Williamsburg)
JAMES CITY
Chickahominy River
(Newport News Waterworks)
WILLIAMSBURG
Skiffes Creek Reservoir
(Newport News Waterworks)
YORK
Lee Hall Reservoir
(Newport News Waterworks)
POQUOSON
Harwood Mills Reservoir
(Newport News Waterworks)
NEWPORT NEWS
HAMPTON
James River


Map 3-17
Water Quality Use Impairments
Southside Sub-Region
Impaired Rivers
Fish Consumption Not Supported
Recreation Not Supported
Aquatic Life Not Supported
Impaired Reservoirs & Estuaries
Fish Consumption Not Supported
Aquatic Life Not Supported
Recreation Not Supported
Shellfish Not Supported
0
6
12 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Dept. of Environmental Quality, 2008
James River
Intown Reservoirs
(City of Norfolk)
Crumps Mill Pond
(City of Suffolk)
Lone Star Lakes
(City of Suffolk)
NORFOLK
Western Reservoirs
(City of Norfolk)
PORTSMOUTH
VIRGINIA BEACH
Lake Meade
(City of Portsmouth)
Stumpy Lake
(City of Virginia Beach)
Lake Cohoon
(City of Portsmouth)
Lake Kilby
(City of Portsmouth)
Speights Run
(City of Portsmouth)
CHESAPEAKE
SUFFOLK
Northwest River
(City of Chesapeake)
Back Bay


Map 3-18
Water Quality Use Impairments
Western Tidewater Sub-Region
Impaired Rivers
Fish Consumption Not Supported
Recreation Not Supported
Aquatic Life Not Supported
Impaired Reservoirs & Estuaries
Fish Consumption Not Supported
Aquatic Life Not Supported
Recreation Not Supported
Shellfish Not Supported
0
6
12 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Dept. of Environmental Quality, 2008
SURRY
James River
ISLE OF WIGHT
Blackwater River
(City of Norfolk)
SOUTHAMPTON
Nottoway River
(City of Norfolk)
FRANKLIN

Impaired Drinking Water Sources

Maps 3-16, 3-17, and 3-18 also identify impaired waters that are sources for community water systems. Impaired drinking water sources are listed in Table 3-14. Many community water system reservoirs are impaired for recreation due to bacteria, or for aquatic life use, primarily due to natural stratification causing dissolved oxygen depletion in the hypolimnon (bottom waters). Also, exceedence of the fish tissue standard for polychlorinated biphenyls (PCBs) and mercury are major causes of fish consumption use impairment in lakes and reservoirs. Impaired segments of listed rivers may be upstream or downstream of surface water intakes.

Publicly-owned CWSs employ various technologies to address source water quality. For example, the City of Norfolk has a hypolimnetic aeration system in Lake Prince and the Western Branch Reservoir. The purpose of the system is to maintain oxygen in the bottom waters during summer stratification. The system consists of 27 aerators, nine compressors, and approximately 20 miles of piping and is designed to improve:

- Reservoir water quality by reducing nutrient (i.e., phosphorus) transport and eutrophification; and
- Treated water quality by reducing undesirable raw water characteristics (i.e., manganese, iron, and other substances).

Table 3-14: 2008 Impaired Drinking Water Sources in Hampton Roads

Sub-Region	Impaired Water Source	Associated CWS	Classification	Impaired Use	Cause
Peninsula	Lee Hall Reservoir	Newport News Waterworks	5A	Aquatic Life	Copper; Dissolved Oxygen
			5A	Wildlife	Copper
Peninsula	Harwood's Mill Reservoir	Newport News Waterworks	5A	Aquatic Life	Copper; Dissolved Oxygen
			5A	Wildlife	Copper
Peninsula	Skiff's Creek Reservoir	Newport News Waterworks	5B	Shellfishing	Fecal Coliform
Southside	Northwest River System - Upper	City of Chesapeake	5A	Recreation	Escherichia coli
			5A	Aquatic Life	Dissolved Oxygen
Southside	Northwest River System - Middle	City of Chesapeake	5A	Recreation	Escherichia coli
			5C	Aquatic Life	Dissolved Oxygen
Southside	Northwest River System - Lower	City of Chesapeake	5C	Aquatic Life	Dissolved Oxygen
Southside	Lake Smith	City of Norfolk	5A	Aquatic Life	Dissolved Oxygen
Southside	Little Creek Reservoir	City of Norfolk	5A	Aquatic Life	Dissolved Oxygen
			5A	Fish Consumption	PCB in Fish Tissue
Southside	Lake Whitehurst	City of Norfolk	5A	Aquatic Life	Dissolved Oxygen
			5A	Fish Consumption	PCB in Fish Tissue
			5A	Fish Consumption	Mercury in Fish Tissue
Southside	Lake Burnt Mills	City of Norfolk	5A	Aquatic Life	Dissolved Oxygen
Southside	Western Branch Reservoir	City of Norfolk	5A	Aquatic Life	Dissolved Oxygen
Southside	Speights Run	City of Portsmouth	5A	Aquatic Life	Dissolved Oxygen
Southside	Lake Kilby	City of Portsmouth	5A	Aquatic Life	Dissolved Oxygen
Southside	Lake Cahoon	City of Portsmouth	5A	Aquatic Life	Dissolved Oxygen
Southside	Lake Meade	City of Portsmouth	5A	Aquatic Life	Dissolved Oxygen
Southside	Lone Star Lakes	City of Suffolk	5A	Aquatic Life	Dissolved Oxygen
Western Tidewater	Blackwater River	City of Norfolk	5A	Recreation	Escherichia coli
			5A	Aquatic Life	Dissolved Oxygen
			5A	Aquatic Life	Benthic-Macroinvertebrate Bioassessments
			5A	Fish Consumption	Mercury in Fish Tissue
Western Tidewater	Nottoway River	City of Norfolk	5A	Recreation	Escherichia coli
			5A	Aquatic Life	Benthic-Macroinvertebrate Bioassessments
			5A	Fish Consumption	Mercury in Fish Tissue

Source: Virginia Department of Environmental Quality, Final 2008 305(b)/303(d) Water Quality Assessment Integrated Report (Integrated Report), December 22, 2008

Point Source Discharges

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. The NPDES program is authorized by Section 402 of the Clean Water Act to limit pollutant discharges into streams, rivers, wetlands, lakes, and bays. Water pollution degrades surface waters, making them unsafe for drinking, fishing, swimming, and other activities.

Point sources of water pollution are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface water discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits in order to emit discharges directly to surface waters.

The Virginia Pollutant Discharge Elimination System (VPDES) permit program is authorized under the State Water Control Law. The Virginia Pollutant Discharge Elimination System Permit Regulation (9 VAC 25-31) incorporates the federal permitting requirements and sets forth the policies and procedures for state-level program administration. The Virginia Department of Environmental Quality (DEQ) and the Department of Conservation and Recreation (DCR) coordinate separate programs that regulate the management of pollutants carried by storm water runoff. DEQ regulates storm water discharges associated with "industrial activities" and DCR regulates storm water discharges from construction sites and from municipal separate storm sewer systems (MS4s).

VPDES Permitted Facilities in Hampton Roads

According to DEQ, there were 137 industrial and municipal VPDES permitted facilities in Hampton Roads in 2005 (see Table 3-15 and Map 3-19). These permitted facilities include Phase I Municipal Separate Storm Sewer Systems (MS4s), local government water and wastewater treatment plants, correctional facilities, military facilities, and Virginia Department of Transportation (VDOT) tunnels. The majority of the VPDES permitted facilities are industrial in nature.

Although DEQ requires VPDES permits for all point source discharges to surface waters, the EPA maintains the authority to review applications and permits for major dischargers, a distinction based on discharge quantity and content.

Source Water Assessment Program

Regulations promulgated by the EPA to implement the Safe Drinking Water Act (SDWA) Amendments of 1996 provide a greater focus on pollution prevention as an approach to ensuring safe drinking water that complements the traditional treatment approach. This approach aims to prevent problems by increasing the capacity of community water systems to provide safe drinking water and by protecting the drinking water supply (source water).

The Source Water Assessment Program (SWAP) is the regulatory first step in developing programs to protect drinking water sources from pollution. Each state is required to conduct a source water assessment for each community water system within the state. VDH is the state agency responsible for developing and implementing programs under the federal SDWA. For Hampton Roads, VDH contracted with the HRPDC to conduct the source water assessments for public utilities that utilize surface water sources. The HRPDC SWAP (August 2002) concentrated on eight area water utilities that primarily rely on surface water sources; 21 surface water sources and 31 conjunctive use wells. The eight surface water dependent public utilities include Gloucester County, and the Cities of Chesapeake, Newport News, Norfolk, Portsmouth, Suffolk, Virginia Beach and Williamsburg.

HRPDC contracted with CH2M Hill to provide technical assistance to the SWAP subcommittee process. Through the subcommittee, CH2M Hill delineated the source assessment areas, inventoried the land use activities, assessed the susceptibility of each source according to the VDH guidance and developed the HRPDC SWAP database integrated with Geographic Information System (GIS) data.

Table 3-15: 2005 VPDES Permitted Facilities in Hampton Roads

Facility	Locality	VPDES Number	Municipal or Industrial	Facility	Locality	VPDES Number	Municipal or Industrial
1. Allied Terminals Incorporated - Chesapeake	Chesapeake	VA0053686	Industrial	18. Chesapeake Bay Bridge and Tunnel District	Chesapeake Bay	VA0006203	Industrial
2. Amerada Hess Corporation - Chesapeake	Chesapeake	VA0053082	Industrial	19. Chesapeake City - Lake Gaston WTP	Chesapeake	VA0091405	Industrial
3. Apex Oil Company - Chesapeake Terminal Division	Chesapeake	VA0053473	Industrial	20. Chesapeake City - Mains Creek Well Pump Station	Chesapeake	VA0073598	Industrial
4. Ashby Subdivision Water Supply	Isle of Wight	VA0088692	Industrial	21. Chesapeake City - MS4	Chesapeake	VA0088625	Municipal
5. Associated Naval Architects	Portsmouth	VA0087599	Industrial	22. Chesapeake City – WTP	Chesapeake	VA0088404	Industrial
6. Atlantic Energy Incorporated	Chesapeake	VA0074454	Industrial	23. Chesapeake Municipal Airport	Chesapeake	VA0068209	Municipal
7. Atlantic Wood Industries Newsoms	Southampton	VA0059056	Industrial	24. Ciba Specialty Chemicals Corporation	Suffolk	VA0058254	Industrial
8. Atlantic Wood Industries Portsmouth	Portsmouth	VA0004189	Industrial	25. Citgo Petroleum Corporation - Chesapeake Terminal	Chesapeake	VA0054623	Industrial
9. BASF Corporation - Portsmouth	Portsmouth	VA0003387	Industrial	26. Clydes Dale Mobile Home Park	Isle of Wight	VA0067318	Municipal
10. BASF Corporation - Williamsburg	James City County	VA0003654	Industrial	27. Cogentrix Virginia Leasing Corporation	Portsmouth	VA0074781	Industrial
11. Bayshore Concrete Products Corp. - Chesapeake	Chesapeake	VA0064645	Industrial	28. Colonial Pipeline Company – Hill	Chesapeake	VA0051853	Industrial
12. Boykins Town – WWTP	Southampton	VA0026417	Municipal	29. Colonial Pipeline Company – Norfolk	Chesapeake	VA0051845	Industrial
13. Brewers Creek Subdivision Water Supply	Isle of Wight	VA0089184	Industrial	30. Colonial Pipeline Company – Yorktown	James City County	VA0051870	Industrial
14. C and M Industries Incorporated	Norfolk	VA0089222	Industrial	31. Colonial Pipeline Surry	Surry	VA0085481	Industrial
15. Capron Town - Elementary School	Southampton	VA0027375	Municipal	32. Colonna Marine LLC - Colonna Yachts	Norfolk	VA0004391	Industrial
16. Carrollton Court	Isle of Wight	VA0088072	Municipal	33. Colonnas Shipyard	Norfolk	VA0053813	Industrial
17. Center Terminal Company - Norfolk	Norfolk	VA0058572	Industrial	34. Columbia Gas Transmission Corp – Chesapeake	Chesapeake	VA0086835	Industrial

Table 3-15: 2005 VPDES Permitted Facilities in Hampton Roads (continued)

Facility	Locality	VPDES Number	Municipal or Industrial	Facility	Locality	VPDES Number	Municipal or Industrial
35. Commonwealth Atlantic Limited - Chesapeake	Chesapeake	VA0087441	Industrial	52. Gloucester County WWTP	Gloucester County	VA0078778	Industrial
36. Commonwealth Wood Preservers Incorporated	Newport News	VA0073555	Industrial	53. Gloucester Lumber Products Incorporated – Dutton	Gloucester County	VA0077879	Industrial
37. Concrete Precast Systems Inc - Chesapeake	Chesapeake	VA0089818	Industrial	54. Grays Creek Marina and Restaurant	Surry	VA0091308	Municipal
38. Courtland Town – WWTP	Southampton	VA0061859	Municipal	55. Hampton City MS4	Hampton	VA0088633	Municipal
39. Davis Boat Works Inc	Newport News	VA0089664	Industrial	56. Hercules Incorporated – Franklin	Southampton	VA0003433	Industrial
40. DMA Air National Guard	Virginia Beach	VA0087912	Industrial	57. HRSD - Army Base STP	Norfolk	VA0081230	Municipal
41. DOC - Southampton Correctional Facility	Southampton	VA0062499	Municipal	58. HRSD - Atlantic STP	Virginia Beach	VA0081248	Municipal
42. DOC - St. Brides Correctional Center	Chesapeake	VA0060526	Municipal	59. HRSD - Boat Harbor STP	Newport News	VA0081256	Municipal
43. Dominion – Yorktown	York County	VA0004103	Industrial	60. HRSD - Chesapeake-Elizabeth STP	Norfolk	VA0081264	Municipal
44. Dominion Terminal Associates	Newport News	VA0057576	Industrial	61. HRSD - James River STP	Newport News	VA0081272	Municipal
45. Dominion Virginia Power – Chesapeake	Chesapeake	VA0004081	Industrial	62. HRSD - Nansemond STP	Suffolk	VA0081299	Municipal
46. Dominion Virginia Power – Southampton	Southampton	VA0082767	Industrial	63. HRSD - Virginia Initiative Plant	Norfolk	VA0081281	Municipal
47. Dominion Virginia Power - Surry and Gravel Neck	Surry	VA0004090	Industrial	64. HRSD - Williamsburg STP	James City County	VA0081302	Municipal
48. Ecolochem Incorporated	Norfolk	VA0053554	Industrial	65. HRSD - York River STP	York County	VA0081311	Municipal
49. ExxonMobil Oil Corporation - Chesapeake Terminal	Chesapeake	VA0053911	Industrial	66. IMTT Chesapeake	Chesapeake	VA0056138	Industrial
50. Franklin City – STP	Franklin	VA0023922	Municipal	67. Indian Cove Campground	Virginia Beach	VA0062391	Municipal
51. Giant Yorktown Refinery	York County	VA0003018	Industrial	68. International Paper - Franklin Mill	Suffolk	VA0004162	Industrial

Table 3-15: 2005 VPDES Permitted Facilities in Hampton Roads (continued)

Facility	Locality	VPDES Number	Municipal or Industrial	Facility	Locality	VPDES Number	Municipal or Industrial
69. JH Miles & Company Incoporated	Norfolk	VA0003263	Industrial	86. Norfolk Oil Transit Incorporated	Norfolk	VA0054828	Industrial
70. Kinder Morgan Bulk Terminals - Pier IX	Newport News	VA0057142	Industrial	87. Norfolk Shiprepair and Drydock	Norfolk	VA0004405	Industrial
71. Kinder Morgan Energy Partners - ERT	Chesapeake	VA0081418	Industrial	88. Norfolk Southern Railway Company - Lamberts Point	Norfolk	VA0003409	Industrial
72. Koch Materials Company	Newport News	VA0055832	Industrial	89. Norshipco - Berkley	Norfolk	VA0004383	Industrial
73. Lyon Shipyard - Sealift Drydock	Norfolk	VA0089168	Industrial	90. Ocean Marine Yacht Center	Portsmouth	VA0090778	Industrial
74. Lyon Shipyard Inc	Norfolk	VA0085855	Industrial	91. Peck Marine Terminal	Chesapeake	VA0004821	Industrial
75. Metro Machine Corporation	Norfolk	VA0073091	Industrial	92. Perdue Farms Incorporated - Chesapeake	Chesapeake	VA0004448	Industrial
76. Moon Engineering Company Incorporated	Portsmouth	VA0089699	Industrial	93. Port Allen Marine Services	Chesapeake	VA0086533	Industrial
77. Nansemond Precast Concrete Company	Suffolk	VA0088781	Industrial	94. Portsmouth City - Lake Kilby Treatment Facility	Suffolk	VA0006301	Industrial
78. Newport News City - Lee Hall WTP	Newport News	VA0089451	Industrial	95. Portsmouth City - MS4	Portsmouth	VA0088668	Municipal
79. Newport News City - Lee Hall WTP	Newport News	VA0050032	Industrial	96. Praxair Incorporated	Hampton	VA0057541	Industrial
80. Newport News City Harwood's Mill Water Filtration	York County	VA0005975	Industrial	97. Rappahannock Community College - Glenns Campus	Gloucester County	VA0028461	Municipal
81. Newport News City MS4	Newport News	VA0088641	Municipal	98. Royster-Clark Inc - Chesapeake - Weaver Lane	Chesapeake	VA0003875	Industrial
82. Newport News Shipbuilding	Newport News	VA0004804	Industrial	99. S W Rawls Incorporated - Franklin	Franklin	VA0055841	Industrial
83. Newport News Williamsburg International Airport	Newport News	VA0089681	Industrial	100. Sentry Services Inc. - Suffolk	Suffolk	VA0086134	Industrial
84. Norfolk City of - MS4	Norfolk	VA0088650	Municipal	101. Siemens VDO Automotive Corporation - Newport News	Newport News	VA0005282	Industrial
85. Norfolk International Airport	Norfolk	VA0089737	Industrial	102. SPSA - Refuse Derived Fuel Plant	Portsmouth	VA0089923	Industrial

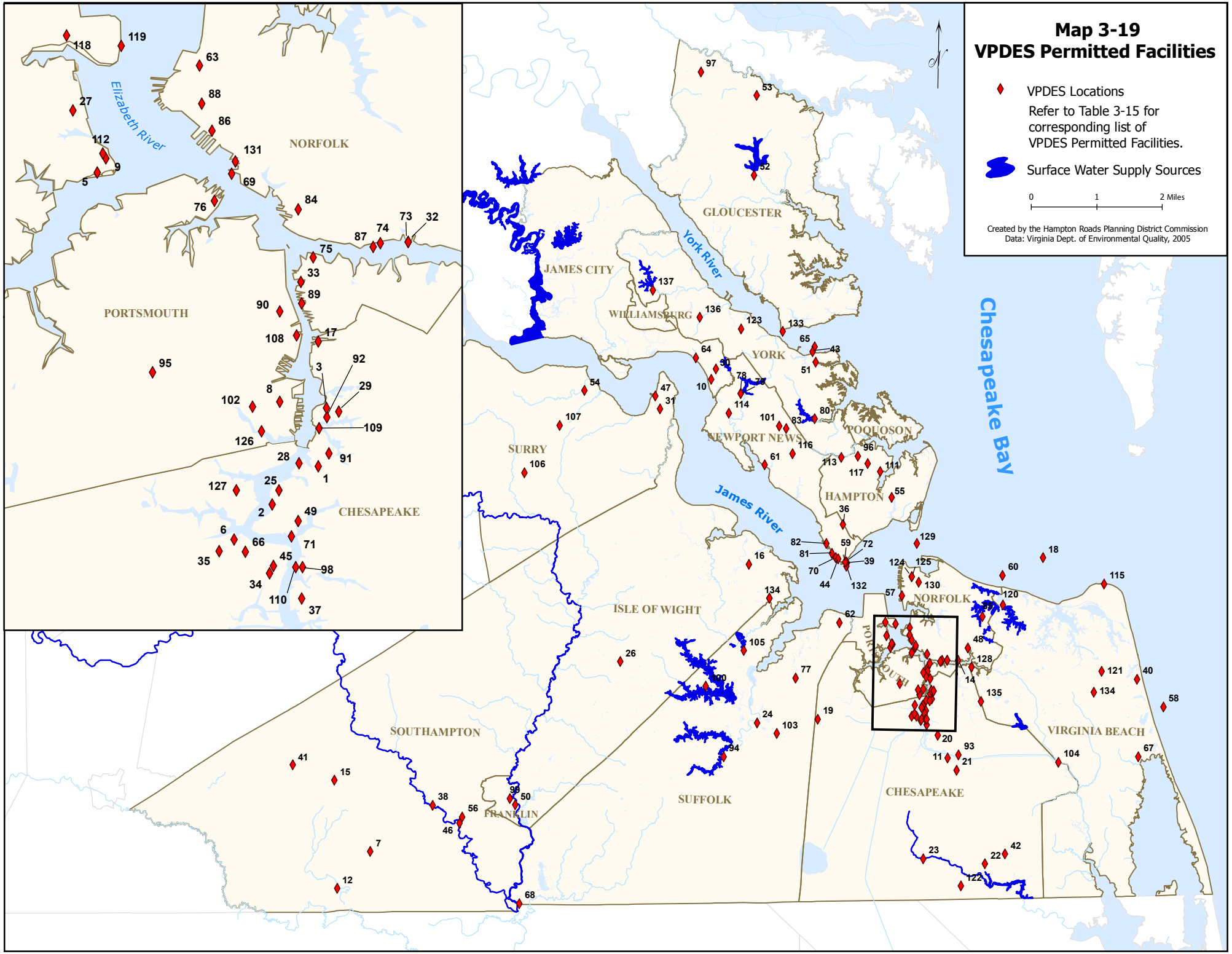
Table 3-15: 2005 VPDES Permitted Facilities in Hampton Roads (continued)

Facility	Locality	VPDES Number	Municipal or Industrial	Facility	Locality	VPDES Number	Municipal or Industrial
103. SPSA - Regional Landfill	Suffolk	VA0090034	Industrial	119. US Navy - Craney Island - WWTP	Portsmouth	VA0089605	Industrial
104. ST Services	Virginia Beach	VA0087548	Industrial	120. US Navy - Little Creek Amphibious Base	Virginia Beach	VA0079928	Industrial
105. Suffolk City of - G Robert House WTP	Suffolk	VA0076473	Industrial	121. US Navy - Naval Air Station - Oceana	Virginia Beach	VA0005266	Industrial
106. Surry County Wastewater Treatment Facility	Surry	VA0088463	Municipal	122. US Navy - Naval Security Group Activity Northwest	Chesapeake	VA0024244	Municipal
107. Surry Town of WWTF	Surry	VA0061646	Municipal	123. US Navy - Naval Weapons Station - Yorktown	York County	VA0087408	Industrial
108. TransMontaigne Product Services Inc - Terminal 1	Portsmouth	VA0023272	Industrial	124. US Navy - Norfolk Naval Base - Sewells Point	Norfolk	VA0004421	Industrial
109. TransMontaigne Product Services Inc - Terminal 2	Chesapeake	VA0053074	Industrial	125. US Navy - Norfolk Naval Base - Sewells Point	Norfolk	VA0089532	Industrial
110. Tri-Port Terminals	Chesapeake	VA0083313	Industrial	126. US Navy - Norfolk Naval Shipyard	Portsmouth	VA0005215	Industrial
111. US Air Force - Langley Air Force Base	Hampton	VA0083194	Industrial	127. US Navy - St Juliens Creek Annex	Chesapeake	VA0089761	Industrial
112. US Amines LLC - Portsmouth	Portsmouth	VA0090298	Industrial	128. VDOT - Downtown Tunnel	Virginia Beach	VA0005851	Industrial
113. US Army - Big Bethel Water Treatment Plant	Hampton	VA0005924	Industrial	129. VDOT - Hampton Roads District - Bridge Tunnel	Chesapeake Bay	VA0005657	Industrial
114. US Army - Fort Eustis - Transportation Center	Newport News	VA0025216	Industrial	130. VDOT - I-564 Tunnel	Norfolk	VA0005835	Industrial
115. US Army - Fort Story	Virginia Beach	VA0031917	Industrial	131. VDOT - Midtown Tunnel	Norfolk	VA0005860	Industrial
116. US DOE - Thomas Jefferson National Accelerator Fac	Newport News	VA0089320	Industrial	132. VDOT - Monitor Merrimac Memorial Bridge Tunnel	Newport News	VA0080179	Industrial
117. US NASA - Langley Research Center	Hampton	VA0024741	Industrial	133. VIMS Toxicology Laboratories	Gloucester County	VA0071528	Industrial
118. US Navy - Craney Island - Fuel Terminal	Portsmouth	VA0005487	Industrial	134. Virginia Beach City - MS4	Virginia Beach	VA0088676	Municipal

Table 3-15: 2005 VPDES Permitted Facilities in Hampton Roads (continued)

Facility	Locality	VPDES Number	Municipal or Industrial	Facility	Locality	VPDES Number	Municipal or Industrial
135. Virginia Beach City – Mt Trashmore Landfill II	Virginia Beach	VA0086169	Industrial	137. Williamsburg Water Filter Plant	York County	VA0056537	Industrial
136. Water Country USA	York County	VA0089826	Industrial				

Source: Virginia Department of Environmental Quality, 2005.
Notes: STP: Sewage Treatment Plant
WTP: Water Treatment Plant
WWTP: Wastewater Treatment Plant


Map 3-19
VPDES Permitted Facilities
VPDES Locations
Refer to Table 3-15 for corresponding list of VPDES Permitted Facilities.
Surface Water Supply Sources
0
1
2 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Dept. of Environmental Quality, 2005
Elizabeth River
York River
James River
Chesapeake Bay
NORFOLK
PORTSMOUTH
CHESAPEAKE
GLOUCESTER
JAMES CITY
WILLIAMSBURG
YORK
SURRY
NEWPORT NEWS
POQUOSON
HAMPTON
ISLE OF WIGHT
SOUTHAMPTON
SUFFOLK
FRANKLIN
VIRGINIA BEACH

The Hampton Roads source water assessment contains the following elements:

- Source water assessment area delineation.
- Inventory of Land Use Activities that are, or could become, potential sources of contamination for a drinking water source.
- Water supply susceptibility determination.

The HRPDC SWAP reports (August 2002) are compiled by jurisdiction, with one report for each of the eight water utilities with surface water sources and conjunctive use wells. The reports were distributed to each water utility and to the host jurisdictions of the SWAP areas. A two-volume document prepared for HRPDC contains all eight reports. All documents, the database and associated GIS data, database user's guide, metadata, and raw data files were provided on CD ROM to each of the sixteen jurisdictions in Hampton Roads. Section 1, Existing Sources, summarizes the findings of the VDH SWAP evaluations and HRPDC SWAP (August 2002) for publicly-owned community water system sources and indicates any determination on susceptibility to contamination.

Active Solid Waste Management Facilities in Hampton Roads

As of April 2008, DEQ listed 47 active permits for solid waste management facilities in Hampton Roads (see Table 3-16). A majority of these facilities are transfer stations operated by the Southeastern Public Service Authority (SPSA) or the Virginia Peninsulas Public Services Authority (VPPSA). Other facilities include sanitary landfills, construction and demolition debris landfills, industrial landfills, yard waste composting facilities, materials recovery facilities, regulated medical waste management facilities, and energy recovery and incineration facilities.

Underground Storage Tanks

Underground storage tanks can contain hazardous substances, such as petroleum, gasoline, diesel fuel, acetone, or kerosene. Over time, these underground storage tanks may corrode and begin to leak. Small leaks in a tank are usually not detected, and have minimal impact on water resources if the leak occurs in shallow, well-aerated soils. Under these conditions, petroleum products will attach to clay and organic material in the soil and naturally occurring bacteria can decompose these products over time. Larger leaks or leaks in very permeable sandy soils do not provide an adequate barrier and can easily result in ground water contamination.

DEQ is charged with regulating underground storage tanks in Virginia. Underground storage tank regulations require that after December 22, 1998, all new tanks be made of non-corrodible materials and be equipped with overfill and spill prevention devices. Tanks already in existence are required to be replaced or retrofitted to meet the new standards. Underground storage tank regulations do not apply to residential underground storage tanks.

Underground storage tank data for the localities within Hampton Roads was obtained from DEQ. In 2008, there were 3,590 registered petroleum underground storage tank sites in the region. Of these, only 213 were classified as open or in use.

Superfund Sites

Superfund is the name given to the federal government's environmental program to clean up uncontrolled hazardous waste sites. Superfund allows the EPA to clean up sites and to compel responsible parties to perform cleanups or reimburse the government for EPA-lead cleanups. Table 3-17 lists the Superfund sites in Hampton Roads as of 2008.

Other Resources

The EPA provides "EnviroFacts," an online resource mapping several environmental databases including: the Toxic Release Inventory (TRI), Aerometric Information Retrieval System (AIRS), Permit Compliance System (PCS), Information Collection Rule (ICR), Superfund and Safe Drinking Water Information System (SDWIS) database. EnviroFacts can be used to query point source discharges and other environmental information such as superfund sites, toxic release sites, water discharges, air emission, and hazardous waste locations by geographic location. EnviroFacts is available online at http://epa.gov/enviro/.

Table 3-16: 2008 Active Solid Waste Management Facilities in Hampton Roads

Facility Name	Locality	Permit Number	Type of Facility
American Environmental Group	Suffolk	PBR542	Regulated Medical Waste Storage Facility
Bay Disposal Incorporated Material Recovery Facility	Norfolk	PBR504	Materials Recovery Facility
Dominion - Chesapeake Energy Center	Chesapeake	SWP440	Industrial Landfill
Dominion - Yorktown Power Station	Yorktown	SWP457	Industrial Landfill
Hampton City - NASA Steam Plant	Hampton	SWP297	Energy Recovery/Incineration Facility
Higgerson Buchanan Incorporated	Chesapeake	SWP493	Construction and Demolition Debris Landfill
Industrial Resource Technology	Gloucester	PBR115	Materials Recovery Facility
International Paper LF No 2 - Isle of Wight	Franklin	SWP504	Industrial Landfill
John C Holland Enterprises Landfill	Suffolk	SWP280	Industrial Landfill
Maryview Hospital	Portsmouth	PBR172	Regulated Medical Waste Steam Sterilizer
Middle Peninsula Landfill	Glenns	SWP572	Sanitary Landfill
Middle Peninsula Landfill	Glenns	PBR125	Yard Waste Composting Facility
Newport News City – Yard Waste Composting Facility - Warwick Blvd	Newport News	PBR096	Yard Waste Composting Facility
Old Dominion University	Norfolk	PBR157	Regulated Medical Waste Steam Sterilizer
Portsmouth City - Craney Island Landfill	Portsmouth	SWP041	Construction and Demolition Debris Landfill
Reclamation Incorporated	Hampton	PBR062	Materials Recovery Facility
Riverside Regional Medical Center	Newport News	PBR165	Regulated Medical Waste Alternate Treatment
Soilex Corporation - Chesapeake	Chesapeake	PBR510	Materials Recovery Facility
Soilex Corporation - Suffolk	Suffolk	PBR155	Materials Recovery Facility
Spivey Disposal LLC	Hampton	PBR533	Materials Recovery Facility
SPSA - Boykins Transfer	Boykins	SWP484	Transfer Station
SPSA - Chesapeake Transfer	Chesapeake	PBR194	Transfer Station
SPSA - Consolidated Yard Waste Facility	Virginia Beach	PBR519	Yard Waste Composting Facility
SPSA - Franklin Transfer Station	Franklin	PBR192	Transfer Station
SPSA – Incinerator	Portsmouth	PBR500	Energy Recovery/Incineration Facility
SPSA - Isle Of Wight Transfer Station	Smithfield	PBR193	Transfer Station
SPSA - Ivor Transfer Station	Ivor	SWP539	Transfer Station
SPSA - Landstown Transfer	Virginia Beach	PBR191	Transfer Station

Table 3-16: 2008 Active Solid Waste Management Facilities in Hampton Roads (continued)

Facility Name	Locality	Permit Number	Type of Facility
SPSA - Norfolk Transfer Station	Norfolk	PBR195	Transfer Station
SPSA - Oceana Transfer Station	Virginia Beach	PBR190	Transfer Station
SPSA - Regional Landfill	Suffolk	PBR518	Transfer Station
SPSA - Regional Landfill	Suffolk	PBR072	Materials Recovery Facility
SPSA - Regional Landfill	Suffolk	SWP417	Sanitary Landfill
United Disposal Incorporated	Norfolk	PBR522	Materials Recovery Facility
US - AFETA Camp Peary	Williamsburg	PBR097	Transfer Station
US Army - Fort Eustis - Transportation Center	Ft Eustis	PBR119	Regulated Medical Waste Incinerator
US Navy - Norfolk Naval Shipyard	Portsmouth	PBR135	Materials Recovery Facility
USA Waste of Virginia Landfills - Bethel Landfill	Hampton	SWP580	Sanitary Landfill
Virginia Beach City - Landfill No 2	Virginia Beach	SWP398	Sanitary Landfill
Virginia Department of Forensic Science - PMS	Norfolk	PBR511	Regulated Medical Waste Steam Sterilizer
Virginia Materials Inc - Norfolk	Norfolk	PBR117	Materials Recovery Facility
Virginia Peninsula Public Services Authority – James City County	Williamsburg	PBR021	Transfer Station
Virginia Peninsula Public Svc Authority York County	Yorktown	PBR022	Transfer Station
VPPSA - YWCF - York County	Yorktown	PBR013	Yard Waste Composting Facility
Waste Industries LLC	Chesapeake	PBR077	Materials Recovery Facility
Waterway Marine Terminal	Chesapeake	PBR506	Materials Recovery Facility
Western Refining Yorktown Incorporated	Yorktown	SWP363	Industrial Landfill

Source: Virginia Economic Development Partnership, Solid Waste Management Facilities in Virginia, May 2008.

.

Table 3-17: 2008 Superfund Sites in Hampton Roads

Site Name	Locality	EPA ID
2020 Chestnut St	Portsmouth	VA0002366946
Abex Corp	Portsmouth	VAD980551683
Atlantic Wood Industries	Portsmouth	VAD990710410
Basic Tool Company	Hampton	VAD988212429
Chesapeake PLT	Chesapeake	VAD001704808
Chisman Creek	York	VAD980712913
Fine Petroleum/Mariner Hi Tech	Norfolk	VAD023837628
Former Nansemond Ordnance Depot	Suffolk	VAD123933426
Fort Eustis	Newport News	VA6210020321
Goodwin Junkyard	Isle of Wight	VAD988187076
Hampton Industrial Plating	York	VAD988201992
Langley AFB/NASA Research Center	Hampton	VA2800005033
Macson's, Inc.	Chesapeake	VA0001118207
Naval Air Station, Oceana	Virginia Beach	VA2170024606
Naval Amphibious Base	Virginia Beach	VA5170022482
Naval Weapons Station Yorktown	York	VA8170024170
Naval Weapons Station Yorktown - Cheatham Annex	Williamsburg	VA3170024605
Norfolk Naval Base	Norfolk	VA6170061463
Norfolk Naval Shipyard	Portsmouth	VA1170024813
St Julien's Creek Annex, US Navy	Chesapeake	VA5170000181
Saunders Supply Company	Suffolk	VAD003117389
Suffolk City LF	Suffolk	VAD980917983
Sutton Enterprises, Inc.	Chesapeake	VAD988173548
Naval Radio Transmitting Facility - Driver	Suffolk	VA9170022488

Source: EPA. Virginia Superfund Sites, http://www.epa.gov/reg3hwmd/super/va.htm.

Uranium Mining

Virginia Uranium, Inc. has proposed a uranium mine at Coles Hill in Pittsylvania County, Virginia. This mine would be located in the Roanoke River Basin, which flows into Kerr Reservoir and Lake Gaston. The Lake Gaston intake is owned by Virginia Beach. Lake Gaston water is blended with Norfolk's water sources and treated at Norfolk's water treatment plants before distribution to Virginia Beach and Chesapeake.

In 1983, the Virginia General Assembly enacted a legislative moratorium on the mining of uranium in Virginia. In 2009, the Virginia Coal and Energy Commission (VCEC) contracted with the Virginia Center for Coal and Energy Research (VCCER) to study the consequences of repealing the moratorium and developing a regulatory framework for uranium mining in Virginia. In addition, the Commonwealth of Virginia has proposed for the National Academy of Sciences to conduct a wide-ranging study of the impact of uranium mining.

The City of Virginia Beach adopted a Resolution opposing the Mining of Uranium in the Commonwealth of Virginia until it is demonstrated to a reasonable degree of scientific certainty that there would be no significant release of radioactive contamination downstream, even as a result of a rainfall event of Probable Maximum Precipitation (PMP) similar to what struck Nelson County in 1969.

Potential water supply threats associated with uranium mining include:

- Significant or PMP rainfall event may erode and fragment virtually any earthen structure, man-made or natural,
- Structure erosion or fragmentation may result in the release of radioactive sediments downstream,
- Radioactive uranium mining tailings are highly susceptible to both air and water transport, and
- Radioactive seepage into groundwater.

Fluoride

Fluoride naturally occurs in the groundwater supplies of many private and publicly owned community water systems in Hampton Roads. The federally established maximum contaminant level (MCL) for fluoride is 4.0 milligrams per liter.

There were approximately fifty-seven systems whose naturally elevated fluoride levels exceeded the MCL in 2000. These systems relied solely on groundwater and were concentrated in the Western Tidewater sub-region of Hampton Roads. Many systems have completed remediation efforts and are now in compliance with fluoride levels. Table 3-18 and Map 3-20 summarize the 24 community water systems that were in violation of fluoride contamination levels as of February 2010, according to the Virginia Department of Health.

The EPA recognizes both benefits and risks associated with fluoride in drinking water.

Potential Water Supply Benefits

The EPA recommends that CWSs fluoridate drinking water to prevent dental caries (tooth decay). The optimum fluoride concentration in the drinking water is from 0.8 to 1.0 milligram per liter.

Water fluoridation is considered the most cost effective and beneficial means for persons unable to afford preventative dentistry to take care of their teeth.

Potential Water Supply Risks

Dental fluorosis is the staining or mottling of the teeth resulting from ingestion of excessive fluoride in drinking water. Studies show that children exposed to daily concentrations of 2.0 milligram per liter or higher may develop dental fluorosis. Although dental fluorosis is not a life threatening disease, the EPA has established a Secondary MCL for fluoride of 2.0 milligrams per liter to protect the consumer from developing dental discoloration. Community water systems producing water in violation of the Secondary MCL must notify their customers of the potential health effects.

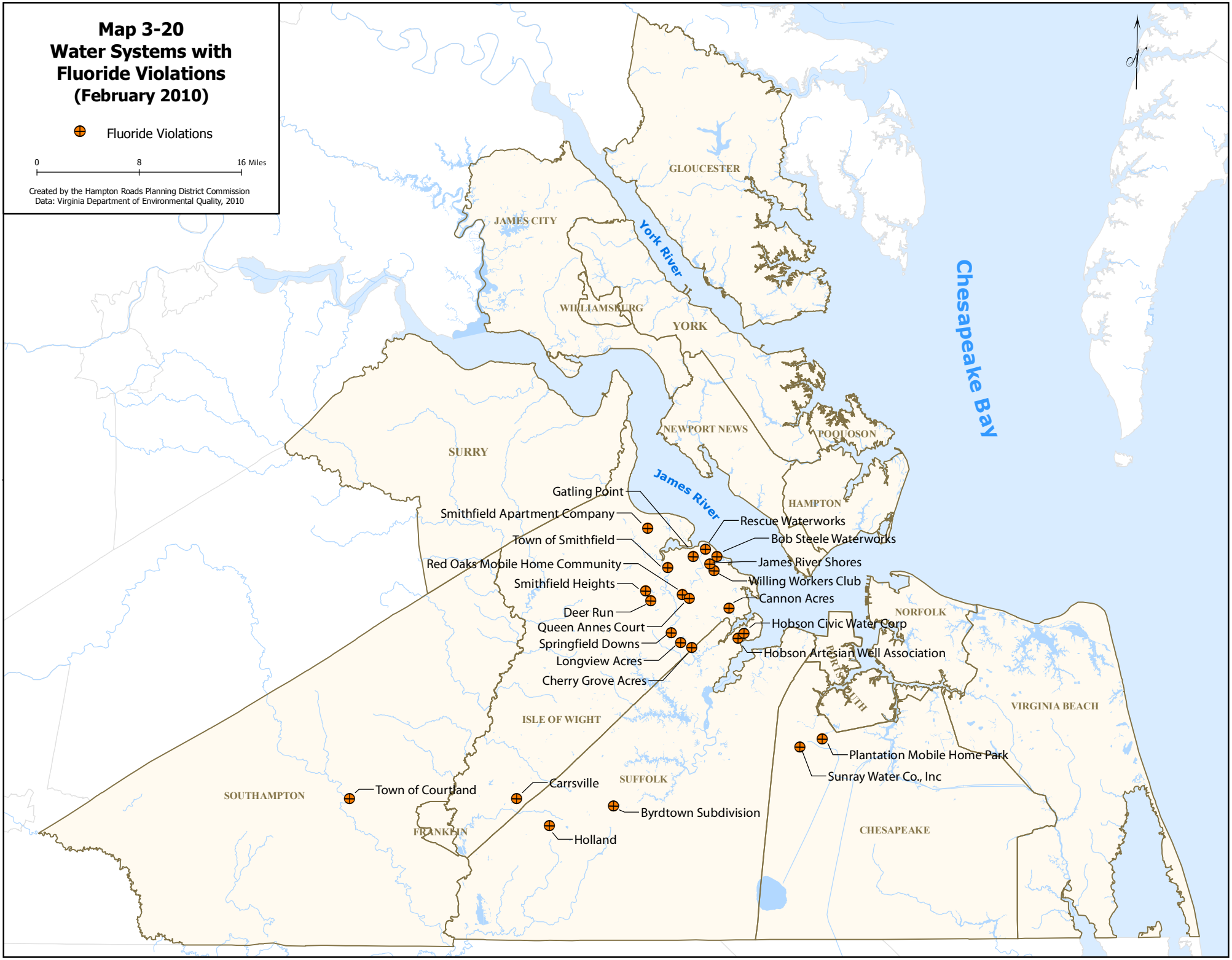
Skeletal fluorosis is a serious bone crippling disorder that resembles osteoporosis. It may also result in dental malformation, decalcification, mineralization of tendons, and digestive and nervous disorders. Skeletal fluorosis is usually only found in areas of the world where long-term exposure to fluoride concentrations of 10 milligram per liter and higher are present. Although there is disagreement within the health community over the concentration at which long-term exposure may result in skeletal fluorosis, this condition can occur in people exposed to very different levels of fluoride. The EPA established the Primary MCL for fluoride in drinking water to protect the consumer from developing skeletal fluorosis.

Table 3-18: Community Water Systems in Violation of Fluoride Levels (February 2010)

System Name	Location	Status
Cannon Acres	Isle of Wight	Referred to EPA, Under Consent Order
Bob Steele	Isle of Wight	Referred to EPA, Under Consent Order
Carrsville[1]	Isle of Wight	Under Consent Order
Cherry Grove Acres	Isle of Wight	Referred to EPA, Under Consent Order
Deer Run	Isle of Wight	Under Consent Order
Red Oaks Mobile Home Park	Isle of Wight	Under Consent Order
James River Shores	Isle of Wight	Referred to EPA, Under Consent Order
Long View Acres	Isle of Wight	Referred to EPA, Under Consent Order
Queen Anne's Court[2]	Isle of Wight	Under Consent Order
Rescue	Isle of Wight	Still needs action by owner
Smithfield Apartments	Isle of Wight	Potential system
Smithfield Heights[1]	Isle of Wight	Under Consent Order
Springfield Downs	Isle of Wight	Referred to EPA, Under Consent Order
Town of Smithfield	Isle of Wight	Under Consent Order
Gatling Pointe	Isle of Wight	Under Consent Order
Willing Workers Club	Isle of Wight	Still needs action by owner
Town of Courtland	Southampton	Under Consent Order
Plantation MHP	Chesapeake	Still needs action by owner
Sunray Water Co.	Chesapeake	Still needs action by owner
Birdsong (Byrdtown)	Suffolk	Still needs action by owner
Hobson Village	Suffolk	Still needs action by owner
Hobson Mt. Lebanon	Suffolk	Still needs action by owner
Holland	Suffolk	Under Consent Order

Source: Virginia Department of Health.

1. As of December 2010, the Carrsville and Smithfield Heights systems were no longer under consent order.
2. In late 2010, Isle of Wight County purchased the infrastructure for the Queen Anne's Court System and connected it to the Western Tidewater Water Authority Source, which is not subject to fluoride violations.


Map 3-20
Water Systems with
Fluoride Violations
(February 2010)
Fluoride Violations
0
8
16 Miles
Created by the Hampton Roads Planning District Commission
Data: Virginia Department of Environmental Quality, 2010
GLOUCESTER
JAMES CITY
York River
WILLIAMSBURG
YORK
Chesapeake Bay
NEWPORT NEWS
POQUOSON
SURRY
James River
HAMPTON
Gatling Point
Smithfield Apartment Company
Town of Smithfield
Red Oaks Mobile Home Community
Smithfield Heights
Deer Run
Queen Annes Court
Springfield Downs
Longview Acres
Cherry Grove Acres
Rescue Waterworks
Bob Steele Waterworks
James River Shores
Willing Workers Club
Cannon Acres
NORFOLK
Hobson Civic Water Corp
Hobson Artesian Well Association
PORTSMOUTH
VIRGINIA BEACH
ISLE OF WIGHT
Plantation Mobile Home Park
Sunray Water Co., Inc
SUFFOLK
Carrsville
Byrdtown Subdivision
SOUTHAMPTON
Town of Courtland
FRANKLIN
Holland
CHESAPEAKE

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Section 4 | Projected Water Demands

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Projected Water Demands

This section presents water demand projections through 2050 for the Hampton Roads region. Demand projections and the methodology and assumptions applied to estimate water demands are provided for:

- Publicly-owned CWSs,
- Privately-owned CWSs,
- Self-supplied water users reporting use over 300,000 gallons per month, and
- Self-supplied users with estimated use under 300,000 gallons per month.

Publicly-Owned CWSs

Assumptions and Methodology

Most of the water users in the Hampton Roads region are served by publicly-owned CWSs. Publicly-owned CWSs serve the majority of the population in the Peninsula and Southside sub-regions, whereas most users in the Western Tidewater sub-region are self-supplied.

For the purposes of this plan, demand projections for publicly-owned CWSs were either developed by HRPDC staff or provided by the utility departments of localities.

HRPDC developed water demand projections for the Cities of Franklin, Hampton, Newport News, Portsmouth, and Poquoson, the Counties of Gloucester, James City, Surry, and York, and the Towns of Smithfield and Windsor. HRPDC's projected water demands for these large systems are based on the following information:

1. Population projections developed by HRPDC with the Regional Economic Models, Inc. (REMI) software. The REMI model projections were developed for the long-term regional transportation plans.
2. Estimates of the portion of each locality's population served by publicly-owned CWSs (see Table 4-1).
3. Average per capita water use in each locality, based on 2004-2008 water use (see Table 4-2).

As described in Section 1, "Existing Sources," several publicly-owned CWSs purchase water from other systems in the Hampton Roads region. In the development of demand projections, particular attention was given to avoid double-counting or omitting demand components affected by water sales.

The Cities of Chesapeake, Norfolk, Suffolk, Virginia Beach, and Williamsburg and the Counties of Isle of Wight and Southampton provided water demand projections through 2050. The demand projections of these large local utilities are based on specific assumptions and data deemed appropriate for use by the departments, including historic use and safe yield studies.

Photo: Lake Gaston, city-data.com

Table 4-1: Percentage of Population Served by Publicly-Owned CWSs by Decade

	2010	2020	2030	2040	2050
Peninsula Sub-Region					
York-James Peninsula					
Hampton	100%	100%	100%	100%	100%
James City County	76%	79%	81%	83%	84%
Newport News	100%	100%	100%	100%	100%
Poquoson	100%	100%	100%	100%	100%
Williamsburg	100%	100%	100%	100%	100%
York County	95%	96%	97%	98%	98%
Middle Peninsula					
Gloucester County	37%	42%	46%	49%	52%
Southside Sub-Region					
Chesapeake	88%	89%	89%	89%	89%
Norfolk	100%	100%	100%	100%	100%
Portsmouth	100%	100%	100%	100%	100%
Suffolk	78%	83%	86%	98%	99%
Virginia Beach	97%	97%	97%	97%	97%
Western Tidewater Sub-region					
Franklin	100%	100%	100%	100%	100%
Isle of Wight County	22%	39%	48%	56%	61%
Smithfield	98%	98%	98%	98%	98%
Windsor	98%	98%	98%	98%	98%
Southampton County	9%	9%	9%	9%	8%
Capron[1]	1%	1%	1%	1%	1%
Courtland[1]	7%	6%	6%	6%	6%
Ivor[1]	2%	2%	2%	2%	2%
Surry County	0%	0%	0%	0%	0%
Claremont[2]	11%	11%	11%	11%	11%
Dendron[2]	5%	5%	5%	5%	5%
Surry Town[2]	8%	10%	10%	10%	10%

1. Percentage of Southampton County population.
2. Percentage of Surry County population.

Table 4-2: 2004 to 2008 Average Per-Capita Water Use

Locality	Water Service Provider	Per-Capita Water Use (gpcpd)*	Locality	Water Service Provider	Per-Capita Water Use (gpcpd)*
City of Franklin	City of Franklin	133	James City County	James City Service Authority	106
City of Hampton	Newport News Waterworks	112	Surry County	Incorporated Town CWSs[1]	100
City of Newport News	Newport News Waterworks	112	Town of Smithfield	Town of Smithfield	141
City of Portsmouth	City of Portsmouth	112	Town of Windsor	Town of Windsor	102
City of Poquoson	Newport News Waterworks	112	York County	Newport News Waterworks	112
Gloucester County	Gloucester County	82			

*The average per-capita water use from 2004 to 2008 was used to develop HRPDC's water demand projections for publicly-owned CWSs for localities listed in table. Other localities provided water demand projections developed by the locality's public utility.

[1] Incorporated Towns of Claremont, Dendron, and Surry

As noted earlier, there are existing contracts for water sales between localities. To provide consistent projections across the region, the projected water demands for the Cities of Franklin, Newport News, Norfolk, and Portsmouth and the Town of Windsor do not include the volumes of water that these utilities are contractually obligated to sell to other localities.

The demands for small publicly-owned CWSs are based on more detailed analysis included in the respective system's groundwater withdrawal permits. For example, the Town of Capron provided estimated water demands for each of the 20 non-residential accounts served by the Town's water system. Since groundwater withdrawal permits only provide 10-year projections, per capita use estimates and county growth rates were used to project demands to 2050.

Projected Demand

Water demands for publicly-owned CWS are projected to increase by almost 44% from 177.7 mgd to 256.9 mgd by 2050. Figure 4-1 shows the total and relative projected water demands of publicly-owned CWSs throughout Hampton Roads. Locality demand projections are included in Attachment 1.

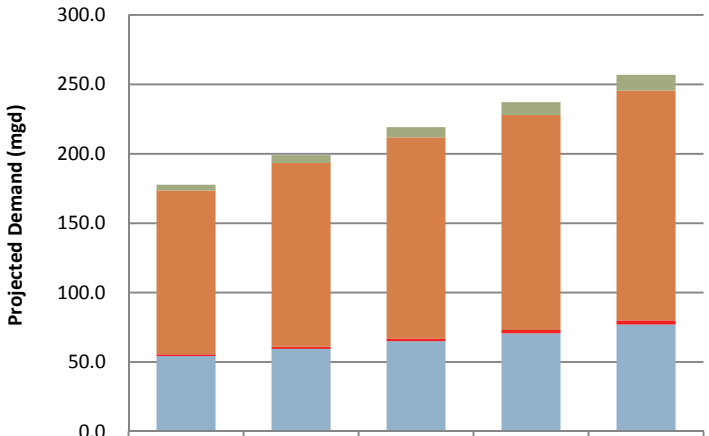
Southside sub-region publicly-owned CWSs contribute the largest projected demand. By 2050, the demands of these systems will total approximately 165.5 mgd, or 64% of the total projected water demand for all publicly-owned CWSs in Hampton Roads.

Peninsula sub-region publicly-owned CWS demand is also expected to increase by approximately 40% over the planning period, as the population in this area continues to grow. By 2050, the combined demand for the York-James and Middle Peninsulas is projected at 80.0 mgd, which is approximately 31% of the total projected water demand for publicly-owned CWSs in Hampton Roads.

Compared to the other sub-regions, publicly-owned CWS demand in the Western Tidewater sub-region appears relatively small. However, by 2050, the sub-region's population is expected to almost triple, and the associated water demand will cause an increase in publicly-owned CWS demand of more than 178% compared to 2010.

In general, the projected increase in water demands of publicly-owned CWSs are caused by population growth and, in some areas, the planned expansion of publicly-owned CWS service areas. Table 4-3 shows the population projected to be served by publicly-owned CWSs by decade.

Figure 4-1: Projected Water Demands for Publicly-Owned CWSs



	2010	2020	2030	2040	2050
Western Tidewater	4.1	5.7	7.3	9.2	11.4
Southside	118.1	132.5	145.0	155.0	165.5
Middle Peninsula	1.2	1.5	1.9	2.4	3.0
York-James Peninsula	54.3	59.4	65.0	70.6	77.0

Table 4-3: Population and Percentage of Population Served by Publicly-Owned CWSs by Decade

	2010	2020	2030	2040	2050
Peninsula Sub-Region					
York-James Peninsula					
Hampton	146,960 100%	150,137 100%	153,382 100%	156,698 100%	160,085 100%
James City County	48,924 76%	63,370 79%	81,401 81%	103,908 83%	132,000 84%
Newport News	185,760 100%	197,082 100%	209,093 100%	221,836 100%	235,356 100%
Poquoson	12,258 100%	13,333 100%	14,504 100%	15,777 100%	17,161 100%
Williamsburg[1]	16,600 100%	17,700 100%	19,000 100%	19,000 100%	19,000 100%
York County	62,867 95%	71,762 96%	81,802 97%	93,238 98%	105,188 98%
Middle Peninsula					
Gloucester County	14,140 37%	18,551 42%	23,689 46%	29,675 49%	36,649 52%
Southside Sub-Region					
Chesapeake	240,087 88%	282,566 89%	325,045 89%	367,524 89%	410,003 89%
Norfolk	236,703 100%	238,236 100%	239,780 100%	241,333 100%	242,897 100%
Portsmouth	99,537 100%	101,576 100%	103,656 100%	105,779 100%	107,945 100%
Suffolk	74,717 78%	105,491 83%	136,898 86%	186,808 98%	219,411 99%
Virginia Beach	425,317 97%	437,492 97%	450,015 97%	462,897 97%	476,147 97%
Western Tidewater Sub-Region					
Franklin	8,678 100%	9,687 100%	10,813 100%	12,071 100%	13,475 100%
Isle of Wight County[2]	6,090 22%	13,400 39%	21,416 48%	31,488 56%	44,190 61%
Smithfield	7,927 98%	9,951 98%	12,492 98%	15,682 98%	19,685 98%
Windsor	2,517 98%	2,921 98%	3,390 98%	3,394 98%	4,566 98%
Southampton County	1,777 9%	2,010 9%	2,301 9%	2,507 9%	2,758 8%
Capron[3]	178 1%	218 1%	251 1%	288 1%	332 1%
Courtland[3]	1,258 7%	1,356 6%	1,559 6%	1,794 6%	2,063 6%
Ivor[3]	403 2%	507 2%	583 2%	671 2%	771 2%
Surry County	0 0%	0 0%	0 0%	0 0%	0 0%
Claremont[4]	786 11%	862 11%	947 11%	1,039 11%	1,141 11%
Dendron[4]	360 5%	395 5%	434 5%	476 5%	523 5%
Surry Town[4]	545 8%	817 10%	897 10%	985 10%	1,081 10%
Hampton Roads Total	1,590,575 91%	1,735,554 91%	1,889,164 91%	2,072,069 92%	2,249,709 92%

1. Williamsburg provided projections of population and percentage of population served by publicly-owned CWSs.
2. Isle of Wight's population served by publicly-owned CWSs includes 480 County residents (Gatling Pointe system) served by Smithfield's publicly-owned CWS.
3. Percentage of Southampton County population.
4. Percentage of Surry County population. Surry County does not have a publicly-owned CWS; publicly-owned CWSs are operated by the incorporated towns.

Table 4-4 shows the projected demands for publicly-owned CWSs disaggregated into water use categories. Use in each category was projected based on the 2007 proportion of use in each category, except for the unaccounted for water (UAW) in the Western Tidewater sub-region, which was estimated at 10% as none of the systems in the Western Tidewater sub-region reported UAW. Projected demands shown in Table 4-4 are for finished water. Production losses in addition to the projected demands vary by sub-region, as indicated in the table notes.

There is not enough information on trends in residential, commercial, industrial, and military use to further refine use projections across these categories. Future updates to the regional water supply plan may focus on additional analysis of disaggregated use.

Table 4-4: Projected Public Water Demands for 2050 Disaggregated into Use Categories

	Percentage of Use in each Sub-Region							Projected PWS Demand in each Sub-Region (mgd)						
	Residential	CIL	Heavy Industrial	Military	Other	UAW	**Total**	Residential	CIL	Heavy Industrial	Military	Other	UAW	**Total**
Peninsula														
York-James Peninsula[1]	50.7%	21.4%	17.0%	5.5%	0.1%	5.3%	**100%**	39.0	16.5	13.1	4.2	0.1	4.1	**77.0**
Middle Peninsula[2]	60.7%	23.9%	0.0%	0.0%	5.3%	9.8%	**100%**	1.8	0.7	0.0	0.0	0.2	0.3	**3.0**
Southside[3]	59.7%	19.2%	2.0%	5.8%	1.9%	11.5%	**100%**	98.8	31.8	3.3	9.6	3.1	19.0	**165.5**
Western Tidewater[4]	80.1%	9.7%	0.2%	0.0%	0.0%	10.0%	**100%**	9.1	1.1	0.2	0.0	0.0	1.1	**11.4**
							Total	**148.8**	**50.1**	**16.4**	**13.8**	**3.4**	**24.5**	**256.9**
	Percentage of 2050 PWS Demand Projected for Hampton Roads Region:							**58%**	**20%**	**6%**	**5%**	**1%**	**10%**	**100%**

1. Production losses are estimated to be an additional 7.6% of use.
2. Production losses are estimated to be an additional 29.5% of use.
3. Production losses are estimated to be an additional 6.6% of use.
4. Production losses are estimated to be an additional 2% of use based on future RO plant and water from Western Tidewater Authority.

Privately-Owned CWSs

Assumptions and Methodology

There are 61 privately-owned CWSs operating in the Hampton Roads region. Most of these systems, described earlier in Section 1, serve less than 500 customers in neighborhoods that are built-out. Water demands for these systems are expected to remain constant at 2007 water use levels over the planning period, as there is no data to support changes in use patterns.

The Lawnes Point system, located in Isle of Wight County, is the only privately-owned CWS where growth is assumed, and water demands are therefore anticipated to increase. This residential development was established in 2010 and approximately 150 lots remain available for construction of homes.

As discussed earlier, some areas are anticipated to experience an increase in the percentage of the population served by publicly-owned CWSs. Isle of Wight County anticipates that some of the privately-owned systems located in the publicly-owned CWS service area will eventually switch to public water service. Table 4-5 summarizes the population in each sub-region expected to be served by privately-owned CWSs through 2050.

Table 4-5: Projected Population Served by Privately-Owned CWSs

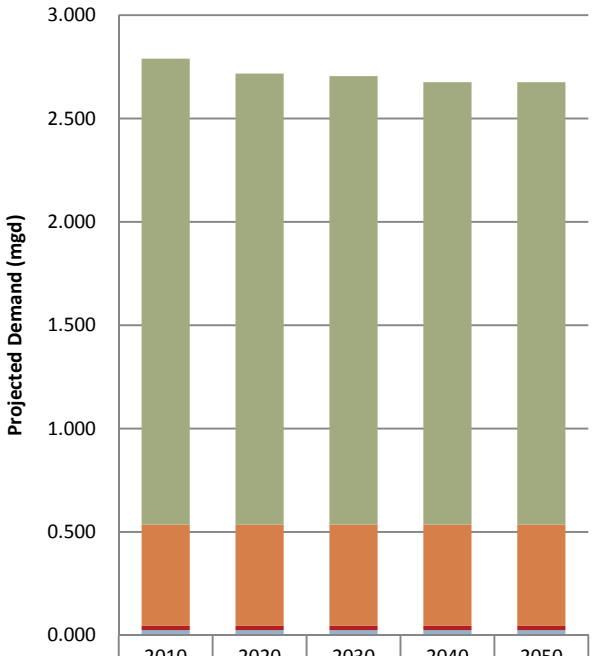
	2010		2020		2030		2040		2050	
Sub-region	**Population**	**%**	**Population**	**%**	**Population**	**%**	**Population**	**%**	**Population**	**%**
Peninsula										
York-James Peninsula	435	0.1	435	0.1	435	0.1	435	0.1	435	0.1
Middle Peninsula	300	0.8	300	0.7	300	0.6	300	0.5	300	0.4
Southside	7,489	0.7	7,489	0.6	7,489	0.6	7,489	0.5	7,489	0.5
Western Tidewater	7,096	9.8	6,501	7.6	6,299	6.1	6,174	5.0	6,174	4.2

Projected Demand

Figure 4-2 illustrates the projected demands for privately-owned CWSs through 2050. In general, no significant changes in water use are expected for privately-owned CWSs across the region, however, demand is anticipated to decrease slightly in the Western Tidewater sub-region reflective of private-systems opting to switch to public water service. Water demands for privately-owned CWS in the Peninsula and Southside sub-regions are expected to remain constant primarily because development patterns have already established urbanized areas served by publicly-owned CWSs.

The privately-owned CWS demands are not shown in terms of disaggregated use categories because these systems only serve residential users. Production losses are negligible, as water from area groundwater sources requires minimal treatment. Estimates of UAW losses are not available.

Figure 4-2: Projected Water Demand for Privately-Owned CWS



	2010	2020	2030	2040	2050
Western Tidewater	2.255	2.183	2.170	2.141	2.141
Southside	0.490	0.490	0.490	0.490	0.490
Middle Peninsula	0.021	0.021	0.021	0.021	0.021
York-James Peninsula	0.024	0.024	0.024	0.024	0.024

Large Self-Supplied Water Users

Assumptions and Methodology

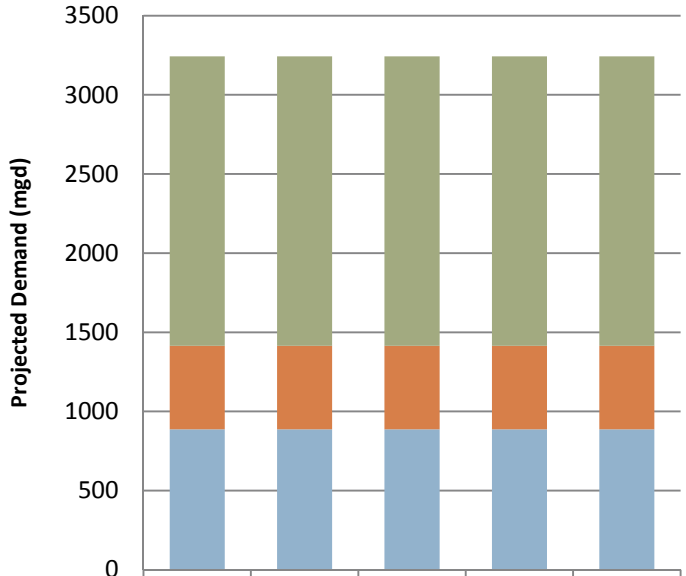
For the duration of the planning period, water use by large self-supplied users (those reporting water use of more than 300,000 gallons per month) is not expected to increase from the amounts reported for 2007. For the purposes of this plan, demand for large self-supplied users was equated to amount of use reported for 2007.

In 2009, International Paper announced that the Franklin mill would be closing and groundwater wells would stop pumping in 2010. However, IP's DEQ Ground Water Withdrawal Permit remained effective as of January 2011, and the permitted withdrawal amount was not decreased. It is possible that IP's groundwater permit may be transferred to another business. No additional information was readily available to predict changes in the demands of large self-supplied users at the time this plan was developed.

Projected Demand

No increases in demands are anticipated for large self-supplied users reporting water use of more than 300,000 gallons per month (see Figure 4-3). Change in demands for these users is difficult to predict because of the magnitude of water involved. It is difficult to anticipate a large user moving into or out of the Hampton Roads region.

Figure 4-3: Projected Water Demands for Large Self-Supplied Users (use > 300,000 gallons per month)



	2010	2020	2030	2040	2050
Western Tidewater	1828.5	1828.5	1828.5	1828.5	1828.5
Southside	527.7	527.7	527.7	527.7	527.7
Middle Peninsula	0.0	0.0	0.0	0.0	0.0
York-James Peninsula	886.9	886.9	886.9	886.9	886.9

Small Self-Supplied Water Users

Assumptions and Methodology

Small self-supplied users are those estimated to use less than 300,000 gallons of water per month. Small users include owners of private business and residential wells who are not required to report water withdrawals to DEQ unless they withdraw more than 300,000 gallons per month. Therefore, water use projections for these small users must be estimated based on existing guidelines and surrogate information.

The future water demands of private business well users are expected to remain constant at 2007 water use estimates for the duration of the planning period, as there is no data to support changes in use patterns. The 2007 water use by small businesses was estimated based on the "Commonwealth of Virginia Guidance for Conducting a Comprehensive Public Drinking Water Supply Needs Assessment".

The future water demands of private residential well users are projected based on a per capita water use factor and the population served by private residential wells. The per capita water use factor of 75 gallons per person per day is based on the USGS study "Private Domestic–Well Characteristics and the Distribution of Domestic Withdrawals among Aquifers in the Virginia Coastal Plain." The population served by residential wells is estimated as the population that is not served by publicly- or privately-owned CWSs, based on the REMI population projections. Table 4-6 summarizes the population in each sub-region expected to be served by private residential wells.

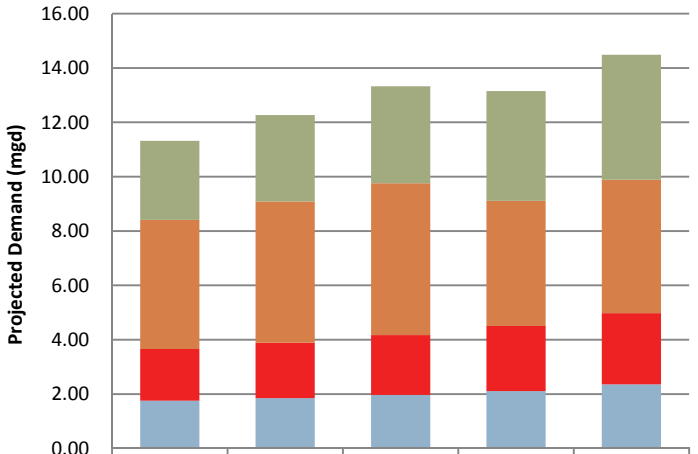
Table 4-6: Projected Population Served by Private Residential Wells

	2010		2020		2030		2040		2050	
Sub-region	**Population**	**%**	**Population**	**%**	**Population**	**%**	**Population**	**%**	**Population**	**%**
Peninsula										
York-James Peninsula	18,704	3.8	19,907	3.7	21,451	3.7	23,324	3.7	26,689	3.8
Middle Peninsula	23,754	62.2	25,644	57.6	27,846	53.7	30,411	50.4	33,400	47.5
Southside	58,089	5.1	64,001	5.2	69,292	5.2	56,090	3.9	60,207	4.0
Western Tidewater	35,255	48.4	38,861	44.4	44,024	41.8	50,339	39.5	57,868	37.4

Projected Demand

Projected demands for small self-supplied users is largely dependent on population growth outside publicly-owned CWS service areas. Figure 4-4 shows the projected demand for small self-supplied business and residential well users. Small self-supplied user demand in the Southside sub-region is projected to increase by 20%. Small self-supplied user demands attributed to the Western Tidewater and Peninsula sub-regions are predicted to increase by approximately 60% and 36%, respectively, by 2050.

Figure 4-4: Projected Water Demands for Small Self-Supplied Users (use < 300,000 gal/month)



	2010	2020	2030	2040	2050
Western Tidewater	2.91	3.18	3.57	4.04	4.60
Southside	4.75	5.20	5.59	4.60	4.91
Middle Peninsula	1.90	2.04	2.20	2.40	2.62
York-James Peninsula	1.76	1.85	1.97	2.11	2.36

Projected Demands Across the Region

Demand across the Hampton Roads region is expected to increase considerably as the population continues to grow. Figure 4-5 shows the projected demand for publicly- and privately-owned CWSs in Hampton Roads through 2050. The Southside sub-region has the largest 2050 projected CWS demand of approximately 165.9 mgd, followed by the Peninsula sub-region at 80.0 (York-James Peninsula demand is 77.0 mgd), and the Western Tidewater sub-region at 13.5 mgd.

Figure 4-6 shows the projected water demands in Hampton Roads for publicly-owned CWS, privately-owned CWS, and small self-supplied users (estimated use less than 300,000 gallons per month). Demand from publicly-owned CWSs is anticipated to increase by about 44% from 177.7 mgd to 256.9 mgd by 2050. Approximately 92% of the 2050 regional projected water demand in these 3 demand sectors is attributed to publicly-owned CWSs; it is likely that the majority of future development will occur within CWS service areas.

A slight decrease in demand from privately-owned CWSs is expected, as some privately-owned systems opt for service from publicly-owned systems and development occurs in publicly-owned CWS service areas.

Demand from small self-supplied users will increase by 27% from 11.3 mgd to 14.5 mgd by 2050; most of this increase is attributed to the Southside sub-region. As previously stated, projecting demand for large self-supplied water users (usage greater than 300,000 gallons per month) is difficult as it is challenging to anticipate large users moving into and out of the Hampton Roads area.

The projected water demands for all Hampton Roads region CWSs and small self-supplied users are summarized in Table 4-7. The table also shows the demands for non-consumptive use by large self-supplied users (those withdrawing more than 300,000 gallons per month). Refer to Figures 4-5 and 4-6 for illustration of the projected increase in demands for consumptive uses of water.

Figure 4-5: Projected Water Demands for Public and Private CWSs through 2050

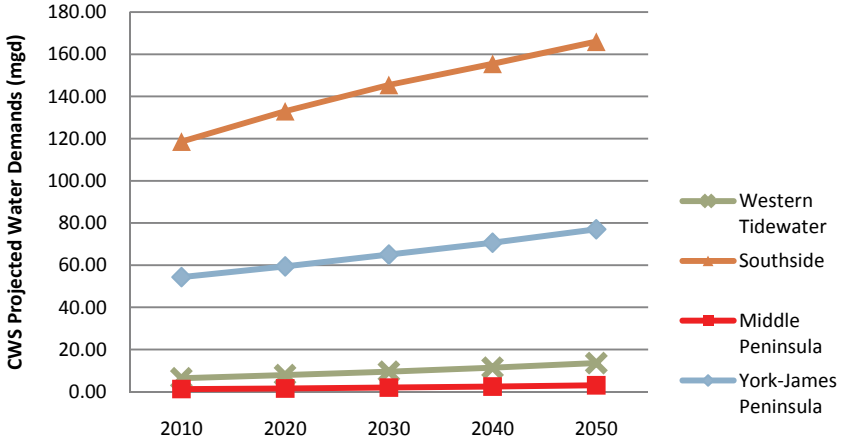
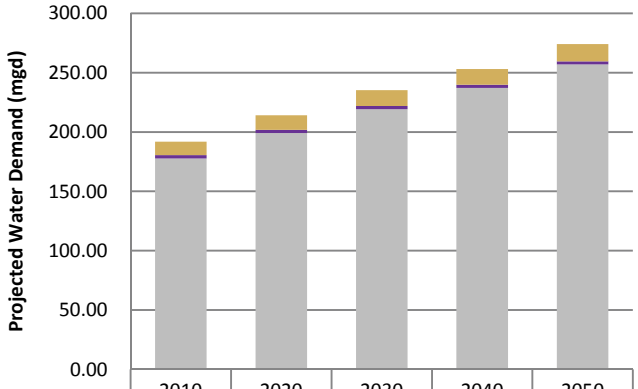


Figure 4-6: Projected Water Demands for Publicly- and Privately-Owned CWSs and Small Self-Supplied Users (use<300,000 gal/month)



	2010	2020	2030	2040	2050
Small Self-Supplied Users	11.32	12.27	13.33	13.15	14.49
Private CWS	2.79	2.72	2.71	2.68	2.68
Public CWS	177.70	199.10	219.20	237.20	256.90

Table 4-7: Hampton Roads 2010 to 2050 Projected Water Demands
(all figures in mgd)

Year	Public Water Systems				Private CWS				Small Self-Supplied Users (use <300,000 gal/month)				Large Self-Supplied Users (use >300,000 gal/month)				Total			
	York-James Peninsula	Middle Peninsula	Southside	Western Tidewater	York-James Peninsula	Middle Peninsula	Southside	Western Tidewater	York-James Peninsula	Middle Peninsula	Southside	Western Tidewater	York-James Peninsula	Middle Peninsula	Southside	Western Tidewater	York-James Peninsula	Middle Peninsula	Southside	Western Tidewater
2010	54.3	1.2	118.1	4.1	0.024	0.021	0.490	2.255	1.8	1.9	4.8	2.9	886.9	0.0	527.7	1828.5	943.0	3.1	651.0	1837.8
2020	59.4	1.5	132.5	5.7	0.024	0.021	0.490	2.183	1.9	2.0	5.2	3.2	886.9	0.0	527.7	1828.5	948.2	3.6	665.9	1839.6
2030	65.0	1.9	145.0	7.3	0.024	0.021	0.490	2.170	2.0	2.2	5.6	3.6	886.9	0.0	527.7	1828.5	953.9	4.1	678.8	1841.5
2040	70.6	2.4	155.0	9.2	0.024	0.021	0.490	2.141	2.1	2.4	4.6	4.0	886.9	0.0	527.7	1828.5	959.6	4.8	687.8	1843.9
2050	77.0	3.0	165.5	11.4	0.024	0.021	0.490	2.141	2.4	2.6	4.9	4.6	886.9	0.0	527.7	1828.5	966.3	5.6	698.6	1846.6

Potential Additional Demands on Publicly-Owned CWSs

The percentage of the population served by publicly-owned CWSs is anticipated to increase partly because some privately-owned CWSs and self-supplied users may choose to switch to public water service. To evaluate the impact of the switch in service and to estimate the potential additional water demand on publicly-owned CWSs, the 2007 water use by privately-owned CWSs and self-supplied users was categorized as either inside or outside the service areas of publicly-owned CWSs (see Table 4-8). Since minimal change is anticipated in water use by privately-owned CWSs and self-supplied users over the planning period, the 2007 use totals were used as a surrogate for demand.

It is estimated that an additional demand of 3.78 mgd could be added to the projected demands for publicly-owned CWSs across the region by 2050. The assumptions used to develop the estimated additional demands shown in Table 4-8 are described below.

Privately-Owned CWSs

All of the privately-owned CWSs located within existing service areas of publicly-owned CWSs are considered likely to hook up to public water service by 2050; these system demands are included in the estimate of potential additional demands for publicly-owned CWSs. Three privately-owned water systems located within future expansion areas of publicly-owned CWSs were also included in the estimate:

- R&L Trailer Park in Gloucester County
- Sunray Artesian Water Supply in Chesapeake
- Sunray Water Company in Chesapeake

Small Self-Supplied Users

Small self-supplied users (use < 300,000 gal/month) include both businesses and homes. It was assumed that 25% of the demands of self-supplied businesses are likely to be met by hook ups to public water before 2050. Since very few self-supplied homes are located within publicly-owned CWS service areas, the number of self-supplied residences that could potentially switch to public water is considered negligible.

Large Self-Supplied Users

Of the large self-supplied users (withdrawing more than 300,000 gal/month) located within the publicly-owned CWS service areas, the following users are considered unlikely to hook up to public water service:

- Northrup Grumman Shipbuilding
- Yorktown Fossil Power Plant
- Chesapeake Energy Center
- International Paper Franklin Mill
- Dominion Power Nuclear Power Plant

These commercial and industrial users have demands totaling approximately 1,360 mgd and are currently supplied by groundwater withdrawals and surface water withdrawals from the Elizabeth, James, and York Rivers. The majority of surface water withdrawals are returned to the respective source rivers.

The demands of the five users listed above cannot be supported by publicly-owned CWSs; therefore, their demands were not included in Table 4-8.

The demands of other large self-supplied users located within publicly-owned CWS service areas total 13.4 mgd. For Table 4-8, it was estimated that 25% of this demand is likely to be met through hook ups to public water before 2050.

Table 4-8: Potential Additional Water Demands for Publicly-Owned CWS
(all figures in mgd)

	2007 Water Use Privately-Owned CWS (mgd)		2007 Water Use Small Self-Supplied Business Users (Use < 300,000 gal/month (mgd))		2007 Water Use Large Self-Supplied Users (Use >300,000 gal/month (mgd))	
	Inside Public CWS Service Area	Outside Public CWS Service Area	Inside Public CWS Service Area	Outside Public CWS Service Area	Inside Public CWS Service Area	Outside Public CWS Service Area
York-James Peninsula	0.007	0.011	0.214	0.926	1.497	0.00
Middle Peninsula	0.000	0.049	0.002	1.836	0.000	0.000
Southside	0.139	0.354	0.264	4.379	4.066	2.850
Western Tidewater	0.162	1.600	0.228	2.626	7.840	1.350
Total	**0.308**	**2.014**	**0.708**	**9.767**	**13.403**	**4.200**
Potential Additional Demand for Publicly-Owned CWSs*	0.308	0.049	0.177	0.000	3.351	0.000

* This estimate is based on the assumption that 100% of the demands of privately-owned CWSs, 25% of the demands of small self-supplied business users, and 25% of the demands of large self-supplied users located within the service areas of publicly-owned CWSs will opt to connect to public water service at some time during the planning period.

Section 5 | **Water Demand Management**

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Water Demand Management

Proactive water supply planning utilizes demand management strategies to promote the viability of future water supplies. The localities of Hampton Roads recognize the importance of demand management in water supply planning and development efforts and understand that it is crucial for the region to conserve local water resources and minimize both current and future water demands.

The region's water supply reservoirs have relatively small tributary watersheds and little natural water supply reserve. Most of the surface water in the region is salty and not readily available for drinking water and the groundwater resource is vulnerable to excessive use and saltwater intrusion.

Numerous water resource studies and plans addressing regional water supply needs have been conducted in the past. Based on those studies, Hampton Roads localities are pursuing programs and projects to meet long-term needs while providing interim and drought-related solutions. Incorporating water demand management practices both in the long and short term is a necessary component to extend the useful life of the regional water supply.

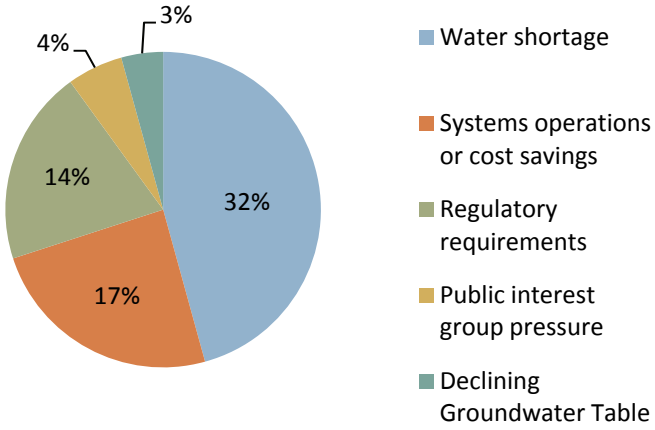
Long-term water demand management is practiced through more efficient water use, water conservation, and reductions in water loss. An American Water Works Association (AWWA) questionnaire distributed to 1,000 utility managers asked for the reasons they implement water demand management programs. The most common reason for program implementation was water shortages (see Figure 5-1).

Successful long-term water demand management programs provide additional water supply by lowering overall water demand. Lower long-term water demand provides cost efficient and effective savings by allowing water systems to avoid, downsize, or defer the need for a new water supply source for a number of years.

Short-term water demand management, or drought management, is used during periods of declining water supply and increasing demand. Drought management measures involve many practices found in long-term water conservation programs along with mandatory water use restrictions, penalties, and rationing.

This section describes water demand management practices in the Hampton Roads region. Long-term water demand management practices are discussed first, followed by a discussion of the Regional Drought Response and Contingency Plan.

Figure 5-1: Reasons for Implementing Water Demand Management Programs



Source: AWWA, *Forecasting Urban Water Demand,* p130. 1996.

Water Demand Management

Water demand management methods and practices allow the region to sustain current and future water needs and conserve water resources. The Hampton Roads region encourages efficient use of water resources by citizens, businesses, and governments alike as one step in enhancing quality of life and economic health.

Regional Water Conservation History

The Hampton Roads region has been promoting water conservation for almost 40 years. In 1977, the Southeastern Virginia Planning District Commission, which was to become part of the Hampton Roads Planning District Commission (HRPDC), provided an analysis of water conservation techniques which served as a basis for local conservation plans.

Under the Groundwater Management Act of 1992, Virginia manages groundwater through a program regulating water withdrawals in certain areas called Groundwater Management Areas. The Eastern Virginia Groundwater Management Area includes the entire Hampton Roads region except for Gloucester County. Any person or entity wishing to withdraw 300,000 gallons per month or more in a Groundwater Management Area must obtain a permit. All of the Hampton Roads localities except for Virginia Beach, Gloucester County, and Surry County have a permit for Public Water Supply. Each withdrawal permit requires a Water Conservation and Management Plan that includes details on the use of water-saving plumbing, a water loss reduction program, a water use education program, evaluation of potential water reuse options, and mandatory use reduction during water shortage emergencies.

Also in 1992, the *Vegetative Practices Guide* was published by HRPDC. This guide described how vegetation could be used for stormwater management and water conservation. This guide asked homeowners to practice water wise landscaping by thinking beyond a traditional grass lawn and provided detailed methods for keeping water onsite.

Faced with a water supply shortage and rapid growth, Virginia Beach instituted mandatory water use restrictions in 1992. The Lake Gaston pipeline was dedicated in 1997, fulfilling the need for additional water in southeast Virginia that was projected by the Southeastern Virginia Planning District Commission in 1970.

In early 1993, as a result of the continued water supply shortage, the individual localities and United States military of Hampton Roads began to work together as partners in water conservation. In February 1994, the Hampton Roads Water Efficiency Team (HR WET) was officially established. HR WET brought together water conservation coordinators and public information specialists to create a regionalized approach to public education. HR WET is a regional water efficiency education and outreach organization that includes all Hampton Roads localities and is administered through HRPDC. This regional group hosts a monthly forum focused on improving water efficiency and conservation. The local conservation projects and regional activities of HR WET are detailed in the public education discussion later in this section.

In 1994, HRPDC published a regional Water Conservation Plan with an introduction that stated:

> *Conservation and efficient use of this important resource (water) is a critical element of any solution to regional water supply shortages, whether they are long-term or short-term, drought induced. The localities of Hampton Roads recognize the importance of water conservation as an integral component of their water supply development efforts.*

Additionally, the Water Conservation Plan encouraged each locality to pursue a water conservation program with a goal to reduce peak demand and overall per capita water consumption through increased awareness.

The following Hampton Roads Water Demand Management Report highlights successful projects and is not a complete list of regional water conservation actions. Not all conservation programs are a good fit for the diverse localities in the region. However, through sharing conservation program information, each locality has found many successful practices that fit the characteristics of their population and water system.

In 2007, the Hampton Roads localities signed a Memorandum of Agreement for Regional Water Supply Planning. The 24 signature localities include the Cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Smithfield, Suffolk, Virginia Beach, Williamsburg, and Windsor; Counties of Gloucester, Isle of Wight, James City, Southampton, Surry, and York; Towns of Boykins, Branchville, Capron, Courtland, Ivor, Newsoms, Smithfield, and Windsor. Table 5-1 lists the relative size of Hampton Roads public utilities involved in the Regional Water Supply Plan.

The larger localities and public utilities have more comprehensive water demand management programs than their smaller counterparts.

Table 5-1: 2007 Hampton Roads Public Utilities

Locality	Population Served	Locality	Population Served
Peninsula Sub-Region			
Middle Peninsula:		York James Peninsula:	
Gloucester County	12,700	Hampton[1]	NNWW
		JCSA[1]	45,836
		Newport News[1]	NNWW
		NNWW[1]	410,000
		Poquoson[1]	NNWW
		York County[1,2]	366
		Williamsburg[1]	13,273
Southside Sub-Region			
Chesapeake	174,586	Suffolk	65,626
Norfolk	235,915	*Virginia Beach*	403,174
Portsmouth	97,851		
Western Tidewater Sub-Region			
Franklin	9,000	Southampton County	2,328
Isle of Wight County	4,625	Town of Boykins[3]	Southampton County
Town of Smithfield	6,750	Town of Branchville[3]	Southampton County
Town of Windsor	2,300	Town of Newsoms[3]	Southampton County
Town of Claremont	343	Town of Capron	167
Town of Dendron	375	Town of Courtland	1,270
Town of Surry	400	Town of Ivor	395

Note: Surry County does not operate any community water systems.
NNWW = Newport News Waterworks
JCSA = James City Service Authority
1. NNWW serves Hampton, Newport News, Poquoson, and parts of James City County, as well as parts of York County (as of 2009).
2. York County transferred ownership of the Lightfoot System to NNWW in 2009.
3. The Towns of Boykins, Branchville, and Newsoms are served by Southampton County.

Water Demand Management Practices

Water conservation strategies include more efficient water use, reductions in water use, and reductions in water loss. These strategies are discussed below.

Water Efficiency

Water efficiency utilizes innovative and smart technologies to accomplish the same amount of work while using less water. Table 5-2 summarizes the following water efficiency practices by locality:

- Wasteful water use ordinance;
- Low water use plumbing fixtures;
- Landscaping;
- Water loss awareness; and
- Water reuse

A "Yes" answer in Table 5-2 means that the locality has participated or is still participating in this water efficiency practice. An answer of "Plan," means that the locality is currently in planning stages of implementing this strategy. Each water efficiency practice is detailed below along with a local program example.

Wasteful water use ordinance: An example wasteful water use ordinance from Windsor states, "No person shall permit the water to run from any hydrant, meter, or fixture without proper care to prevent waste." Many additional localities throughout Hampton Roads have adopted ordinances concerning the waste of water.

Low water use plumbing fixtures: In 1987, the State of Virginia General Assembly adopted legislation for low water use plumbing fixtures. The localities of Hampton Roads have adopted these regulations, standards and updates as set forth in the Virginia Uniform Statewide Building Code (VA USBC). The VA USBC has required low-water-use plumbing fixtures in new construction since 1993.

Landscaping: Water demand can be reduced through the use of landscaping which is more water efficient. In James City County, the James City Service Authority (JCSA) encouraged efficient residential landscaping practices by hosting an innovative Landscape Challenge in 2004. JCSA asked homeowners, "What does it take to be water smart?" The winner of the contest applied several water smart principles, including a rain garden, water reuse, mulching, and more to eliminate the need for constant watering while producing a beautiful home landscape.

Success Story

In 2006, JCSA teamed up with Housing Partnerships, a non-profit agency that repairs and restores homes for people in need. One selected family received a free landscape makeover along with a refurbished home. Materials and labor were provided from JCSA WaterSmart Partners: Peninsula Hardwood Mulch, STI Turf Care, Williams Landscaping & Design, Meadow Spring Turf, Belden Landscapes, Cooke's Gardens, Ace Hardware, Virginia Cooperative Extension, James City County and Williamsburg Master Gardeners, Turf Love, Housing Partnerships and Harmony Design.

The Waterwise Landscape & Watering Guide is the most requested document that HR WET has produced and published. A water-wise landscape doesn't mean giving up your lawn or making dramatic changes to your landscape or lifestyle. The guide provides tips on how to water efficiently and lists low water use plants. The Guide was downloaded 8,770 times in fiscal year (FY) 2008 and has been downloaded nearly 20,000 times since originally posted.

Water conservation guidelines may also create more efficient water landscaping. Beginning in 2002, JCSA offered water conservation guidelines for both residential and non-residential development. These guidelines cover water efficient landscaping, irrigation

systems and indoor appliances. To date more than 60 different developments and/or subdivisions have agreed to the guidelines for water conservation.

Water loss awareness: Water loss awareness programs are designed for residential water customers and increase knowledge of water loss. HR WET has implemented an educational program to reduce residential water loss using leak detection tablets.

Leak detection tablets are provided to customers to put in the toilet tank to test for a slow water leak. For the period of July 2007 through June 2008, HR WET provided almost 3,000 leak detection tablets with instructions in both English and Spanish to residential customers through local outreach activities taking place at regional demonstrations and events.

Table 5-2: Water Efficiency Practices by Locality

	Wasteful Water Use Ordinance	Low Water Use Plumbing Fixtures	Landscaping	Water Loss Awareness	Water Reuse
Chesapeake	Yes	Yes	No	Yes	No
Franklin	Yes	Yes	Yes	Yes	No
Gloucester County	Yes	Yes	No	No	Yes
Isle of Wight County	No	Yes	No	No	No
JCSA	No	Yes	Yes	Yes	No
NNWW[1]	Yes	Yes	No	Yes	Yes
Norfolk	Yes	Yes	Yes	Yes	Plan
Portsmouth	Yes	Yes	No	Yes	No
Southampton County	Yes	Yes	No	No	Plan
Suffolk	Yes	Yes	Yes	Yes	No
Surry County	No	Yes	No	No	No
Claremont	Yes	Yes	No	No	No
Smithfield	No	Yes	Yes	Yes	Plan
Surry (town)	No	Yes	No	Yes	No
Windsor	Yes	Yes	No	No	No
Virginia Beach	Yes	Yes	No	No	No
Williamsburg	No	Yes	No	Yes	No
York County[1,2]	Yes	Yes	Yes	No	Yes

1. NNWW provides water to Newport News, Hampton, Poquoson, and parts of James City County, as well as parts of York County as of 2009. NNWW Programs are implemented throughout the service area.
2. York County practices applied prior to transfer of ownership of the Lightfoot System to NNWW in 2009. Following system transfer, NNWW practices apply.

Water Reuse: The reuse of treated wastewater, or effluent, reduces the demand on water systems. The Hampton Roads Sanitation District (HRSD) was created in 1940 to eliminate sewage pollution in the tidal waters of the Chesapeake Bay. Today HRSD's wastewater service area includes 17 cities and counties of southeast Virginia and several water reuse projects.

The first permitted industrial water reuse project in Virginia was a public-private partnership between HRSD and Giant Industries, the former York River Western Refinery that was endorsed by Newport News Waterworks (NNWW). The HRSD York River Treatment Plant began delivering 500,000 gallons a day of treated wastewater to the adjacent refinery in July 2002. Prior to closure of the refinery, the project received several awards, including the Water Reuse Association's 2003 "Outstanding Project of the Year," and the American Council of Engineering Companies of North Carolina's 2004 "Honors Award for Engineering Excellence." HRSD funded the $3 Million York River project using a 20-year, low-interest loan from the Virginia Water Facilities Revolving Fund.

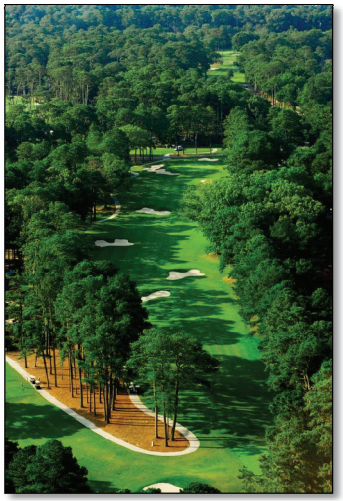


Photo: Cavalier Golf Course and Yacht Club, Virginia Beach, Audubon Golf Certified.

HRSD also provides 14 million gallons per day (mgd) of effluent to the closed-loop heating and cooling systems of Dam Neck Naval Annex. A 66-inch diameter HRSD line through the Dam Neck Naval Annex transported between 32 to 40 mgd of effluent into the Atlantic Ocean. Following ribbon cutting in October 2008, the Navy began reusing 14 mgd of effluent water as a single pass heat sink, providing more efficient service for about the same cost.

HRSD continues to pursue markets for water reuse. With minor additional treatment, reclaimed water can safely replace the high-quality drinking water now meeting the non-potable demands for industry and irrigation. Ideal potential customers include not only industries, but also municipalities, power plants, and others that consistently need large quantities of non-potable water and are located near one of the nine major treatment plants. HRSD evaluates potential water reuse projects on a case-by-case basis in order to reduce long-term demand.

Water reuse projects are also implemented by the localities of Hampton Roads. For example, the City of Virginia Beach has a policy within the Comprehensive Plan to encourage city golf courses to maximize use of recycled water for irrigation instead of groundwater. The plan also seeks full Audubon certification for City golf courses that use recycled water, to use as a means to encourage private golf courses to do the same. This water policy is included in Chapter 9 of the City of Virginia Beach 2003 Comprehensive Plan Policy Document.

Success Story

The City of Norfolk recycles 7,500 tons of water treatment residuals. These residuals are utilized as a soil amendment by local farms. The City also recycles 1.2 million gallons of filter backwash daily.

Gloucester County has sponsored rain barrel making classes for its citizens to learn how they can conserve time, energy and money by using rain barrels. The classes, sponsored by the Tidewater Soil and Water Conservation District, invited all participants to create rain barrels for accessing free water in local gardens. The City of Newport News also hosts rain barrel "make and take" workshops sponsored by the City's Master Gardeners Association, Department of Public Works, NNWW, and the Virginia Cooperative Extension Office.

Other water efficiency practices applied in the Hampton region include:

Maximum flow and water consumption rates and quantities of the VA USBC: The maximum flow and consumption rates are established by the International Plumbing Code, which determines the requirements for plumbing fixtures found in the Virginia Plumbing Code (see Table 5-3).

Table 5-3: Maximum Flow Rates and Consumption for Plumbing Fixtures

Plumbing Fixture or Fixture Fitting	Maximum Flow Rate or Quantity
Lavatory, private	2.2 gallons per minute at 60 psi*
Lavatory, public metering	0.25 gallon per metering cycle
Lavatory, public	0.5 gallons per minute at 60 psi
Showerhead	2.5 gallons per minute at 80 psi
Sink faucet	2.2 gallons per minute at 60 psi
Urinal	1.0 gallon per flushing cycle
Water closet	1.6 gallons per flushing cycle

Source: Virginia Plumbing Code. "Design of Building Water Distribution System." Section 604. 2006
psi = pounds per square inch

WaterSense: WaterSense is a water conservation partnership program sponsored by the Environmental Protection Agency (EPA) that can be compared to the Energy Star energy efficiency program. The WaterSense mission is to protect the future of our nation's water supply by promoting and enhancing the market for water-efficient products and services. This program makes it easy for Americans to save water and protect the environment by choosing water efficient products and services. Table 5-4 lists the Hampton Roads WaterSense partners and service providers in November 2008.

Table 5-4: Hampton Roads WaterSense Partners

American Water Resources Association	Bill Kennon, Richard Ledvina
Association of State Drinking Water Administrators	National Turf Irrigation, Inc.
Comet Plumbing, Inc.	James Haines
Ferguson Enterprises	Plumbing, Heating, Cooling Contractors National Association
Hampton Roads Water Efficiency Team	A-1 Sewer and Drain, Inc.
JCSA	American Mechanical, Inc.
NNWW	Atomic Plumbing, Heating and Electrical Corporation.
Virginia Beach	D.E. Kirby, Inc.
Virginia Department of Health	East Coast Plumbing and Heating
Water Environment Federation	Ellsworth Plumbing and Heating
Irrigation Association	Evan Hibbs Plumbing
April Showers, Inc	JMM Plumbing & Utilities, Inc.
James Sheshene	Lindsey Brothers Plumbing & Heating
Gentle Rain Irrigation Company	Mechanical Service Co., Inc.
Bill French	Norfolk Plumbing, Inc.
Heads-Up Sprinkler Systems	Ward & Son, Inc.

Source: EPA. *Meet Our WaterSense Partners.* http://www.epa.gov/watersense/partners/partners.htm. Accessed November 2008

The EPA is actively developing new specifications to expand the WaterSense family such as the Water Budget Tool. This tool is designed to guide builders, landscape professionals, and irrigation partners through water budget calculations for water-efficient single-family new homes.

Figure 5-2: EPA Water Sense Partner Logo

Water Conservation Measures

Water Conservation measures are used throughout Hampton Roads to encourage people to change behaviors and habits in order to reduce their use of water. Water conservation consists of any beneficial reduction in water losses, waste or use. Water conservation programs are aimed toward water consumers and can involve technical or financial means and public education programs. Table 5-5 summarizes water conservation practices by locality.

Table 5-5: Water Conservation Practices by Locality

	Conservation Program	Conservation Ordinance	Install Low Water Use Fixture	Provide Retrofit Kits	Water Pressure Reduction	Irrigation Management	Rebate Programs	Public Education
Chesapeake	Yes	Yes	Yes	No	No	Yes	No	Yes
Franklin	No	Yes	Yes	Yes	No	Yes	No	Yes
Gloucester County	Yes	Yes	No	No	No	No	No	Yes
Isle of Wight County	Yes	No	Yes	No	No	No	No	Yes
JCSA	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
NNWW[1]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Norfolk	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Portsmouth	Yes	Yes	Yes	No	No	Yes	No	Yes
Southampton County	No	Yes	Yes	No	No	Yes	No	Yes
Suffolk	Yes	Yes	Yes	Yes	No	No	No	Yes
Surry County	No	No	No	No	No	No	No	No
Claremont	Yes	Yes	No	No	No	No	No	Yes
Smithfield	Yes	Yes	No	No	No	Yes	No	Yes
Surry (town)	Yes	No	No	No	No	No	No	Yes
Windsor	No	Yes	No	No	No	No	No	Yes
Virginia Beach	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Williamsburg	Yes	Yes	Yes	Yes	No	No	No	Yes
York[1,2]	Yes	Yes	Yes	Yes	No	No	No	Yes

1. NNWW provides water to Newport News, Hampton, Poquoson, and parts of James City County, as well as parts of York County as of 2009. NNWW Programs are implemented throughout the service area.
2. York County practices applied prior to transfer of ownership of the Lightfoot System to NNWW in 2009. Following system transfer, NNWW practices apply.

Technical Practices

The following information highlights some of the practices for improving regional water conservation using technical means. This includes the use of water conservation programs, ordinances, installation of low water use fixtures, retrofits, system-wide water pressure reduction and irrigation management.

Water Conservation Program: Localities throughout Hampton Roads have taken the lead in water conservation by developing and implementing long-term Water Conservation Programs and Plans. These programs reflect the common sense need for municipal water purveyors to manage water supply resources in a responsible and efficient manner and to meet regulatory permit requirements. Short-term water supply Drought Response and Contingency Plans also include water conservation actions and are discussed later in this section. Water Conservation Programs help local utilities provide the most beneficial and cost effective methods of water conservation for their customers.

Water Conservation Ordinances: The following five policies are from existing water conservation ordinances.

1. Car Wash: All new car wash installations using the public water supply shall be equipped with a water recycling system approved by the Director of the Department of Public Utilities. All existing car wash installations using the public water supply shall install a water recycling system no later than one year from the effective date of this subsection.
2. Continuous Flow Equipment: In all new construction and all repair or replacement of continuous flow devices, any water connector device or appliance requiring a continuous flow of 5 gallons per minute or more shall be equipped with an approved water recycling system.
3. Leak Repairs: Any owner of any residential unit, commercial or industrial establishment who, by determination of the Director of the Department of Public Utilities, is found to use an excessive amount of water due to leakage from water lines or plumbing fixtures on the premises shall repair and stop such leakage upon notice from the Department of Public Utilities.
4. Waste of Water: No person shall permit water to run from any hydrant, meter, fixture, hose, sprinkler system or any other device without taking such measures as are necessary to prevent waste of the public water supply.
5. Violation: Unless otherwise required under VA USBC, this section shall be enforced by the Department of Public Utilities. Any person violating the provisions of this section shall, upon conviction thereof, be subject to a fine.

The following Hampton Roads localities have already enacted a comprehensive water conservation ordinance: Chesapeake, Franklin, Gloucester County, James City County, NNWW, Norfolk, Portsmouth, Smithfield, Southampton County, Suffolk, Town of Claremont, Virginia Beach, Williamsburg, Windsor, and York County. Users of water supplied through a water system where a locality has enacted water conservation regulations must comply with the conservation procedures.

Installation of Low Water Use Plumbing Fixture: All newly constructed government facilities in Hampton Roads must meet current VA USBC regulations, which include installation of Low Water Use Plumbing Fixtures. There are many different types of low flow products and fixtures such as toilets, showers, sink faucets and urinals. Hampton Roads government buildings constructed later than 1994 have low water use plumbing fixtures installed.

This type of fixture may also be installed in an older building. In November 2008, the City of Chesapeake completed an energy retrofit project in the 20-year-old City Hall building. The project included heating, ventilation, and air conditioning (HVAC), lighting, and water system retrofits. The water system retrofits included installation of flow restrictors on all faucets, replacement of all

toilets with low-flow designs, and replacement of all urinal flush valves with low-flow kits. The predicted annual water savings is approximately 1.0 million gallons per year, or 45 percent of earlier use. Chesapeake also offered employee training in spring 2009 explaining the City Hall energy retrofit project and what can be done to conserve energy and resources at work and at home.

Retrofit Kits: A retrofit kit provides low water use fixtures to water customers at free or reduced prices. Retrofitting involves making improvements to existing fixtures or appliances in order to increase water use efficiency. A retrofit kit may include more efficient shower heads, faucet aerators and toilets. HR WET provided retrofit kits at no charge to localities throughout the region to distribute to local populations.

In March 2000, three localities in the Hampton Roads region, Hampton, Franklin, and James City County, participated in an EPA Environmental Justice Grant administered by HRPDC and HR WET. Using the EPA grant monies, volunteers retrofitted more than 900 lower-income homes with retrofit kits which included 1.6 gallon per minute (gpm) low-flow toilets, showerheads, and faucet aerators. One hundred percent of the old toilets were then recycled and used as base layer materials for an oyster reef in the Chesapeake Bay Watershed. Water fixture retrofitting is also handled through local rebate programs, and covered in the Financial Measures section below.

Water Pressure Reduction: Lowering the water pressure of a system improves conservation by reducing the amount of water available for use while maintaining water system integrity and customer service quality. Many local Hampton Roads Utility Departments already utilize the lowest water pressure possible and cannot reduce pressure any further.

The NNWW was able to implement a voluntary pressure reduction in 1986 from a range of 82 to 92 pounds per square inch (psi) to a range of 72 to 82 psi; the lowest level possible. This represents a reduction of about 12 to 16 percent. The pressure reduction lowered water usage by up to 3 MGD with no action required by the customer. The lower overall water pressure also contributed to a reduction in water loss because there were fewer water system leaks.

Irrigation Management: Irrigation management may be used to conserve water through a set watering schedule or irrigation meters. James City County has adopted an ordinance to conserve outdoor water use and reduce irrigation. A 2003 ordinance stated that all customers of the James City Service Authority (JCSA) were limited to three watering days a week throughout the summer season. In 2005, the county adopted an ordinance that stated any automatic irrigation system installed after March 8, 2005 shall include an automatic rain sensor gauge that cuts off water use after one-quarter inch of rain.

The City of Suffolk water utility offers customers the option of irrigation meters. An irrigation meter is an additional water meter which helps to monitor water use and helps local landscape efficiency by increasing customer awareness of outdoor water use. The additional water meter is used to separate interior and exterior water use and lowers the sewer bill. The predominant consumer of this service has been large-volume commercial clients.

Financial Practices

Water conservation can be improved using financial programs. The Hampton Roads program examples are rebate programs and incentives, rate structure and customer water bills.

Rebate Programs: A rebate program offers customers a financial incentive to retrofit or replace fixtures and appliances to reduce water use. JCSA has several rebate programs ranging from $50 to $500 in value. JCSA initiated the Rain Sensor Rebate Program on July 28, 2005, the Rain Barrel Rebate Program on January 1, 2008, and Rebate Programs for Water Smart landscapes; cisterns; 'on demand' hot water re-circulators; and high-efficiency toilet, washing machine, and dishwasher replacements on August 1, 2008. So far there have been 490 approved applications and more than $40,000 in

customer refunds through the rebate programs. The rain barrel is the most popular with more than half of the approved rebates. JCSA is currently researching grant opportunities to help offset the cost of this successful rebate program.

The Virginia Beach Department of Public Utilities Toilet Rebate Program was started in 1993 and currently offers customers a $75 rebate for each conventional toilet replaced with an ultra low-flush toilet. An estimated $3.2 Million has been provided to customers in rebates and more than 42,000 toilets have been replaced throughout the City helping customers save money and conserving millions of gallons of water.

Rate Structure: Public Utility water rates may also lead to increased water conservation by water customers. Hampton Roads water utilities use two different rate structures: 1) increasing block rates; and 2) uniform rates. An increasing block rate assigns a single rate per unit of water use until a certain amount, and then the rate per unit increases. A uniform water rate structure charges a constant rate per unit of water use. Water rates may vary throughout the year, typically increasing during the peak outdoor water usage season. NNWW charges an increased block rate for above average water use during the summer. Table 5-6 summarizes local water rate structures. One of the goals of increasing and seasonal water rates is to reduce excessive discretionary water use and encourage customers to monitor water usage. Several local utilities also provide "life-line" assistance for low and fixed income customers.

NNWW studied the relationship of water elasticity, comparing price change to change in water demand. Water use data from 1992 to 2002 were analyzed and over that period there was a 26 percent average increase in the price of water and overall demand reduction of 11 percent. During this period, the basic rate changed from a decreasing block rate to a uniform rate with summer consumption surcharges. A decreasing block rate assigns a single rate per unit of water use until a certain amount, and then the rate per unit decreases. The change in rate from decreasing block to uniform rates with summer surcharges has significantly contributed to the reduction in per capita water use and water conservation efforts in the region.

Water Bills: Water bills throughout Hampton Roads offer customers features beyond basic payment information that help to maximize water customer conservation efforts. Tips to conserve water, comparisons to previous water use, inserts and newsletters containing tips for home water conservation all help improve water demand management.

Public Education Practices

Public education is critical to achieving public cooperation and support of water conservation goals. The precise savings attributable to education are hard to quantify, but can produce water savings when customers change their long-term water habits. Experts consider public education to be a key component of an effective multi-faceted water efficiency program.

Table 5-6: Local Water Rate Structures

Increasing Block Rate	Uniform Rate
Gloucester County	Chesapeake
Isle of Wight County	Franklin
NNWW*	Smithfield
James City County	Norfolk
Southampton County	Portsmouth
Surry County	Suffolk
	Virginia Beach
	Williamsburg
	Windsor

*NNWW provides water to Newport News, Hampton, Poquoson, and parts of James City County, as well as parts of York County as of 2009. NNWW rates are implemented throughout the service area

The Hampton Roads localities have active public education programs. For example in James City County, the JCSA has created *Let's be Water Smart.* This public/private partnership includes a comprehensive water management and education program to help residents maintain high quality landscaping while taking a "smart" approach to water use.

NNWW takes the conservation and water supply message into classrooms and public meetings to explain and educate the community about the need for a sufficient water supply. Programs are presented to students, scouts, civic and church groups. A quarterly customer newsletter provides water-wise advice and tips directly to all NNWW customers throughout the Peninsula.

The City of Norfolk's Department of Utilities offers a variety of public education activities to its customers. Utilities personnel provide classroom presentations to include the water cycle, source water protection and water conservation. Classroom presentations are available for every grade level and are tailored to meet the Virginia Standards of Learning requirements. The Department of Utilities also offers presentations to community groups and civic leagues. Presentations are on the water treatment process, billing procedures, services offered, meter reading procedures, and general Department information; however, all presentations can be tailored to meet the needs of the requesting group. The Department of Utilities also provides displays and distributes Norfolk Pure drinking water for public events. Interested parties can request a classroom visit, presentation, or display from the Norfolk Department of Utilities website.

The Virginia Beach Department of Public Utilities has held an annual Water Awareness Calendar Contest since 1994. There were 829 entries for the 2009 calendar contest from children in kindergarten through fifth grades. In 2008, 6,000 free calendars featuring award winning posters were distributed through the Virginia Beach Public Schools, Public Libraries, and Recreation Centers.

Virginia Beach has contracted with the National Theatre for Children since 1992 to provide water conservation-themed performances in the elementary schools. The slap-stick comedic theater with the recurring theme of *Water Pirates* is designed to be easy to remember as the children progress through school grades. In 2008, 12,129 students attended these theatrical performances.

Water conservation education throughout Hampton Roads is not a burden of a single locality, but a team effort with marketing a regional message through HR WET. HR WET is a committee comprised of local government staff committed to regional water efficiency education to implement a regional approach to communicating the need for water efficient practices by all residents and industries in Hampton Roads.

The HR WET education campaign addresses specific measures and social aspects of enhancing water conservation among water consumers. HR WET conveys to the public an understanding of why water conservation is important and why the combined efforts of thousands of households can significantly contribute to reducing water demand. Monthly HR WET meetings provide a forum for communication, information sharing and collaboration among local government staff. Through the team's focus and dedication, successful programs promoting the efficient use of water throughout the region have been initiated and continue today.

The mission of HR WET is to develop and implement a regional approach to promoting efficient water use throughout Hampton Roads. HR WET has the following goals:

- Raise public awareness of the region's water supplies.
- Reduce per capita water consumption by increasing the number of people using water more wisely.

To achieve these goals, HR WET conducts a comprehensive water conservation education program involving media relations, exhibits, educational resources and an informative website.

Media: HRPDC, on behalf of HR WET, contracts with Cox Media for cable television advertising. HR WET ads appear on channels such as WHRO, CW Metro Networks, The Weather Channel, ESPN2, CNBC, MSNBC, HGTV and WVEC Channel-13. WVEC airs *HR WET Water - Use it Wisely* tips during peak viewing times such as The View, Oprah, and Jeopardy.

WVEC Channel 13 scheduled a taping of Dialogue that originally aired on August 27, 2006. Two members of HR WET were interviewed and introduced the *Waterwise Landscape & Watering Guide*. HRPDC staff represented HR WET during the WTBN Channel 21 Joy in Our Town community resources segment and discussed practical ways for viewers to conserve water.

HR WET has also worked with Metro Networks, the region's transportation and traffic radio reporters. Through this partnership, HR WET has been able to deliver live messages about water efficiency to listeners on several radio stations during peak drive times. These spots, along with the television ads, continue to provide reinforcement of the *HR WET Water - Use It Wisely* tagline, "There are a number of ways to save water, and they all start with you."

A one-page tip sheet is used in a variety of regional publications such as the WVEC Channel-13 Hurricane Guide, distributed to the public at local Dodge automobile dealers and made available on the WVEC Channel-13 website. HR WET partnered with HR STORM, the HRPDC stormwater education program, to develop a joint tip sheet for *The Virginian-Pilot's* Homearama program guide in 2006.

Exhibits: The HR WET Team provides demonstrations and events with the HR WET Mobile Educational trailer. The mobile educational trailer is a 21-foot vehicle transported to different Hampton Roads events. HR WET team members distribute educational materials and answer questions from event attendees. The trailer has attended the following events in 2007 and 2008.

Figure 5-3: "Water Use it Wisely" logo

Table 5-7: HR WET Mobile Educational Trailer Events (2007-2008)

Date	Event	Location
February 2-4, 2007	Home & Garden Show	Hampton Convention Center
March 2-4, 2007	Outdoor 2007	McDonald's Nursery, Hampton
March 16-18, 2007	Good Living Show	McDonald's Nursery, Virginia Beach
April 20, 2007	Earth Day	Legacy Hall, James City County
April 27-29, 2007	History Fest	Oceanfront, Virginia Beach
May 6, 2007	Earth Day	Mt. Trashmore Park, Virginia Beach
May 17-20, 2007	Chesapeake Jubilee	Chesapeake City Park
June 2-3, 2007	Relay for Life	Dam Neck, Virginia Beach
June 6, 2007	Employee Safety Day	City of Norfolk
September 7-9, 2007	Hampton Bay Days	Hampton
September 22, 2007	Estuaries Day	York River State Park, Williamsburg
October 27, 2007	Virginia Fall Classic	Newport News City Park
February 8-10, 2008	Home and Garden Show	Hampton Convention Center
March 7-9, 2008	Cox Food & Flower Show	McDonald's Nursery, Hampton
March 29-30, 2008	Daffodil Festival	Gloucester
April 26, 2008	Earth Day Celebration	Christopher Newport University
May 4, 2008	Earth Day Celebration	Virginia Beach
May 7, 2008	Drinking Water Week	Newport News / Hampton
May 15-18, 2008	Chesapeake Jubilee	Chesapeake
June 7-8, 2008	Relay for Life	Virginia Beach
June 27-28, 2008	Olden Days	Smithfield

Educational Resources: HR WET participated in the creation of the Newspapers in Education *We All Live on the Water* newspaper distributed to almost 25,000 Hampton Roads third grade students. The paper was partially funded by a grant from the Chesapeake Bay License Plate Fund. *We All Live on the Water* helped to educate regional youth about local watershed information and included a Teacher's Guide correlated to the Virginia Department of Education Standards of Learning requirements.

Through the HR[4] Mini-Grant Program, schools and youth groups are eligible to receive up to $500 toward environmental projects that meet the goals of HR CLEAN, HR STORM, HR FOG and HR WET; $6,714 in grant funds were provided to different groups and more than 7,000 Hampton Roads youth were reached.

As part of the education program, HR WET orders and distributes a variety of promotional giveaways that encourage water efficiency. Magnets, post-it notes, stickers, toothbrushes, shower timers, and rain gauges with the *Water - Use It Wisely* logo are just some examples of the many educational items distributed by HR WET. Recently, team members developed a dry-erase board with popular water conservation tips and images. Some additional giveaways have been:

- *Waterwise Landscape & Watering Guide* 6-inch ruler that converts water faucet drip size to flow rate in gallons per minute
- Sponge in the shape of a *Water – Use it Wisely* water drop

Another component of the regional education program is the HR WET website, www.hrwet.org. From the website, users are able to download and print information, apply for a HR[4] Mini-Grant, e-mail local representatives and more. The website also provides indoor and outdoor conservation tips, water efficiency techniques and procedures for conducting a home water audit. The HR WET website is enhanced and updated frequently with information received from team members and staff. For additional visibility, the HR WET site has been linked to many regional municipal websites.

HR WET is focused on the education of all local citizens, including youth and businesses, on the need for water efficiency and conservation. HR WET continues to develop and provide the region of Hampton Roads with programs promoting efficient water use and ways to reduce the per capita water consumption by teaching people how to use water more wisely.

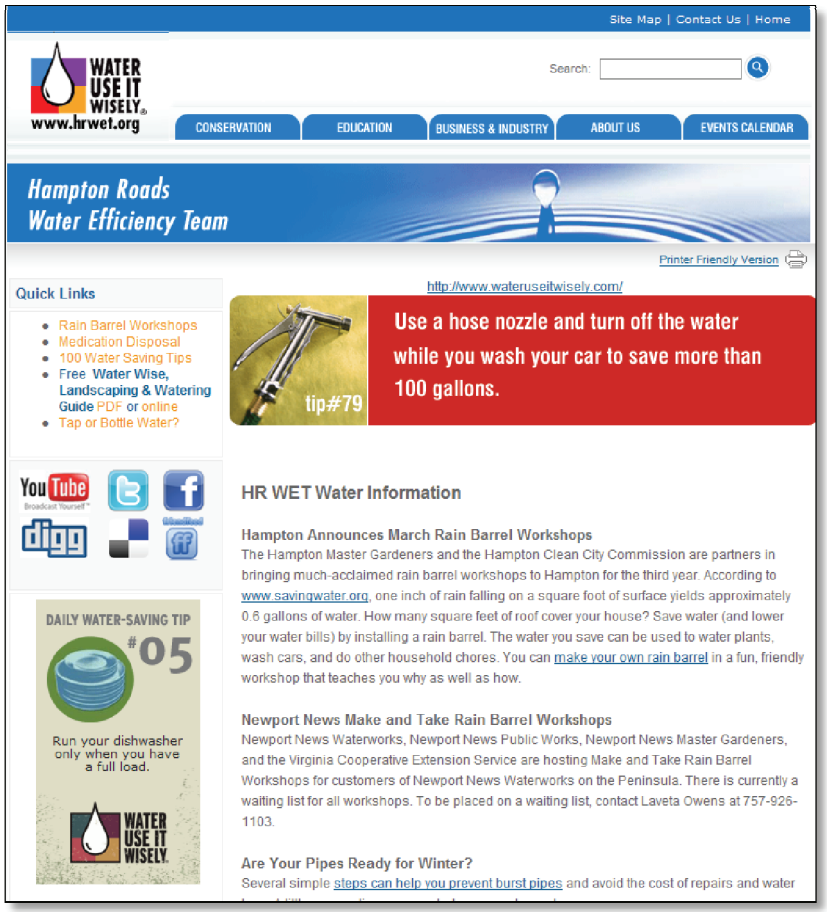


Figure 5-4: HR WET website

Reducing Water Loss

Water conservation practices begin with water supply systems. Hampton Roads regional water providers are working to reduce leakage within their systems and unbilled water loss. Leakage within the water system is reduced or eliminated through system maintenance. Unbilled water loss is water use that is unmetered or unauthorized. Table 5-8 summarizes local practices to address water loss.

Practices to Reduce System Water Loss

Leakage within the water system, also called real water loss, occurs when water exits the system without metering and can be lessened through water system maintenance and local ordinance.

Repair of Leaking Fixtures Ordinance: Many localities throughout Hampton Roads have adopted a Repair of Leaking Fixtures Ordinance. This ordinance requires repairs to leaking water fixtures within a reasonable period of time. Virginia Beach ordinance 37-20 reads:

> *No person shall permit the water to run from any hydrant, meter, cock or fixture without proper care to prevent waste. If any pipe, hydrant, meter, cock or other fixture is found leaking, the owner of the premises shall have the necessary repairs made immediately upon notice from the department of public utilities to do so, and failure to repair shall require the discontinuance of the water supply until repairs are made.*

Capital Improvement Plans (CIP): Local governments approve CIPs that provide blueprints for spending. CIP programs often include dedicated funding to upgrade existing facility infrastructure and help to reduce water loss. Most localities in Hampton Roads have CIPs that provide funding for water systems. As an example, the Norfolk Department of Utilities builds, maintains, and improves the City's water and sewer systems. These systems include a vast network of pipes, pump stations, treatment plants, and storage facilities. Norfolk's water system has one of the lowest leak rates in the industry. Although both systems currently work sufficiently to provide water and sewer services, the City's goal is to be proactive to provide the best service possible. From 2004-2013, Norfolk is committed to spending $170 million for water system improvements.

System Maintenance: Maintaining water systems by replacing old lines, system rehabilitation, improving leak detection and repair will help reduce water loss and lower water demand. For example, the City of Franklin has an active program of replacing undersized and older pipelines throughout the distribution system. The number of leaks per unit pipe length, age, work orders, cost for replacement, and reports of inadequate pressure are factors that determine replacement priority. This program has proven effective in reducing system leaks and improved fire protection capabilities by increasing flow to the fire hydrants. The City of Franklin has also improved the overall response time to line breaks and leaks, which provides an additional component of water conservation efforts.

Leak Detection Program: A local program that can detect water leaks quickly may lower the total amount of water loss. Water lost to leaks produces no revenues for the utility and should be minimized. The City of Norfolk has had a leak detection program in place since 1980. A two-person crew surveys the City with listening equipment that enables them to track down all but the smallest leaks. They also respond to requests from meter mechanics to check for leaks in suspected locations. Water main breaks

Success Story

The City of Norfolk Department of Utilities was awarded Commitment Level River Star status by the non-profit Elizabeth River Project. The Elizabeth River Project's River Stars program is one of the most successful local pollution prevention and habitat restoration programs in Virginia. The Department of Utilities was awarded this status for their multiple efforts in energy conservation, recycling, water and sewer leak prevention and employees awareness programs.

are repaired immediately. Top priority is assigned to service line leaks, with a goal to repair any leaks within 24 hours of notice. Norfolk also has a number to report leaks and maintains a 24-hour stand-by crew for responding to any water emergency.

Several localities also have automated systems to report high water bills, which could be due to leaks. Norfolk customers can call the utilities department high bill and leak reporting system, and they will investigate the situation within two business days.

Table 5-8: Practices by Locality to Reduce Water Loss

	Leaking Fixtures ordinance	Water CIP Projects	System Maintenance	Leak Detection Program	Unauthorized Connection Ord.	Metering of All Uses	Meter Testing, Replacement	Residential Water Audits
Chesapeake	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Franklin	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gloucester County	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Isle of Wight County	No	Yes	Yes	Yes	Yes	Yes	Yes	No
JCSA	No	Yes	Yes	No	Yes	Yes	Yes	No
NNWW[1]	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Norfolk	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portsmouth	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Southampton County	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Suffolk	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Surry County	No	Yes	Yes	No	No	Yes	Yes	No
Claremont	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Smithfield	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Surry (town)	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Windsor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Virginia Beach	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Williamsburg	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
York[1,2]	Yes	Yes	Yes	No	Yes	Yes	Yes	No

1. NNWW provides water to Newport News, Hampton, Poquoson, and parts of James City County, as well as parts of York County as of 2009. NNWW Programs are implemented throughout the service area.
2. York County practices applied prior to transfer of ownership of the Lightfoot System to NNWW in 2009. Following system transfer, NNWW practices apply.

NNWW currently has a system leakage rate of 5 percent, one of the lowest rates in the industry. The industry average for water loss is between 12 and 15 percent. Through an aggressive water conservation program, NNWW was able to reduce water loss from 5.6 MGD in 1993 to 1.3 MGD in 1999. NNWW credits the strong educational program, metering of uses, pressure reduction and leak repair in helping to reduce the amount of water loss.

Practices to Reduce Unbilled Water Loss

Metering problems and customer water use that is unauthorized are examples of unbilled water loss. The following methods are used in Hampton Roads to lower unbilled water loss: unauthorized connection ordinance, increasing the numbers of customers that have metered water connections, meter testing and replacement programs and residential water audits.

Unauthorized Connection Ordinance: Localities throughout the Hampton Roads region have ordinances declaring unauthorized connections to water lines unlawful. These ordinances may lower the overall amount of water loss. Ordinance 90-127 from Suffolk states:

> *No person, except one properly authorized by the city, shall tap or make any connection with the main or distributing pipes. No person, except a licensed plumber or an employee of the city approved by the city for such purpose, shall be permitted to do any work in connection with the water service to any premises supplied by the city.*

Metering: Accurate water metering is a fundamental tool of water system management and conservation because a working meter prevents water loss. All Hampton Roads water suppliers use service connection metering to inform customers about how much water they are using and accurately track water use. In 1975, the Southeastern Water Authority of Virginia made the following statement about water metering which remains accurate today,

> *Timely information on water use must be available in order to establish normal consumption patterns, adjust rates, identify trends and make reliable projections, and detect accidental losses as well as wasteful tendencies. The very presence of meters and monitoring policies would generally tend to discourage waste.*

Meter Testing and Replacement: All meters should be regularly tested for accuracy and replaced when needed. Meters can become damaged and they deteriorate with age. In the City of Norfolk, meters are replaced for residential customers after 15 years of use. Meters for wholesale customers are calibrated annually and replaced if necessary.

Success Story

The Hampton Roads region has been actively conserving water with proven results. The regional per capita water use has lowered dramatically, from 116.4 gallons per capita per day in 1990 to 97.6 gallons per capita per day in 2007.

Future improvement in lowering per capita usage will be more difficult because of water demand hardening. Demand hardening occurs as the discretionary use of water diminishes, leaving only necessary water use; which is more difficult to reduce. While water conservation may be difficult in the future, it remains a priority for Hampton Roads.

In 2000, Maddaus Water Management provided a water conservation analysis for the Peninsula Cities of Newport News, Poquoson, Hampton, Williamsburg, James City and York Counties. Water demand for the Peninsula leveled off in the mid 1990s, despite an annual 1.4 percent increase in the number of water customers. The study also found an overall 21 percent decline in total consumption per active account from the mid 1980s to 2005 due to aggressive water conservation programs such as summer conservation rates, water pressure reduction, distribution system improvements, regional and local water efficiency education programs, leak detection and meter calibration.

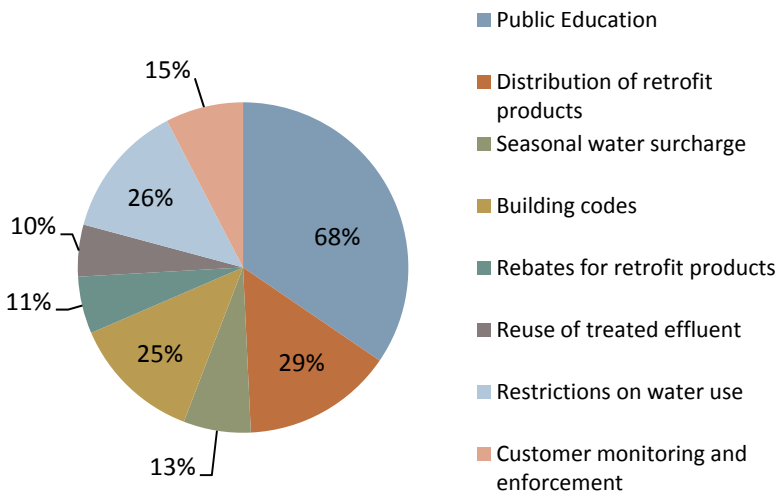
Residential Water Audits: Audits can help customers to improve their water usage habits and avoid high water bills by demonstrating water usage habits. Virginia Beach has a program that automatically includes a special insert in a customer bill when the usage spikes without explanation. The insert offers the customer a free water audit to find out if the problem is system based or from overuse. If the water audit finds that the problem was due to a system leak, the customer is credited for a portion of the bill once repairs have been made. The customer is also provided with lessons on water conservation practices if the overage is due to excessive water use.

Water Conservation Summary

Hampton Roads recognizes water conservation is an integral component of water supply development efforts. AWWA identified the most popular water conservation programs across the United States (see Figure 5-7). All top eight water conservation programs are currently implemented within Hampton Roads, demonstrating the continuing regional commitment to water conservation.

Hampton Roads water demand management practices are regularly reviewed and evaluated for effectiveness. Local water demand management programs are updated based on the feasibility, cost-effectiveness, conservation measures already in place, and water use required for human health and sanitation. Per 9 VAC 25-780-110B, regional water conservation practices were considered when projecting long-term water demands presented in Section 4 of this plan. Improving water efficiency, increasing water conservation, and reducing water loss are practices necessary to ensure the viability of water supplies across the region.

Figure 5-5: Top U.S. Water Conservation Programs



AWWA. Forecasting Urban Water Demand. p130. 1996.

Regional Drought Response and Contingency Plan

The Hampton Roads Regional Drought Response and Contingency Plan addresses the requirements set by the State of Virginia Local and Regional Water Supply Planning regulation (9 VAC 25-780). The purpose of a drought management plan is to manage a period of declining supply and increasing demand so that demand does not exceed either supply or system capacity.

The region's vulnerability to drought has long been recognized. Drought conditions previously occurred in 1977, 1980-81, 1986, 1993, 2002, and 2007. During past drought events, several localities in the region implemented water restrictions.

In 2007, the Hampton Roads localities signed a Memorandum of Agreement for Regional Water Supply Planning. The 24 signature localities include the Cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach and Williamsburg; Counties of Gloucester, Isle of Wight, James City, Southampton, Surry, and York; Towns of Boykins, Branchville, Capron, Courtland, Ivor, Newsoms, Smithfield, and Windsor. All of the listed localities are included in the Hampton Roads Drought Response and Contingency Plan.

The Hampton Roads localities have completed many successful regional efforts that address water use, source water protection, and water supply issues. The HRPDC Source Water Assessment Program (HRPDC SWAP), the regional water conservation education program (HR WET), and the groundwater, stormwater, and wastewater management programs are a few examples of regional cooperation in water resources management.

Local governments operate all of the large community water systems in the region. Drought response planning in Hampton Roads is led by the Utility Departments of the local governments. The Directors of the Utilities began meeting monthly in the summer of 1993, as part of the HRPDC water program and continue their meetings today. The Directors of Utilities Committee meeting provides an opportunity for water providers to discuss their concerns and actions related to drought or emergencies. Every Hampton Roads locality is represented on the Directors of Utilities Committee and water supply is a monthly discussion topic.

The interdependence among all of the localities in terms of water supply creates an opportunity to approach many regional water problems with a regional or subregional solution. The Hampton Roads Drought Response and Contingency Plan is structured to address the variety of water sources that are utilized in the region and enhances established local drought management policies. Individual ordinances and reports described in the next section document the drought response planning that local governments have already adopted. Nothing in this plan should be viewed as limiting local governments or waterworks from taking more stringent actions to respond to local conditions at any time.

Water System Relationships

The following section defines the sub-regions and the relationships between the localities in each sub-region. Because many of the water providers serve multiple localities, agreements have been established to coordinate the implementation of drought response policies. The three sub-regions are the Peninsula, Southside, and Western Tidewater.

Peninsula Sub-Region

The Peninsula sub-region includes Gloucester County on the Middle Peninsula, and James City County, York County, and the Cities of Hampton, Newport News, Poquoson, and Williamsburg on the York-James Peninsula (see Figure 5-6).

Gloucester County is located on the Middle Peninsula and the County's water supply system is not tied into any of the other systems in the sub-region. Gloucester's reservoir and the Newport News reservoirs generally experience the same precipitation rates and the localities benefit from sharing information about their drought concerns.

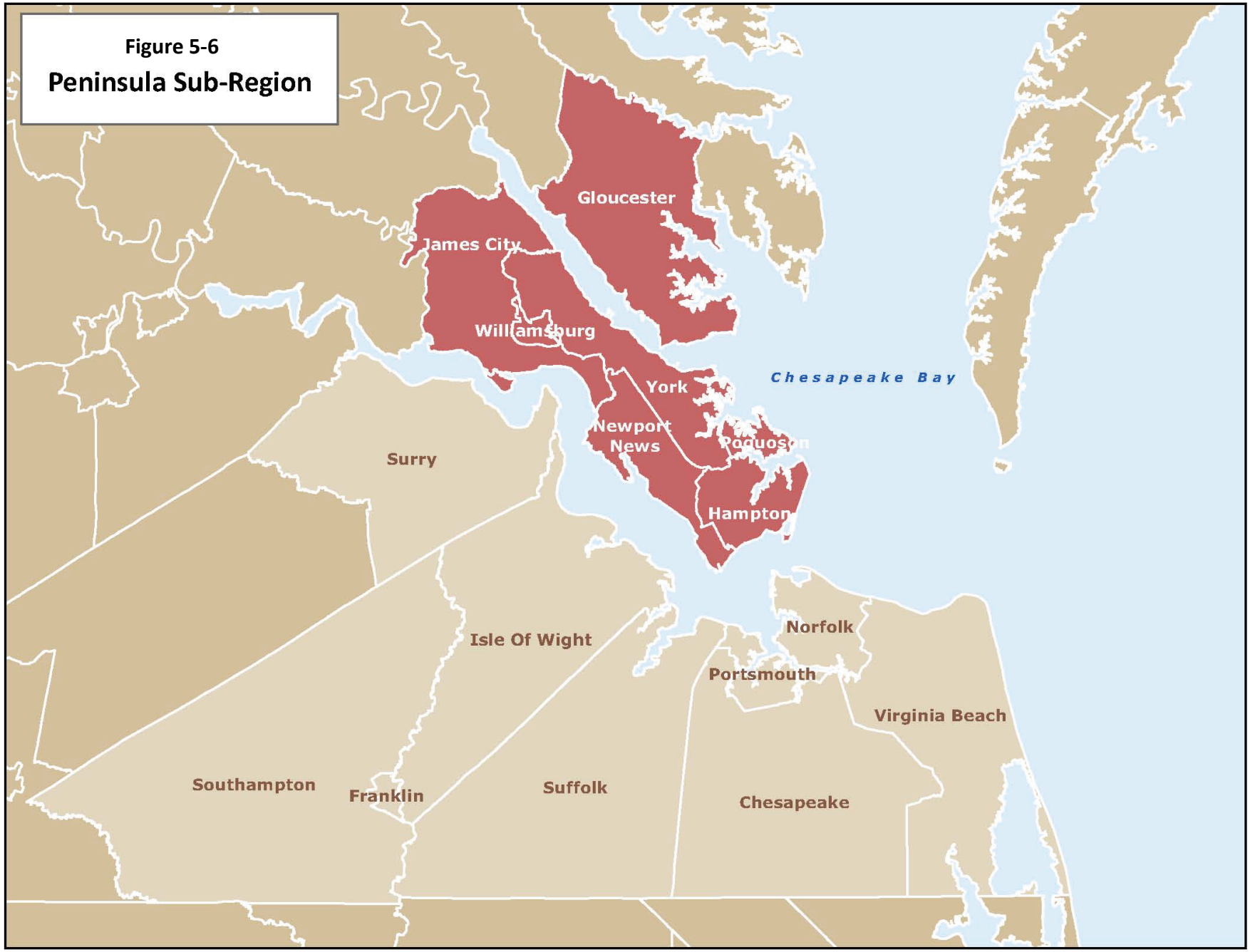


Figure 5-6
Peninsula Sub-Region
Gloucester
James City
Williamsburg
York
Chesapeake Bay
Newport News
Surry
Hampton
Isle Of Wight
Norfolk
Portsmouth
Virginia Beach
Southampton
Franklin
Suffolk
Chesapeake

NNWW owns and operates the majority of the water supply resources and distribution systems on the York-James Peninsula. NNWW serves over 400,000 people in Hampton, Newport News, Poquoson, and portions of York and James City Counties.

The NNWW Acts of Assembly enabling legislation was signed by the Virginia General Assembly on March 25, 1926. This legislation authorized the City of Newport News to purchase the Newport News Light and Water Company and:

> *…operate, control, extend and improve said plant for the purpose of supplying water to the inhabitants of York County, James City County, Warwick County, Elizabeth City County, the City of Hampton, the Town of Phoebus, the village of Kecoughtan and certain areas and properties owned by the United States.* (Virginia Assembly 880)

This legislation allowed NNWW to become the water supplier for the City of Hampton. The City of Poquoson incorporated from York County in 1952 and became an independent city in 1975. Poquoson continues to use NNWW for its water supply. All water for the cities of Newport News, Hampton and Poquoson is supplied by NNWW.

Williamsburg Public Works provides water service to all of Williamsburg and a portion of York County. JCSA has over 45,000 customers who are served by multiple groundwater systems. Williamsburg and the JCSA have both signed Long-term Water Supply Agreements with NNWW. James City County has a contract with NNWW to provide supplemental water of 4 to 5 MGD to the County groundwater supply until water from a new water supply project is available. Williamsburg has a contract with Newport News to purchase up to 2.0 MGD.

The Long-term Water Supply agreements between Newport News and James City County and Williamsburg describe the implementation of water use restrictions. The long-term agreement states, that if conditions such as drought or other emergencies cause the federal government, Commonwealth of Virginia, or City to impose or enact water use restrictions on its water system customers, then JCSA and Williamsburg and their customers will also be subject to the same restrictions which will be imposed and enforced by JCSA and Williamsburg. Bound by these agreements, Williamsburg and James City County are obligated to follow the drought management plan of Newport News. However, either local government can enact more stringent drought plans than Newport News at any time.

York County currently is served by NNWW and Williamsburg directly and also by several private community water systems. The private water systems buy water from York County master meters, and York County buys the finished water from NNWW or Williamsburg. As they are within the NNWW service area, York County customers must follow water restrictions imposed by NNWW. Also, York County's ordinance states that the water conservation program shall generally be in accordance with the program requirements of the Newport News City Council.

For the purpose of the Regional Drought Response and Contingency Plan, NNWW represents customers in several localities. The cities of Newport News, Hampton, Poquoson, Williamsburg, and York County will generally follow the drought management restrictions set by NNWW and are all represented in this plan by NNWW. JCSA will at a minimum follow the lead of NNWW, but may set more stringent standards based on its groundwater system.

Southside Sub-Region

The Southside sub-region includes the Cities of Norfolk, Portsmouth, Virginia Beach, Chesapeake, and Suffolk (see Figure 5-7).

The City of Norfolk provides water to its entire City and is contracted to provide water to several other localities. Under an existing cost of service contract, Norfolk "wheels and treats" water for the City of Virginia Beach's publicly-owned CWS. Lake Gaston water, owned by Virginia Beach, is piped to Norfolk's Lake Prince reservoir system. The Lake Gaston water and water from Norfolk's water sources are blended and treated at Norfolk's Moores Bridges Treatment Plant and Norfolk's 37th Street Treatment Plant.

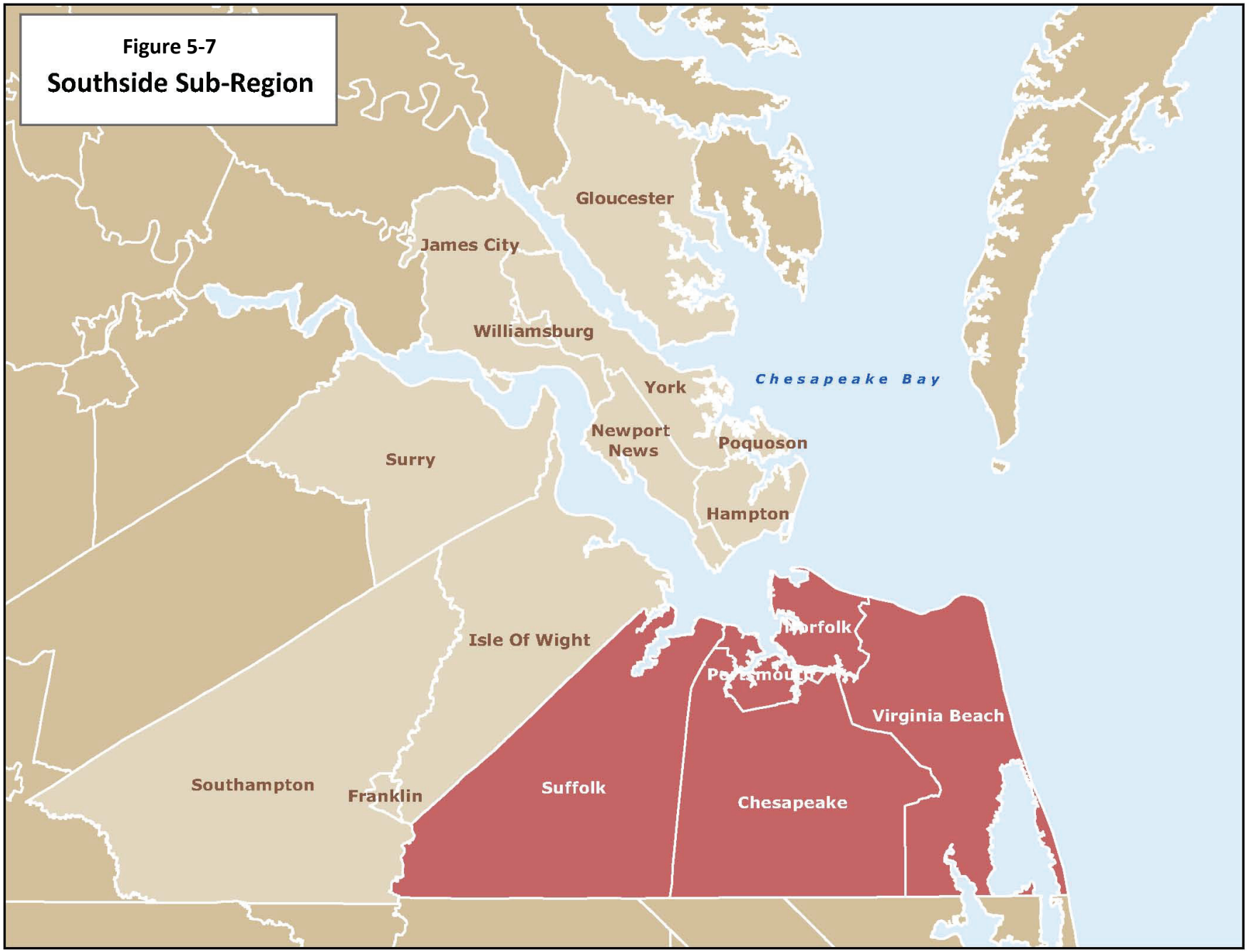


Figure 5-7
Southside Sub-Region
Gloucester
James City
Williamsburg
York
Chesapeake Bay
Newport News
Poquoson
Surry
Hampton
Isle Of Wight
Norfolk
Portsmouth
Virginia Beach
Southampton
Franklin
Suffolk
Chesapeake

Norfolk sells finished water and raw water to the City of Chesapeake's publicly-owned CWSs and, beginning in 2014, will also sell raw water to the Western Tidewater Water Authority. Norfolk has a contract to sell raw water to Portsmouth for drought and emergencies. The City of Norfolk provides water service to the military installations located in Norfolk and Virginia Beach: Norfolk Naval Base, Fort Story, Little Creek, Oceana Naval Air Station, the Dam Neck Annex, and Camp Pendleton. Norfolk also provides water for fire protection to the Navy at Craney Island.

Portsmouth sells bulk, treated water to Suffolk and Chesapeake. Portsmouth provides direct water service to the northwest portion of Chesapeake. Portsmouth provides water to the Norfolk Naval Shipyard and the Naval Medical Center. Suffolk provides water to the U.S. Joint Forces Command installation.

Since all of the localities in the Southside sub-region have one or more agreements with other localities in the sub-region regarding water supplies, they have coordinated drought responses in the past and plan to continue to work together.

Western Tidewater Sub-Region

The Western Tidewater sub-region includes the City of Franklin, Isle of Wight County, Southampton County, Surry County, and the incorporated Towns of Smithfield, Windsor, Claremont, Dendron, Surry, Capron, Courtland, Ivor, Boykins, Branchville, and Newsomes (see Figure 5-8). In Western Tidewater, the community water systems are much smaller than in other parts of the region and the localities rely on groundwater sources.

Isle of Wight and Suffolk formed the Western Tidewater Water Authority (WTWA), which holds a groundwater permit for a portion of their supplies. In 2014, WTWA will begin purchasing raw water from the City of Norfolk.

The City of Franklin provides water service to the entire city and sells 200,000 gallons per day (gpd) of water to Isle of Wight County. Southampton County Waterworks provides all water service to the towns of Boykins, Branchville, and Newsoms. The three towns of Capron, Courtland and Ivor have individual waterworks and local water supply emergency ordinances that match the criterion of Southampton County. Within this document, the town policies are not individually identified because they match the policies of Southampton County. Southampton County drought response includes the towns of Boykins, Branchville, Capron, Courtland, Ivor, and Newsoms.

The public water system in Isle of Wight is limited to three service districts. The Newport Development Service District is adjacent to the Town of Smithfield. The Windsor Development Service District surrounds the Town of Windsor. The Camptown Development Service District is adjacent to the City of Franklin. In addition to water purchased from Franklin, Isle of Wight purchases water from the Town of Smithfield and the City of Suffolk. As noted earlier, Isle of Wight will also receive water from Norfolk via WTWA supply beginning in 2014.

The towns of Smithfield and Windsor are located in Isle of Wight County. Both towns have local waterworks and their policies are identified separately from Isle of Wight County policies throughout the Drought Response Plan.

Surry County completed a Comprehensive Water and Sewer Plan in July 2008. Population projections for Surry County predict very low growth over the next 22 years. Even if all the predicted growth occurs within areas with central water and sewer utilities, the increase in capacity demand would be less than 4,000 GPD per year. The County of Surry does not use enough water to require a DEQ Ground Water Withdrawal Permit or drought response plan. There are three incorporated towns within Surry County: Claremont, Dendron, and Surry. Only the towns of Claremont and Surry use enough water to require DEQ permits and drought response plans.

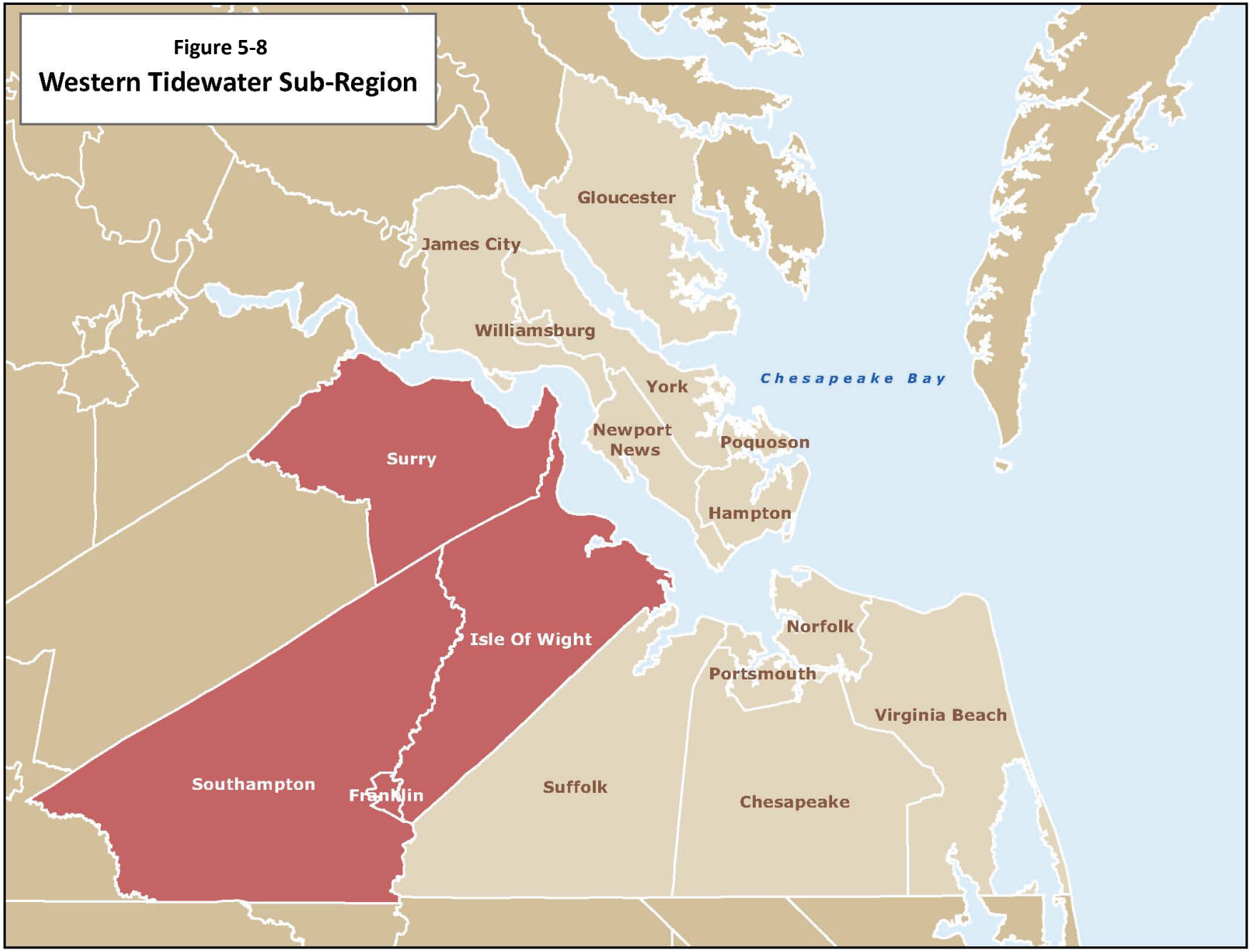


Figure 5-8
Western Tidewater Sub-Region
Gloucester
James City
Williamsburg
York
Chesapeake Bay
Newport News
Poquoson
Surry
Hampton
Isle Of Wight
Norfolk
Portsmouth
Virginia Beach
Southampton
Franklin
Suffolk
Chesapeake

The entire county relies solely on groundwater wells and bases drought response on monitoring, the HR WET campaign and information shared through the regional decision making process. The Towns of Claremont and Surry generally follow the drought response guidance of the state and local neighbors and are partners in regional efforts to reduce water use during emergencies.

Since all of the localities in the Western Tidewater sub-region rely on groundwater, they share information about drought indicators such as shallow, private wells losing head and impacts on the agricultural community.

Local Policies

All of the jurisdictions in the Hampton Roads region have adopted or have agreed to water conservation plans and/or water supply emergency ordinances (see Table 5-9). The localities of Hampton Roads have local drought management policies in addition to a regional drought response plan. The local drought response policies and ordinances are included in Attachment 1.

The localities have developed the Hampton Roads Drought Response Plan, which contains several sections: establishing drought authority, water emergency stages, indicators, public notice, actions, penalties, exemptions, termination of restrictions, and revision of the plan.

Authority

All drought response plans must clearly define an Authority to enact contingencies and restrictions during a water supply emergency and/or water shortage. The overall Hampton Roads drought authority is represented through the regional Directors of Utilities Committee. The Committee consists of Directors from local and regional water suppliers. The Committee meets monthly to talk about water supply and utility issues throughout the region.

Local governments have different methods of establishing authority to implement emergency water conservation measures. Many local jurisdictions must declare a water supply emergency prior to establishing authority. Table 5-10 summarizes the methods of establishing Local Drought Authority from local ordinances and plans.

The Newport News City Council declares a water supply emergency and submits a report to each jurisdiction for which the NNWW supplies water. The Newport News City Council then agrees to empower the City Manager to act as the authority on emergency water conservation plans. Drought response actions for all NNWW customers (including those outside the City) are enforced through billing, which requires no civil action by other localities.

Table 5-9: Local Drought Management Policy Formats

Codified Water Supply Emergency Ordinance		
Franklin	Norfolk[2]	Town of Capron
Gloucester County	Southampton County[3]	Town of Courtland
Isle of Wight County	Suffolk	Town of Ivor
James City County	Virginia Beach	Town of Smithfield
Newport News[1]	York County	Town of Windsor
Special Ordinance enacted *only* during Water Supply Emergency Situations		
Chesapeake	Portsmouth	Williamsburg
Water Conservation Plan		
JCSA	NNWW[1]	Town of Claremont
Williamsburg		Town of Surry[4]

1. NNWW supplies water to the cities of Newport News, Hampton, Poquoson and portions of Williamsburg and York County (York as of 2009).
2. Norfolk supplies water to Chesapeake, Virginia Beach, and Portsmouth.
3. Southampton County supplies water to the Towns of Boykins, Branchville and Newsoms. These towns have local plans to follow the lead of Southampton County.
4. Surry County and the Town of Dendron do not use enough water to require a DEQ Ground Water Withdrawal Permit or drought response plan.

DEQ has developed a drought response plan that describes the State's authority to impose regional and statewide drought responses. Any local government may declare a local water emergency and implement drought response action prior to the declaration of emergency by the Governor of Virginia.

In the past, Utility Directors in the region have informed their counterparts when their locality enters a water emergency stage. During a Stage II Drought Warning, a weekly update of water resources is compiled by HRPDC. The Utility Directors continue to share their concerns with each other about drought to insure that all localities within the Region are prepared to deal with the developing emergency.

Table 5-10: Establishing Local Drought Authority in a Water Emergency

City or Town Manager	County Administrator	Utility Director	Governing Body
Chesapeake	James City County[1]	Isle of Wight County	Franklin
NNWW[1]	Gloucester County		Windsor
Norfolk	York County[1]		Southampton County[3]
Portsmouth			Town of Claremont
Smithfield			Town of Surry
Suffolk			
Virginia Beach[2]			
Williamsburg			

1. NNWW represents Newport News, Hampton, Poquoson, James City County, and York County. York County and James City County may follow the actions of Newport News or their County Administrator.
2. Virginia Beach Authority is either the City Manager or Utility Director.
3. A Southampton County response applies to Southampton County and Towns of Boykins, Branchville, Capron, Courtland, Ivor, and Newsoms throughout the Drought Response Plan

Stages of Water Emergency

The DEQ drought response plan provides for four stages of water supply emergency. The actions associated with each stage of water emergency are discussed in Section 5 below.

- Stage I: Drought Watch occurs when moderate but limited supplies of water are available.
- Stage II: Drought Warning occurs when very limited supplies of water are available.
- Stage III: Drought Emergency occurs when critically limited supplies of water are available.
- Stage IV: Extreme Drought Emergency occurs when only crucial supplies of water are available.

Every drought has a particular signature and the impacts of no two droughts will be identical. Due to the complex nature of droughts, responses to individual drought events must be tailored to the impacts that are being propagated.

Indicators

Indicators are pieces of easily accessible information that can be used to help determine the local water supply status and the severity of drought. Water supply indicators are based on climate, season and infrastructure; all of which may change on a daily basis. Indicators monitored by Hampton Roads may include: precipitation levels, gauged streamflows, groundwater levels, water supply reservoirs, and the US Drought Monitor Index.

The U.S. Drought Monitor Index was developed in 1999 to help assess national drought conditions. The Drought Monitor is a collaborative effort between Federal and academic partners, including the University of Nebraska-Lincoln National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA)/Office of the Chief Economist (OCE)/World Agricultural Outlook Board (WAOB) Joint Agricultural Weather Facility, the National Oceanic and Atmospheric Administration (NOAA)/

National Weather Service (NWS)/National Centers for Environmental Prediction (NCEP)/Climate Prediction Center (CPC), and the NOAA National Environmental Satellite, Data, and Information Service National Climatic Data Center (NCDC).

The U.S. Drought Monitor is a synthesis of multiple indices, outlooks, and impacts such as the Palmer Drought Index, CPC Soil Moisture Model, United States Geological Survey (USGS) Weekly Streamflow, and Standardized Precipitation index. The Drought Monitor is produced on a weekly basis and depicted both on a map and in narrative form. The Drought Monitor is released each Thursday at 8:30 a.m. Eastern Time on the following website: http://www.usda.gov/oce/weather/DroughtMonitor/index.htm

The U.S. Drought Monitor is monitored as an indicator for regional response to water supply issues. The localities of Hampton Roads monitor this indicator for drought conditions and may also utilize additional modeling and methods as applicable for the region's varied water sources.

When the U.S. Drought Monitor indicates a D1: Moderate Drought for any water utility; water supply conditions will be an item for regional discussion at the following Directors of Utilities Committee meeting. The Hampton Roads Directors of Utilities Committee has been meeting monthly since 1993 and includes all of the Hampton Roads Planning District Commission localities. During the meeting, there will be a regional discussion of water supply and analysis of drought probability. Water Supply will remain a monthly agenda item until the U.S. Drought Monitor for the entire region returns to D0: Abnormally Dry.

The regional discussion of the Utility Directors, recommendations of local water supply staff and local data and trends will be considered by the Utility Directors to develop recommendations for the Local Drought Authority in each locality. The Local Drought Authority is discussed later in this section. The Local Drought Authority will determine when to implement drought ordinances and plans.

The Hampton Roads localities have not defined specific triggers for individual drought stages to allow for flexibility because of the varying characteristics of the multiple regional water sources and the nature of drought.

Public Notice

Informing the public about water emergency and conservation efforts is critical to the success of the drought response plan. The public must be informed and actively involved in managing water use. Once the Authority determines there is a water supply emergency, a notification will be issued to the public indicating the reasons for the declaration.

Notification of water use restrictions may be printed in a newspaper of general circulation and broadcast over one or more radio or television stations serving the service area. Localities may jointly issue public notices of water emergencies through HRPDC or increase public education campaigns to reduce water demand. Additional means available to contact the public are print media, billing inserts, internet, flyers, direct mail, e-mail, door hangers, local government, speaker's bureau and direct customer contact.

HR WET is a public outreach program designed to develop and implement a regional approach to promoting efficient water use throughout Hampton Roads. The HR WET program message is targeted toward all water users within the entire Hampton Roads planning area, whether supplied by public water systems or self-supplied users. Public awareness of water conservation is a year-round program throughout Hampton Roads and HR WET is used to disseminate a uniform message region wide. HR WET increases advertising during water emergencies as budget permits. HR WET goals are to:

- Raise public awareness of the region's water supplies.
- Reduce per capita water consumption by increasing the number of people using water more wisely.

HR WET has been helping the Hampton Roads region move toward more efficient water use for 17 years. As the population has continued to increase, regional water demand has remained basically flat. For more information about HR WET, please visit www.hrwet.org.

Water Emergency Actions

The Hampton Roads Drought Response and Contingency Plan describes four drought stages and outlines response measures for each stage. Drought response procedures, discussed later in this section, include a variety of actions for the different stages of drought.

Penalties

Hampton Roads jurisdictions may utilize a combination of penalties such as fines, suspension of service, misdemeanors and jail time to enforce water emergency violations. Implementation of penalties places the enforcing entity into a policing mode of operations. Table 5-11 outlines penalties utilized by localities. The local ordinances and plans contain complete penalty descriptions.

A person charged with violating any provision of the water restrictions may be assessed a financial penalty varying from $50 to $2,500 by locality. The legal ramifications of these fines are similar to those of traffic tickets and must be able to stand up in court. Suffolk, the towns of Claremont and Surry and York County are the only jurisdictions which do not assess a fine for violations.

In the majority of jurisdictions, water service may be suspended to customers who continually violate the provisions of a water supply emergency. Following service suspension, all of these localities; except for Franklin, Norfolk and Virginia Beach, require payment of all outstanding charges and a reconnection fee before service is restored.

Penalties quickly add up in 11 jurisdictions because each act or each day's continuation of a water violation is considered a separate offense. Five localities consider water violations a misdemeanor; while Gloucester and Southampton Counties include provisions for jail time.

Norfolk's and James City County's policies state that violators will be charged appropriate fines and penalties for excess water usage.

The towns of Claremont and Surry do not have provisions in place for the use of penalties to enforce water violations.

Table 5-11: Penalties Used to Enforce Water Violations

Fines	Suspend Service	Separate Offenses	Misdemeanor
Chesapeake	Chesapeake	Chesapeake	Franklin
Franklin	Franklin	Gloucester County	Gloucester County
Gloucester County	Isle of Wight County	Isle of Wight County	Southampton County
Isle of Wight County	NNWW[1]	NNWW[1]	Virginia Beach
NNWW[1]	Norfolk	Portsmouth	Windsor
Norfolk	Portsmouth	Smithfield	
Portsmouth	Smithfield	Southampton County	
Smithfield	Suffolk	Windsor	
Southampton County	Virginia Beach	James City County	
Virginia Beach	James City County	Williamsburg	
Windsor	Williamsburg		
James City County			
Williamsburg			

1. NNWW represents Newport News, Hampton, Poquoson, and York County. Penalties are imposed on water bills and service can be suspended after four violations.

Appeal for Exemptions

Appeals procedures, summarized by locality in Table 5-12, is included in the Drought Response and Contingency Plan to allow for an exception from restrictions on water usage or excess charges.

Within the Hampton Roads planning area, most jurisdictions have an appeal process in place. The majority of local jurisdictions establish an Appeals Review Board upon declaration of a Water Supply Emergency. James City County and Virginia Beach enact an Appeals Review Board after a Stage II Water Emergency has been declared; and the City of Norfolk only during a Stage III Water Emergency.

The Hampton Roads localities of Isle of Wight County, Portsmouth, Smithfield, Southampton County, Suffolk, and the towns of Claremont, Smithfield, Surry and Windsor do not have provisions in place for an Appeals Procedure.

The Appeals Review Board will hear appeals for exemption on water allocations and surcharges. The Boards have the power by vote to approve, modify, or revoke earlier determinations.

Table 5-12: Appeals Procedure during a Water Emergency

Appeals Review Board	City Council
Chesapeake	Franklin
Gloucester County	
NNWW[1]	
Norfolk	
Virginia Beach	
James City County	

1. NNWW represents Newport News, Hampton, Poquoson, and York County

Note: Williamsburg also allows for a written challenge to fines within 14 days of receipt of the bill

Termination of Restrictions

The majority of local jurisdictions operate under emergency water conditions until the Authority notifies the governing body that the shortage is over and the water emergency no longer exists. Prior to the termination of a drought emergency, the Directors of Utilities Committee will discuss the regional water supply situation. Once a group decision has been made, the water supply emergency restrictions may be terminated in the localities. The local methods for terminating a regional drought emergency are summarized in Table 5-13.

Table 5-13: Terminating Drought Emergency

Authority Notify Governing Body		Ordinance	Specific Trigger
Franklin	Portsmouth	Chesapeake	Gloucester County
Isle of Wight County	Suffolk	Portsmouth	James City County
NNWW[1]	Town of Claremont	Virginia Beach	
Smithfield	Town of Surry	Williamsburg	
Southampton County	Windsor		

1. NNWW represents Newport News, Hampton, Poquoson, and York County.

Three cities depend on ordinance adoption to terminate a water emergency. In Chesapeake and Virginia Beach, the City Manager issues an order to rescind the emergency ordinance that restricted water use. Williamsburg enacts a new ordinance to repeal the previous water emergency.

Gloucester and James City County have specific triggers to terminate a drought emergency.

Norfolk's City Manager can issue a declaration to terminate a water shortage or water emergency.

Once a water supply emergency has been terminated, the message may be posted for the public in a similar fashion to declaring a water emergency. The public is encouraged to continue following prudent restraint and conserve water voluntarily following the water emergency.

Plan Revision

The Hampton Roads Drought Response and Contingency Plan is part of the Regional Water Supply Plan that must be regularly reviewed and evaluated for effectiveness. Following state regulation 9 VAC 25-780, the drought response plan will be reviewed at least once every 5 years and revised at least once every 10 years to facilitate better drought response in the future.

Drought Response Actions

The Hampton Roads Drought Response and Contingency Plan drought stages and response measures are described below. Specific actions to include measures, monitoring and enforcement procedures, along with water use reduction goals are also described. The activities delineated below should be viewed as general activities and not required events that are "written in stone."

Stage I: Drought Watch

A Drought Watch is designed to increase public and private sector awareness to climatic conditions likely to precede a significant drought event. During a Drought Watch, prudent water use is encouraged and preparation begins for more serious drought response action if needed. Public outreach is used to inform all water users within the region of the potential for drought conditions to intensify and provides potential water conservation activities. Stage I of the Virginia State Drought regulation requires activities to increase public and private sector awareness to climatic conditions that are likely to precede the occurrence of a significant drought event. In Hampton Roads, Stage I provides increased public awareness and requests voluntary water conservation from water users.

Measures: Measures taken in the Commonwealth of Virginia during a Drought Watch rely on voluntary conservation and the cooperation of customers to meet target consumption goals. Setting the exact conservation measures is left to the individual localities.

Throughout the Hampton Roads planning area, the Authority in each locality may ask for voluntary water conservation and prudent restraint in water use. Franklin, Hampton, Newport News and Poquoson specifically outline three areas for voluntary conservation.

- Watering of shrubbery, trees, lawns, grass, plants, or other vegetation.
- Washing of automobiles, trucks, trailers, or any other type of mobile equipment.
- Washing of streets, driveways, parking lots, service station aprons, office building, exteriors of homes or apartment or other outdoor surfaces.

Monitoring and Enforcement Procedures: Stage I actions rely primarily on voluntary conservation and cooperation of customers to meet target consumption goals and is monitored by the individual localities. If one locality moves into a Stage I Drought Watch, they will inform the entire Hampton Roads region through the Directors of Utilities Committee. Stage I will also result in an increase in the public notification and regional education programs. HR WET is used as a regional voice for Water Conservation measures in addition to the work of localities. There is no method to enforce voluntary water restrictions.

Water Use Reduction Goal: Target reduction goals vary by locality. Increased public awareness of target consumption goals and of voluntary water conservation activities may reduce water use up to 5 percent.

Stage II: Drought Warning

Drought Warning responses are required when the onset of a significant drought event is imminent. Stage II of the Virginia State Drought regulation requires voluntary water conservation. In the Hampton Roads region, Stage II requires more stringent mandatory water conservation and restricts or limits certain actions.

Measures: The specific mandatory measures to decrease water use are left to the individual localities. Localities may curtail or even prohibit the "Less Essential Usages of Water" during a Drought Warning. The following are generalized definitions for seven "Less Essential Water Uses" from the 2003 Virginia Drought Assessment and Response Plan.

1. Watering of shrubbery, trees, lawns, grass, plants, or other vegetation.
2. Washing of automobiles, trucks, trailers, or any other type of mobile equipment, excepting in facilities operating with a water recycling system approved by local government staff.
3. Washing of streets, driveways, parking lots, service station aprons, office buildings, home or apartment exteriors or other outdoor surfaces.
4. Operation of any ornamental fountain or other structure making similar use of water.
5. Filling or refilling of swimming or wading pools after the effective date of the order.
6. The use of water from fire hydrants for any purpose other than fire suppression or essential public purposes.
7. The serving of drinking water in restaurants, cafeterias or other food establishments unless requested by the individual.

Monitoring and Enforcement Procedures: Specific monitoring and enforcement procedures for Stage II Drought Warning mandatory water conservation actions are up to the individual localities. Table 5-14 summarizes the specific policies in local ordinances and plans. The City of Suffolk and NNWW also incorporate water rate increases during Stage II actions. NNWW customers are charged at the normal rate for basic consumption per billing cycle; and the normal rate increases for greater consumption.

Suffolk has two levels of response during a Stage II Drought Warning. The first response is to implement a rate increase for customers who exceed their average water use and the second to curtail water use if the drought worsens.

Table 5-14: Stage II Drought Warning Response

Curtail 7 Uses of Water	Curtail Some Non-Essential Uses of Water
Chesapeake	Isle of Wight County - Except #7
Franklin	Smithfield – Except #7
Gloucester County	Suffolk[3] – Except #7
NNWW[1]	Town of Surry – Curtail #1,2,3 and 5
Norfolk	Windsor – Except #6
Portsmouth	
James City County	
Williamsburg[2]	
Southampton County	
Town of Claremont	
Virginia Beach	

1. NNWW represents Newport News, Hampton, Poquoson, Williamsburg, and York County. NNWW includes a 15 percent surcharge to current water rates after 600 cubic feet of water use per billing cycle.
2. Williamsburg adds Less Essential Use #8: Watering of golf course tees and greens is permitted daily between the hours of 8:00 pm and 8:00 am.
3. Suffolk implements both a rate increase and curtails water use.

Water Use Reduction Goal: Mandatory water use restrictions are the critical portion of Stage II Drought Warning actions and are monitored and enforced through the localities. The goal of Stage II Drought Warning action is water use reduction of 5 to 10 percent.

Stage III: Drought Emergency

Drought Emergency responses are required during the height of a significant drought event. During these times, it is likely that water supplies will not provide the amount of water needed by all users and non-essential uses of water should be eliminated. Stage III of the Virginia State Drought regulation requires the initiation of mandatory water conservation activities In the Hampton Roads region, Stage III includes a combination of mandatory water use restrictions, rate increases and water allotments as defined by the locality.

Measures: Stage III Drought Emergency addresses a severe need for water demand reduction and includes a combination of mandatory restrictions, rate increases and water allotments as defined by the locality. Mandatory water use restrictions from Stage II would remain in place.

A temporary water rate increase may be used to reduce water use. During a water emergency, customers are allotted a percentage of water based on average consumption, specified volume or percent reduction of water use per billing period. Customers may be charged an increase for consumption above the allotted level.

Monitoring and Enforcement Procedures: The procedure for enforcing Stage III water allotments and rate increases is through retail billing (see Table 5-15). In Chesapeake, Portsmouth, Smithfield, Williamsburg, and Isle of Wight County the water rate increases over the standard amount and is applied to the entire amount of water used. Norfolk and James City County increase rates for water use in excess of the conservation goal.

The NNWW bases water allotments on the average use for a customer. Customers are charged at the normal rate for consumption up to 600 cubic feet of water per billing cycle and the normal rate plus 30% for greater consumption.

Additional details covering specific rate increases are outlined in local ordinances and plans. Water allotments and rate increases are enacted through retail billing and are easier to enforce than mandatory water use restrictions. Significantly higher costs of water should encourage more prudent water use.

Water Use Reduction Goal: The goal of Stage III Water Emergency actions is water use reduction of 10 to 25 percent.

Table 5-15: Stage III Drought Emergency Response

Water Allotment and/or Rate Increases	
Chesapeake	Southampton County
Franklin	Suffolk
Isle of Wight County	Town of Claremont
James City County	Town of Surry
NNWW[1]	Virginia Beach
Norfolk	Williamsburg
Portsmouth	Windsor
Smithfield	

1. NNWW represents Newport News, Hampton, Poquoson, and York County.

Stage IV: Extreme Drought Emergency

A Stage IV: Extreme Drought Emergency is the final stage of a progressive situation, such as a drought of increasing severity or extreme facility failure. This stage addresses a critical need for water demand reduction. The Virginia State Drought regulation does not require a Stage IV drought emergency; however this additional stage has been adopted by most of the localities in the Hampton Roads region.

Measures: A Stage IV: Extreme Drought Emergency measures include all actions from Stage III along with further tightening of water restrictions and additional rate increases that apply to all water customers served by a local waterworks. Actions taken in a Stage IV Extreme Water Emergency are due to a critical need for water demand reduction and are extreme in order to quickly and significantly reduce water demand.

Specific measures for Stage IV water restrictions are left to the individual localities (see Table 5-16). Additional details are contained in local ordinances and plans. Chesapeake, Portsmouth, Smithfield and Isle of Wight County all give the local drought Authority power to further restrict water use to purposes that are absolutely essential to life, health and safety. Virginia Beach outlines Stage IV to specifically restrict or discontinue the supply of water to any industrial or commercial activity which uses water beyond the sanitary and drinking needs of its employees and invitees.

The localities of Franklin, Gloucester County, Southampton County, Town of Claremont, Town of Surry and Town of Windsor do not have provisions for a Stage IV Extreme Water Emergency.

Table 5-16: Stage IV Extreme Drought Emergency Response

Increased Water Restrictions and Rate Increases	Increased Water Restrictions
Chesapeake	Isle of Wight County
James City County	Portsmouth
NNWW[1]	Smithfield
Norfolk	
Suffolk	
Virginia Beach	
Williamsburg	

1. NNWW represents Newport News, Hampton, Poquoson, and York County.

Monitoring and Enforcement Procedures: Stage IV rate increases are enforced through retail billing as described in local ordinances and plans. NNWW employs an across the board water rate surcharge during a Stage IV Extreme Water Emergency. Additionally, both Newport News and James City County do not allow new water service connections during this stage.

Water Use Reduction Goal: The goal of Stage IV Extreme Drought Emergency actions is water use reduction of more than 15 percent.

Summary

The Hampton Roads Drought Response and Contingency Plan enhances local drought management policies with a regional framework for water emergencies. Long-term water demand management practices, discussed at the beginning of this section, along with the local drought ordinances and the regional drought plan provide complimentary tools for localities to apply in promoting the viability of future water supplies for the region.

Section 6 | **Statement of Need**

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Statement of Need

This section evaluates the Region's future CWS and domestic use demands in comparison to future water supplies. A discussion of the water needs of self-supplied users throughout the region is also included. To support the development of a statement of need for publicly-owned CWSs, the projected water demands were compared to projected water supplies. The Region's projected water supply is adequate to meet the projected future water demands through the year 2050. However, the statement of need for the York-James Peninsula sub-region includes the possibility of the projected water demand exceeding the available water supply near the year 2040. The current water supply and future water demands are evaluated at +/-10% to address uncertainties within the projections. Section 1 of this plan describes existing sources and Section 4 provides future demand projections.

Uncertainties Associated with Statement of Need

There are inherent uncertainties associated with the estimation of future water demands. Demand projections utilize population growth estimates that are subject to accuracy limitations. Other socio-economic factors also contribute to uncertainty. For example, Table 4-8 (see Section 4, Projected Water Demands) describes the potential additional demands on publicly-owned CWSs that may develop if private CWSs and self-supplied commercial and industrial water users choose to be serviced by publicly-owned CWS water systems by the end of the planning period. To address the uncertainties in water demand projections, future publicly-owned CWS demands were also evaluated at +/-10% of the projected demands.

Uncertainty exists in predicting the yield and availability of source waters. Two significant issues may impact the region's available water supply over the planning period:

1) Regulatory climate (e.g., the availability of groundwater), and
2) Natural physical constraints (e.g., climate change).

Both issues are discussed here to explain the potential impacts on the future water supplies for CWSs and self-supplied users. Evaluations of +/-10% of the current water supply are included to address uncertainties.

Availability of Groundwater

Groundwater provides 23% of the raw source water for publicly-owned CWSs in the Hampton Roads region. Most of the region relies on conjunctive use systems, as found in Chesapeake, Isle of Wight, Newport News (and localities it serves), Norfolk, Portsmouth, Suffolk, and Williamsburg. However, some localities rely exclusively on groundwater (e.g., the James City Service Authority on the York-James Peninsula and most systems in the Western Tidewater sub-region). Also, all private CWSs and all self-supplied commercial and industrial users rely on groundwater, with the exception of the self-supplied users in the energy industry.

Under the authority of the 1992 Groundwater Management Act, the State has established Ground Water Management Areas (GWMA) where groundwater resources have been determined to be stressed and interference is likely to occur between nearby wells. The HRPDC localities, with the exception of Gloucester County, fall within the Eastern Virginia GWMA. Groundwater users in a GWMA must apply for a permit from DEQ to withdraw more than 300,000 gallons per month. Permits are effective for a period of 10 years and permit holders must re-apply prior to the expiration of a current permit.

Permitted withdrawals are based on the justification of need over the 10-year permit period. Most self-supplied users in the region withdraw groundwater and must project demands for the ten-year permit period. Active permits can be re-opened during this period, and permitted amounts can be reduced if actual use is significantly less than the permitted use. This has not occurred as of the time of this report (communication with DEQ).

The Coastal Plain aquifer system is wedge-shaped with a thin edge to the west near Richmond and a thick edge to the east in the Atlantic Ocean (see Figure 6-1). Increased pumping throughout the Coastal Plain generally has greater impacts on existing wells near the thin edge of the system. DEQ has identified areas along the western edge of the Eastern GWMA where groundwater levels have dropped below the top of the aquifer. Through the permit renewal process, DEQ has required many permit holders to reduce their withdrawal limits due to low water level measurements in these areas, and simulated decreasing groundwater levels in the future.

There are indicators of a relationship between groundwater withdrawals and land subsidence in the Hampton Roads region. Land subsidence rates in the Chesapeake Bay range from 1.3 millimeters per year (mm/yr) to 4.0 mm/yr (Boon, Brubaker and Forrest 2010). It is hypothesized that groundwater withdrawals are responsible for some portion of local land subsidence.

The USGS Virginia Coastal Plain groundwater model indicates that a significant amount of the 100 mgd of groundwater withdrawn from the aquifer system is released from soft clay layers that form the confining units between the aquifers. The release of water from these clay layers causes the clay material to shrink and compress under the weight of overlying stone and sediment formations. As clay layers compress, the cumulative result is the "sinking" of the ground surface, which is referred to as land subsidence. It is possible that groundwater withdrawals may be further limited in the future to mitigate subsidence. It is also important to understand that compression causes clay layers to lose inelastic storage, which means that the material becomes unable to expand again to hold the same amount of water, even if groundwater withdrawals stop. Therefore, land subsidence results in decreased aquifer storage capacity, effectively reducing the availability of groundwater.

Several public water systems in the Region have been encouraged by DEQ to reduce the amount requested in their permit renewal applications. If HRPDC Locality permitted withdrawals are reduced, the available water supply for the region is also reduced. Virginia's groundwater management policy has been to issue permits on a first-come, first-served basis, and there is no guarantee that the same amount (or greater amount) of groundwater will be available to publicly-owned CWSs in 20 to 30 years. Each submittal for permit renewal must undergo the same administrative process and technical evaluation of need and aquifer sustainability. Reductions of permitted withdrawals for publicly-owned CWSs and/or commercial and industrial users will effectively reduce the available water supply in the Hampton Roads region.

As of August 2010, the major groundwater user International Paper ceased groundwater withdrawals to support operations at its former Franklin, Virginia mill. While in operation, withdrawals for the Franklin mill comprised approximately one third of all groundwater withdrawals in the Virginia Coastal Plain. Water levels are rebounding, but have not yet stabilized. The DEQ Ground Water Withdrawal Permit for International Paper remains active. If the property associated with the permit is purchased by another industrial user, the State Water Control Board could allow the permit to be transferred to the new property owner. Therefore, this report cannot conclude whether more or less groundwater will be available for other users in Hampton Roads as a consequence of the plant's closure.

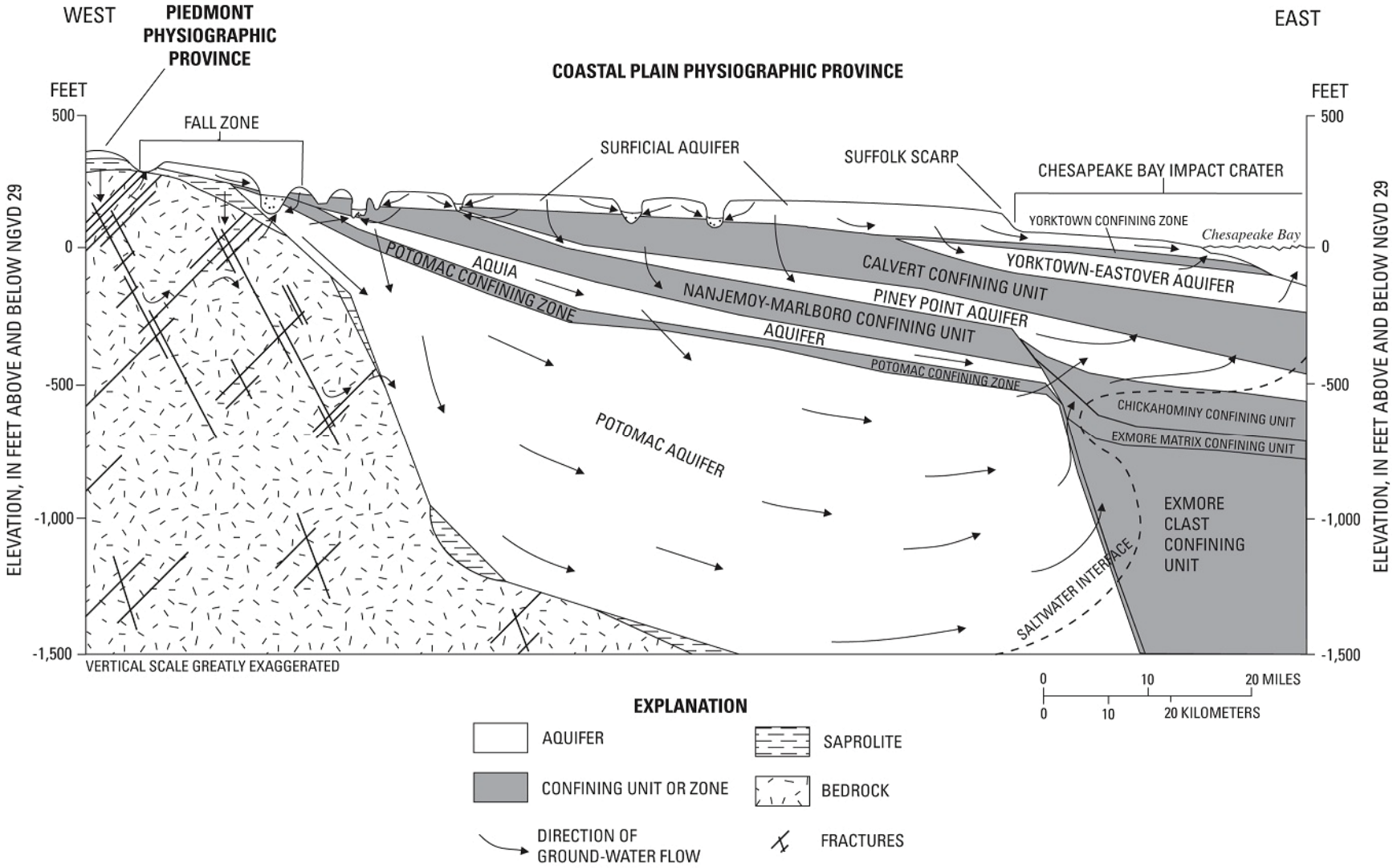

Figure 6-1: Cross section of Coastal Plain aquifer system (McFarland and Bruce 2006).
This generalized cross section shows the hydrogeologic units and the groundwater flow direction from the Fall Zone near Richmond in the west to the Chesapeake Bay in the east.

Climate Change Impacts

As of August 2010, models of climate change do not provide specific predictions for changes in temperature, precipitation, and sea level rise in the Hampton Roads region. Climate changes could result in increases or decreases in regional water supplies. The following section discusses the possible impacts on the region.

Temperature

Studies indicate that the average temperature is likely to rise. With higher average temperatures, increased reservoir water losses can be anticipated due to higher evaporation rates. Evapotranspiration, the sum of evaporation from the ground surface and transpiration loss through vegetation, would also increase. Less runoff would be available to recharge shallow groundwater aquifers, which provide base flows to streams and rivers.

Precipitation

Climate change projections regarding changes in precipitation are very sensitive location; in addition, many of the climate models used for these projections are too coarse to predict changes at anything smaller than the state or regional scale. Researchers for the Virginia Governor's Commission on Climate Change found that Virginia and its neighbors could expect to see an 11% increase in precipitation by 2099 (Governor's Commission on Climate Change 2008). However, recent observations have shown a shift in rainfall, with summer and fall precipitation increasing and winter and spring precipitation decreasing (Karl, Melillo and Peterson 2009). By 2099, Virginia is expected to see increases in the winter, with slightly more or less precipitation occurring throughout the rest of the year (Karl, Melillo and Peterson 2009). In addition, more precipitation is expected to occur during the heaviest events. Changes in the distribution of rainfall throughout the year could result in longer periods of dry weather. Additional efforts should be made to prepare the region for droughts and increase the resiliency of water supply systems. The region could take advantage of additional rainfall during wet seasons by developing additional storage capacity (e.g., new or expanded reservoir capacity or Aquifer Storage Recovery systems).

Changes in the average precipitation patterns to more intense, shorter duration storms could reduce the amount of water currently recharging the shallow aquifers that feed streams and rivers. This could also lead to periodic water losses over reservoir dams, as the reservoirs may fill faster than the water can be withdrawn.

Sea Level Rise

Sea level rise is predicted to continue, potentially pushing the saltwater transition zone in tidal rivers farther inland. The water supply intake on the Northwest River already withdraws brackish water during a portion of the year. Chesapeake's Northwest River water treatment plant is designed to treat brackish water, but water of higher salinity would increase treatment costs. Newport News Waterworks withdraws approximately 70% of its water supply from the Chickahominy River. Withdrawals from the Chickahominy River may be suspended when tidal influences occur and downstream chlorides are elevated, as may occur during drought conditions. During those periods, pumping ceases so as to avoid drawing high chloride water into the intake. Sea level rise may impact Waterworks' available water supply or require changes to operations and infrastructure.

Sea level rise will also slowly move the saltwater transition zone in the groundwater system farther inland (see Figure 6-2). Because saltwater is denser than the freshwater contained in the aquifer, a wedge of saltwater forms under the freshwater. If the wedge moves farther inland with sea level rise, deep wells in the eastern portion of the Hampton Roads region may begin to yield brackish water. The USGS monitors chloride levels in wells near the saltwater transition zone as part of a cooperative agreement with the HRPDC. Thus far, the USGS monitoring results have not indicated the inland migration of the saltwater transition zone.

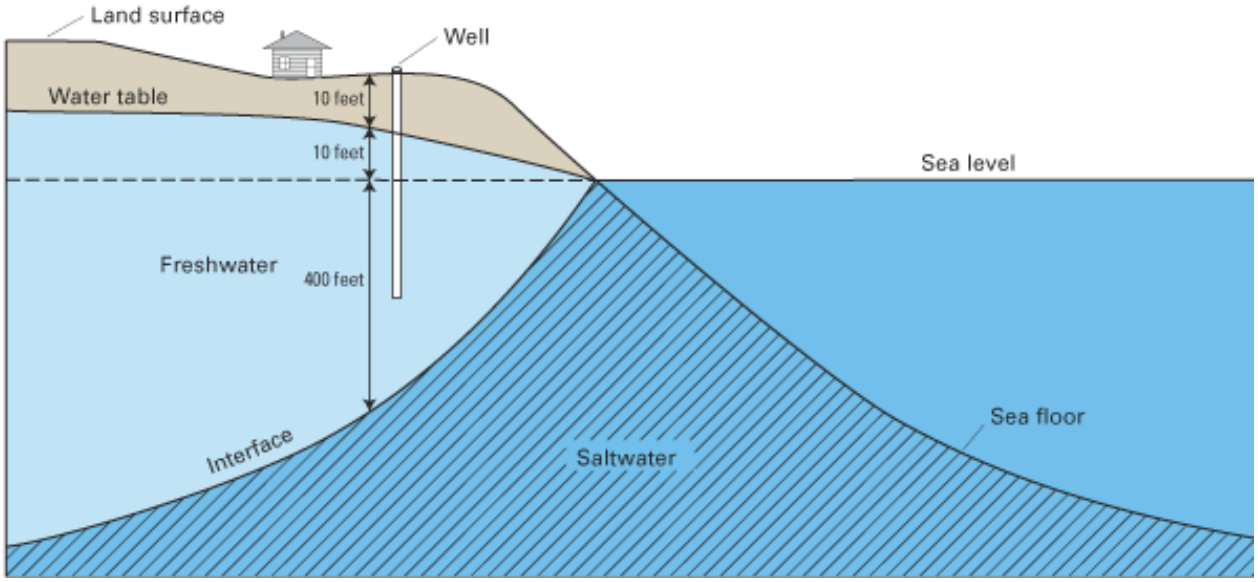

Figure 6-2: Saltwater may migrate farther inland if sea level rises (Barlow 2003).

The impacts of climate change are not well defined at the regional scale. However, they should be considered because they may undermine the assumption that the current water supply will be available 40 years from now. The potential changes in temperature, precipitation, and sea level rise require additional study to support long-term water supply planning. Future investigation efforts should focus on developing better models of climate trends in Hampton Roads and estimating how those trends impact the quantity and quality of water available in the future.

Southside Sub-Region Statement of Need: CWS and Domestic Users

The Southside sub-region includes the Cities of Chesapeake, Norfolk, Portsmouth, Suffolk, and Virginia Beach. The available water supply for these cities exceeds their projected demands. The water systems are interconnected to some degree, increasing the resiliency of the entire sub-region.

The majority of the population in the Southside sub-region is currently served by publicly-owned CWSs and will continue to be served by publicly-owned CWSs through 2050. There are plans to expand the Chesapeake and Suffolk publicly-owned CWS service areas. However, it is anticipated that the number of domestic users located outside of these CWS service areas will also increase through 2050.

The water sources serving the CWSs in the Southside sub-region are diversified and include river intakes, reservoirs, and groundwater. The existing water sources available to the Southside sub-region are adequate to meet the current and projected water demands through the end of the planning period in 2050.

Western Tidewater Sub-Region Statement of Need: CWS and Domestic Users

Many residences and businesses in the Western Tidewater sub-region rely on groundwater. Under current conditions, wells drilled anywhere in the Western Tidewater sub-region will produce enough water to support an individual home or small business. It is estimated that water supplies are adequate to meet sub-regional demands over the next 40 years. Most of the CWSs in the sub-region have projected little growth in demands. If a new commercial or manufacturing facility wanted to locate in the sub-region, the CWSs would probably not have enough water to support the associated additional demand. There may not be enough groundwater available to support new commercial facilities.

There are some issues of concern associated with groundwater in the Western Tidewater sub-region. Future planning efforts should address water quality, well interference, and system resiliency issues described below.

Water quality is a concern in some areas of the sub-region, where groundwater sources have been found to contain naturally elevated concentrations of fluoride (above regulatory limits). Therefore, in the future, water quality requirements may necessitate deeper wells in these areas or some degree of treatment for groundwater withdrawn from area sources.

There is the potential for well interference to occur in the sub-region. Groundwater users may impact each other, as withdrawals from wells influence local water levels. If a large groundwater withdrawal is permitted in the sub-region, local water levels may fall, forcing residents and businesses served by groundwater wells to lower the elevation of their pumps and/or deepen their wells. This scenario has implications for the groundwater permitting process and regulatory context.

The low population densities across large portions of the Western Tidewater sub-region are not easily served by centralized water system infrastructure. Therefore, a smaller percentage of the population is served by CWSs compared to other sub-regions. As noted earlier, the CWSs in the Western Tidewater sub-region have adequate future water supplies to meet projected demands. The sub-region's water supplies include permitted withdrawals from groundwater sources and water supplied per the purchase contract between the Western Tidewater Water Authority and the City of Norfolk. The CWSs in the Western Tidewater sub-region are spread out over a large geographic area; only a few systems are interconnected or have the potential for future connection. Such connections increase water system resiliency by allowing source water to be shared and water to be delivered to areas of need.

The population density in the eastern portion of Isle of Wight County is greater than the rest of the sub-region. Eastern Isle of Wight

County is the only portion of the sub-region that has a viable option to use water sources other than groundwater. Higher population density makes expanding water distribution systems more economical. Isle of Wight County's Newport Development Service District is already connected to the publicly-owned CWSs in the Southside sub-region, and plans also exist to connect the County's Windsor Development Service District.

In view of the growing interconnectivity between publicly-owned CWSs in the Southside and Western Tidewater sub-regions it is prudent to compare the combined projected available water supply and projected demands for the Southside and Western Tidewater sub-regions (see See Figure 6-3). Norfolk currently sells water to Western Tidewater Water Authority (WTWA) which provides part of the water supply for Suffolk and Isle of Wight County. Evaluation of the adequacy of water supplies is better accomplished by looking at these two sub-regions together.

If trends continue under average conditions as projected, by the year 2050 upper estimates of demand will be equal to the readily available water supply. Under extreme conditions, the upper range of demand will exceed the lower range of supply by 2050, creating a shortage of approximately 15 mgd.

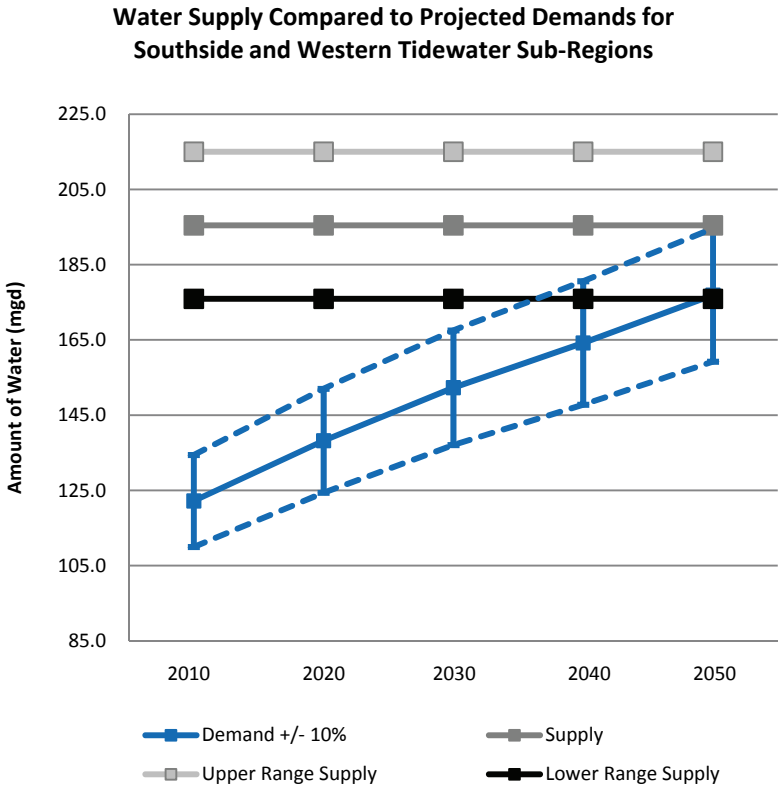

Figure 6-3: Comparison of the combined water supplies and projected demands for the Southside and Western Tidewater sub-regions.

York-James Peninsula Statement of Need: CWS and Domestic Users

The York-James Peninsula includes James City County, York County, and the Cities of Hampton, Newport News, Poquoson, and Williamsburg. The majority of the population for the York-James Peninsula resides within publicly-owned CWS service areas and will continue to be served by publicly-owned CWSs through 2050. The privately-owned CWSs purchase water from the publicly-owned systems. James City County predicts some continued growth outside of the CWS service areas. Those homes will require individual wells. In the next 40 years, wells may need to be drilled in different aquifers but there should be enough water to meet these small demands. The CWSs for the York-James Peninsula are currently supported by a variety of sources including river intakes, reservoirs, and groundwater. However, current estimates indicate that the projected water demand for the York-James Peninsula will exceed the available water supply near the year 2040 (see Figure 6-4).

If trends continue as projected, under average conditions, the projected water demand will exceed the available water supply for the York-James Peninsula in the year 2041. By 2050, a shortage of approximately 6 mgd is predicted (see Figure 6-4). Under extreme conditions, the upper range of projected demand will exceed the lower range of supply by approximately 21 mgd in 2050.

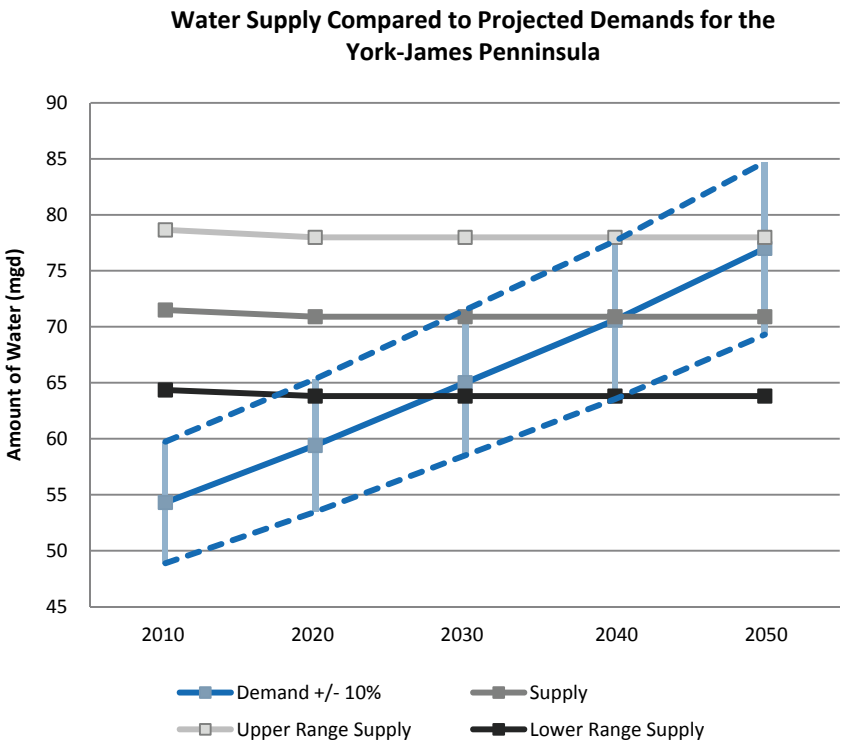

Figure 6-4: Comparison of the water supply and projected demands for the York-James Peninsula.

Middle Peninsula Statement of Need: CWS and Domestic Users

The Middle Peninsula includes only Gloucester County; it is separated from the rest of the Hampton Roads region by the York River. As a result, its water supply is completely independent from that of other sub-regions.

The Middle Peninsula supports a relatively small population compared to that of other sub-regions. Most of the population is served by residential wells or privately-owned CWSs.

Wells in Gloucester County may be impacted by sea level rise and the associated migration of the saltwater transition zone in the groundwater system (see Figure 6-2). Water quality in Gloucester wells may deteriorate toward more brackish quality water if the saltwater wedge moves inland. Additional research is required to estimate the area in Gloucester that would be impacted by saltwater intrusion over the next 40 years. As shown in Section 4, Table 4-3 approximately 52% of the population of the Middle Peninsula will be served by a publicly-owned CWS in 2050. Currently, the available water supply for Gloucester County exceeds demands. The existing sources that serve the Middle Peninsula publicly-owned CWS include wells and the Beaverdam Reservoir located in Gloucester County.

If trends continue as projected, the available water supply for the Middle Peninsula in 2050 will be in excess of projected demand. Under extreme conditions, the upper range of 2050 demand is projected to slightly exceed the lower range of supply, resulting in a shortage of approximately 0.15 mgd (see Figure 6-5).

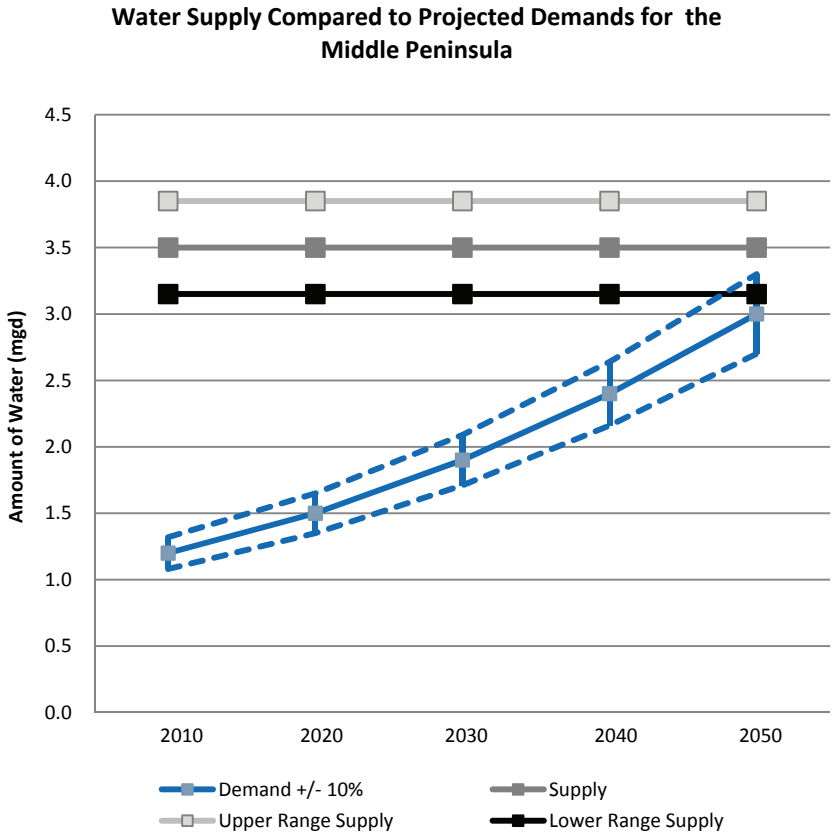

Figure 6-5: Comparison of the water supply and projected demands of the Middle Peninsula.

Statement of Need: Self-Supplied Users

Groundwater supports many agricultural, commercial, and industrial users throughout the Hampton Roads region. It is unclear if existing groundwater demands for these users can be met for the next 40 years. Existing users have permits that support their current use and may support user projected demands for the next 10 years. Future water supply planning efforts should include more robust water projections for self-supplied users; better projections of future water use for the energy and agriculture industries are of particular interest. Also, additional research is required to understand how much groundwater will be available in 40 years. Future studies should focus on the data and tools required to estimate the sustainable yield of the aquifer system and consider the prioritization of groundwater uses.

The energy industry is responsible for the largest volume of self-supplied surface water use in the Hampton Roads region; 2007 surface water use exceeded 3,100 mgd. The three primary users are Dominion Power Nuclear Power Plant (2007 average annual use of 1,774 mgd from the James River), Yorktown Fossil Power Plant (2007 average annual use of 817 mgd from the York River), and Chesapeake Energy Center (2007 average annual use of 521 mgd from the Elizabeth River). Nearly all of the surface water withdrawn by these users is returned to source rivers. Currently, the James, York, and Elizabeth Rivers are not used as drinking water sources, and there are no known conflicts between water users of these rivers. Therefore, the available surface water sources for energy production are considered adequate to meet future industry demands.

Agricultural users also utilize surface water, but sources are typically isolated farm ponds that do not significantly influence water supply planning. The demands of agricultural users are estimated to be small, and their water use decreases or increases based on the abundance or scarcity of rainfall. Therefore, the existing surface water sources for agriculture in Hampton Roads are adequate to meet the existing demands, assuming no significant variation in precipitation patterns and frequency.

Statement of Need: Summary

All of the sub-regions and the majority of self-supplied users in the Region have adequate water supplies to meet their projected demands through 2040. Water supplies in the Southside and Western Tidewater sub-regions and the Middle Peninsula are expected to exceed water demands until at least 2050. The York-James Peninsula may have a small deficit in 2040-2050. If water demands continue to increase over the next two decades, the York-James Peninsula may consider alternatives to satisfy the projected deficit. Potential alternatives are discussed in Section 7.

Section 7 | **Alternatives**

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Alternatives

Statements of need for the Southside and Western Tidewater sub-regions and the Middle Peninsula, as well as for the majority of self-supplied users in the Region, indicate water supplies meet or exceed projected water demands. However, the statement of need for the York-James Peninsula includes the possibility of the projected water demand exceeding the available water supply near the year 2040. The alternatives described in this section are potential options for addressing any gaps that may arise and can generally be classified into two categories:

1. Alternatives to increase water supply, and
2. Alternatives to decrease water demand.

This section provides a discussion of alternatives that is intended to provide general information and broad indications of capabilities and resource requirements subject to the following limitations:

- **Alternative Descriptions and Capabilities.** The discussion in this section is neither exhaustive nor descriptive of any specific water supply system discussed in this report. The information is offered as a generalized discussion of potential alternatives and anecdotal experiences. Therefore, none of the information presented should be construed as a recommendation that can be directly applied to any system's situation.
- **Resource Requirements and Cost Descriptions.** Cost information provided in this section is extracted from isolated regional projects and is anecdotal; it is not descriptive of any or all specific water supply alternatives and/or future application of alternatives relative to the Hampton Roads PDC localities referenced in this report. The information is provided only for general, conceptual and descriptive purposes and is not intended for comparison of specific future water supply alternative projects or applications. As such, information provided herein is representative of order-of-magnitude costs for various types of water supply projects.

Historical Alternatives Projects

The Hampton Roads region relies on a diverse system of water sources. Historically, there have been many projects that have utilized various alternatives. Table 7-1 provides a summary of previously completed projects in the Hampton Roads region. The table describes project capacities and costs; table information should be considered in the context of the discussion of methods provided below. Cost information shown in Table 7-1 is not adjusted to current year dollars; comparison of costs across different years is generally not appropriate.

Table 7-1: Historical Alternative Plant Capacity and Cost

Alternative	Project Description	Year Installed	Capacity (MGD)	Constructed Cost (nearest million $)	Cost per MGD (nearest million $)
Desalination	NNWW Lee Hall Brackish Groundwater Desalting Reverse Osmosis Water Treatment Plant: desalting deep brackish groundwater	1990	5.7	$16 to $17	$2.81 to $2.98
Desalination	City of Chesapeake Northwest River Reverse Osmosis Water Treatment Plant: desalting brackish surface water and deep groundwater	1994	14.0	$44.1	$3.15
ASR	City of Chesapeake Northwest River ASR well: treated water is injected for storage to meet peak demands.	1989	3.0	$1.5	$0.5
Electrodialysis Reversal Water Treatment Plant	City of Suffolk Water Treatment Plant expansion: treatment of fresh, high fluoride groundwater	2008	6.25	$42	$6.72
Conventional Surface Water Plant[1]	Stafford County: conventional treatment with ultrafiltration	2014	12.5	$35	$2.8
Interconnection Pipeline	WTWA Raw Water Pipeline: interconnection of the Norfolk reservoir system with the Portsmouth reservoir system via pipeline from Lake Prince pumping station to Lake Cahoon and Lake Mead	2003	8.0	$5.1	$0.64
Surface Water Reservoir[2]	NNWW King William Reservoir Project: development of new surface water reservoir	N/A	20.0	$170	$8.5
Non-Potable Water Reuse[3]	Thomas Jefferson National Accelerator Facility, City of Newport News: reclaimed wastewater from HRSD for cooling tower and irrigation use	2008	0.2	$6.3 to $7.8	$31.5 to $39.0
Non-Potable Water Reuse [3]	Northrop Grumman, City of Newport News: reclaimed wastewater from HRSD for shipyard powerhouse and demineralization facility	2009	0.16	$12 to $23	$75.0 to $143.8

NNWW = Newport News Waterworks
[1]Project is still in design phase and is included as an example of a recent ultrafiltration surface water treatment project. Cost and year installed are projected.
[2]The King William Reservoir Project proposal was discontinued in 2009.
[3]Cost estimates are based on feasibility studies conducted by CH2M HILL and represent costs to the end user, not to the wholesaler.

Alternatives for Increasing Water Supply

Surface Water Storage

Creating additional storage is the most traditional method of increasing source water resources. It can be accomplished by either developing surface water resources or by storing treated water within an available aquifer.

The region's reservoirs capture and store a certain amount of the annual runoff from within their respective watersheds. Additional runoff could be captured in reservoirs by increasing the storage volume of individual reservoirs.

Increasing the storage volume of any existing reservoir would require either raising the spillway height of the reservoir's dam or dredging. Both methods are problematic. The cost of such an approach is dependent on the site-specific situation. Factors that could affect cost include: procurement of state and federal permits, mitigation of impacts to natural resources and surrounding land uses, property acquisition requirements, location, lake volume, reservoir depth, current dam and spillway construction, and contractor market conditions. Similar factors affect cost when considering dredging. However, dredging would potentially release large amounts of suspended solids and other pollutants to the reservoir water column and would likely require a reconfiguration of the water withdrawal system.

The utilities in the region have considered developing new reservoirs for many years. Specifically, the utilities in the York-James Peninsula have made several proposals to develop additional water sources in the past three decades (e.g., Ware Creek Reservoir and King William Reservoir). The most recent proposed reservoir project, the Newport News Waterworks (NNWW) King William Reservoir, was officially terminated in October 2009. Although planning for the reservoir project had begun in the 1980s, it was not until 2005 that the multitude of required entitlements, environmental clearances, and permits were approved and project implementation commenced. Then in 2009, following a series of delays and legal proceedings, a key construction permit was suspended by the U.S. Army Corps of Engineers (Corps), the authorizing agency, and Newport News stopped work on all activities previously authorized by the permit. By September of that year, the City of Newport News had assessed the viability of the project and concluded that the project was unlikely to obtain or retain all regulatory permits required and that permit-related efforts would likely require millions of dollars in additional costs and years of further delay.

There are no on-going projects to create new reservoirs or develop new surface water intakes to support the York-James Peninsula public water systems. Given the history of proposed reservoir projects and comprehensive searches for viable options, it is not likely that a new reservoir or surface water source will be approved in the foreseeable future. The communities of the York-James Peninsula must consider other approaches to meet future water demands.

Groundwater Withdrawal

The Virginia Coastal Plain aquifer system is a resource that could help meet the future water needs of the region. However, it is difficult to define how much water is available to new users and existing users. As indicated in Section 6, Statement of Need, groundwater withdrawals throughout the Coastal Plain aquifer system have greater impacts on water levels in the western Coastal Plain where aquifers are thin and shallow.

In recent years, DEQ has determined based on field observations that existing withdrawals have lowered groundwater levels below the top of some aquifers in portions of the western Coastal Plain. Historical water level data from the state and federal monitoring well network indicate that the current use of groundwater has resulted in water level drops of 2 feet per year in much of the aquifer system. Groundwater modeling simulations of the total permitted withdrawal amounts indicate further decline in water levels. These conditions are contrary to the Groundwater Management Act and Groundwater Management Regulations.

Under the current regulations, new groundwater permits and re-applications requesting increases in many aquifers that yield higher quality water cannot be granted, and DEQ is also having difficulty approving re-applications for permits that request the same withdrawal amount as the previous term. As discussed in Section 4, Projected Water Demands, International Paper's Ground Water Withdrawal Permit remains active as of January 2011, despite the plant's 2009 closure, and the permitted withdrawal amount was not decreased. In consideration of the 10-year permit term, expanding deep groundwater supplies in the Coastal Plain may not be a viable alternative.

Some limited expansion could possibly occur in the Lower Potomac Aquifer, as it is currently less utilized; however, water from this aquifer in the Hampton Roads area is not of the highest quality and will likely require treatment. Much of the Lower Potomac contains brackish water and would require desalination. It is possible that revisions to the Groundwater Withdrawal Regulation could limit the use of higher quality source aquifers for public water supply only, requiring industrial and commercial users to relocate withdrawals to aquifers of lower quality water. Aside from changing the regulations to prioritize potable supply over industrial use, Virginia could establish funding to move industrial withdrawals to lower quality source aquifers.

While limited as a major supply alternative, utilizing the water table aquifer for irrigation would alleviate some stress on current water supplies. One important factor to consider in the use of the water table aquifer is its rapid recharge from annual precipitation. Because there is no confining unit associated with this aquifer precipitation is allowed to percolate directly through the unsaturated surface layers and into the aquifer, which results in much quicker recharge rates than the deeper aquifers. In this way the water table aquifer is a sustainable source if managed properly. Though not historically used due to the high iron content of the water, point of use treatment options exist that allow utilization of this aquifer without the negative consequences of iron staining. There are potential impacts to natural resources associated with use of the water table aquifer. Impacts to wetland areas and other resources should be evaluated prior to pursuing any significant withdrawals or encouraging withdrawals in areas that may have sensitive groundwater-surface water interactions.

It is difficult to quantify the added capacity and sustainable yield that could be derived from the Lower Potomac aquifer and use of the shallow water table aquifer. The Coastal Plain aquifer system is a complex heterogeneous system containing aquifers separated by leaking confining units that vary in thickness from east to west. The potential groundwater yield varies depending upon location; modeling of specific scenarios using the Coastal Plain regional groundwater model is required to develop estimates of yield.

Aquifer Storage and Recovery

Aquifer recharge and aquifer storage and recovery (ASR) well technology can be used to store treated water in groundwater aquifers during wet periods or periods of low demand, and recover stored water during dry periods or times of high demand. ASR wells have been used in the U.S. to store and recover water for drinking supplies, irrigation, and ecosystem restoration projects. ASR systems have not been proven to add capacity or increase water supplies. The City of Chesapeake is currently using an ASR well to store treated water for meeting peak demands. The Coastal Plain aquifer system underlies the entire Hampton Roads region and has the capacity to store relatively large amounts of water.

ASR systems inject water that has been treated at a water treatment plant into deep wells to form a "bubble" of treated water underground until it is needed. With ASR systems, it is challenging to predict and manage the water quality impacts of injecting water into the natural groundwater system. The water chemistry of treated water is different than that of natural groundwater, and there is potential for treated water to react with the sediments of the aquifer system. The most common reactions associated with ASR injected water can lead to the dissolution of some metals, most commonly

arsenic, manganese, and iron. Comprehensive, project-specific ASR system planning programs are necessary to evaluate the feasibility of such projects and understand and mitigate potential water quality concerns.

Most ASR wells can only withdraw 70% of the amount of water that was injected for storage. Therefore, the yield and cost effectiveness is low considering that all of the injected water must undergo treatment. It would be less costly to store raw water in the aquifer system. However, ASR wells are regulated by the EPA's Underground Injection Control (UIC) program, which is very restrictive. The Safe Drinking Water Act in 1980 established this national program to ensure that the subsurface emplacement of fluids via injection wells does not threaten present and future drinking water sources. The program was originally set up to regulate injections of chemicals used to extract oil and natural gas. The program has not been revised to provide more flexibility for injections of water for storage purposes.

Under the UIC program, EPA regulations provide that "no owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR part 142 or may otherwise adversely affect the health of persons" (40 CFR 144.12). In other words, this requires that water used for ASR injection be potable water or drinking water treated to national Drinking Water Standards. Potable water generally refers to water that is high quality and poses no immediate or long term health risk when consumed.

ASR wells are regulated as Class V injection wells. As such, ASR well owners and operators are required to submit basic inventory information. If the owner or operator submits the inventory information and operates the well in a manner that does not endanger underground sources of drinking water, the well is typically authorized by rule, however, EPA does have authority to require a permit for a Class V well. The UIC program regulates the injection of fluids, not the production or recovery of fluids.

Depending on the type and quality of water injected at an ASR well and/or the local geology, there is increasing potential for endangering the aquifer source. Installing an ASR system requires extensive study of the source water, the geology, and the native groundwater to ensure success. An ASR system planning program should consider the following:

- Pathogens may be introduced into an aquifer if the water injected is not disinfected. The growth of microorganisms within the aquifer could cause decreased water recovery efficiency by clogging the well screen or risks to public health from contamination of the aquifer.
- If water is disinfected prior to injection, disinfection by-products may impact the aquifer.
- Chemical differences between the injected water and water in the receiving aquifer may cause undesirable reactions that are public health risks, such as leaching of arsenic and the formation of radionuclides. Components of the well can also become clogged by carbonate precipitation within the aquifer.
- Injected water has been known to cause the dissolution of metals such as arsenic, manganese, and iron from the surrounding geologic formation, which impacts the water quality the aquifer. In some cases, water injected at ASR wells in brackish aquifers or aquifers with poor quality water has improved the ambient water quality.

Desalination

Currently there are five desalination plants in the Hampton Roads region:

1) Lee Hall Brackish Groundwater Desalting Water Treatment Plant in Newport News,
2) Gloucester Desalination Reverse Osmosis Plant,
3) Five Forks Groundwater Treatment Facility in James City County,
4) Electrodialysis Reversal Plant in Suffolk,
5) Northwest River Water Treatment Plant in Chesapeake.

Each of these plants withdraws either brackish groundwater or surface water and employs some form of desalination. Hampton Roads has many sources of brackish surface water that could be treated with desalination.

Brackish groundwater is a potential water source for desalination. The lower portion of the deepest aquifer in the Coastal Plain system, commonly referred to as the Lower Potomac aquifer, contains brackish groundwater. Few wells withdraw water from this portion of the aquifer system because the water quality is so poor. The James City Service Authority, Chesapeake Public Utilities, and Newport News Waterworks all withdraw brackish groundwater from deep aquifers in the Coastal Plain system and treat the water using reverse osmosis technology. The challenges associated with using brackish groundwater are treatment costs, disposal of the brine (concentrated salts removed from the source water), and impacts to other groundwater users. Significant withdrawals from the lower portions of the Potomac Aquifer could exacerbate saltwater intrusion. Additional research and modeling would be required to estimate impacts.

The Atlantic Ocean, Chesapeake Bay, James River, and York River are surface water bodies that are potential water sources for desalination. Challenges associated with desalination of ocean water or tidally-influenced surface water include disposal of brine and treatment cost. If the salinity of the brine is low, it may be discharged back to the surface water source, contingent upon the evaluation of potential impacts to aquatic life and habitat. Otherwise, alternative disposal methods must be designed. The cost of treatment is dependent on salinity of the source water and pre-treatment requirements, which may be necessary to address seasonal salinity variations associated with tidally-influenced surface waters. Pre-treatment systems may be required to condition the water for the desalination process and to prevent fouling of the reverse osmosis membranes. The viability of desalination plants should be evaluated on a project-specific basis. In some cases, it could be more expensive to desalinate ocean water compared to brackish surface water sources. In other cases, the cost of brine discharge and pre-treatment of certain brackish surface waters may be more than that of ocean water, offsetting the membrane treatment costs for higher salinity waters.

For the Hampton Roads region, desalination treatment systems would generally consist of the following components:

- River intake and conveyance system
- Coagulation and clarification systems
- Filtration with either granular media filters, microfiltration membranes, or ultrafiltration membranes
- Reverse osmosis treatment with ancillary cleaning facilities
- Taste and odor control measures
- Solid residuals handling
- Liquid brine residuals handling
- Finished water storage and high service pumping
- Ancillary chemical facilities

Alternative pretreatment systems could be considered, but would need significant evaluation and testing prior to implementation.

Capital costs for a desalination plant treating brackish surface water could range from $5 to $8 dollars per gallon[1], compared to a conventional surface water treatment plant, with capital costs from $3 to $5 per gallon[1]. Additional costs for the development of an intake and disposal of brine are difficult to generalize and should be estimated on a project-specific basis.

Operating costs for a desalination plant treating brackish surface water could range from $3 per thousand gallon (kgal) to upwards of $5 per kgal, compared to operating costs for a conventional surface water treatment plant, which range from $2 per (kgal) to $4 per kgal.

Alternatives for Decreasing Demands

Conservation

Water Conservation measures are used throughout Hampton Roads to encourage people to change behaviors and habits to reduce water use. Water conservation also includes any beneficial reduction in water losses or waste. Water conservation programs are aimed toward water consumers and can involve technical or financial means and public education programs.

Conservation in the Hampton Roads region supports the reduction of demand for potable water. Conservation technologies are applicable to all of the major demand sectors including residential, commercial, industrial, and agricultural use. Technologies such as low-flow faucets, low-flush toilets, underground irrigation systems and energy and water efficient appliances are utilized in new construction and rehabilitation projects.

Other conservation technologies, while not focusing on reducing demands, but on alternative sources, such as rainwater harvesting and water reuse are subject to site condition requirements and have limited applications. However, these and other "green" technologies are gaining popularity as environmentally sustainable means to effectively reduce demands on publicly-owned CWSs and potable water supplies by incorporating alternative supplies.

The more common water conservation technologies have been widely applied over the last two decades to successfully decrease water use. With federal water efficiency standards for showers, faucets, toilets, and washing machines, water use declined slightly after 1990 nationally and locally. A 2009 report prepared by NNWW for the Newport News City Council in response to a resolution to suspend work on the King William Reservoir project acknowledged a steady increase in customer accounts over 15 years with no significant increase in annual or maximum daily demand since the mid-to-late 1990s (NNWW 2009). In the report's transmittal letter, the acting city manager noted that water demand in NNWW's service area did not increase as was previously predicted, largely due to enhanced conservation by industries, residents, and other customers, and emphasized that area utilities have worked hard to imbue a water conservation ethic in Hampton Roads residents, industries and businesses. It is likely that the initial implementation of conservation measures in residences and industry facilities, as well as the continued application of such technologies in new development projects have decreased demand on the York-James Peninsula such that NNWW has been able to service the increased customer base. As noted in the 2009 report, future demand projections will better characterize the role of conservation as a component of everyday water use and as a demand management tool during drought conditions.

Section 5 of this plan details long-term water demand management practices and outlines the Regional Drought Response and Contingency Plan. Water conservation strategies include efficient water use, reductions in water use, and reductions in water losses. Practices to encourage conservation are summarized by locality in Section 5.

The effectiveness of conservation programs and their demand management strategies should be evaluated through the analysis of

[1] These estimates are Class 5 as defined by the American Association of the Advancement of Cost Engineering International. This level estimate is generally a concept, screening, or feasibility cost estimate.

long-term data including water use by demand sector, water rates, and precipitation. Currently, only limited data is available and use by demand sector cannot be adequately characterized. Also, it is difficult to understand the impact of increasing water rates on customer use and conservation behavior. A preliminary analysis by HRPDC of the historical data available for water use and water rates yielded unrealistic results due to data gaps and variability between locality data. A more thorough and useful analysis could be performed if consistent water use and rate data, disaggregated across demand sectors, becomes available in the future. It is likely that such an analysis would indicate that water use trends for business customers are more sensitive to changes in water rates. The analysis could also indicate sectors and geographic areas where water conservation programs should be refocused or adjusted to further reduce demand, as well as sectors and areas where conservation technologies have likely been optimized to the extent practicable.

The various options for conservation provide a variety of different ways to reduce stresses on existing water sources. Additionally, many of these conservation methods reduce energy use during transportation and treatment of water, have financial benefits, reduce the volume of runoff, and reduce pollutant loads. A financially based strategy using tiered rate increases tied to increased consumption has been implemented in some HRPDC Localities and shown to be effective in reducing overall demand.

Historical demand data shown in Figure 7-1 indicates that demand has decreased. Older localities with stable or decreasing populations experienced demand reductions after plumbing code changes were initiated. Demand lows that appear in the 2003-2004 timeframe reflect drought-related water use restrictions.

The per capita use for the Southside sub-region appears stable in Figure 7-1, indicating that the effect of conservation efforts has reached a steady state. Similarly, the York-James Peninsula has experienced a significant reduction in per capita use since 1990 and use has begun to stabilize. The effects of long term application of water conservation practices in the Hampton Roads region indicates the diminished opportunity to further reduce demand with conservation practices.

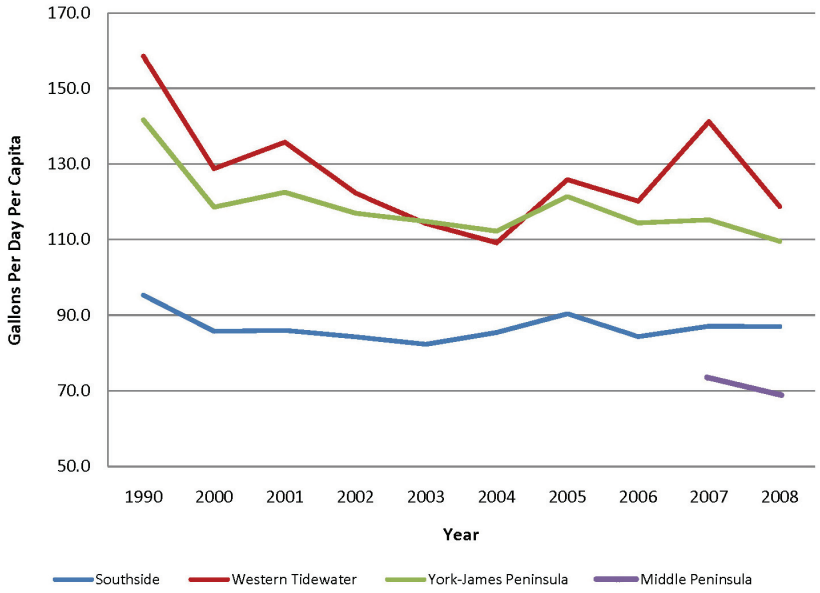

Figure 7-1: Historical demand throughout the Hampton Roads region.
*Note: Historical data for the Middle Peninsula was not available until 2007

Southside - York-James Peninsula Interconnect

As discussed in Section 6, Statement of Need, the water demand of the York-James Peninsula is projected to exceed the upper range of supply prior to 2050. Section 6, Figure 6-4 indicates that the 2050 average demand for the York-James Peninsula is approximately 80 mgd. The 2050 projected available water supply is roughly 75 mgd. Figure 6-3 shows that the Western Tidewater and Southside sub-regions are projected to have approximately 8 mgd of excess water supply in 2050. This excess water could be utilized by the York-James Peninsula to alleviate demand if it could be transported across the James River.

The primary challenge in implementing this alternative is the development of infrastructure to transport water across the James River. The feasibility of this alternative has not been evaluated.

Water Reuse

Water reuse is an alternative that can decrease demands on existing water sources. Two types of reuse can be utilized to alleviate demand in the Hampton Roads region. The first method, direct reuse, utilizes reclaimed water immediately after treatment. Reclaimed water, or treated wastewater, can be safely applied to a variety of non-potable uses including car washing and irrigation of community parks, golf courses, and residential lawns. However, direct water reuse is most cost effective when used for large-scale processes. Industrial and commercial customers are best served by reclaimed water, as reclaimed water can be used for cooling and other water-intensive industrial purposes. For example, the Hampton Roads Sanitation District (HRSD) York River Water Treatment Plant provided up to 0.5 mgd of reclaimed water to Giant's Western Refinery until its closure in 2010.

The second method, indirect reuse, is better suited for wide scale implementation and can be used for more purposes. Two common types of indirect reuse include indirect non-potable reuse and reclaimed water ASR systems. Indirect non-potable reuse mixes reclaimed water into existing freshwater reservoirs; mixing dilutes any microconstituents potentially remaining after treatment. Reclaimed water ASR systems utilize groundwater aquifers instead of surface water impoundments to store reclaimed water. When compared to indirect non-potable reuse, reclaimed water ASR systems have the advantage of not being subject to losses attributable to evapotranspiration. However, as noted earlier, ASR systems typically yield 70% of the injected volume of water.

Current estimates project that demand in Hampton Roads will exceed 250 mgd by the year 2050. This figure does not include large self-supplied users (those with demands greater than 300,000 gallons per month). Water reuse can offset some of the projected demand. In 2009, the total average wastewater discharges from the following wastewater treatment plants was approximately 160 mgd: Army Base, Atlantic, Boat Harbor, Chesapeake-Elizabeth, James River, Virginia Initiative Plant, Williamsburg, and York River. While utilizing the total amount of treated wastewater for reuse is impractical, some amount may be reclaimed and used to reduce demand.

There are many issues associated with water reclamation and reuse. A primary issue discouraging direct water reuse is capital cost. Currently, the cost to produce reclaimed water exceeds the cost to produce potable drinking water from existing sources. Although most wastewater plants can meet Level 2 Virginia Reclaimed Water Standards with minimal improvements, the use of water that meets Level 2 standards is limited to construction, industrial, and agricultural applications. In order to produce water that meets the Level 1 Virginia Reclaimed Water Standards, significant treatment plant retrofits would be required. Level 1 standards are more stringent and water meeting these standards may be applied to any public use.

In addition to increased production costs, reuse applications have additional distribution costs. Transmission lines, separate from potable waterlines, must be installed to serve customers. The cost to install new transmission infrastructure, or convert old or abandoned infrastructure, may be cost prohibitive beyond a 5 to 10 mile radius

of treatment facilities. Further research is necessary to determine customers who would be viable candidates for reclaimed water use.

Another important issue is public acceptance. The primary concerns associated with indirect water reuse include the removal of potentially harmful microconstituents and the reduction of nutrient levels to protect public health. According to a customer telephone survey conducted by HRSD in 2009, there is public support for utilizing reclaimed water for the purposes described above.

In 2011, notice of intended regulatory action was issued indicating that the State Water Control Board intends to consider amending the Water Reclamation and Reuse Regulation (9 VAC 25-740) to improve the Board's ability to implement an effective water reclamation and reuse regulatory program. As of May 2011, Advisory Committee meetings had commenced to discuss proposed amendments to the regulation.

System Optimization

Water utilities experience two types of water losses: production losses and unaccounted-for-water (UAW) losses. Production losses are the difference between the amount of raw water withdrawn from a well or reservoir and the amount of treated water leaving a treatment facility. Treatment processes may include backwashing filters or membranes, as well as the water component of brine from ultrafiltration or reverse osmosis systems.

UAW is the difference between the amount of water that leaves a treatment facility and the amount of water that is billed to customers or accounted for with non-billed meters (e.g., fire hydrants). UAW losses include leaks in the distribution system, unmetered water use, and errors in metering. Meters are less accurate if they are not sized appropriately for the volume of water being measured.

Currently, all utilities in the Hampton Roads region report UAW losses below the current AWWA standard of 10-15%. Further reducing the amount of UAW in each sub-region would be an expensive alternative, as system losses are on the low end of the recommended standard. However, reducing UAW would reduce demands to some degree and extend the period over which existing water supplies could meet the regional needs. Most production losses are inherent to the type of treatment process and are unavoidable. Losses might be further reduced with additional maintenance.

Summary

Based on the data presented in the Hampton Roads Regional Water Supply Plan, the Region's water supply is sufficient to meet the needs of the current and projected demand for the next forty years. The existing water sources available to the CWSs in the Southside and Western Tidewater sub-regions and the Middle Peninsula are adequate to meet the current and projected water demands through 2050. The existing water sources available to the CWSs in the York-James Peninsula are not adequate to meet the projected water demands through 2050. The water demand is projected to exceed the available water supply in year 2042, creating an estimated shortage of 5 mgd by 2050.

The appropriateness of applying alternatives to reconcile gaps between demand and supply is to be determined locally. In the long-term, some portions of the Hampton Roads region may require additional water sources to meet future demands and to increase the resiliency of local water systems.

The development of new water sources is challenging. The planning horizon, funding, and the availability of technical resources are major considerations. Priorities and policies may need to be established at the State level to encourage the development of new sources in a safe and efficient manner. Beyond existing regulations, Virginia lacks a program to encourage innovation in water supply development.

Management of water resources is a primary tool for sustaining Virginia's people, environment, economy, and lifestyle. Land use planning and water resource planning are closely linked. Water can be a factor limiting growth and development, and in turn, growth and development can limit and decrease the viability of the resource.

Alternatives should be developed not only to meet future water demands, but also to help ensure the long-term viability of groundwater aquifers and watershed areas. Overall, the Hampton Roads region has adequate water to meet projected demands, but some systems may benefit from the timely exploration of alternatives to ensure that they are prepared to meet unexpected changes in demands or available supplies.

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Section 8 | **References**

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Appendix A | **Data Sheets**

Department of Environmental Quality Data Sheets for
Local and Regional Water Supply Planning Criteria

Existing Water Source (9 VAC 25-780-70) and
Existing Water Use (9 VAC 25-780-80) Information

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Attachment 1 | **DVD**

Hampton Roads Regional Water Supply Plan (Electronic Copy) and Supporting Information

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