Chloride Concentrations in Hampton Roads Drinking Water Sources

Salt Water Intrusion and Potential Impacts to Community Water Systems

Prepared for the:

HAMPTON ROADS PLANNING DISTRICT COMMISSION
DIRECTORS OF UTILITIES COMMITTEE

Prepared by the:

STAFF OF THE HAMPTON ROADS
PLANNING DISTRICT COMMISSION

SEPTEMBER 2014

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Executive Summary

The primary drinking water aquifers in Hampton Roads are at risk of degradation from saltwater intrusion. Local governments should support DEQ's groundwater monitoring strategy for improving the existing chloride monitoring program. In Hampton Roads, 19 municipal water systems and 51 private water systems are supplied partially or completely by groundwater from four primary drinking water aquifers. Additionally, about 77,200 private wells provide water from these aquifers to homes and small businesses in the region. A comprehensive chloride monitoring program with "sentinel" monitor well sites is needed to effectively assess:

- Saltwater intrusion at the coast; and
- Upconing of saltwater related to well pumping.

There are strategies to mitigate saltwater intrusion, such as changing rates and locations of pumping or injecting water into the aquifer. Early detection of saltwater intrusion or upconing through a properly designed chloride monitoring network will allow water utilities to apply management strategies and plan for extensions of municipal systems.

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Introduction

In Hampton Roads, many homeowners and communities rely on wells to provide their drinking water. If the well water becomes salty, additional treatment is necessary to make the well water drinkable. The treatment can be very expensive for individual homeowners and small communities and often there is not a viable alternative because the public water system does not provide service to the area. From 2000 to 2012, the Hampton Roads Planning District Commission (HRPDC) partnered with the United States Geological Survey (USGS) to monitor chloride concentrations in the region's groundwater. Since 2012, monitoring has been conducted by the Virginia Department of Environmental Quality (DEQ). Chloride monitoring provides the data needed to evaluate the potential for wells in the region to become salty.

Because we live along the coast, seawater encroaches on the fresh groundwater and some wells may become salty over time as the seawater moves inland. Because seawater has a higher density than freshwater, the freshwater typically sits on top of the seawater. The point where seawater and freshwater meet is called the saltwater interface. The saltwater interface doesn't move very quickly because groundwater in Hampton Roads moves very slowly (often less than a few feet per year). However, large wells that pump out millions of gallons of water can cause the saltwater interface to move faster and may cause the groundwater to start flowing towards the well instead of towards the ocean. If the rate of sea level rise increases, the saltwater interface may also move inland at a faster rate. The interface moves because of water pressure. Increased sea level rise adds water pressure pushing saltwater inland; large groundwater withdrawals reduce water pressure and allow groundwater to move inland to fill the void and equalize water pressure across the aquifer.

Large withdrawals from wells can also cause upconing in the aquifer. Upconing is the process by which saline water underlying freshwater in an aquifer rises upward into the freshwater zone as a response to well pumping. Upconing will cause wells to become saltier. Upconing can cause localized short-term changes in water quality that reverse when pumping is discontinued, but prolonged pumping may result in increasingly saltier water.

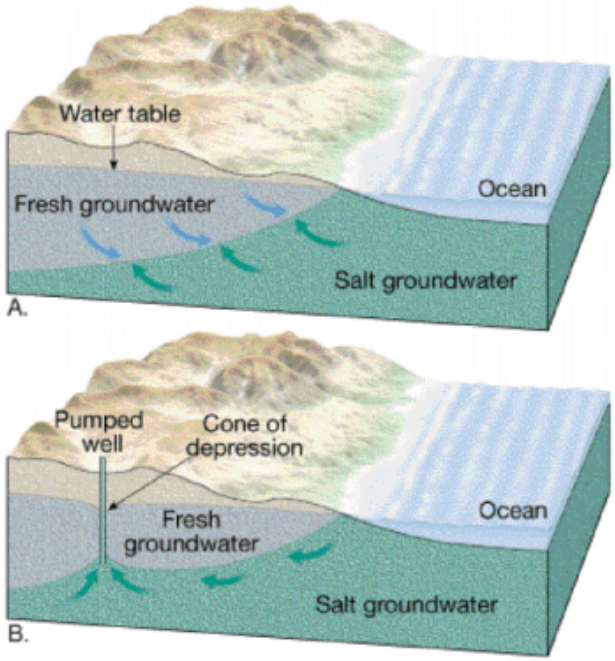


Figure 1. Saltwater Interface. The zone where freshwater meets seawater is called the saltwater interface, which can be disturbed by upconing.

HRPDC partnered with the USGS and DEQ to evaluate all of the historic chloride data available for eastern Virginia (see "Groundwater-quality data and regional trends in the Virginia Coastal Plain" (PP-1772)). By mapping the wells that were monitored and the chloride concentrations at those wells, USGS was able to estimate the chloride concentration in the groundwater all across Hampton Roads. Some wells in the monitoring network were tested every few years. At those wells, USGS could determine whether or not the well water was getting saltier over time.

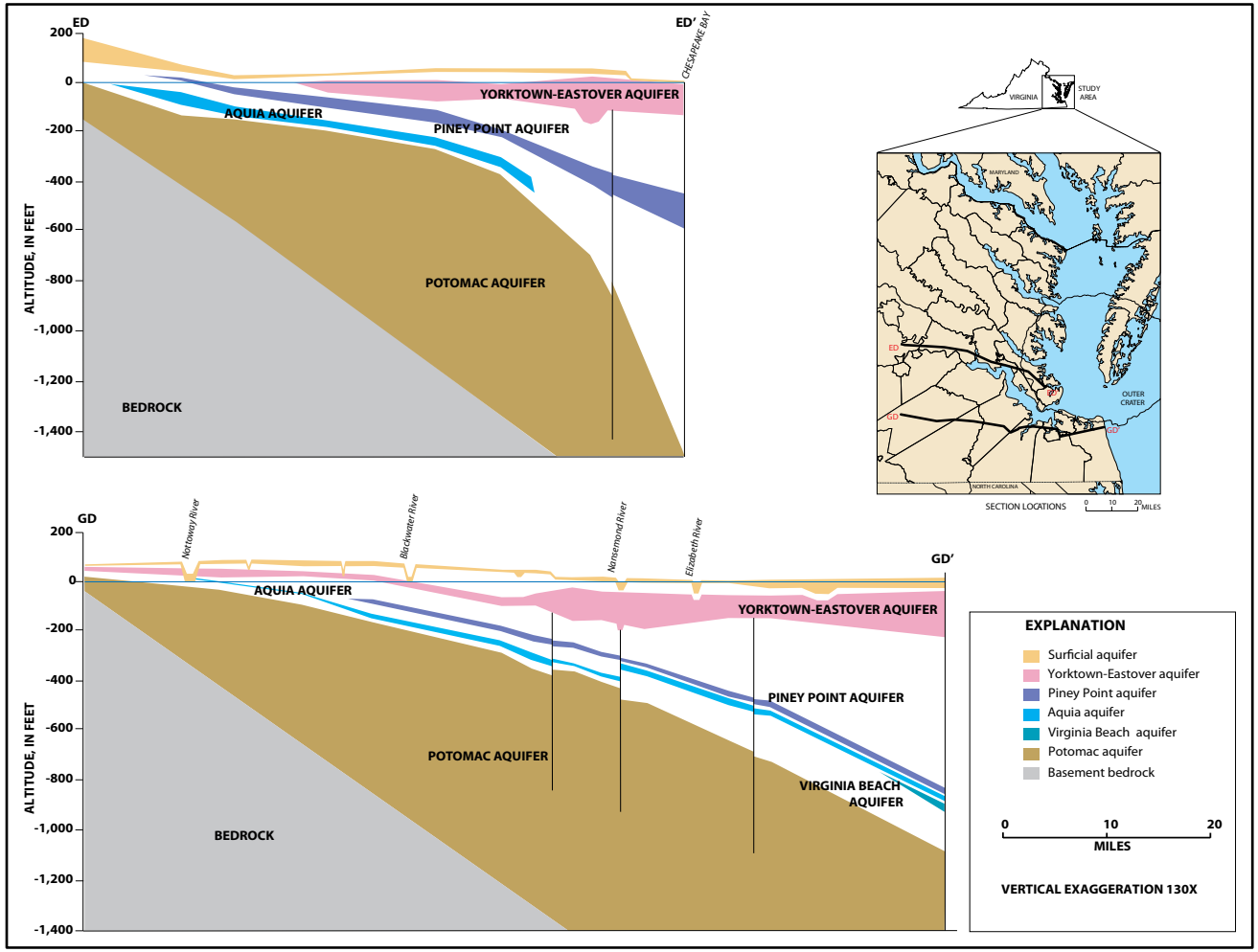


Figure 2. Coastal Plain Aquifers. Beneath Hampton Roads, sand and gravel aquifers are separated by confining units of clay.

Groundwater flows through layers of sand and gravel called aquifers. Under Hampton Roads, there are several aquifers separated by layers of clay (McFarland and Bruce, 2006). Groundwater barely moves through these clay layers. The clay layers are called confining units because they act as barriers to the movement of groundwater between aquifers. Figure 2 illustrates a cross-section of the aquifers under Hampton Roads. At any location, the chloride concentrations are different at different depths because each aquifer has a different chloride concentration. Typically, deeper aquifers have higher chloride concentrations.

Chloride Concentrations across Hampton Roads

Maps 1 through 4 show the estimated chloride concentrations in four Hampton Roads Drinking Water aquifers: the Yorktown-Eastover aquifer, the Piney Point aquifer, the Aquia aquifer, and the Potomac aquifer. Each map shows the chloride concentrations across the aquifer, the location of public and private water system wells withdrawing from that aquifer, and the portions of the region where all homes and businesses rely on individual wells. Most wells only withdraw water from one aquifer. Chloride concentrations are represented by contour lines ranging from 50 to 10,000 milligrams per liter (mg/l). The significance of the chloride concentrations are described in Table 1:

Table 1. Significance of Chloride Concentrations

Chloride Concentration	Significance
1 - 250 mg/l	Freshwater
250 - 400 mg/L	Water tastes salty
500 - 5,000 mg/L	Brackish water that needs treatment
19,400 mg/L	Seawater

Additionally, Maps 1 through 4 show the estimated number of small capacity private drinking water wells (small private wells) in each locality and aquifer. This information is also provided in Table 2. Small private well data is summarized from the USGS report, "Private Domestic-Well Characteristics and the Distribution of Domestic Withdrawals among Aquifer in the Virginia Coastal Plain" (SIR 2007-5250). The report estimated the number of drinking water wells serving homes and businesses; it does not address wells used only for irrigation.

Table 2. Distribution of Small Capacity Private Drinking Water Wells among Selected Drinking Water Aquifers

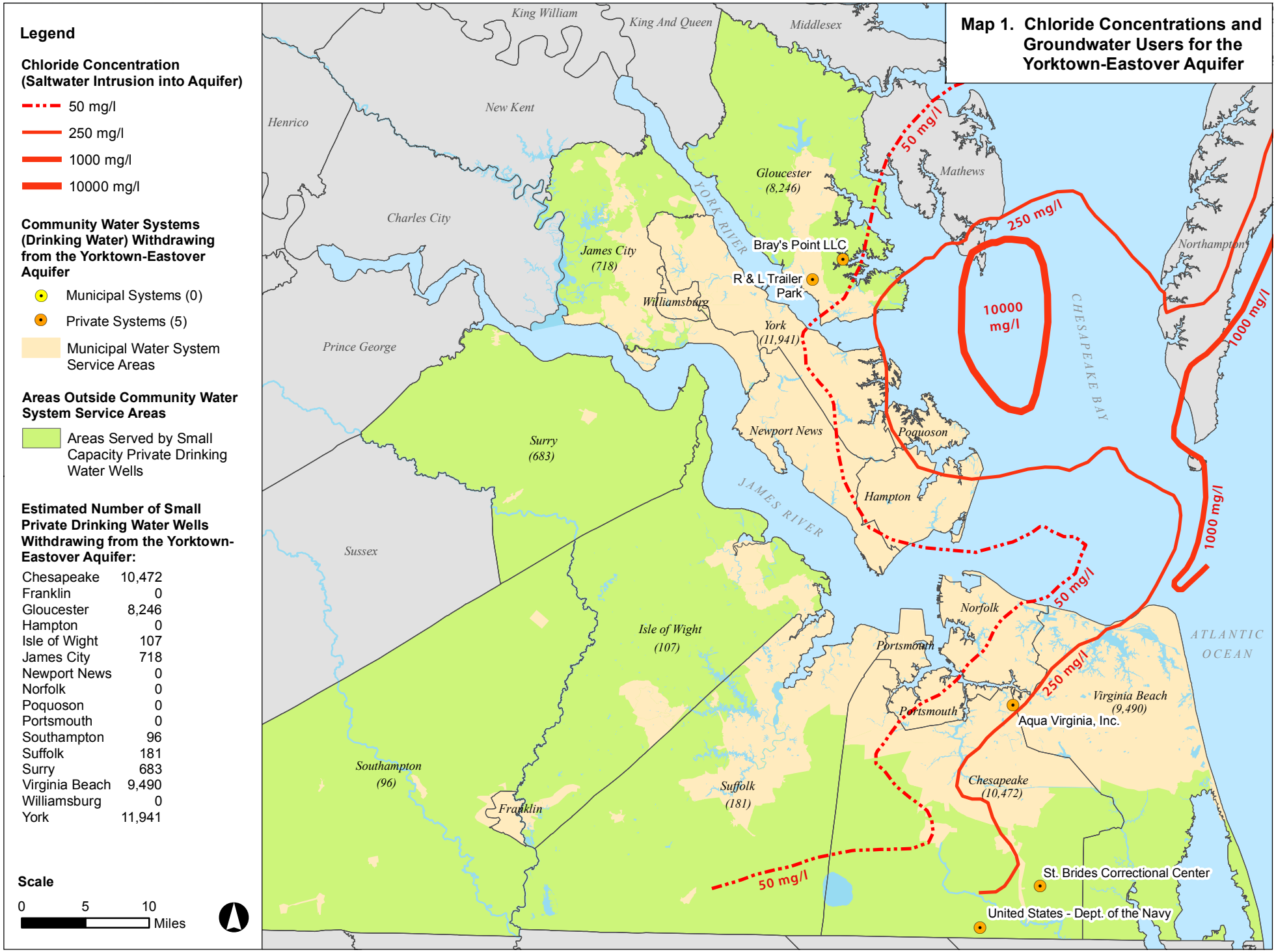
Locality	Estimated Number of Small Private Wells (2000)	Distribution of Small Private Wells (number, %)			
		Yorktown -Eastover Aquifer	Piney Point Aquifer	Aquia Aquifer	Potomac Aquifer
Chesapeake	12,617	10,472 (83%)	0	126 (1%)	0
Franklin	0	0	0	0	0
Gloucester	9,478	8,246 (87%)	569 (6%)	0	0
Hampton	0	0	0	0	0
Isle of Wight	5,359	107 (2%)	54 (1%)	375 (7%)	3,430 (64%)
James City	7,183	718 (10%)	2,011 (28%)	3,376 (47%)	1,006 (14%)
Newport News	0	0	0	0	0
Norfolk	0	0	0	0	0
Poquoson	0	0	0	0	0
Portsmouth	0	0	0	0	0
Southampton	3,188	96 (3%)	0	64 (2%)	2,072 (65%)
Suffolk	6,019	181 (3%)	0	120 (2%)	1,986 (33%)
Surry	1,952	683 (35%)	0	98 (5%)	527 (27%)
Virginia Beach	15,306	9,490 (62%)	0	0	0
Williamsburg	0	0	0	0	0
York	16,137	11,941 (74%)	4,196 (26%)	0	0

Map 1. Chloride Concentrations and Groundwater Users for the Yorktown-Eastover Aquifer. Although the Yorktown-Eastover Aquifer is not a drinking water source for any municipal water systems, the aquifer provides water for five private community water system wells and many small private wells serving homes and businesses throughout Hampton Roads. In Gloucester, 87% (8,246) of small private wells in the County rely on the Yorktown-Eastover Aquifer. In the City of Chesapeake and York County, 83% (10,472) and 74% (11,941) of small private wells in these localities, respectively, are supplied by the aquifer. Small private wells in James City County (718 wells, 10%), Isle of Wight County (107 wells, 2%), Southampton County (96 wells, 3%), the City of Suffolk (181 wells, 3%), Surry County (683 wells, 35%), and the City of Virginia Beach (9,490 wells, 62%) are also dependent on the aquifer (see Table 3).

Chloride concentrations of 250 mg/l estimated at the top of the aquifer appear in portions of Chesapeake, Gloucester, Hampton, Norfolk, Poquoson, Virginia Beach, and York. Based on the location of the 250 mg/l chloride contour and the extent of areas served by municipal water systems, a few private water systems and some homes and businesses in Gloucester, Chesapeake, and Virginia Beach may be producing water that is salty to the taste.

Table 3. Estimated Number of Small Capacity Private Drinking Water Wells in the Yorktown-Eastover Aquifer

Locality	Total Number of Small Private Wells (Estimated, Year 2000)	Small Private Wells in the Yorktown-Eastover Aquifer	
		Number	Percent
Chesapeake	12,617	10,472	83%
Franklin	0	0	0%
Gloucester	9,478	8,246	87%
Hampton	0	0	0%
Isle of Wight	5,359	107	2%
James City	7,183	718	10%
Newport News	0	0	0%
Norfolk	0	0	0%
Poquoson	0	0	0%
Portsmouth	0	0	0%
Southampton	3,188	96	3%
Suffolk	6,019	181	3%
Surry	1,952	683	35%
Virginia Beach	15,306	9,490	62%
Williamsburg	0	0	0%
York	16,137	11,941	74%

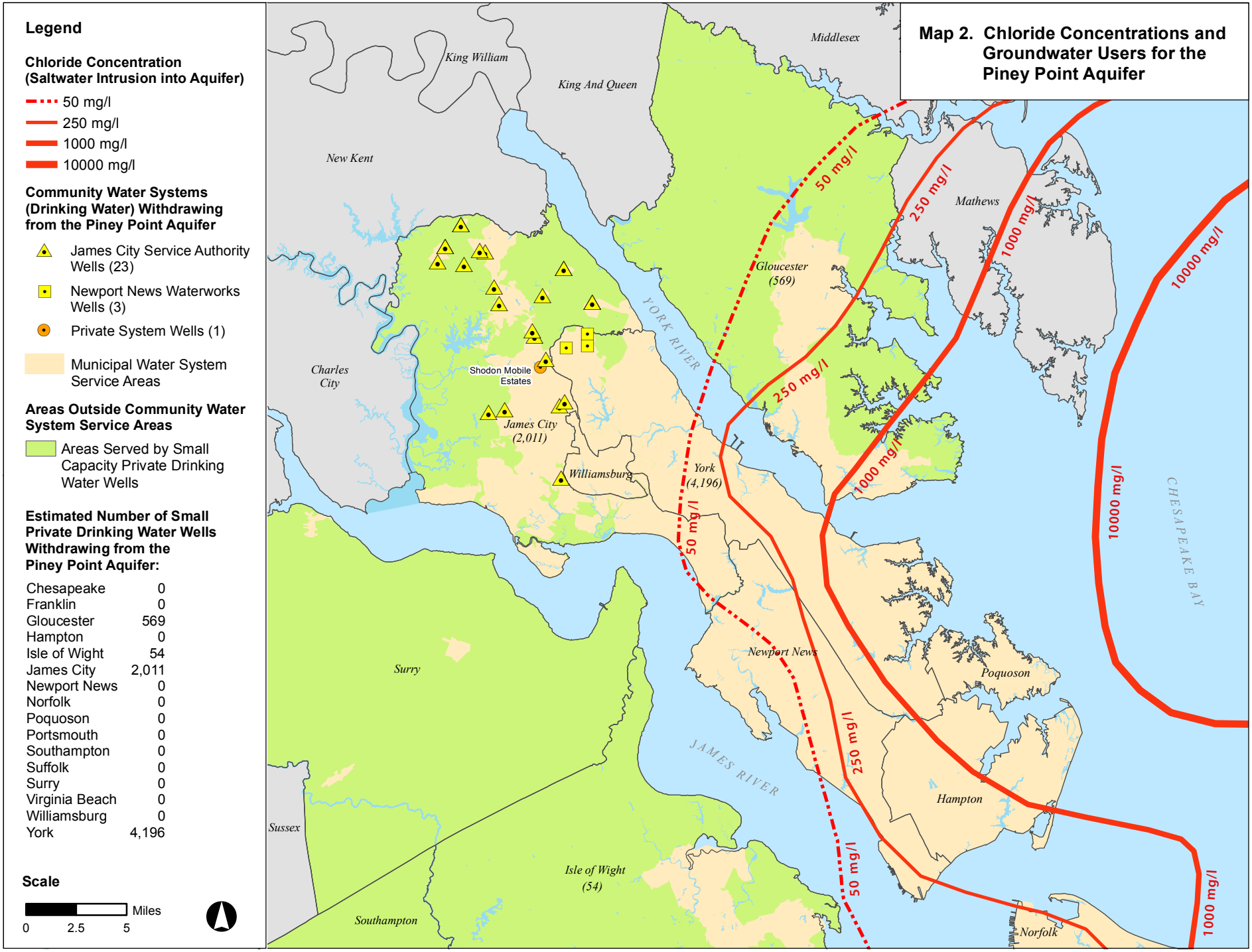

Map 1. Chloride Concentrations and Groundwater Users for the Yorktown-Eastover Aquifer
Legend
Chloride Concentration (Saltwater Intrusion into Aquifer)
50 mg/l
250 mg/l
1000 mg/l
10000 mg/l
Community Water Systems (Drinking Water) Withdrawing from the Yorktown-Eastover Aquifer
Municipal Systems (0)
Private Systems (5)
Municipal Water System Service Areas
Areas Outside Community Water System Service Areas
Areas Served by Small Capacity Private Drinking Water Wells
Estimated Number of Small Private Drinking Water Wells Withdrawing from the Yorktown-Eastover Aquifer:
Chesapeake 10,472
Franklin 0
Gloucester 8,246
Hampton 0
Isle of Wight 107
James City 718
Newport News 0
Norfolk 0
Poquoson 0
Portsmouth 0
Southampton 96
Suffolk 181
Surry 683
Virginia Beach 9,490
Williamsburg 0
York 11,941
Scale
0 5 10
Miles
King William
King And Queen
Middlesex
New Kent
Henrico
Charles City
Prince George
Sussex
Surry (683)
James City (718)
Gloucester (8,246)
Mathews
Northampton
York (11,941)
Williamsburg
Newport News
Poquoson
Hampton
Isle of Wight (107)
Southampton (96)
Franklin
Suffolk (181)
Norfolk
Portsmouth
Virginia Beach (9,490)
Chesapeake (10,472)
YORK RIVER
JAMES RIVER
CHESAPEAKE BAY
ATLANTIC OCEAN
Bray's Point LLC
R & L Trailer Park
Aqua Virginia, Inc.
St. Brides Correctional Center
United States - Dept. of the Navy
50 mg/l
250 mg/l
1000 mg/l
10000 mg/l

Map 2. Chloride Concentrations and Groundwater Users for the Piney Point Aquifer. The Piney Point Aquifer is an important water source for the York-James Peninsula, supplying 23 municipal water system wells operated by the James City Service Authority and 3 municipal water system wells operated by Newport News Waterworks. The aquifer also provides water to one private community water system and 28% (2,011) of small private wells in James City County. In York County, 26% (4,196) of small private wells rely on the Piney Point Aquifer. Some small private wells in Gloucester County (569 wells, 6%) and Isle of Wight County (54 wells, 1%) are also dependent on the aquifer (see Table 4).

Chloride concentrations of 250 mg/l estimated at the top of the aquifer appear in portions of the Cities of Chesapeake, Newport News, Norfolk, Portsmouth, and Suffolk, and the Counties of Gloucester County and York. Most of the areas with chloride concentrations of 250 mg/l or higher are served by municipal water systems that use surface water or treated groundwater. The southern portion of Gloucester County is the only area in Hampton roads where small private wells in the Piney Point aquifer may be producing water that is salty to the taste.

Table 4. Estimated Number of Small Capacity Private Drinking Water Wells in the Piney Point Aquifer

Locality	Total Number of Small Private Wells (Estimated, Year 2000)	Small Private Wells in the Piney Point Aquifer	
		Number	Percent
Chesapeake	12,617	0	0%
Franklin	0	0	0%
Gloucester	9,478	569	6%
Hampton	0	0	0%
Isle of Wight	5,359	54	1%
James City	7,183	2,011	28%
Newport News	0	0	0%
Norfolk	0	0	0%
Poquoson	0	0	0%
Portsmouth	0	0	0%
Southampton	3,188	0	0%
Suffolk	6,019	0	0%
Surry	1,952	0	0%
Virginia Beach	15,306	0	0%
Williamsburg	0	0	0%
York	16,137	4,196	26%

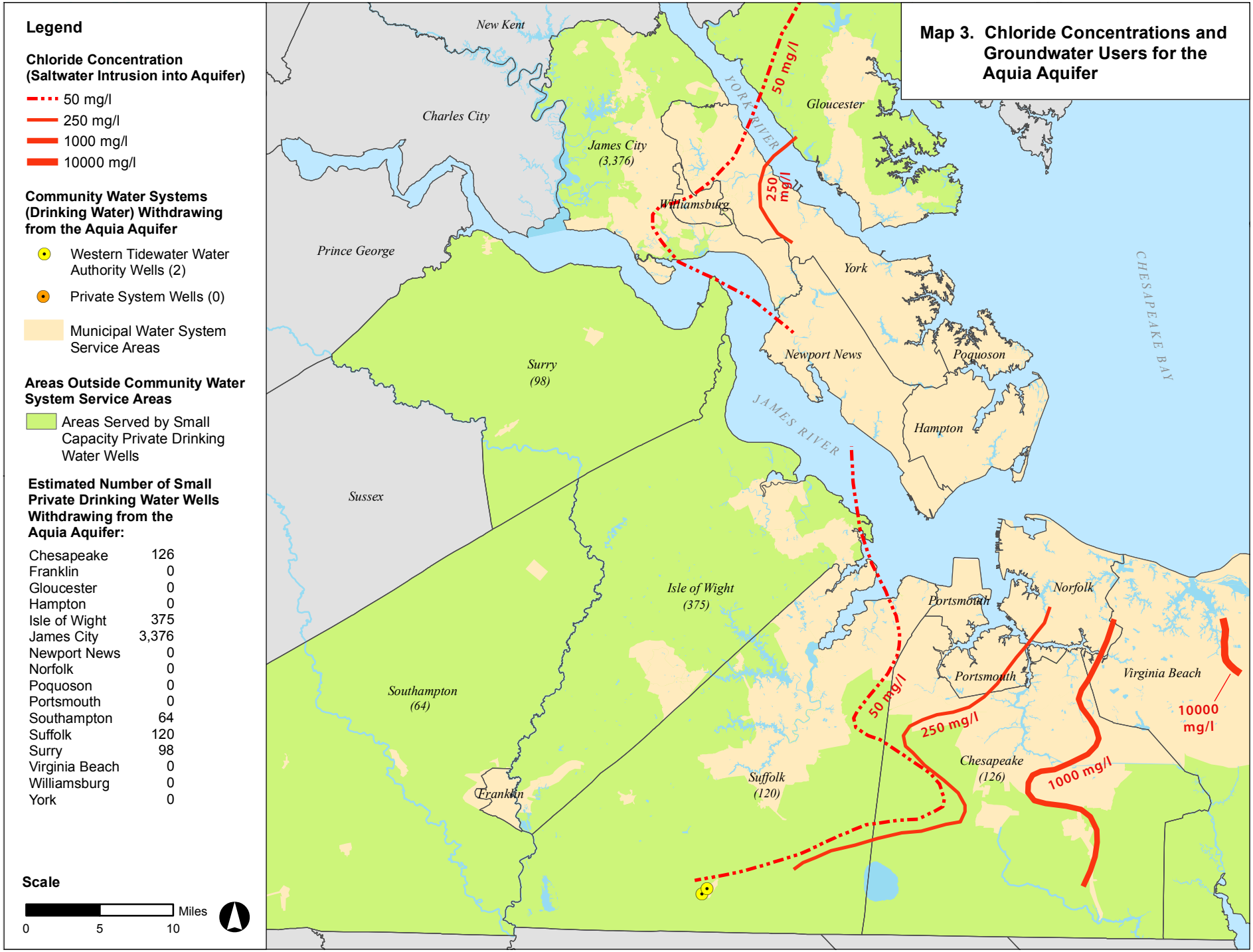

Legend
Chloride Concentration (Saltwater Intrusion into Aquifer)
50 mg/l
250 mg/l
1000 mg/l
10000 mg/l
Community Water Systems (Drinking Water) Withdrawing from the Piney Point Aquifer
James City Service Authority Wells (23)
Newport News Waterworks Wells (3)
Private System Wells (1)
Municipal Water System Service Areas
Areas Outside Community Water System Service Areas
Areas Served by Small Capacity Private Drinking Water Wells
Estimated Number of Small Private Drinking Water Wells Withdrawing from the Piney Point Aquifer:
Chesapeake 0
Franklin 0
Gloucester 569
Hampton 0
Isle of Wight 54
James City 2,011
Newport News 0
Norfolk 0
Poquoson 0
Portsmouth 0
Southampton 0
Suffolk 0
Surry 0
Virginia Beach 0
Williamsburg 0
York 4,196
Scale
Miles
0 2.5 5
Map 2. Chloride Concentrations and Groundwater Users for the Piney Point Aquifer
King William
King And Queen
Middlesex
New Kent
Mathews
Gloucester (569)
Charles City
Shodon Mobile Estates
James City (2,011)
Williamsburg
York (4,196)
YORK RIVER
Surry
Newport News
Poquoson
Hampton
JAMES RIVER
Sussex
Isle of Wight (54)
Southampton
Norfolk
CHESAPEAKE BAY
50 mg/l
250 mg/l
1000 mg/l
10000 mg/l

Map 3. Chloride Concentrations and Groundwater Users for the Aquia Aquifer. The Aquia Aquifer is the source for two wells operated by the Western Tidewater Water Authority, which supplies municipal water systems in the City of Suffolk and Isle of Wight County. Although no private community water systems have wells in the Aquia Aquifer, many homes and businesses throughout Hampton Roads depend on the aquifer for drinking water. Approximately 47% (3,376) of small private wells in James City County pump water from the Aquia Aquifer. Some small private wells in the City of Chesapeake (126 wells, 1%), Isle of Wight County (375 wells, 7%), Southampton County (64 wells, 2%), the City of Suffolk (120 wells, 2%), and Surry County (98 wells, 5%) also utilize the aquifer (see Table 5).

Chloride concentrations of 250 mg/l estimated at the top of the aquifer appear in portions of the Cities of Chesapeake, Norfolk, Portsmouth, and Suffolk and the Counties of Gloucester and York. Most of these areas are served by municipal water systems. The southern portions of Chesapeake and Suffolk are the only areas where small private wells in the Piney Point aquifer may be producing water that is salty to the taste.

Table 5. Estimated Number of Small Capacity Private Drinking Water Wells in the Aquia Aquifer

Locality	Total Number of Small Private Wells (Estimated, Year 2000)	Small Private Wells in the Aquia Aquifer	
		Number	Percent
Chesapeake	12,617	126	1%
Franklin	0	0	0%
Gloucester	9,478	0	0%
Hampton	0	0	0%
Isle of Wight	5,359	375	7%
James City	7,183	3,376	47%
Newport News	0	0	0%
Norfolk	0	0	0%
Poquoson	0	0	0%
Portsmouth	0	0	0%
Southampton	3,188	64	2%
Suffolk	6,019	120	2%
Surry	1,952	98	5%
Virginia Beach	15,306	0	0%
Williamsburg	0	0	0%
York	16,137	0	0%

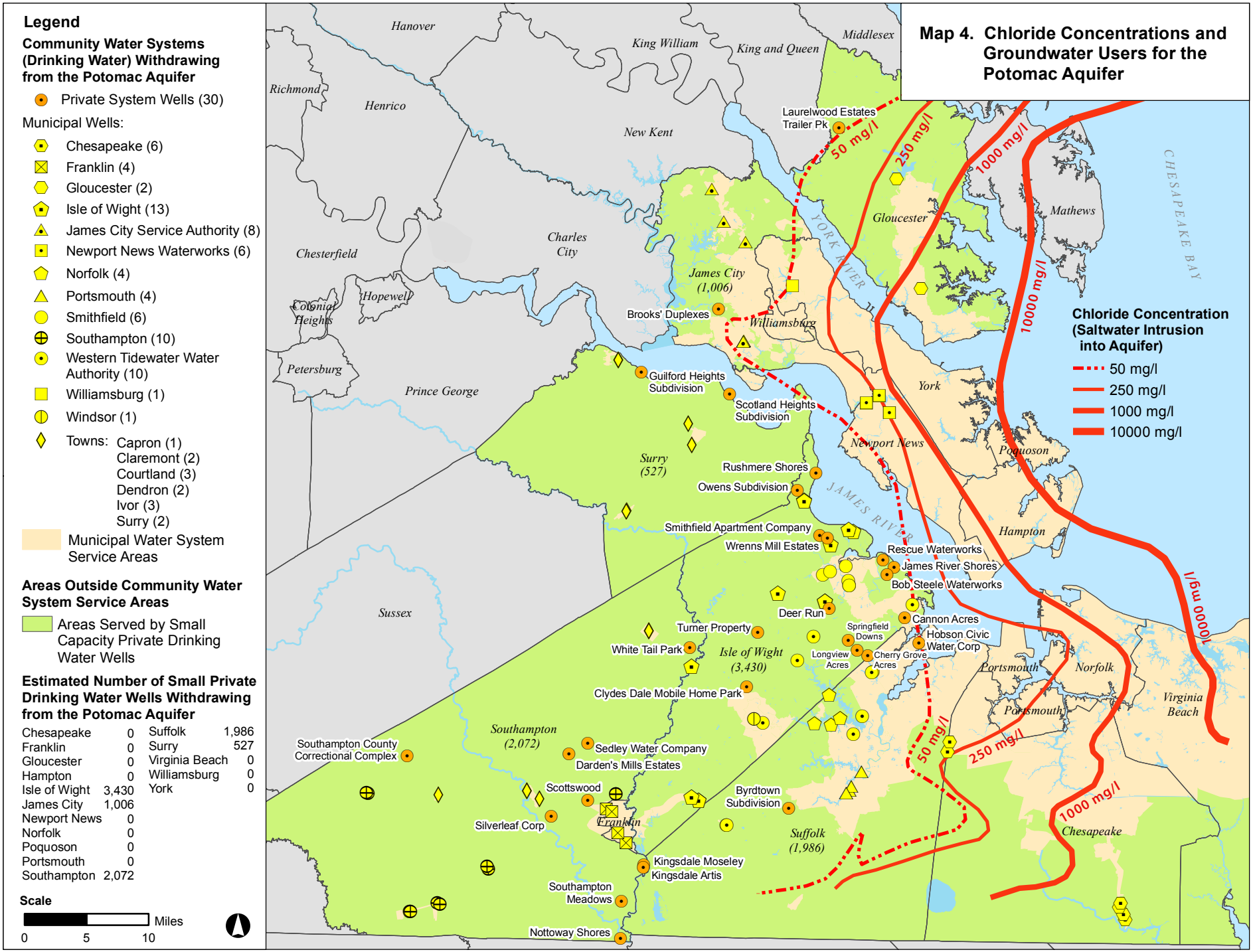

Legend
Chloride Concentration (Saltwater Intrusion into Aquifer)
50 mg/l
250 mg/l
1000 mg/l
10000 mg/l
Community Water Systems (Drinking Water) Withdrawing from the Aquia Aquifer
Western Tidewater Water Authority Wells (2)
Private System Wells (0)
Municipal Water System Service Areas
Areas Outside Community Water System Service Areas
Areas Served by Small Capacity Private Drinking Water Wells
Estimated Number of Small Private Drinking Water Wells Withdrawing from the Aquia Aquifer:
Chesapeake 126
Franklin 0
Gloucester 0
Hampton 0
Isle of Wight 375
James City 3,376
Newport News 0
Norfolk 0
Poquoson 0
Portsmouth 0
Southampton 64
Suffolk 120
Surry 98
Virginia Beach 0
Williamsburg 0
York 0
Scale
Miles
0
5
10
Map 3. Chloride Concentrations and Groundwater Users for the Aquia Aquifer
New Kent
Charles City
James City (3,376)
Williamsburg
Gloucester
York
Prince George
Surry (98)
Newport News
Poquoson
Hampton
Sussex
Isle of Wight (375)
Portsmouth
Norfolk
Virginia Beach
Southampton (64)
Chesapeake (126)
Suffolk (120)
Franklin
YORK RIVER
JAMES RIVER
CHESAPEAKE BAY
50 mg/l
250 mg/l
1000 mg/l
10000 mg/l

Map 4. Chloride Concentrations and Groundwater Users for the Potomac Aquifer. The Potomac Aquifer, the largest and most heavily used source of groundwater in the Virginia Coastal Plain, provides water for 88 municipal water supply wells. A total of 30 private community water system wells utilize the Potomac Aquifer. The aquifer also provides water to a significant portion of small private wells in Isle of Wight County (3,430 wells, 64%), James City County (1,006 wells, 14%), Southampton County (2,072 wells, 65%), the City of Suffolk (1,986 wells, 33%), and Surry County (527 wells, 27%).

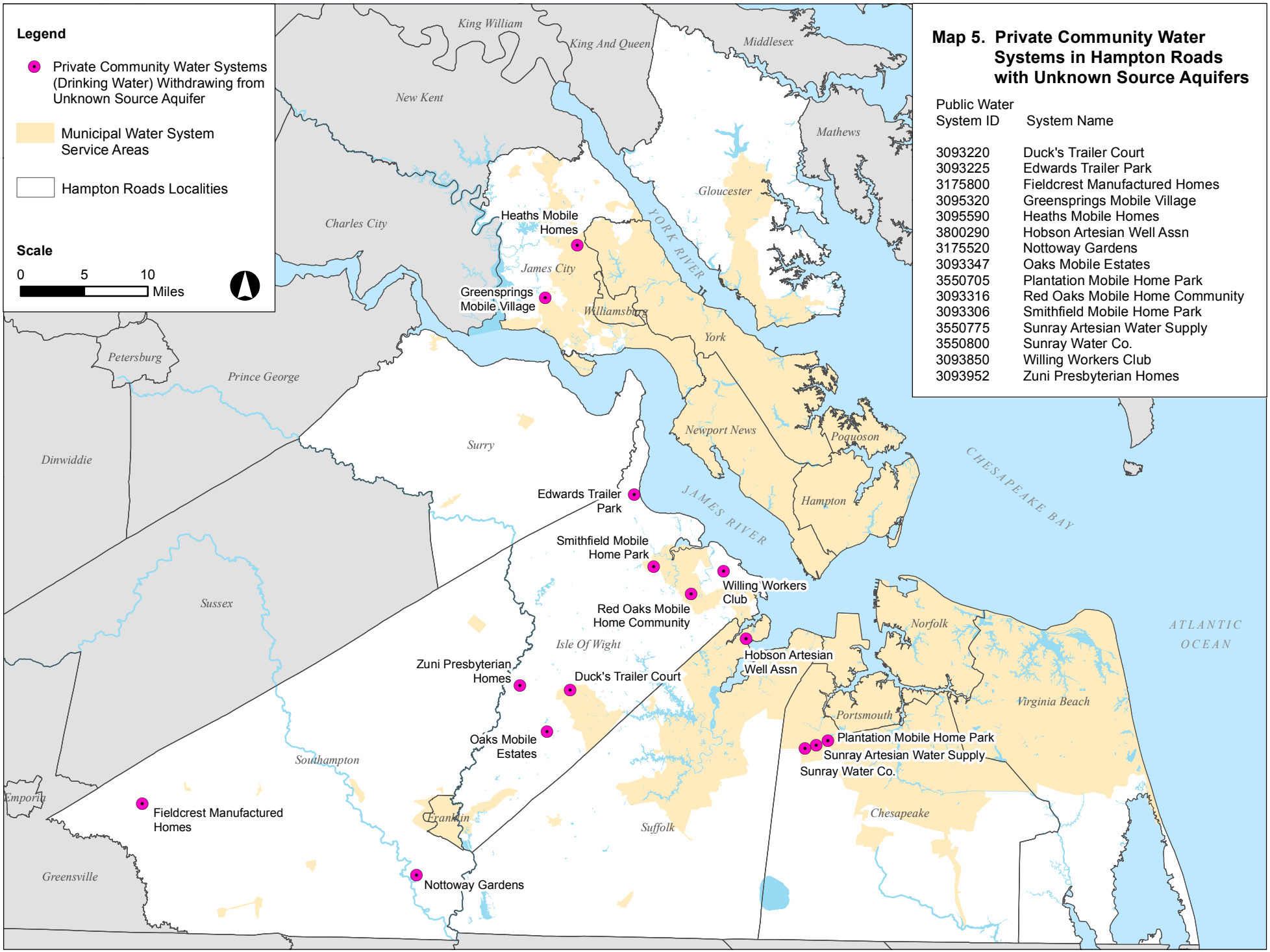
Chloride concentrations of 250 mg/l estimated at the top of the aquifer appear in portions of the Counties of Gloucester, York, and James City and the Cities of Newport News, Norfolk, Portsmouth, Chesapeake, and Suffolk. Based on the location of the 250 mg/l chloride contour and the extent of areas served by municipal water systems, there may be some small private wells in Suffolk may be producing water that is salty to the taste.

Table 6. Estimated Number of Small Capacity Private Drinking Water Wells in the Potomac Aquifer

Locality	Total Number of Small Private Wells (Estimated, Year 2000)	Small Private Wells in the Potomac Aquifer	
		Number	Percent
Chesapeake	12,617	0	0%
Franklin	0	0	0%
Gloucester	9,478	0	0%
Hampton	0	0	0%
Isle of Wight	5,359	3,430	64%
James City	7,183	1,006	14%
Newport News	0	0	0%
Norfolk	0	0	0%
Poquoson	0	0	0%
Portsmouth	0	0	0%
Southampton	3,188	2,072	65%
Suffolk	6,019	1,986	33%
Surry	1,952	527	27%
Virginia Beach	15,306	0	0%
Williamsburg	0	0	0%
York	16,137	0	0%


Map 4. Chloride Concentrations and Groundwater Users for the Potomac Aquifer
Legend
Community Water Systems (Drinking Water) Withdrawing from the Potomac Aquifer
Private System Wells (30)
Municipal Wells:
Chesapeake (6)
Franklin (4)
Gloucester (2)
Isle of Wight (13)
James City Service Authority (8)
Newport News Waterworks (6)
Norfolk (4)
Portsmouth (4)
Smithfield (6)
Southampton (10)
Western Tidewater Water Authority (10)
Williamsburg (1)
Windsor (1)
Towns: Capron (1)
Claremont (2)
Courtland (3)
Dendron (2)
Ivor (3)
Surry (2)
Municipal Water System Service Areas
Areas Outside Community Water System Service Areas
Areas Served by Small Capacity Private Drinking Water Wells
Estimated Number of Small Private Drinking Water Wells Withdrawing from the Potomac Aquifer
Chesapeake 0
Franklin 0
Gloucester 0
Hampton 0
Isle of Wight 3,430
James City 1,006
Newport News 0
Norfolk 0
Poquoson 0
Portsmouth 0
Southampton 2,072
Suffolk 1,986
Surry 527
Virginia Beach 0
Williamsburg 0
York 0
Scale
Miles
0 5 10
Chloride Concentration (Saltwater Intrusion into Aquifer)
50 mg/l
250 mg/l
1000 mg/l
10000 mg/l
Hanover
King William
King and Queen
Middlesex
Richmond
Henrico
New Kent
Chesterfield
Charles City
James City (1,006)
Gloucester
Mathews
Colonial Heights
Hopewell
Petersburg
Prince George
Surry (527)
York
Poquoson
Newport News
Hampton
Sussex
Isle of Wight (3,430)
Southampton (2,072)
Suffolk (1,986)
Portsmouth
Norfolk
Virginia Beach
Chesapeake
Franklin
Williamsburg
YORK RIVER
JAMES RIVER
CHESAPEAKE BAY
Laurelwood Estates Trailer Pk
Brooks' Duplexes
Guilford Heights Subdivision
Scotland Heights Subdivision
Rushmere Shores
Owens Subdivision
Smithfield Apartment Company
Wrenns Mill Estates
Rescue Waterworks
James River Shores
Bob Steele Waterworks
Deer Run
Cannon Acres
Springfield Downs
Hobson Civic Water Corp
Longview Acres
Cherry Grove Acres
Turner Property
White Tail Park
Clydes Dale Mobile Home Park
Southampton County Correctional Complex
Sedley Water Company
Darden's Mills Estates
Scottswood
Silverleaf Corp
Byrdtown Subdivision
Kingsdale Moseley
Kingsdale Artis
Southampton Meadows
Nottoway Shores

Map 5. Private Community Water Systems in Hampton Roads with Unknown Source Aquifers. This map shows the general locations and names of fifteen private community water systems for which source aquifer information is unavailable. This may be because the information was not reported during the permitting process, the system withdrawals are too small to require a groundwater withdrawal permit from the Department of Environmental Quality, or the information is not available from the Department of Health's public water system records. Without water quality monitoring data or source aquifer information for these wells, it is difficult to anticipate current or future impacts of chloride concentrations to these private community water systems.



Map 5. Private Community Water Systems in Hampton Roads with Unknown Source Aquifers

Public Water System ID	System Name
3093220	Duck's Trailer Court
3093225	Edwards Trailer Park
3175800	Fieldcrest Manufactured Homes
3095320	Greensprings Mobile Village
3095590	Heaths Mobile Homes
3800290	Hobson Artesian Well Assn
3175520	Nottoway Gardens
3093347	Oaks Mobile Estates
3550705	Plantation Mobile Home Park
3093316	Red Oaks Mobile Home Community
3093306	Smithfield Mobile Home Park
3550775	Sunray Artesian Water Supply
3550800	Sunray Water Co.
3093850	Willing Workers Club
3093952	Zuni Presbyterian Homes

Chloride Trends over Time

Chloride data from selected wells in the Chloride Monitoring Network and the DEQ Groundwater Withdrawal Permitting Program were analyzed for changes in chloride concentrations over time (see Figure 3). The results are summarized in the following sections. A detailed analysis of groundwater quality in the Virginia Coastal Plain is provided in the USGS report, "Groundwater-Quality Data and Regional Trends in the Virginia Coastal Plain, 1906-2007" (PP-1772).

Chloride Monitoring Network Well Data

Chloride data was analyzed from 22 monitoring wells in the Hampton Roads region (see Figure 4). The total time span of all chloride data analyzed is 1969-2012. Each of the 22 wells has at least 4 chloride samples collected at least 1 month apart over a span of at least 3 years. There are over 100 wells in the chloride monitoring network, but only 22 wells have been sampled this consistently.

The analysis of well data from the Chloride Monitoring Network is summarized below:

- 10 of the 22 wells showed increasing chloride concentrations
- 3 wells showed decreasing chloride concentrations
- 9 wells showed no clear trend up or down.

Of the ten wells where chloride concentrations were observed to be increasing, eight of these wells withdraw water from the Potomac aquifer. The remaining two wells (61B 15 SOW 091H and 59F 1 SOW 027) withdraw water from other aquifers.

DEQ Groundwater Withdrawal Permitting Program Data

Chloride data is required by DEQ as part of groundwater withdrawal permits. Data from 24 wells was analyzed (see Figure 4). Each of the 24 wells is an active water supply well with at least 10 chloride samples taken over a period of at least 3 years. Only 24 wells in DEQ's program have been sampled this frequently. The total time span of all chloride data analyzed is 1980-2012. The analysis of DEQ Groundwater Withdrawal Permitting Program data is summarized below:

- 3 of the 24 wells showed increasing chloride concentrations, all in the Potomac
- 13 wells showed decreasing chloride concentrations
- 8 wells showed no clear trend up or down.

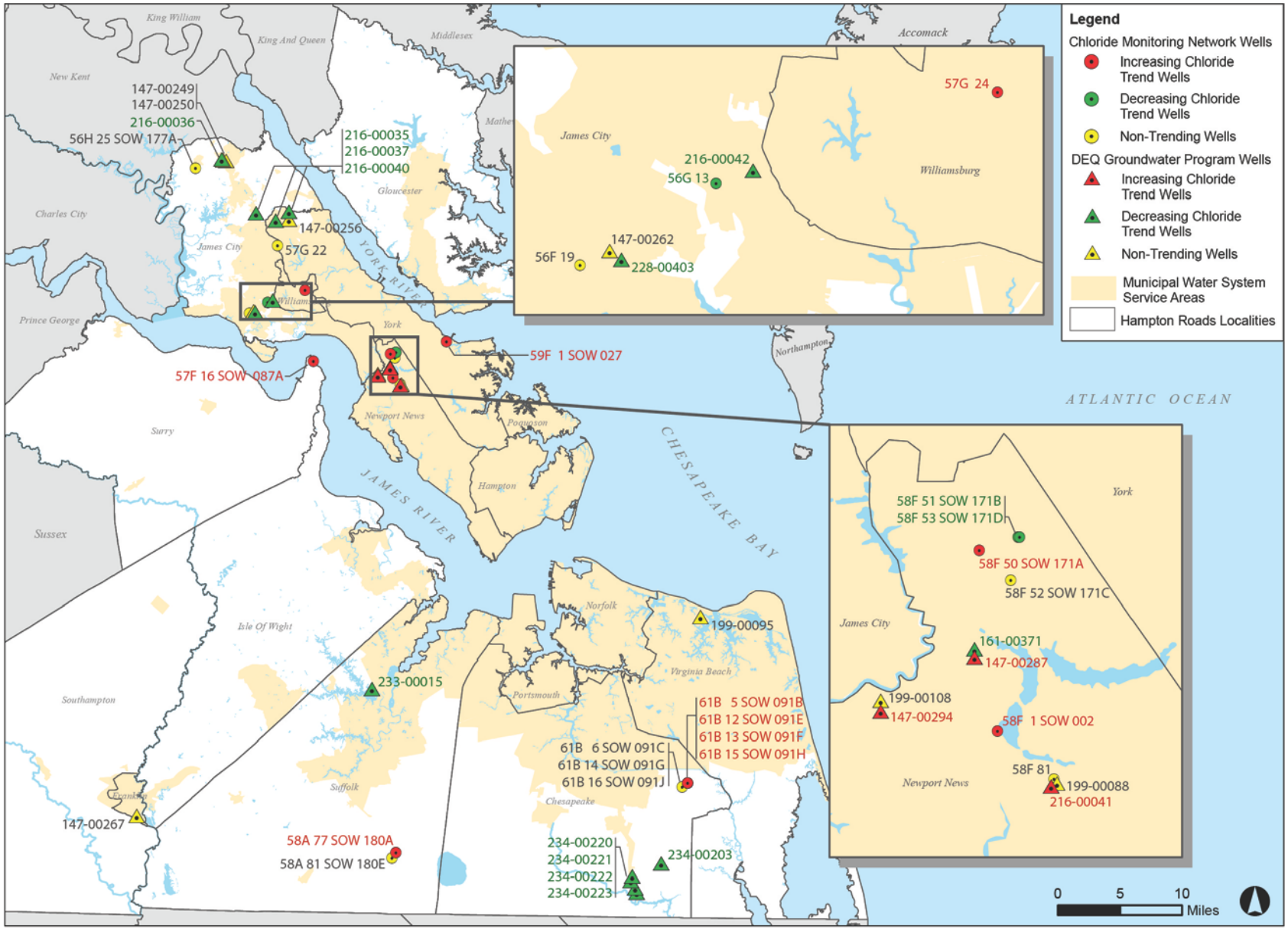


Figure 3. Selected Wells Included in the Chloride Trend Analysis. Samples from 22 Chloride Monitoring Network wells and 24 wells in the DEQ Groundwater Withdrawal Permit Program were analyzed for changes in chloride concentrations over time.

Chloride Monitoring and Implications for Water Resource Management

Because groundwater levels in the major Hampton Roads aquifers are below sea level, saltwater intrusion should be monitored. Chloride monitoring provides an early warning system for saltwater intrusion into water supply aquifers. By regularly collecting chloride measurements, water resource managers can focus on sensitive areas and important water supply wells with increasing salinity.

DEQ is developing a groundwater quality monitoring strategy, which includes improving the chloride monitoring program in the Coastal Plain aquifer system. The current chloride monitoring network is inadequate. A better understanding of how groundwater withdrawals impact chloride concentrations is needed to support resource management decisions. DEQ's draft strategy recommends identifying areas of potential saltwater intrusion, siting of monitoring wells to intercept intrusion, and sampling at more frequent intervals.

When saltwater intrusion is found, there are strategies to manage it such as changing rates and locations of pumping or injecting water into the aquifer. Early detection of saltwater intrusion or upconing may allow utilities time to plan for extensions of municipal systems. Proper management of groundwater resources requires monitoring data to maintain an up-to-date understanding of water quality.

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