

HAMPTON ROADS REGIONAL SOURCE WATER PROTECTION PLAN

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HAMPTON ROADS PLANNING DISTRICT COMMISSION
DIRECTORS OF UTILITIES COMMITTEE
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ABSTRACT:

The *Hampton Roads Regional Source Water Protection Plan* summarizes risks to municipal source water quality, existing regional source water protection measures, and potential protection and management strategies for future implementation. Regional strategies to manage and minimize current risks and future threats to municipal drinking water sources water are described.

ACKNOWLEDGEMENTS:

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Hampton Roads Regional Source Water Protection Plan

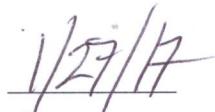
Hampton Roads Planning District Commission
Directors of Utilities Committee

The Hampton Roads Regional Source Water Protection plan was approved by the Hampton Roads Planning District Commission (HRPDC) Directors of Utilities Committee on January 4, 2017.



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Date

Subsequent plan reviews and updates are listed below:

Review Date	Reviewer	Changes or Comments

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EXECUTIVE SUMMARY

Hampton Roads municipal water utilities are committed to protecting the region's drinking water sources. This document, the *Hampton Roads Regional Source Water Protection Plan*, summarizes risks to municipal source water quality, existing regional source water protection measures, and potential protection and management strategies for future implementation.

The 1986 Amendments to the Safe Drinking Water Act (SDWA) established the Source Water Protection Program. The primary goal of source water protection efforts under the SDWA is to prevent contamination of drinking water supplies. Source water protection is a process of:

- Identifying public water supply sources;
- Assessing the potential contamination risks; and
- Implementing measures to manage risks and enhance source water quality.

This document may be used to:

- Serve as a guidance document to assist Hampton Roads municipal water utilities in planning efforts to protect water quality;
- Outline the primary drinking water protection issues based upon existing data and local knowledge;
- Develop ideas for projects to preserve or enhance water quality; and
- Provide guidance to local and regional land use planning and zoning processes.

The *Hampton Roads Regional Source Water Protection Plan* addresses source water protection goals to the extent practicable at the regional level. There is no legal requirement to implement the strategies and recommendations herein. Actions on public lands will be subject to federal, state, and local policies and procedures. Actions on private land may require compliance with local land use ordinances, building codes, local covenants, and permission from the landowner. Regional strategies to manage and minimize current risks and future threats are described in Section 4 of the plan.

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LIST OF ACRONYMS

BMPs	Best management practices
CBPAs	Chesapeake Bay Preservation Areas
DEQ	Department of Environmental Quality
EPA	Environmental Protection Agency
EVGWMAC	Eastern Virginia Groundwater Management Advisory Committee
GWMAAs	Groundwater Management Areas
HRPDC	Hampton Roads Planning District Commission
HRSD	Hampton Roads Sanitation District
HRSWAP	Hampton Roads Source Water Assessment Program
HUC	Hydrologic unit code
LUAs	Land use activities
MOA	Memorandum of Agreement
MS4s	Municipal Separate Storm Sewer Systems
NCDC	National Climatic Data Center
NPMS	National Pipeline Mapping System
PCBs	Polychlorinated biphenyls
PCS	Potential Contamination Sources
PHMSA	Pipeline and Hazardous Materials Safety Administration
SDWA	Safe Drinking Water Act
SSOs	Sanitary sewer overflows
SSORS	Sanitary Sewer Overflow Reporting System
SWAP	Source Water Assessment Program
SWPAs	Source Water Protection Areas
SWPP	Source Water Protection Plan
TMDL	Total Maximum Daily Load
UASI	Urban Areas Security Initiative
USGS	U.S. Geological Survey
VDH	Virginia Department of Health
VDOT	Virginia Department of Transportation
VPDES	Virginia Pollution Discharge Elimination System Permits
VOCs	Volatile organic compounds

1 Introduction

Approximately 1,480,600 people in the Hampton Roads region rely on municipal water utilities for continuous, on-demand drinking water service. Municipal water utilities also deliver reliable service to commercial, industrial, and military customers across the region. The water supplied to municipal customers in Hampton Roads comes from surface water reservoirs and groundwater aquifers. Additionally, about 15,200 people are served by privately-owned community water systems, and 124,500 people rely on private domestic wells for drinking water. Approximately 200 businesses in the Region have their own water sources. These non-municipal water users must be considered in the overall protection of drinking water resources.

Hampton Roads municipal water utilities are committed to protecting the region's drinking water sources. This document, the *Hampton Roads Regional Source Water Protection Plan*, summarizes risks to municipal source water quality, existing regional source water protection measures, and potential protection and management strategies for future implementation.

This plan was prepared by the staff of the Hampton Roads Planning District Commission (HRPDC) for the HRPDC Directors of Utilities Committee in cooperation with the Virginia Department of Health (VDH), Office of Drinking Water.

1.1 Virginia Department of Health, Office of Drinking Water SWPP Development Approach

A Source Water Protection Plan (SWPP) provides guidance for waterworks and a framework for protecting drinking water resources. The primary goal of source water protection efforts under the Safe Drinking Water Act (SDWA) is to prevent the contamination of water supplies and to promote their continued maintenance. The 1986 Amendments to the SDWA established the Source Water Protection Program. Source water protection is a process of:

- Identifying the area's public water supply sources (wells and surface water intakes);
- Assessing the potential risks to groundwater and surface water sources; and
- Implementing measures to manage these risks and prevent contamination.

A SWPP outlines strategies and actions available to protect drinking water sources. A SWPP may be used to:

- Serve as a guidance document to assist municipal water systems in their planning efforts to protect water supplies and preserve water quality;
- Outline the primary drinking water protection issues based upon existing data and local knowledge;
- Develop ideas for projects to preserve or improve water quality; and
- Provide guidance to local and regional planning and zoning processes.
- Identify potential risks to drinking water supplies and develop plans to mitigate those risks.

The VDH Office of Drinking Water administers the Commonwealth’s source water programs¹ and applies a six-step approach to developing SWPPs:

- Step 1: Formation of a Local Advisory Committee
- Step 2: Educate the Committee
- Step 3: Source Water Assessment Review
- Step 4: Identification of Source Water Protection Options
- Step 5: Source Water Protection Plan Development
- Step 6: Source Water Protection Plan Implementation

A description of the VDH’s SWPP development approach is provided in Appendix A-1.

1.2 Local Advisory Committee

The HRPDC Directors of Utilities Committee serves as the Local Advisory Committee for the *Hampton Roads Regional Source Water Protection Plan*. The Directors of Utilities Committee is recognized as a formal advisory committee to HRPDC and is charged with addressing technical, policy and administrative issues associated with the planning and operation of the region’s water supply and wastewater systems, as well as a broad range of other water resource management issues. The Committee meets monthly and includes the Utility Director or a senior representative from the HRPDC member local governments, the Hampton Roads Sanitation District, and the HRPDC. Semiannually, the Committee meets jointly with local health district directors and the VDH Office of Drinking Water to discuss issues of mutual concern associated with drinking water and other water quality issues. The Committee also holds an annual joint meeting with local emergency managers, local health district directors, and the VDH Office of Drinking Water. Members of the HRPDC Directors of Utilities Committee are listed below:

- Lynn Allsbrook, City of Hampton
- Daniel G. Clayton III, City of Williamsburg
- James “Chris” Dawson, Gloucester County
- W. Scott Dewhirst, Newport News Waterworks
- H. Reed Fowler II, City of Newport News
- Tyrone W. Franklin, Surry County
- Edward G. Henifin, Hampton Roads Sanitation District
- Donald Jennings, Isle of Wight County
- Julien W. Johnson Jr., Southampton County
- David Jurgens, City of Chesapeake
- Whitney Katchmark, Hampton Roads Planning District Commission
- Kristen M. Lentz, City of Norfolk
- Robert S. Montague Jr., City of Virginia Beach
- Albert Moor II, City of Suffolk
- Russell Pace, City of Franklin
- Doug Powell, James City Service Authority
- Everett Skipper, City of Newport News
- Robert Speechley, City of Poquoson
- Michael M. Stallings, Town of Windsor
- Peter M. Stephenson, Town of Smithfield
- Erin Trimyer, City of Portsmouth
- Brian Woodward, York County

¹ Virginia Department of Health, Office of Drinking Water, “Source Water Programs,” Virginia Department of Health, <http://www.vdh.virginia.gov/ODW/SourceWaterPrograms/index.htm>

1.3 Hampton Roads Municipal Community Water Systems

Hampton Roads municipal water utilities own and operate 41 community water systems throughout the region. The Hampton Roads Regional Water Supply Plan² describes the municipal water system sources and service areas. Table 1-1 lists the 34 systems that have raw water sources (reservoirs, river intakes, and wells) with source water protection measures.

Table 1-1: Municipal Community Water Systems with Raw Water Sources

Municipal Utility	Community Water System	Public Water System
Chesapeake Public Utilities	Northwest River System ¹	3550051
Franklin Public Works	City of Franklin	3620350
Gloucester Public Utilities	Gloucester County WTP	4073311
Isle of Wight Utility Services	Bethel Heights	3093111
	Carrsville	3093170
	Days Point	3093200
	Rushmere (Burwell's Bay)	3093470
	Rushmere Shores	3093480
	Smithfield Heights - Sandy Mount Manor	3093580
	Thomas Park Community	3093650
	Tormentor Creek Estates	3093665
	Zuni	3093950
James City Service Authority	Central System	3095490
	Glenwood Acres	3095317
	Kings Village	3095528
	Racefield	3095750
	Retreat	3095760
	Ware Creek Manor	3095858
	Wexford Hills	3095862
	Liberty Ridge	3095600
	Westport	3095861
Newport News Waterworks	City of Newport News ²	3700500
	Lightfoot	3199380
Norfolk Public Utilities	City of Norfolk	3710100
Portsmouth Public Utilities	City of Portsmouth	3740600
Smithfield Public Works	Town of Smithfield	3093640
Southampton Public Utilities	Boykins-Brachville System	3175100
	Drewryville System	3175300
	Edgehill System	3175340
	Town of Newsoms	3175500
Suffolk Public Utilities	Main System	3800805
	Whaleyville Water Works	3800880
Williamsburg Public Works and Utilities	City of Williamsburg	3830850
Windsor Public Works and Utilities	Town of Windsor	3093900

1. A portion of the raw water supply for the City of Chesapeake's Northwest River System is purchased from the City of Norfolk.
 2. The City of Newport News System (PWS ID 3700500) service area includes the entire cities of Newport News, Hampton, and Poquoson, the majority of York County, and a portion of James City County.

² Hampton Roads Planning District Commission, "Hampton Roads Regional Water Supply Plan (2011)," http://www.hrpdcva.gov/uploads/docs/FINAL_HR%20RWSP_Jul2011_Report_only.pdf

Table 1-2 lists the 7 systems that are currently supplied through the purchase of finished water from other municipal water systems. As such, these systems benefit from the source water protection measures implemented by the finished water provider.

Table 1-2: Municipal Community Water Systems Currently Supplied by Finished Water Purchases

<u>Water Sold By:</u> Community Water System (PWS ID) Municipal Water Utility	<u>Water Sold To:</u> Community Water System Name (PWS ID) Municipal Water Utility
City of Norfolk (3710100) Norfolk Public Utilities	South Norfolk System (3550052) Chesapeake Public Utilities
City of Norfolk (3710100) Norfolk Public Utilities	City of Virginia Beach System¹ (3810900) Virginia Beach Public Utilities
City of Portsmouth (3740600) Portsmouth Public Utilities	City of Suffolk, Main System² (3800805) Suffolk Public Utilities
City of Portsmouth (3740600) Portsmouth Public Utilities	Western Branch System (3550050) Chesapeake Public Utilities
City of Franklin (3620350) Franklin Public Works	Camptown Development Service District (3093117) Isle of Wight Utility Services
Town of Smithfield (3093640) Smithfield Public Works	Gatling Point (3093260) Isle of Wight Utility Services
Town of Windsor (3093900) Windsor Public Works and Utilities	Windsor Development Service District (3093125) Isle of Wight Utility Services
City of Suffolk, Main System² (3800805) Suffolk Public Utilities	Newport Development Service District³ (3093120) Isle of Wight Utility Services

1. The City of Norfolk treats and wheels the entire water supply for the City of Virginia Beach in accordance with a cost of service contract. The Lake Gaston water owned by Virginia Beach is discharged from the Lake Gaston Pipeline to Norfolk's Western Reservoirs, and then treated at Norfolk's water treatment plants.
2. A portion of the finished water supply for the City of Suffolk's Main System is purchased from the City of Portsmouth.
3. The Isle of Wight County Newport Development Service District is supplied by finished water from the Western Tidewater Water Authority. The City of Suffolk Main System (PWS ID 3800805) treats and distributes water for the Western Tidewater Water Authority.

1.4 Hampton Roads Regional SWPP Primary Contact

The HRPDC Water Resources Department is the primary contact for this document:

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Phone: (757) 420-8300

2 Background

2.1 VDH Source Water Programs

2.1.1 VDH Source Water Assessment Program

The 1996 Amendments to the SDWA required states to develop a Source Water Assessment Program (SWAP). One-time funding was set-aside in 1996 to complete the required Source Water Assessments and to encourage the development of Source Water Protection Programs. The VDH is the agency responsible for developing and implementing programs under the SDWA. The 2003 VDH Source Water Assessments, completed for all public water supply systems in the Commonwealth, provide initial inventories of potential sources of contamination, as well as general assessments of the susceptibility of water sources to contamination.

The 2003 VDH Source Water Assessments and susceptibility evaluations included the following components:

- Delineation of Source Water Protection Areas (SWPAs);
- Identification of potential sources of contamination within the delineated SWPAs;
- Identification and inventory of land use activities and potential pollution conduits in SWPAs; and
- Determination of the relative susceptibility of drinking water sources to potential contamination sources and land use activities.

For the Hampton Roads Region, the VDH conducted source water assessments for groundwater-dependent municipal water utilities. The VDH partnered with the HRPDC to conduct source water assessments for municipal water utilities that rely on surface water sources.

In 2013, the VDH implemented new SWAP procedures and GIS capabilities. The VDH continues to enhance the SWAP GIS program, which can generate maps and potential sources of contamination summary reports for any public water source in the Commonwealth of Virginia. The VDH's GIS tool also performs customized mapping, including surface water intake delineations, analyses of land use and soils, and impaired waterways referencing for any point location or set of geographic coordinates.

2.1.2 VDH Source Water Protection Program

Source Water Protection Programs are voluntary in the Commonwealth of Virginia. The VDH encourages and supports the development and implementation of SWPPs by providing technical and financial assistance through the Drinking Water State Revolving Fund Program and other funding programs available to local governments for implementation of protection measures. Source Water Protection Programs provide for:

- Better management of existing contamination threats to drinking water supplies, and
- Minimization of current and future risks of potential contamination threats to drinking water sources.

Source Water Protection Plans focus protection efforts to minimize risks of contamination and to ensure that high quality drinking water is delivered to the public. A community's water source represents a valuable resource and investment which, if it were to become polluted, could

negatively impact public health and would be expensive to restore or replace. Reducing or preventing chemical and microbiological contamination of water sources can ideally allow public water systems to avoid costly treatments and minimize future monitoring requirements. Protection efforts may include encouraging the use of best management practices (BMPs), developing alternative backup water sources and emergency action plans, establishing local protection teams, and using other source water protection measures described in this document.

The goals of a Source Water Protection Plan are described as:

- To promote public health, economic development, and community infrastructure by maintaining an adequate drinking water supply for all residents of the community;
- Create an awareness of the drinking water sources of the community to protect water sources from the threat of contamination as a result of accidents or unwise practices from nearby residential, industrial, commercial, agricultural, waste management, or transportation activities;
- Provide for a comprehensive action plan in case of an emergency to the water source; and
- To cooperate with the VDH in carrying out the Safe Drinking Water Act purposes and provisions.

The VDH Office of Drinking Water conducts an annual source water protection program survey from June to August. The information gathered is reported to the U.S. Environmental Protection Agency (EPA) in an annual progress report on the protection status of community water systems and the implementation status of source water protection measures. The VDH recognizes that waterworks alone have limited options to protect water sources and, in 2014, amended Virginia's Source Water Protection Program definitions to allow waterworks to obtain "substantial implementation" status credits for initiatives completed through direct or indirect partnerships with local, state, and federal programs, citizen groups, and businesses (see Appendix A-2). This approach to program evaluation emphasizes the benefits of collaboration with community partners as part of a multi-barrier approach to provide safe drinking water.³

2.2 Hampton Roads Source Water Assessment Program

The HRPDC Directors of Utilities Committee, in cooperation with the VDH, carried out a regional source water assessment of the surface water and conjunctive use wells that serve Hampton Roads municipal water utilities. The *Hampton Roads Source Water Assessment Program* (HRSWAP) was completed in 2003 for the VDH Source Water Assessment Program and included enhancements to support the long-term regional objectives of the HRPDC Directors of Utilities Committee. To facilitate the initiative, the HRPDC Directors of Utilities Committee formed the HRSWAP Subcommittee, which was comprised of watershed managers, water resource planners, and production managers from the participating water utilities. Program development involved a high level of cooperation between the HRSWAP Subcommittee, HRPDC localities, and municipalities outside of Hampton Roads.

The HRSWAP focused on 21 surface water sources and 31 conjunctive use wells operated by 8 municipal water utilities in Hampton Roads. The water supply watersheds vary from rural to

³ Virginia Department of Health, Office of Drinking Water, "Source Water Protection Program," Virginia Department of Health, <http://www.vdh.state.va.us/ODW/SourceWaterPrograms/SourceWaterProtection.htm>

urban, and sources vary from tidal surface water to groundwater. Land uses within watersheds range from agricultural and low density housing to high density industrial and commercial uses with high percentages of impervious surfaces. Multi-jurisdictional watersheds and complex purveyor and host relationships further complicate source water protection efforts.

As part of the HRSWAP project, the HRSWAP Data Management System (HRSWAP database) was developed as a watershed management and protection tool to assist municipal water utilities and locality planning departments in enhancing the protection of drinking water sources. Copies of the HRSWAP report and HRSWAP database were distributed to the participating localities. Geographical Information System (GIS) software was used to complete the following program components:

- Delineation of watershed and wellhead areas,
- Completion of an inventory and risk analysis of potential sources of contamination,
- Development of an updateable Regional Source Water Assessment Database and mapping system,
- Analysis of the susceptibility of source waters,
- Development of a regional land use classification system for the source watersheds, and
- Compilation of regional land use information into GIS.

This effort was completed under the Regional Water Supply Watershed Management Program, which is described in Section 4.2.2.

2.3 Description of the Hampton Roads Region

2.3.1 Regional Profile

The Hampton Roads region is home to approximately 1.7 million residents and is among the top forty largest Metropolitan Statistical Areas in the country, the sixth largest in the Southeast. Hampton Roads is situated in Southeastern Virginia on the Atlantic Ocean. A defining feature of the Hampton Roads region is its location at the mouth of the Chesapeake Bay, which is known as the “world’s greatest natural harbor.” A significant portion of the regional economy derives from the competitive advantage provided by this natural harbor, which enhances the region’s strategic capabilities to support military activities, foreign trade operations, and port facilities. Hampton Roads boasts a unique combination of physical and socio-economic features. The region is an important military center and hosts one of the largest seaports in the world. The region is also a prime East Coast tourist destination, with beaches, recreational waterways, and historic resources. The coastal and estuarine topography of Hampton Roads is low-lying and prone to tidal flooding. With the prevalence of water bodies throughout the area, seven bridges and tunnels comprise major components of the region’s transportation system. A nuclear power plant is also located in the region.

The Hampton Roads region includes 27 localities: 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 (see Figure 2-1). The region can be generally discussed in terms of three sub-regions:

Peninsula: 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. The Peninsula sub-region includes both urban and rural areas.

Southside: The James River separates the Southside sub-region from the Peninsula sub-region to the north. The Southside sub-region includes the Cities of Chesapeake, Norfolk, Portsmouth, Suffolk, and Virginia Beach. Each of these cities have dense population centers, however, Chesapeake, Suffolk, and Virginia Beach also have rural areas.

Western Tidewater: The Western Tidewater sub-region is located to the west of the Southside sub-region and is also separated from the Peninsula sub-region by the James River. 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 in Western Tidewater is the City of Franklin. The sub-region is mostly rural with scattered, small population centers.

2.3.2 Physiographic Setting

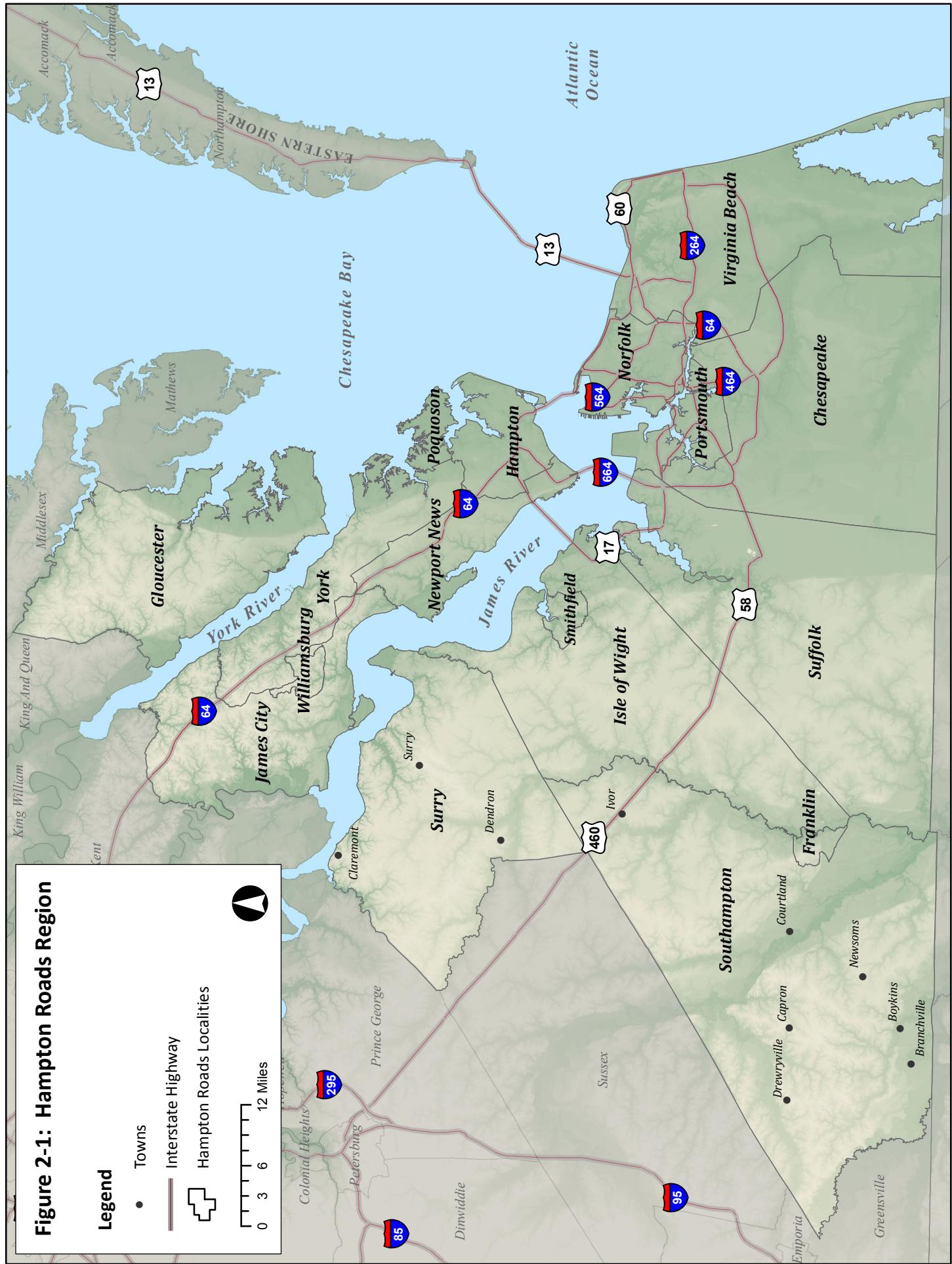
The entire Hampton Roads region is located in the Virginia Coastal Plain physiographic province in Southeastern Virginia at the mouth of the Chesapeake Bay. The lowland topography is generally flat, with little relief, and is laced by several major rivers. The region enjoys mild winters with warm, humid summers. In addition to summer thunderstorms, Nor'easters and tropical storms bring significant rainfall to the region. The National Climatic Data Center (NCDC) annual climate normals for precipitation and temperature in the region, as indicated by data from four selected weather stations, are shown in Table 2-1.

Table 2-1: 1981-2010 Annual Climate Normals, Selected Weather Stations in Hampton Roads

Weather Station (Location)	Subregion	Precipitation (Inches)	Minimum Temperature (Fahrenheit)	Average Temperature (Fahrenheit)	Maximum Temperature (Fahrenheit)
Langley Air Force Base (Hampton)	Peninsula	46.70	50.9	59.5	68.2
Williamsburg (Williamsburg)	Peninsula	48.31	48.9	58.7	68.5
Holland (Suffolk)	Southside and Western Tidewater	48.20	48.2	59.8	71.4
Norfolk International Airport (Norfolk)	Southside	46.53	52.1	60.2	68.3

Source: NOAA National Climatic Data Center 1981-2010 Climate Normals: <http://www.ncdc.noaa.gov/cdo-web/datatools/normals>

Figure 2-1: Hampton Roads Region



More than 45 inches of annual rainfall are well distributed throughout the year, with the wettest months typically being July and August. Evaporation is greatest during the months of June and July, with the monthly average ranging from 7.0 to 7.31 inches.⁴ January is the coldest month on average, while July is the hottest. Coastal communities enjoy onshore winds that moderate temperature extremes.

2.3.3 Geology

The Virginia Coastal Plain physiographic province extends from the Fall Line in the west to the Atlantic Ocean in the east, to the Maryland border in the north, and to the North Carolina border in the south. The surficial geology consists of unconsolidated sediments that were deposited in fluvial, estuarine, and shallow marine environments. The subsurface is characterized by wedge shaped unconsolidated sedimentary deposits that slope (dip) and thicken towards the east, underlain by crystalline bedrock that also slopes gently to the east. 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.⁵ The Chesapeake Bay impact crater is greater than 50 miles in diameter and extends across a large part of the southeastern Virginia Coastal Plain. The crater was formed over 35 million years ago and has impacted the groundwater quality and flow pattern within the region.

2.3.4 Groundwater Resources

The Virginia Coastal Plain is underlain by a regionally extensive aquifer system – a wedge of eastward dipping sedimentary rock layers that function as water-bearing units and confining units. As shown in Figure 2-2, the wedge thickens eastward from the Fall Line (the dividing line between the harder rocks of the Piedmont physiographic province and the softer strata of the Coastal Plain), ranging in thickness from zero feet near Richmond to more than 6,000 feet along the Atlantic coast. Beneath the shallow, unconfined Columbia water table aquifer, the U.S. Geological Survey (USGS) identifies several confined aquifers beneath the Hampton Roads region: Yorktown-Eastover, Piney Point, Chickahominy, Aquia, and Potomac aquifers. Groundwater flow and chemistry in the region is also influenced by the Chesapeake Bay impact crater. The USGS report “The Virginia Coastal Plain Hydrogeologic Framework” by McFarland and Bruce⁶ provides a comprehensive description of the aquifer system in the Hampton Roads region.

In general, water from shallow aquifers is used primarily by individual residences, irrigation systems, and agricultural operations. The deeper aquifers are more productive and are used extensively to supply water to public and private community water systems and industrial sites. Under the Groundwater Management Act of 1992, groundwater withdrawals are managed through a Virginia Department of Environmental Quality (DEQ) permitting program regulating

⁴ Total evaporation data for the Holland weather station (Holland 1E) is available for the years from 1989 to 2007 from the NOAA National Centers for Environmental Information. Data was extracted from the Climatological Data Annual Summaries for Virginia (<http://www.ncdc.noaa.gov/IPS/cd/cd.html>). Monthly averages for the period of record are as follows: April 5.44 in.; May 6.31 in.; June 7.00 in.; July 7.31 in.; August 6.31 in.; September 4.93 in.; October 3.69 in.

⁵ Powars, D.S., and Bruce, T.S., 1999, The Effects of the Chesapeake Bay Impact Crater on the Geological Framework and Correlation of Hydrogeologic Units of the Lower York-James Peninsula, Virginia: U.S. Geological Survey Professional Paper 1612. <http://pubs.usgs.gov/prof/p1612/>

⁶ McFarland, E.R. & Bruce, T.S., 2006, The Virginia Coastal Plain Hydrogeologic Framework. U.S. Geological Survey Professional Paper 1731, 118 p., 25 pls. <http://pubs.water.usgs.gov/pp1731/>

withdrawals in designated Groundwater Management Areas (GWMA). Virginia has two GWMA: the Eastern Virginia GWMA and the Eastern Shore GWMA. All of the localities in the Hampton Roads Region are within the Eastern Virginia GWMA. Any groundwater withdrawal greater than 300,000 gallons per month and located in a GWMA must obtain a groundwater withdrawal permit from the DEQ.

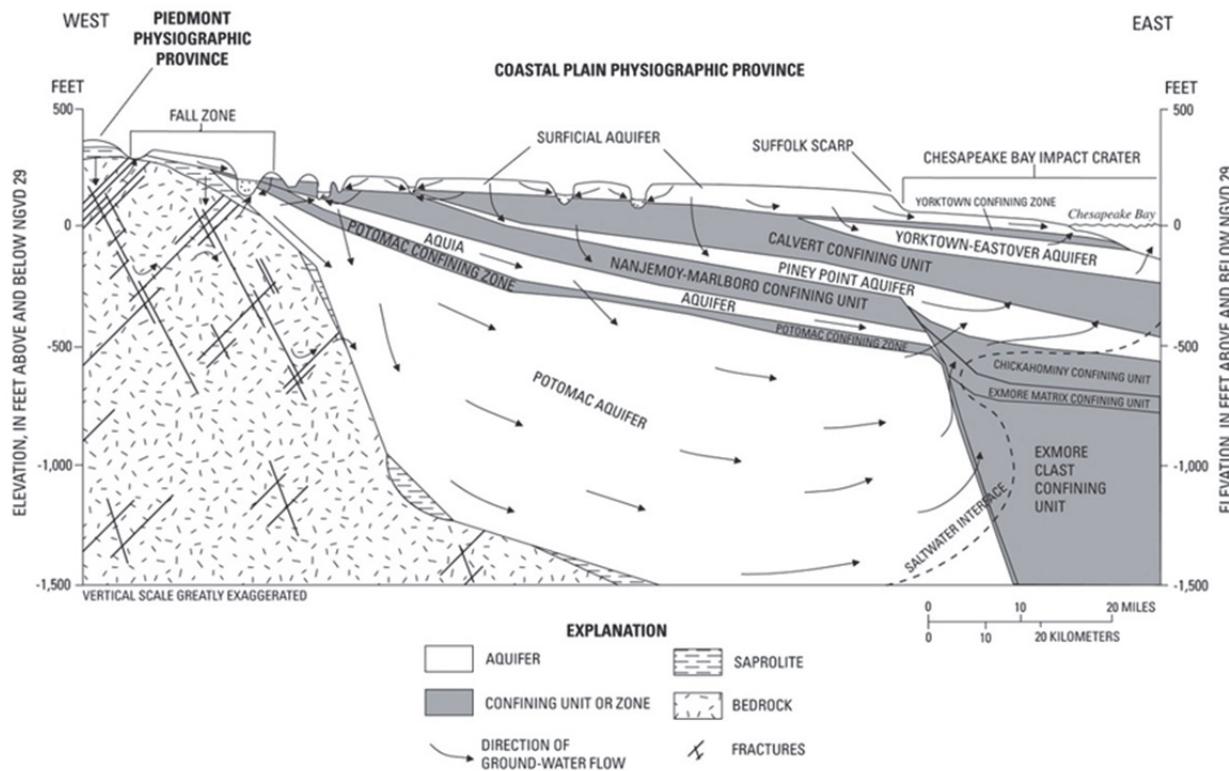


Figure 2-2: Cross-section of the Coastal Plain aquifer system (McFarland & Bruce, 2006).

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, and groundwater flow gradients have shifted toward these inland pumping centers, creating the potential for saltwater intrusion into freshwater aquifers along the coast. Pursuant to legislation adopted in 2015 by the General Assembly, the Eastern Virginia Groundwater Management Advisory Committee was established to assist the State Water Commission and the DEQ in developing, revising, and implementing a management strategy for groundwater in the Eastern Virginia Groundwater Management Area.

The Eastern Virginia Groundwater Management Advisory Committee is tasked with examining: (i) options for developing long-term alternative water sources, including water reclamation and reuse, groundwater recharge, desalination, and surface water options, including creation of storage reservoirs; (ii) the interaction between the DEQ's groundwater management programs and local and regional water supply plans within the Eastern Virginia Groundwater Management Area for purposes of determining water demand and possible solutions for meeting that demand; (iii) potential funding options both for study and for implementation of management options; (iv) alternative management structures, such as a water resource trading program, formation of a long-term groundwater management committee, and formation of a commission;

(v) additional data needed to more fully assess aquifer health and sustainable groundwater management strategies; (vi) potential future groundwater permitting criteria; and (vii) other policies and procedures that may enhance the effectiveness of groundwater management in the Eastern Virginia Groundwater Management Area. The Advisory Committee will report the results of its examination and related recommendations to the DEQ Director and the State Water Commission no later than August 1, 2017.

2.3.5 Surface Water Resources

Hydrologic units are drainage areas delineated within a multi-level hierarchical drainage system. According to the USGS, hydrologic units are classified into four levels (regions, sub-regions, accounting units, and cataloging units) that are nested within each other from largest to smallest geographic area; each unit is assigned a unique hydrologic unit code (HUC) consisting of two to eight digits based on the classification level.⁷ Accounting units are also referred to as basins; cataloging units are also called sub-basins or watersheds. The hydrologic conditions of Hampton Roads are described below to the cataloging unit (sub-basin) level. Cataloging units are assigned eight-digit HUCs (HUC 8) and represent part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature. Figure 2-3 shows the watersheds (HUC 8 sub-basins) that are located within and around the Hampton Roads region.⁸

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 that ultimately discharges into the Atlantic Ocean between the states of New York and Virginia and from the Long Island Sound (south of the New York-Connecticut State Line). 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 sub-regions that are identified by four-digit HUCs. Hampton Roads municipal drinking water sources and designated source water protection areas are located within the Lower Chesapeake sub-region (0208).

Lower Chesapeake Sub-region (0208)

The Lower Chesapeake sub-region (0208) encompasses portions of Virginia, West Virginia, Maryland, and Delaware and includes drainage to the southern portion of the Chesapeake Bay. The total area of the Lower Chesapeake sub-region is 20,682 square miles.

The Lower Chesapeake sub-region is split into several basins that are identified by six-digit HUCs. Hampton Roads municipal drinking water sources and designated source water protection areas are located within two basins: the Lower Chesapeake basin (020801) and the James basin (020802).

⁷ U.S. Geological Survey, “Hydrologic Unit Maps,” U.S. Geological Survey, <http://water.usgs.gov/GIS/huc.html>

⁸ This figure was created with the Watershed Boundary Dataset, a coordinated effort between the U.S. Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS), the U.S. Geological Survey (USGS), and the Environmental Protection Agency (EPA). The Watershed Boundary Dataset was created from a variety of sources from each state and aggregated into a standard national layer for use in strategic planning and accountability. Watershed Boundary Dataset for Virginia, <http://datagateway.nrcs.usda.gov>

Figure 2-3: Watersheds

Legend

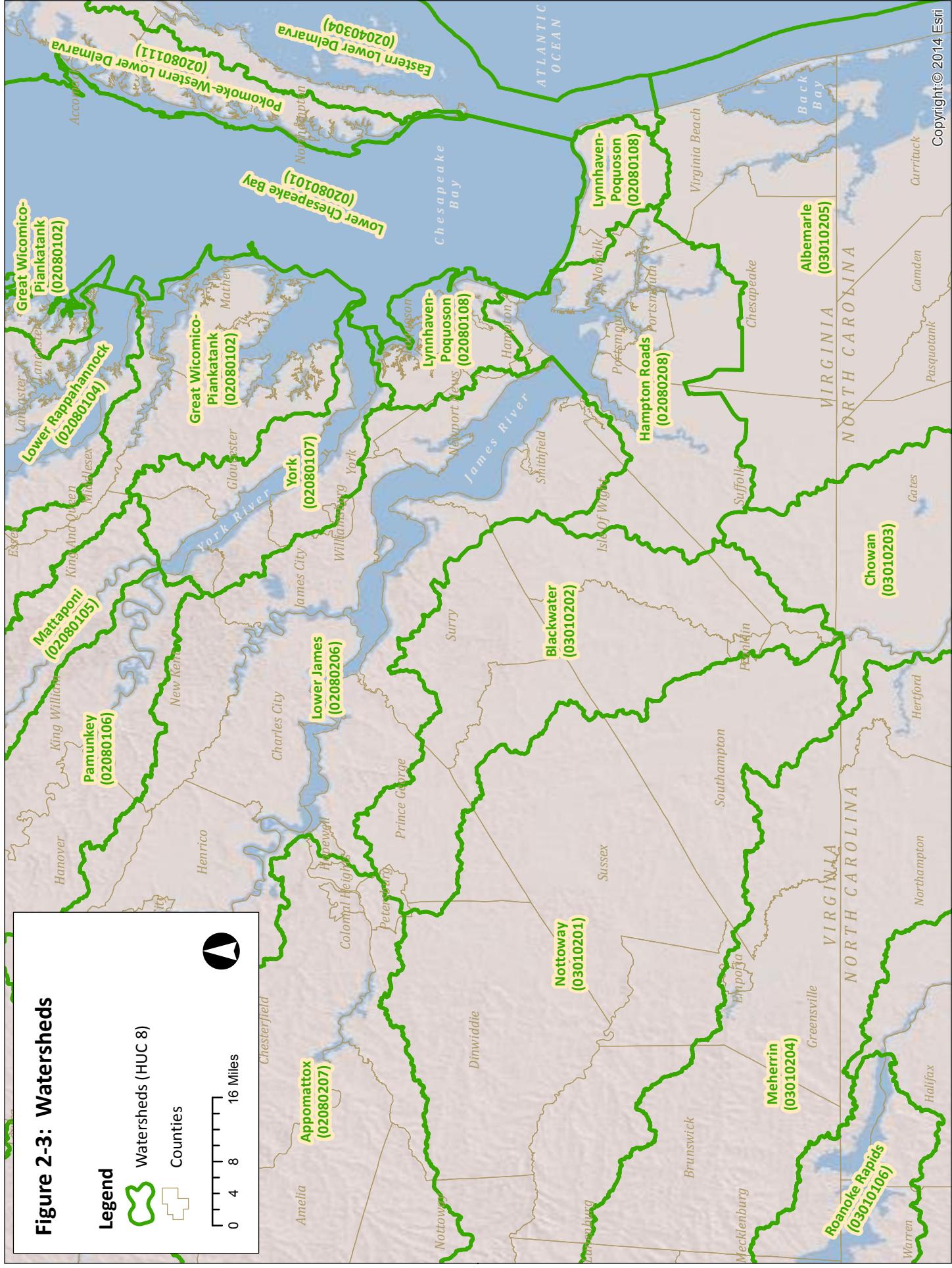


Watersheds (HUC 8)



Counties

0 4 8 16 Miles



Lower Chesapeake Basin (020801)

The Lower Chesapeake basin lies in the central and eastern section of Virginia and covers 10,340 square miles or approximately 24 percent of the Commonwealth's total area. The V-shaped basin begins in Rappahannock County, Virginia and Caroline County, Maryland and extends south to Hampton Roads to include the lower Chesapeake Bay. The basin is divided into eleven sub-basins identified by eight-digit HUCs (see Table 2-2). Hampton Roads municipal drinking water sources and designated source water protection areas are located within three sub-basins: the Great Wicomico-Piankatank sub-basin (02080102); the York sub-basin (02080107); and the Lynnhaven-Poquoson sub-basin.

Table 2-2: Lower Chesapeake Basin USGS HUC 8 Sub-Basins

Sub-Basin Name	Area (square miles)	HUC 8 Code
Lower Chesapeake Bay	1,177	02080101
Great Wicomico-Piankatank	671	02080102
Rapidian-Upper Rappahannock	1,557	02080103
Lower Rappahannock	1,156	02080104
Mattaponi	911	02080105
Pamunkey	1,472	02080106
York	292	02080107
Lynnhaven - Poquoson	230	02080108
Nanticoke	827	02080109
Tangier	971	02080110
Pocomoke-Western Lower Delmarva	1,076	02080111

James Basin (020802)

The James basin occupies the central portion of Virginia and covers 10,342 square miles or approximately 24 percent of the Commonwealth's total land area. The James basin begins in the Alleghany Mountains and drainage flows in a southeasterly direction to Hampton Roads where it enters the Chesapeake Bay. The basin is divided into eight sub-basins identified by eight-digit HUCs (see Table 2-3). Hampton Roads municipal drinking water sources and designated source water protection areas are located within two sub-basins: the Lower James sub-basin (02080206); and the Hampton Roads sub-basin (02080208).

Table 2-3: James Basin USGS HUC 8 Sub-Basins

Sub-Basin Name	Area (square miles)	HUC 8 Code
Upper James	2,212	02080201
Maury	838	02080202
Middle James - Buffalo	2,023	02080203
Rivanna	768	02080204
Middle James - Willis	945	02080205
Lower James	1,441	02080206
Appomattox	1,610	02080207
Hampton Roads	505	02080208

South Atlantic-Gulf Region (03)

A portion of Hampton Roads is located within the South Atlantic-Gulf Region of the United States, which contains all areas where the drainage ultimately discharges into the Atlantic Ocean between southern Virginia and Florida and the Gulf of Mexico from Florida to the eastern end of Louisiana. 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 sub-regions that are identified by four-digit HUCs. Hampton Roads municipal drinking water sources and designated source water protection areas are located within the Chowan-Roanoke sub-region (0301).

Chowan-Roanoke Sub-region (0301)

The Chowan-Roanoke sub-region is located within Virginia and North Carolina and includes the Albemarle Sound and coastal drainage, including the Back Bay drainage to Currituck Sound and Oregon Inlet. The total area of the Chowan-Roanoke sub-region is 19,063 square miles.

The Chowan-Roanoke sub-region is split into several basins that are identified by six-digit HUCs. Hampton Roads municipal drinking water sources and designated source water protection areas are located within two basins: Roanoke basin (030101) and Albemarle-Chowan basin (030102).

Roanoke Basin (030101)

The Roanoke basin extends across the southern portion of central Virginia to northeastern North Carolina and covers 9,767 square miles. The basin includes areas from Roanoke, Virginia to Washington County, North Carolina and discharges to the Albemarle Sound. The basin is divided into seven sub-basins identified by eight-digit HUCs (see Table 2-4). Hampton Roads municipal drinking water sources and designated source water protection areas are located within the Roanoke Rapids sub-basin (03010106).

Table 2-4: Roanoke Basin USGS HUC 8 Sub-Basins

Sub-Basin Name	Area (square miles)	HUC 8 Code
Upper Roanoke	2,191	03010101
Middle Roanoke	1,738	03010102
Upper Dan	2,055	03010103
Lower Dan	1,284	03010104
Banister	597	03010105
Roanoke Rapids	592	03010106
Lower Roanoke	1,310	03010107

Albemarle-Chowan Basin (030102)

The Albemarle - Chowan basin is located in southeastern Virginia and northeastern North Carolina and covers 9,296 square miles. The basin extends eastward from Charlotte County, Virginia to Albemarle Sound, Currituck Sound, and the northern portion of Pamlico Sound in North Carolina. The basin is divided into five sub-basins identified by eight-digit HUCs (see Table 2-5). There are Hampton Roads municipal drinking water sources and designated source water protection areas located within all five sub-basins.

Table 2-5: Albemarle-Chowan Basin USGS HUC 8 Sub-Basins

Sub-Basin Name	Area (square miles)	HUC 8 Code
Nottoway	1,723	03010201
Blackwater	740	03010202
Chowan	898	03010203
Meherrin	1,612	03010204
Albemarle	4,323	03010205

3 Source Water Protection Areas and Potential Contamination Sources

3.1 Delineation of Source Water Protection Areas

Source water protection areas have been delineated for water sources serving municipal community water systems in Hampton Roads (see Sections 2.1 and 2.2). Maps illustrating source water protection area boundaries for each municipal source were produced by VDH in 2015; the maps were provided to the municipal utilities separately from this document. Source water protection area (SWPA) delineations are meant as a guide and a visual aid for elected officials, water managers, or other readers of the SWPP to see the aerial extent of land use activities influencing the quality of source water. General descriptions of SWPAs are provided below.

3.1.1 Groundwater Sources

The Virginia Source Water Assessment Program defines the Zone 1 SWPA for groundwater sources as the area within a 1,000-foot fixed radius surrounding each water supply well. Zone 1 is a priority protection radius; within Zone 1 all land use activities (LUAs), including potential contaminant sources (PCS) sites and potential conduits to groundwater (improperly constructed or abandoned wells, elevator shafts, geothermal heat pump wells, etc.), should be delineated.

The Zone 2 SWPA for groundwater sources is the area within a fixed 1-mile radius from the source. Within Zone 2, PCS sites should be identified by available environmental, regulatory and land use databases. The SWPA boundary is meant as a visual reference to delineate the surface or subsurface recharge area surrounding a well that needs to be protected from contaminant sources.

There are other more sophisticated techniques to delineate source water protection areas, including travel time and flow boundary methods. These methods may be warranted depending on the vulnerability of the groundwater source, the complexity of the groundwater flow system, and the type of source water protection measures planned. The VDH has determined that the fixed radius approach to delineate source water protection areas for groundwater sources is the approach of choice for Virginia.⁹ The VDH considers the fixed-radius approach to be a reasonable approximation of the area surrounding the wellhead where contamination could reach the well in a reasonable period of time.

In Hampton Roads, municipal drinking water wells are screened in the deeper confined aquifers of the Virginia Coastal Plain. These aquifers are not subject to significant influence by surface land use activities, as they are separated from the shallow water table by confining units. The deep aquifers are primarily recharged by infiltration and percolation along the Fall Zone (generally along the I-95 corridor, where the Piedmont transitions to the Coastal Plain Physiographic Province), with the general direction of groundwater flow moving eastward.

⁹ The basis for selecting the fixed radius delineation approach for groundwater sources is explained in the document “Virginia Source Water Assessment Program (1999),” available at: http://www.vdh.virginia.gov/content/uploads/sites/14/2016/04/1999VDH_SWAP.pdf

3.1.2 Surface Water Sources

For surface water sources, the VDH has determined that a 5-mile fixed distance approach to delineate source water protection areas is the approach of choice for Virginia.¹⁰ Surface water SWPA zones are delineated differently depending on the source type:

Non-Tidal Sources:

Zone 1 SWPA:	Upgradient watershed within a 5-mile radius from the intake
Zone 2 SWPA:	Upgradient watershed beyond the 5-mile radius from the intake

Tidal Sources:

Zone 1 SWPA:	Upgradient and downgradient watershed within a 5-mile radius from the intake
Zone 2 SWPA:	Upgradient watershed beyond the 5-mile radius from the intake

Impounded Sources:

Zone 1 SWPA:	Upgradient watershed within a 5-mile radius from the intake and downgradient watershed as far as the impoundment dam
Zone 2 SWPA:	Upgradient watershed beyond the 5-mile radius from the intake and downgradient watershed as far as the impoundment dam

3.2 Susceptibility to Contamination

The vulnerability of water sources to contamination as defined by VDH ranges from low to high susceptibility. The susceptibility ranking is determined by factors including the presence of potential conduits, the presence of potential sources of contamination or land use activities of concern in the Zone 1 assessment area, unknown or inadequate well construction information, or water quality indicators of contamination. The contaminants of concern are primarily chemicals such as petroleum products, solvents and degreasers containing VOCs, and inorganic chemicals. The susceptibility classes defined by VDH are summarized in Appendix A-3.

3.3 Inventory of Potential Contamination Sources

Potential contamination sources (PCS) and land use activities of concern have been identified for water sources serving municipal community water systems in Hampton Roads. PCS inventories, as well as maps illustrating PCS locations and land use activities of concern relative to SWPA boundaries, were produced by VDH; the inventories and maps were provided to Hampton Roads municipal water utilities separately from this document.

3.3.1 PCS Identification

Land use activities of concern and PCS were compiled from VDH's Source Water Assessments and from Virginia Environmental Geographic Information Systems databases, including the Virginia DEQ Solid Waste Facilities, Virginia Pollution Discharge Elimination System facilities, EPA Facility Registry System, Registered Petroleum Facilities, and Petroleum Releases. To reduce risks to source water quality, regular review of land use activities and potential contamination sources is recommended.

¹⁰ The basis for selecting the 5-mile fixed distance delineation approach for surface water sources is explained in the document "Virginia Source Water Assessment Program (1999)," available at: http://www.vdh.virginia.gov/content/uploads/sites/14/2016/04/1999VDH_SWAP.pdf

Point Sources and Non-point Sources of Contamination

Groundwater and surface water bodies may be exposed to point source contamination through a pipe, ditch, spills, leaks or other well-defined point of discharge, and potential conduits such as wells. The primary pollutants associated with point source discharges include oxygen-demanding waste, nutrients, sediment, color and toxic substances including volatile organic compounds (VOCs), oils, petroleum products, pesticides, chlorine, ammonia, and metals.

Industrial land uses commonly use toxic substances as part of manufacturing, warehousing, and/or distribution. Chemicals, petroleum products, cleaning supplies, machinery, metals, electronic products, asphalt, and other substances pose a potential threat to the water supply and must be managed. Commercial land uses may include commercial operations that use toxic and hazardous materials in their processes.

Examples of industrial and commercial land uses include:

- Auto repair shops, gas stations, car washes, paint shops;
- Road maintenance depots and de-icing operations;
- Construction areas;
- Landfills;
- Dry cleaners and laundromats;
- Medical institutions, research laboratories, photography, and printing facilities;
- Restaurants and bakeries;
- Woodworking and finishing facilities.

The storage, use, and disposal of chemicals required by industrial and commercial operations can pose a potential threat to water since even small amounts of the hazardous materials can contaminate large amounts of surface or groundwater. Storing quantities of the material can also create a serious problem if they are not contained and stored properly. Leaks and spills from storage tanks and pipes can contaminate water, rendering the water unfit for consumption. Improper retention, storage, and or disposal of waste products from industrial and commercial land uses can also pose threats to water supplies.

Fuel oil tanks represent a potential source of contamination from petroleum products, as well as chemical additives that may be present in the fuel. The potential threat of contamination from underground and above ground storage tanks would be from a leak, overfill, or spill.

Non-point sources are described as dispersed contamination from many sources such as soil erosion, septic systems, storm water runoff, and agricultural activities. The most significant non-point sources of contamination are nitrates associated with the use of manure, fertilizer, and pesticides which can infiltrate into groundwater. Manure storage facilities and manure/septage sludge spreading can also lead to high levels of e-Coli bacteria and nitrate concentrations within surface and groundwater due to runoff.

Roadways are a potential source of contamination due to potential petroleum leaks from vehicles, the application of road salts which could cause elevated levels of sodium and chlorides, and maintenance activities which may include herbicide and pesticide applications. Accidents also pose a potential source of contamination to groundwater due to spills of oil, gas, antifreeze, and hydraulic fluids.

Household hazardous and commercial/industrial waste (e.g., ammonia, chlorides, paint, paint thinners, waste oil, antifreeze, solvents, etc.) may be spilled on the ground or disposed of in septic systems, and therefore are also potential sources of non-point pollution. When properly stored, handled and disposed of, these chemicals have little chance of contaminating the environment.

Residential land use contamination threats, if taken on a case-by-case basis, are normally less than other land uses, but can form a significant source of contamination on a large scale. Residents may be unaware of the effects of numerous potential contaminants stored, used, and disposed of from residential homes. The potential contaminants include:

- Household chemicals;
- Automotive products;
- Paint/solvents;
- Fuel storage systems;
- On-site septic/sand mound systems;
- Lawn/garden chemicals; and
- Abandoned wells (potential conduits for pollutants).

3.3.2 Additional Concerns Identified for Hampton Roads

The HRPDC Directors of Utilities Committee identified the following additional concerns, particularly with regard to surface water reservoirs:

- Highway/roadway transportation of hazardous materials: Chemicals, fuels, and waste are transported via trucks along highways/roadways located within SWPAs. A tanker truck spill, a vehicular accident, or roadway infrastructure failure could expose source waters to a hazardous materials release.
- Railroad transportation of hazardous materials: Shale oil and other hazardous materials are transported by rail cars through SWPAs. An accident or infrastructure failure could cause a release of hazardous materials with the potential to contaminate source waters.
- Hazardous liquid and gas transmission pipelines: Transmission pipelines carry hazardous materials to local distribution systems. A pipeline failure within a SWPA could cause the contamination of drinking water resources.
- Municipal wastewater pump stations: Wastewater pump stations are located within SWPAs. A sanitary sewer overflow at a wastewater pump station could potentially impact source waters.

Maps showing railroads in relation to source water protection area boundaries are provided in Appendix B. Geospatial information on roadways, railroads, and municipal wastewater pump stations was compiled by the HRPDC staff from regional and local data sets. A geodatabase was provided to municipal utilities to serve as an inventory of these land uses in relation to sources and source water protection areas.

National Pipeline Mapping System (NPMS) data on hazardous liquid and gas transmission pipelines was requested and received¹¹ from the U.S. Department of Transportation's Pipeline

¹¹ NPMS data consists of gas transmission pipelines and hazardous liquid trunklines. It does not contain gathering or distribution pipelines, such as lines which deliver gas to a customer's home. The HRPDC's NPMS data set request was fulfilled on March 25, 2016 and reflects data available at that time. Pipeline operators are required to update data every 12 months. NPMS data is confidential. Requests for access to the NPMS

and Hazardous Materials Safety Administration (PHMSA) to support this planning document. The NPMS maintains an interactive online map that allows the user to view limited-scale pipeline information one county at a time. The HRPDC staff used NPMS data to produce static maps, in accordance with NPMS policies, showing gas transmission pipelines and hazardous liquid trunklines for a single county at a scale no larger than 1:24,000.¹² The maps are provided in Appendix C.

Another resource that may be useful to utilities in identifying energy-related PCS is the U.S. Energy Information Administration's interactive online maps¹³, which allow the user to view publicly available information on energy infrastructure (pipelines, processing plants, rail and port terminals, etc.) for multiple counties at a scale no larger than 1:1,000,000 (1 inch is approximately 16 miles). The geodatabase provided to municipal utilities includes the geospatial datasets that were available for download from the U.S. Energy Information Administration's website as of September 2016. A regional map showing the natural gas and petroleum pipelines from this dataset is included in Appendix B (see map entitled "Hampton Roads Area Rail and Pipeline Facilities").

Salt water intrusion is a concern for the region's groundwater resources. The primary drinking water aquifers in Hampton Roads are at risk of water quality degradation from increasing chloride concentrations. A 2014 report¹⁴ prepared for the HRPDC Directors of Utilities Committee estimates the chloride concentration in the region's four primary drinking water aquifers and recommends support for the Virginia DEQ's groundwater monitoring strategy and a properly designed chloride monitoring well network. The report includes maps showing the estimated chloride concentrations across each aquifer, the location of public and private water system wells, and the portions of the region where all homes and businesses rely on individual wells. The geodatabase provided to municipal utilities includes this information to serve as a resource for management strategies and future planning efforts.

information system or records derived from NPMS must be submitted to the PHMSA Associate Administrator for Pipeline Safety. For more information, see <https://www.npms.phmsa.dot.gov/>.

¹² Static maps containing NPMS data are restricted to displaying NPMS data for a single county and at a scale no larger than 1:24,000.

¹³ U.S. Energy Information Administration, "Layer Information for Interactive State Maps," U.S. Department of Energy, http://www.eia.gov/maps/layer_info-m.php

¹⁴ Hampton Roads Planning District Commission, "Chloride Concentrations in Hampton Roads Drinking Water Sources, Salt Water Intrusion and Potential Impacts to Community Water Systems (2014)," http://www.hrpdcva.gov/uploads/docs/FINAL_ChloridesHRDrinkingWaterSources_Sept.2014.pdf

4 Hampton Roads Regional Source Water Protection Plan

This regional planning document addresses source water protection goals to the extent practicable at the regional level. The VDH recognizes that waterworks alone have limited options to protect water sources and, in 2014, amended Virginia's Source Water Protection Program definitions to allow waterworks to obtain "substantial implementation" status credits for initiatives completed through direct or indirect partnerships with local, state, and federal programs, citizen groups, and businesses (see Appendix A-2). This approach to program evaluation emphasizes the benefits of collaboration with community partners as part of a multi-barrier approach to provide safe drinking water.¹⁵

The Hampton Roads Regional SWPP is a planning document and there is no legal requirement to implement the strategies and recommendations herein. Actions on public lands will be subject to federal, state, and local policies and procedures. Actions on private land may require compliance with local land use ordinances, building codes, local covenants, and permission from the landowner.

According to the VDH SWPP Development Approach (see Appendix A-1) a SWPP typically includes the following components:

- Description of the water system;
- Inventory of identified PCS;
- Strategy to manage/minimize current risks; and
- Goal to minimize future threats.

Water system descriptions are included in the Hampton Roads Regional Water Supply Plan (see Section 4.2.2). PCS inventories and maps were provided to Hampton Roads municipal water utilities separately from this document. Regional strategies to manage and minimize current risks and future threats are discussed in the sections below. The VDH SWPP Development Approach states that the SWPP should be an active document with recommendations that are implemented in a timely and efficient manner, and the SWPP should be revisited, reviewed, and updated at least every three years.

4.1 General Management Strategies

General management strategies for source water protection include measures in the following categories: public education, planning and policy approaches, regulatory approaches, and non-regulatory approaches. Table 4-1 lists examples of each type of protection measure. Applicable and appropriate protection measures differ depending on the water source. Many general management strategies are being implemented through regional programs and initiatives administered through the HRPDC (see Section 4.2).

¹⁵ Virginia Department of Health, Office of Drinking Water, "Source Water Protection Program," Virginia Department of Health, <http://www.vdh.state.va.us/ODW/SourceWaterPrograms/SourceWaterProtection.htm>

Table 4-1: Source Water Protection Approaches and Examples of Measures

Public Education	<ul style="list-style-type: none"> • Work with community groups • Post signs along roads that state “Entering a Source Water Protection Area” • Display educational material on town or water system web site • Distribute brochures to water customers and residents in the Source Water Protection Area
Planning and Policy	<ul style="list-style-type: none"> • Compliance planning • Memo of inter-jurisdictional cooperation • Capital improvement plan • Emergency response plan
Regulatory	<ul style="list-style-type: none"> • Zoning: source water protection overlay district • Review procedure for subdivisions specifically for source water protection • Septic System ordinances • Sinkhole ordinances
Non-regulatory	<ul style="list-style-type: none"> • Acquisition of property easements • Use of value taxation

Source: Virginia Department of Health SWPP Development Approach (see Appendix A-1)

4.2 Existing Regional Source Water Protection Strategies

The HRPDC member localities have promoted and implemented initiatives for source water and water quality protection and water resource management through cooperative efforts since the 1990s. Completed and ongoing regional initiatives are listed in Table 4-2. Summaries of each initiative are provided in the sections below.

Table 4-2: Existing Regional Source Water Protection Activities

Public Education	<ul style="list-style-type: none"> • askHRgreen.org (2011 – present) • Hampton Roads Water Efficiency Team (1994-2011) • Hampton Roads Regional Water Supply Plan (2011, updates ongoing) • Regional Groundwater Mitigation Program (1994 – present) • Regional Watershed Management Program (1997 – 2003)
Planning and Policy	<ul style="list-style-type: none"> • Regional Stormwater Management Program (2003 – present) • HRPDC-USGS Cooperative Studies and Programs (1995 – 2012) • Hampton Roads Water Quality Response Plan (2000 – present) • Hampton Roads Water and Wastewater Systems Emergency Preparedness and Response Regional Improvement Plan (2012)
Regulatory	<ul style="list-style-type: none"> • Sanitary Sewer Overflow Reporting System (2004 – present) • Regional Construction Standards (1999 – present)

4.2.1 Public Education: askHRgreen.org

An informed and educated community helps ensure the protection of healthy water supplies. Hampton Roads benefits from a comprehensive environmental public awareness and education program called askHRgreen.org. The askHRgreen.org partnership is a regional program that strives to turn environmental awareness into engagement and positive stewardship behaviors. The askHRgreen.org partnership supports Hampton Roads municipal water utilities in a multi-barrier approach to source water protection with media campaigns, public relations events, and

outreach materials to encourage individuals, citizen groups, and communities to adopt green practices that protect drinking water sources.

The askHRgreen.org partnership is funded by local governments and the Hampton Roads Sanitation District (HRSD) and is administered through the HRPDC. Members of askHRgreen.org include 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; the town of Smithfield; and the HRSD.

askHRgreen.org, launched in 2011, provides consistent, easy-to-understand environmental messaging across the Hampton Roads region to help citizens understand how personal actions can help improve and protect water quality and benefit the larger environment. askHRgreen.org coordinates four public education programs under an umbrella brand¹⁶: water conservation and water stewardship; stormwater pollution prevention; prevention of SSOs caused by improper disposal of household materials; and recycling and litter prevention. By creating award winning¹⁷ outreach materials under an umbrella brand, askHRgreen.org delivers environmental messages in a format that “humanizes” environmental thinking and inspires stewardship through compelling storytelling and in-person and online experiences.

The askHRgreen.org website, “[y]our go-to resource for everything green in Hampton Roads,” serves as the primary digital resource for the program. The website includes all outreach materials developed for askHRgreen campaigns, as well as an event calendar, the “Let’s Talk Green” blog, articles, and an online media toolkit. “Good to Know” environmental tips and “Good to Do” practices and resource links are organized on the website in the following categories:

- Your Home
- Your Business
- Your Classroom
- Your Yard
- Your Community
- Your 3Rs (Reduce, Reuse, Recycle)

The askHRgreen.org online media toolkit provides print and digital resources for download by Hampton Roads localities and the general public. Designed for sharing, toolkit materials are especially useful for civic leagues, community groups, home owners associations, schools, clubs, businesses and any organization with an interest in improving neighborhoods and communities. The media toolkit resources include both printable materials (brochures, rack cards, print ads, posters, infographics, stickers, publications, seasonal articles, and logos) and digital materials (radio ads, digital/online ads, video spots). The Water Quality Toolkit includes fact sheets for maintaining stormwater best management practices, as well as a subset of the media toolkit materials that address the reduction of non-point source pollution.

The Bay Star Homes program, which is administered through askHRgreen.org, recognizes residents who pledge to avoid behaviors that are harmful to local waterways. Participants are also encouraged to incorporate environmentally-friendly choices into their daily routines. Because the program incorporates broad environmentally-friendly behaviors from all askHRgreen.org education programs, the program focuses on clean waterways, green living, and clean communities in general. The program is open to any Hampton Roads resident, regardless

¹⁶ askHRgreen.org, “Reaching the Target Audience, askHRgreen.org Brand,” <http://askhrgreen.org/wp-content/uploads/2016/01/askRHgreen-ReachingtheTargetAudience.pdf>

¹⁷ The Public Relations Society of America, 2016 Pinnacle Awards recognized two askHRgreen.org initiatives: “What Does Water Mean to You?” was awarded first place for Video Programs (\$5,000 and above); and the *Green Magazine*, a 2015 supplement to *Coastal Virginia Magazine*, was awarded second place for Magazines (\$4,999 and below).

of their watershed. This regional program fills a gap for those that do not reside in a watershed covered by an active restoration/protection group. Residents are also encouraged to be “multi-star” homes where watershed protection programs or local restoration groups offer similar programs in specific watersheds (e.g., Norfolk Utilities offers the Lake Star Homes program¹⁸ to residents in certain parts of Norfolk and Virginia Beach). To register as a Bay Star Home, residents provide contact information and pledge to do at least two behaviors from each of the following categories: Grow Green, Water Connections, Conserve Resources, and Get Involved. The registration process allows the resident to request more information about residential best management practices (installing a rain barrels, rain gardens, pet waste stations, etc.). Once registered, the resident receives a welcome packet with information on environmentally-friendly behaviors and community resources, as well as a garden flag and flag pole to display in their yard. The program launched in 2015 and participation continues to grow steadily. By June 2016, a total of 2,011 Bay Star Homes were registered throughout Hampton Roads.

Through the askHRgreen.org Executive Committee, initiatives generated by four subcommittees are coordinated into annual campaigns incorporating research on target audiences and campaign effectiveness. Campaigns include public relations activities, themed media campaigns, creative advertising materials, and special projects and events.¹⁹ The subcommittees, which meet monthly, are described below:

- The Water Awareness Subcommittee is an education committee comprised of local government staff members who are committed to promoting and educating citizens about aging infrastructure, the value of tap water, and the importance of being good water stewards. This cooperative effort, which began in 1994 as the Hampton Roads Water Efficiency Team (HR WET), continues to promote conservation and awareness of the importance of water to the quality of life in Hampton Roads; efforts assist localities in meeting requirements of various water supply and ground water permits.
- The Stormwater Education Subcommittee is a cooperative partnership of the region's seventeen member cities and counties. This cooperative effort has been underway since 1997 as a formal adjunct to the required public information component of the Virginia Pollution Discharge Elimination System Permits (VPDES) for Phase I and Phase II Municipal Separate Storm Sewer Systems (MS4s). Local government staff members work together to share ideas and pool resources for various education programs tailored to stormwater pollution prevention.
- The Fats, Oils, and Grease (FOG) Education Subcommittee is a coalition of local government staff members and HRSD working together to share ideas and pool resources for various education programs tailored to preventing sanitary sewer overflows and backups caused by improper disposal of fats, oils, and grease. This cooperative effort has been underway since 2007 when 13 of the region's localities and HRSD entered into the Regional Special Order by Consent with the Virginia Department of Environmental Quality.
- The Recycling and Beautification Subcommittee is a coalition of local government staff members from across Hampton Roads who are working together to share ideas and pool

¹⁸ The City of Norfolk Department of Utilities offers the Lake Star Homes program to encourage residents to adopt behaviors that help protect source water quality in the areas surrounding the Intown Reservoirs.

Program information is available at <http://www.norfolk.gov/LSH>.

¹⁹ The askHRgreen.org marketing campaigns, subcommittee plans, and campaign updates are available online: <http://askhrgreen.org/askhrgreen-public-documentation/>

resources for various education programs tailored towards community beautification, litter prevention, and recycling education.

The askHRgreen.org member jurisdictions have made significant investments to develop this valuable and impactful public education program. Beginning in fiscal year 2011, the askHRgreen.org member jurisdictions have provided \$100,000 in annual funding to support the program's print media activities, research, public relations and social media efforts, and creative development and consulting support. This level of funding is anticipated to be sustained through fiscal year 2017 and the near future.

The success and effectiveness of the askHRgreen.org partnership is demonstrated through a comparison of the results of focus group and benchmark surveys to tracking survey results. In the most recent tracking survey, the number of unique visitors to the askHRgreen.org website increased from 21,393 in fiscal year 2012 to 42,539 in fiscal year 2016. The most recent askHRgreen.org Fiscal Year 2016 Annual Report²⁰ provides a summary of the 2015-2016 campaign schedule, activities, and results; a summary of research conducted during the fiscal year; and descriptions of each subcommittee's initiatives and results. The 2015-2016 campaign achieved a total of 20.1 million impressions through combined media advertising, including the askHRgreen.org website, social media, online newspapers, search engine optimization and marketing, radio advertising, movie theater advertising, the partnership with *Coastal Virginia Magazine*, and 27 community events in Hampton Roads. Public relations activities included twelve news releases covering seasonal topics, news, events, and promotions that were picked up by a variety of media outlets; numerous guest columns in various publications; and several television interviews.

4.2.2 Planning and Policy: Hampton Roads Regional Water Supply Plan

The Hampton Roads Regional Water Supply Plan, developed under the direction of the HRPDC Directors of Utilities Committee, was submitted to the DEQ in 2011. The 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 plan received a final determination of compliance from the DEQ on November 15, 2013.²¹ The five-year plan update is due for submittal to the DEQ in 2018.

The 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 was developed in accordance with the administrative framework established by the March 7, 2007 "Memorandum of Agreement Guiding the Hampton Roads Regional Water Supply Planning Process." All 27 participating localities held public hearings and approved the plan between August and October 2011.

²⁰ Hampton Roads Planning District Commission (2015), "askHRgreen.org Annual Report for Fiscal Year 2016." http://askhrgreen.org/wp-content/uploads/2011/06/askHRgreen-FY15-16-Annual-Report_final.pdf

²¹ The Hampton Roads Regional Water Supply Plan, the 2013 compliance determination letter and compliance checklist from the DEQ are available at <http://www.hrpdcva.gov/departments/water-resources/water-supply-planning/>.

The regional water supply plan includes information on existing water sources, existing water use, projected water demands and an alternatives analysis, and water conservation and drought response actions. The plan includes information on the Source Water Assessment Program evaluations for publicly-owned community water system sources in Hampton Roads; determinations on susceptibility to contamination are indicated for each source. The plan summarizes the inventory of land use activities that are, or could become potential sources of contamination for drinking water sources, including active solid waste management facilities, underground storage tanks, Superfund sites, toxic release sites, air emissions, and hazardous waste locations.

With respect to groundwater, the plan recognizes that resources are limited and that water quality degradation due to salt water intrusion could potentially occur. All localities in the Hampton Roads region are within the Eastern Virginia Ground Water Management Area. Groundwater withdrawal permits continue to receive significant scrutiny due to concerns that the resource might not support all the requested withdrawals. 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. Groundwater flow gradients have been altered from a previously seaward direction to a landward direction, creating the potential for saltwater intrusion. The Chesapeake Bay Impact Crater causes the unusual distribution of salinity in groundwater around the crater. 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 of the Crater 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. Groundwater salinity is a concern for drinking water wells in these areas. The plan also discusses naturally occurring fluoride in some Hampton Roads sources.

The regional water supply plan includes information on riparian buffers and conservation easements in place to protect surface water resources. All localities in the Hampton Roads regional water supply planning area, with the exception of Southampton County and the City of Franklin have implemented a Chesapeake Bay Preservation Act Ordinance and have designated Chesapeake Bay Preservation Areas (CBPAs) in accordance with state regulations. The plan provides a summary of the drinking water sources that are within the CBPAs. In many cases, localities have acquired the lands surrounding reservoirs and conserve these areas under watershed or forestry management programs. Localities have also established reservoir protection buffers, easements, and watershed protection districts and have implemented watershed protection ordinances and development ordinances to protect sensitive areas (see Table 4-3). The plan also discusses concerns related to potential uranium mining impacts to surface water resources. Impaired surface waters that are sources for community water systems are identified in the plan. Impairments include recreational use impairments due to bacteria, aquatic life use impairments due to dissolved oxygen depletion, and fish consumption impairments due to exceedance of the fish tissue standard for polychlorinated biphenyls (PCBs) and mercury. Publicly-owned CWSs employ various technologies to address source water quality through the water treatment process to produce high-quality drinking water for customers.

Water demand management practices employed by Hampton Roads localities, including efficiency and conservation measures and drought response plans, are detailed in the regional water supply plan. Long-term water demand management practices, 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.

Table 4-3 Local Watershed Protection Programs

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.
Gloucester	Gloucester County requires the protection of buffers as necessary within CBPAs. Portions of Gloucester's Beaverdam Reservoir are located within the CBPA.
James City	The reservoir watersheds in James City County receive protection as prescribed by the County's CBPA Ordinance. Watershed areas contributing to Diascund Creek, Little Creek, Skiffes Creek, and Waller Mill Reservoirs are located within the County. These sources are owned and operated by Newport News Waterworks (Diascund Creek, Little Creek, and Skiffes Creek) and the City of Williamsburg (Waller Mill).
Newport News	Newport News Waterworks owns and operates five reservoirs in Newport News, James City, New Kent, and York: Diascund Creek, Harwoods Mill, Lee Hall, Little Creek, and Skiffes Creek. Newport News Waterworks owns 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. The Diascund Creek Reservoir watershed in New Kent County receives protection as prescribed by the County's CBPA Ordinance.
Norfolk	The City of Norfolk Department of Utilities 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. Norfolk has established reservoir protection buffers around the Western Reservoirs (located within the City of Suffolk and Isle of Wight County) and the Intown Reservoirs (located within the Cities of Norfolk and Virginia Beach). These buffer areas are owned by the City 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. To encourage residential behaviors to protect source water in the urban areas surrounding the Intown Reservoirs, the Norfolk Department of Utilities offers the Lake Star Homes program to recognize those who pledge to adopt environmentally-friendly actions. Participants receive a yard flag and welcome packet with resources and information. Program information is available at http://www.norfolk.gov/LSH .

Table 4-3 Local Watershed Protection Programs (continued)

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 City of Suffolk recognizes the buffer properties within their zoning regulations as covered by the Chesapeake Bay Preservation Act and CBPAs. 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.
Williamsburg	Williamsburg requires the protection of buffers as necessary within Chesapeake Bay Preservation Areas. Williamsburg owns the land designated for conservation surrounding the Wallers Mill reservoir (located in York County), which is within the CBPA.
York	York County has implemented a reservoir protection overlay district for the portions of watersheds that lie within the County. The specific protective provisions are similar to those in Newport News. Watershed areas contributing to Harwoods Mill, Lee Hall, Skiffes Creek, and Wallers Mill Reservoirs are located within the County. These sources are owned and operated by Newport News Waterworks (Harwoods Mill, Lee Hall, Skiffes Creek) and the City of Williamsburg (Wallers Mill).

Source: Hampton Roads Planning District Commission, "Hampton Roads Regional Water Supply Plan (2011)," http://www.hrpdcva.gov/uploads/docs/FINAL_HR%20RWSP_Jul2011_Report_only.pdf

In discussing future water supply needs, the plan notes that the Region's overall projected water supply is adequate to meet demands through 2050; however, it is possible that the projected water demand for the York-James Peninsula sub-region will exceed available supply near the year 2042. The plan includes a discussion of potential alternatives for addressing this deficit, and emphasizes that the pursuit of alternatives is to be determined locally. The Hampton Roads Regional Water Supply Plan was incorporated by the DEQ into the Virginia Water Resources Plan (2015). The state plan is Virginia's first effort to compile information from local and regional water supply plans to look at surface water and groundwater sources and assesses the capacity of these sources to meet projected 2040 water demands. The state plan does not project a water deficit for the Hampton Roads region. Although the state plan identifies the need for additional water sources in general, it does not recommend alternatives for new source development or address how to accommodate demands from population growth.

Since the Hampton Roads Regional Water Supply Plan was published in 2011, the DEQ identified reduction targets for certain groundwater permits that have been administratively continued beyond the 10-year permit term and are currently in the reapplication phase. Several public water systems in the Region have been encouraged by the DEQ to reduce the amount requested in their permit renewal applications. If permitted withdrawals for municipal water systems 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 in the future. Pursuant to legislation adopted in 2015 by the General Assembly, the Eastern Virginia Groundwater Management Advisory Committee (EVGMAC) was established to assist the State Water Commission and the DEQ in developing, revising, and implementing a management strategy for groundwater in the Eastern Virginia Groundwater Management Area. The EVGMAC is tasked with examining: (i) options for developing long-term alternative water sources, including water reclamation and reuse, groundwater recharge, desalination, and surface water options, including creation of storage reservoirs; (ii) the interaction between the Department of Environmental Quality's groundwater management programs and local and regional water supply plans within the Eastern Virginia Groundwater Management Area for purposes of determining water demand and possible solutions for meeting that demand; (iii) potential funding options both for study and for implementation of management options; (iv) alternative management structures, such as a water resource trading program, formation of a long-term groundwater management committee, and formation of a commission; (v) additional data needed to more fully assess aquifer health and sustainable groundwater management strategies; (vi) potential future groundwater permitting criteria; and (vii) other policies and procedures that may enhance the effectiveness of groundwater management in the Eastern Virginia Groundwater Management Area. The EVGMAC will report the results of its examination and related recommendations to the DEQ Director and the State Water Commission no later than August 1, 2017.

4.2.3 Planning and Policy: Regional Groundwater Mitigation Program

Many homeowners, communities, and small businesses rely on private wells to provide their drinking water. It is estimated that 77,200 small capacity private drinking water wells in Hampton Roads provide water to homes and small businesses from the Yorktown-Eastover, Piney Point, Aquia, and Potomac aquifers. It is important to protect these small, privately-owned wells to prevent the need for expensive mitigation actions, which may include the extension of public water services. All groundwater withdrawals of more than 300,000 gallons per month require a permit from the DEQ. The DEQ requires all permit holders, including municipal water utilities, to establish a mitigation process to compensate pre-existing well owners that are impacted by the permit holder's withdrawals.

The HRPDC Directors of Utilities Committee developed a regional, streamlined process to evaluate and address claims from well owners asserting that municipal pumping has impacted the use of private well(s). The HRPDC Regional Groundwater Mitigation Program provides groundwater hydrology and computer modeling expertise, as well as technical support to participating municipal water utilities. The program operates through a Memorandum of Agreement (MOA) between HRPDC and the member localities that was executed in 1994 and renewed in 2000, 2006, 2010, and 2016. Mitigation claims are evaluated using a regional groundwater model and the methodology adopted in 2004. HRPDC staff produces a report that indicates whether pumping from municipal wells has impacted the private well(s); the

proportionate impact of each associated municipal well is identified. Localities reimburse a well owner for mitigation based on the findings.²²

4.2.4 Planning and Policy: Regional Watershed Management Program

Through the HRPDC, member localities pursued a comprehensive Regional Water Supply Watershed Management Program focused on protection of surface water components of municipal water supplies. Regional best management practices and other stormwater management practices were identified as important tools for protecting water supplies. Working with the HRPDC Directors of Utilities Committee, in cooperation with the Directors of Planning for the member localities, several efforts were completed between 1997 and 2003:²³

- Water supply watershed management principles (1997): Planning Directors and Utility Directors of the region's member localities developed water supply watershed management principles to guide interjurisdictional management efforts for the watersheds of municipal water supply reservoirs.
- Water Supply Watershed Management in Hampton Roads (1997): This resource document recommends a comprehensive regional approach to water supply protection and establishes a set of regional guidelines to direct source water management and protection efforts.
- Model Water Supply Watershed Management Ordinance (1997): This model ordinance was developed to facilitate local ordinances to establish overlay zones for either the entire source water watershed or designated portions of the watershed.
- Public information brochure (2003): To enhance educational efforts on watershed management, including both water supply and water quality issues, the HRPDC developed a public information brochure describing steps that individual citizens can take to protect their drinking water.
- Hampton Roads Source Water Assessment Program (2003)²⁴. This effort involved the development of comprehensive inventories of land use activities within the watersheds of the region's water supply reservoirs, river intakes, and wells. Risks associated with those land uses were analyzed and the susceptibility of the region's water sources to contamination from those land use activities was determined. This effort satisfied the requirements of the EPA and the VDH under the Safe Drinking Water Act. A more detailed program description is provided below.

4.2.5 Planning and Policy: Regional Stormwater Management Program

Stormwater management provides multiple environmental benefits and contributes to the protection of source water quality. The Hampton Roads Regional Stormwater Management Program coordinates actions and leverages funding for cooperative stormwater management

²² To recoup the total cost of damages or well replacement, impacted well owners may need to request mitigation from commercial or industrial permit holders, as well private water systems with withdrawals permitted by the DEQ. These permittees are required by DEQ to have a mitigation program, but they do not participate in the Hampton Roads Regional Groundwater Mitigation Program.

²³ Hampton Roads Planning District Commission, “Regional Cooperation in Stormwater Management Fiscal Year 2005-2006: A Status Report (2006),” <http://www.hrpdcva.gov/Documents/Phys%20Planning/SWMSUM06.pdf>

²⁴ For more information on the 2003 Hampton Roads Source Water Assessment Program, see Section 2.2 of this document.

activities undertaken by the region’s local governments. The program’s Memorandum of Agreement, established in 2003 and renewed in 2008 and 2013²⁵, provides guidance and sets forth goals, responsibilities, and key elements of the region’s approach to stormwater management. The program, facilitated through HRPDC’s Regional Environmental Committee, includes cooperative initiatives in the following areas:

- Environmental education (askHRgreen.org),
- Control of construction site stormwater runoff,
- Management of stormwater impacts associated with post-construction,
- Illicit discharge detection and elimination,
- Municipal pollution prevention,
- Regional cooperative monitoring,
- Regional cooperative data tracking, and
- Monitoring of regulatory changes.

As part of the Regional Stormwater Management Program, the HRPDC facilitates local government involvement in Total Maximum Daily Load (TMDL) studies being prepared through the DEQ and the EPA, as well as the preparation of TMDL Implementation Plans for impaired waters in the Hampton Roads Region.

The Regional Stormwater Management program also provides stormwater permit support to localities. Water Resources Department staff work with local governments to facilitate administration and compliance with stormwater permits administered by the DEQ for stormwater discharges from municipal separate storm sewer systems (MS4s). MS4s are owned by the locality and consist of the road drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels and storm drains designed to collect and convey stormwater. MS4s are not connected to the wastewater collection and treatment system. Six cities in Hampton Roads are subject to the requirements of the Phase I Stormwater Permit Regulations and are authorized to discharge stormwater from their MS4s under VSMP Individual Permits: Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach. Five localities in Hampton Roads are subject to the requirements of the Phase II Stormwater Permit Regulations and are authorized to discharge stormwater from their MS4s under the VSMP General Permit: Cities of Poquoson, Suffolk, and Williamsburg; and the Counties of James City and York. All Hampton Roads MS4 localities conduct inspections of stormwater best management practices (BMPs) in accordance with their respective permit requirements. BMP inspections provide assurance that stormwater management facilities are functioning properly and providing the intended water quantity and/or quality benefits.

4.2.6 Planning and Policy: HRPDC-USGS Cooperative Studies and Programs

The HRPDC and the USGS have jointly funded many research studies and monitoring programs for the region. These efforts support the sound management of groundwater resources in the Virginia Coastal Plain through data collection and the development of appropriate analysis tools. HRPDC-USGS cooperative efforts are summarized below.

- **Groundwater Level Monitoring:** The groundwater level monitoring program, initiated in 2000, is a long-term program designed to evaluate trends in the water levels in the Virginia Coastal Plain. Measurements of water levels are made in many types of wells

²⁵ Hampton Roads Planning District Commission, “Hampton Roads Regional Stormwater Management Program, Memorandum of Agreement (2013),” <http://www.hrpdcva.gov/uploads/docs/09192013-PDC-E14.pdf>

using consistent equipment and techniques to ensure that the measurements can be compared over time and at different locations. The program was jointly funded by HRPDC and USGS through fiscal year 2012. The program continues to be supported by the USGS and DEQ.

- **Chloride Monitoring:** The chloride-monitoring program was initiated in 1995. The objectives of the program are to: 1) Evaluate the spatial and temporal distribution of chloride concentrations in the groundwater; 2) Evaluate the factors that influence the distribution of chloride; and 3) Assess the potential for up-coning or lateral intrusion of saltwater in the aquifers. The program was jointly funded by HRPDC and USGS through fiscal year 2012. The program continues to be supported by the USGS and DEQ.
- **Chloride Concentrations in Hampton Roads Drinking Water Sources:** The HRPDC partnered with the USGS and the DEQ to evaluate all available historic chloride data for eastern Virginia to estimate the chloride concentrations in drinking water aquifers in Hampton Roads. Maps in this report show the estimated chloride concentrations across the Yorktown-Eastover, Piney Point, Aquia, and Potomac aquifers. Each map shows chloride concentrations represented by contour lines, locations of public and private water system wells withdrawing from each aquifer, the areas where all homes and businesses rely on individual wells, and the estimated number of small capacity private drinking water wells (small private wells) in each locality and aquifer. Chloride trends over time and implications for water resource management are also discussed.²⁶
- **Regional Groundwater Quality Trends:** The assessment of regional groundwater quality trends was a collaborative effort between HRPDC, USGS, and the DEQ. The study provides an updated regional characterization of groundwater quality to facilitate effective resource management and planning. This effort consolidated groundwater quality data from USGS, DEQ, the EPA, and the VDH. Water quality data was evaluated with respect to the revised hydrogeologic framework and the associated groundwater flow model developed by the USGS. The study is documented in the report, “Groundwater-Quality Data and Regional Trends in the Virginia Coastal Plain, 1906–2007,” USGS Professional Paper 1772 (2010)²⁷.
- **Groundwater Withdrawals by Private Domestic Wells:** A significant portion of the population of southeastern Virginia relies on private wells to supply water for household consumption and other uses. A comprehensive analysis of private domestic well withdrawals in the Coastal Plain was conducted, and study results indicate that the overall magnitude of these withdrawals and associated effects on local and regional ground-water flow are larger and more important than reported by previous studies. Private well withdrawals for domestic use in the Coastal Plain are estimated to be approximately 40 million gallons per day, or about 28 percent of all ground-water withdrawals in the area. The study is documented in the report, “Private Domestic-Well

²⁶ Hampton Roads Planning District Commission, “Chloride Concentrations in Hampton Roads Drinking Water Sources, Salt Water Intrusion and Potential Impacts to Community Water Systems (2014),” http://www.hrpdcva.gov/uploads/docs/FINAL_ChloridesHRDrinkingWaterSources_Sept.2014.pdf

²⁷ McFarland, E.R., 2010, Groundwater-quality data and regional trends in the Virginia Coastal Plain, 1906–2007: U.S. Geological Survey Professional Paper 1772, 86 p., 14 pls. <http://pubs.usgs.gov/pp/1772/>

Characteristics and the Distribution of Domestic Withdrawals among Aquifers in the Virginia Coastal Plain,” USGS Scientific Investigations Report 2007-5250 (2007)²⁸.

- **Groundwater Model for Virginia Coastal Plain Aquifer System:** The Virginia Coastal Plain Groundwater Model was developed to provide a better tool to understand the groundwater resource through simulation of groundwater withdrawals, drought, and saltwater intrusion. The model is documented in the report, “Simulation of Groundwater Flow in the Coastal Plain Aquifer System of Virginia,” USGS Professional Paper 1731 (2006)²⁹.
- **GW Virginia Coastal Plan Hydrogeologic Framework:** This study provides a refined description of the aquifer system of the Virginia Coastal Plain and presents a hydrogeologic framework for ground-water investigation and a new perspective on the regional ground-water system by incorporating information from studies of the Chesapeake Bay impact crater. The study is documented in the report, “Virginia Coastal Plain Hydrogeologic Framework,” USGS Professional Paper 1731 (2006)³⁰.
- **Chesapeake Bay Impact Crater Study:** Approximately 35 million years ago, a large comet or meteorite crashed into the shallow waters of the Atlantic Ocean near the mouth of the Chesapeake Bay. The force of the collision dramatically disrupted the existing geology and formed a large regional anomaly that changed existing rock formations, sediment accumulation patterns, compaction forces, and groundwater movement. Studies to help understand the physical features of the Chesapeake Bay impact crater and the relationship to eastern Virginia’s groundwater system are documented in two reports: “The Effects of the Chesapeake Bay Impact Crater on the Geologic Framework and the Correlation of Hydrogeologic Units of Southeastern Virginia, South of the James River,” USGS Professional Paper 1622 (2000)³¹, and “The Effects of the Chesapeake Bay Impact Crater on the Geological Framework and Correlation of Hydrogeologic Units of the Lower York-James Peninsula, Virginia,” USGS Professional Paper 1612 (1999)³².

4.2.7 Planning and Policy: Water Utilities Emergency Response and Infrastructure Security

The HRPDC Directors of Utilities Committee has completed planning efforts for regional water utility emergency response and infrastructure security. These projects contribute to the protection of water supplies and public health in Hampton Roads.

²⁸ Pope, J.P., McFarland, E.R., and Banks, R.B., 2008, Private domestic-well characteristics and the distribution of domestic withdrawals among aquifers in the Virginia Coastal Plain: U.S. Geological Survey Scientific Investigations Report 2007-5250, 47 p. <http://pubs.water.usgs.gov/sir2007-5250>

²⁹ Heywood, C.E., and Pope, J.P., 2009, Simulation of groundwater flow in the Coastal Plain aquifer system of Virginia: U.S. Geological Survey Scientific Investigations Report 2009-5039, 115 p. <http://pubs.usgs.gov/sir/2009/5039/>

³⁰ McFarland, E.R., and Bruce, T.S., 2006, The Virginia Coastal Plain Hydrogeologic Framework: U.S. Geological Survey Professional Paper 1731, 118 p., 25 pls. <http://pubs.usgs.gov/pp/2006/1731/>

³¹ Powars, D.S., 2000, The Effects of the Chesapeake Bay Impact Crater on the Geologic Framework and the Correlation of Hydrogeologic Units of Southeastern Virginia, South of the James River: U.S. Geological Survey Professional Paper 1622. <http://pubs.usgs.gov/pp/p1622/p1622.pdf>

³² Powars, D.S., and Bruce, T.S., 1999, The Effects of the Chesapeake Bay Impact Crater on the Geological Framework and Correlation of Hydrogeologic Units of the Lower York-James Peninsula, Virginia: U.S. Geological Survey Professional Paper 1612. <http://pubs.usgs.gov/prof/p1612/>

- **Hampton Roads Water Quality Response Plan:** The Hampton Roads Water Quality Response Plan, initially prepared in 2000, details an emergency management process to protect citizens in the case of drinking water emergencies. The plan was developed by the HRPDC Directors of Utilities Committee, the Hampton Roads Health District Directors, the VDH Office of Drinking Water, and the VDH Office of Epidemiology. The plan establishes procedures to assemble emergency representatives of the water utilities, regional health department, and local health districts in the event of a water quality emergency to determine the correct course of action and a coordinated response to the public and/or media. This cooperative endeavor ensures that the various agencies will respond to a drinking water health threat in a unified, synchronized effort. The most recent plan update was completed in 2013³³; the HRPDC staff maintains the plan's emergency contact list with annual updates.
- **Hampton Roads Water and Wastewater Systems Emergency Preparedness and Response Regional Improvement Plan:** The HRPDC Directors of Utilities Committee conducted a regional assessment of the emergency preparedness and response capabilities of public water and wastewater systems in the region. The project was funded by the United States Department of Homeland Security Urban Areas Security Initiative (UASI) program, which provides grants to address the needs of multi-disciplinary planning, operations, equipment, training, and exercise needs of high-threat, high-density urban areas. Six representative risk scenarios were developed to provide a foundation for the study and to anchor data collection and analysis efforts within a framework for emergency preparedness, response, and recovery capabilities of water and wastewater systems. The project examined interdependencies within and between utility systems in the region, the emergency management agencies, and selected infrastructure sectors. Tabletop training exercises validated trends and identified gaps and areas for improvement. The assessment resulted in a strategic plan was completed in 2012 for enhancing the ability of the region's water and wastewater utilities to prepare for, respond to, and recover from disasters.

4.2.8 Regulatory: Sanitary Sewer Overflow Reporting System

Sanitary sewer overflows (SSOs) can pose bacterial, viral, and other pollution risks to source water.³⁴ In addition to wastewater system monitoring, maintenance, and improvement activities, the Hampton Roads Sanitation District (HRSD) and municipal wastewater collection systems continue to protect water quality and public health across the region through the timely reporting of SSO occurrences and response efforts through the regional Sanitary Sewer Overflow Reporting System (SSORS).

SSORS, which is administered by the HRPDC and funded by local governments and the HRSD through the Regional Wastewater Program, is used by municipal wastewater utilities to document reportable releases from the sanitary sewer system. SSORS is a web-based reporting and tracking system that streamlines the initial notification and 5-day letter reporting requirements to the DEQ. Initially created in 2004, SSORS was upgraded in 2007-2008, 2010,

³³ Hampton Roads Planning District Commission, “2013 Update, Hampton Roads Water Quality Response Plan (2013),” http://www.hrpdcva.gov/uploads/docs/2013Update_PublicVer_HRWaterQualityResponsePlan_PEP13-07.pdf

³⁴ U.S. EPA, Office of Water, “Source Water Protection Practices Bulletin: Managing Sanitary Sewer Overflows and Combined Sewer Overflows to Prevent Contamination of Drinking Water (2001),” <http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=901V1Q00.txt>

and 2013. The following entities have user privileges and data entry and management responsibilities within SSORS: the DEQ; the HRSD; 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 Town of Smithfield. The VDH and the EPA have “read only” access to system data and SSORS reports. The HRPDC has “read only” data access and serves as the system administrator, providing ongoing website support and maintenance.

Timely reporting through SSORS facilitates DEQ and VDH actions to protect public health and the environment. The VDH has praised SSORS, noting in a July 31, 2012 memorandum to HRPDC that “SSORS reporting is viewed as one of the best sewage notification systems in the Commonwealth.” The VDH uses SSORS to assess sanitary sewer overflow impacts to drinking water sources, shellfish waters, fish consumption, and recreational swimming areas. Follow-up actions may include beach closures, fishing advisories, water quality testing, and other actions.

4.2.9 Regulatory: Regional Construction Standards

Construction standards help ensure the protection of healthy water supplies by reducing contamination threats from some activities. The HRPDC Regional Construction Standards, first published in 1999, is a reference manual of uniform construction standards for improvements in public rights-of-way. The Standards represent the collaborative effort of the HRPDC, the 17 member localities, the Hampton Roads Sanitation District, and the Hampton Roads Utility and Heavy Contractors Association. The Standards incorporate pollution prevention practices with provisions for permits and regulations; environmental stipulations; construction material delivery and storage; clearing, grubbing, and debris disposal; and landscaping.

In June 2016, the HRPDC published the sixth and latest edition of the Standards, which are maintained and improved through a regular update process. The Standards address “horizontal” improvements and those involving the major elements of roadways, drainage and utilities (water distribution and wastewater collection); and are intended to accommodate most of the “typical” construction projects in the region and to support the majority of issues communities face in building minor roads and utilities.

By December 2015, more than 1000 construction projects worth over \$1.13 billion, were under design, construction, or built using a portion or all of the Standards, with more than \$500 million in the last 5 years. Examples of such projects include sewer system rehabilitation, Virginia Department of Transportation (VDOT) Urban-Funded Roadway Improvements, streetscape improvements, water distribution systems, sanitary sewer systems, stormwater systems, site plans, and demolition projects.

4.3 Potential Regional Source Water Protection Strategies

Implementation of potential regional source water protection strategies would be based on discussion and action by the HRPDC Directors of Utilities Committee (Local Advisory Committee). Potential strategies and initiatives are listed in Table 4-4 and are described in the sections below.

Table 4-4: Potential Regional Source Water Protection Activities

1. Continuation of Current Regional Source Water Protection Activities
2. Source Water Protection Plan Local Advisory Committee Meetings
3. Potential Contamination Source Inventory Updates
4. Sanitary Sewer Overflows Notices
5. Coordination with Dominion Power
6. Coordination with Roadway Operators
7. Coordination with Railroad Operators
8. Coordination with Gas Transmission Pipelines and Hazardous Liquid Trunkline Operators
9. Location-Based Analyses
10. Policy Summary

4.3.1 Continuation of Current Regional Source Water Protection Activities

The HRPDC Directors of Utilities Committee and the HRPDC Regional Environmental Committee should continue to endorse the existing source water protection activities being implemented through the Regional Water Program, the Regional Wastewater Program, and the Regional Stormwater Management Program. These established programs and activities are listed in Table 4-5 (detailed descriptions are provided in Section 4.2).

Table 4-5: Current Regional Source Water Protection Activities to be Continued

Public Education	<ul style="list-style-type: none"> • askHRgreen.org (2011 – present) • Hampton Roads Regional Water Supply Plan (2011, updates ongoing)
Planning and Policy	<ul style="list-style-type: none"> • Regional Groundwater Mitigation Program (1994 – present) • Regional Stormwater Management Program (2003 – present) • Hampton Roads Water Quality Response Plan (2000 – present)
Regulatory	<ul style="list-style-type: none"> • Sanitary Sewer Overflow Reporting System (2004 – present) • Regional Construction Standards (1999 – present)

4.3.2 Source Water Protection Plan Local Advisory Committee Meetings

The HRPDC Directors of Utilities Committee, which serves as the Local Advisory Committee, should meet once per year to review the Plan and the potential regional source water protection strategies. The Committee may consider incorporating strategies into the annual work plan for the HRPDC's Regional Water and/or Wastewater Program, as appropriate. Strategies that could be pursued through the HRPDC regional programs include those identified in Sections 4.3.3

through 4.3.9, as well other initiatives such as monitoring the development of DEQ's chloride monitoring well program.

4.3.3 Potential Contamination Source Inventory Updates

When updated VDH SWAP GIS data sets are available, the HRPDCs staff will obtain copies and distribute the data sets to Hampton Roads municipal water utilities. The HRPDC staff will inquire with VDH annually as to the status of updates.

4.3.4 Sanitary Sewer Overflows Notices

Water utility staff contacts may be added to wastewater utility SSORS notice distribution lists for those localities where water sources are located. The HRPDC staff can coordinate this effort for interested utilities. For example, Newport News Waterworks has several drinking water sources throughout the York-James Peninsula. In 2012, Waterworks staff was added to the SSORS distribution lists maintained by the following jurisdictions: Hampton, HRSD, James City, Newport News, Poquoson, Williamsburg, and York. Similarly, Suffolk Public Utilities includes Portsmouth and Norfolk Utilities on Suffolk's SSORS distribution list. Including water utility staff in the SSORS notification process allows the water utility to immediately assess impacts to source waters, rather than wait for the VDH to complete the agency's review of SSORS reports and provide subsequent notifications to water utilities.

4.3.5 Coordination with Dominion Power

Dominion Power maintains electric transmission lines³⁵ that cross Zone 1 SWPAs for several surface water sources that serve municipal systems: Blackwater River Intake and Western Reservoirs (City of Norfolk); Lake Kilby and Lake Meade (City of Portsmouth); Crumps Mill Pond (City of Suffolk); Lake Gaston Intakes (City of Virginia Beach); Waller Mill Reservoir (City of Williamsburg); and Diascund Creek, Harwood's Mill, Lee Hall, Little Creek, and Skiffe's Creek Reservoirs and the Chickahominy River Intake (Newport News Waterworks). Transmission lines cross Zone 2 SWPAs for the sources listed above, as well as the following municipal sources: Northwest River Intake (City of Chesapeake) and Nottoway River Intake (City of Norfolk). It is likely that heavy equipment and herbicides are used to clear vegetation and maintain required clearances. Such management practices may pose certain risks to source water quality. Certain electrical equipment associated with transmission lines and substations may contain polychlorinated biphenyls (PCBs), another potential contamination source. Any such equipment within a SWPA should be located and inventoried.

On behalf of the HRPDC Directors of Utilities Committee (Local Advisory Committee), the HRPDC staff could work with Dominion Power to identify contacts within the electric utility to help water utilities to pursue management strategies like the examples below. The HRPDC staff could provide technical assistance to support these strategies at the Committee's request.

Example management strategies:

- Inform Dominion Power land managers of source water protection area boundaries and work with them to locate all electrical transmission lines, substations, and support

³⁵ U.S. Energy Information Administration, "Virginia State Profile and Energy Estimates, Profile Overview," U.S. Department of Energy, <http://www.eia.gov/state/?sid=VA>

facilities within designated SWPAs. Ask Dominion Power to identify any equipment containing PCBs and provide information on the associated pollution prevention plan, remaining useful service life and/or replacement date.

- Work with Dominion Power to ensure that, in the event of a fuel or hazardous material spill along the transmission line corridor, Dominion Power's emergency response plan incorporates adequate measures to prevent impacts to drinking water sources.
- Discuss Dominion Power's vegetation management practices for the portions of the transmission line corridor that are within source water protection areas; request information land management practices and maintenance schedules; the herbicides and pesticides being applied in SWPAs; the timing of applications; and spill prevention and clean up practices.
- Identify areas where signage would be helpful to notify maintenance crews and/or emergency response teams of the drinking water source and water utility contact information.

4.3.6 Coordination with Roadway Operators

On behalf of the HRPDC Directors of Utilities Committee (Local Advisory Committee), the HRPDC staff could conduct outreach to establish or reestablish points of contact between the VDOT, local public works and emergency management departments, and water utilities. The HRPDC staff could generate a contact list for distribution to water utilities and update the list annually. The contact list would facilitate communication in the event of an accident or emerging concern. Norfolk Utilities has already established coordination points with roadway operators for this purpose.

Once points of contact are identified, individual water utilities could then elect to pursue management strategies like the examples below. The HRPDC staff could provide technical assistance to support these strategies at the Committee's request.

Example management strategies:

- Inform VDOT/local emergency managers of source water protection area boundaries and Work with the agencies to ensure that, in the event of a hazardous material spill on the road network, the VDOT or local emergency response plans incorporate adequate measures to prevent impacts to drinking water sources. Identify areas where signage would be helpful to notify emergency response teams of the drinking water source and water utility contact information.
- Discuss the VDOT/locality's vegetation management practices for the portions of the right-of-way that are within source water protection areas; request information on the herbicides and pesticides being applied in SWPAs, the timing of applications, and spill prevention and clean up practices.
- Discuss the VDOT/locality's roadway deicing activities for the portions of the right-of-way that are within source water protection areas. Consider information on deicing chemical storage facility locations, storage and handling practices, and best management practices being used during roadway application (pretreatment, spreading rates and amount, alternative chemicals, timing of application, etc.) and discuss ways to minimize potential impacts to drinking water sources.

4.3.7 Coordination with Railroad Operators

On behalf of the Local Advisory Committee (the HRPDC Directors of Utilities Committee), the HRPDC staff could conduct outreach to establish points of contact between rail operators, emergency management departments, and water utilities. The HRPDC staff could generate a contact list for distribution to water utilities and update the list annually. The contact list would facilitate communication in the event of an accident or emerging concern. Norfolk Utilities has already established coordination points with railroad operators for this purpose.

Once points of contact are identified, individual water utilities could then elect to pursue management strategies like the examples below. The HRPDC staff could provide technical assistance to support these strategies at the Committee's request.

Example management strategies:

- Inform operators of source water protection area boundaries and work with them to ensure that, in the event of a rail accident and/or hazardous materials release, the operator's emergency response plans incorporate adequate measures to prevent impacts to drinking water sources.
- Discuss the operator's vegetation management practices for the portions of the railroad right-of-way that are within source water protection areas; request information on the herbicides and pesticides being applied, the timing of applications, and spill prevention and clean up practices; and identify sensitive areas where signage along the right-of-way would further prevent source water contamination.

Rail operators maintain facilities within certain localities as described in Table 4-6. Maps showing railroads in relation to source water protection area boundaries are provided in Appendix B (see Section 3.3.2 for a discussion of these maps). Table 4-7 lists drinking water reservoirs where railroads overlap designated source water protection areas.

Table 4-6: Rail Operators by Locality

Locality	Rail Operators								
	Bay Coast Railroad	Chesapeake & Albemarle Railroad	CSX Transportation	Commonwealth Railway	HRTA	North Carolina and Virginia Railroad	Norfolk & Portsmouth Beltline Railroad	Norfolk Southern Railway	United States Government
Chesapeake	✗	✗	✗			✗	✗	✗	
Franklin		✗						✗	
Hampton		✗							
Isle of Wight		✗						✗	
James City		✗							✗
New Kent		✗							
Newport News		✗							✗
Norfolk	✗				✗	✗	✗	✗	
Portsmouth		✗	✗				✗		
Southampton		✗				✗		✗	
Suffolk		✗	✗					✗	
Virginia Beach	✗							✗	
Williamsburg			✗						
York									✗

Source: HRPDC, “Hampton Roads Rail Network” Shapefile (2011).

Table 4-7: Railroads in Designated Source Water Protection Areas

Municipal Community Water System (CWS)		Railroad			Source Water Protection Area (SWPA)
Reservoir or Intake Name	Receiving CWS	Operator	Line Status	Line Location	
Blackwater River	Norfolk, City of	Norfolk Southern Railway	Main line	Isle of Wight, Southampton, Sussex	Zone 2
Chickahominy River	Newport News Waterworks	CSX Transportation	Main line	New Kent	Zone 1 and 2
Harwoods Mill	Newport News Waterworks	CSX Transportation	Major industrial lead	York	Zone 1 and 2
Intown Reservoirs	Norfolk, City of	Bay Coast Railroad	Major industrial lead	Norfolk, Virginia Beach	Zone 1 and 2
Intown Reservoirs	Norfolk, City of	Norfolk Southern Railway	Major industrial lead	Norfolk, Virginia Beach	Zone 1 and 2
Lake Kilby, Lake Mead, & Pitchkettle	Portsmouth, City of	CSX Transportation	Main line	Suffolk	Zone 1 and 2
Lake Kilby, Lake Mead, & Pitchkettle	Portsmouth, City of	Norfolk Southern Railway	Main line	Suffolk	Zone 1 and 2
Lee Hall	Newport News Waterworks	CSX Transportation	Main Line; Major industrial lead	Newport News, York	Zone 1 and 2
Lee Hall	Newport News Waterworks	United States Government	Major industrial lead	York	Zone 1 and 2
Northwest River	Chesapeake, City of	Chesapeake & Albemarle Railroad	Main line	Chesapeake	Zone 1 and 2
Nottoway River	Norfolk, City of	Norfolk Southern Railway	Main line	Southampton	Zone 1 and 2
Skiffes Creek	Newport News Waterworks	CSX Transportation	Main line	James City	Zone 1 and 2
Skiffes Creek	Newport News Waterworks	United States Government	Major industrial lead	James City, York	Zone 1 and 2
Waller's Mill	Williamsburg, City of	CSX Transportation	Main Line; Minor industrial lead	James City, Williamsburg, and York	Zone 1 and 2
Western Reservoirs	Norfolk, City of	Norfolk Southern Railway	Main line	Isle of Wight	Zone 2

Source: HRPDC, "Hampton Roads Rail Network" Shapefile (2011).

4.3.8 Coordination with Gas Transmission Pipelines and Hazardous Liquid Trunkline Operators

On behalf of the Local Advisory Committee (the HRPDC Directors of Utilities Committee), the HRPDC staff could conduct outreach to establish points of contact between pipeline operators and individual water utilities. The HRPDC staff could generate a contact list for distribution to water utilities and update the list annually. The contact list would facilitate communication in the event of an accident or emerging concern.

Once points of contact are identified, individual water utilities could then elect to pursue management strategies like the examples below. The HRPDC staff could provide technical assistance to support these strategies at the Committee's request.

Example management strategies:

- Inform operators of source water protection area boundaries and work with them to ensure that, in the event of an accident and/or hazardous materials release, the operator's emergency response plans incorporate adequate measures to prevent impacts to drinking water sources.
- Discuss the operator's vegetation management practices for the portions of the pipeline corridor/easement that are within source water protection areas; request information on the herbicides and pesticides being applied, the timing of applications, and spill prevention and clean up practices; and identify sensitive areas where signage along the corridor/easement would further prevent source water contamination.

Pipeline operators maintain facilities within certain localities as described in Table 4-8. A regional map showing the natural gas and petroleum pipelines is included in Appendix B (see map entitled "Hampton Roads Area Rail and Pipeline Facilities"); generalized maps of pipeline corridors in each locality are provided in Appendix C (see Section 3.3.2 for a discussion of these maps). Table 4-9 lists drinking water reservoirs where pipeline corridors overlap designated source water protection areas.

Table 4-8: Pipeline Operators by Locality

Locality	Pipeline Operators						
	Colonial Pipeline Co.	Columbia Gas of Virginia Inc.	Columbia Gas Transmission, LLC	Nustar Terminals Operations Partnership LP	Suffolk Transmission Partners, LP	Transcontinental Gas Pipe Line Company	Virginia Natural Gas
Brunswick						x	
Chesapeake	x	x					x
Hampton							x
Isle of Wight	x	x	x				
James City	x		x				x
New Kent							x
Newport News	x		x				x
Norfolk							x
Portsmouth	x	x					x
Southampton			x				
Suffolk	x		x		x		x
Surry	x		x				
Virginia Beach				x			
Williamsburg							x
York	x						x

Source: National Pipeline Mapping System, “Find Who’s Operating Pipelines in Your Area,” U.S. DOT Pipeline and Hazardous Materials Safety Administration, <https://www.npms.phmsa.dot.gov/FindWhosOperating.aspx>

Table 4-9: Pipeline Facilities in Designated Source Water Protection Areas

Municipal Community Water System (CWS)		Pipeline Facility			Source Water Protection Area (SWPA)
Reservoir or Intake Name	Receiving CWS	Operator	Type	Line Location	
Blackwater River	Norfolk, City of	Columbia Gas Trans Co	Natural Gas	Isle of Wight, Prince George, Southampton, Surry, Sussex	Zone 1 and 2
Chickahominy River	Newport News Waterworks	Kinder Morgan	Petroleum Product	Hanover, Henrico	Zone 2
Chickahominy River	Newport News Waterworks	Virginia Natural Gas Co.	Natural Gas	Charles City, Hanover, Henrico	Zone 1 and 2 (Charles City) Zone 2 (Charles City, Hanover, Henrico)
Harwoods Mill	Newport News Waterworks	Colonial Pipeline Co.	Petroleum Product	York	Zone 1 and 2
Lee Hall	Newport News Waterworks	Colonial Pipeline Co.	Petroleum Product	Newport News; York	Zone 1 and 2
Lee Hall	Newport News Waterworks	Virginia Natural Gas Co.	Natural Gas	Newport News	Zone 1 and 2
Northwest River	Chesapeake, City of	Virginia Natural Gas Co.	Natural Gas	Chesapeake	Zone 2
Nottoway River	Norfolk, City of	Columbia Gas Trans Co	Natural Gas	Dinwiddie, Greensville, Prince George, Southampton, Sussex	Zone 1 and 2
Skiffes Creek	Newport News Waterworks	Colonial Pipeline Co.	Petroleum Product	James City	Zone 1 and 2
Skiffes Creek	Newport News Waterworks	Columbia Gas Trans Co	Natural Gas	James City	Zone 1 and 2
Stumpy Lake	Norfolk, City of	Virginia Natural Gas Co.	Natural Gas	Chesapeake, Virginia Beach	Zone 1 and 2
Western Reservoirs	Norfolk, City of	Columbia Gas Trans Co	Natural Gas	Isle of Wight, Suffolk	Zone 1 and 2

Source: U.S. Energy Information Administration, “U.S. Natural Gas Pipelines” Shapefile (2016).

4.3.9 Location-Based Analyses

The HRPDC Directors of Utilities Committee, which serves as the Local Advisory Committee, could direct HRPDC staff to complete geospatial analyses as appropriate to support source water protection and management strategies. Examples include:

- Create map products to facilitate source water protection discussions with VDOT, rail operators, pipeline operators, and other sectors;
- Identify specific businesses or organizations in the source water protection area for targeted education and outreach or potential partnerships;

- Use Esri Business Analyst to create mailing lists for specific business sectors for distributing pollution prevention and good housekeeping brochures from the askHRgreen.org Media Toolkit or other resources.
- Use Esri Business Analyst and other resources, such as the EPA’s Drinking Water Mapping Application to Protect Source Waters (DWMAPS)³⁶, to generate lists of high risk PCS by industry code, type of permitted facility, or PCS within a certain radius or distance upstream of water sources. Utilities could then prioritize these businesses by contamination risk and contact them to educate them about their location in the source water protection area and to gain an understanding of their discharges, chemical use, chemical management plan, and spill response plan.
- Develop a recognition/awards program to acknowledge businesses that go beyond regulatory requirements to voluntarily implement environmentally responsible practices to reduce and prevent water pollution and enhance watershed protection. The program could be called Bay Star Businesses, leveraging the brand of the existing Bay Star Homes program (see Section 4.2.1) administered through askHRgreen.org. The Bay Star Businesses program could be funded through the portion of the HRPDC Regional Water Program contribution to the askHRgreen.org budget that is designated for water awareness priorities, including source water protection. An example of a successful business recognition program for environmental stewardship is the Elizabeth River Project’s River Star Businesses³⁷ program.

- Identify areas with unique conditions that may warrant additional management strategies. If not already completed, inventory high priority conservation lands or parcels for potential land acquisition;
- Identify managed open spaces, golf courses, and agricultural uses to assess pesticide, herbicide, and fertilizer application; and
- Coordinate with the VDH to generate regional data sets of private water supply wells and septic systems; outreach to property owners could include information on how the utility is protecting the resource, as well as information on proper well and septic system abandonment.

4.3.10 Policy Summary

Based on direction from the HRPDC Directors of Utilities Committee (Local Advisory Committee), the HRPDC staff could review and summarize locality comprehensive plans for provisions for source water protection. The effort could be expanded to review and summarize all locality drinking water protection policies, including groundwater/watershed protection ordinances, wellhead protection programs, source water protection overlay districts or special zoning districts (some of these provisions are summarized in Section 4.2.2). The HRPDC staff could subsequently provide technical assistance to those localities wishing to implement or amend plans and policies.

³⁶ U.S. EPA, “Drinking Water Mapping Application to Protect Source Waters,” <https://www.epa.gov/sourcewaterprotection/dwmaps>

³⁷ Information about the Elizabeth River Project’s River Star Businesses program is available at <http://www.elizabethriver.org/river-star-businesses>

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APPENDIX A-1

Virginia Department of Health's SWPP Development Approach

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Source Water Protection Plan Development Approach

There are several approaches to prepare and implement a Source Water or Wellhead Protection Plan. The approach typically followed for the Virginia Department of Health (VDH) Source Water Protection Program is based on community involvement by the development of a Local Advisory Committee. Through a series of meetings, this committee works closely with the VDH contractor to identify the potential source water threats (based on the VDH Source Water Assessment) and the options for controlling those threats for that particular waterworks. This information is consolidated in a written Plan that is provided to the waterworks for implementation. The VDH contractor provides guidance and technical support through all phases of Plan development. The general steps in developing a Plan are summarized as follows:

Step 1: FORMATION OF A LOCAL ADVISORY COMMITTEE

Community involvement is key to a successful Source Water Protection Plan. The Local Advisory Committee (LAC) consists of waterworks employees, town or local government officials, county or regional government representatives, board members, and/or water customers. The LAC meets to develop the plan. Extensive knowledge of source water protection or the water system components is not a prerequisite to being a committee member. For those waterworks participating in the Source Water Protection Program, the VDH contractor will assist as needed in forming the LAC.

Step 2: EDUCATE THE COMMITTEE

As an initial step in the development of the Plan, the VDH contractor will meet with the LAC to review source water protection concepts and discuss the details of their water system. Previous knowledge of these issues is not a requirement for participating as a LAC member and assisting in the Plans development. The steps that will be used to prepare the Plan are also presented so that LAC members know what to expect in future meetings.

Step 3: SOURCE WATER ASSESSMENT REVIEW

In most cases, a Source Water Assessment was completed as part of the state Source Water Assessment Program. This assessment acts as an initial inventory of potential sources of contamination and provides a general assessment of the water supply susceptibility. The LAC reviews the findings of the Source Water Assessment and updates the inventory of the potential sources of contamination as necessary. The goal of this step is to identify key issues and challenges for developing and implementing a source water protection plan.

Step 4: IDENTIFICATION OF WELLHEAD PROTECTION OPTIONS

There are a number of protection measures that may be implemented; these include public education, planning and policy approaches, regulatory approaches, and non-regulatory approaches. The following table includes examples of each type of protection measure. The LAC will discuss options that are applicable to their water system, identify and then select protection measures that best protect their water source. The VDH contractor will assist participants in the Source Water Protection Program by providing technical expertise, reference materials, and advice.

<i>Source Water Protection Approaches and Examples of Measures</i>	
Public Education	<ul style="list-style-type: none"> • Working with community groups • Signs along roads that state "Entering a Source Water Protection Area" • Display material on town or water system web site. • Distribute brochures to water customers and residents in the Wellhead Protection Area
Planning and Policy	<ul style="list-style-type: none"> • Compliance Planning • Memo of Inter-jurisdictional Cooperation • Capital Improvement Program • Emergency Response Plan
Regulatory	<ul style="list-style-type: none"> • Zoning: Wellhead Protection Overlay District • Review procedure for subdivisions specifically for Source Water Protection • Septic system ordinances • Sinkhole ordinances
Non-regulatory	<ul style="list-style-type: none"> • Acquisition of property of easements • Use of Value Taxation

Step 5: SOURCE WATER PROTECTION PLAN DEVELOPMENT

Information from the waterworks is used in conjunction with the Source Water Assessment; other identified potential threats, and the control options selected by the LAC to prepare the Plan. Plan components typically include:

- a description of the water system;
- inventory of identified potential sources of contamination (PSC);
- a strategy to manage/minimize current risks;
- a goal to minimize future threats.

The VDH contractor will assist small community waterworks that participate in the Source Water Protection Program in developing their Source Water Protection Plan and will provide copies of the plan for use and implementation by the waterworks.

Step 6: WELLHEAD PROTECTION PLAN IMPLEMENTATION

Once the Plan is completed, the selected protection options are implemented by the waterworks. Implementation often includes notifying the users and nearby residents of the protection measures that are in-place or planned. Community participation is critical to a successful program. The Plan should be an active document with recommendations that are implemented in a timely and efficient manner. The plan should be revisited, reviewed, and appropriately updated at least once a year.

APPENDIX A-2

VDH 2014 Memorandum on Definition of Substantial Implementation

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Virginia Department of Health
Office of Drinking Water
Memorandum

SUBJECT: Definition of Substantial Implementation

TO: John J. Aulbach II, PE, Director, Office of Drinking Water

THROUGH: Susan E. Douglas, PE, Director, Division of Technical Services *AS*

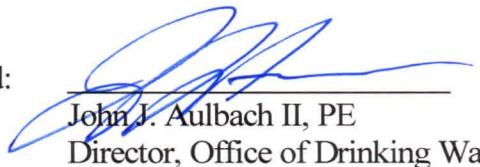
FROM: Roy Soto, PE, PMP, Special Projects Engineer *RS*

DATE: October 31, 2014

Staff Recommendation:

The staff recommends that the attached definitions be submitted to EPA – Region III to update the Commonwealth of Virginia's Source Water Protection Program approach.

Approved:


John J. Aulbach II, PE
Director, Office of Drinking Water

11/8/14
Date

VDH Source Water Protection Program Definitions

BACKGROUND OF PROPOSED AMENDMENTS

There are numerous state and federal programs that support source water protection from Clean Water Act and Safe Drinking Water Act perspectives. The Virginia Department of Health (VDH) recognizes that development and implementation of source water protection measures may be achieved in several ways. Therefore, the VDH has updated definitions and clarifications for its Source Water Protection Program.

The updated definitions introduce an opportunity for waterworks to obtain substantial implementation (SI) status credits for the completion of source water protection initiatives by direct or indirect partners. Partners may be from local, state, and federal government programs, citizen groups, and the business community. This updated approach to evaluating success reemphasizes the need for collaboration with outside resources, as in most cases waterworks alone have limited options to protect their source(s).

Although source water protection is voluntary for waterworks in Virginia, VDH is required to submit annual progress reports to the Environmental Protection Agency (EPA) about the protection status of community water systems (CWSs) in Virginia. Thus, VDH or its contractors may inquire about protection strategy in-place (SIP) and SI during their interactions with waterworks or during the source water protection program annual survey. This survey is typically performed from June to August of each year.

BENEFITS OF PROPOSED ACTION

- Aligns the program management and tracking needs with the pace at which protection initiatives are implemented
- Allows waterworks to obtain SI credit from protection initiatives executed by direct or indirect partners
- Improves SP-4 metrics reported to EPA
- Increases the pool of eligible waterworks for grant opportunities by allowing our Source Water Assessment Reports (SWARs) to be considered as a SIP
- Reduces the gap between source water assessments (SWAs) required from states and source water protection (SWP), which is voluntary for waterworks

DEFINITIONS

Source Water Protection Committee (SWPC): Defined as a local or regional team responsible for source water protection planning. SWPCs are typically composed of three to five members and meet on a regular basis. SWPCs promote the selection of objective protection measures and implementation of recommended initiatives.

Examples of a SWPC include, but are not limited to:

- Board of Directors or other oversight board
- Local TMDL implementation team
- Soil and Water Conservation Roundtable team who implement the BMPs
- Other organization of members from local, state, and federal government programs, citizen groups, and the business community

VDH Source Water Protection Program Definitions

Protection Strategy In-Place (SIP): Defined as a document or set of documents established by or for a community waterworks that addresses the following four source water protection elements¹:

1. A delineation of the source assessment area (for surface based systems, this is the watershed; for groundwater based systems this may be the fixed radius method or a more technically defensible delineation of a well's recharge area)
2. Inventory of major potential sources of contamination (PSCs) within their source(s) delineation(s)
3. Recommended actions to eliminate/reduce the risks of impact by PSCs
4. Contingency plan to address contamination events

Examples of SIP include, but are not limited to:

- Source Water Protection Plan (SWPP) developed through one of VDH's assistance programs or other means
- Source Water Assessment Report (SWAR) issued after January 1, 2015
- Local or Regional Water Supply Plans submitted to the Virginia Department of Environmental Quality ([9VAC25-780](#)) when protection strategies are specifically referenced
- Any combination of programs or ordinances focused on watershed or wellhead protection (e.g., environmentally oriented or citizen groups, stormwater best management practices (BMPs), agricultural BMPs, etc.)

Waterworks are encouraged to contact the VDH while developing or updating a SIP. VDH can provide technical assistance to support the efforts.

Substantial Implementation (SI) of protection goals: Defined as completing source water protection activities in intervals no greater than three years from last action's date.

VDH tracks the SI status of CWSs and submits an annual report to EPA. The reported values are associated with the SP-4 metrics from the National Water Program Metrics. VDH will credit CWSs with SI status as follows:

SI Scenario 1

CWS wells in the coastal plain may be deemed as having a SIP and SI status when the well is constructed pursuant to the *Virginia Waterworks Regulations* and supporting documentation exists².

SI Scenario 2

CWS sources not meeting criteria under SI Scenario 1 may obtain SI status when:

- a. A SIP is developed³
- OR

¹ It is strongly recommended that the above criteria be reviewed and approved by a SWPC.

² This type of SI status does not expire unless there is evidence that well structure or aquifer has been compromised.

³ This is a one time achievement applicable only for the first approved SIP.

VDH Source Water Protection Program Definitions

- b. A SIP is updated when it is more than 3 years old⁴
OR
- c. One SIP recommendation or other protection/contingency measure is executed

Examples of SI actions include, but are not limited to:

- Distribution of educational material
- Acquisition of easements
- Proposing/approving ordinances or zoning
- Installation of signs
- Hiring an employee dedicated to source water protection

Since the SI status should be maintained, waterworks are encouraged to contact the VDH when they plan to or have completed implementation actions. This helps the agency to maintain more accurate program records and offers an opportunity to the waterworks to learn about possible ways in which the agency may support planned initiatives.

⁴ This cannot be the implementation action for two consecutive 3-year intervals.

APPENDIX A-3

VDH Source Water Assessment Program Susceptibility Classes,
Definitions, Land Use Inventory, and
Potential Conduits to Groundwater

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Chart A
Susceptibility Classes

Susceptibility	Explanation
Very low	[choose] [Properly constructed groundwater source located in an area that tends to inhibit contaminant migration, is protected with an appropriate aquitard, and has had no known detection of contamination within the last 5 years] [or] [Properly constructed groundwater source located in an area that tends to promote contaminant migration (or provide little protection against contaminant migration), but determined by the U. S. Geological Survey to be developed in a 'confined' or 'nonsensitive' aquifer within that groundwater area] with no land use activities of concern or potential conduits to groundwater in the Zone 1 assessment area nor potential sources of contamination in the Zone 1 or Zone 2 assessment areas
Low	[choose] [Properly constructed groundwater source located in an area that tends to inhibit contaminant migration, is protected with an appropriate aquitard, and has had no known detection of contamination within the last 5 years] [or] [Properly constructed groundwater source located in an area that tends to promote contaminant migration (or provide little protection against contaminant migration), but determined by the U. S. Geological Survey to be developed in a 'confined' or 'nonsensitive' aquifer within that groundwater area] with [choose] [land use activities of concern][and][potential conduits to groundwater] in the Zone 1 assessment area[potential sources of contamination in the Zone 1 or Zone 2 assessment areas]
Moderate	[choose] [Groundwater source constructed in an area that promotes migration of contaminants] [or] [groundwater source located in an area that tends to inhibit contaminant migration but unprotected by an appropriate aquitard] [or] [Groundwater source located in an area that tends to inhibit contaminant migration in which contaminants have been detected within the past five years] with no land use activities of concern or potential conduits to groundwater in the Zone 1 assessment area nor potential sources of contamination in the Zone 1 or Zone 2 assessment areas
High	[choose] [Groundwater source constructed in an area that promotes migration of contaminants] [or] [groundwater source located in an area that tends to inhibit contaminant migration but is unprotected by an appropriate aquitard] [or] [Groundwater source located in an area that tends to inhibit contaminant migration in which contaminants have been detected within the past five years] with [choose] [land use activities of concern][and][potential conduits to groundwater] in the Zone 1 assessment area [and/or potential sources of contamination in the Zone 1 or Zone 2 assessment areas]
Moderate	[choose] [Surface water] [or] [Groundwater under the direct influence of surface water source] exposed to an inconsistent array of contaminants at varying concentrations due to changing hydrologic, hydraulic and atmospheric conditions with no land use activities of concern in the Zone 1 assessment area
High	[choose] [Surface water] [or] [Groundwater under the direct influence of surface water source] exposed to an inconsistent array of contaminants at varying concentrations due to changing hydrologic, hydraulic and atmospheric conditions with land use activities of concern in the Zone 1 assessment area

Chart B: Definitions of Key Terms

Aquifer:	A water bearing geological unit that will yield water to wells or springs.
Aquitard:	An underground confining bed of earthen material that retards, but does not prevent, the flow of water between adjacent aquifers.
Best Management Practices:	Practices utilized by the owner and/or operator of land use activities in attempts to reduce or eliminate contamination of the environment.
Community Waterworks:	A waterworks which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.
Confined or Nonsensitive Aquifer:	An aquifer that is bounded by impervious confining layers both at the top and the bottom. Also referred to as an artesian aquifer
Delineation:	The process of defining or mapping a boundary that approximates the areas that contribute water to a particular water source used as a public water supply. For surface waters, the land area usually consists of the watershed for a reservoir or stream. For groundwater sources, the boundary typically approximates the surface area that contributes water to the aquifer.
Groundwater:	Water that is beneath the ground and that does not meet the definition of surface water.
Groundwater Under the Direct Influence of Surface Water:	A groundwater with (i) significant occurrence of insects, microorganisms, algae, or pathogens, or (ii) significant and relatively rapid shifts in water characteristics which closely correlate to climatological or surface water conditions. The Virginia Department of Health designates a groundwater source meeting certain conditions as a Groundwater Under the Direct Influence of Surface Water in accordance with 12 VAC 5-590-430 of the <i>Waterworks Regulations</i> .
Identified Flowing Surface Source:	A surface water stream that enters the groundwater by flowing into a sinkhole, the bottom of a stream bed, or by other means and which has been verified through tracer or other studies to reemerge from the ground as a spring or through a well; or which flows beneath broken rubble (which is strewn down the side of a mountain) with openings to the atmosphere and which is collected at a 'springbox'.
Impoundment Source Intake:	A raw water intake that feeds from a surface water consisting of a reservoir or other type of impoundment.
Land Use Activity:	An activity that stores, uses, or produces chemicals or biological pathogens and that has the potential to release such contaminants within the source water assessment area.

Chart B: Definitions of Key Terms
Page 2

Non-Community Waterworks:	A waterworks that is not a community waterworks but serves any 25 or more persons for 60 or more days per year.
Non-Tidal Source Intake:	A raw water intake that feeds from a surface water that is not influenced by tidal action and possesses a stream flow which travels down gradient.
Non-Transient Non-Community Waterworks:	A waterworks that is not a community waterworks but that regularly serves at least 25 of the same persons for 6 months or more per year.
Potential Conduits to Groundwater:	A fracture, sinkhole, drilled hole, well or any type of conduit through the ground that has the potential to carry surface water or surface runoff directly into a groundwater.
Potential Sources of Contamination:	A land use activity whose presence and location have been identified in selected state, federal, or private databases during the assessment.
Raw Water Intake:	The suction intake that draws water from a surface water source for use as a public water supply.
Sensitivity:	The relative ease with which a contaminant applied near the land surface, or to the subsurface, can migrate to the delineated source water area.
Source Water Assessment:	An assessment to provide information on the potential contaminant threats to the water source(s) of a waterworks and the susceptibility of those sources to contamination.
Surface Water:	Water open to atmosphere and subject to receiving surface runoff.
Susceptibility to Contamination:	The determined classification (or rating) of the susceptibility of a source to contamination based on its sensitivity and the presence of land use activities of concern, potential sources of contamination, or potential conduits to groundwater (for groundwater sources only) within the assessment area.
Tidal Source Intake:	A raw water intake that feeds from a surface water that is influenced by tidal action resulting in a stream flow that travels in either direction based on the rise or fall of moon or wind driven tides.
Upgradient:	The directions from a source in which ground elevation rises with distance. Opposite is downgradient. Water will flow downgradient.
Watershed:	A topographical area that is within a line drawn connecting the highest points uphill of a drinking water intake from which overland flow drains to a water supply intake.

Table 1
LAND USE ACTIVITY INVENTORY
(Community and Nontransient Noncommunity Waterworks)

CLASSIFICATION	CONTAMINANT	SURFACE WATER RISK	GROUND WATER RISK	NAICS CODE
Residential/Commercial				
Fuel Storage Systems [ground water only]	V	X	medium	814110
On-site sewage system [ground water only]	M, N	X	medium	814110
Agriculture				
Chemical/fuel storage areas	V, S, N	low	medium	111, 112
Crop and fodder production	S, N	low	medium	111
Specialty crop production/nursery (e.g. horticulture, citrus, nuts, fruits)	S, N	low	medium	112
Livestock/poultry				
Pasture (grazing)	M, N	medium	low	112
Intensive animal feeding operations				112
Confined animal feeding operations (permitted)	M, N	high	high	112
Confined animal feeding operations (non-permitted)	M, N	high	high	112
Aquaculture	M, N	low	medium	11251
Animal burial areas	M, N	low	medium	112
Manure holding or spreading	M, N	medium	medium	112
Other				
Industrial/Commercial [Dry and Discharging]				
Above ground storage tank (> 660 gallons) excluding potable water and petroleum	V, S, N	medium	medium	
Animal Slaughtering or Processing	M, N	low	medium	311
Asphalt Plants	V, S, N	low	medium	32412
Car Wash	V	low	low	811192
Cemetery [ground water only]	M, N, S	X	low	812220
Coal Gasification Facility	V	low	medium	324199
Dry Cleaning Establishment	V	low	medium	812320
Electrical and Electronic Product Manufacturing	I, V	low	medium	335310, 334410
Electroplating/Metal Finishing	I, V	low	medium	332813
Fertilizer/Manufacturer/Distributor/Storage	N, S	medium	medium	325, 422
Fire Training Facilities	V	low	medium	922160
Food Processing	M, N	low	low	311
Funeral Home/Mortuary	M, V	low	low	812210
Furniture/Boat Refinish (Boat Yards)	V, S, N	medium	medium	811420, 336612
Gasoline Station/Service Center	V, S, N	low	medium	447100
Golf Course	N, S	low	medium	713910
Hazardous Waste Recovery Facility	V, S, R, M	high	high	562211
Hazardous Waste Transfer, Storage or Disposal	V, S, R, M	high	high	562
Hospital	V, S, R, M	low	medium	622110
Laboratories	V, S, R, M	low	medium	541380, 621510
Machine Shops	V	low	medium	332710
Marina [Surface Only]	M, V, S	medium	X	713930
Military Base	V, S, R, M	high	high	928110
Oil & Gas Production (Refining)/Storage/Pipelines	V	medium	medium	324110, 422710, 486910
Paint Shop	V	low	medium	811121
Pesticide/Herbicide Manufacturer/Distributor/Storage	S	medium	medium	325320, 422690, 422910
Photo Processor/Printer	I	low	medium	812290
Pipeline / Powerline Right of Way	S	low	low	486910, 221120
Plastic Manufacturer	V, S	low	medium	326100, 325211
Power Generation Station	S	medium	low	221110
Scrap and Junk Yards	V, I	low	medium	421930
Solid Waste Collection/Transfer Site	V, S, M, I	low	low	562111
Superfund Site	V, S, R, M, I	high	high	562211
Underground Injection Well [groundwater only]	V, S, R, M, I	X	high	562
Underground Storage Tanks [excluding potable water][groundwater only]	V	X	medium	
Underground Storage Tanks [leaking][regulated][groundwater]	V	X	high	
Wood Preservative Manufacturer/Wood Preserver	S	low	medium	321114
Other				
Wastewater Facilities				
Combined Sewer Overflow/Discharge	M, N, V, S	high	low	22132
Septage Lagoon	M, N	medium	medium	22132

VIRGINIA SOURCE WATER ASSESSMENT PROGRAM

Table 1
LAND USE ACTIVITY INVENTORY
(Community and Nontransient Noncommunity Waterworks)

CLASSIFICATION	CONTAMINANT	SURFACE WATER RISK	GROUND WATER RISK	NAICS CODE
Sewer Lines (Surface-crossing and adjacent lines only) [surface water only]	M, N	High	X	22132
Storm Sewer Discharges and Stormwater infiltration ponds	V, N, S	Medium	low	22132
Untreated Piped Discharge [straight pipe]	M, N	High	low	22132
Wastewater Pump Station	M, N, V	High	low	22132
Wastewater Treatment Facility [point source discharge]	M, N, V	Medium	low	22132
Wastewater Treatment Nondischarging lagoon/mass drainfield	M, N, V	Low	medium	22132
Land Disposal				
Biosolids	M, N, I	low	low	111, 112
Industrial Sludge	M, N, I, S, V	low	low	562
Landfill (Lined)	M, N, V, S	low	medium	562212
Landfill (Unlined)	M, N, V, S	low	high	562212
Open Dump	M, N, V, S	low	High	5622
Septage	M, N	medium	Medium	111, 112, 562
Tire Pile	V	high	High	5622
Wastewater	M, N	medium	Medium	22132
Other				
Resource Extraction				
Coal	V	low	Low	21211
Oil + Gas	V	medium	Medium	211
Sand, Gravel, Limestone	V	low	Low	2123
Other				
Transportation				
Airport	V	low	Medium	422720
Parking Lots	V	low	Low	814
Primary Roadways	V, S, N, M, R	medium	Low	48
Railroad Tracks and Yards	V, S, N, M, R	medium	Low	482110
Salt Storage Sites	I	low	Low	48
Truck Terminals	V, S, N, M, R	medium	Medium	484
Special Cases (specifically identified as a significant source of contaminants)				
Barge and Vessel Traffic for surface sources		high	X	483211
Caves/Sinkholes for surface sources			X	

"X" – does not mean no risk

M = microbiological
N = nitrate/nitrite
V = volatile organic chemicals
S = synthetic organic chemicals
I = inorganic chemicals
R = radiological contaminants

(NOT all inclusive)

VIRGINIA SOURCE WATER ASSESSMENT PROGRAM
Table 2
LAND USE ACTIVITY INVENTORY
(Transient Noncommunity Waterworks)

Appendix A-3

CLASSIFICATION	CONTAMINANT	SURFACE WATER RISK	GROUND WATER RISK	NAICS CODE
Residential On-site sewage system [ground water only]	M, N	X	medium	814110
Agriculture Chemical/fuel storage areas	V, S, N	low	medium	111, 112
Crop and fodder production	S, N	low	medium	111
Specialty crop production/nursery (e.g. horticulture, citrus, nuts, fruits)	S, N	low	medium	111
Livestock/poultry				112
Pasture (grazing)	M, N	medium	low	112
Intensive animal feeding operations				112
Confined animal feeding operations (permitted)	M, N	high	high	112
Confined animal feeding operations (unpermitted)	M, N	high	high	112
Aquaculture	M, N	low	medium	11251
Animal burial areas	M, N	low	medium	112
Manure holding or spreading	M, N	medium	medium	112
Other				
Industrial/Commercial [Dry and Discharging]				
Above ground storage tank (> 660 gallons) excluding potable water and petroleum	V, S, N	medium	medium	
Animal Slaughtering or Processing	M, N	low	medium	311
Fertilizer/Manufacturer/Distributor/Storage	N, S	medium	medium	325310
Hospital	V, S, R, M	low	medium	622110
Laboratories	V, S, R, M	low	medium	541380, 621510
Marina [Surface Only]	M, V, S	medium	X	713930
Solid Waste Collection/Transfer Site	V, S, M, I	low	low	562111
Underground Injection Well [groundwater only]	V, S, R, M, I	X	high	562
Other				
Wastewater Facilities				
Combined Sewer Overflow/Discharge	M, N, V, S	high	low	22132
Septage Lagoon	M, N	medium	medium	22132
Sewer Lines (Surface-crossing and adjacent lines only) [surface water only]	M, N	high	X	22132
Storm Sewer Discharges and Stormwater infiltration ponds	V, N, S	medium	low	22132
Untreated Piped Discharge [straight pipe]	M, N	High	low	22132
Wastewater Pump Station	M, N, V	High	low	22132
Wastewater Treatment Facility [point source discharge]	M, N, V	Medium	low	22132
Wastewater Treatment Nondischarging lagoon/mass drainfield	M, N, V	Low	medium	22132
Land Disposal				
Biosolids	M, N, I	Low	low	111, 112
Industrial Sludge	M, N, I, S, V	Low	low	562
Landfill (Lined)	M, N, V, S	Low	medium	562212
Landfill (Unlined)	M, N, V, S	Low	high	562212
Open Dump	M, N, V, S	Low	high	5622
Septage	M, N	Medium	medium	111, 112 562
Wastewater	M, N	Medium	medium	22132
Other				
Special Cases (specifically identified as a significant source of contaminants)				
Barge and Vessel Traffic for surface sources		High	X	483211
Caves/Sinkholes for surface sources			X	

"X" – does not mean no risk

M = microbiological
N = nitrate/nitrite
V = volatile organic chemicals
S = synthetic organic chemicals
I = inorganic chemicals
R = radiological contaminants

(NOT all inclusive)

October 15, 1999

VIRGINIA SOURCE WATER ASSESSMENT PROGRAM

Table 3
POTENTIAL CONDUITS TO GROUNDWATER
(All Waterworks Utilizing Groundwater)

Abandoned Wells (which have not been permanently abandoned according to the Virginia Department of Health Regulations)
Caves / Sinkholes
Elevator shafts
Other Wells in Use (other than wells constructed in accordance with the Virginia Department of Health Regulations)
Ponds, streams
Vertical Ground Source Heat Pump systems

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APPENDIX B

Maps of Major Roads, Railroads, and Source Water Protection Areas

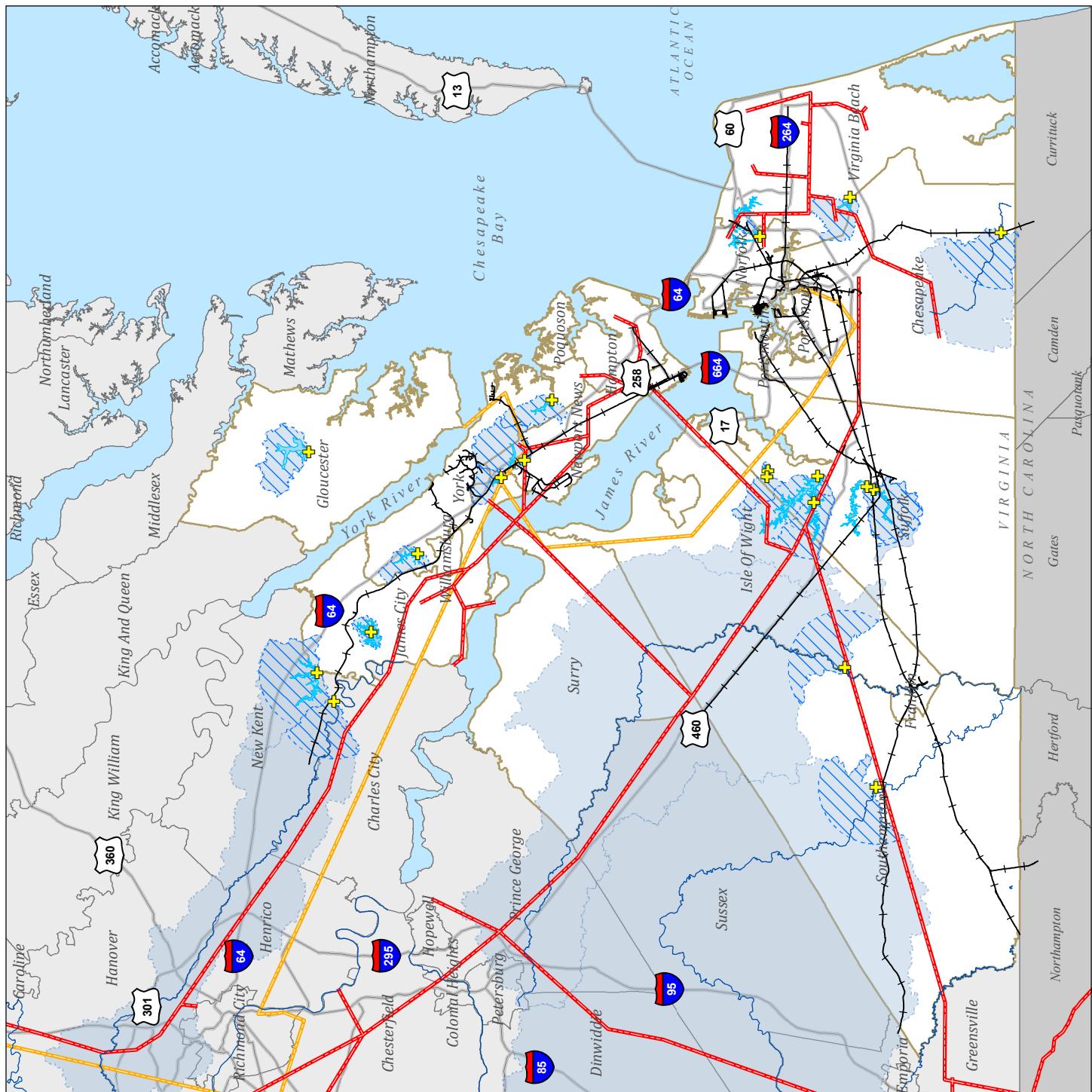
List of Maps:

Hampton Roads Area Rail and Pipeline Facilities

Hampton Roads Railroad Facilities:

- Map 1, Upper York-James Peninsula
- Map 2, Lower York-James Peninsula
- Map 3, Southside: Chesapeake, Norfolk, Portsmouth, and Virginia Beach
- Map 4, Southside: Chesapeake, Portsmouth, and Eastern Virginia Beach
- Map 5, Southside: Suffolk and Isle of Wight
- Map 6, Southside: Franklin, Isle of Wight, and Southampton

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HAMPTON ROADS AREA RAIL AND PIPELINE FACILITIES

Legend

- Railroad (Hampton Roads Lines)
- Natural Gas Pipeline
- Petroleum Product Pipeline
- Hampton Roads Municipal Surface Water Sources
- ⊕ Surface Water Intake
- SWPA - Zone 1
- SWPA Zone 2

Absolute Scale 1:1,000,000
0 4 8 16 Miles

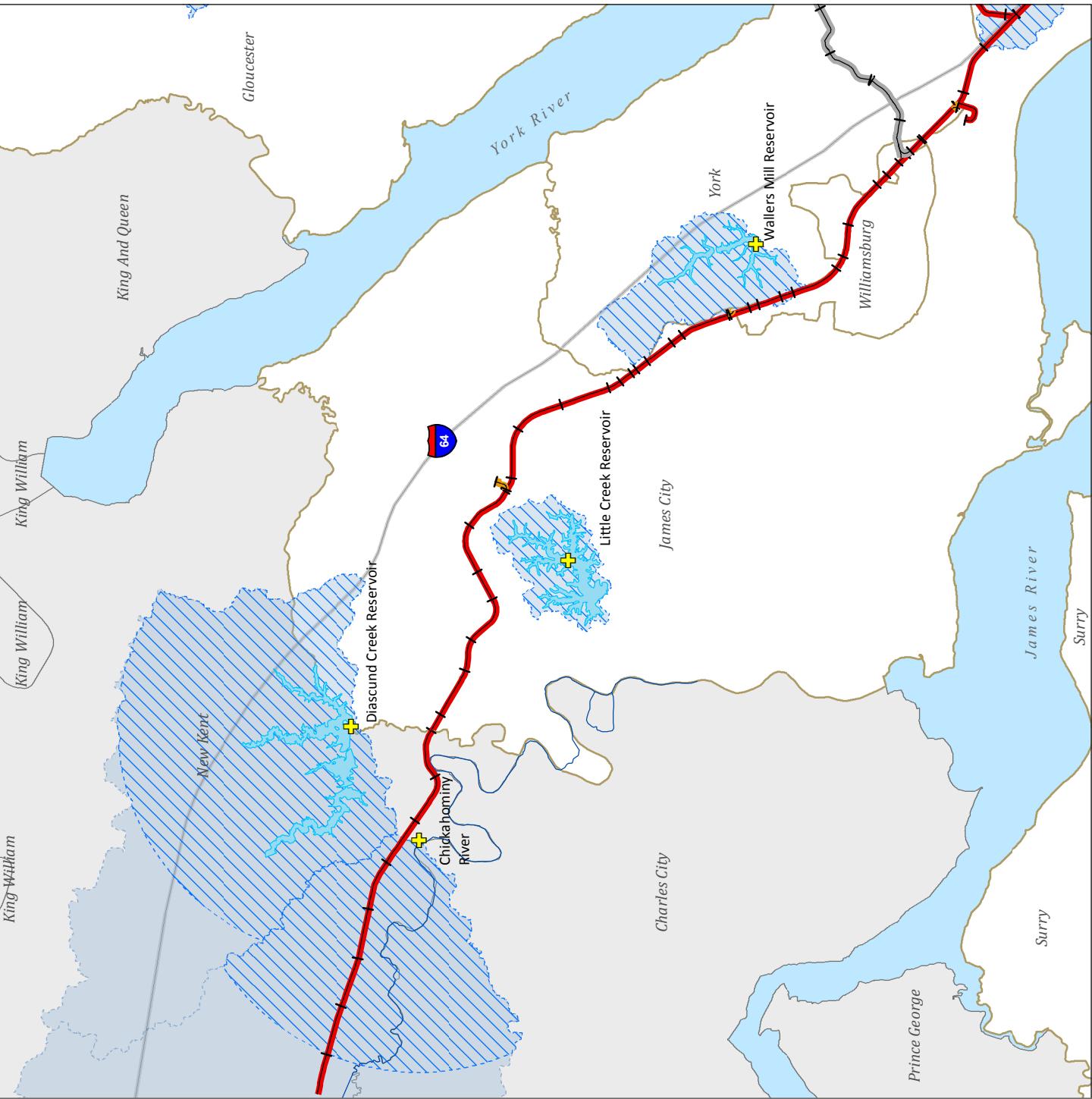
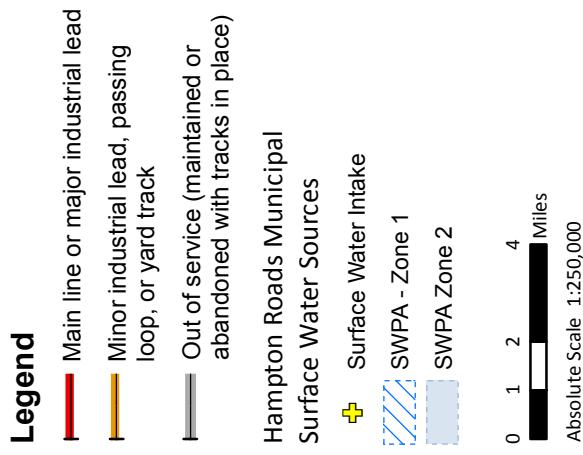


Natural gas and petroleum pipeline information shown on this map is limited to the 1:1,000,000 viewing scale (Source: U.S. Energy Information Administration, Layer Information for Interactive State Maps, http://www.eia.gov/maps/layer_info-m.php, Updated 7-7-16.)

Map produced by the staff of the Hampton Roads Planning District Commission (November 2016).

HAMPTON ROADS RAILROAD FACILITIES

Map 1 Upper York-James Peninsula

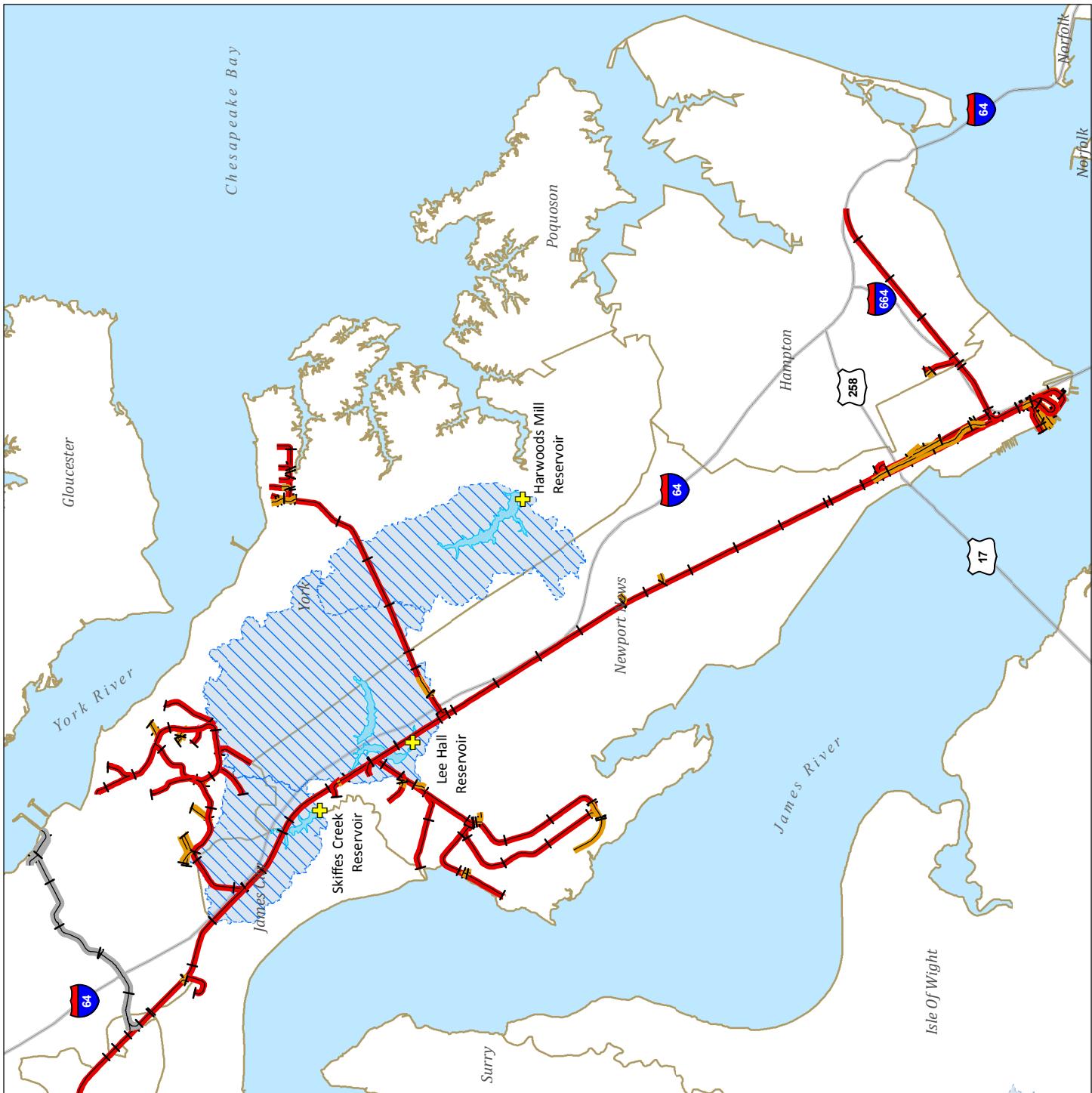
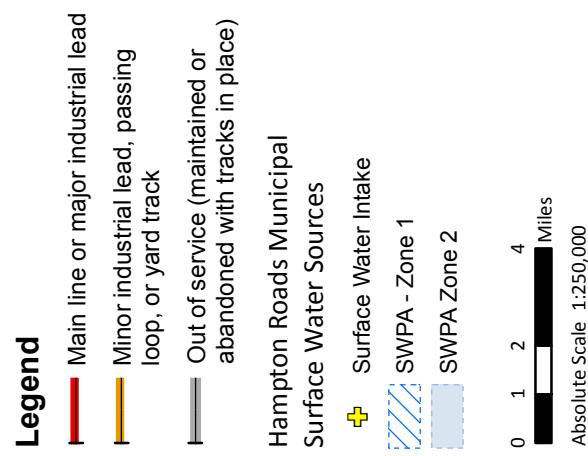


Railroad information shown on this map is from the "Hampton Roads Rail Network" shapefile (HRPDC, 2011), which includes rail networks within the Hampton Roads Planning District Commission's political boundaries. The data is intended for regional planning purposes and should not be used for site specific studies. The displayed rail network does not contain every individual rail line. For example, in rail yards only a representative number of lines are shown.

Map produced by the staff of the Hampton Roads Planning District Commission (November 2016).

HAMPTON ROADS RAILROAD FACILITIES

Map 2 Lower York-James Peninsula



Railroad information shown on this map is from the "Hampton Roads Rail Network" shapefile (HRPDC, 2011), which includes rail networks within the Hampton Roads Planning District Commission's political boundaries. The data is intended for regional planning purposes and should not be used for site specific studies. The displayed rail network does not contain every individual rail line. For example, in rail yards only a representative number of lines are shown.

Map produced by the staff of the Hampton Roads Planning District Commission (November 2016).

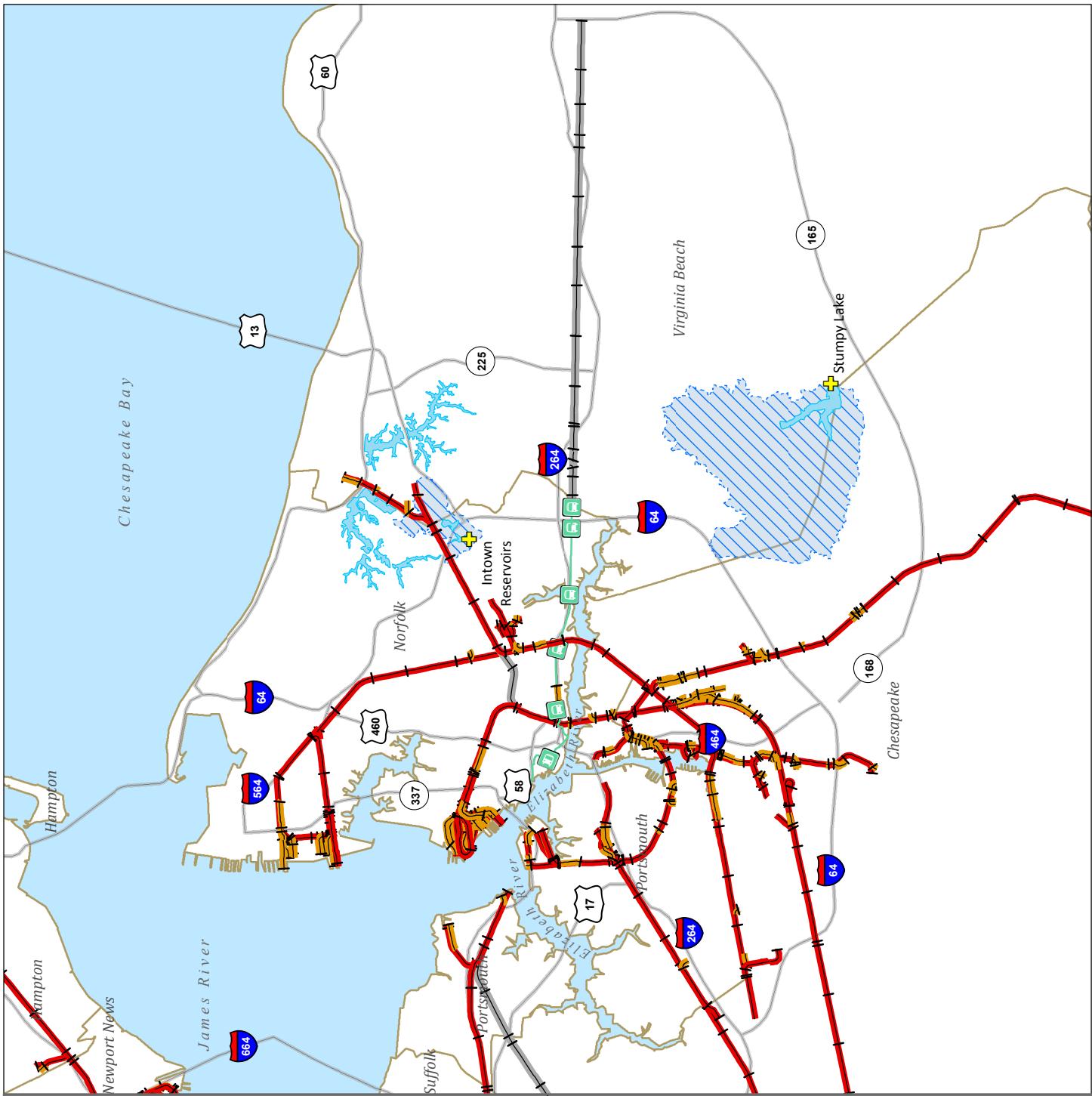
HAMPTON ROADS RAILROAD FACILITIES

Map 3 Southside: Chesapeake, Norfolk, Portsmouth, and Virginia Beach

Legend

- Main line or major industrial lead
- Minor industrial lead, passing loop, or yard track
- Out of service (maintained or abandoned with tracks in place)
- Light rail
- Hampton Roads Municipal Surface Water Sources
- + Surface Water Intake
- SWPA - Zone 1
- SWPA Zone 2

Absolute Scale 1:250,000



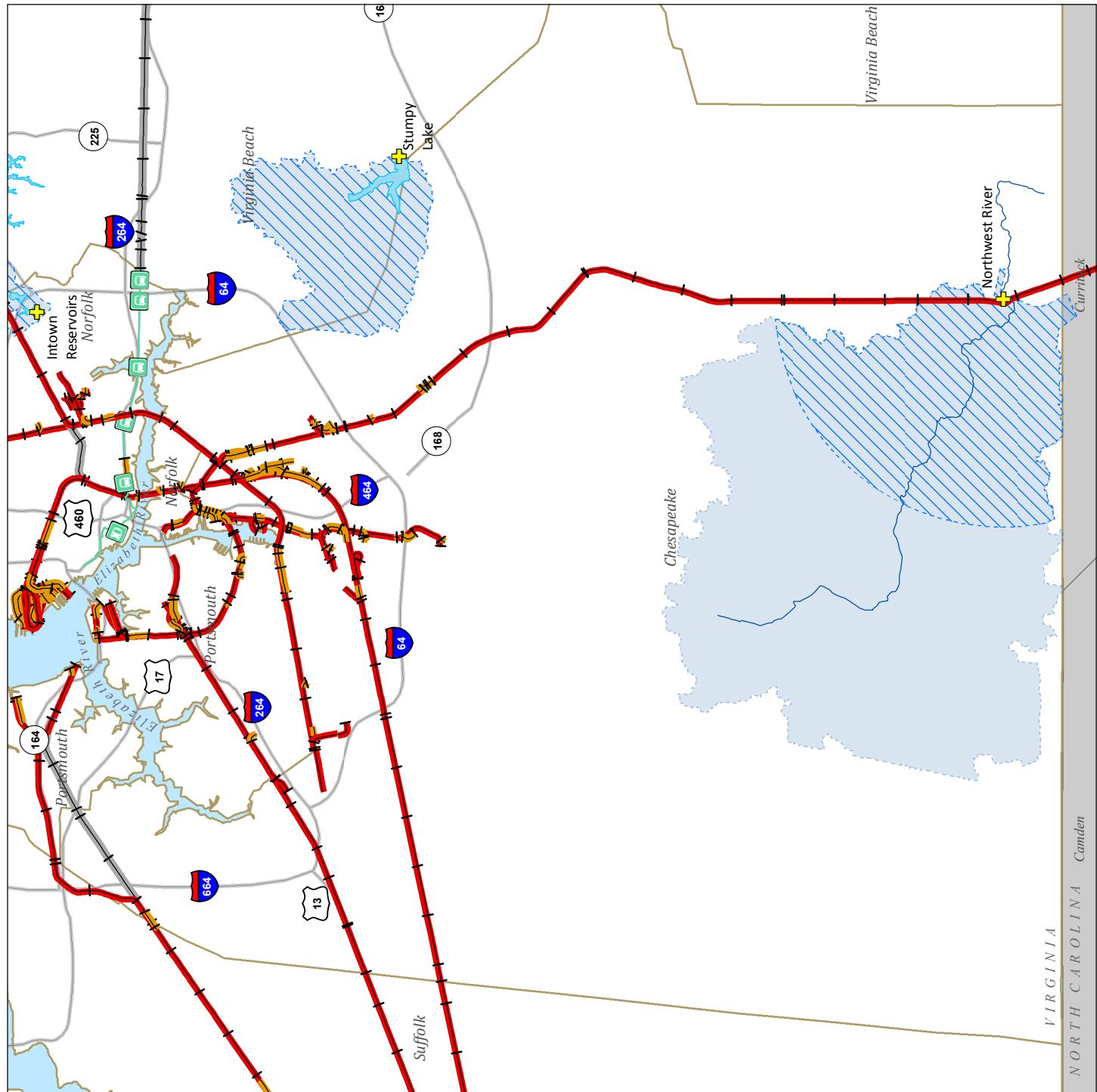
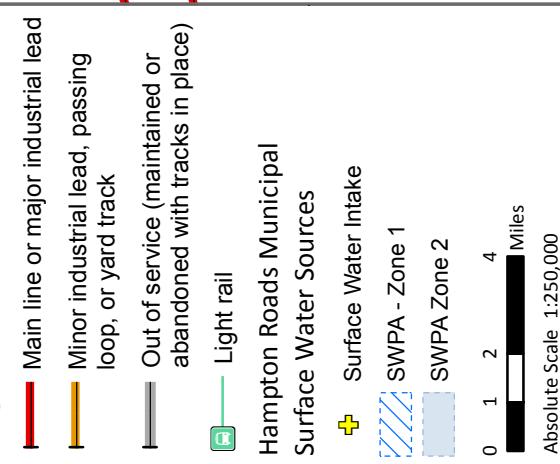
Railroad information shown on this map is from the "Hampton Roads Rail Network" shapefile (HRPDC, 2011), which includes rail networks within the Hampton Roads Planning District Commission's political boundaries. The data is intended for regional planning purposes and should not be used for site specific studies. The displayed rail network does not contain every individual rail line. For example, in rail yards only a representative number of lines are shown.

Map produced by the staff of the Hampton Roads Planning District Commission (November 2016).

HAMPTON ROADS RAILROAD FACILITIES

Map 4 Southside: Chesapeake, Portsmouth and Eastern Virginia Beach

Legend



Railroad information shown on this map is from the "Hampton Roads Rail Network" shapefile (HRPDC, 2011), which includes rail networks within the Hampton Roads Planning District Commission's political boundaries. The data is intended for regional planning purposes and should not be used for site specific studies. The displayed rail network does not contain every individual rail line. For example, in rail yards only a representative number of lines are shown.

Map produced by the staff of the Hampton Roads Planning District Commission (November 2016).

VIRGINIA
NORTH CAROLINA
Camden

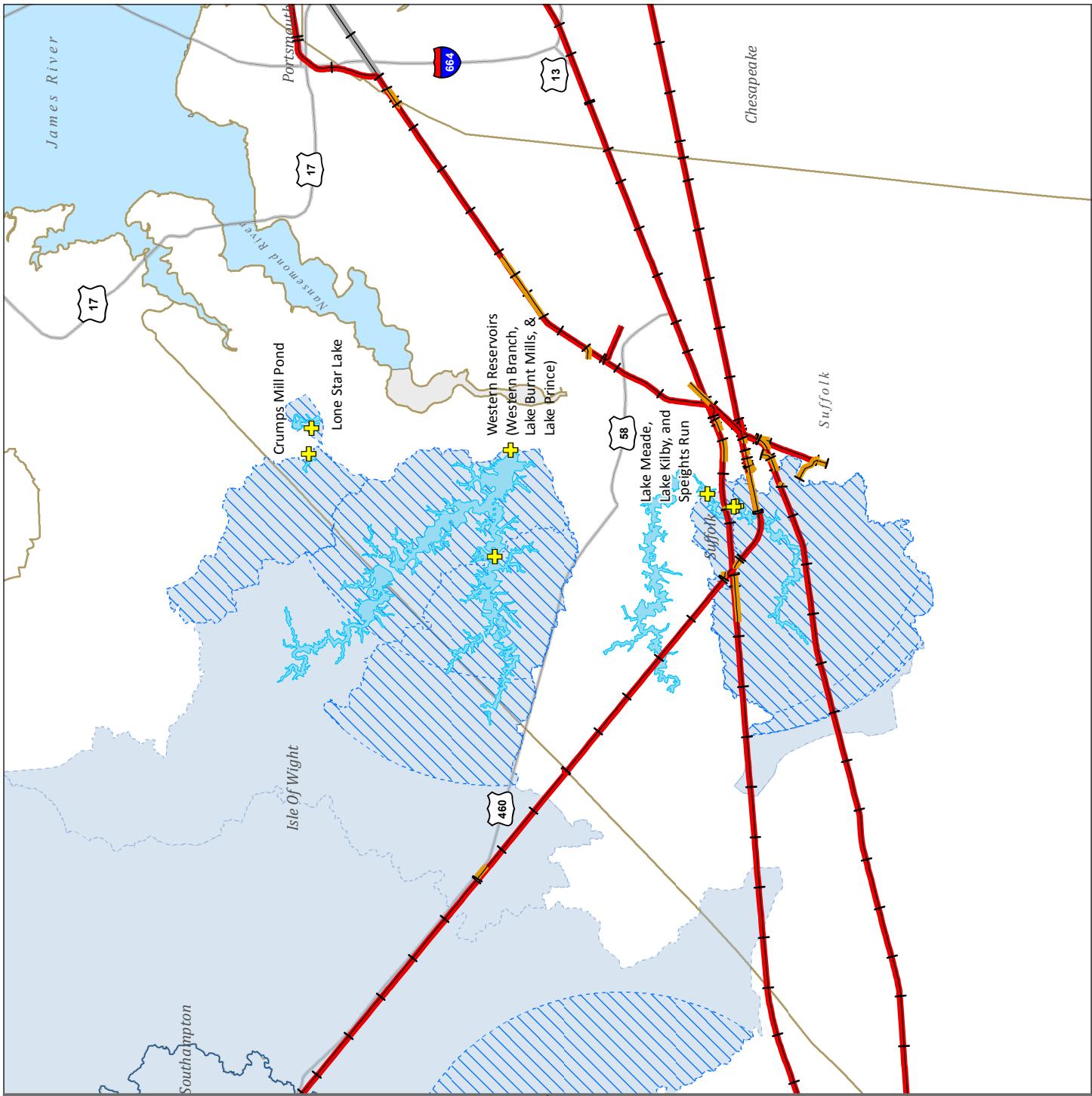
HAMPTON ROADS RAILROAD FACILITIES

Map 5 Southside: Suffolk and Isle of Wight

Legend

- Main line or major industrial lead
- Minor industrial lead, passing loop, or yard track
- Out of service (maintained or abandoned with tracks in place)
- Hampton Roads Municipal Surface Water Sources**
- + Surface Water Intake
- SWPA - Zone 1
- SWPA Zone 2

Absolute Scale 1:250,000



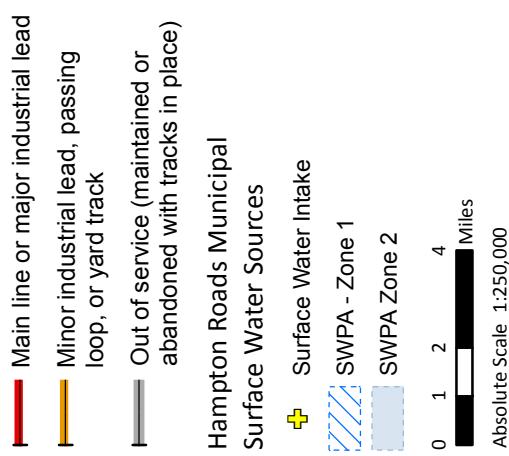
Railroad information shown on this map is from the "Hampton Roads Rail Network" shapefile (HRPDC, 2011), which includes rail networks within the Hampton Roads Planning District Commission's political boundaries. The data is intended for regional planning purposes and should not be used for site specific studies. The displayed rail network does not contain every individual rail line. For example, in rail yards only a representative number of lines are shown.

Map produced by the staff of the Hampton Roads Planning District Commission (November 2016).

HAMPTON ROADS RAILROAD FACILITIES

Map 6 Southside: Franklin, Isle of Wight, and Southampton

Legend



Railroad information shown on this map is from the "Hampton Roads Rail Network" shapefile (HRPDC, 2011), which includes rail networks within the Hampton Roads Planning District Commission's political boundaries. The data is intended for regional planning purposes and should not be used for site specific studies. The displayed rail network does not contain every individual rail line. For example, in rail yards only a representative number of lines are shown.

Map produced by the staff of the Hampton Roads Planning District Commission (November 2016).

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APPENDIX C

Maps of Gas Transmission and Hazardous Liquid Pipelines by Locality

List of Maps:

Brunswick, VA
Chesapeake, VA
Franklin, VA
Gloucester, VA
Hampton, VA
Isle of Wight, VA
James City, VA
New Kent, VA
Newport News, VA
Norfolk, VA
Poquoson, VA
Portsmouth, VA
Smithfield, VA
Southampton, VA
Suffolk, VA
Surry County, VA
Virginia Beach, VA
Williamsburg, VA
York, VA

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GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Brunswick County, VA

Brunswick County, VA

Legend

Pipeline Infrastructure

Gas Transmission Pipeline

Hampton Roads

Municipal Water Sources

Surface Water Intake

Source Water Protection Areas

SWPA - Zone 1

SWPA - Zone 2

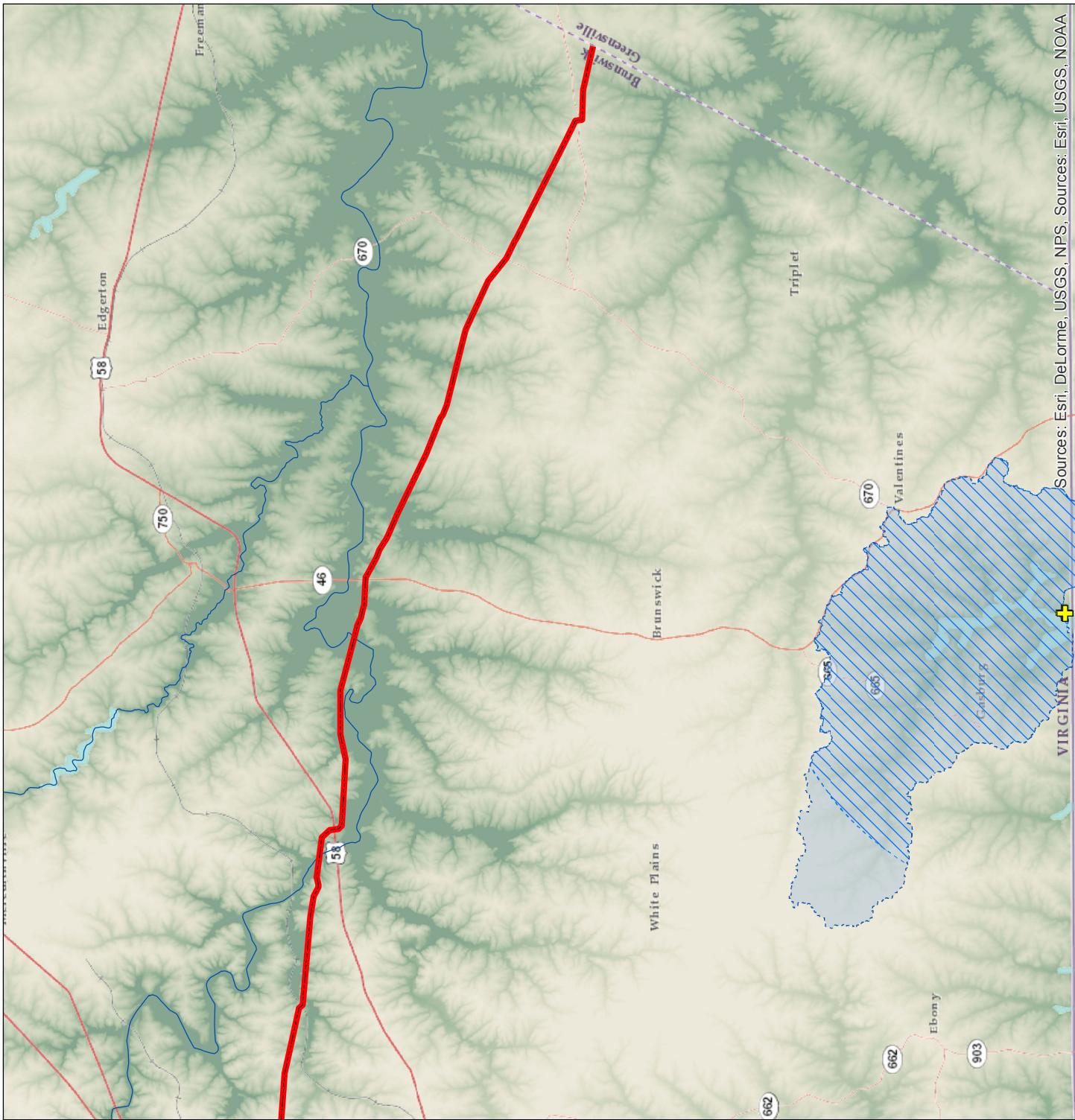
0 0.75 1.5 3 Miles
Absolute Scale 1:190,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Chesapeake, VA

Legend

Pipeline Infrastructure

Gas Transmission Pipeline

Hazardous Liquid Pipeline

LNG Plants

Breakout Tanks

Hampton Roads

Municipal Water Sources

Surface Water Intake

Municipal Well
(DEQ permitted well)

Surface Water Intake

Source Water Protection Areas

SWPA - Zone 1

SWPA - Zone 2

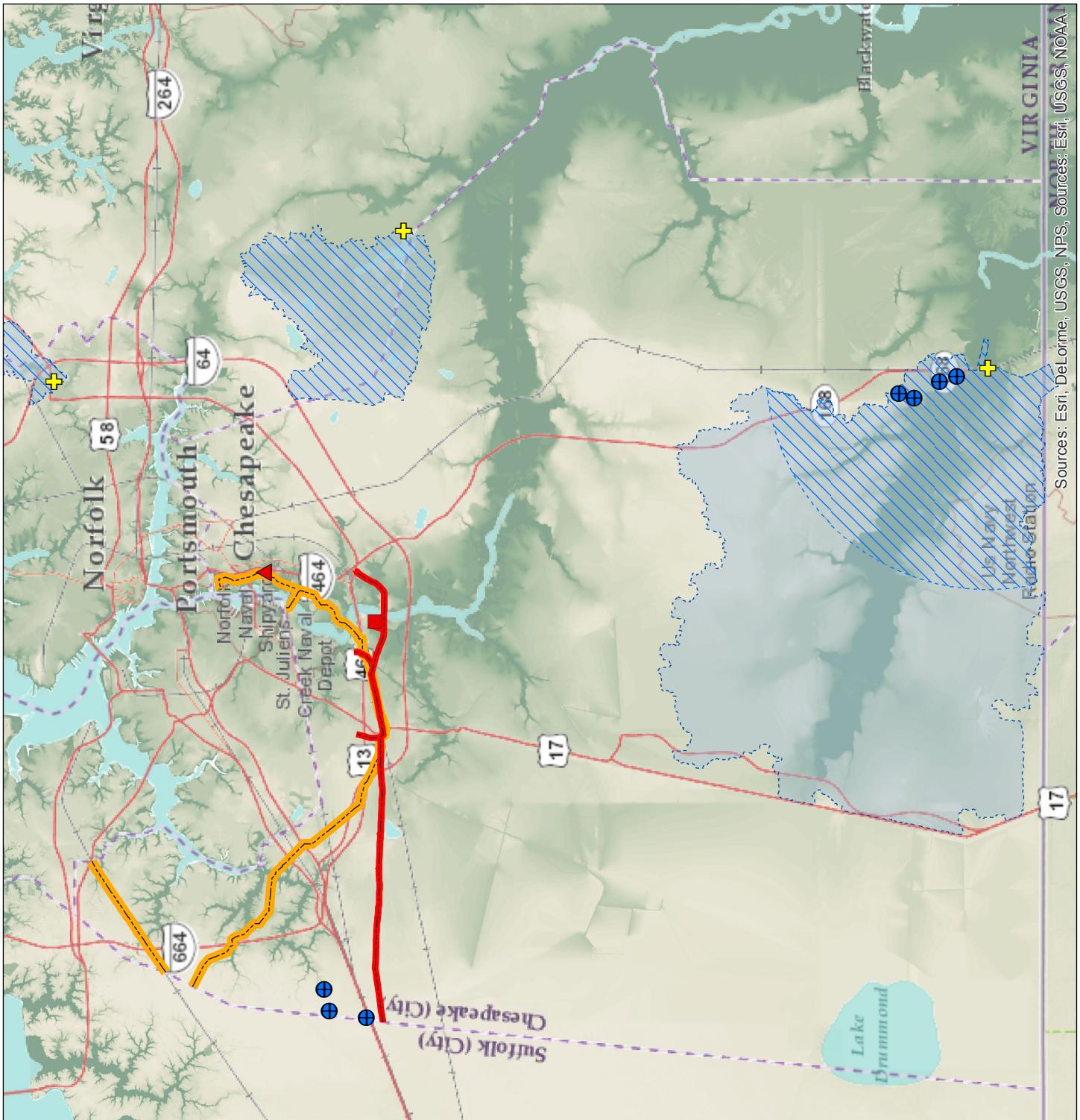
0 1 2 4 Miles
Absolute Scale 1:255,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

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Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Franklin, VA

Legend

Pipeline Infrastructure
— Gas Transmission Pipeline

Hampton Roads
Municipal Water Sources

⊕ Surface Water Intake

⊕ Municipal Well
(DEQ permitted well)

Surface Water Intake
Source Water Protection Areas

— SWPA - Zone 1

— SWPA - Zone 2

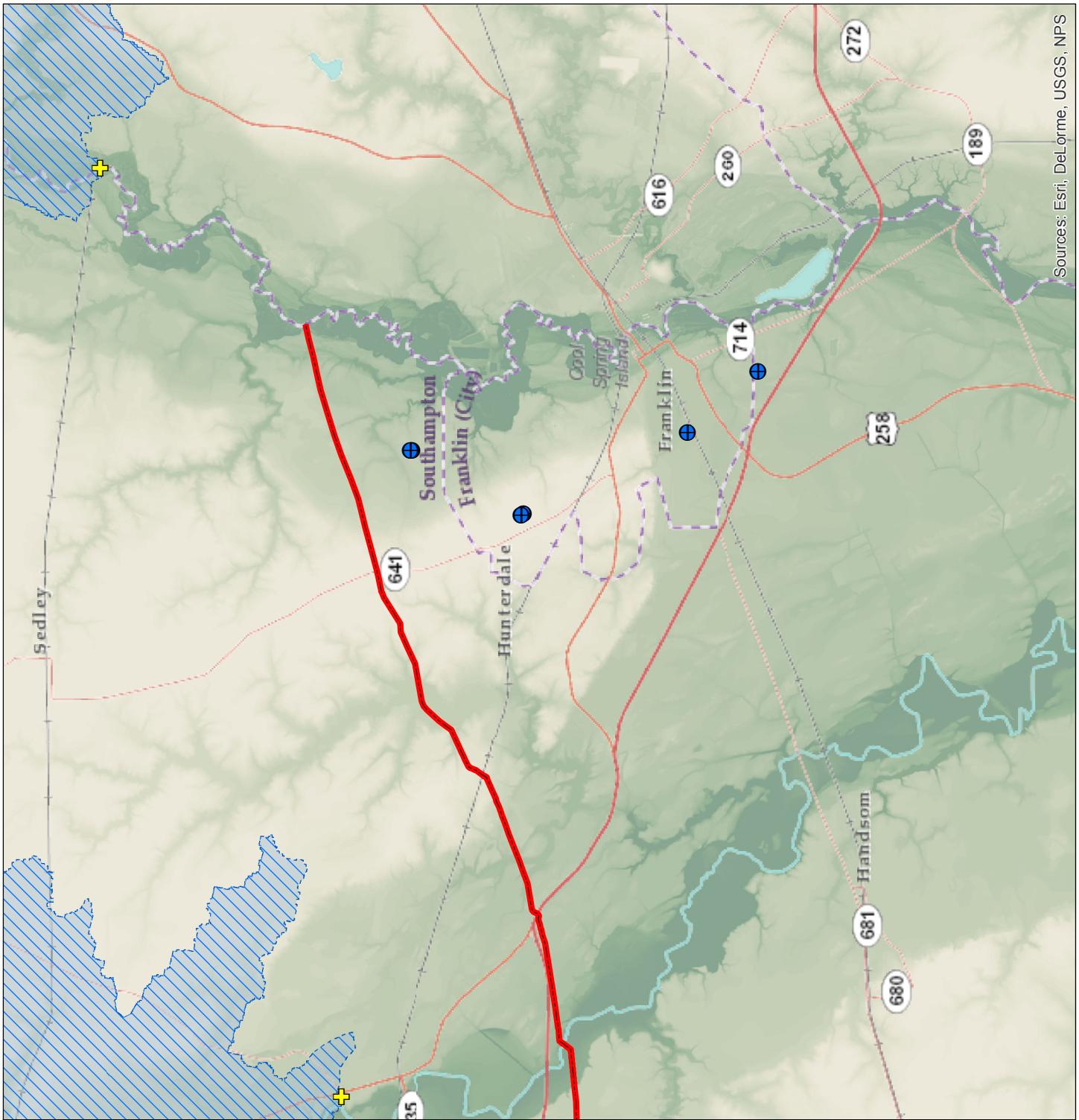
0 0.5 1 2 Miles
Absolute Scale 1:127,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Sources: Esri, DeLorme, USGS, NPS

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Gloucester, VA

(There are no gas transmission or hazardous liquid pipelines within Gloucester County, VA.)

Legend

Hampton Roads Municipal Water Sources

- Surface Water Intake
- Municipal Well (DEQ permitted well)
- Municipal Well (DEQ permit pending)

Surface Water Intake
Source Water Protection Areas

- SWPA - Zone 1
- SWPA - Zone 2

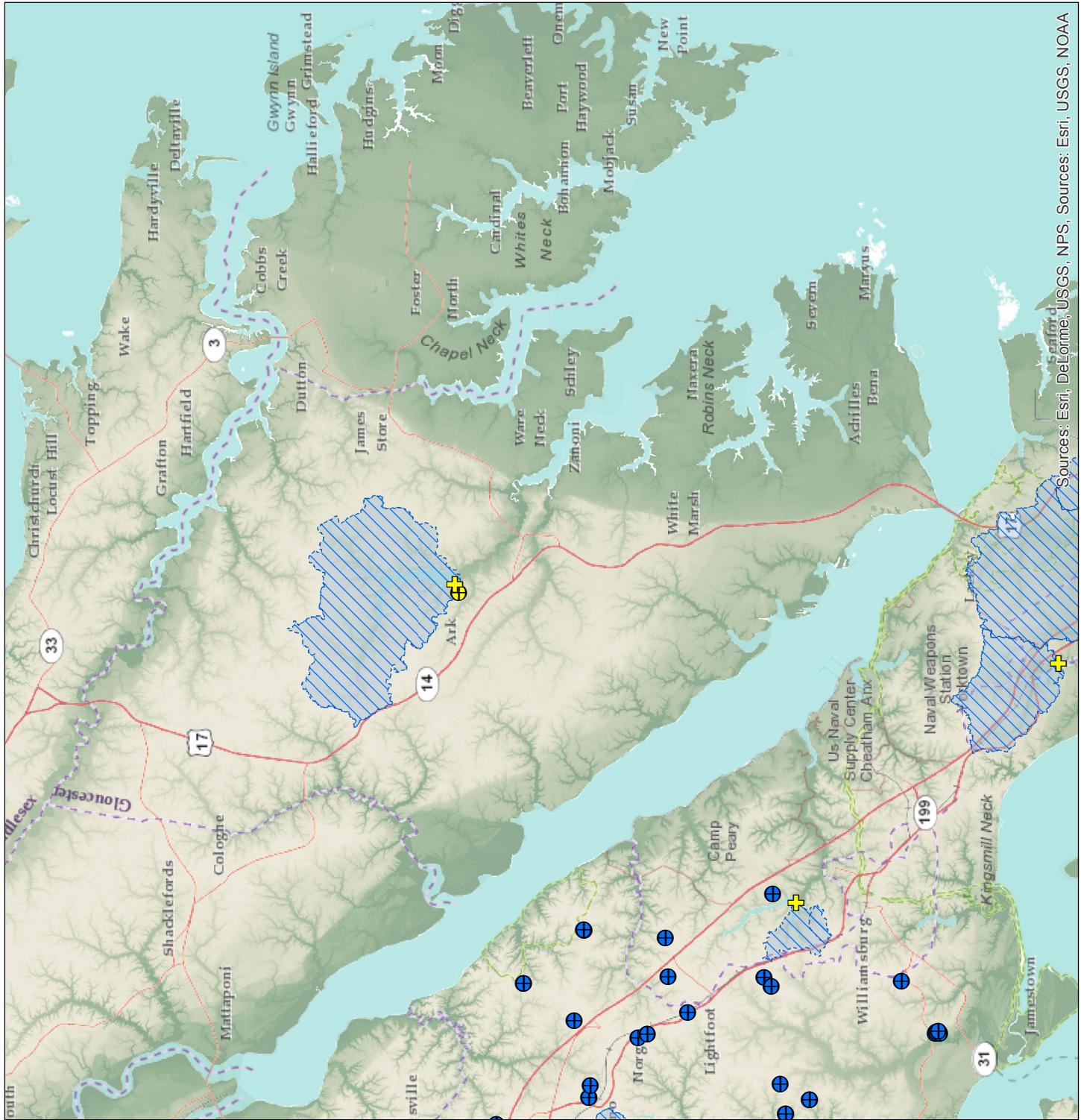
0 1.25 2.5 5 Miles
Absolute Scale 1:315,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Hampton, VA

Legend

- Pipeline Infrastructure
 - Gas Transmission Pipeline
 - Hampton Roads Municipal Water Sources
 - Surface Water Intake
 - Surface Water Protection Areas
- SWPA - Zone 1
- SWPA - Zone 2

0 0.5 1 2 Miles
Absolute Scale 1:127,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

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Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Isle of Wight County, VA

Legend

Pipeline Infrastructure
— Gas Transmission Pipeline
— Hazardous Liquid Pipeline

Hampton Roads
Municipal Water Sources

- ⊕ Surface Water Intake
- ⊕ Municipal Well
(DEQ permitted well)
- ⊕ Municipal Well
(DEQ permit not required)

Surface Water Intake
Source Water Protection Areas

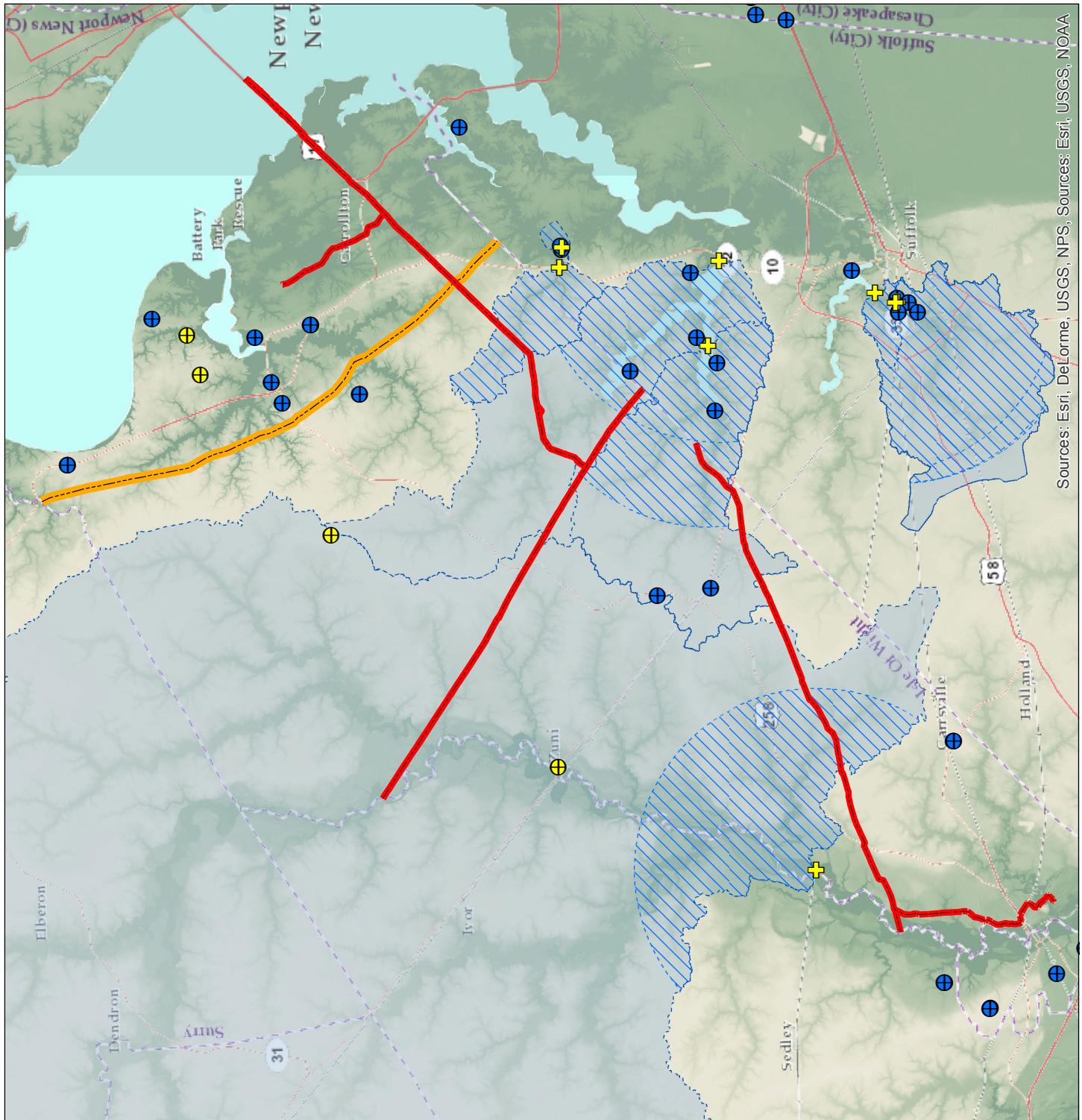
- SWPA - Zone 1
- SWPA - Zone 2

0 1 2 4 Miles
Absolute Scale 1:250,000

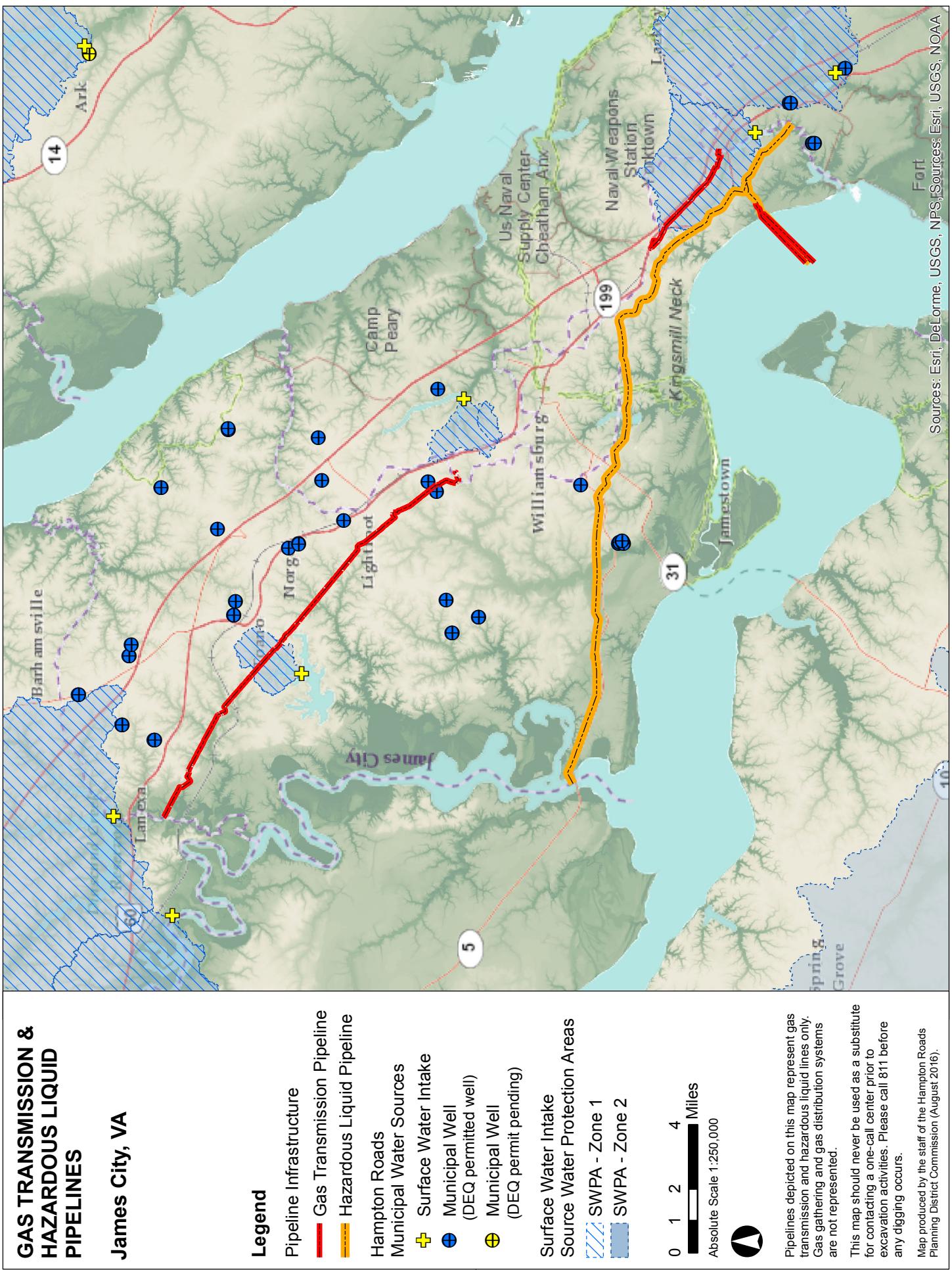
Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA



GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

New Kent, VA

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).

Legend

Pipeline Infrastructure

- Gas Transmission Pipeline
- Hampton Roads
- Municipal Water Sources
- Surface Water Intake
- Municipal Well (DEQ permitted well)

Source Water Protection Areas

- SWPA - Zone 1
- SWPA - Zone 2

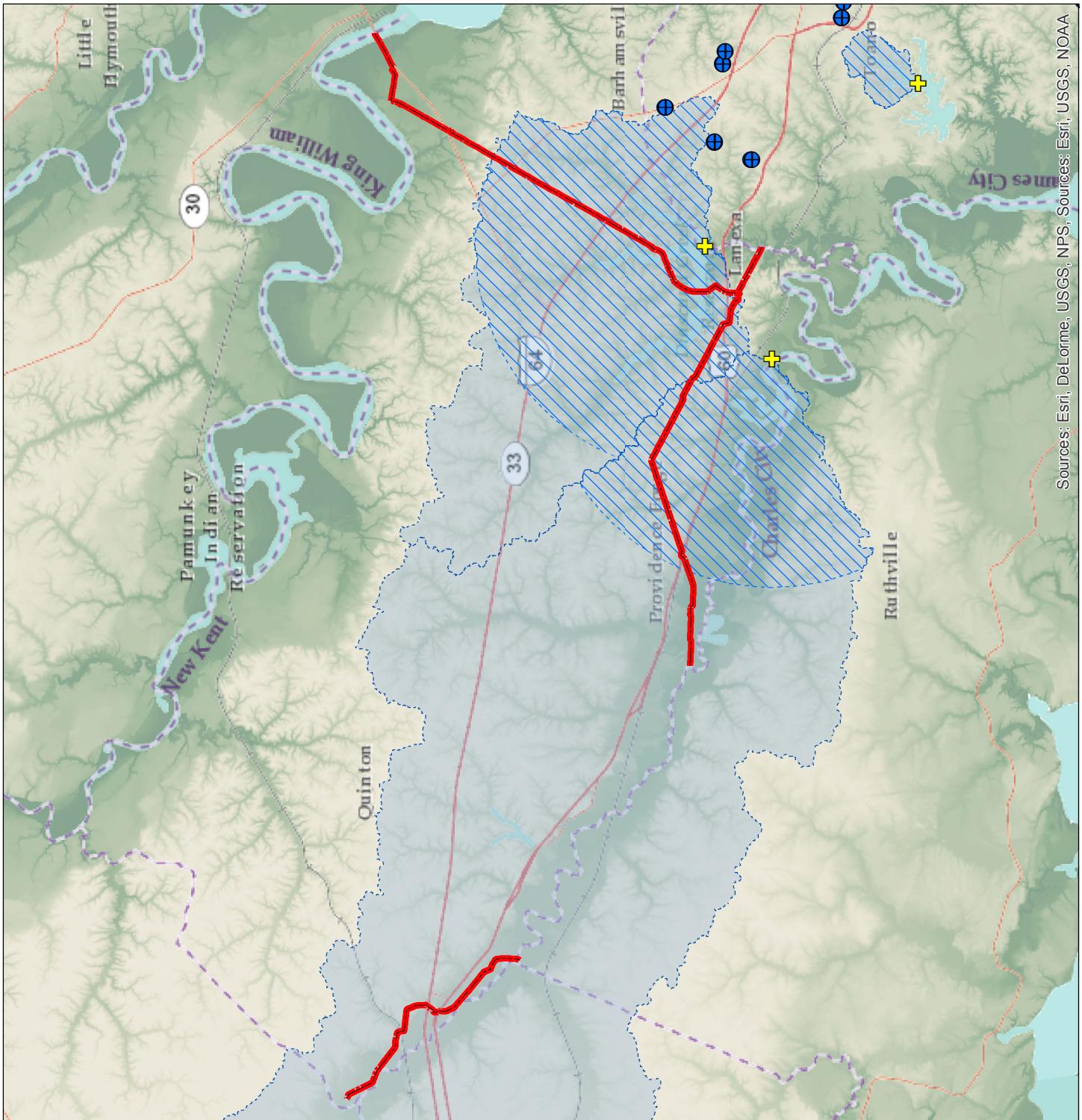
0 1 2 4 Miles
Absolute Scale 1:250,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Newport News, VA

Legend

Pipeline Infrastructure

Gas Transmission Pipeline

Hazardous Liquid Pipeline

Hampton Roads

Municipal Water Sources

Surface Water Intake

Municipal Well

(DEQ permitted well)

Municipal Well

(DEQ permit not required)

Surface Water Intake

Source Water Protection Areas

SWPA - Zone 1

SWPA - Zone 2

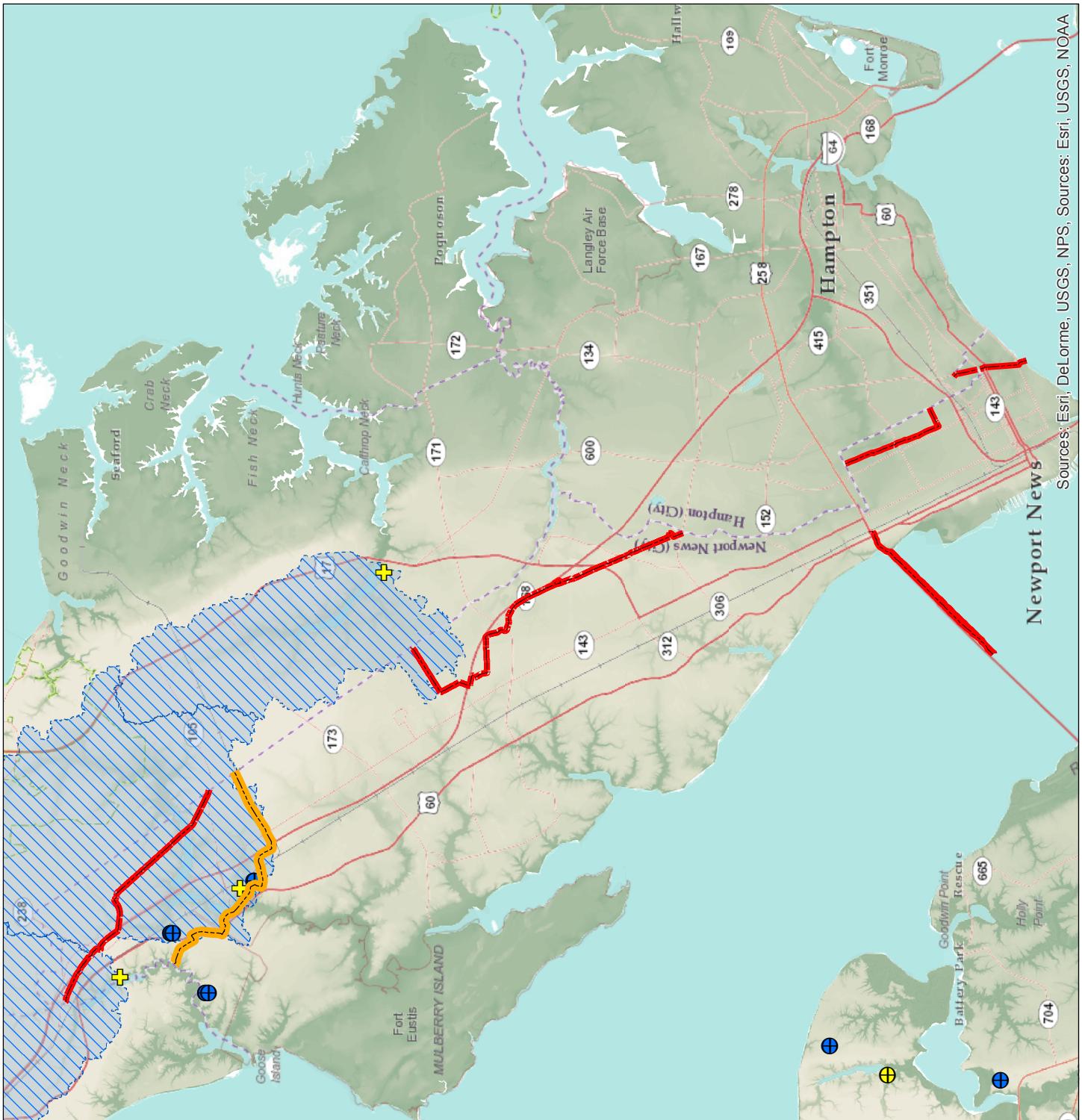
0 0.75 1.5 3 Miles
Absolute Scale 1:190,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Newport News

Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Norfolk, VA

Hampton
Roads

Legend

- Gas Transmission Pipeline
- Hampton Roads Municipal Water Sources
- Surface Water Intake
- Surface Water Protection Areas
- SWPA - Zone 1
- SWPA - Zone 2

0 0.5 1 2 Miles
Absolute Scale 1:125,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

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Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Poquoson, VA

(There are no gas transmission or hazardous liquid pipelines within Poquoson, VA.)

Legend

- Hampton Roads Municipal Water Sources
- Surface Water Intake
- Source Water Protection Areas
- SWPA - Zone 1
- SWPA - Zone 2

0 0.5 1 2 Miles
Absolute Scale 1:127,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

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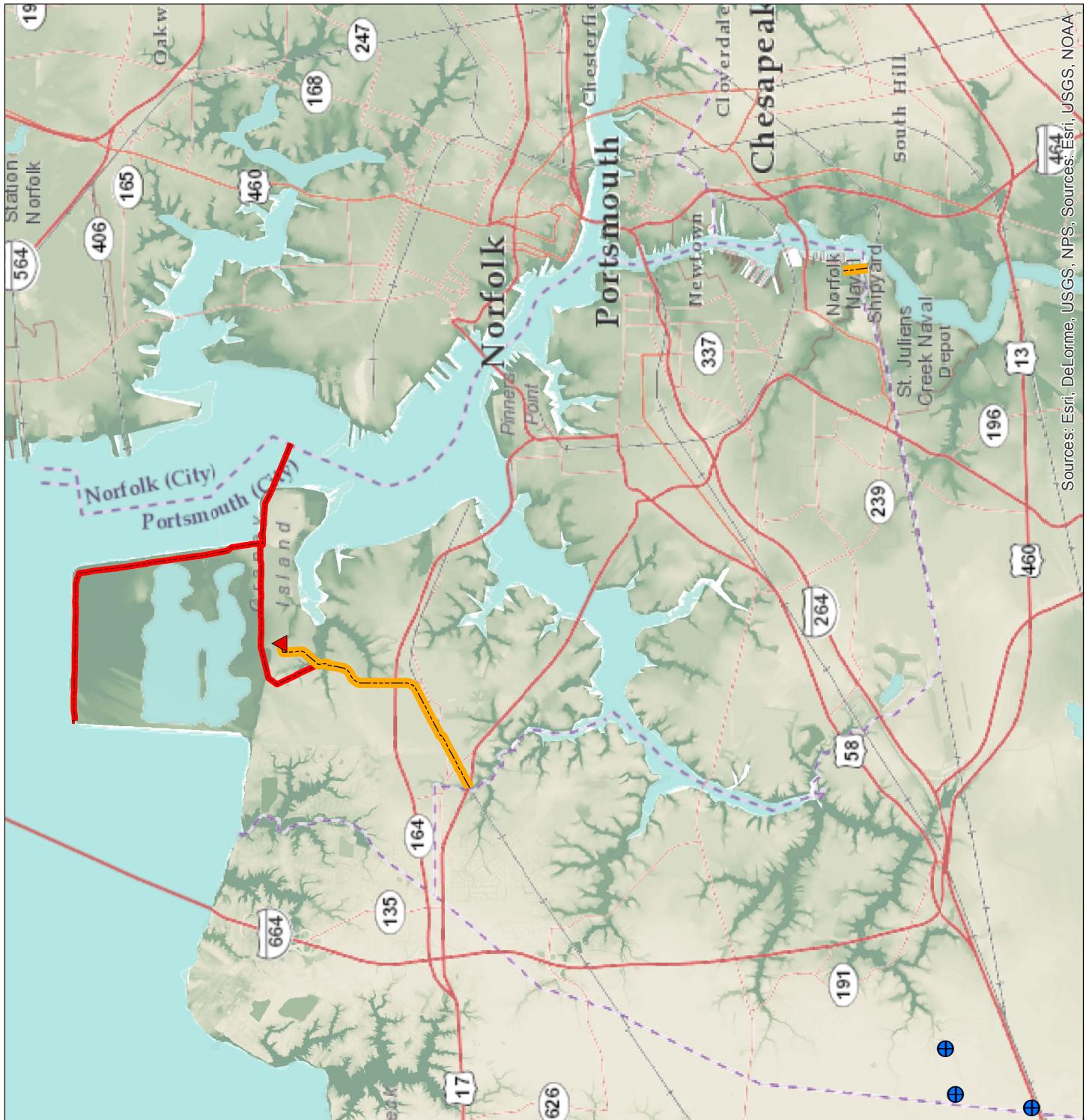
Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Map Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Portsmouth, VA



Legend

Pipeline Infrastructure

— Gas Transmission Pipeline

— Hazardous Liquid Pipeline

▲ Breakout Tanks

Hampton Roads

Municipal Water Sources
● Municipal Well
(DEQ permitted well)

0 0.5 1 2 Miles
Absolute Scale 1:125,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

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Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Smithfield, VA (Isle of Wight County, VA)

Legend

Pipeline Infrastructure

- Gas Transmission Pipeline
- Hazardous Liquid Pipeline

Hampton Roads Municipal Water Sources

- Surface Water Intake
- Municipal Well (DEQ permitted well)
- Municipal Well (DEQ permit not required)

Surface Water Intake Source Water Protection Areas

- SWPA - Zone 1
- SWPA - Zone 2

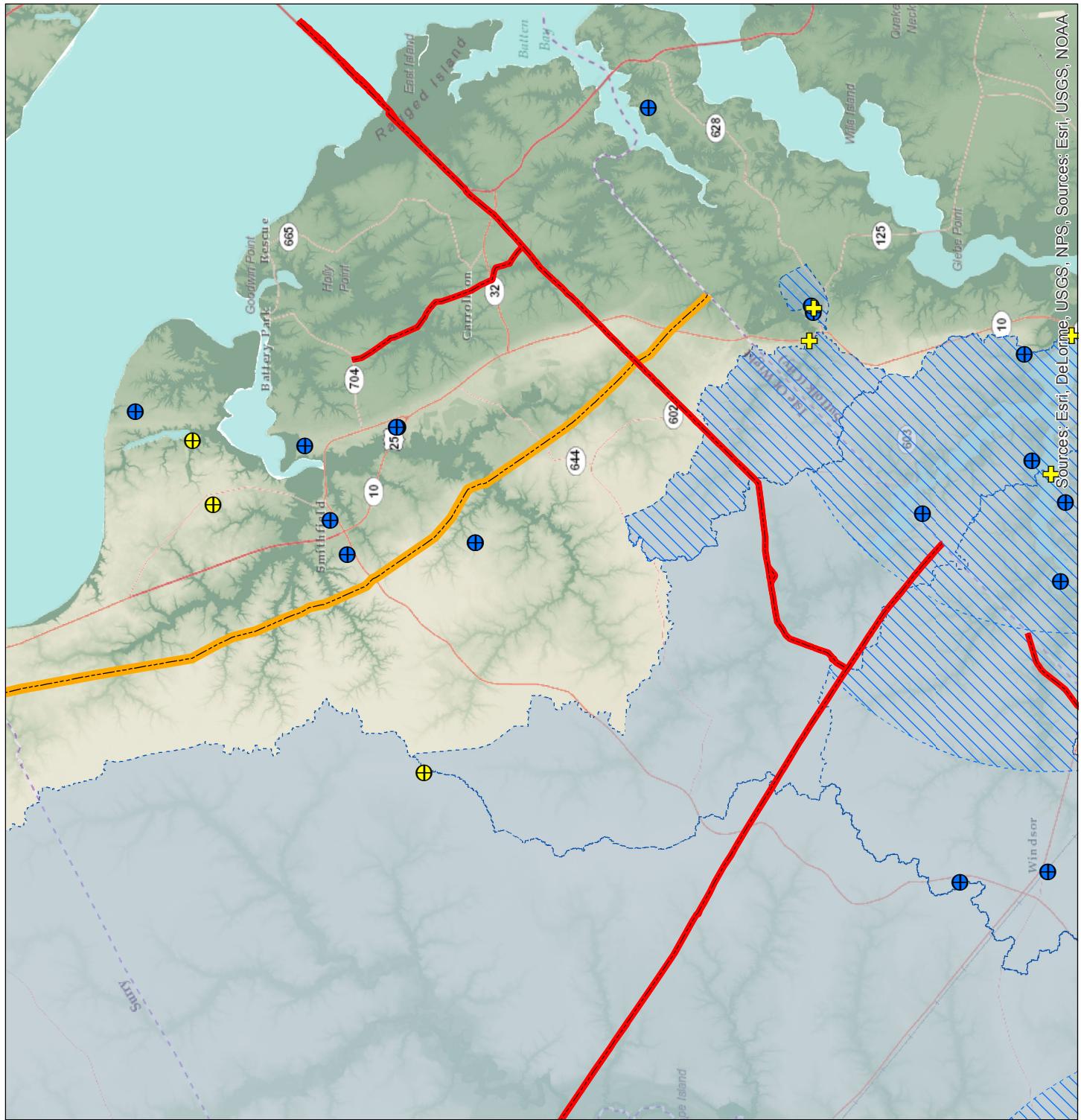
0 0.75 1.5 3 Miles
Absolute Scale 1:190,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Southampton County, VA

Legend

Pipeline Infrastructure

Gas Transmission Pipeline

Hampton Roads Municipal Water Sources

Surface Water Intake

Municipal Well (DEQ permitted well)

Municipal Well (DEQ permit not required)

Surface Water Intake

Source Water Protection Areas

SWPA - Zone 1

SWPA - Zone 2

0 1.5 3 6 Miles
Absolute Scale 1:380,000

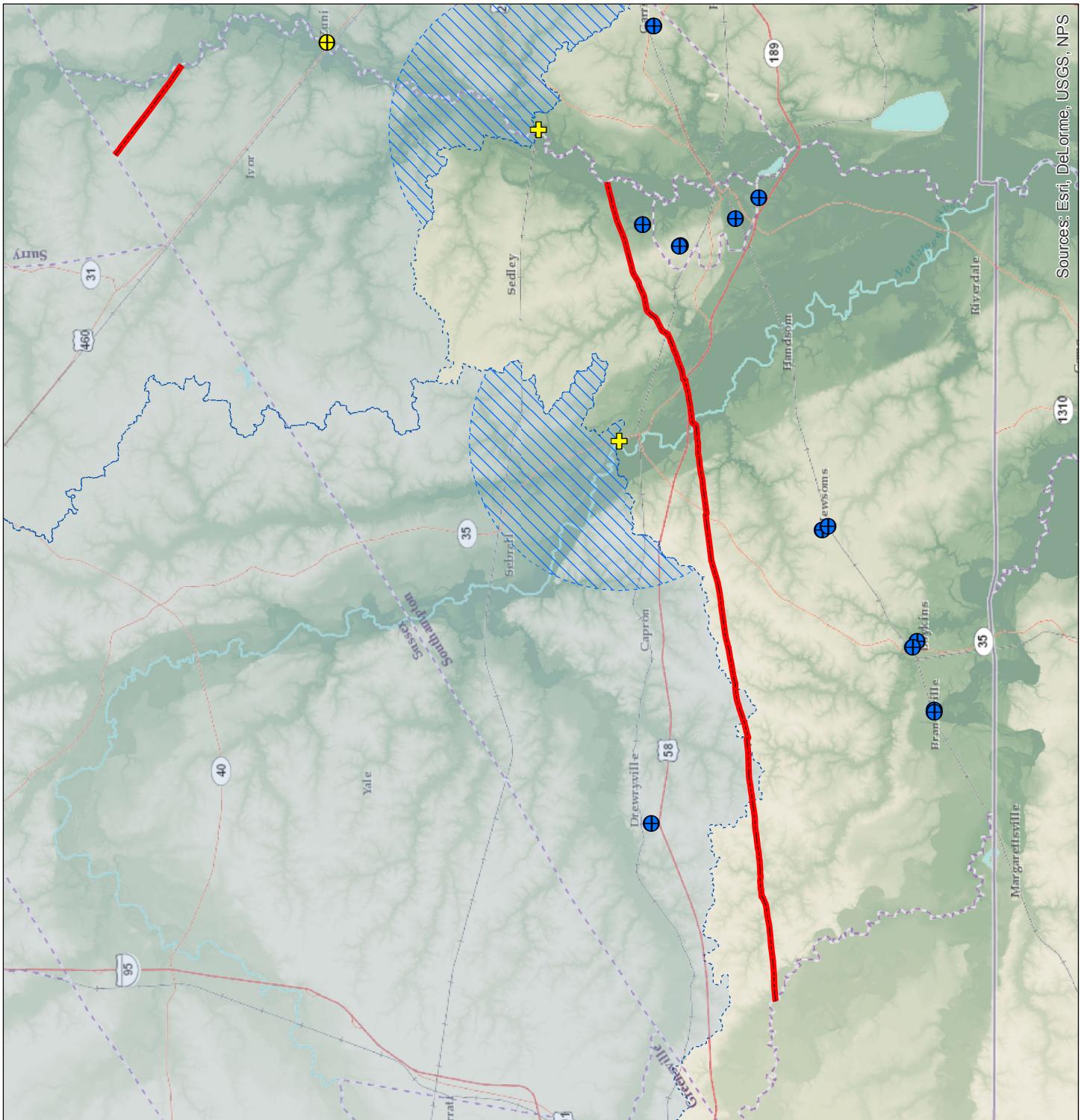


Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).

Sources: Esti, DeLorme, USGS, NPS



GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Suffolk, VA

Legend

Pipeline Infrastructure

- Gas Transmission Pipeline
- Hazardous Liquid Pipeline

Hampton Roads

Municipal Water Sources

- Surface Water Intake
- Municipal Well (DEQ permitted well)

Surface Water Intake

Source Water Protection Areas

SWPA - Zone 1

SWPA - Zone 2

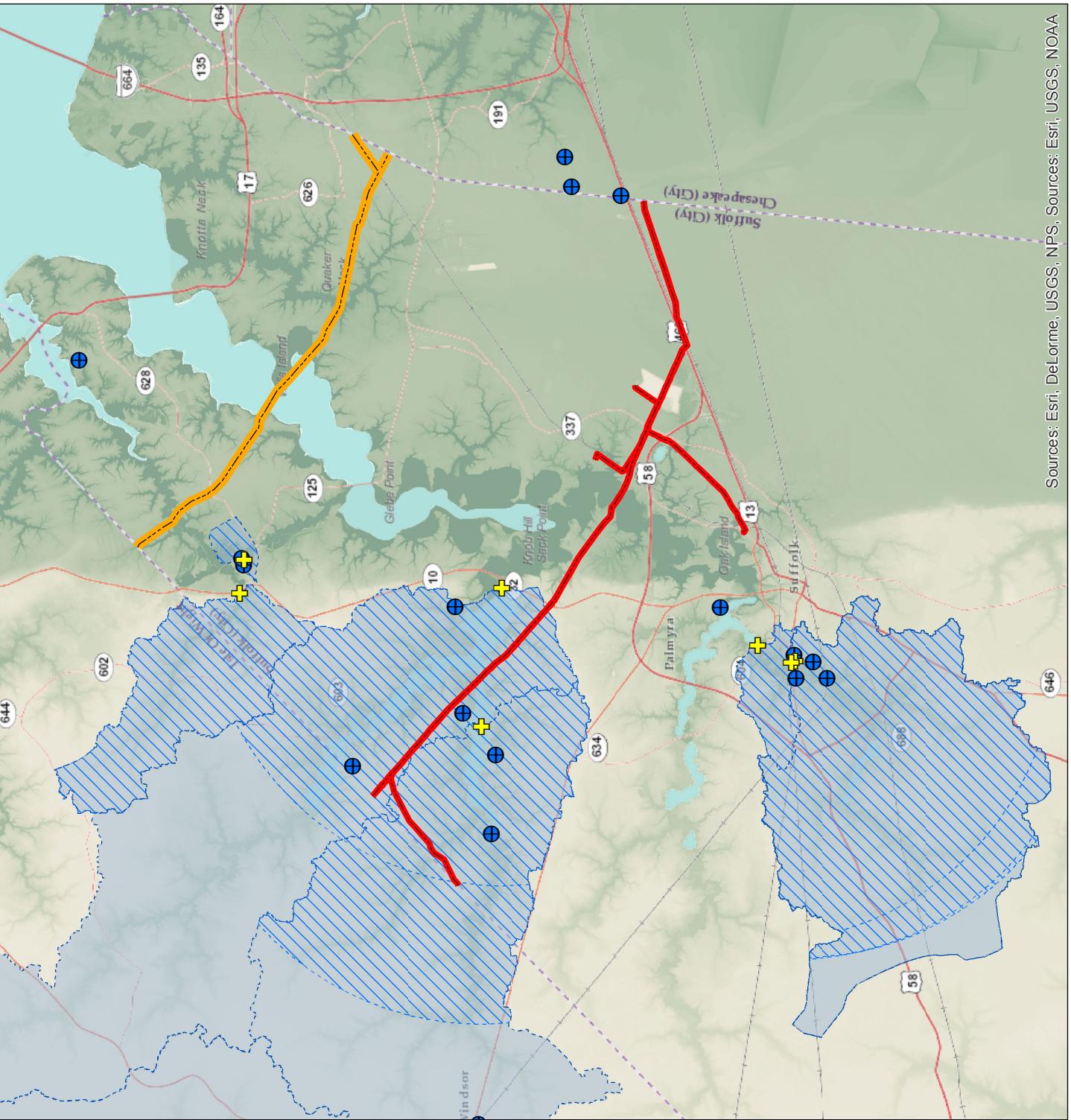
0 0.75 1.5 3 Miles
Absolute Scale 1:190,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Surry County, VA

Legend

Pipeline Infrastructure

- Gas Transmission Pipeline
- Hazardous Liquid Pipeline

I. AZERBAIJANI EDITION | PART

Hampton Roads

- Municipal Water Sources
- Surface Water Intake

- **Municipal Well**
(DEQ permitted well)
- **Private Well**
(unpermitted well)

(DEQ permitted well)  Municipal Well (DEQ permit not required)

(DEQ permit not required)

Source Water Protection Areas

SWPA - Zone 1

SWPA - Zone 2

0 1.5 3 6 Miles

Absolute Scale 1:380,000

Binelines depicted on this map represent case

Points depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

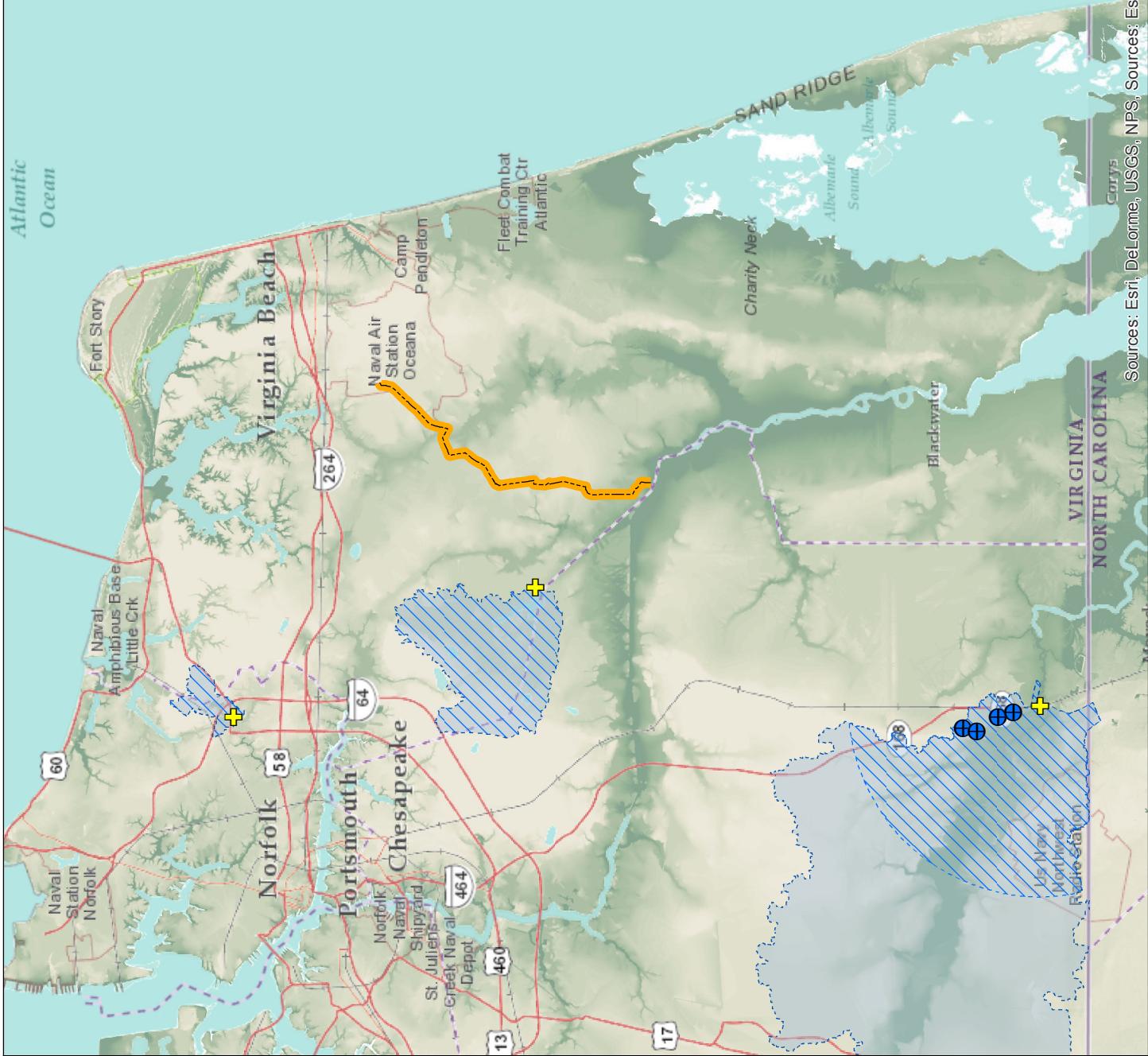
This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).

Sources: Esri, DeLorme, USGS, NPS

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Virginia Beach, VA



Legend

Pipeline Infrastructure

Hampton Roads Municipal Water Sources

Surface Water Intake

Source Water Protection Areas

SWPA - Zone 1

SWPA - Zone 2

0 1.25 2.5 5 Miles
Absolute Scale 1:315,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

Williamsburg, VA

Legend

- Pipeline Infrastructure
 - Gas Transmission Pipeline
- Hampton Roads Municipal Water Sources
 - Surface Water Intake (Yellow plus sign)
 - Municipal Well (Blue circle with DEQ permitted well)
- Surface Water Intake Source Water Protection Areas
 - SWPA - Zone 1 (Blue diagonal lines)
 - SWPA - Zone 2 (Blue solid)

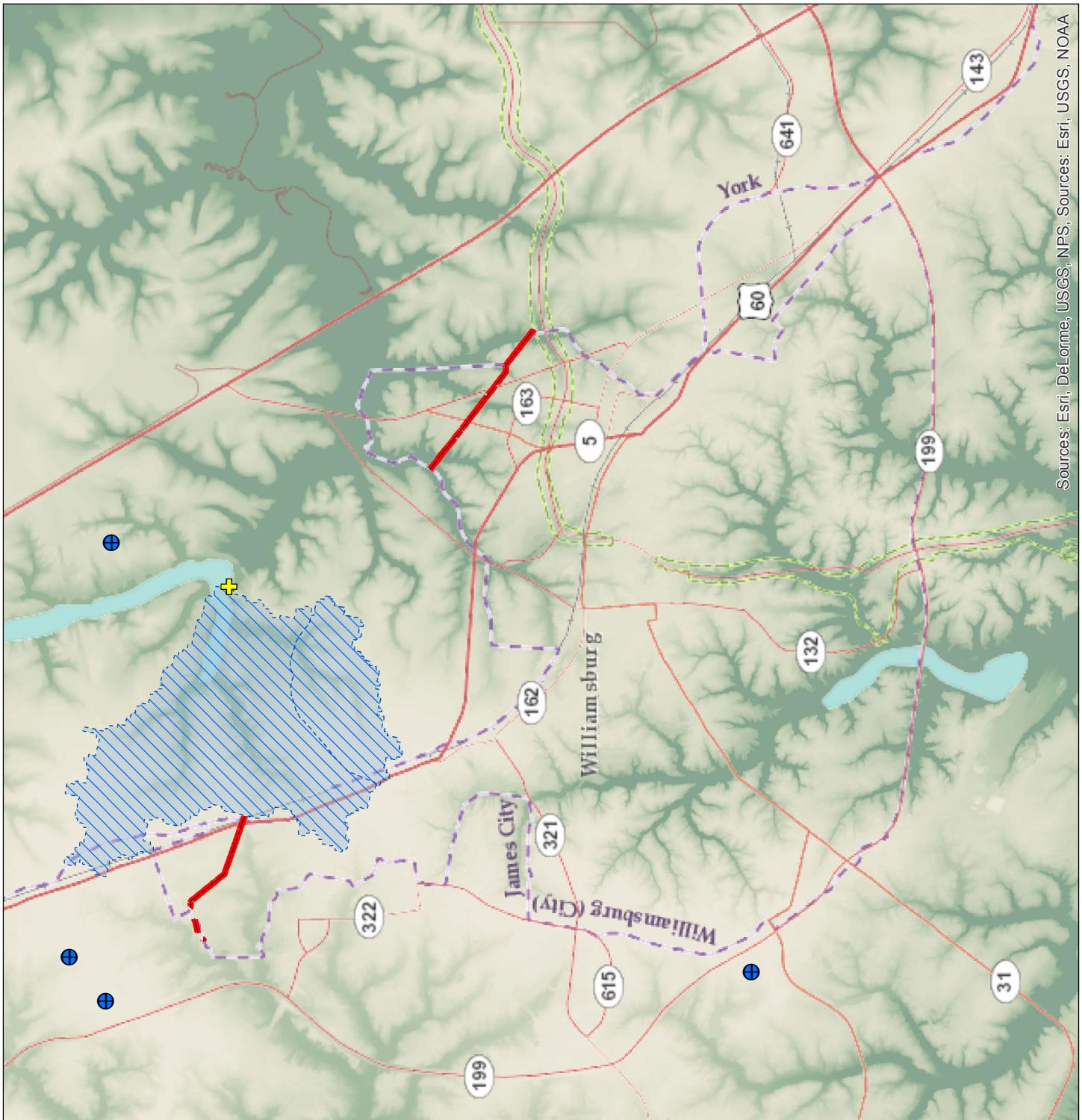
0 0.25 0.5 1 Miles
Absolute Scale 1:63 500



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

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Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).



Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

GAS TRANSMISSION & HAZARDOUS LIQUID PIPELINES

York, VA

Legend

Pipeline Infrastructure

- Gas Transmission Pipeline
- Hazardous Liquid Pipeline

- Breakout Tanks

Hampton Roads Municipal Water Sources

- Surface Water Intake
- Municipal Well (DEQ permitted well)
- Municipal Well (DEQ permit not required)

Surface Water Intake Source Water Protection Areas

- SWPA - Zone 1
- SWPA - Zone 2

0 1 2 4 Miles
Absolute Scale 1:250,000



Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

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Map produced by the staff of the Hampton Roads Planning District Commission (August 2016).

Sources: Esri, DeLorme, USGS, NPS. Sources: Esri, USGS, NOAA

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