swift Sustainable Water Initiative for Tomorrow

2016 Hampton Roads Water Symposium

Jamie Mitchell – Chief of Technical Services | HRSD

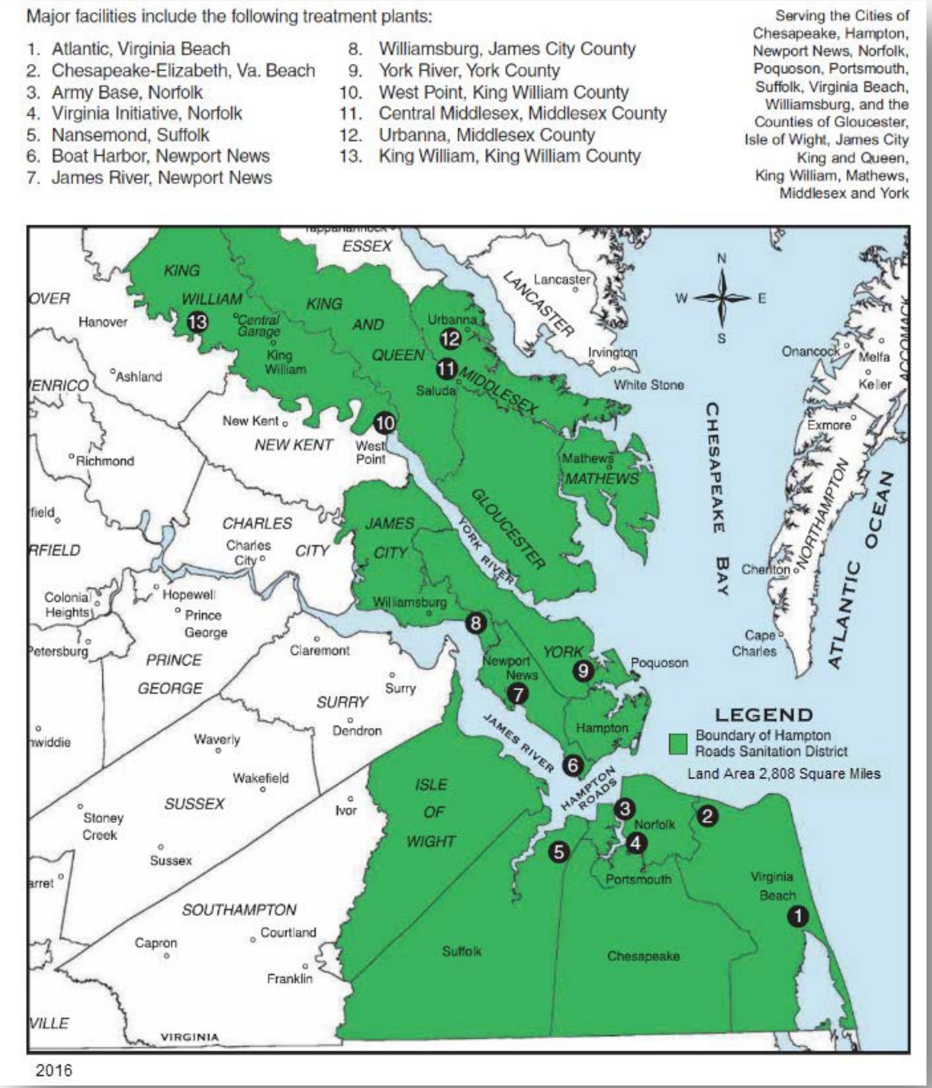
Daniel Holloway, P.G. | CH2M

September 20, 2016

swift

HRSD

- Provides wastewater treatment for 17 localities (249 mgd treatment capacity)
- Serves 1.7 million people (20% of all Virginians)
- Independent political subdivision with Governor appointed Commission

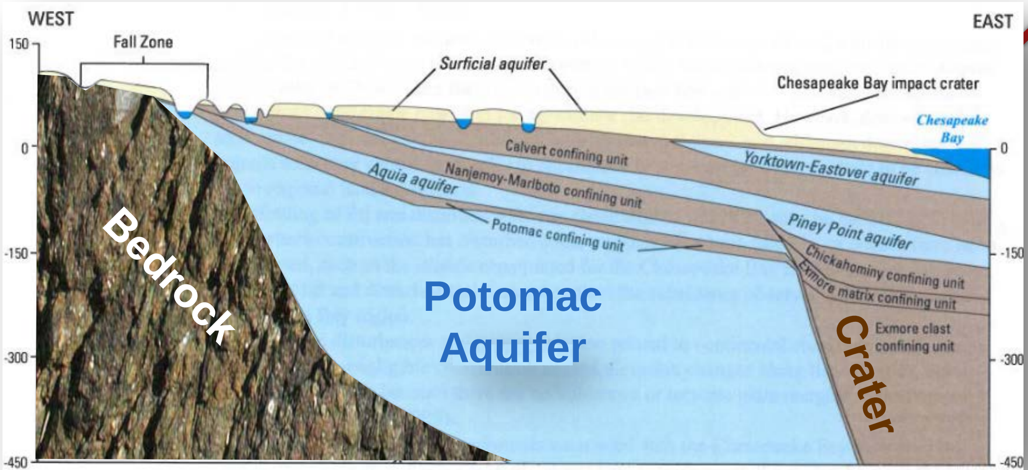


Water Issues Challenging Virginia and Hampton Roads

- Depletion of groundwater resources
  - Including protection from saltwater contamination
- Restoration of the Chesapeake Bay
  - Harmful Algal Blooms
  - Localized bacteria impairments
  - Urban stormwater retrofits (cost and complexity)
- Adaptation to sea level rise
  - Recurrent flooding
- Wet weather sewer overflows
  - Compliance with Federal enforcement action

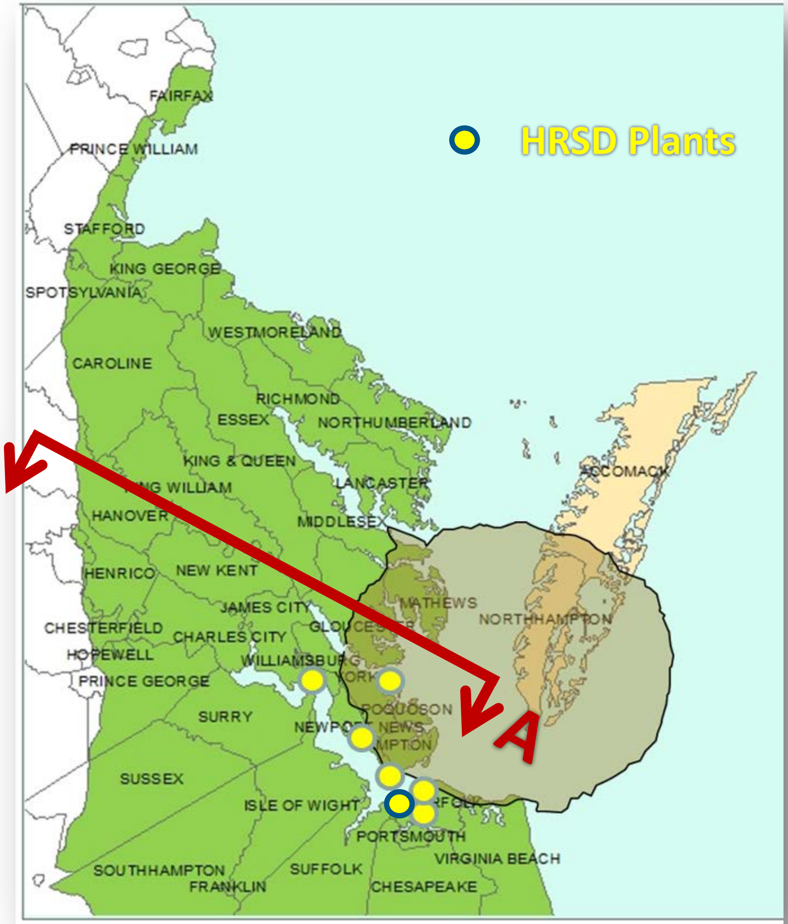
Virginia Coastal Plain Aquifer System

- Fall Zone (around I-95 corridor) to the Ocean
- Truncated by Chesapeake Bay Impact Crater (Bolide/Meteor)
- Alternating layers of coarse grain and fine grain unconsolidated sediments



Section A-A

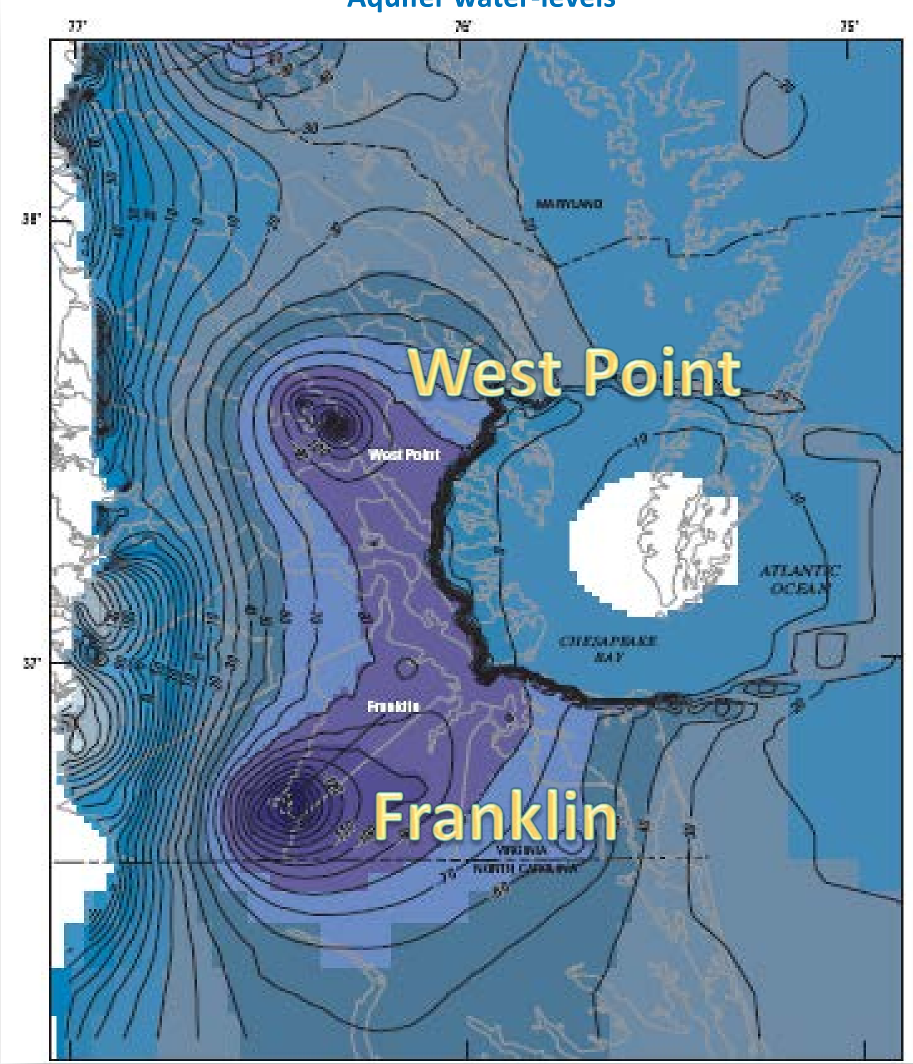
Eastern Va Groundwater Management Area



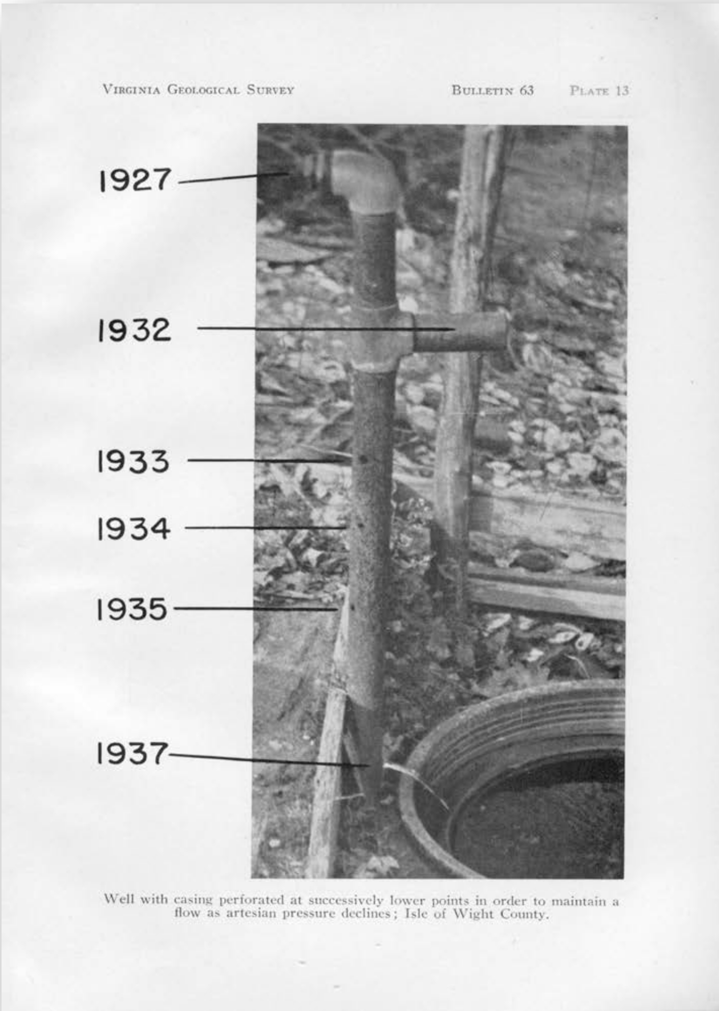
Unsustainable Aquifer Withdrawals

- Water levels falling several feet/yr
- Permitted Withdrawal = 147 MGD
- Actual Withdrawal = 115 MGD
- 200,000 unpermitted “domestic” wells
  - –Estimated @ 40 mgd
  - –Growing at 1 mgd per year

Aquifer water-levels



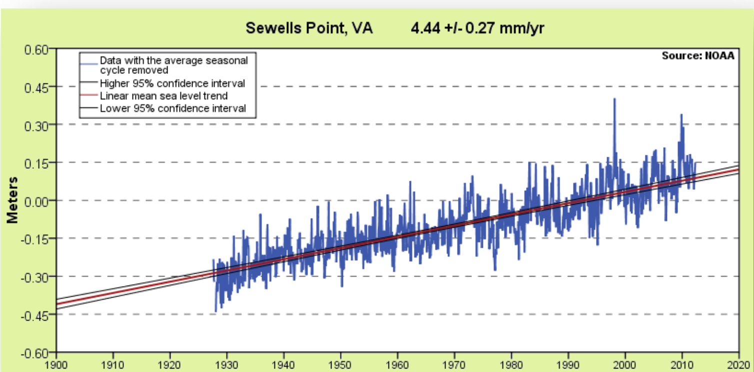
Groundwater depletion has been rapid



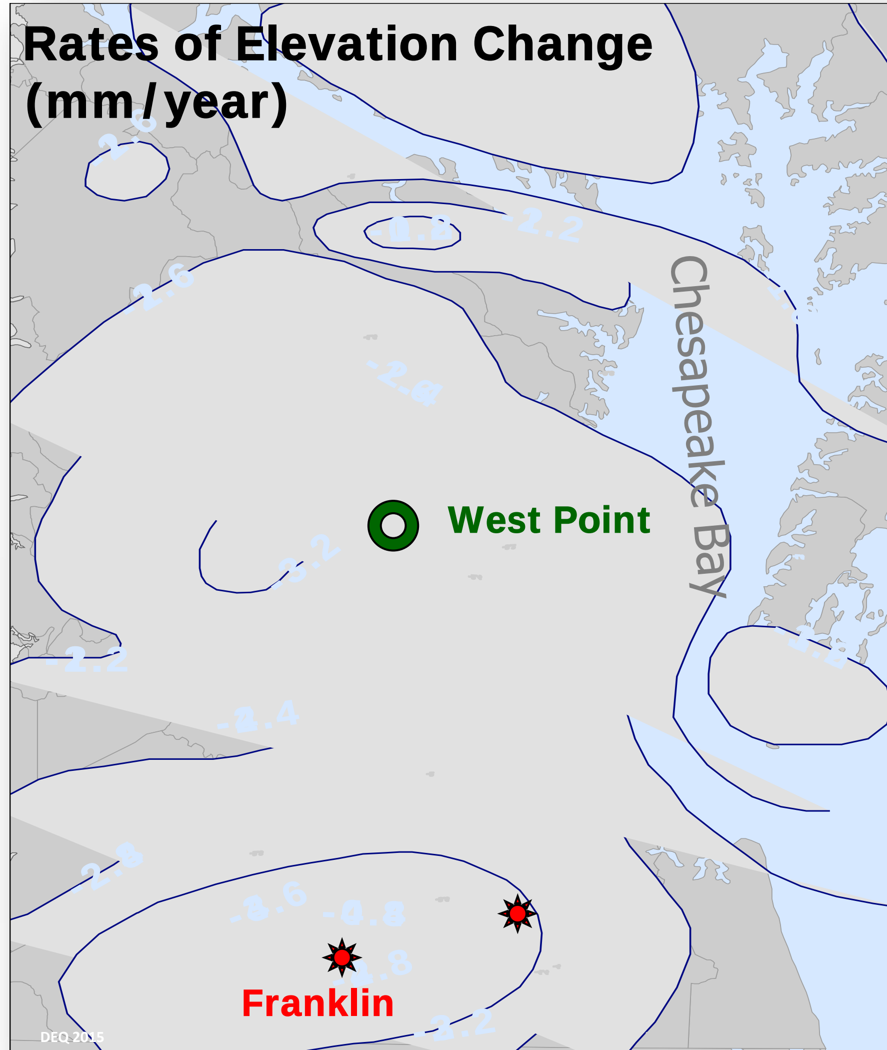
- Artesian wells in early 1900s – groundwater wells required valves not pumps!
- In about 100 years, water levels went from 31 feet **above** sea level to 200± feet **below**.

Land subsidence – *we are sinking*

- According to USGS
  - Up to 50% of sea-level rise may be due to land subsidence
  - **Up to 50% of land subsidence may be due to aquifer compaction**



HAMPTON ROADS IS THE #2 LARGEST POPULATION CENTER AT RISK



Saltwater contamination of groundwater caused by over withdrawal

- Potentially irreversible contamination

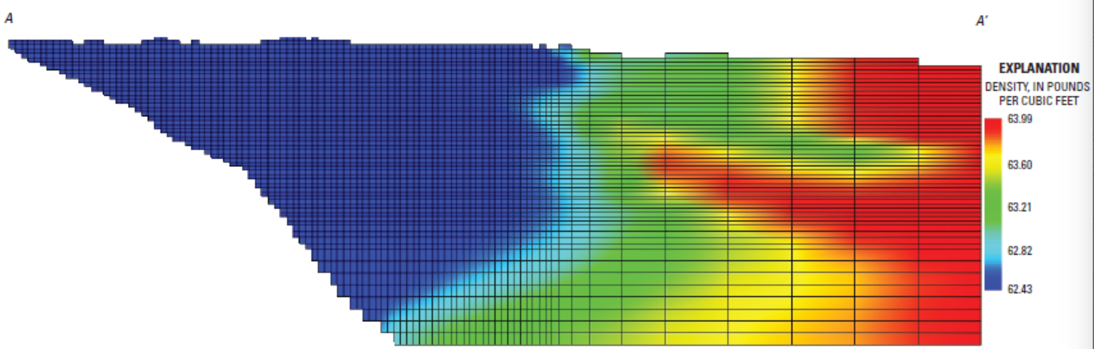
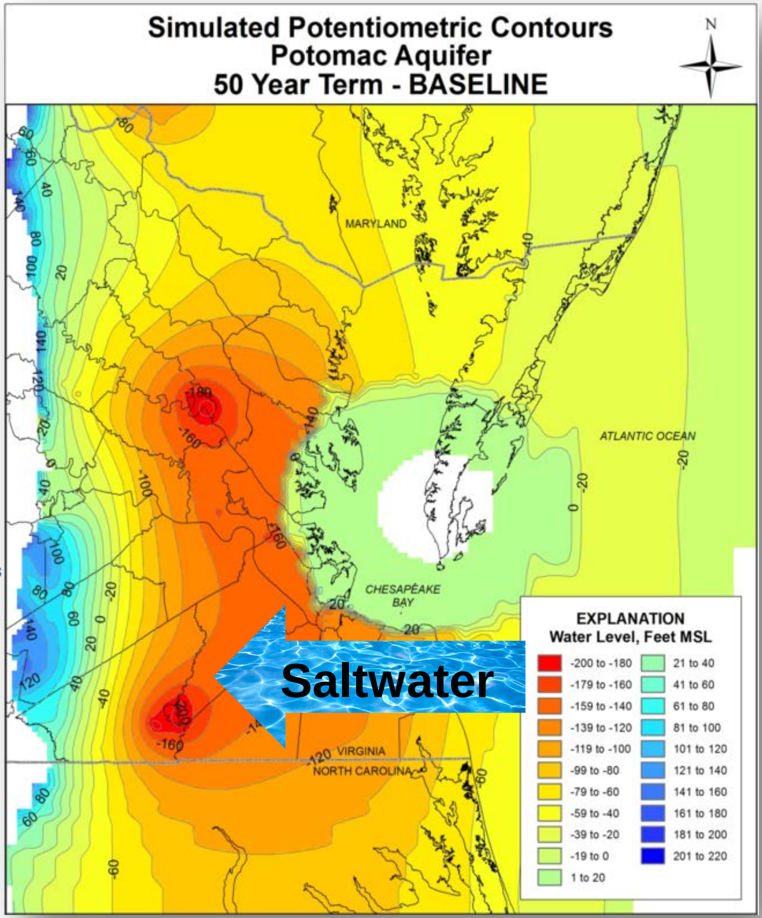
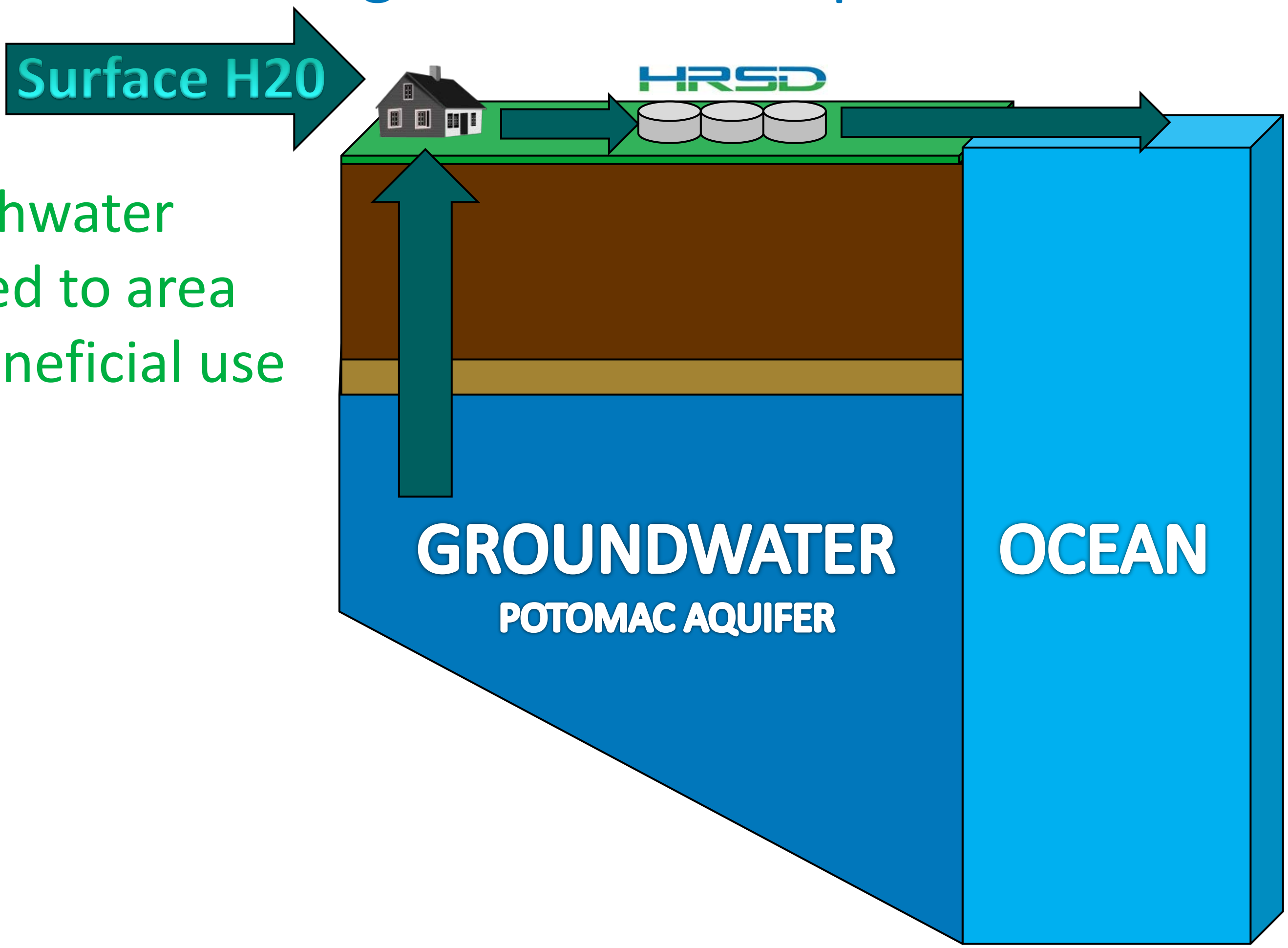


Figure A3. Simulated water density near the saltwater transition zone of the Virginia Coastal Plain. (Location of cross section shown in figure A2.)



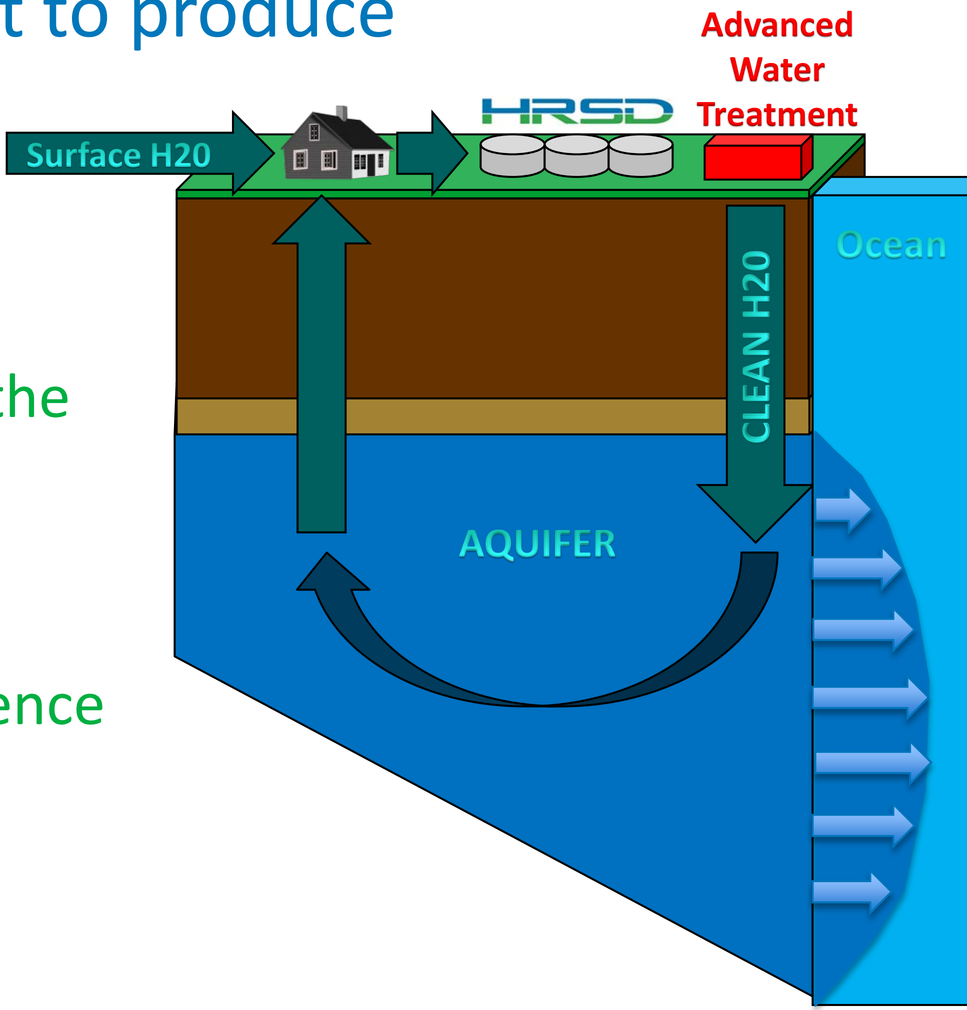
Current state of water management in Hampton Roads

Highly treated freshwater currently discharged to area waterways – no beneficial use



Advanced water treatment to produce **PURIFIED WATER**

- SWIFT concept - replenish the aquifer with purified water to:
  - Reduce nutrient discharges to the Bay
  - Provide a sustainable supply of groundwater
  - Reduce the rate of land subsidence
  - Protect the groundwater from saltwater contamination



Phased Approach

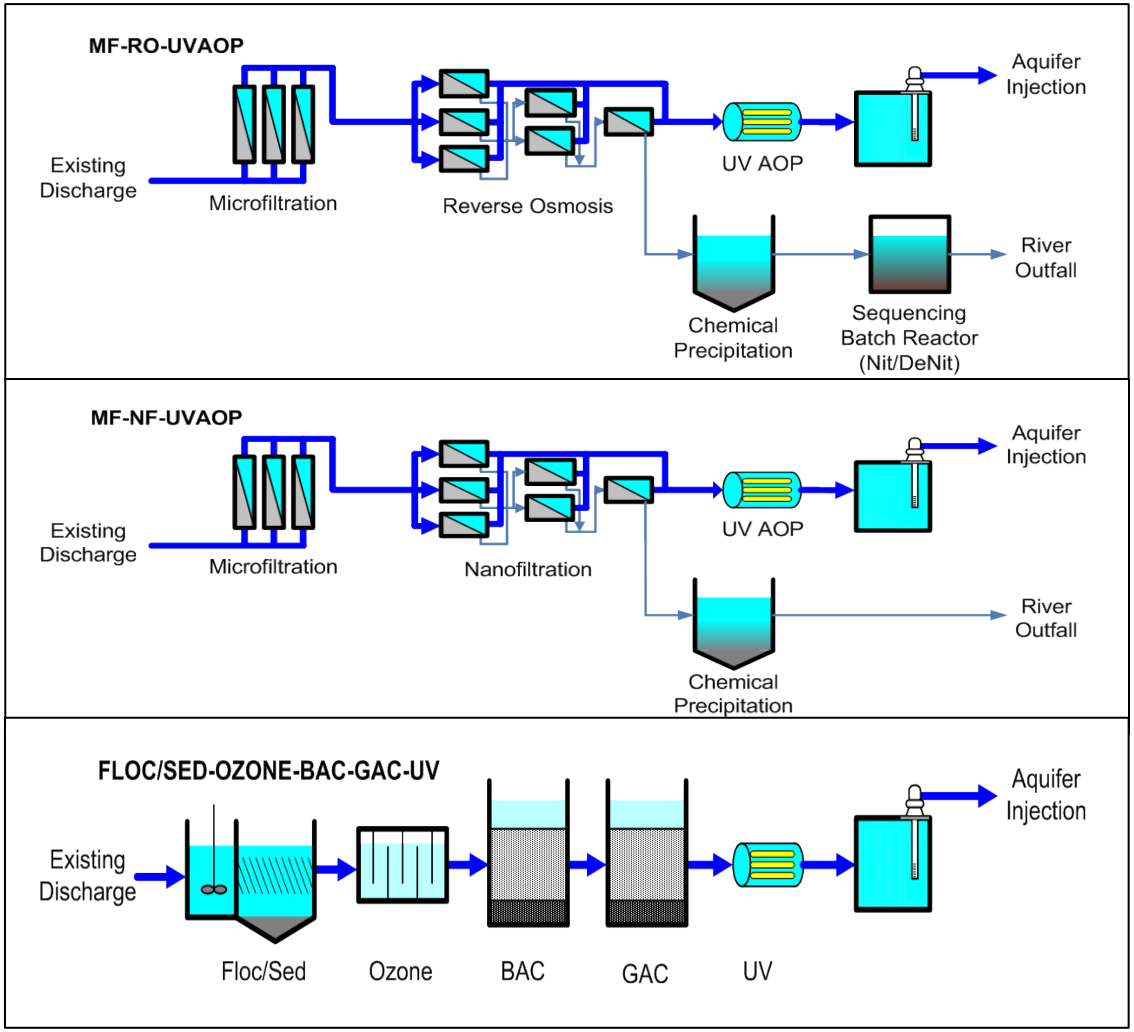
- Phase 1 – Concept Feasibility (Fatal Flaw) Analysis
  - Desktop study
  - Can we treat to acceptable standards?
  - Can we make compatible with the aquifer?
  - Can we get water into the ground?
  - Will it make any difference?
- Phase 2 – Concept Development (Site Specific Investigation)
  - Pilot treatment plant(s)
  - Test well(s)

Advanced water treatment alternatives

Reverse Osmosis (RO)

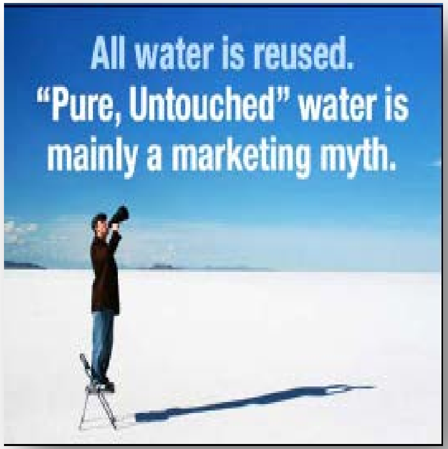
Nanofiltration (NF)

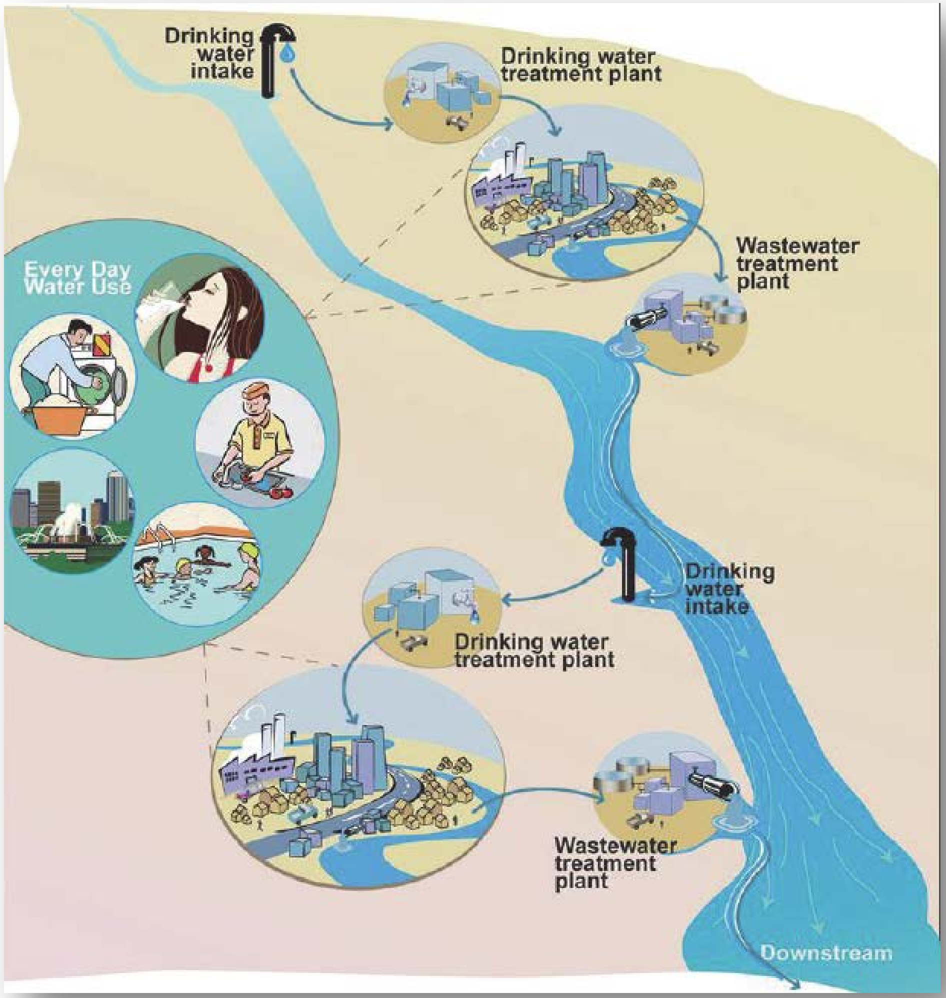
Biologically-Active Granular Activated Carbon (BAC)/ Granular Activated Carbon (GAC)



De Facto water recycling

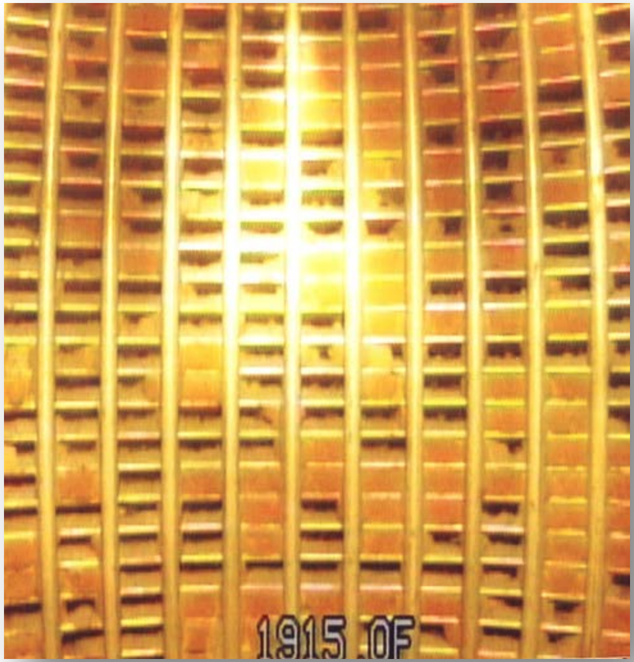
- **Common throughout the world and in Virginia**
  - James River
  - Shenandoah
  - Potomac
  - Roanoke River Basin (Lake Gaston)





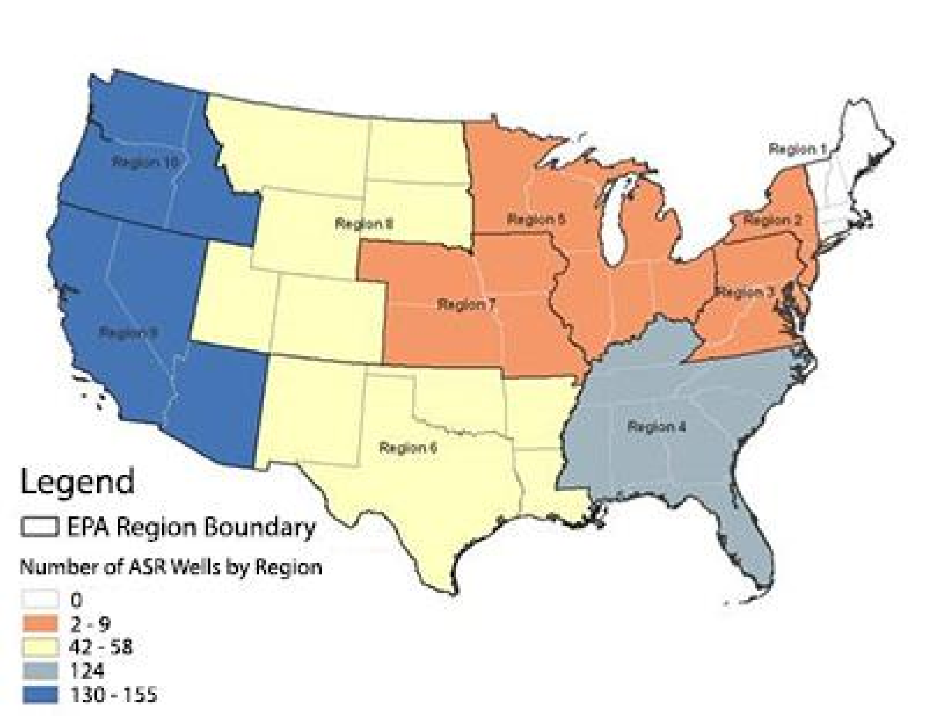
Geochemistry and Aquifer Compatibility

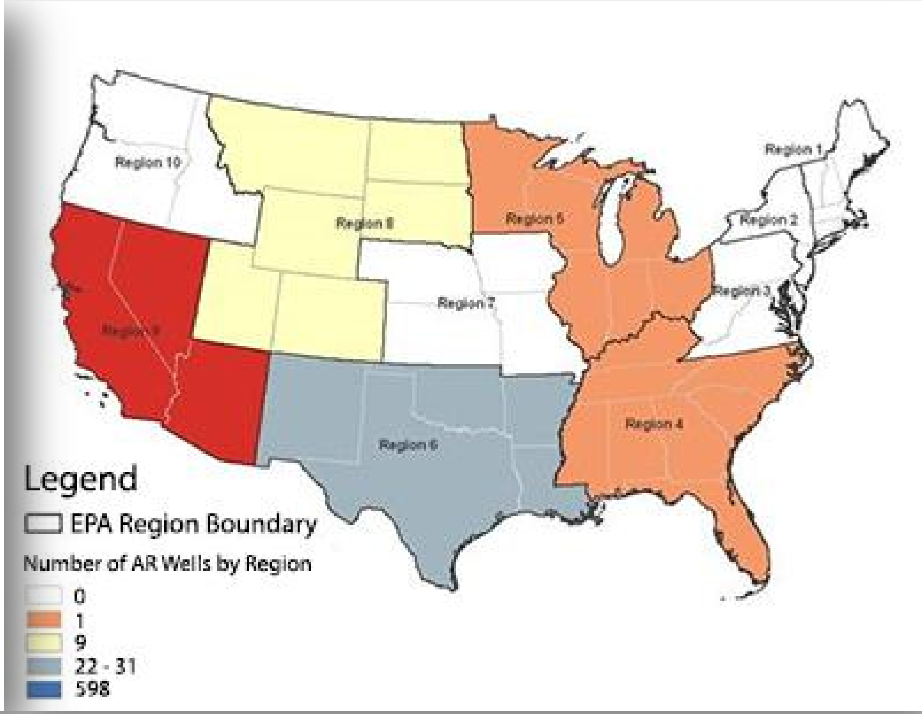
- Water put into aquifer must be compatible with native groundwater and aquifer material
  - Operational issues
  - Regulatory issues
- Physical plugging
  - Disrupting clay particles
  - Precipitating minerals
  - Can clog the well/formation
- Dissolution/mobilization of metals
- Compare treated water with aquifer material and native water quality



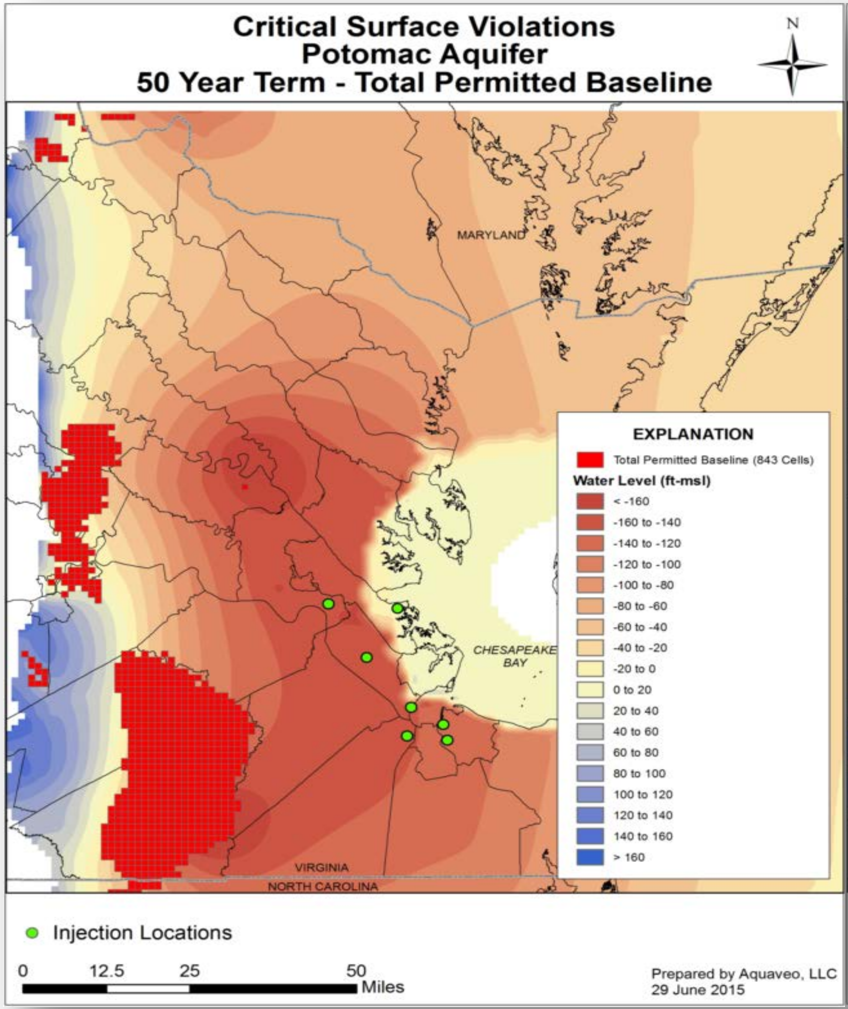
Injectability

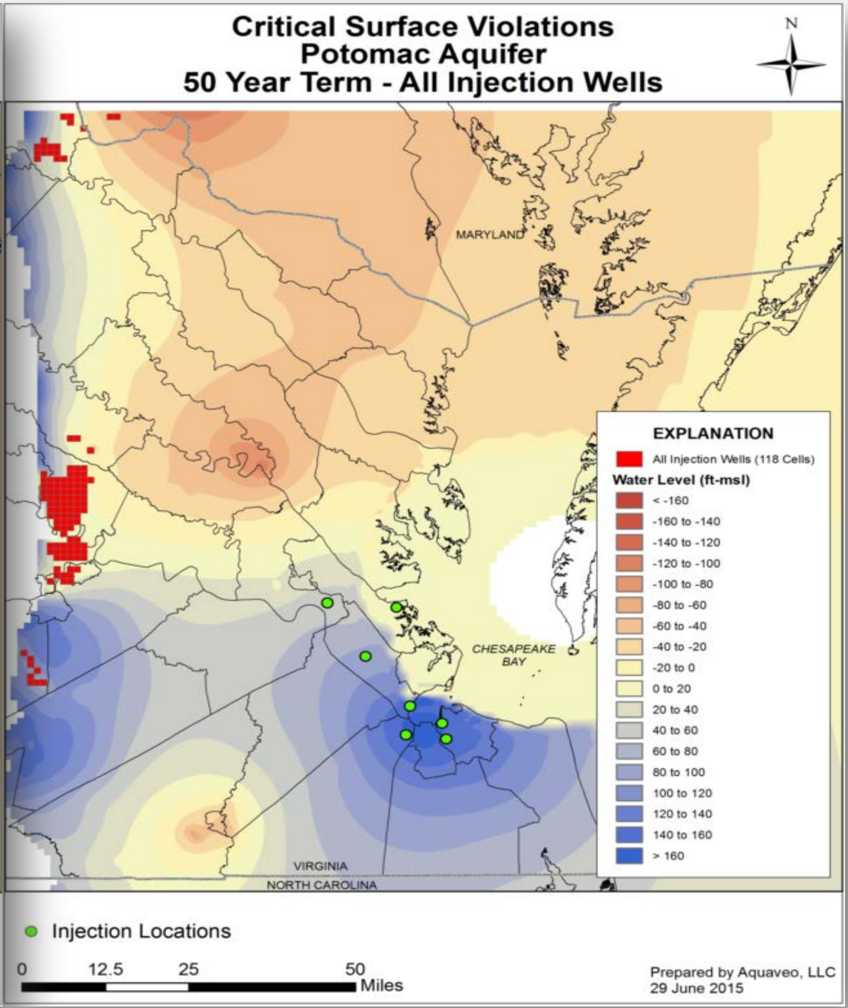
- Injection is not a new idea
- City of Chesapeake, VA – ASR injected 2.8 billion gallons since 1987





Aquifer Withdrawals Before and After SWIFT

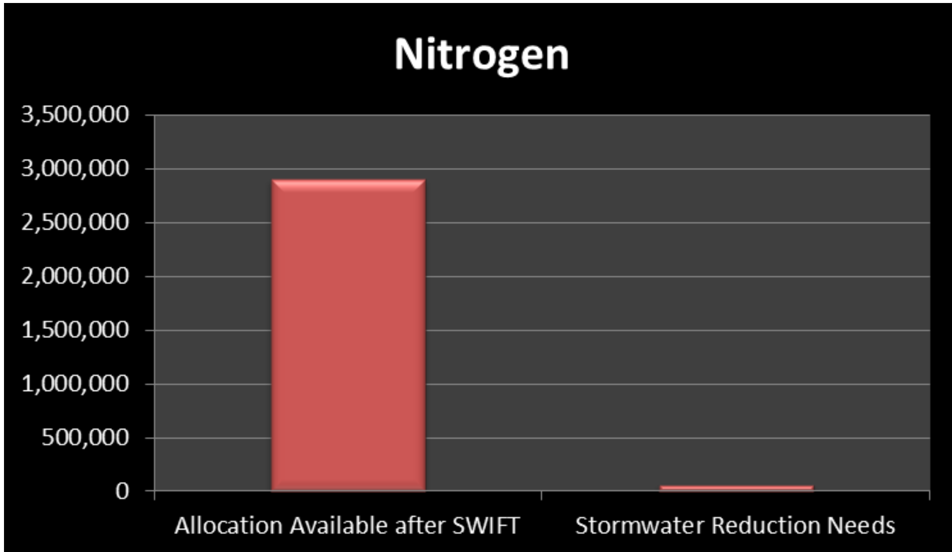


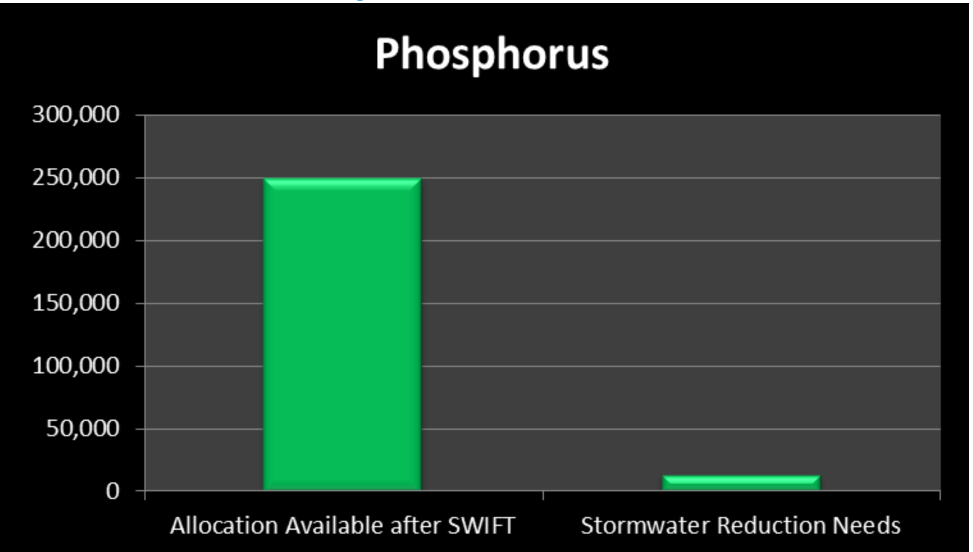


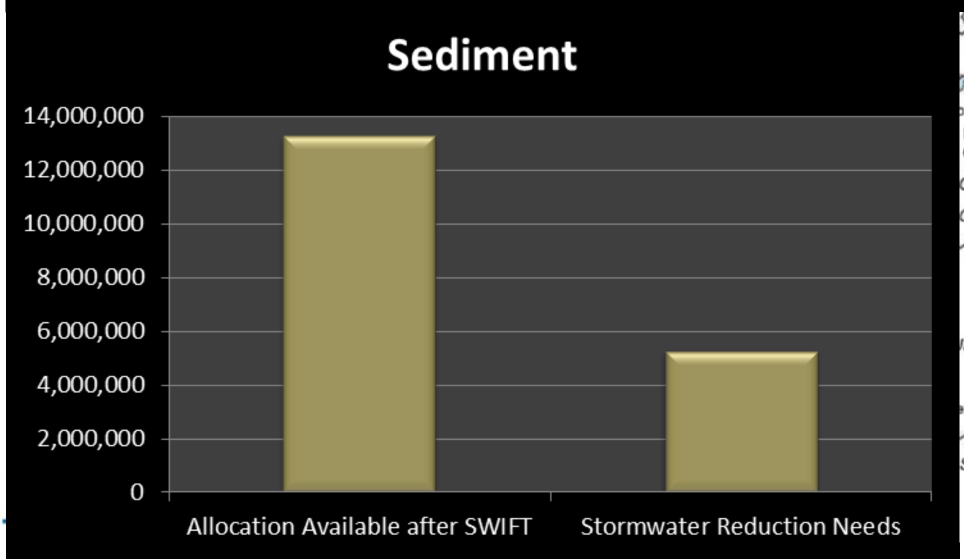
Evidence of groundwater impacts on subsidence

- USGS found ground level rose 32 mm between 2002 and 2015 coinciding with reduced groundwater withdrawal by Franklin paper mill.

SWIFT's potential to offset stormwater TMDL reductions – James River Basin Example







Phase 1 results

- The water is treatable to drinking water standards, etc.
- The water can be made compatible with the aquifer
- The water can be successfully injected
- The benefits have been demonstrated by modeling
- Proceed to Phase 2

Phase 2

- Pilot test the Advanced Water Treatment processes
- Install Test Wells to obtain hydrogeologic data
- Take results from both and refine geochemical/hydraulic modeling
- Install Extensometer to observe impact to subsidence

Pilot Testing Objectives

- Primary Objective
  - Compare water quality between two advanced water treatment trains
- Secondary Objectives
  - Gain operational experience for HRSD staff with AWT processes
  - Establish preliminary design criteria for full scale, where possible
  - Monitor FW quality for compatibility with aquifer
  - Understand removal of Contaminants of Emerging Concern (CECs) and additional forward looking water quality parameters
  - Verify the treatment performance during WWTP excursions

MF/RO/UVAOP Pilot Systems

Floc/Sed/O3/BAC/GAC/UVD Pilot Systems

UV & UVAOP

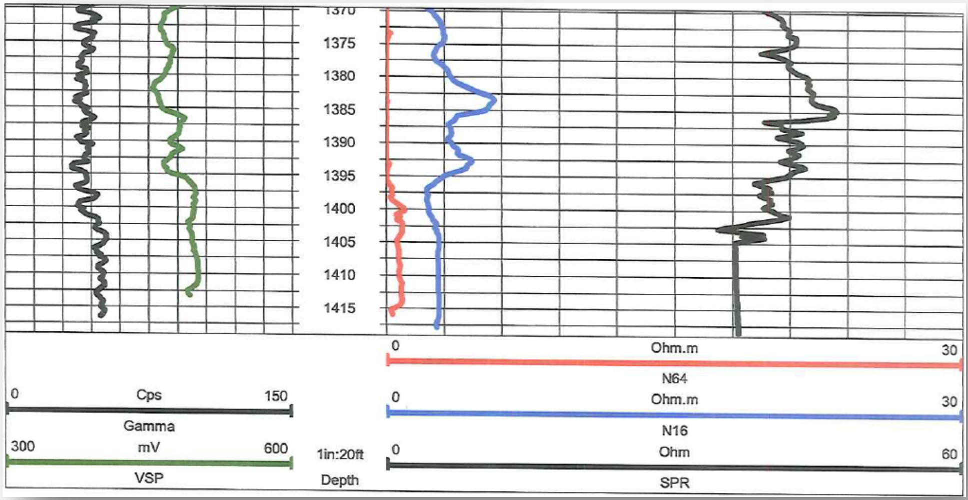
- Trojan Pro30 UV Reactor will be used for UVD and UVAOP
- Validation test performed during commissioning

Test Wells

- Install 2 test wells, Nansemond and York River
- Perform withdrawal testing and sampling
  - Step testing
  - Constant rate testing
  - Zone isolation testing
- Obtain site specific hydrogeologic information:
  - Aquifer hydraulic properties
  - Aquifer mineralogical analysis
  - Aquifer water quality data

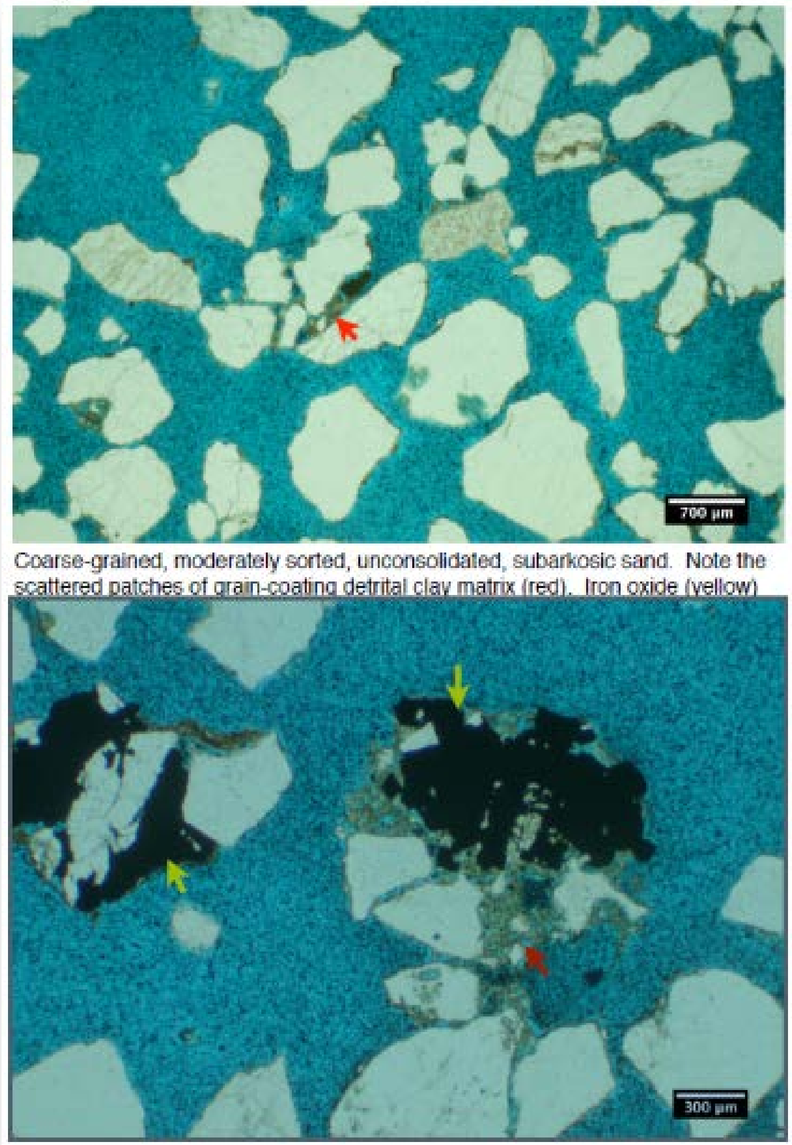
Nansemond Test Well

- Will serve as Demonstration Facility injection well
- Installed 12” diameter well down to 1420’ below ground surface
- Screened approximately 400’ of aquifer
- Encountered greater amount of coarse sands than we originally predicted



Nansemond Test Well

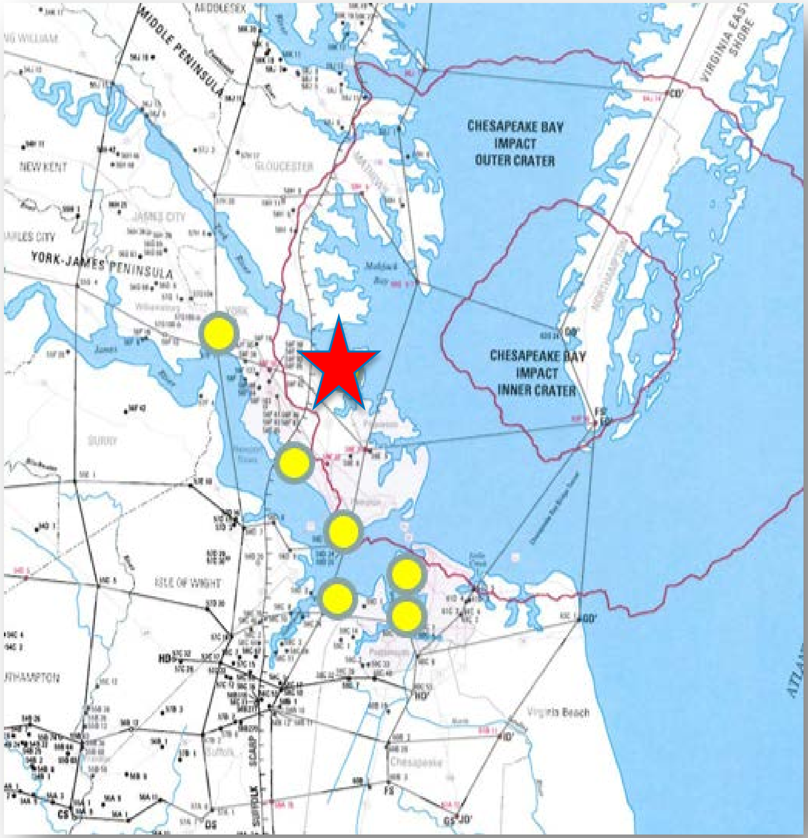
- Sand units ranged from 92% – 97% feldspar and quartz
- 1.5% - 6.5% clays



Coarse-grained, moderately sorted, unconsolidated, subarkosic sand. Note the scattered patches of grain-coating detrital clay matrix (red). Iron oxide (yellow)

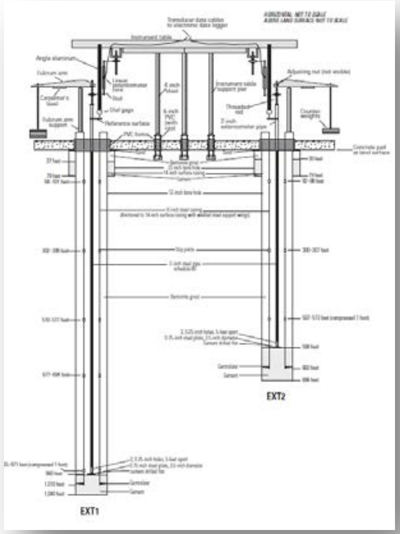
York River Test Well

- York River WWTP is situated in the outer rim of the CBIC
- Installing 8” diameter well down to 1960’ below ground surface - Bedrock
- Encountered greater amount of coarse sands than we originally predicted
- Screened approximately 645’ of aquifer sands



Extensometer @ Nansemond

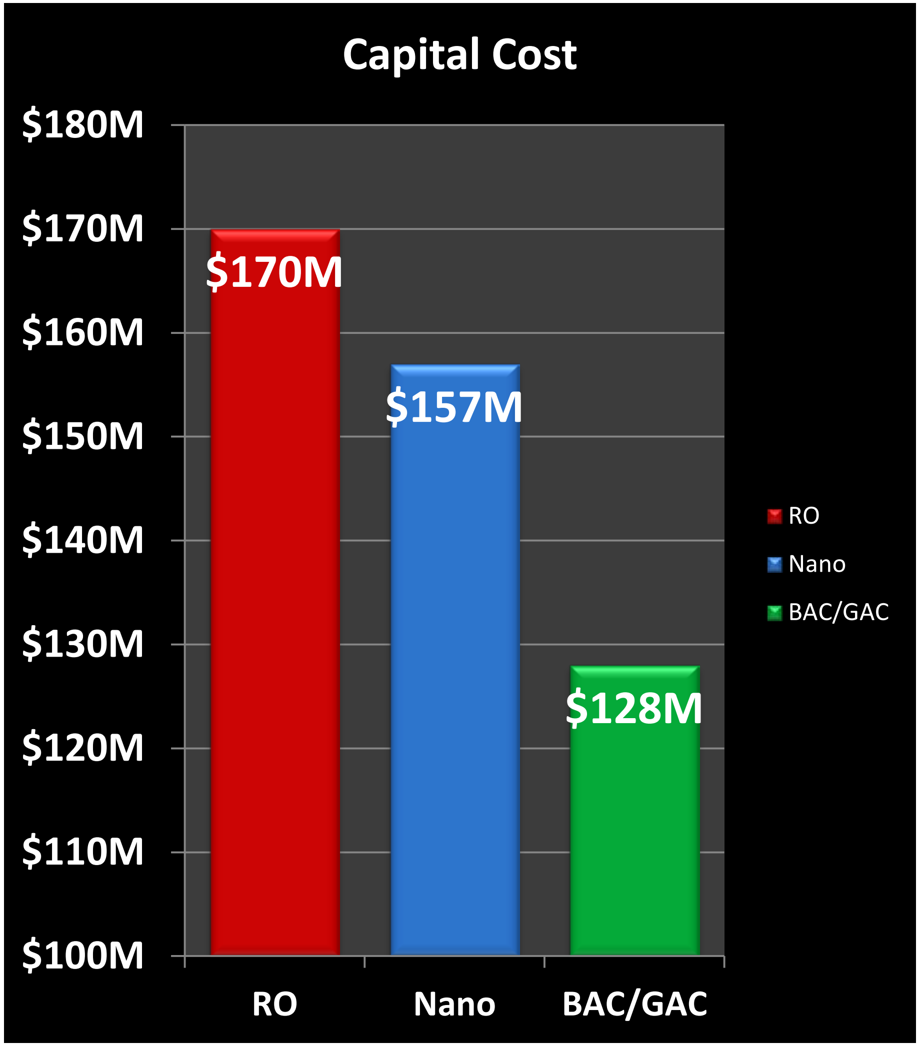
- Installing an extensometer
- Measure subsidence before and after water is put into the ground
- Gain an understanding of the impact injection has on land subsidence

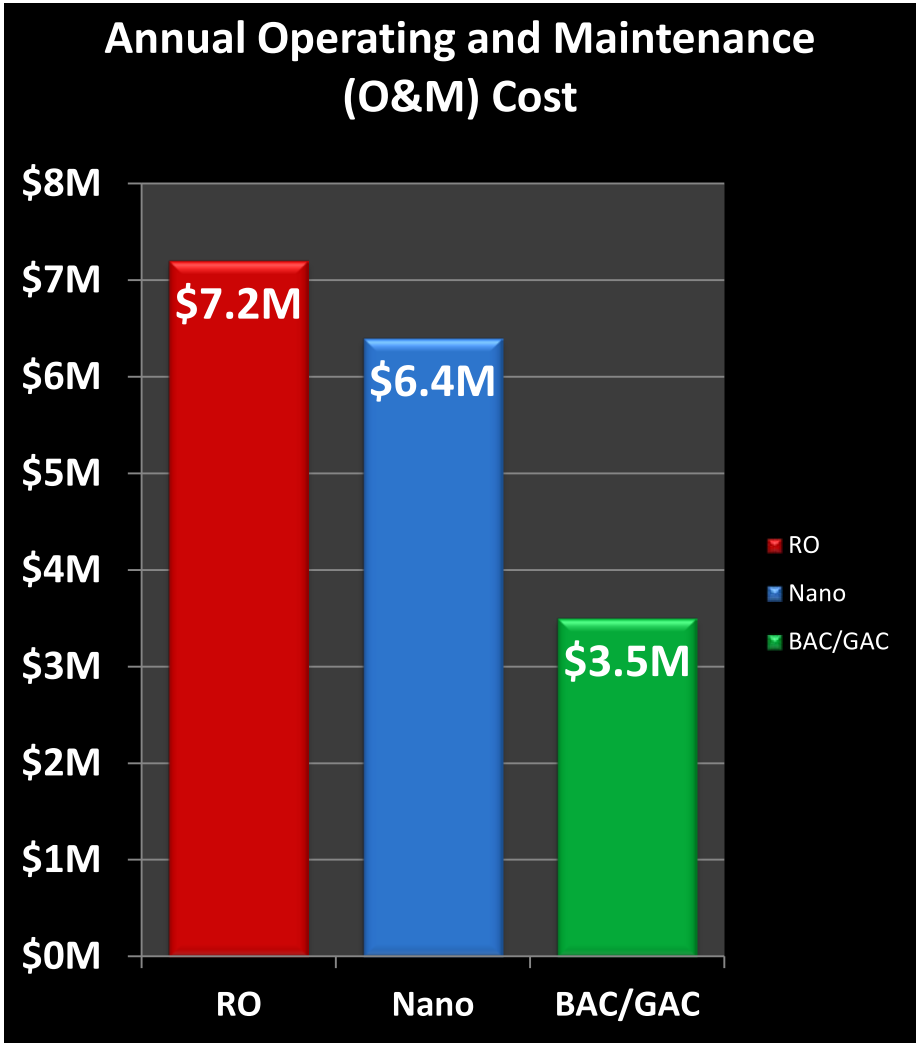


Phase 3 Demonstration Facility

- Approximately 1 MGD Demonstration Facility
- Treatment Facilities and Injection
- Currently in process of selecting a Design Build firm

Cost for 20 MGD





Cost Summary

- Total project in the $1 billion range (120 mgd)
  - For 7 plants (not Chesapeake-Elizabeth or Atlantic)
- Annual operating costs $21 - $43 M
- EPA Integrated Plan approval required
  - Reprioritize SWIFT against $2.1B Consent Decree wet weather improvements

Timeline

- Room scale pilot projects – operating since June 2016
- 2018 – 1 MGD Demonstration facility (2 year study)
- 2020 – EPA/DEQ/VDH formally approves Certificate to Construct for SWIFT
- 2020 to 2030 – Construction through phased implementation
- 2030 Fully operational – 120 MGD of purified water put into the aquifer

Conclusion – SWIFT Summary of Benefits

- Regulatory stability for treatment processes
- Nutrient trading with Localities – offset Stormwater TMDL requirements
  - 90% reduction of HRSD discharges into James, York and Elizabeth Rivers
  - Creates source of nutrient allocation to support other needs
- Potential reduction in the rate of land subsidence
- Sustainable source for groundwater replenishment
  - Important economic driver
- Potential protection of groundwater from saltwater contamination

Questions?

www.SWIFTVA.com

J. Dano – jdano@hrsd.com
Charles Bott – cbott@hrsd.com
Jamie Mitchell – jmitchell@hrsd.com
Dan Holloway – Daniel.Holloway@CH2M.com
Ed Snyder – Ed.Snyder@CH2M.com