Salinity in Hampton Roads

Research, Risks & Management

Salinity trends in the Chesapeake Bay region are no longer a distant concern — **they are an active infrastructure, water supply, and ecological management challenge** for Hampton Roads localities today.

KC Filippino, PhD, Senior Water Resources Planner| Hampton Roads Planning District Commission

Why Hampton Roads Is Especially Exposed

Relative Sea Level Rise

~5 mm/yr

relative SLR rate at Sewells Point

Hampton Roads experiences some of the fastest relative sea level rise on the East Coast — driven by both rising ocean levels and land subsidence from groundwater withdrawals.

The Coastal Plain Aquifer System

1.9 M

residents served by HRSD

The Potomac Aquifer supplies drinking water for eastern Virginia. Overpumping and reduced recharge are shrinking the aquifer, creating conditions for saltwater intrusion into groundwater supplies.

Aging Urban Infrastructure

6,700+ mi

locality sewer mains

Over 6,700 miles of locality-owned gravity sewers, stormwater pipes, and pump stations face increased corrosion and inflow from saltier, tidally-influenced water

Sources: USGS Virginia Water Science Center; HRPDC Regional Sea Level Rise Policy

Salinity as a Cross-Cutting Local Risk

01

Water Supply Security

Saltwater intrusion into the Coastal Plain Aquifer and surface intakes (Chickahominy, York R.) threatens long-term groundwater and drinking water availability. HRSD's SWIFT actively recharges the aquifer to counter intrusion.

02

Stormwater & BMP Performance

Saltier tailwater from tidal backflow compromises drainage and degrades vegetation-based BMPs. HRPDC's 2025 guidance calls for accounting for tailwater and compound storm events.

03

Infrastructure Corrosion

Saltwater accelerates deterioration of pipes, pump stations, tide gates, roads, and utilities — raising long-term asset management costs across thousands of miles of locality infrastructure.

04

Wetlands & Natural Infrastructure

Freshwater wetlands are converting to brackish or salt marsh. Ghost forests expanding in low-lying areas. Restoration designs must account for shifting salinity over multiple sea level rise scenarios.

05

Compound Flooding Risk

Storm surge, king tides, drought low-flow, and sea level rise push salty water farther inland. HRPDC projects 1.5 ft SLR by 2050 and 4.5 ft by 2100, amplifying exposure.

06

Regulatory & Planning Uncertainty

Changing salinity may alter nutrient cycling, BMP performance expectations, TMDL assumptions, and MS4 requirements — creating conflicting demands on locality planning programs.

Sources: HRPDC Policy Guidance; USGS Hampton Roads WQ Dashboard; USGS OFR 2011-1191; Chesapeake Bay Program STAC

Drinking Water & Groundwater: From Science to Action

Newport News Waterworks: A Proactive Response

A 2011 USGS study modeled salinity intrusion in the Chickahominy and York Rivers under multiple sea-level rise scenarios.

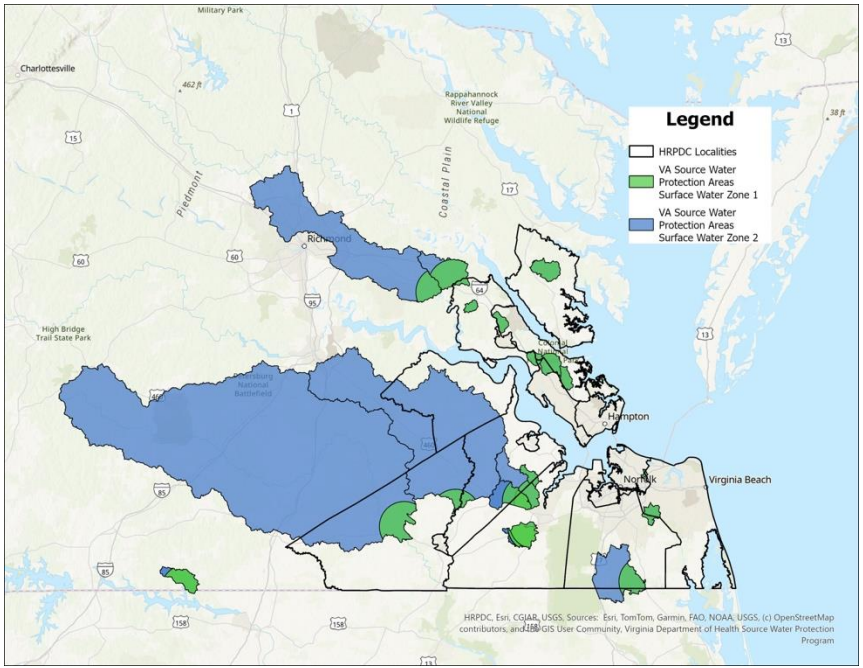
- **At the Chickahominy intake, salinity could more than double during dry years even under a modest 30-cm rise**
- **Under 100-cm rise, concentrations would exceed EPA drinking water standards**

Incorporated salinity thresholds into source water protection planning and long-range capital investment decisions

Pursued watershed land protection — securing easements on 550+ acres around reservoirs to maintain water quality buffers

Engaged in regional water supply planning via HRPDC to build system redundancy against a degrading Chickahominy source

Source Water Protection Areas in Hampton Roads



Virginia Beach: Early Warning for Private Well Users

Over **20,000 private wells** in northern Virginia Beach's shallow aquifer serve irrigation, heat pumps, and domestic use. USGS & Virginia Beach operate a real-time chloride monitoring network — 15-minute continuous sensors — to detect intrusion **before production wells are compromised.**

If salinity rises further, well users lose irrigation supply and may shift to municipal water — adding demand pressure to their surface water source.

Sources: Rice et al. (2011), USGS OFR 2011-1191; USGS Virginia Beach Shallow Groundwater Study; HRPDC Source Water Protection Program; Newport News Waterworks SWPP

HRSD Conductivity Source Tracking

Finding where saltwater enters the sewer system

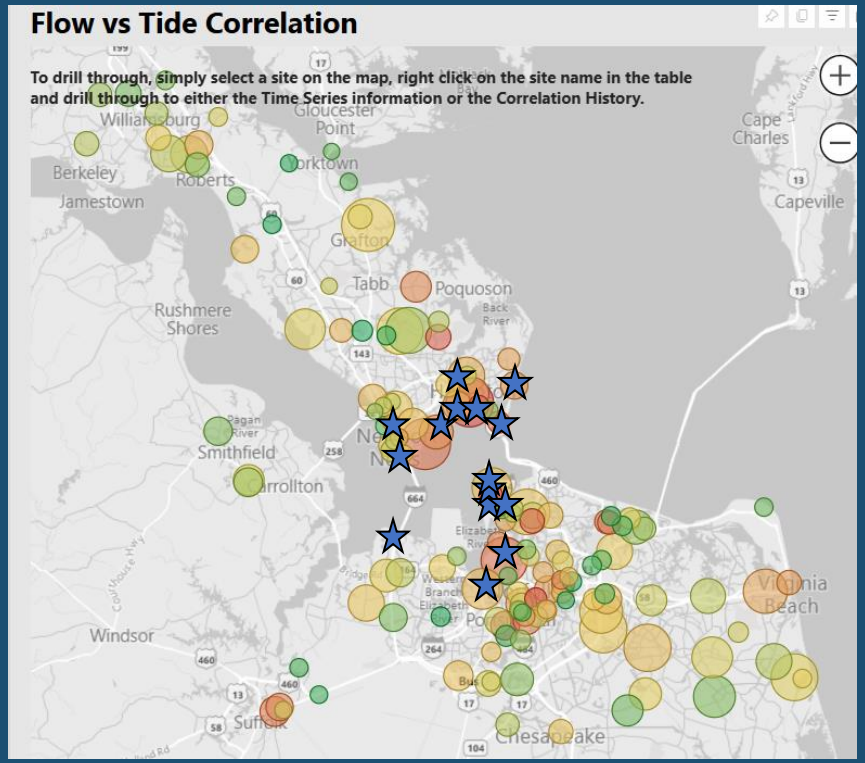
The Problem

Saltwater inflow and infiltration (I/I) into sewers poses major operational and water quality challenges. High-salinity wastewater arriving at treatment plants increases settling demand, inhibits biological nutrient removal, raises treatment costs, and converts bromide to bromate during ozone disinfection, threatening the quality of HRSD's SWIFT aquifer recharge water.

The Approach

Conductivity is measured throughout the collection system using data loggers and field meters to pinpoint where saltwater enters, enabling targeted, cost-effective repairs.

HRSD Service Area – Desktop Analysis of flow versus tide correlation



Bubble size = flow volume; color = tide correlation (green=low, red=high). Stars = priority investigation sites.

CST: Methods, Tools & Key Findings

How CST Works

1

Desktop Analysis

SCADA data, past field data, system maps, and predictive modelling identify high-probability I/I locations before field deployment.

2

Conductivity Data Loggers & Field Measurements

Temporary sensors in wet wells & gravity mains capture time-series data correlated with tidal events. Point measurements during high-tide events identify specific assets for follow-up inspection or repair.

3

Mass Balance Calculations

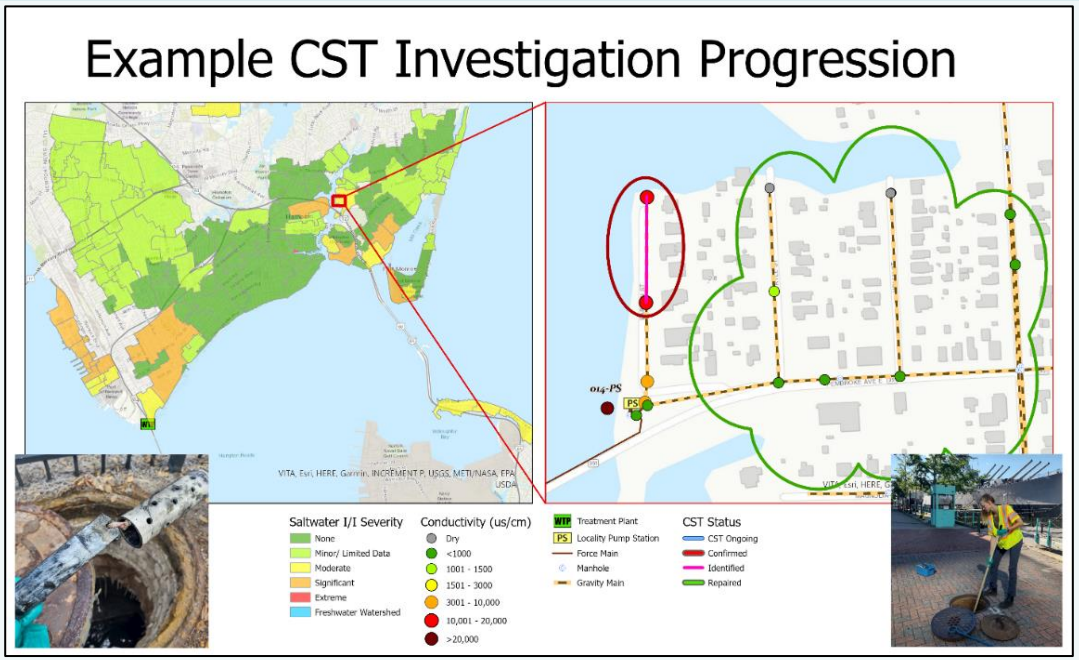
Conductivity + flow data enable sub-basin mass balances to estimate saltwater I/I fraction, prioritizing repairs.

4

Key Takeaways

CST gives HRSD a faster, lower-cost way to identify likely saltwater I/I sources, reduce false positives/negatives, and focus follow-up sanitary sewer evaluation survey & repair decisions where they are most likely to matter.

Example CST Investigation Progression



50,500 LF

pipe identified with saltwater I/I

~87%

locality-owned small-diameter pipe

~1/3

Local pump station avg flow = saltwater I/I before repairs

Source: HRSD Conductivity Source Tracking Overview, October 2025

What Localities Need from Science

Translating salinity research into local planning, design, and management decisions

Localized Risk Maps

Connect salinity changes to specific assets, drainage systems, groundwater supplies, and capital projects.

Pulse Monitoring

Capture salinity spikes during droughts, storm surge, king tides, and compound tidal-rainfall events — not just averages.

Design Guidance

When should salinity change material selection, vegetation choices, BMP design, tailwater assumptions, and maintenance cycles?

Action Thresholds

Conductivity/salinity levels that matter for wetland function, corrosion risk, drinking water intakes, agricultural soils, and BMPs.

Hampton Roads localities are taking a proactive, scientific approach to salinity risk by treating it as a cross-cutting planning issue — one that affects water supply, stormwater systems, infrastructure, natural resources, and long-term resilience.