Maryland's Plan to Adapt to Saltwater Intrusion and Salinization

Policies and Priority Research Needs for Managing Saltwater Intrusion Risks in Maryland

STAC Salinity Risks Workshop

May 27, 2026

Legal Basis

Section 3-1012, Natural Resources Article, Annotated Code of Maryland

- On or before December 15, 2019, the Department of Planning, in consultation with the Department of Natural Resources, the Department of the Environment, and the Department of Agriculture, shall establish a plan to adapt to saltwater intrusion.
- The plan shall be updated at least once every 5 years.

Legal Definition and Interpretation

Section 3-1001 of the Natural Resources Article, Annotated Code of Maryland

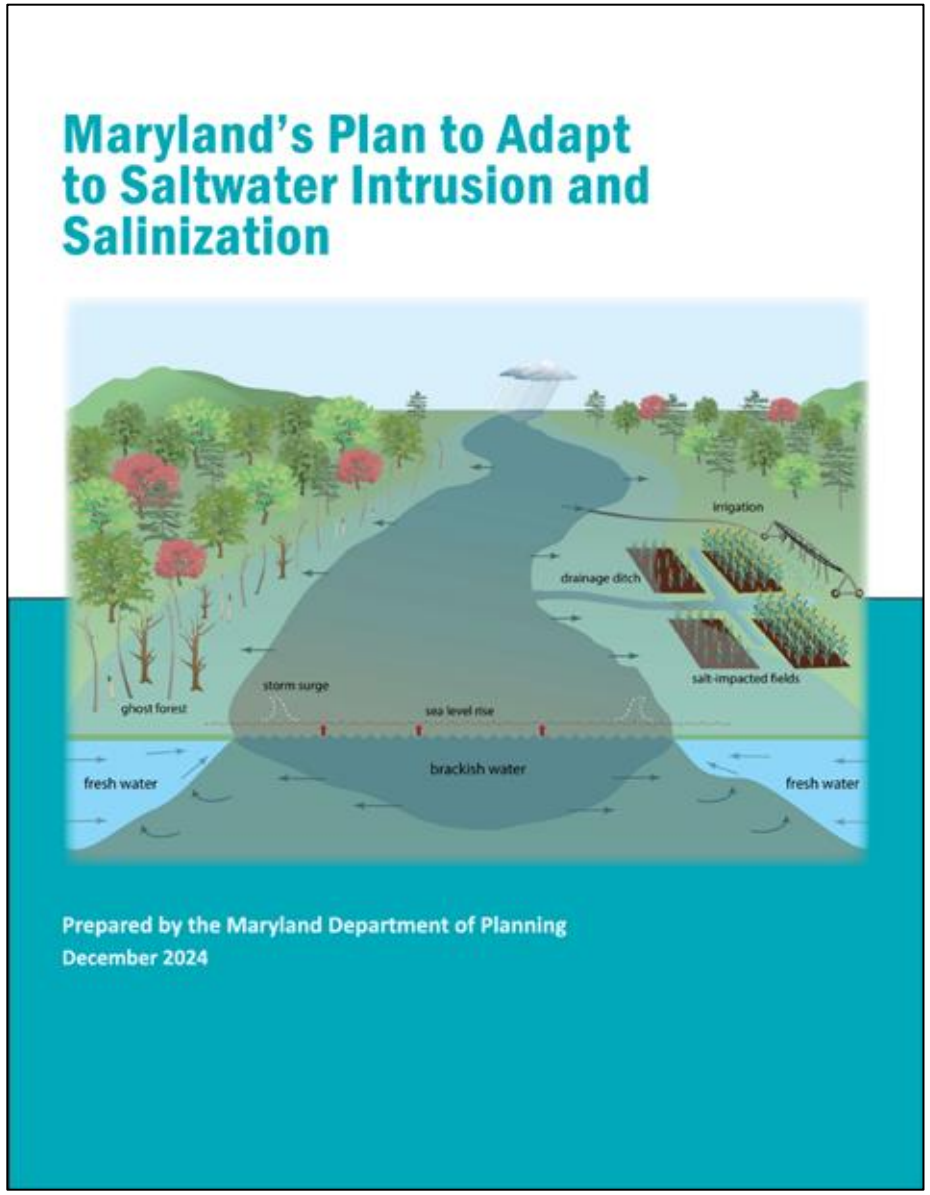
- Defines “saltwater intrusion” as the movement of brackish water into freshwater, including into surface waters, aquifers, and water within soils.
- Plan terminology:
  - “saltwater intrusion” to describe the movement of saltwater into aquifers only.
  - “salinization” to describe the process by which water-soluble salts accumulate in fresh surface waters or in soils within agricultural land, wetlands, and coastal forests.

Legal Definition and Interpretation

Section 3-1012, Natural Resources Article, Annotated Code of Maryland

- Does not focus on salt application on roads.

- Only focuses on salinity increases due to climate change, such as coastal storms, hurricanes, coastal flooding, and sea level rise.



- First plan published December 2019
- Updated plan published December 2024

Maryland Department of Planning, "State of Maryland Plan to Adapt to Saltwater Intrusion and Salinization: 2024 Update," Dubow, J and D.H. Cornwell, primary authors, D. Andreasen, A. Staley, K. Tully, K. Gedan, and R. Epanchin-Niell, and E. Marcian, contributing authors, 2024.

MDP's Role in Developing the Plan

1. Convene Subject Matter Experts
2. Facilitate Discussions
3. Conduct Research and Interviews
4. Identify Priority Actions
5. Develop Draft Plan
6. Gather Feedback
7. Finalize Plan

Plan Contents

- Background
- Aquifers
- Surface Waters
- Agriculture
- Coastal Wetlands
- Coastal Forests
- Infrastructure
- Long-Term Plan Implementation

Long-Term Plan Implementation

- Researchers are using the plan to support their funding applications
- The plan recommends a permanent Salinity Resilience Network of researchers, grantmaking organizations, policy-makers, and others centered on implementing the plan
- No statutory implementation role for state government

What I'll Discuss Today

- Based on our session topic, "Management Strategies & Freshwater Salinization Syndrome":
  - Plan findings regarding Maryland's aquifers and surface waters
  - Maryland regulations focused on protecting Maryland's aquifers from saltwater intrusion
  - Well water monitoring in Maryland
  - Overall research needs for aquifers and surface waters
  - Overall priority research and adaptation recommendations from the plan

Aquifers - Findings

- In 1958, the Maryland Geological Survey published data documenting sea level rise in the Chesapeake Bay and its likely impact of saltwater intrusion into Maryland's aquifers.
- Most of Maryland's groundwater users rely on aquifers that are not currently impacted by saltwater intrusion.
- Maryland's unconfined aquifer is at a low risk of saltwater intrusion now; however, the portion of the unconfined aquifer that will be inundated by sea level rise will be at greater risk of having saltwater intrusion in the future.

Aquifers - Findings

- The exact number of Maryland groundwater users that are at risk due to increasing saltwater intrusion due to climate change is currently unknown.
- The last comprehensive study of Maryland's coastal plain aquifer system, both unconfined and confined, was completed in 2013 by MGS; however, that work did not include an investigation of saltwater intrusion.
- More localized mapping of saltwater intrusion in specific confined aquifers within certain locations in Maryland has been conducted over the past decades by the Maryland Geological and U.S. Geological surveys.

Maryland Aquifer Protection Regulations

- MDE is prohibited from granting a water appropriation and use permit that causes or contributes to saltwater intrusion into a freshwater aquifer (COMAR 26.17.06.06.D.(8))
- MDE policy of incorporating climate change vulnerabilities into the Water Appropriation and Use Permit has significantly reduced the risk of saltwater intrusion due to overpumping.

Maryland Aquifer Protection Regulations

- Wells must be constructed at least 2 feet above grade in flood-prone areas (COMAR 26.04.04.21.C)
- Flood resistant caps, which include a gasket that forms a waterproof seal, on wells must be used in flood-prone areas (COMAR 26.04.04.21.G)
- Bentonite grout is prohibited where groundwater is at 1,000 mg/l of TDS (COMAR 26.04.04.19.C(2) (b)), given that brackish water reduces the viscosity, and therefore, the effectiveness of the grout.

Maryland Aquifer Protection Regulations

- MDE can designate water management strategy areas for aquifers that are at risk from saltwater intrusion.
- The designation results in special groundwater management considerations, including limiting withdrawals in a certain aquifer, directing withdrawals to a different aquifer, or additional analysis and/or monitoring when permits are requested for these areas.
- Several areas of the state have been designated as water management strategy areas.

Well Water – Monitoring

- Currently, salt (sodium chloride) is not a frequent water-quality test constituent when new or replacement private wells are constructed in Maryland's coastal plain.
- In some counties in Maryland's coastal plain, county environmental health departments test wells, including domestic wells, in select areas for chloride.
- Public groundwater drinking systems in Maryland are required to test for chloride whenever a new source is constructed, although there is no ongoing chloride monitoring except in special cases.

Well Water – Monitoring

- Sodium is routinely tested for though and can be used as a surrogate for saltwater in most aquifers.
- TDS and specific conductance, which can be used to help identify the presence of brackish and salty water, are tested sporadically in both public water systems and domestic wells in Maryland.
- Although the presence of high chlorides or TDS does not legally require the drilling of a new well, some individual households might not report an impacted well out of fear that other contaminants could be found that would require the closure of the well.

Surface Waters - Findings

- Increased salinization due to climate change may impact tidal surface water users, including:
  - farmers withdrawing from tidal streams and rivers (such as the Choptank and Tuckahoe rivers on the Eastern Shore)
  - golf courses withdrawing from tidal streams
  - power plants and industries using tidal water for non-contact cooling.
- Salinization of surface waters may have pronounced impacts on aquatic habitat and attendant communities. Studies of increased salinity in freshwater habitats have documented declines in fish diversity, indicated potential losses in benthic invertebrate species, and raised concerns over indirect impacts to fish health and reproduction.

Aquifers – Overall Research Needs in Maryland

- **Significant research has been conducted over the years such as developing numerical groundwater-flow and solute transport models to predict future changes to the saltwater-freshwater interface in select aquifers and monitoring to detect changes in chloride concentrations in targeted areas/aquifers.**

Aquifers – Overall Research Needs in Maryland

- While this research has provided valuable information to water managers, the extent of saltwater intrusion in many of Maryland's coastal plain aquifers remains unknown.
- There is presently a lack of tools (flow and transport models) and monitoring networks to effectively track, forecast and manage saltwater intrusion as groundwater withdrawals continue or increase and sea level rises.

Surface Waters – Overall Research Needs in Maryland

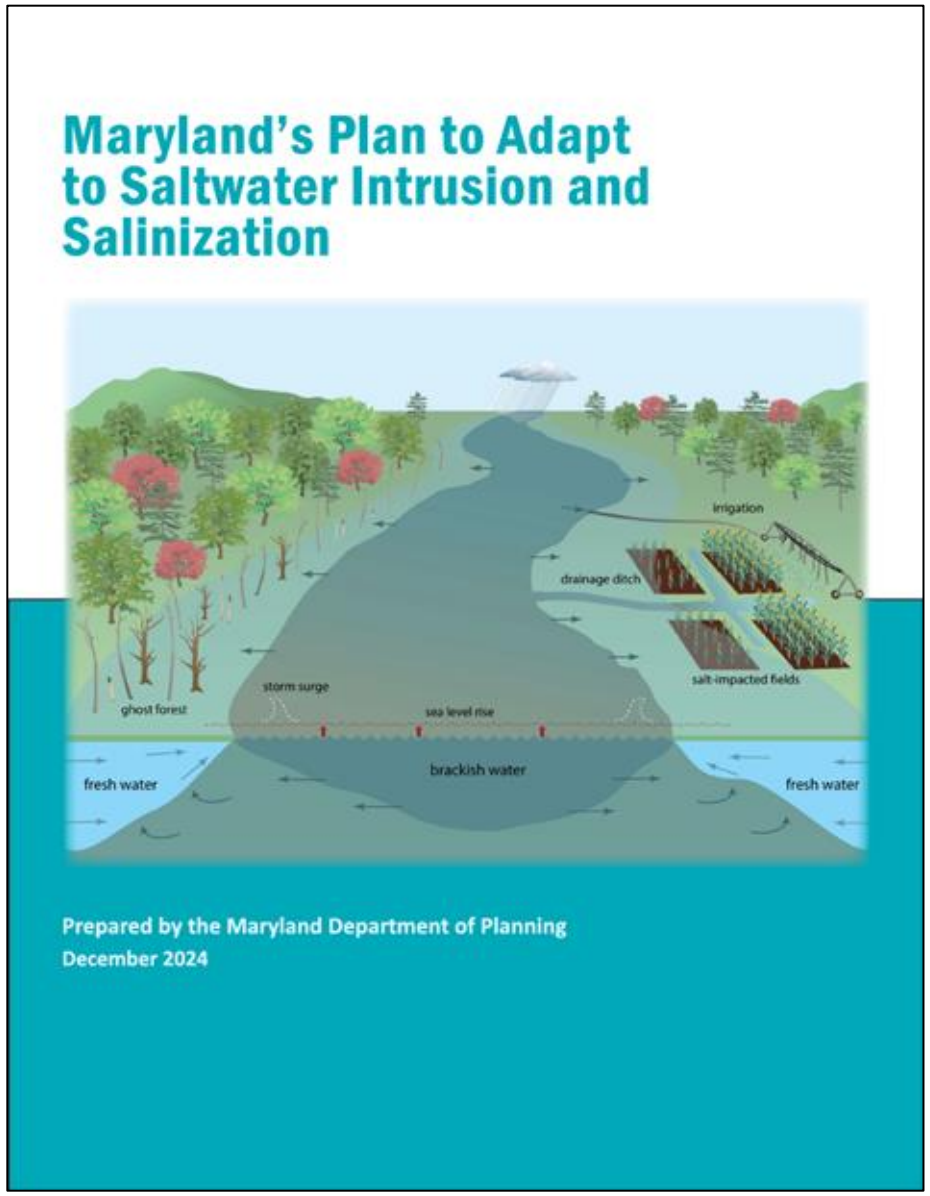
- SaltCast project is helping to meet the surface waters research needs identified in the plan
- SaltCast uses a watershed-estuary model to simulate the transport and fate of major salt ions and the model output is combined with artificial intelligence algorithms to identify management strategies to increase the resilience of coastal infrastructure, water security and public health

Priority Research/Adaptation Actions

- Conduct a pilot study of surficial aquifers in Maryland to identify coastal infrastructure, including building foundations, most at risk of saltwater intrusion.
- Support the variety of adaptation needs for Maryland farmers, including creating markets for salt-tolerant crops, and establishing coastal resilience easements when land can no longer support farming.

Priority Research/Adaptation Actions

- Research the net methane emissions from salinization of wetlands and uplands.
- Research impact of salinization of wetlands and uplands on phosphorus storage and release, with a focus on farmlands.
- Host an annual forum to share knowledge and support continued, collaborative progress.



Thank you!

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Maryland Water Management Strategy Areas

- The MDE water management strategy areas currently listed for saltwater intrusion in Maryland are:
  - Aquia aquifer on Kent Island in Queen Anne's County (groundwater in the Aquia along the western edge of Kent Island adjacent to the Bay has locations of elevated chloride)
  - Patapsco aquifer on Indian Head peninsula (Charles County) has had elevated chloride in the past
  - Aquia aquifer (shallow surficial aquifer at this location) on Annapolis Neck and Mayo Peninsula (Anne Arundel County) has had areas of elevated chloride
  - Surficial aquifer in West Ocean City (Worcester County) - St. Martins River - no documented elevated chloride - concern is for potential due to the connectivity of Columbia aquifer to the Atlantic Coastal Bays and the water level trend observed from 1994 through 2005