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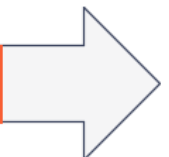
# Septic Management in Coastal Virginia

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## 1.2 Abstract

Rising sea levels, increasing inland flooding, and land subsidence in coastal areas of Virginia threaten septic systems that many homeowners rely on. Because of the legal framework that depends on homeowners to maintain their systems and leverages penalties when these systems fail, many septic system failures go unreported. Failing septic systems have human health and environmental consequences. As sea levels rise, this problem will continue to be exacerbated. Current methods including septic system pumpouts are short-term solutions and do not address underlying problems. Therefore, creative methods must be employed to provide longer-term solutions to the problem of failing septic systems.

**Keywords:** resilience, climate change, adaptation, septic system, sea level rise

# 1 Introduction

The increasing severity and frequency of inundation events as a result of human-induced climate change produce a series of secondary consequences beyond the immediate aspects of flooding. Among these secondary consequences is contamination via wastewater released from private septic systems as filtering efficacy and structural integrity are challenged by saturated soils and saltwater intrusion. Mitigation and adaptation strategies that address this issue face the particular challenge of coordinating action among disorganized stakeholders who are each responsible for the maintenance of their respective systems. Despite the reality that septic tank degradation is a chronic issue that affects infrastructure on a regional level due to particular geographic characteristics, the systems themselves are legally maintained by private property owners and are therefore managed on a case-by-case basis. Moreover, since the absence of a public sewer system often implies the absence of an incorporated urban community, these property owners are predominantly residents of rural localities and frequently do not possess the resources to adequately maintain their septic tanks. Combined with a regulatory framework that can leverage hefty penalties against owners who do not comply with the septic code, many rural areas must contend with private septic infrastructure that is undermaintained yet underreported. This is particularly severe in low-lying coastal communities whose rural character produces the aforementioned issues in management and regulation and whose geographic and climatic conditions can accelerate the physical deterioration of septic systems.

## 2 Septic Systems

Septic systems, as opposed to septic sewers, are decentralized treatment systems that treat low volumes of wastewater from residences or small businesses. Unlike septic sewers, which are typically public infrastructure networks that serve a given municipality, septic systems provide water treatment for individual buildings and are managed by the building's owner. These systems are usually buried underground and process wastewater through anaerobic digestion before releasing it into surrounding soil via the system's drainfield. This soil serves as the final filtration medium and therefore absorbs any material which remains after being processed through the septic tank (EPA, 2022).

## 3 Environmental and Public Health Implications

Because of rising sea levels and coastal subsidence, buried septic systems can become inundated and fail. Additional issues can arise when substances such as household chemicals and pharmaceuticals, which are not properly broken down through anaerobic digestion, are sent through the septic system and flushed into the landscape. When systems are damaged or malfunctioning and wastewater is improperly treated, pathogens, nutrients, and harmful chemicals can contaminate the surrounding soil or water. This creates subsequent consequences including eutrophic algal blooms, damage to agricultural food supplies, and degradation of an area's recreational capacity. Furthermore, pathogens leaked into the surrounding environment can cause illnesses including dysentery, hepatitis, typhoid, and hookworm (Huffman et al. 2018).

### 3.1 Environmental Justice

Parts of rural, coastal Virginia lack access to affordable wastewater disposal that is protective of human health and the environment. Often, homeowners in these areas rely on private septic systems. Because of racial covenants and systematic disinvestment following emancipation, many residents in low-lying areas are Black (Frank, 2020). Homeowners in impoverished, rural communities cannot afford to repair their systems, let alone pay fines for failing systems. Common issues resulting from failing septic systems are exacerbated by sea level rise and coastal subsidence and have public health and environmental consequences. Failing wastewater systems can release parasites, such as hookworm, that can be transmitted to humans through soil contaminated with fecal matter (McKenna, 2017). In some parts of Virginia, homeowners live without access to indoor plumbing. According to a 2007 study, there were 117 occupied homes on the Eastern Shore with no indoor plumbing. Homeowners resorted to unpermitted solutions including backyard port-a-johns (Skeo Solutions, 2015).

## 4 Regulatory Framework and Data Collection

Until 1990, information on private septic systems was regularly collected by the American Census Bureau. When this ended, data collection in Virginia became the responsibility of local health districts operating under the Virginia Department of Health (VDH). In 2003, VDH established a database that served to centralize and digitize all septic information gathered by local health offices (Huffman et al., 2018). VDH's efforts to move all dispersed physical documentation to this central database are ongoing, but there remains a significant hole regarding the information on the prevalence and location of private systems in the state, particularly in rural areas. Additionally, changes were made to Virginia's septic code in 2000 which allowed for the installation of "alternative" systems whose drainfield filters were augmented by technology rather than relying solely on the surrounding soil (Huffman et al., 2018). Since the first three years of alternative system installation predated the establishment of VDH's database, a lot of the initial information regarding these systems' prevalence and location is missing. These alternative systems, unlike standard private septic systems, also require a five-year maintenance report to be submitted to VDH in order to monitor filtration efficacy. It is estimated that 58% of owners have not complied (Vogelsohn, 2019).

State septic code, as well as penalties for violations, are set by the Virginia Administrative Process Act. VDH is responsible for enforcing the code and therefore has the ability to report violators who are potentially subject to \$25,000 fines for each offense or possible jail time. For standard (non-alternative) systems, VDH requires an inspection before and after installation but has no mechanism for ongoing inspections (Sewage Handling and Disposal Regulations, 2022). Even if the agency had the financial and political resources to send inspectors into rural areas to check on system health, property owners who are financially unable to repair or replace damaged systems have a vested interest in obfuscating disrepair, as code violations would only worsen their situation economically. Combined with structural issues in centralized reporting as detailed above, rural Virginia must simultaneously deal with failing septic systems whose location and status of the operation are largely unknown and whose property owners are hesitant to disclose. This hesitation has affected the efficacy of financial assistance opportunities provided by organizations like VDH, Virginia Cooperative Extension (VCE), Southeast Rural Assistance Project (SERCAP), and the Department of Agriculture (USDA).

## **5 Mitigation Strategies**

Septic education can be leveraged to prevent system failure, water quality, and human health impacts. Septic owners who are knowledgeable about how to properly maintain their systems are more likely to preemptively address issues and prevent system failures. Additionally, septic owners who are aware of available resources can leverage financial assistance to maintain their systems. When systems fail, owners have three options – septic pumpouts, system replacement, and system relocation. Septic pumpout refers to the extraction of material that is clogging a system and disrupting wastewater treatment and is the cheapest option, but it is a short-term solution that does not address underlying issues. System replacement refers to the installation of a new system in the same place as its nonfunctioning predecessor. This is a medium-term solution that properly addresses all issues stemming from the system itself, but does not reckon with the surrounding context which potentially accelerates degradation. System relocation refers to the installation of a new septic system, or the use of a public sewer system, in a more geographically viable location, and has the potential to deal with environmental conditions brought about by climate change. For the purpose of this project, pumpouts and replacement will be treated as a mitigation strategy, while relocation will serve as an adaptation measure.

## **6 Adaptation Measures**

The vast majority of coastal Virginia is vulnerable to a series of common consequences produced by climate change in the Eastern United States, including sea level rise, increasingly frequent inland flooding, and intensifying hurricane seasons. The extent of this vulnerability is based on the rate of sea level rise, annual precipitation, frequency of storm-induced inundation, and the relative rate of land subsidence (Adapt VA, 2022). Since many of these vulnerable areas rely on septic systems, it is critical to think of longer-term adaptation measures that can be used to prevent human health and water quality impacts when septic systems inevitably fail. Longer-term solutions include changes to the regulatory framework, external funding for wide-scale infrastructure replacement, and managed retreat strategies.

### **6.1 Changes to Regulatory Framework**

Because of the current structure of VDH's regulatory framework, homeowners are responsible for the maintenance and repair of their septic systems. There are three areas of this framework that could be altered for more thorough reporting by individual homeowners: penalty reduction, ongoing maintenance updates, and structural public funding. By reducing punitive measures outlined in the Virginia Administrative Process Act, hesitation from homeowners to self-report failing systems could be abated. As it functions now, owners with dysfunctional systems who are unable to pay for pump-outs or replacements are deterred from reporting issues due to additional financial burdens potentially brought by hefty fines (up to \$25,000). This could also affect willingness to seek out existing funding opportunities. However, penalty reduction should be employed in tandem with an actual mechanism to regularly collect maintenance reports, which does not currently exist for the majority of Virginia's standard private septic systems. Alternative systems, which were first legalized in 2000 and utilize technology to aid wastewater filtration, require five-year maintenance reports to be submitted to VDH. Systems within the authority of the Chesapeake Bay Preservation Act are also

subject to regular on-site inspections and must install specific plastic filtration devices to augment treatment. These standards can be extended to all systems state-wide so as to provide a useful political scaffolding that records system location and ensures ongoing health. These standards must also be employed with structural changes to public repair and replacement funding if they are to overcome social resistance to more stringent requirements. This will be elaborated further in the following section, but the disparate nature of current funding opportunities precludes a meaningful address to the chronic and economically dire reality of widespread coastal septic failure.

## **6.2 External Funding Solutions**

Many funding sources exist to help property owners with onsite septic systems, including regional nonprofits (SERCAP), federal (USDA), and state agencies (VDH, VCE). Although these options exist, they are limited in the amount of funding available, and some have eligibility requirements. System owners may also be unaware that such opportunities exist, meaning centralization of available resources in an accessible location (both digitally and physically) could be a good first step. More broadly speaking, however, current assistance funding treats the issue at a piecemeal level, assuming that an owner unable to meet the financial burden of system repair is a sporadic phenomenon that is not necessarily reflective of an entire region. Environmental and socio-economic conditions in areas like Tidewater Virginia produce system disrepair on a scale that must be handled on a structural level, and a broader, coordinated approach is necessary to sufficiently address this challenge. Private dams and waterworks often benefit from structural assistance via public funds and low-interest loans, despite ownership remaining private following construction (VCPC, 2018). This rationale can be extended to private septic systems, which are currently treated as discrete units but could be conceptually bundled together so as to better situate public-private partnerships. Specific commonwealth-level assistance programs can also be bolstered and modeled after states like Minnesota, Oregon, and Washington, which have developed innovative solutions beyond scattered agency programs. For instance, in Minnesota, a state sales tax contributes to a Clean Water Fund that is distributed to counties for grants to low-income homeowners with non-compliant systems (Wysocky, 2013).

## **6.3 Managed Retreat**

It is worth considering that parts of Virginia's coast that will be inundated by sea level rise should not be inhabited in the future. Managed retreat from these areas could prevent impacts on homeowners including septic problems. Relocating these vulnerable communities, while immensely challenging, has the potential to resolve current and future human health and water pollution challenges stemming from septic system failure. Extending the rationale behind the relocation, which states that the financial, social, and ecological ramifications of rebuilding in areas prone to flooding, to the installation and maintenance of septic systems lead to possibly radical solutions (Hino, 2017). For instance, if a series of properties within a given area are relocated due to their presence in a floodplain, they could be centralized in a safer location to an extent that would allow for the installation of a public sewer system. This would transfer authority to public works departments and allow for transparent and tax-funded maintenance in areas especially vulnerable to soil and water contamination. There are obvious implications as it regards industries such as agriculture or shellfishing (both very prevalent in coastal Virginia), but the placement of dwellings within a region is often defined by necessitated conditions that are no longer persistent. Managed

retreat provides a rare opportunity to fundamentally reorient infrastructural organization around anticipated climate impacts.

## **7 Discussion and Conclusions**

Failing septic systems contaminate surrounding waters and threaten human health. These issues are exacerbated by sea level rise due to human-caused climate change. Despite the reality that septic system degradation is a chronic issue that affects Virginia's coastal infrastructure, the responsibility of system maintenance falls upon private property owners who may not possess the resources to adequately maintain their systems. Combined with a regulatory framework that can leverage hefty penalties against owners who do not comply with the septic code, many rural areas must contend with private septic infrastructure that is undermaintained and underreported. Short-term solutions including septic pumpouts and replacement do not address larger structural issues and will not be adequate as sea levels continue to rise. Therefore, broader solutions including changes to the regulatory framework, innovative funding methods, and managed-retreat strategies should be leveraged by coastal communities to ensure the health and safety of residents.



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