UMass Boston
Stone Living Lab
School for the Environment
100 Morrissey Boulevard, Boston, MA 02125-3393
P 617.287.7440 | umb.edu/environment

Distinguished Professor Katherine A. Dafforn
School for the Environment
UMass Boston

September 14, 2026

Mr. Todd Randall
U.S. Army Corps of Engineers
New England District
ATTN: COB CSRM Project Team, 696 Virginia Road, Concord, MA 01742-2751

**RE: Comment on the Boston Coastal Storm Risk Management Study Draft Feasibility Report**

Dear Mr Randall,

Thank you for the opportunity to provide comments on the Boston Coastal Storm Risk Management Study Draft Feasibility Report. I am a Distinguished Professor in the School for the Environment at UMass Boston and Director of the Stone Living Lab, a partnership focused on developing, testing, evaluating, and scaling nature-based approaches to coastal resilience.

I commend the City of Boston and the U.S. Army Corps of Engineers (USACE) for undertaking a comprehensive assessment of coastal flood risk across Boston's 47 miles of coastline and for evaluating adaptation strategies under multiple sea-level-change scenarios over a long planning horizon. The scale and complexity of this effort are substantial, and the report provides an important foundation for future investment in Boston's coastal resilience. In particular, I appreciate the report's consideration of increasing coastal flood risk over time, the evaluation of phased implementation pathways, and the acknowledgement that adaptation strategies must remain effective under a range of future climate conditions.

As a researcher focused on climate adaptation in urban coastal environments and a resident of the City of Boston, I strongly support efforts to reduce current and future flood risks. I encourage USACE to advance Action Plan 2 as a core component of the final recommendation while also recommending Action Plan 3 as an early implementation priority. I also believe there are opportunities to strengthen the final report to better reflect current and potential future advances in science and engineering, acknowledge the value of nature-based and hybrid approaches, broaden the evaluation of project benefits, include public access along the waterfront, and increase flexibility for future adaptation pathways. My recommendations are as follows:

**1. Strengthen adaptive management and flexibility for future innovation**
The report appropriately acknowledges uncertainty and evaluates alternatives under high and intermediate sea-level-change scenarios. It also recognizes opportunities for phased implementation and identifies incremental delivery of strategies at the neighborhood scale. In addition, the report provides opportunities for future refinement through subsequent reviews

and later phases of project implementation. I also appreciate the report's acknowledgement of the importance of incorporating adaptable features with risk management strategies.

While these elements provide an important foundation for adaptive planning, they do not yet constitute a formal adaptive management framework (McQueen et al. 2025). This is especially important with the uncertainty of future SLR and storm conditions; the plan has been developed for scenarios that may never occur. Given that many projects are likely to be designed, funded, and constructed over the next decade and then operate for many decades thereafter under deeply uncertain conditions, I encourage more consideration of incremental, flexible adaptation approaches where adaptation actions are implemented in response to observed changes in risk and climate conditions. This will require establishing clearer mechanisms for periodic reassessment of climate conditions, monitoring for informed decision-making, and consideration of future changes in community priorities and land use. Such a framework could also acknowledge circumstances under which alternative adaptation pathways, including strategic relocation or managed retreat, may become appropriate in the longer term as sea levels rise and risk profiles change (Hino et al. 2017). Given the dynamic nature of coastal systems and climate projections, resilience planning should not only identify preferred solutions today but also establish clear mechanisms for continuing to improve those solutions over time and preserving the options to adjust as the uncertain climate changes (Ranger et al. 2013). An adaptive management approach can also be extremely cost effective; adaptation actions are only funded as the climate changes instead of large investments made now for uncertain conditions that may be decades or more in the future.

Research programs like those at the Stone Living Lab are actively generating evidence regarding coastal processes, flood hazards and adaptation measures that was unavailable when many existing risk models and methodologies were developed. Through our Climate Change Observatory, the Lab collects real-time data on water levels, waves, flooding and coastal conditions across Boston Harbor. The Lab also maintains long-term monitoring programs focused on biodiversity and shoreline change. These datasets can help support adaptive management decisions as conditions change over time.

Adaptive management is particularly important because resilience planning is occurring in a rapidly evolving scientific and technological environment. New information will emerge throughout project implementation and so the final report should establish explicit decision points where this new information can be incorporated without requiring fundamental redesign of the overall strategy.

**2. Evaluate resilience investments based on their full range of benefits, including waterfront access**

Throughout the report, proposed investments are primarily evaluated through avoided flood damages, benefit-cost ratios, and reductions in life-safety risk. These metrics are clearly important and should remain central to decision-making. However, they capture only part of the value generated by coastal resilience investments.

Coastal adaptation projects to reduce flooding risk that incorporate hybrid approaches can also generate important co-benefits including wave attenuation, overtopping reduction, erosion reduction, sediment stabilization and enhanced infrastructure longevity while

simultaneously providing ecological and community benefits such as enhanced biodiversity and improved public access to the waterfront (McQueen et al. 2025). These co-benefits are particularly important in dense urban environments such as Boston where shoreline investments influence not only flood protection but also the quality of life experienced by residents and visitors (Sutton-Grier et al. 2015). Major resilience investments also provide a rare opportunity to enhance public open space, strengthen connections between communities and the waterfront and improve the overall public realm while delivering climate adaptation benefits.

While the report acknowledges that resilience investments can provide environmental and social co-benefits, these outcomes appear to play a relatively limited role in project evaluation relative to avoided damages and economic performance metrics. This challenge is not unique to the current study and reflects a broader need for improved methods to quantify and evaluate the full range of co-benefits generated by resilience investments (Sutton-Grier et al. 2015). Through the Stone Living Lab, researchers are developing and testing approaches to quantify a broader suite of resilience outcomes, including shoreline condition, biodiversity, water quality and community wellbeing. These efforts may help improve future evaluation frameworks by providing locally derived evidence on the multiple benefits generated by resilience investments within Boston Harbor.

Consideration of these broader benefits is particularly relevant in Boston, where the waterfront is both a resilience asset and a major recreational and economic resource. For example, the National Park Service reported that visitors to National Parks of Boston generated $196.5M in spending in 2023, supported 2430 jobs and produced $298.8M in economic output for the local economy. Resilience investments that maintain or enhance access to waterfront parks, beaches, harborwalks, and the Harbor Islands may therefore contribute benefits that extend well beyond avoided flood damages.

In the final report, I suggest expansion of the discussion and evaluation of resilience benefits beyond avoided flood damages, and to more explicitly consider environmental, ecological and social co-benefits when comparing alternatives. Given Boston's commitment to waterfront access, environmental justice and climate resilience, resilience investments should be viewed as opportunities to improve both human and ecological systems rather than solely serving as flood-protection projects.

**3. Strengthen consideration of nature-based and hybrid approaches**

I appreciate that the report references nature-based and hybrid approaches and that several were retained after screening. I also recognize that severe space constraints and highly urbanized waterfront conditions create challenges for solely implementing some nature-based approaches.

However, the overall impression conveyed by the report is that nature-based approaches are only applicable in limited locations and under specific conditions. This characterization does not reflect the rapidly expanding body of evidence demonstrating the effectiveness of nature-based and hybrid approaches across a broad range of urban coastal environments. The report would benefit from greater transparency regarding the evaluation of nature-based solutions within Boston Harbor. While the report identifies locations where nature-based approaches

were considered and, in some cases, screened from further analysis, it is not always clear whether constraints relate to available space, engineering feasibility, performance under storm surge conditions, regulatory considerations, uncertainty in available data, or other factors.

USACE's Planning Guidance explicitly requires NBS and nonstructural approaches to be formulated and considered as an integral component of Civil Works project evaluation. The final report should therefore clearly document how NBS and hybrid alternatives were evaluated, the assumptions applied during screening, the basis for exclusion where alternatives were rejected and the extent to which project benefits beyond flood-damage reduction were considered. Such information would also help identify locations where emerging evidence or future innovations may create opportunities for complementary measures that are not currently considered viable.

Coastal resilience is most effectively achieved through layered systems that combine engineered infrastructure, natural infrastructure, stormwater improvements and adaptive management. Nature-based solutions should therefore be evaluated as complementary components of a broader resilience strategy rather than as alternatives competing directly with traditional infrastructure. Their greatest value often occurs when they are integrated with traditional engineering approaches to create hybrid systems that provide flood-risk reduction while simultaneously delivering ecological, social, and climate-resilience benefits (McQueen et al. 2025). Salt marshes, beaches, dunes, oyster reefs, living shorelines, and other habitat-forming systems can reduce wave energy, stabilize sediments, reduce erosion, and help maintain shoreline elevations. Although individual nature-based features may not independently provide the level of protection required to manage large storm-surge events in highly urbanized locations, they can increase the performance and longevity of conventional infrastructure when integrated within hybrid systems. International experience increasingly demonstrates that combining natural and engineered approaches can provide multiple lines of defense while delivering broader environmental and social benefits (Bishop et al. 2017).

I therefore encourage the final report to more fully explore opportunities for hybrid gray-green infrastructure and living shorelines that provide layered resilience. Where conventional infrastructure is ultimately selected, the report should identify opportunities for associated mitigation investments that enhance ecological function and resilience elsewhere within Boston Harbor. Such investments could include marsh, beach and dune enhancement or demonstration projects designed to test emerging resilience approaches, as well as investments in the health of natural ecosystems such as saltmarshes that exist in segments around the harbor.

It is particularly important that the final report avoid implying that nature-based approaches are ineffective in urban environments simply because they may not alone be feasible everywhere. The key question is not whether NBS can independently solve every challenge, but where they can complement conventional infrastructure and increase overall system performance.

The Stone Living Lab is currently evaluating several examples of this layered approach in Boston Harbor. These include living seawalls that are investigating both ecological

enhancement of hardened infrastructure and the potential for habitat features to influence wave overtopping. The Lab is also evaluating shoreline stabilization approaches including cobble berms, boulder field concepts and other nature-based interventions intended to complement conventional engineering systems. Collectively, these projects are generating performance data that could help inform future design guidance, mitigation investments and adaptive management strategies for Boston Harbor.

**4. More fully evaluate the environmental consequences of gray infrastructure**

While the report evaluates environmental consequences for each neighbourhood, I encourage greater consideration of how large-scale coastal infrastructure may alter ecological connectivity across Boston Harbor. Coastal structures can modify the movement of organisms, sediments, nutrients, organic matter, and energy between habitats, while also altering hydrology and resource exchange between terrestrial, intertidal, and subtidal environments (Bishop et al. 2017). These connections support ecosystem functions that extend beyond individual project footprints and can influence biodiversity, productivity, and resilience at the harbor scale. The implications of altered connectivity should be considered alongside more traditional assessments of habitat loss and direct project impacts.

I am also concerned that the ecological importance of soft-sediment habitats may be underrepresented within the current assessment. The report acknowledges losses of benthic habitat associated with certain alternatives, but soft-sediment environments provide ecosystem services that extend beyond their footprint, including nutrient cycling, contaminant processing, fisheries support, shoreline stabilization, and food-web support for fish, birds, and other wildlife (Heery et al. 2017). Modifications to hydrodynamics, sediment transport, and organic matter inputs associated with coastal infrastructure can affect these habitats at scales considerably larger than the area directly occupied by a structure.

Finally, I encourage additional consideration of the ecological trade-offs associated with shoreline armoring and vertical flood-protection structures. Conventional seawalls and floodwalls frequently provide habitat that differs substantially from natural shorelines, often supporting lower ecological complexity, creating shaded conditions that may reduce primary production by photosynthetic organisms, altering species interactions, and in some circumstances facilitating the establishment and spread of non-native species (Bulleri and Chapman 2010). These broader ecological considerations become particularly important where hard infrastructure is proposed as the primary resilience intervention.

Where impacts to ecological connectivity, benthic habitat or shoreline function are unavoidable, the final report should identify a clear strategy for compensatory mitigation that seeks measurable improvements in ecological condition. New gray infrastructure should require that ecological enhancements and habitat-supporting design features are incorporated during design and mitigation planning. Research conducted through the Stone Living Lab is helping develop and evaluate approaches that increase habitat value on engineered shorelines while maintaining their primary flood-protection and engineering functions.

**5. Consider the role of the Boston Harbor Islands in a harbor-scale resilience strategy**

An additional opportunity that could be explored in the final report is the role of the Boston Harbor Islands within a broader harbor-scale resilience strategy. The report appropriately recognizes that the islands are an important component of the Boston Harbor's physical setting and wave climate, noting that they help reduce wave energy reaching the inner harbor. This is a well-recognized ecosystem service provided by the island chain and contributes to the comparatively sheltered conditions experienced throughout much of the harbor. As sea levels rise and storm conditions change over coming decades, understanding how the geomorphic and ecological condition of the islands influences harbor-scale resilience may become increasingly important.

I recognize that the report identifies storm surge and inundation as the dominant flood hazards affecting Boston and therefore prioritizes measures that directly address rising water levels. However, this appears to result in the Boston Harbor Islands being considered primarily as wave attenuators rather than as components of a broader nature-based resilience strategy. While the islands alone are unlikely to provide sufficient protection from future storm surge, enhancing the long-term resilience of the island system could nevertheless form an important component of a hybrid coastal adaptation approach.
The islands, together with their associated shorelines, salt marshes and other nearshore habitats, provide ecological, recreational, and coastal protection benefits that contribute to the functioning of the harbor as an integrated system. The Boston Harbor Islands may provide opportunities for resilience-focused mitigation investments. Habitat restoration, shoreline stabilization, sediment management, and enhancement of beaches and salt marshes on the islands could complement mainland flood-protection measures while delivering additional environmental and social benefits and generating information relevant to future harbor-scale adaptation strategies. Projects currently underway through the Stone Living Lab, including boulder field investigations, are evaluating whether strategic placement of habitat-enhanced boulders can simultaneously reduce shoreline erosion and enhance biodiversity. These efforts, combined with ongoing monitoring of waves, currents, shoreline change and ecological condition provide an opportunity to generate early evidence regarding the role of island-scale interventions in a broader harbor-wide resilience strategy.

More broadly, should be viewed as an interconnected resilience system, in which the urban shoreline, islands, wetlands, beaches and gray infrastructure together multiple lines of defense (McQueen et al. 2025). Considering resilience at the scale of the harbor system may help identify additional opportunities for future nature-based and hybrid approaches.

**6. Establish a comprehensive monitoring and evaluation framework and identify mitigation opportunities**

The scale of investment contemplated by this study is unprecedented for Boston Harbor. As such, long-term monitoring and performance evaluation should be considered essential components of implementation (McQueen et al. 2025) as well as performance evaluation. Monitoring is necessary to evaluate engineering performance and also understand ecological outcomes, water quality responses, public use patterns, environmental justice outcomes and the effectiveness of nature-based and hybrid approaches over time. Establishing a coordinated monitoring framework would support adaptive management, improve future project phases, and create opportunities for continual learning and refinement of coastal resilience strategies.

The Stone Living Lab is well positioned to support such efforts. Through the Climate Change Observatory and associated monitoring programs, the Lab already maintains infrastructure and expertise relevant to long-term observations of flooding, waves, water levels, coastal processes, biodiversity, shoreline change, topography and bathymetry. Leveraging existing monitoring networks may provide an efficient mechanism for evaluating project performance and supporting adaptive management over time.

The final report would also benefit from greater specificity regarding ecological mitigation associated with project construction and habitat impacts. Given the scale of the proposed interventions and the acknowledged impacts to aquatic and coastal habitats, mitigation should extend beyond replacement of lost area wherever possible and seek to improve ecological function and resilience within Boston Harbor. Pilot projects supported through mitigation funding could also generate valuable information to guide future implementation. Examples include ecological enhancement of coastal infrastructure, living seawalls, nature-based shoreline stabilization projects, cobble berms, habitat restoration initiatives and island-based resilience interventions. Such projects could help reduce uncertainty while also contributing to harbor-wide resilience objectives. Incorporating clear mitigation objectives and performance measures would help ensure that mitigation contributes meaningfully to the long-term environmental resilience of the harbor rather than simply offsetting project impacts.

Existing wetland resources should also be prioritized within mitigation planning. In areas such as Chelsea Creek, Neponset River Estuary, Tenean Beach and Savin Hill Cover where wetlands have already been heavily modified, fragmented, and subjected to long histories of industrial development, mitigation presents an opportunity not only to offset impacts but also to improve ecological condition and long-term resilience. Restoration of hydrologic connectivity, enhancement of degraded marsh habitat, removal of ecological barriers where feasible, and investments in long-term monitoring could generate lasting benefits for ecosystem health while contributing to broader resilience objectives.

Boston is uniquely positioned to advance the evidence base for nature-based and hybrid approaches through initiatives such as the Stone Living Lab. The final report should establish mechanisms for incorporating emerging findings into future project phases and adaptive management decisions.

**7. Strengthen consideration of compound flooding and long-term operation**

The report appropriately focuses on coastal storm risk, but I encourage additional attention to compound flooding and stormwater management challenges that may emerge behind coastal protection features. Flood barriers, berms, and shoreline protection systems can alter drainage patterns, affect outfalls, and increase reliance on pumping infrastructure. Additional consideration should be given to interactions between coastal flooding and inland stormwater flooding. While these hazards are often evaluated separately, extreme events may create conditions where surge-related closure of tide gates reduces system drainage capacity and increases the likelihood of inland flooding. Understanding long-term operation and maintenance as well as energy requirements associated with these systems will also be critical determinants of project success. Overall, greater consideration of how stormwater

systems interact with proposed coastal protection measures, including operational implications for gates, outfalls and pumping systems as well as funding implications associated with these systems would strengthen confidence in long-term system performance.

**Summary**
Overall, I appreciate the effort to address Boston's growing coastal flood risk and appreciate the extensive work already represented in this study. The final report provides an important opportunity to demonstrate how resilience investments can simultaneously protect people, support ecological systems, and improve quality of life.

As USACE finalizes the study, I encourage consideration of three overarching priorities. First, advance Action Plan 2 as a core component of the recommended strategy while also carrying forward Action Plan 3 as an important early implementation priority. Second, establish a more explicit adaptive management framework that enables future decisions to be informed by monitoring, new scientific information, and changing risk conditions. Third, continue expanding opportunities for layered resilience through hybrid infrastructure, strategic mitigation investments, and the integration of nature-based solutions where they can improve overall system performance.

The Stone Living Lab was established to generate the science, partnerships, monitoring infrastructure and demonstration projects needed to support implementation of coastal resilience solutions in Greater Boston. Through ongoing work on living seawalls, cobble berms and boulder fields as well as monitoring networks and long-term ecological and physical monitoring programs, the Lab is actively generating information directly relevant to many of the questions raised by this study. The Lab would welcome opportunities to support future project phases through pilot project development, monitoring and adaptive management, performance evaluation of hybrid infrastructure, data sharing, scientific advisory support and assessment of mitigation outcomes. Such collaboration would help ensure that implementation remains flexible, evidence-based and consistent with evolving science, engineering practice and USACE requirements regarding Nature-Based Solutions and adaptive management.

Thank you for considering these comments. I welcome the opportunity to discuss any of these points further.

Sincerely,



**Dr. Katherine A. Dafforn**
Distinguished Professor
School for the Environment, UMass Boston
Director, Stone Living Lab

**References**

Bishop, M. J., Mayer-Pinto, M., Airoldi, L., Firth, L. B., Morris, R. L., Loke, L. H. L., Hawkins, S. J., Naylor, L. A., Coleman, R. A., Chee, S. Y., and Dafforn, K. A. 2017. Effects of ocean sprawl on ecological connectivity: impacts and solutions. Journal of Experimental Marine Biology and Ecology 492:7-30.

Bulleri, F., and Chapman, M. G. 2010. The introduction of coastal infrastructures as a driver of change in marine environments. Journal of Applied Ecology 47:26-35.

Heery, E. C., Bishop, M. J., Critchley, L. P., Bugnot, A. B., Airoldi, L., Mayer-Pinto, M., Sheehan, E. V., Coleman, R. A., Loke, L. H. L., Johnston, E. L., Komyakova, V., Morris, R. L., Strain, E. M. A., Naylor, L. A., and Dafforn, K. A. 2017. Identifying the consequences of ocean sprawl for sedimentary habitats. Journal of Experimental Marine Biology and Ecology 492:31-48.

Hino, M., Field, C. B., and Mach, K. J. 2017. Managed retreat as a response to natural hazard risk. Nature Climate Change 7:364-370.

McQueen, A., Suedel, B., Copp Franz, S., Cardona, T., McDermott, M., Collins, S., Magar, V., and Herzog, J. 2025. Application of a nature-based solution adaptive management framework for improving coastal resiliency in a highly urbanized environment. Frontiers in Ecology and Evolution Volume 13 - 2025.

Ranger, N., Reeder, T., and Lowe, J. 2013. Addressing 'deep'uncertainty over long-term climate in major infrastructure projects: four innovations of the Thames Estuary 2100 Project. EURO Journal on Decision Processes 1:233-262.

Sutton-Grier, A. E., Wowk, K., and Bamford, H. 2015. Future of our coasts: The potential for natural and hybrid infrastructure to enhance the resilience of our coastal communities, economies and ecosystems. Environmental Science & Policy 51:137-148.