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November 5, 2018

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RE: Public Comments on the New York New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study

Dear Mr. Wisemiller and Ms. Brighton,

Thank you for the opportunity to submit comments on the New York-New Jersey Harbor and Tributaries (NYNJHAT) Coastal Storm Risk Management Feasibility Study ("the Study"). As faculty members of the School for Earth and Environmental Sciences (SEES) at Queens College CUNY, our research involves the assessment of contaminant impacts on New York City coastal waters caused by combined sewer overflows (CSO), and the role of environmental factors such as tidal circulation and weather on the ability to detect and mitigate such impacts. As environmental scientists, we are also mindful of the long-term risks of climate change to the growing populations of coastal urban areas like New York City, especially the potential impacts of sea-level rise. We recognize the prospect of rising storm surge levels from increasingly severe storms poses a significant risk of coastal damage, however the complexities of addressing such risks are enormous, as we detail below.

The information provided to date on the proposed alternatives is not adequate to determine if any would provide an acceptable solution, but it does provide reasons for serious concern related to many of the proposed alternatives. Specifically, we have major concerns for open-water storm-surge barriers, both in terms of their inability to address the tightly coupled issue of sea-level rise when barrier gates are open and the related environmental issues that would be caused by these in-water barriers. We therefore urge the USACE to greatly expand the scope of its analysis and public outreach to fully meet the criteria of the National Environmental Policy Act (NEPA), and not restrict its feasibility assessment to an artificial "3x3x3" time and funding constraint. We are aware of the concerns and support the detailed comments from advocacy groups including Save the Sound and Riverkeeper. It is important that concerns expressed by the public, by advocacy groups, and by scientists are seriously considered. We agree that the extent of public engagement in this process has not been adequate for management actions of this scale. We are concerned that the scoping process itself apparently aims to limit the alternatives to be addressed by an Environmental Impact Study (EIS), as mandated by the National Environmental Policy Act (NEPA), and artificially restricts the study area to exclude nearby shoreline communities in New Jersey, Long Island and Connecticut. Due to the major concerns for open-water barriers, it is important that alternatives focusing on shoreline protection approaches be retained in the alternatives selected for more complete study.

Beyond these general concerns, we focus our comments on three particular topics. Each of the following topics encompasses multiple major issues that have yet to be meaningfully addressed as summarized below:

I. **Sea-level rise will worsen over time making fixed in-water barriers obsolete.**

Coastal damage risk due to storm intensification and increasing storm surge height cannot be considered in isolation because it is a function of sea-level rise caused by changing climate. All of the proposed in-water (as opposed to shore-based) barrier alternatives will not be able to address dynamic sea-level rise because tidal gates will have to be open most of the time to allow navigation access to the NY-NJ Harbor Estuary. Therefore, rising sea-levels will be present both outside and inside of proposed barriers as water is exchanged through tidal gates. As shown by other studies (Boston Harbor Barrier Analysis, Kirshen et al. 2018), the base level for storm surge will therefore inevitably rise over the lifespan of proposed barriers, resulting in gradual obsolescence of the storm surge protection at fixed elevations of the barriers. If gates for tidal barriers are closed more and more frequently in response, eventual overtopping by storm surge could cause flooding in areas inside the area ostensibly protected by the barriers. The need for sea level rise protection could also cause these barriers to be used in ways (with gates commonly closed) that are not intended or adequately considered by the initial design studies creating a devastating choice between sea level rise protection and unintended environmental consequences of using these barriers with the gates commonly closed.

While the direct Congressional authority of the USACE in undertaking this study (Public Law 71, June 15, 1955) specifies the risks of damage caused by coastal storms, specifically hurricanes, meaningful consideration must be also given to the changing sea-level conditions caused by climate change and sea-level rise that aggravate such potential coastal damage. Only the shore-based measures, presented in even less detail than in-water barriers, are likely to provide protection against long-term sea-level rise as well as storm surge.

II. Irreversible restriction of the partially-mixed open Hudson River estuary.

Addressing coastal risk from storm surge by drastic restriction of the estuary with in-water storm surge barriers presents enormous potential for unintended adverse consequences. In-water alternatives for storm barriers risk changing the baseline of current environmental conditions: a natural harbor with free tidal exchange of water to the open ocean. This has unexamined implications for anadromous fisheries, sediment transport, pollutant concentrations, salinity stratification and estuary ecology, as well as ongoing environmental restoration through the combined sewer overflow (CSO) Long Term Control Plans in New York City.

Unlike the settings of most other existing and planned barriers around the world (Orton and Ralston 2018, Mooyaart and Jonkman 2017), the NY-NJ Harbor Estuary is a partially mixed estuary with relatively large tides, larger total cross-section inlet area and more salinity variation. The gradually improving environmental conditions over the last four decades are largely due to the elimination (eg. PCBs) or limitation (eg, sewage and CSO) of contaminant inputs to the Hudson River and associated waterways. The natural tidal flushing of these waterways through Long Island Sound, the Narrows and the New York Bight has improved water quality to the best it has been since predevelopment time, allowing the flourishing of a sport fishery and increased sightings of whales. Although "hot spots" of unacceptable coastal water quality persist in estuary embayments such as Newtown Creek, the Gowanus Canal, the Hutchinson River and Flushing Bay, the existing exchange of water through the open waterways is essential to the continued improvement of NY-NJ Harbor Estuary water quality. Indeed, the present free tidal exchange with the ocean is a baseline upon which major efforts for environmental restoration (from CSO and stormwater impacts) are premised, in addition to being a fundamental requirement for sustaining the ecology of the Hudson River Estuary.

The construction of in-water storm surge barriers, particularly across the Throgs Neck outlet to Long Island Sound, the Narrows and the Outer Harbor from Sandy Hook to Breezy Point will substantially reduce this exchange of water by reducing tidal range and restricting inlet flow to the dimensions of tidal gates in these barriers. Preliminary modeling by Orton and Ralston (2018) show that for realistic fractions (30% or less) of cross-sectional flow area (tidal gate area as percentage of total inlet area), tidal range will be reduced by 50% or more. Studies elsewhere, summarized by Orton and Ralston (2018), also confirm that the net effect will increase salinity stratification, increase salt intrusion and reduce sediment transport, as observed in the Netherlands and Maine, as well as from a modeling study in the Chesapeake

Bay. The adverse ecological impacts of such tidal and flow restriction would be immense, difficult to predict and in some cases irreversible.

III. Deflection and focusing of storm energy and water flows.

Decades of history of armoring and installing jetties and groins along barrier island coasts have shown that reinforcement of coastal defenses in some areas shifts the focus of storm energy elsewhere and disrupts natural sand transport and replenishment. Similarly, constriction of waterways that convey a given tidal prism inevitably increases water velocities and scouring through the restrictions compared to the previous openings. Increased flow velocities have been found to create serious maintenance problems and expenses due to this scouring in one of the largest European storm surge barriers in the Netherlands (Mooyaart and Jonkman 2017).

For the present NYNJHAT Study, the specified study area is clearly too small to account for the potential adverse impacts of deflected storm energy on coastlines along southern Long Island, on Long Island Sound and the Jersey Shore. Historical hurricanes have already modified the southern Long Island barrier islands by opening new inlets. Notably, the 1938 hurricane opened the present Shinnecock Inlet (Morang 2016), and during Superstorm Sandy in 2012, three new inlets were breached through Fire Island, one of which has remained. Clearly these new inlets were created at the weakest points, and with the armoring of Lower Manhattan created by the most complex in-water barriers proposed by the Study, storm energy will be deflected from the Harbor area to less well protected coastlines on Staten Island or Nassau County and along the Jersey Shore. Prime candidate locations for aggravated future storm impacts under this scenario include Long Beach in New York and the southern end of Sandy Hook, where topographic elevations do not exceed 4 m above sea-level. Long Beach, and communities along the Jersey Shore south of Sandy Hook, were especially hard hit by Superstorm Sandy in 2012 due to these low elevations.

Basic hydrodynamics indicates that drastic reductions in cross-sectional inlet area caused by a limited number of tidal gates in the most complex in-water barrier scenarios will radically increase the water velocities channeled through these narrow openings. Already in New York Harbor, the hazardous currents of the Hell Gate section of the East River provides a natural example of the effects of such constriction on ship navigation. Even today, after 19th century removal of tons of rock by blasting, it remains a danger to navigation with currents reaching 3 m/s. Model simulations (Orton and Ralston 2018) show that expected flow velocities through tidal gate openings in the Outer Harbor proposed barrier range from 2 m/s to 3 m/s, confirming studies on the Boston Harbor proposed barrier system (Kirshen et al. 2018). These predicted strong velocities and intensified currents in and around tidal gate openings represent serious hazards to navigation – indeed, from European studies (Mooyaart and Jonkman 2017), velocity of 1.5 m/s is considered to be a navigable limit. In effect, construction of storm surge barriers with tidal gates could be recreating man-made Hell Gate-style navigational hazards for shipping in and out of the NY-NJ Harbor Estuary.

In summary, and to conclude our comments, we support the stated effort of the NYNJHAT Study to "manage the risk of coastal storm damage in the New York and New Jersey Harbor and tributaries study area, while contributing to the resilience of communities, critical infrastructure and the environment". We stress, however, that due to the prospect of long-term climate change and sea-level rise, which are not adequately accounted for in the available information presented to date, the in-water fixed-elevation storm-surge barrier alternatives are likely to become rapidly obsolete. Furthermore, there is an enormous risk of irreversible unintended consequences in disrupting the present estuarine system by obstructing free tidal exchange of water to the open ocean. The present partially-mixed estuarine circulation in the NY-NJ Harbor Estuary supports a complex system of natural tidal flushing that present-day environmental conditions (anadromous fisheries, associated estuary ecology, sediment transport) and continued future environmental and water quality improvement depend on. Many of the proposed in-water storm surge barrier alternatives are likely to severely restrict the tidal prism to narrow tidal gate openings, creating high water velocities in these areas that will be hazardous to navigation. There is also a significant risk of diverting storm energy and thereby focusing coastal damage on areas outside the present Study area such as the barrier islands in Nassau County and the Jersey Shore. In our view, it is important for alternatives focused on shoreline protections to be included in the expanded study of alternatives.

Other comparable major historical engineering efforts of the USACE such as the Florida Everglades drainage/channelization and the dike system built to protect the City of New Orleans from hurricanes have in retrospect been, at best, of limited benefit, and are requiring additional major investment to reverse or mitigate. It would be unfortunate if due to limited consideration of the important issues we have raised, and failure to adequately consider on-shore storm-surge barrier options, future generations must deal with the negative consequences of USACE efforts to protect the New York-New Jersey Harbor Estuary from storm surge and climate change.

Thank you.

Sincerely,

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