TESTIMONY OF THE MAYOR'S OFFICE OF RESILIENCY
BEFORE THE NEW YORK CITY COUNCIL
COMMITTEES ON RESILIENCY AND WATERFRONTS AND HOUSING AND BUILDINGS

Monday, February 8, 2021

Good morning. I am Jainey Bavishi, Director of the Mayor's Office of Resiliency. I would like to thank Chairs Brannan and Cornegy for the opportunity to testify today. I would also like to acknowledge my colleague Joe Ackroyd, Assistant Commissioner for Technical Affairs and Code Development at the Department of Buildings, who will be providing testimony and joining both me and Mikelle Adgate, Senior Advisor for Strategic Planning at the Department of Environmental Protection, in answering your questions today.

As you know, the Mayor's Office of Resiliency is responsible for ensuring that New York City is prepared to withstand and emerge stronger from the impacts of climate change. With 520 miles of shoreline, adapting to more frequent and severe coastal storms is a critical part of our work. However, we're also preparing for a variety of other threats, including chronic tidal flooding caused by sea level rise; precipitation-based flooding, which can have severe impacts on inland neighborhoods; and extreme heat, which is the deadliest form of extreme weather in New York City.

We call this a "multi-hazard" approach, since it addresses *all* the climate threats that impact our city.

We are also taking a "multi-layered" approach. This means that we're focused on establishing multiple lines of defense at different scales all across the city.

Some of our efforts occur at the neighborhood scale: these include enormous infrastructure projects like the Rockaways – Atlantic Shorefront or the East Side Coastal Resiliency project. These efforts are extraordinarily complex, extremely costly, difficult to site, and require careful design and robust community input over the course of the design, planning, and implementation phases. However, they also bring about significant and wide-ranging benefits for thousands of New Yorkers. Another example of a neighborhood-scale effort is the Department of City Planning's Special Coastal Risk Districts, which were created with extensive community input and developed to limit density in our lowest-lying waterfront area. These zoning rules apply to entire neighborhoods and place restrictions on what property owners can build there.

We're also establishing protections at the building level. The Build It Back program, which elevated hundreds of Sandy-impacted homes, is an excellent example of a building-level strategy. The NYC CoolRoofs program is another example: by painting individual rooftops with

a white, reflective coating, we can help reduce temperatures inside a given building. This also has the benefit of reducing energy costs for residents. Yet another example is Appendix G of the Building Code, which sets stringent standards for construction of all new structures in the flood plain.

A third important pillar of our work centers around critical infrastructure. We have partnered extensively with local utilities to harden the electrical grid; Con Edison has invested more than $1 billion in climate adaptation, and just last month released a new report detailing how it will incorporate climate change into its planning, design, operations, and emergency response. The City has also developed the Climate Resiliency Design Guidelines, which provide guidance on how to incorporate forward-looking climate change data in the design and construction of City capital projects. First issued in 2017, the Guidelines were developed through a collaborative process with over 20 City agencies and authorities. The Guidelines are already being used by some City agencies today. For example, DEP incorporates the Guidelines related to sea level rise into their standard operating procedures across all capital projects. As we discussed at the Council hearing on January 25th, the City is now prepared to pilot the Guidelines more broadly across the City's capital portfolio.

The fourth and final pillar of our multi-layered approach consists of supporting communities and residents. Examples of this work include the Department of Small Business Service's BusinessPREP program, which provided grants and technical assistance to Sandy-impacted small businesses to not only recover from, but also prepare for, the next disaster. Another example is our flood insurance outreach in coastal communities through FloodHelpNY, which is designed to help families understand the financial benefits of maintaining flood insurance policies for their homes. Yet another example is the Department of Health and Mental Hygiene's Be a Buddy program, which promotes social cohesion by creating networks of volunteers to check in on vulnerable residents during heat waves.

To reiterate, our multi-layered approach includes developing neighborhood coastal resiliency strategies, building and asset level protections, infrastructure planning and hardening, and direct engagement with communities, businesses, and residents. All of this work is grounded in the best available science, guided in large part by the New York City Panel on Climate Change. Together, this represents the core of MOR's approach to climate adaptation. Our office had the opportunity to share our progress in several recent testimonies offered to Council over the past few months and we would be happy to provide more information about any specific initiatives upon your request.

There is no doubt that much more work remains to be done to adapt New York City to a hotter and wetter future. A lack of funding for new projects and programs is the biggest barrier we face.

Even with more funding, implementing new, complex solutions won't be easy, and will require incredible thoughtfulness and participation of many communities and stakeholders over the coming years and decades. Despite the significant scope of the work ahead, I remain optimistic about our ability to meet these challenges.

In conclusion, I would like to thank the Committee on Resiliency and Waterfronts and the Committee on Housing and Buildings for allowing me to testify here today. I will now yield to my colleague Joe Ackroyd, and I look forward to answering your questions after my colleague's testimony.

NEW YORK CITY DEPARTMENT OF BUILDINGS
TESTIMONY BEFORE THE NEW YORK CITY COUNCIL
FEBRUARY 8, 2021

Good morning Chair Cornegy, Chair Brannan, and members of the Committees on Housing and Buildings, and Resiliency and Waterfronts. I am Joseph Ackroyd, Assistant Commissioner for Technical Affairs and Code Development at the New York City Department of Buildings ("the Department"). I am pleased to be here to discuss how the New York City Construction Codes ("Construction Codes") address building resiliency and the legislation before the Committees.

The Construction Codes, including the New York City Building Code ("Building Code"), are revised periodically to keep them up-to-date with the latest versions of the International Codes, and to ensure they reflect innovation in the construction industry and the latest safety standards. Since the early 1980s, when the Federal Emergency Management Agency ("FEMA") first released its Flood Insurance Rate Maps for New York City, the Building Code has been periodically updated to ensure that building construction in high-risk flood areas complies with, and exceeds, the minimum standards of the National Flood Insurance Program ("NFIP") administered by FEMA. This process has improved the resiliency of building construction in high-risk flood areas over time and is a process the Department is committed to continuing.

For example, the Building Code requires buildings constructed in high-risk flood areas to be elevated to a higher standard than that required under the NFIP to ensure buildings are further protected from flood impacts. The Building Code also requires buildings to be flood-proofed and limits use of spaces below the flood elevation to ensure the safety of occupants, which must be documented on a building's Certificate of Occupancy or through a restrictive declaration. Regulations in the Building Code also work to protect building systems by requiring certain components to be located above the flood elevation, where the NFIP would otherwise allow such components to be located below the flood elevation. The Department is in the process of revising

the Construction Codes and expects to discuss additional amendments to the flood-resistant construction requirements in the Building Code with the City Council in the next few weeks.

Turning now to the legislation before the Committees.

Intro. 566 would create an elevation certificate program for low-to-moderate income owners of buildings located in high-risk flood areas. Elevation certificates include important information about a building and its characteristics, including its elevation, and are an important tool for assessing a building's flood risk. The Department requires that elevation certificates be submitted in connection with new building construction in high-risk flood areas and recognizes the value that they could have in determining flood insurance premiums for a building.

It is important that building owners understand how to use elevation certificates, which makes coupling them with financial counseling critical. Services provided to building owners through FloodHelpNY, which is managed by the Center for New York City Neighborhoods, and supported by the Mayor's Office of Resiliency, offer up a useful example of how this could work, though it's important to note that the program's funding is set to expire in late 2022. FloodHelpNY offers free services for low-to-moderate-income New Yorkers living in select areas in the floodplain. These services include a home resiliency audit, which includes a free elevation certificate, backwater valve installation, and financial counseling services related to flood insurance. Financial counseling helps a building owner understand how the information on the elevation certificate may impact their flood insurance premium, how to use the elevation certificate to potentially lower their flood insurance premium, and the steps to take if there are issues with their flood insurance. The Department shares the City Council's goal of helping owners understand their building's flood risk and looks forward to discussing this proposal further with the City Council to determine how best to accomplish this goal in light of the current fiscal climate.

Intro. 962 would require that impervious surfaces be limited during new construction and certain alteration projects. Effectively managing stormwater helps prevent adverse impacts, including overwhelming the sewer system and flooding. There are existing regulations in place to address this issue. Through the Department's enforcement of the Construction Codes, the Department ensures that stormwater management regulations promulgated by the Department of

Environmental Protection are complied with where a new building is being constructed, a building is being horizontally enlarged, or an alteration is increasing impervious surface areas. The Department looks forward to discussing this legislation further with the Committees, and our partner agencies, to better understand how this proposal interacts with existing regulations intended to address stormwater management, including upcoming updates to such regulations.

Thank you for the opportunity to testify before you today. We welcome any questions you may have.

REBNY
REAL ESTATE BOARD OF NEW YORK

REBNY Testimony | February 8, 2020

The Real Estate Board of New York to

The Committees on Resiliency and Waterfronts and Housing and Buildings of the New York City Council Concerning Intro 962 – Impermeable Area

The Real Estate Board of New York (REBNY) is the City's leading real estate trade association representing commercial, residential, and institutional property owners, builders, managers, investors, brokers, salespeople, and other organizations and individuals active in New York City real estate. REBNY thanks the Committees on Resiliency and Waterfronts and Housing and Buildings for the opportunity to submit feedback on Intro 962, which proposes to amend Appendix A of the Building code to limit the allowed amount of impermeable area of zoning lots.

Confronting climate change requires collective effort from both the public and private sectors to deal with the crisis at hand. REBNY supports City and State emissions reductions goals and we are proud to represent members who are innovating in the fields of building construction and technology to reduce carbon footprints, increase energy efficiencies and take concrete steps to strengthen climate resilience.

We need strong, coordinated mitigation efforts to address the climate crisis. However, successful climate change adaptation requires multiple modes of intervention. Not every building encounters the same risks in the same way and a one-size fits all approach in anathema to the science, site-specific constraints and neighborhood level risk. As New York continues to fight COVID-19, we also need predictable and transparent city regulations to create a sustainable economic recovery, especially in development. The real estate and construction industries are vital to New York's livelihood, creating thousands of jobs and billions of dollars in tax revenue.

For these reasons, we cannot support Intro 962 as drafted. The bill language states that no permit may be issued for work at a zoning lot unless the applicant demonstrates to the satisfaction of the commissioner that such work will not increase the impermeability factor of such lot to greater than the maximum impermeability factor for such lot. First, this fails to account at all for the below grade conditions in a city that is hundreds of years old with centuries of layered building strata, utility lines, and transit infrastructure. There is zero distinguishing language between high-density districts where sites are excavated lot line to lot line and low-density districts with existing controls on natural area management. There is also no consideration for the drainage complications of permeable surfaces over below grade building portions or if there were purposeful containment strategies put in place to

mitigate below grade brownfield conditions. This is by no means exhaustive given the complexities of designing these systems and the variety of below grade conditions – further study and outreach is necessary.

Second, we oppose as a manner of process. The city's code revision process is existing, robust and provides for multiple avenues for stakeholder engagement, discussion and mediation of disagreements to revise the building code. Legislating resiliency measures one by one does not build upon the vast expertise and stakeholder engagement that is part of the city's code revision process, nor from city's ongoing study and work around climate resiliency and adaptation. For a body that is requesting holistic study at the Federal Government level for regional interventions and has demanded holistic planning measures from the city administration, this is baffling at best. The Council should at minimum consult with appropriate professional associations, including landscape architects, civil engineers and architects, taking into account their recommendations and taking such measures as are reasonable and necessary if this bill is to move forward.

Thank you for the opportunity to share these concerns with the committee.

CONTACT(s):

RYAN MONELL
Director of City Legislative Affairs
Real Estate Board of New York

212.616.5247
rmonell@rebny.com

TESTIMONY OF THE BUILDING INDUSTRY ASSOCIATION OF NEW YORK CITY 0N INTRO. NO. 962-A

FEBRUARY 8 ,2020

I am Robert Altman and I am submitting this testimony on behalf of the Building Industry Association of New York City in opposition to Intro. No. 962-A which would create a fifty-percent impermeability limit on zoning lots.

The first issue is that the use of the zoning lot is term is problematic, especially when talking about developments with multiple tax lots owned by different parties on a single zoning lot. If owned by multiple parties, then each party has a race to see which owner can use the remaining impermeability factor. And if then used, that can lead to lawsuits.

Next, the bill will limit a homeowner's ability to install a pool or finish their yard areas with hardscape.

Additionally, the bill will have significant impacts on one- and two-family developments, especially where the average lot size is 40 by 100 feet or smaller. Development on such lots will almost always exceed the 50% impermeability threshold once you've designed the house, driveway and associated walkways.

If this is a storm drainage issue, then the problem can be addressed in other ways. For example, one can do a storm water balance calculation, and then require that additional runoff measures by the development so that the storm water can be contained on the site (for example, by using a drywell).

If this is an ambient temperature issue, this can be addressed in other ways such as using different materials for patios and walkways and adopting a color scheme for roof tops and hard surfaces.

There are other concerns which are more detailed and we would like to discuss further with you.

But the legislation's restriction is just as likely to restrict with no real gain on either issue. There are other, more scientific ways to address storm water and ambient temperature matters without the blunt fifty-percent rule. Our Association's engineers stand ready to work with the Council to come forward with more scientific methods to reach its goals.

SWIM Coalition

Stormwater Infrastructure Matters

Written Testimony of the Stormwater Infrastructure Matters (SWIM) Coalition for the New York City Council Committee on Resiliency and Waterfronts Public Hearing on Int 0962-2018 February 8, 2021

Sent via email to testimony@council.nyc.gov

Thank you for the opportunity to provide public comment on NYC City Council Intro 962 (Int. 0962-2018), regarding NYC building code in relation to revisions to "limit allowed amount of impermeable area of zoning lots."

Stormwater Infrastructure Matters (SWIM) Coalition is a group of 70 organizations dedicated to ensuring swimmable and fishable waters around New York City through natural, sustainable stormwater management practices. The below comments reflect our Steering Committee's comments on Intro 962.

SWIM Coalition's Steering Committee recognizes that the complexities inherent in incentivizing the reduction of impervious surfaces in New York City to maximize infiltration of stormwater and reduce the incidence of combined sewer outfalls cannot be encapsulated in one building code revision. Our primary recommendation is that this and other proposed building and zoning code revisions be pursued in conjunction with the City's forthcoming 2021 Unified Stormwater Rule, to ensure a comprehensive and transdisciplinary review of these complex issues.

The language of Intro 962 focuses on exceptions, and simplifies the issues into regulations that we believe will not lead to broad impact and implementation. The text of such a proposed code change would be best proposed as a full appendix to the NYC Construction Codes, including definitions of perviousness, permeability, vegetated surfaces and other key terms; what materials constitute impervious and pervious surfaces, how these regulations are connected to the City's stormwater rules, and examples of what systems can mitigate permeability (e.g. bioswales, rain gardens, etc). We also recommend that the text is further refined and expanded to limit exemptions, account for site soil and hydrological conditions, and better align with the stated intent of the bill. Specifically, the following areas should be addressed:

- Under the definition of "maximum impermeability factor" in section BC A101.1, subsection two does not specify whether a lot is developed or undeveloped. This lack of clarity can lead to the "grandfathering in" of currently vacant, underutilized, or undeveloped lots that are paved and impervious.

- While surface conditions are included in this rule change, there is no consideration for sub-surface conditions and stormwater management strategies. This proposed code section should make

references to water detention and retention systems, soil conditions, and relevant NYC Construction Code sections. References to relevant NYC Stormwater Rules and NYC DEP regulations shall also be included.

- Exception 1 under section BC A101.2 holds F-1 and F-2 Use Groups exempt from the 50% maximum impervious area rule. As designated in Chapter 3 of the 2014 NYC Building Code (BC 306), these Use Groups include factory and industrial uses, but do not include use and storage of designated hazardous materials. All else being equal, these Use Groups include large waterfront sites and reinforced concrete buildings with large footprints, which provide some of the best opportunities for climate adaptive coastal green infrastructure, living shoreline, and intensive green roof retrofits in The City. We recommend that a more nuanced exception is listed here, or to remove F uses from this Exception.

- Exception 2 appears arbitrary, as perviousness does not by default correlate to vegetative surfaces, nor to the need for sun exposure. If this Exception is to be kept, it more narrowly defined to ensure that it is describing shading percentages on the incident vegetated surfaces (roof surfaces included) of a proposed development.

Thank you for the opportunity to provide public comment on the proposed Intro 962. We look forward to continuing a productive dialogue on this subject in the months ahead and would be happy to meet with appropriate staff to discuss our recommendations. We can be reached via email at swimmablenyc@gmail.com

Testimony of New York Coalition of Code Consultants (NYCCC) regarding Introduction 962-A 2020

February 8, 2021

Good morning Council Member Cornegy and Members of the New York City Council Committee on Housing and Buildings. My name is Laura Rothrock and I am providing testimony on behalf of the New York Coalition of Code Consultants, also known as NYCCC. NYCCC is a non-profit trade organization whose members specialize in securing construction and development approvals from municipal agencies, as well as building code and zoning consulting. I am testifying today in opposition to Intro 962-A, which would limit the allowed amount of impermeable area of zoning lots.

As currently drafted, the proposed law would limit development of new zoning lots to 50% of the total area. This is contrary to the zoning law which stipulates lot coverage and in many cases allows developments to be greater than 50% lot coverage, up to 100% for some sites.

While we understand the importance of permeable surfaces and their positive environmental impact, this proposed legislation is extreme. New York City may be a concrete jungle, but residents also live sustainability through dense housing, and take advantage of walkability, proliferating bike lanes and public transportation. There are ways to encourage more sustainable development without completely stifling new construction opportunities.

Should the law be accepted as drafted, it would do irreparable harm to future development in the city including housing and affordable housing. Our city is in a crisis and we will need to encourage new development, not completely restrain it, as part of our economic recovery.

We thank you for your consideration.

NEW YORK STATE WATER RESOURCES INSTITUTE
Department of Biological & Environmental Engineering
B60 Riley-Robb Hall, Cornell University
Ithaca, NY 14853-5701
t 607.254.7163 | f 607.255.4449 | nyswri@cornell.edu

Written Testimony of the New York State Water Resources Institute
Before the New York City Council Committee on Housing and Buildings and the
New York City Council Committee on Resiliency and Waterfronts
Regarding Intro 566 and Intro 962

February 8, 2021

The New York State Water Resources Institute respectfully submits the following written statement to provide the council with scientific input regarding Intro 566 and Intro 962.

The New York State Water Resources Institute ("WRI"), based at Cornell University, is a federally and state-mandated institution formed to advance water resource management and to address critical water resource problems in New York State. WRI conducts and funds research, provides technical support to communities and institutions, trains undergraduate and graduate students, and coordinates outreach and education programs across the state. Over the past decades, WRI—in collaboration with academics and practitioners across the state and country—has done significant work on flood hazards, especially given the critical and ongoing threat of climate and ecological change. WRI thanks council for the opportunity to provide this testimony.

Intro 566: Given the significant and persistent inequities in access to flood insurance (Finch et al. 2010), a free elevation certificate program could be an important step in making flood insurance more accessible to low-to-moderate income households. Research has shown that flood vulnerability is not equally distributed across socioeconomic factors, with lower income and BIPOC communities often disproportionately vulnerable to flooding due both to increased exposure to flooding and decreased capacity to deal with its impacts (Cutter et al. 2009, Cutter 2012). Flood insurance increases homeowner's capacity to recover from flooding, but less than half of homeowners in flood zones are insured (Kriesel et al. 2004). Free elevation certificates reduce barriers to participation in flood insurance programs, while still allowing for risk-based premiums (Michel-Kerjan & Kunreuther 2011). Elevation certificates in the New York City region are valued at $800 to $1,000 and can lower a homeowner's premiums in a high-risk flood zone by more than 50% (Dixon et al. 2017).

While likely helpful, a free elevation certificate program alone is insufficient given New York City's significant and escalating flood risk (Garner et al. 2017, DeGaetano & Castellano 2017). Nor would the program mitigate the effects of increasing flood insurance burdens on low-income homeowners (Dixon et al. 2017, Elliott 2019).

Intro 962: Reducing impervious cover reduces peak runoff and, in turn, pluvial flooding (Schuster et al. 2005, Du et al. 2015) and can reduce urban heat island effects if a green infrastructure approach is employed (Takebayashi & Moriyama 2007, Susca et al. 2011). Therefore, this measure may have positive impacts on stormwater management and could help promote urban design with secondary benefits.

That said, New York City is approximately 60% impervious surfaces already (MacFaden et al. 2012), suggesting that limiting new development to 50% impermeability may not meaningfully reduce flooding. Additionally, much of the catastrophic flooding in New York City is forecasted to come from storm surge (Lin et al. 2010, Rahmstorf 2017). While there are compounding effects of rainfall and storm surge on flooding (Wahl et al. 2015), it is not likely that reducing impervious cover alone will significantly mitigate storm surge flooding.

While we endeavor to scientifically evaluate the pros and cons of each of these bills, we stress that it is difficult to evaluate their utility without accounting for the broader context of New York City and New York State's approach to flood risk management, climate adaptation, and environmental justice. Generally speaking, given the significant challenges New York City faces with respect to flooding, we feel it would be prudent to:

- monitor the impacts of these laws within a framework of adaptive management,
- encourage the incorporation of green infrastructure and ecological restoration in site design where appropriate,
- closely consult with the populations these laws are most likely to impact, especially the most vulnerable and marginalized, and
- continue to take a broad, research-informed view of flood risk reduction in New York City that incorporates the risks of flooding from multiple drivers and reduces inequities in flood vulnerability.

WRI thanks council for the opportunity to provide this testimony and urges council to continue advancing work that is grounded in scientific knowledge and that upholds the principles of climate and environmental justice.

Kristen Hychka, New York State Water Resources Institute
James Knighton, University of Connecticut
Ingrid Vianna Sydenstricker, New York State Water Resources Institute
Brian Gramlich Rahm, New York State Water Resources Institute

Literature Cited:

Cutter, S. L. (2012). Hazards vulnerability and environmental justice. Routledge.

Cutter, S. L., Emrich, C. T., Webb, J. J., & Morath, D. (2009). Social vulnerability to climate variability hazards: A review of the literature. Final Report to Oxfam America, 5, 1-44.

DeGaetano, A. T., & Castellano, C. M. (2017). Future projections of extreme precipitation intensity-duration-frequency curves for climate adaptation planning in New York State. Climate Services, 5, 23-35.

Dixon, L., Clancy, N., Miller, B. M., Hoegberg, S., Lewis, M. M., Bender, B., Ebinger S., Hodges M., Syck G.M., Nagy C, & Choquette, S. R. (2017). The cost and affordability of flood insurance in New York City. Santa Monica, CA: RAND Corporation.

Du, S., Shi, P., Van Rompaey, A., & Wen, J. (2015). Quantifying the impact of impervious surface location on flood peak discharge in urban areas. Natural Hazards, 76(3), 1457-1471.

Elliott, R. (2019). 'Scarier than another storm': values at risk in the mapping and insuring of US floodplains. The British journal of sociology, 70(3), 1067-1090.

Finch, C., Emrich, C. T., & Cutter, S. L. (2010). Disaster disparities and differential recovery in New Orleans. Population and environment, 31(4), 179-202.

Garner, A. J., Mann, M. E., Emanuel, K. A., Kopp, R. E., Lin, N., Alley, R. B., ... & Pollard, D. (2017). Impact of climate change on New York City's coastal flood hazard: Increasing flood heights from the preindustrial to 2300 CE. Proceedings of the National Academy of Sciences, 114(45), 11861-11866.

Kriesel, W., & Landry, C. (2004). Participation in the National Flood Insurance Program: An empirical analysis for coastal properties. Journal of Risk and Insurance, 71(3), 405-420.

Lin, N., Emanuel, K. A., Smith, J. A., & Vanmarcke, E. (2010). Risk assessment of hurricane storm surge for New York City. Journal of Geophysical Research: Atmospheres, 115(D18).

MacFaden, S. W., O'Neil-Dunne, J. P., Royar, A. R., Lu, J. W., & Rundle, A. G. (2012). High-resolution tree canopy mapping for New York City using LIDAR and object-based image analysis. Journal of Applied Remote Sensing, 6(1), 063567.

Michel-Kerjan, E., & Kunreuther, H. (2011). Redesigning flood insurance. Science, 333(6041), 408-409.

Rahmstorf, S. (2017). Rising hazard of storm-surge flooding. Proceedings of the National Academy of Sciences, 114(45), 11806-11808.

Shuster, W. D., Bonta, J., Thurston, H., Warnemuende, E., & Smith, D. R. (2005). Impacts of impervious surface on watershed hydrology: A review. Urban Water Journal, 2(4), 263-275.

Susca, T., Gaffin, S. R., & Dell'Osso, G. R. (2011). Positive effects of vegetation: Urban heat island and green roofs. Environmental pollution, 159(8-9), 2119-2126.

Takebayashi, H., & Moriyama, M. (2007). Surface heat budget on green roof and high reflection roof for mitigation of urban heat island. Building and environment, 42(8), 2971-2979.

Wahl, T., Jain, S., Bender, J., Meyers, S. D., & Luther, M. E. (2015). Increasing risk of compound flooding from storm surge and rainfall for major US cities. Nature Climate Change, 5(12), 1093-1097.