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**THE COUNCIL OF THE CITY OF NEW YORK**

BRIEFING PAPER OF THE INFRASTRUCTURE DIVISION

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**COMMITTEE ON ENVIRONMENTAL PROTECTION**

Hon. James F. Gennaro, Chair

August 16, 2022

Oversight: Sinkholes, Flooding and Heatwaves:

Infrastructure Challenges in the Face of Extreme Weather

**INTRODUCTION**

 On August 16, 2022, the Committee on Transportation and Infrastructure, Chaired by Majority Whip Selvena N. Brooks-Powers; the Committee on Resiliency and Waterfronts, Chaired by Council Member Ari Kagan; and the Committee on Environmental Protection, Chaired by Council Member James F. Gennaro, will conduct a joint hearing titled, “Oversight: Sinkholes, Flooding and Heatwaves: Infrastructure Challenges in the Face of Extreme Weather.” Those invited to testify include representatives from the New York City (NYC) Department of Transportation (DOT), representatives from the NYC Department of Environmental Protection (DEP), representatives from the Mayor’s Office of Climate and Environmental Justice (MOCEJ), transportation advocates, resiliency and environmental advocates, and other interested stakeholders.

**BACKGROUND**

*Many Roadways in the City*

There are over 18,000 lane miles of local streets and 306 lane miles of highway in the five boroughs of the City.[[1]](#footnote-1) The DOT is the agency that is responsible for the maintenance of the local streets. On average, City roads have a useful life of 17 to 18 years.[[2]](#footnote-2) The DOT sets the goal of replacing roughly 1,000 lane miles of roadway every year.[[3]](#footnote-3) Since Fiscal Year (FY) 2014, the City has met or exceeded that goal, with the exception of FY 2021 when only 918 lane miles were resurfaced due to the New York State PAUSE order that was implemented as a result of the COVID-19 pandemic.[[4]](#footnote-4)

*Condition of Roadways in the City*

Each year the City assesses the status of its roads in advance of the annual Mayor’s Management Report (MMR). This assessment ranks each City block as either “good,” “fair,” or “poor” based on the quality of the pavement in a particular area. In the year 2000, 84.3 percent of the City’s roadways were rated in “good” condition, but that percentage fell to 69.3 by 2014.[[5]](#footnote-5) In FY 2021, that percentage rose to 73.6, meaning more than 26 percent of the City’s roadways are currently in “poor” or “fair” condition.[[6]](#footnote-6)

 While resurfacing is one critical component to repairing the City’s roadways, reconstruction of roadway foundations is just as important in order to protect the many utility mains that exist under City streets.[[7]](#footnote-7) There are approximately 7,000 miles of water mains, 98,000 miles of underground electric lines, 4,400 miles of gas mains, over 100 miles of steam pipes, and thousands of miles of telephone and cable television lines.[[8]](#footnote-8) After only reconstructing a total of 55.8 lane miles in FY 2018 and FY 2019, the City has more than doubled that number in recent years.[[9]](#footnote-9) Between FY 2020 and FY 2021, DOT, in conjunction with the Department of Design and Construction (NYCDDC), reconstructed more than 116 lane miles.[[10]](#footnote-10) On average, City roads outlive their useful life by 20 percent before being resurfaced or reconstructed, presenting a source of danger for the period of time between the end of their useful life and resurfacing or reconstruction.[[11]](#footnote-11)

*Jurisdiction Over Cave-Ins*

 DOT engages with the public via the nyc.gov website and 311 to receive reports of potholes, cave-ins, utility damage, and other street surface complaints.[[12]](#footnote-12) DOT defines a pothole as a “hole in the street with a circular or ovular shape and a definable bottom.”[[13]](#footnote-13) Street cave-ins, or sinkholes, as they are commonly referred to, are larger and deeper than potholes.[[14]](#footnote-14) Cave-ins are usually jagged holes with a deep void, and the pavement has cracked apart and fallen into a deep empty space without a solid bottom.[[15]](#footnote-15) According to DOT, cave-ins are typically caused by problems with the underground infrastructure.[[16]](#footnote-16) An article in the Architectural Digest notes that “sinkholes tend to form for two reasons: sections of a street can collapse because of water main breaks (or old pipes giving way) and changes to natural water-drainage patterns.”[[17]](#footnote-17) While DOT is the City agency that may initially investigate reports of cave-ins, they are not responsible for performing the repairs.[[18]](#footnote-18) DOT’s role is to investigate and determine who is responsible for restoring the roadway so that they can refer the complaint to the corresponding City agency or appropriate utility company for follow-up repairs.[[19]](#footnote-19) If it is on City property, then the cave-in repairs fall under the jurisdiction of DEP.[[20]](#footnote-20)

*Frequency of and Response to Cave-Ins*

According to DEP, cave-ins in the City were down 25 percent in 2021.[[21]](#footnote-21) A review of the Preliminary Fiscal 2022 Mayor’s Management Report (2022 PMMR) seems to support that assertion. In FY 2021, DEP received 2,839 street cave-in complaints, down from the 3,098 received in FY 2020 and the 3,769 that were received in FY 2019.[[22]](#footnote-22) The City has attributed this decline to the continued coordination between DOT and DEP to proactively investigate and discover infrastructure defects sooner which allows repairs to be made before a street failure or collapse occurs.[[23]](#footnote-23) However, the data in the 2022 PMMR also reveals that there has been an upward trend in the number of complaints that were received in FY 2022, as the numbers reveal that 1,758 complaints were received during the first four months of FY 2022 as opposed to the 1,255 received during the same time period in FY 2021.[[24]](#footnote-24) Despite this upward trend in the number of cave-in complaints, DEP has improved on the average time it takes to respond to street cave-in complaints to make them safe, taking 1.9 days to respond in FY 2019 down to taking 1.2 days to respond in FY 2020 and then down to taking 0.7 days to respond in FY 2021.[[25]](#footnote-25)

As discussed above, with the exception of the recent upward trend in the number of complaints, the number of cave-in complaints reported to DEP over the last couple of years has declined; however, there have been several high-profile sinkholes that have occurred in various parts of the City during that same timeframe. The most recent one occurred on July 19, 2022 on Radcliff Avenue, in the Morris Park neighborhood of the Bronx.[[26]](#footnote-26) Video images circulated in the press and online show a van being “swallowed” by the sinkhole.[[27]](#footnote-27) While DEP is still investigating the collapse and has not released its findings on what caused the ground to buckle, a spokesperson for the agency indicated on the day of the incident that the “weather certainly could have played a part” in causing it.[[28]](#footnote-28) Prior to the collapse of the sinkhole on Radcliff Avenue, the City had experienced torrential rainfalls that caused flooding throughout the five boroughs, with reports indicating that the Bronx had been the hardest hit region.[[29]](#footnote-29) The heavy rains caused flooding in some subway stations, the West Side Highway, and the Major Deegan Expressway, causing subway service disruptions and traffic delays.[[30]](#footnote-30) Another sinkhole occurred on June 21, 2022 on 89th Street between Central Park West and Columbus Avenue on the Upper West Side of Manhattan.[[31]](#footnote-31) Reports indicated that gas service had to be shut off to about 25 local residents after a DEP truck fell into the sinkhole and damaged a gas line.[[32]](#footnote-32)

During the summer of 2021, there were two sinkholes that formed in Manhattan within the span of one week.[[33]](#footnote-33) The first one occurred on July 11, 2021 on Riverside Drive near the intersection of 97th Street on the Upper West Side.[[34]](#footnote-34) Online images of the collapsed roadway show two cars that had partially fallen into the sinkhole.[[35]](#footnote-35) The second sinkhole occurred on East 89th Street between York Avenue and East End Avenue on the Upper East Side.[[36]](#footnote-36) This particular sinkhole caused local water outages and was described as being 20 feet deep and measuring 15 feet by 15 feet.[[37]](#footnote-37) While an official cause for these two sinkholes is not readily available, there were reports at the time that the cause of the sinkhole on East 89th Street could have been related to a 12-inch water main and a six-inch sewer line.[[38]](#footnote-38) However, it is worthwhile to note that a couple of days prior to the first sinkhole appearing on the Upper West Side, Tropical Storm Elsa had inundated the City with heavy rainfall, causing flooding along streets.[[39]](#footnote-39)

Much of the City’s underground infrastructure is old and fragile, with the average age of water mains being an astonishing 66 years old.[[40]](#footnote-40) When these water mains break and leak, they weaken the area beneath a street.[[41]](#footnote-41) Heavy storms can also accelerate a water main’s decay.[[42]](#footnote-42) Additionally, CNN reports that climate scientists have warned that extreme rainfall events will occur with increasing frequency and intensity and states that the infrastructure in many places, including the City, was never built to withstand the effects of climate change and severe weather.[[43]](#footnote-43) CNN also cites a recent United Nations climate report stating that “the frequency and intensity of heavy precipitation events have increased since the 1950s over most land area.”[[44]](#footnote-44) [[45]](#footnote-45)

*Increase in Flooding in the City*

A report by the National Oceanic and Atmospheric Administration (NOAA) forecasts that by 2100, “[H]igh tide flooding will occur ‘every other day’ (182 days/year) or more often in the Intermediate Low Scenario within the Northeast and Southeast Atlantic ….”[[46]](#footnote-46) This report also projects that the low- and high-end estimates of high tide flood frequency along the coast of the Northeast Atlantic “will reach on average about 235 and 365 days/year (with 95 and 100% from tides),” respectively.[[47]](#footnote-47) The City’s waterfront communities face significant threats from extreme weather events and high tides, and projections show that these communities will experience greater and more frequent damage because of climate-related weather events and sea level rise. Neighborhoods such as Broad Channel, Howard Beach, Hamilton Beach,[[48]](#footnote-48) Rosedale, Far Rockaway, Coney Island, Stapleton, Arrochar, and Midland Beach (where eight New Yorkers drowned in Sandy’s floodwaters)[[49]](#footnote-49) already regularly experience tidal inundation,[[50]](#footnote-50) a trend that will likely only be exacerbated by continued sea level rise.

Urban areas are also highly susceptible to pluvial flooding, which is flooding caused by rainfall.[[51]](#footnote-51) Concrete surfaces that exist throughout the City exacerbate this problem, and sea barriers and coastal defenses put in place to protect against coastal storm surge will not solve flooding caused by heavy rainfall events.[[52]](#footnote-52) Timon McPhearson, a member of the New York City Panel on Climate Change (NPCC) and a researcher of urban climate resiliency at the New School, stated that “[t]he way we’ve developed New York City has caused the flood problem.”[[53]](#footnote-53)

*Disproportionate Impacts of Flooding on Low-Income and Minority Communities*

As flooding from climate change worsens, urban flooding’s disproportionate impact on minority and low-income communities is a major specific concern. The most vulnerable residents, those who live in flood-prone areas with little green space to absorb the floodwaters, are often poor and members of minority groups.[[54]](#footnote-54) According to a study led by researchers at the University of Arizona, people who are Black, Hispanic or of low-income are more likely to live in areas at high risk from flooding from natural disasters.[[55]](#footnote-55) Further, according to Sam Brody, a flood expert at Texas A&M University, “[u]rban flooding is a growing source of significant economic loss, social disruption and housing inequality.”[[56]](#footnote-56) As reported by the Scientific American, a March 2019 report of the National Academies of Sciences, Engineering and Medicine concluded that storms do indiscriminately affect all residents – rich and poor; however, “[T]he capacity to respond to and recover from flooding is much lower in socially vulnerable populations that even in the best of times are struggling to function.”[[57]](#footnote-57)

*Future Storms and Flooding Events*

 Global warming is expected to cause sea level rise and storms to intensify in the City.[[58]](#footnote-58) A study by climate experts predicts that over the next 300 years, there will be higher seas, larger storm surges and more frequent and intense hurricanes.[[59]](#footnote-59) In today’s warmer climate, 7.5-foot floods are projected to happen every 25 years, as opposed to 7.5 foot floods occurring only a few times per millennium in the past.[[60]](#footnote-60) Predictions state that by 2030, these floods will occur every five years.[[61]](#footnote-61) Flooding from rainstorms is not a new phenomenon. However, the frequency and intensity of such events is new.[[62]](#footnote-62) Additionally, such flooding tends to be localized – low-lying areas that typically experience coastal flooding may not flood during a heavy precipitation event that is concentrated in another area of the City.

*Storms – The City’s Stormwater Flood Plan*

Local Law 172 of 2018 requires the City to produce maps showing flood vulnerability linked to the anticipated effects of climate change, to update these maps at least every four years, and to publish a long-term flood vulnerability plan to prevent or mitigate such flooding.[[63]](#footnote-63) Published in May of 2021, the current iteration of the City’s Stormwater Resiliency Plan notes that the City is expected to experience 25% more rainfall by the end of the century, and includes four goals intended to optimize emergency response to rainfall events and to ensure that City investments take climate risk into consideration.[[64]](#footnote-64) The goals include public outreach regarding flood vulnerability from extreme rain, updated flash flood response procedures prioritizing response in areas known to be vulnerable, advancing policies that reduce urban flooding and research pertaining to future risk, and leveraging stormwater investments to address future flood risk from rain and sea level rise.[[65]](#footnote-65)

In May of 2021, the City released preliminary stormwater flood maps, aimed at helping City residents understand their local risk of rainfall-based flooding.[[66]](#footnote-66) [[67]](#footnote-67) Residents in high-risk areas are encouraged to make emergency evacuation plans, learn the safest route from their location to high ground, and stay informed via the Notify NYC system or calling 311.[[68]](#footnote-68) The preliminary stormwater maps show wide swaths of extreme flood risk across Queens, northeast Bronx, South Brooklyn and waterfront neighborhoods in Staten Island, in the event of a storm projected to drop 3.5 inches of rain in one hour.[[69]](#footnote-69) To mitigate the risks of flooding during intense rain events, the City uses a mix of both “gray” infrastructure resources aimed at reducing combined sewer overflows and flooding, as well as “green” infrastructure assets such as rain gardens and Bluebelt natural drainage networks aimed at allowing more rainwater to infiltrate naturally into the ground before reaching the sewage system.[[70]](#footnote-70) To this end, the City has constructed new high level storm sewers; expanded Bluebelt networks in Queens and the Bronx after successful implementation in Staten Island; designed 10,000 distributed green infrastructure assets; issued new stormwater retention and detention guidelines for new and redeveloped properties aimed at restricting the volume and rate of stormwater draining into sewer systems; incentivized grant funding for green roofs and large-scale retrofit programs; and planned approximately $2 billion of comprehensive drainage system improvements in southeast Queens, which currently lacks fully built out storm sewer infrastructure.[[71]](#footnote-71) On March 9, 2022, Mayor Eric Adams announced the completion of a $50 million sewage and water main renovation in southeast Queens to alleviate flooding that has plagued the area for decades.[[72]](#footnote-72) The project includes six miles of new sewers and water mains and 55 new catch basins in Rochdale.[[73]](#footnote-73)

*Storms – The City’s Climate Resiliency Design Guidelines*

In March 2021, the City Council passed Local Law 41, which requires the Mayor’s Office of Long-Term Planning and Sustainability (OLTPS) to develop climate resiliency design guidelines, pursuant to a pilot program, for City capital projects.[[74]](#footnote-74) OLTPS, in consultation with other City agencies and members of the public with expertise in climate resiliency, climate design and the built environment, would also use the climate resiliency design guidelines to develop a climate resiliency score metric for capital projects, and future such projects would be required to meet certain scores. Such score would account for flooding risk, energy efficiency, energy resilience and on-site water capture and management.

*Storms – The Citywide Climate Adaptation Plan*

In October 2021, the City Council passed Local Law 122, which requires OLTPS, or another office or agency designated by the Mayor, to develop and make available to the public on its website a comprehensive citywide climate adaptation plan.[[75]](#footnote-75) This plan, which the Administration must reevaluate and publish every 10 years, will consider climate hazards such as extreme storms, sea level rise, tidal flooding, extreme heat, extreme precipitation, extreme wind, wild fire and flooding surge events associated with a storm. It will also include recommendations for resiliency and adaptation measures to protect residents, property and infrastructure in the City; identify areas that are highly vulnerable to climate hazards to help determine where resiliency and adaptation measures should first be implemented; and consider the potential impact of such measures on environmental justice areas. The first plan is expected to be released by September 30, 2022.

*Storms – The City’s Neighborhood Coastal Flood Protection Project Planning Guidance*

After the passage of these bills, in December 2021, the then-Mayor’s Office of Climate Resiliency released its “Neighborhood Coastal Flood Protection Project Planning Guidance (Version 1.0)” to provide guidance for initial concept planning, feasibility and design stages for coastal flood protection projects throughout the City.[[76]](#footnote-76) The purpose of this guidance document is “to guide the development of a particular neighborhood-based coastal protection approach” and to “creat[e] consistency and standardization” of coastal protection projects to ensure that such projects “meet the City’s resiliency goals” – specifically that they are equitable, resilient and well-designed.[[77]](#footnote-77)

*Storms – Rainfall Ready NYC Action Plan*

 On July 7, 2022, Mayor Eric Adams, along with DEP and NYC Emergency Management, released the Rainfall Ready NYC action plan (Action Plan) to prepare City government and residents for more extreme rainfall in the future.[[78]](#footnote-78) The Action Plan includes actions the City will take to plan and prepare for storms, steps residents should take to plan and prepare for storms and approaches for how the City and its residents can recover after a storm.[[79]](#footnote-79) Specifically, the Action Plan encourages New Yorkers to use new interactive stormwater flood maps to understand the likelihood of flooding on one’s block and to make a plan to get to higher ground if needed, inspect chronic flooding locations and clear debris from catch basins in at-risk locations prior to predicted storms, and deploy barriers to protect low-lying areas.[[80]](#footnote-80) The Action Plan also expands FloodNet, a network of street flooding sensors designed to better understand the frequency, severity and impacts of flooding in the City.[[81]](#footnote-81) The sensors will be installed in the most vulnerable areas for real-time data collection during severe weather events.[[82]](#footnote-82) Sandbags and flood barriers will also be provided by DEP to residents in areas vulnerable to flooding.[[83]](#footnote-83)

*Storms – Inflatable Dams*

 In July, shortly after the start of the 2022 Atlantic hurricane season, DEP began distributing inflatable dams and sandbags to residents whose homes are in areas prone to flooding during rainstorms.[[84]](#footnote-84) The inflatable dams can be placed in an interlocking row across the entrance to the driveways of residents’ homes.[[85]](#footnote-85) In July 2022, DEP stated that approximately 25,000 inflatable dams were available for residents to pick up at distribution points across the City.[[86]](#footnote-86) Residents will also have access to as many sandbags as they need to protect their homes from flooding.[[87]](#footnote-87) This initiative will cost the City approximately $2.5 million.[[88]](#footnote-88)

*Storms – The New York-New Jersey Harbor and Tributaries Focus Area Feasibility Study*

The New York-New Jersey Harbor and Tributaries Focus Area Feasibility Study (HAT Study) is a coastal storm risk management study covering the New York-New Jersey Harbor (“Harbor”) and tidally affected tributaries encompassing all of the City the Hudson River to Troy; the Lower Passaic, Hackensack, Rahway, and Raritan Rivers; the Upper and Lower Bays of New York Harbor; the bays of Newark, Jamaica, Raritan and Sandy Hook; the Kill Van Kull, Arthur Kill and East River tidal straits; and the western Long Island Sound.[[89]](#footnote-89) The HAT Study began in 2016 and is one of nine studies that were recommended by the Unites States Army Corps of Engineers (USACE) 2015 North Atlantic Coast Comprehensive Study to manage future potential coastal storm risks facing the region – including those from predicted sea level rise and extreme weather events – by developing possible means of preventing the loss of human lives and damages to property.[[90]](#footnote-90)

The intent of the HAT Study was to propose a comprehensive plan for managing such risks, and the study is a necessary precursor to beginning any federally funded Harbor-wide resiliency projects.[[91]](#footnote-91) However, federal funding was halted in 2020, curtailing any work on the HAT Study, including public meetings and engagements, which also postponed any published reports regarding the HAT Study.[[92]](#footnote-92) In addition, the Notice of Intent issued for the HAT Study was withdrawn.[[93]](#footnote-93)

In April 2021, USACE was approved for additional study time by the Senior Official on behalf of the Office of the Assistant Secretary of the Army for Civil Works, and federal funding was included in the Biden’s administration’s Fiscal Year 2022 budget, allowing for work on the HAT Study to resume in October of 2021.[[94]](#footnote-94) On July 26, 2022, a Tentatively Selected Plan milestone meeting was held between USACE, the New York State Department of Environmental Conservation, the New York State Department of State, the New Jersey Department of Environmental Protection and the City (represented by MOCEJ).[[95]](#footnote-95) A Notice of Intent for preparing a HATS Tier 1 Environmental Impact Statement (EIS) is now under development and is planned for release shortly, with public review to follow.[[96]](#footnote-96) After federal, state and local agencies review a draft Feasibility Report and draft HATS Tier 1 EIS, USACE will develop a Final Feasibility Report and Final Tier 1 EIS to develop the HAT Study’s final product, the Chief of Engineer’s Report, which is scheduled to be released on or before June 15, 2024.[[97]](#footnote-97)

*Heat Waves*

Temperatures have been rising more rapidly over the last century, and one in 10 Americans are currently living in rapidly heating regions, including the City.[[98]](#footnote-98) Heat waves in the City are exacerbated by the Urban Heat Island (UHI) effect, a phenomenon in which urban areas experience higher temperatures than surrounding suburban and rural areas.[[99]](#footnote-99) Heat islands develop from the replacement of vegetation with asphalt and concrete, which absorb rather than reflect heat.[[100]](#footnote-100) Heat islands can increase energy demand, air conditioning costs, air pollution, greenhouse gas (GHG) emissions and heat-related illness and deaths.[[101]](#footnote-101) According to a study by the University of Maryland published in 2019, temperatures in the City will be up to 5℃ warmer, with a climate similar to Jonesboro, Arkansas, by 2080.[[102]](#footnote-102)

Urban areas can be up to 5.4 degrees Fahrenheit warmer during the day and up to 22 degrees Fahrenheit hotter at night than surrounding rural and suburban areas, affecting City residents’ quality of life and the City’s infrastructure.[[103]](#footnote-103) For example, buildings retain heat overnight, which prevents people from sleeping well; air pollution can be worse on hotter days and that may lead to respiratory problems; and warmer conditions may also lead to heavy rainfall, causing flooding.[[104]](#footnote-104)

Over the last decade, the City has experienced some of its hottest summer months ever recorded,[[105]](#footnote-105) and heat waves like the one that hit the City this past July, which was projected as the longest heat wave in the City since 2013,[[106]](#footnote-106) are expected to become more frequent. The NPCC predicts that heat waves, which it defines pursuant to the National Weather’s definition of heat waves as three or more days with temperatures at or above 90 degrees Fahrenheit, will become longer, hotter and more frequent, especially in areas where the UHI effect is present, like many areas in the City.[[107]](#footnote-107) The NPCC also predicts that based on the 25th and 75th percentile of climate model outcomes, in the 2020s the City will experience two to four heat waves per year, with each heat wave lasting four to six days (average number).[[108]](#footnote-108) Furthermore, the NPCC predicts that based on the 75th percentile of climate model outcomes, by the 2050s and in comparison to the 2020s, there will be one additional heat wave per year (average number) and more than 1.5 times the number of days above 90 degrees Fahrenheit per year (average number)s.[[109]](#footnote-109)

According to the Center for Disease Control and Prevention, an average of 13 City residents died each year from heat-related illnesses between 2000 and 2011.[[110]](#footnote-110) In July of 2022, four deaths were attributed to extreme heat across the City.[[111]](#footnote-111) Heat wave deaths occur primarily among people from poorer neighborhoods and with underlying health conditions.[[112]](#footnote-112) However, some studies indicate that official numbers may be much lower than the actual number of heat-related deaths because of differences in how a “hot day” is defined.[[113]](#footnote-113) Excess heat can also significantly increase incidences of heart attacks, strokes and fatal respiratory conditions, which may not necessarily be recorded as heat-related fatalities, further complicating accurate record-keeping.[[114]](#footnote-114) The City reports an average of 115 excess heat-related deaths, 150 heat-related hospitalizations, and 450 heat-related emergency department visits each year.[[115]](#footnote-115) With rising temperatures because of climate change, the risk of extreme heat waves will become more acute each year.[[116]](#footnote-116)

Public health experts are warning that the COVID-19 pandemic could make heat waves much deadlier, with a disproportionate effect on elderly and low-income residents, many of whom are less likely to have or use air conditioning units.[[117]](#footnote-117) Also, the elderly and those with underlying health conditions are urged to stay at home because of COVID-19. However, “the people who need to stay home the most are in the greatest danger of dying there during a heat wave.”[[118]](#footnote-118) Furthermore, new data released on the number of cases and deaths by zip code show a worrying overlap between the neighborhoods most affected by COVID-19 and those that lost power in the summer of 2019.[[119]](#footnote-119)

In recent years in the City, over 80 percent of heat-related deaths occurred in homes without air conditioning.[[120]](#footnote-120) A recent study published by the office of the City Comptroller Brad Lander also exposed significant inequities in City residents’ access to cooling centers, noting that East Flatbush, Elmhurst, Corona, Kingsbridge Heights, Bedford, Kew Gardens, Woodhaven, Crown Heights, Prospect Heights, Borough Park, South Crown Heights, Lefferts Gardens, Bedford Stuyvesant, Fordham and University Heights, and Highbridge and Concourse were neighborhoods that despite having the highest level of heat vulnerability (Highest Heat Vulnerability (HVI) 4 and 5) were served by the lowest number of cooling centers per 100,000 people.[[121]](#footnote-121) Additionally, nearly half of the City’s activated cooling centers were senior centers, which prohibit use by individuals under 60 years old.[[122]](#footnote-122) Barring children and younger adults from half of all available cooling centers also creates significant barriers for older adults who provide childcare and for intergenerational families seeking to access cooling centers together.[[123]](#footnote-123) Of the 254 cooling centers serving older people, 56 percent did not offer extended hours and 22 percent were not wheelchair accessible.[[124]](#footnote-124) Citywide, 16 percent of total cooling centers were not wheelchair accessible.[[125]](#footnote-125)

Extreme heat also has significant deleterious effects on the City’s built environment, with high temperatures putting stress on bridge infrastructure via thermal expansion of bridge joints and paved surfaces; and accelerated deterioration of steel, asphalt, protective cladding, coats and sealants.[[126]](#footnote-126) Extreme heat can soften asphalt pavement, potentially leading to permanent deformation of road surfaces, and can cause the migration of liquid asphalt, which further affects structural stability.[[127]](#footnote-127) In addition to spiking demand for electricity due to increased air conditioner usage, extreme heat can affect the generation and transmission of electricity, reducing the power output of peaking generation sources like gas turbines, which are less efficient at generating electricity as the density of air decreases, and affecting photovoltaic solar cells, which lose efficiency at high air temperatures.[[128]](#footnote-128) Transmission infrastructure is also negatively affected by heat, as wires can sag from excess thermal expansion, increasing the likelihood of unintended contact with surrounding obstacles, which can lead to short circuits and fires.[[129]](#footnote-129) Overheated lines are also less efficient at maintaining a steady voltage, which can further overburden the power grid, which requires steady voltages.[[130]](#footnote-130)

*Conclusion*

During today’s hearing, the Committees will seek to get an update from the Administration on the state of the City’s infrastructure as it relates to the ever-increasing severity of storms and heat waves. The hearing will also give Council Members and members of the public – especially those recently affected in the Bronx – a chance to specifically question the Administration regarding its efforts to prevent and mitigate sinkholes and other road collapses caused by severe storms.

1. *See* Center for an Urban Future, Caution Ahead (2014), available at <http://nycfuture.org/pdf/Caution-Ahead.pdf> [↑](#footnote-ref-1)
2. *Id.* [↑](#footnote-ref-2)
3. *Id.*  [↑](#footnote-ref-3)
4. City of New York, Mayor’s Management Report (2021) available at <https://www1.nyc.gov/assets/operations/downloads/pdf/mmr2021/2021_mmr.pdf> [↑](#footnote-ref-4)
5. City of New York, Mayor’s Management Report (2014) available at <https://www1.nyc.gov/assets/operations/downloads/pdf/mmr2014/2014_mmr.pdf> [↑](#footnote-ref-5)
6. City of New York, Mayor’s Management Report (2021) available at <https://www1.nyc.gov/assets/operations/downloads/pdf/mmr2021/2021_mmr.pdf> [↑](#footnote-ref-6)
7. *See* Center for an Urban Future, Caution Ahead (2014), available at <http://nycfuture.org/pdf/Caution-Ahead.pdf> [↑](#footnote-ref-7)
8. James Barron, “Water Mains Are Bursting All Over New York. Can They Be Fixed?” The New York Times, Updated Feb. 13, 2020, available at <https://www.nytimes.com/2020/02/12/nyregion/nyc-water-mains.html#:~:text=But%20much%20of%20New%20York's,boomers%20born%20when%20Dwight%20D> [↑](#footnote-ref-8)
9. City of New York, Mayor’s Management Report (2021) available at <https://www1.nyc.gov/assets/operations/downloads/pdf/mmr2021/2021_mmr.pdf> [↑](#footnote-ref-9)
10. *Id.* [↑](#footnote-ref-10)
11. *See* Center for an Urban Future, Caution Ahead (2014), available at <http://nycfuture.org/pdf/Caution-Ahead.pdf> [↑](#footnote-ref-11)
12. 311 Portal, *Pothole or Cave-In on Street,* <https://portal.311.nyc.gov/article/?kanumber=KA-01093> (*last accessed April 7, 2022*) [↑](#footnote-ref-12)
13. *See* NYC DOT Customer Service at <https://www1.nyc.gov/html/dot/html/contact/customer-service.shtml> [↑](#footnote-ref-13)
14. *See* NYC DOT Customer Service at <https://www1.nyc.gov/html/dot/html/contact/customer-service.shtml> [↑](#footnote-ref-14)
15. *Id.* [↑](#footnote-ref-15)
16. *Id.*  [↑](#footnote-ref-16)
17. Jessica Cherner, *“What’s the Deal With All of Those City-Center Sinkholes,”* Architectural Digest, July 19, 2021 available at <https://www.architecturaldigest.com/story/new-york-city-sinkholes> [↑](#footnote-ref-17)
18. 311 Portal, *Pothole or Cave-In on Street,* <https://portal.311.nyc.gov/article/?kanumber=KA-01093> [↑](#footnote-ref-18)
19. *Id.*  [↑](#footnote-ref-19)
20. *See* NYC DOT Customer Service at <https://www1.nyc.gov/html/dot/html/contact/customer-service.shtml> [↑](#footnote-ref-20)
21. Jessica Cherner, “*What’s the Deal With All of Those City-Center Sinkholes*,” Architectural Digest, July 19, 2021 available at <https://www.architecturaldigest.com/story/new-york-city-sinkholes> [↑](#footnote-ref-21)
22. City of New York, Mayor’s Management Report, Preliminary Fiscal 2022, p.240, available at <https://www1.nyc.gov/assets/operations/downloads/pdf/pmmr2022/2022_pmmr.pdf> [↑](#footnote-ref-22)
23. City of New York, Mayor’s Management Report (2021), p.339, available at <https://www1.nyc.gov/assets/operations/downloads/pdf/mmr2021/2021_mmr.pdf> [↑](#footnote-ref-23)
24. City of New York, Mayor’s Management Report, Preliminary Fiscal 2022, p.240, available at <https://www1.nyc.gov/assets/operations/downloads/pdf/pmmr2022/2022_pmmr.pdf> [↑](#footnote-ref-24)
25. *Id.* [↑](#footnote-ref-25)
26. Eyewitness News, WABC-TV, “Crews work to repair giant sinkhole that swallowed Bronx van,” July 19, 2022, available at <https://abc7ny.com/nyc-sinkhole-bronx-weather-van-into/12060415/> [↑](#footnote-ref-26)
27. *Id.* [↑](#footnote-ref-27)
28. *Id.* [↑](#footnote-ref-28)
29. David Lazar and Patrick Adcroft, *“Day after torrential rains and flooding, subways resume normal service,”* NY1, Updated on July 20, 2022, available at <https://www.ny1.com/nyc/all-boroughs/weather/2022/07/18/parts-of-city-experienced-heavy-flooding-monday-afternoon> [↑](#footnote-ref-29)
30. *Id.*  [↑](#footnote-ref-30)
31. Gus Saltonstall, “*Sinkhole Opens Up On Upper West Side, Takes Truck With It: Photos,*” Patch, June 21, 2022, available at <https://patch.com/new-york/upper-west-side-nyc/sinkhole-opens-upper-west-side-takes-car-it-photos> [↑](#footnote-ref-31)
32. *Id.*  [↑](#footnote-ref-32)
33. Precious Fondren and Ashley Wong, *“2 Sinkholes in a Week Signal Weak Spots in N.Y.C.’s Aging Infrastructure,”* The New York Times, July 16, 2021, available at <https://www.nytimes.com/2021/07/16/nyregion/sinkholes-manhattan.html> [↑](#footnote-ref-33)
34. Eyewitness News, WABC-TV, “*2 cars stuck as sinkhole collapses under Upper West Side street,*” July 11, 2021, available at <https://abc7ny.com/sinkhole-street-collapse-cars-stuck-upper-west-side/10879527/> [↑](#footnote-ref-34)
35. *See* July 11, 2021 Twitter feed of @MarkLevineNYC at <https://twitter.com/MarkLevineNYC/status/1414251057375584259?ref_src=twsrc%5Etfw%7Ctwcamp%5Etweetembed%7Ctwterm%5E1414251057375584259%7Ctwgr%5E2928099ee04cd4fea7ac3904120f68538c6ddb35%7Ctwcon%5Es1_&ref_url=https%3A%2F%2Fabc7ny.com%2Fsinkhole-street-collapse-cars-stuck-upper-west-side%2F10879527%2F> [↑](#footnote-ref-35)
36. Emily Higginbotham, “*Sinkhole on the Upper East Side,*” Our Town, July 16, 2021, available at <https://www.ourtownny.com/news/sinkhole-on-the-upper-east-side-YY1717144#:~:text=Crater%20on%20East%2089th%20Street%20causes%20water%20outages&text=Days%20after%20a%20sinkhole%20partially,emergency%20construction%20at%20the%20site> [↑](#footnote-ref-36)
37. *Id.* [↑](#footnote-ref-37)
38. *Id.*  [↑](#footnote-ref-38)
39. Michael Hill and Tom Hays, *“Tropical Storm Elsa soaks NYC as it races up East Coast,”* The Associated Press Updated July 9, 2021, available at <https://apnews.com/article/environment-and-nature-storms-tropical-storms-32dd89fe657e8a3330bbd326742391d1> [↑](#footnote-ref-39)
40. James Barron, “*Water Mains Are Bursting All Over New York. Can They Be Fixed?*” The New York Times, Updated Feb. 13, 2020, available at <https://www.nytimes.com/2020/02/12/nyregion/nyc-water-mains.html#:~:text=But%20much%20of%20New%20York's,boomers%20born%20when%20Dwight%20D> [↑](#footnote-ref-40)
41. Precious Fondren and Ashley Wong, *“2 Sinkholes in a Week Signal Weak Spots in N.Y.C.’s Aging Infrastructure,”* The New York Times, July 16, 2021, available at <https://www.nytimes.com/2021/07/16/nyregion/sinkholes-manhattan.html> [↑](#footnote-ref-41)
42. *Id.*  [↑](#footnote-ref-42)
43. Rachel Ramirez and Drew Kann, “*New York City was never built to withstand a deluge like the one Ida delivered. It showed.*,” CNN, Updated September 5, 2021, available at <https://www.cnn.com/2021/09/05/us/new-york-infrastructure-climate-change/index.html> [↑](#footnote-ref-43)
44. *Id.* [↑](#footnote-ref-44)
45. *See* also the “Summary for Policymakers” of the IPCC Sixth Assessment Report: Working Group 1: The Physical Science Basis, p.8, available at <https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf> [↑](#footnote-ref-45)
46. National Oceanic and Atmospheric Administration (NOAA), Patterns and Projections of High Tide Flooding Along the U.S. Coastline Using a Common Impact Threshold," (February 2018) at ix, <https://tidesandcurrents.noaa.gov/publications/techrpt86_PaP_of_HTFlooding.pdf> [↑](#footnote-ref-46)
47. *Id*. at 25 [↑](#footnote-ref-47)
48. Nathan Kensinger. “*In Queens, chronic flooding and sea-level rise go hand in hand,”* October 12, 2017. Curbed NY. <https://ny.curbed.com/2017/10/12/16462790/queens-climate-change-jamaica-bay-flooding-photos> [↑](#footnote-ref-48)
49. Amy Plitt. “*These NYC Neighborhoods Experience Chronic Street Flooding*, December 3, 2018. Curbed NY. <https://ny.curbed.com/2018/12/3/18015910/new-york-weather-street-flooding-rainfall> [↑](#footnote-ref-49)
50. Nathan Kensinger. “*In Queens, chronic flooding and sea-level rise go hand in hand,”* October 12, 2017. Curbed NY. <https://ny.curbed.com/2017/10/12/16462790/queens-climate-change-jamaica-bay-flooding-photos>; Amy Plitt. “*These NYC Neighborhoods Experience Chronic Street Flooding*, December 3, 2018. Curbed NY. <https://ny.curbed.com/2018/12/3/18015910/new-york-weather-street-flooding-rainfall> [↑](#footnote-ref-50)
51. Ivan Maddox, “*Three common types of flood explained*,” Intermap, October 13, 2014, available at: <https://www.intermap.com/risks-of-hazard-blog/three-common-types-of-flood-explained>. [↑](#footnote-ref-51)
52. Casey Crownhart, MIT Technology Review, “How Ida dodged NYC’s flood defenses,” Sept. 3, 2021, available at: <https://www.technologyreview.com/2021/09/03/1034315/ida-dodged-nyc-flood-defenses-climate-change-storm/>. [↑](#footnote-ref-52)
53. *Id.*  [↑](#footnote-ref-53)
54. Thomas Frank, E&E News, “Flooding Disproportionately Harms Black Neighborhoods,” June 2, 2020, available at: <https://www.scientificamerican.com/article/flooding-disproportionately-harms-black-neighborhoods/>. [↑](#footnote-ref-54)
55. Kyle Mittan, University of Arizona News, “Black and Hispanic People More Likely to Live in High-Risk Flood Zones, Study Finds,” October 5, 2020, available at: <https://news.arizona.edu/story/black-and-hispanic-people-more-likely-live-high-risk-flood-zones-study-finds>. [↑](#footnote-ref-55)
56. Thomas Frank, E&E News, “Flooding Disproportionately Harms Black Neighborhoods,” June 2, 2020, available at: <https://www.scientificamerican.com/article/flooding-disproportionately-harms-black-neighborhoods/>. [↑](#footnote-ref-56)
57. Thomas Frank, E&E News, “Flooding Disproportionately Harms Black Neighborhoods,” June 2, 2020, available at: <https://www.scientificamerican.com/article/flooding-disproportionately-harms-black-neighborhoods/>. [↑](#footnote-ref-57)
58. Robinson Meyer, The Atlantic, “*Climate Change Will Bring Major Flooding to New York Every 5 Years*,” October 24, 2017, available at <https://www.theatlantic.com/science/archive/2017/10/climate-change-nyc-floods/543708/> [↑](#footnote-ref-58)
59. *Id.* [↑](#footnote-ref-59)
60. *Id.* [↑](#footnote-ref-60)
61. *Id.* [↑](#footnote-ref-61)
62. Ari Ephraim Feldman, NY1, “*Flooding shows risks to city posed by increasing storm deluges*,” July 9, 2021, available at <https://www.ny1.com/nyc/all-boroughs/news/2021/07/09/flooding-shows-risks-to-city-posed-by-increasing-storm-deluges> [↑](#footnote-ref-62)
63. New York City Council. Local Law Number 172 of 2018. <https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=3371671&GUID=36F04A1F-7293-4173-B29F-A4065A5046A2> (last accessed 9/8/21) [↑](#footnote-ref-63)
64. Mayor’s Office of Resiliency. New York City Stormwater Resiliency Plan. May 2021. <https://www1.nyc.gov/assets/orr/pdf/publications/stormwater-resiliency-plan.pdf> (last accessed 9/8/21) [↑](#footnote-ref-64)
65. *Id.* [↑](#footnote-ref-65)
66. New York City’s Stormwater Flood Maps. May 2021. <https://experience.arcgis.com/experience/4b290961cac34643a49b9002f165fad8/> (last accessed 9/8/21) [↑](#footnote-ref-66)
67. See Cityland, City Releases Rainfall-Based Flooding Analysis for Flood Preparedness, available at: <https://www.citylandnyc.org/city-releases-rainfall-based-flooding-analysis-for-flood-preparedness/> [↑](#footnote-ref-67)
68. *Id.* [↑](#footnote-ref-68)
69. Ari Ephraim Feldman. Flooding shows risk to city posed by increasing storm deluges. New York One. July 9, 2021, available at: <https://www.ny1.com/nyc/all-boroughs/news/2021/07/09/flooding-shows-risks-to-city-posed-by-increasing-storm-deluges> [↑](#footnote-ref-69)
70. [The](file:///C%3A%5CUsers%5Cpmulvihill%5CAppData%5CLocal%5CMicrosoft%5CWindows%5CINetCache%5CContent.Outlook%5CRZU5WGN0%5CThe) New Normal: Combating Storm-Related Extreme Weather in New York City (November 2021 Monthly Update), available at: <https://www1.nyc.gov/assets/orr/pdf/publications/120921_weather-report_al_002-em.pdf>. [↑](#footnote-ref-70)
71. New York City’s Stormwater Flood Maps. May 2021. <https://experience.arcgis.com/experience/4b290961cac34643a49b9002f165fad8/> [↑](#footnote-ref-71)
72. Gwynne Hogan, $50M southeast Queens sewage project completed, Mayor says, Gothamist, March 9, 2022, available at: <https://gothamist.com/news/50m-southeast-queens-sewage-project-completed-mayor-says> [↑](#footnote-ref-72)
73. *Id.* [↑](#footnote-ref-73)
74. Local Law 41 of 2021, available at: <https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=4648590&GUID=F7CCBD21-44D7-4280-AB54-3D419D2AE033&Options=ID|Text|&Search=design+guidelines>. [↑](#footnote-ref-74)
75. Local Law 122 or 2021, available at: <https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=3996243&GUID=8BA20DCE-2975-4E72-A812-0320EE34B96C&Options=ID|Text|&Search=1620>. [↑](#footnote-ref-75)
76. MOCR, Neighborhood Coastal Flood Protection Project Planning Guidance, December 2021, available at: <https://www1.nyc.gov/assets/orr/pdf/publications/Coastal-Protection-Guidance.pdf>. [↑](#footnote-ref-76)
77. MOCR, Neighborhood Coastal Flood Protection Project Planning Guidance, December 2021, available at: <https://www1.nyc.gov/assets/orr/pdf/publications/Coastal-Protection-Guidance.pdf>. [↑](#footnote-ref-77)
78. Press Release of Mayor Eric Adams, *Mayor Adams Releases Rainfall Ready NYC Action Plan, Preparing City Government and New Yorkers for More Extreme Rainfall,* July 7, 2022, available at: <https://www1.nyc.gov/office-of-the-mayor/news/478-22/mayor-adams-releases-rainfall-ready-nyc-action-plan-preparing-city-government-new-yorkers-for?utm_medium=email&_hsmi=219030037&_hsenc=p2ANqtz--ajYch-Wgn8dOMhvEoQth90Hrz_ryNW8zhBHaZv9b-oQsiHCpb89TAN7fd5ONq-Igdq5PoObrnxkoJ21noK7mHaXTbfg&utm_content=219030037&utm_source=hs_email> [↑](#footnote-ref-78)
79. Press Release of Mayor Eric Adams, *Mayor Adams Releases Rainfall Ready NYC Action Plan, Preparing City Government and New Yorkers for More Extreme Rainfall,* July 7, 2022, available at: <https://www1.nyc.gov/office-of-the-mayor/news/478-22/mayor-adams-releases-rainfall-ready-nyc-action-plan-preparing-city-government-new-yorkers-for?utm_medium=email&_hsmi=219030037&_hsenc=p2ANqtz--ajYch-Wgn8dOMhvEoQth90Hrz_ryNW8zhBHaZv9b-oQsiHCpb89TAN7fd5ONq-Igdq5PoObrnxkoJ21noK7mHaXTbfg&utm_content=219030037&utm_source=hs_email>; NYC Environmental Protection, Rainfall Ready NYC Action Plan, available at: <https://www1.nyc.gov/site/dep/whats-new/rainfall-ready-nyc.page> (last accessed Aug. 11, 2022). [↑](#footnote-ref-79)
80. Press Release of Mayor Eric Adams, *Mayor Adams Releases Rainfall Ready NYC Action Plan, Preparing City Government and New Yorkers for More Extreme Rainfall,* July 7, 2022, available at: <https://www1.nyc.gov/office-of-the-mayor/news/478-22/mayor-adams-releases-rainfall-ready-nyc-action-plan-preparing-city-government-new-yorkers-for?utm_medium=email&_hsmi=219030037&_hsenc=p2ANqtz--ajYch-Wgn8dOMhvEoQth90Hrz_ryNW8zhBHaZv9b-oQsiHCpb89TAN7fd5ONq-Igdq5PoObrnxkoJ21noK7mHaXTbfg&utm_content=219030037&utm_source=hs_email> [↑](#footnote-ref-80)
81. *Id.* [↑](#footnote-ref-81)
82. *Id.* [↑](#footnote-ref-82)
83. *Id.* [↑](#footnote-ref-83)
84. Ari Ephraim Feldman, *City’s Latest Plan to Face Down Flooding: Inflatable Dams, Sandbags to At-Risk Homes,* NY1, July 6, 2022, available at: <https://www.ny1.com/nyc/all-boroughs/news/2022/07/06/city-s-latest-plan-to-face-down-flooding--pass-out-inflatable-dams-to-at-risk-homes?utm_source=First+Read+Newsletters&utm_campaign=449802adbe-First_Rear_Tonight_070722&utm_medium=email&utm_term=0_252d27c7d1-449802adbe-34707812&mc_cid=449802adbe&mc_eid=8dd499739f> [↑](#footnote-ref-84)
85. *Id.* [↑](#footnote-ref-85)
86. *Id.* [↑](#footnote-ref-86)
87. *Id.* [↑](#footnote-ref-87)
88. *Id.* [↑](#footnote-ref-88)
89. See US Army Corps of Engineers, New York District Website, available at: <https://www.nan.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/2495552/fact-sheet-new-yorknew-jersey-harbor-tributaries-focus-area-feasibility-study/> [↑](#footnote-ref-89)
90. *Id.* [↑](#footnote-ref-90)
91. *Id.* [↑](#footnote-ref-91)
92. See US Army Corps of Engineers, New York District Website, available at: <https://www.nan.usace.army.mil/Missions/Civil-Works/Projects-in-New-York/New-York-New-Jersey-Harbor-Tributaries-Focus-Area-Feasibility-Study/> [↑](#footnote-ref-92)
93. *Id.* [↑](#footnote-ref-93)
94. *Id.*  [↑](#footnote-ref-94)
95. *Id.* [↑](#footnote-ref-95)
96. *Id.* [↑](#footnote-ref-96)
97. *Id.* [↑](#footnote-ref-97)
98. Steven Mufson, Chris Mooney, Juliet Eilperin and John Muyskens, “2℃: Beyond The Limit, Extreme Climate Change has Arrived in America,” *The Washington Post,* August 13, 2019, available at: <https://www.washingtonpost.com/graphics/2019/national/climate-environment/climate-change-america/>. [↑](#footnote-ref-98)
99. *Id.* [↑](#footnote-ref-99)
100. U.S. Environmental Protection Agency, “Heat Island Effect” <https://www.epa.gov/heat-islands> [↑](#footnote-ref-100)
101. *Id.* [↑](#footnote-ref-101)
102. Pam Radtke “Death, blackouts, melting asphalt: ways the climate crisis will change how we live,” *The Guardian,* August 20, 2019, available at: <https://www.theguardian.com/cities/2019/aug/20/death-blackouts-melting-asphalt-ways-the-climate-crisis-will-change-how-we-live?utm_campaign=citylab-daily-newsletter&utm_medium=email&silverid=%25%25RECIPIENT_ID%25%25&utm_source=newsletter>. [↑](#footnote-ref-102)
103. See: “Cool Neighborhoods NYC: A Comprehensive Approach to Keep Communities Safe in Extreme Heat,” June 2017, available at: <https://www1.nyc.gov/assets/orr/pdf/Cool_Neighborhoods_NYC_Report_FINAL.pdf> [↑](#footnote-ref-103)
104. Pam Radtke “Death, blackouts, melting asphalt: ways the climate crisis will change how we live,” *The Guardian,* August 20, 2019, available at: <https://www.theguardian.com/cities/2019/aug/20/death-blackouts-melting-asphalt-ways-the-climate-crisis-will-change-how-we-live?utm_campaign=citylab-daily-newsletter&utm_medium=email&silverid=%25%25RECIPIENT_ID%25%25&utm_source=newsletter>. [↑](#footnote-ref-104)
105. Jeff Coltin, “Bracing for Heat Waves and Hurricanes During a Pandemic,” *City & State New York,* May 6, 2020 available at: <https://www.cityandstateny.com/articles/policy/small-business/coronavirus-adjusts-plans-future-emergencies.html>. [↑](#footnote-ref-105)
106. Gwynne Hogan. National Weather Service projects longest heat wave in nearly a decade, as NYC Electrical Grid Strains. <https://gothamist.com/news/national-weather-service-projects-longest-heat-wave-in-14-years-as-nyc-electrical-grid-strains> [↑](#footnote-ref-106)
107. New York City Panel on Climate Change” 2019 Report, Chapter 2: New Methods for Assessing Extreme Temperatures, Heavy Downpours, and Drought, section 2.3 ‘Extreme temperature and humidity,’” (March, 2019, available at: <https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/nyas.14007#nyas14007-bib-0047>. [↑](#footnote-ref-107)
108. New York City Panel on Climate Change “2019 Report, Chapter 2: New Methods for Assessing Extreme Temperatures, Heavy Downpours, and Drought, section 2.3.2 ‘New methods for projected changes in heat waves’” 2019 , available at: <https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/nyas.14007#nyas14007-bib-0047> (last visited Feb. 26, 2020). [↑](#footnote-ref-108)
109. New York City Panel on Climate Change “2019 Report, Chapter 2: New Methods for Assessing Extreme Temperatures, Heavy Downpours, and Drought, Table 2.2 ‘Results from new projection methods for future assessments of heat wave across 52‐member ensemble (26 models, RCPs 4.5 and 8.5) for New York City” 2019, available at: <https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/nyas.14007#nyas14007-bib-0047> (last visited May 20, 2020). [↑](#footnote-ref-109)
110. Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report (MMWR), “Heat Illness and Deaths – New York City, 2000-2011,” Aug. 9, 2013, available at: <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6231a1.htm>. [↑](#footnote-ref-110)
111. Alexandra Tremayne-Pengelly. Gov Report Shows NYC is Disastrously Unprepared for Heat Waves: Cooling Centers Closed on weekends, Not Open to Families. Observer. 8/5/22. <https://observer.com/2022/08/gov-report-shows-nyc-is-disastrously-unprepared-for-heat-waves-cooling-centers-closed-on-weekends-not-open-to-families/> [↑](#footnote-ref-111)
112. Kay Dervishi, “Vulnerable New Yorkers hit hardest by COVID-19 – and heat waves”, *City & State*, May 12, 2020, available at: [https://www.cityandstateny.com/articles/politics/new-york-city/vulnerable-new-yorkers-hit-hardest-covid-19-–-and-heat-waves.html](https://www.cityandstateny.com/articles/politics/new-york-city/vulnerable-new-yorkers-hit-hardest-covid-19-%E2%80%93-and-heat-waves.html). [↑](#footnote-ref-112)
113. Kay Dervishi, “Vulnerable New Yorkers hit hardest by COVID-19 – and heat waves”, *City & State*, May 12, 2020, available at:https://www.cityandstateny.com/politics/2020/05/vulnerable-new-yorkers-hit-hardest-by-covid-19-and-heat-waves/176019/. [↑](#footnote-ref-113)
114. United States Environmental Protection Agency. Climate Change Indicators: Heat Related Deaths. <https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths> [↑](#footnote-ref-114)
115. New York City Environmental Justice Alliance, NYC Climate Justice Agenda, “Midway to 2030: Building Resiliency and Equity for a Just Transition”, April 2018, available at: <https://www.nyc-eja.org/wp-content/uploads/2018/04/NYC-Climate-Justice-Agenda-Final-042018-1.pdf>. [↑](#footnote-ref-115)
116. Kay Dervishi, “Vulnerable New Yorkers hit hardest by COVID-19 – and heat waves”, *City & State*, May 12, 2020, available at: [https://www.cityandstateny.com/articles/politics/new-york-city/vulnerable-new-yorkers-hit-hardest-covid-19-–-and-heat-waves.html](https://www.cityandstateny.com/articles/politics/new-york-city/vulnerable-new-yorkers-hit-hardest-covid-19-%E2%80%93-and-heat-waves.html). [↑](#footnote-ref-116)
117. Anna M. Phillips and Tony Barboza, “Summer heat waves could be deadlier because of COVID-19, health officials warn”, *Los Angeles Times*, May 6, 2020, available at: <https://www.chicagotribune.com/coronavirus/ct-nw-coronavirus-summer-heat-waves-20200506-2wzd2rkrura7hjdwb3bchb2vcy-story.html>. [↑](#footnote-ref-117)
118. Anna M. Phillips and Tony Barboza, “Summer heat waves could be deadlier because of COVID-19, health officials warn”, *Los Angeles Times*, May 6, 2020, available at: <https://www.chicagotribune.com/coronavirus/ct-nw-coronavirus-summer-heat-waves-20200506-2wzd2rkrura7hjdwb3bchb2vcy-story.html>. [↑](#footnote-ref-118)
119. Michael Schwirtz and Lindsey Rogers Cook, “These N.Y.C. Neighborhoods Have the Highest Rates of Virus Deaths,” *New York Times*, May 18, 2020, available at: <https://www.nytimes.com/2020/05/18/nyregion/coronavirus-deaths-nyc.html?action=click&module=Top%20Stories&pgtype=Homepage>. [↑](#footnote-ref-119)
120. See: NYC Health Website available at: <https://www1.nyc.gov/site/doh/health/emergency-preparedness/emergencies-extreme-weather-heat.page>. [↑](#footnote-ref-120)
121. Office of New York City Comptroller: Brad Lander. Overheated, Underserved: Expanding Cooling Center Access. <https://comptroller.nyc.gov/reports/overheated-underserved/> [↑](#footnote-ref-121)
122. *Id.* [↑](#footnote-ref-122)
123. *Id.* [↑](#footnote-ref-123)
124. *Id.* [↑](#footnote-ref-124)
125. *Id.* [↑](#footnote-ref-125)
126. American Association of State Highway and Transportation Officials. Extreme Weather and the Transportation System. <http://climatechange.transportation.org/pdf/extreme_weather_briefings/AASHTO_Heat_Waves.pdf> [↑](#footnote-ref-126)
127. *Id.* [↑](#footnote-ref-127)
128. Bartos et al. Impacts of rising air temperatures on electric transmission ampacity and peak electricity load in the United States. Environmental Reasearch Letters. November, 2016. <https://iopscience.iop.org/article/10.1088/1748-9326/11/11/114008> [↑](#footnote-ref-128)
129. Lewis University. Why does hot weather cause power outages?. ScienceDaily, 19 July 2013. www.sciencedaily.com/releases/2013/07/130719103146.htm [↑](#footnote-ref-129)
130. *Id.* [↑](#footnote-ref-130)