NATURAL RESOURCES DEFENSE COUNCIL

April 30, 2013

Submitted via email to brad.loar@dhs.gov

Brad Loar, Region IV Director of Mitigation
Federal Emergency Management Agency
3003 Chamblee Tucker Road
Atlanta, GA 30341

Re: *North Carolina's 2013 State Hazard Mitigation Plan update*

Dear Mr. Loar:

These comments are submitted by the Natural Resources Defense Council (NRDC), which on behalf of our more than 1.3 million members and online activists, uses law and science to protect the planet's wildlife and wild places and to ensure a safe and healthy environment for all living things. North Carolina's Division of Emergency Management informed NRDC that they have submitted their draft 2013 State Hazard Mitigation Plan (SHMP) update to the FEMA Region IV office. Because the state was unwilling to share a copy of North Carolina's draft 2013 update, NRDC reviewed North Carolina's 2010 SHMP. Based on this review, we have developed recommendations for FEMA's consideration regarding its approval of North Carolina's 2013 SHMP.

North Carolina is vulnerable to the impacts of climate change, including sea level rise, changes in storm intensity that can cause flooding and compromise water quality, increases in extreme heat, and longer dry periods that lead to droughts and wildfires.[1] NRDC commends North Carolina for recognizing in its 2010 SHMP the impacts of climate change, especially in the "Long Term Hazards" section of Appendix A.[2] We urge that FEMA ensures that climate change is adequately addressed in the NC 2013 SHMP update before approving the plan. Climate change poses a significant threat to public safety and will increase the damages caused by natural disasters. As affirmed by numerous international and national

[1] North Carolina Interagency Leadership Team, *Climate Ready North Carolina: Building a Resilient Future* (2012), *available at* https://connect.ncdot.gov/municipalities/InteragencyLeadership/Goals/Climate%20Ready%20North%20Carolina%20-%20Building%20a%20Resilient%20Future.pdf; U.S. Global Change Research Program (USGCRP), *Global Climate Change Impacts in the United States* (2009), *available at* http://nca2009.globalchange.gov/southeast

[2] North Carolina Division of Emergency Management, *Standard State Hazard Mitigation Plan* (2010), *available at* https://www.nccrimecontrol.org/index2.cfm?a=000003,000010,001623,000177,002107,001563 (hereinafter "North Carolina 2010 SHMP").

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scientific bodies, including the Intergovernmental Panel on Climate Change (IPCC),[3] the National Research Council (NRC),[4] and the U.S. Global Change Research Program (USGCRP),[5] the impacts of climate change are already visible, and the risks to people, property and natural resources posed by climate change are expected to grow in the future. Other professional organizations or governments that have adopted policies or resolutions noting the importance of responding to the risks posed by climate change include: the National Academies of Science of 13 nations;[6] the US American Planning Association;[7] and the American Public Health Association,[8] among many others.

In Appendix A, the 2010 NC plan references a joint project of FEMA and North Carolina's Division of Emergency Management (NCEM) to fully assess long term hazards, indicating that these study results will be included in the 2013 update of the NC SHMP.[9] "Long term hazards" are defined as changes in weather patterns and sea level due to global climate change, which also are identified as hazards of secondary concern for North Carolina.[10] In May 2010, North Carolina's General Assembly introduced House Bill 1808, the NC Climate Change Adaptation Strategy. Section 3(a)(6) of this Bill, "Directs the Department of Environment and Natural Resources or the Division of Emergency Management of the Department of Crime Control and Public Safety to integrate post-disaster planning requirements with hazard mitigation planning requirements into one plan that includes the latest scientific understanding of sea level rise, erosion, and other coastal hazards and environmental impacts of global climate change."[11] NRDC urges FEMA to ensure that any information on the progress and results of these studies is included in NC's 2013 SHMP update.

NRDC also urges FEMA to require North Carolina to delete the designation of climate change impacts as hazards of secondary concern from its SHMP. The effects of climate change are already being felt across the country, altering the frequency and intensity of hazard events that North Carolina defines as "greater hazards" of "primary concern," such as flooding, hurricanes, storms, coastal erosion, and wildfires.[12] Because of these impacts, climate change must be integrated into the analysis of all hazards affecting North Carolina.

Abrupt changes are another reason that climate change should not be considered a secondary concern. The "Long Term Hazards" section of Appendix A refers to the crossing of thresholds, resulting in abrupt

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[3] S. Solomon et al. (eds.), *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (2007), *available at* http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html.
[4] National Research Council, Committee on America's Climate Choices, *America's Climate Choices* (2011), *available at* http://dels.nas.edu/Report/Americas-Climate-Choices/12781.
[5] USGCRP 2009 *supra* note 1
[6] Joint Science Academies' 2008 Statement at http://www.science.org.au/policy/climatechange-g8+5.pdf.
[7] APA 2011 *Policy Guide on Planning and Climate Change*, available at: http://www.planning.org/policy/guides/pdf/climatechange.pdf.
[8] Reference in APHA Executive Director Dr Georges Benjamin's testimony at: http://www.apha.org/about/news/briefing0224.htm.
[9] North Carolina 2010 SHMP, *supra* note 2 at 3.1 (Appendix A "Long Term Hazards")
[10] *Id.*
[11] See Appendix I in NRDC's *Getting Climate Smart* report (2013), pp.116-121.
[12] *Id.* at 2.1 (Appendix A "Greater Hazards")

climate changes such as "the sudden loss of landforms due to storms, rapid saltwater intrusion into coastal forests and freshwater aquifers, and intense wildfires or pest outbreaks due to change in soil moisture and temperature. While ecological and natural thresholds are often difficult to predict, the possibility of sudden environmental changes poses substantial threats."[13] Although abrupt climate change is considered a low-probability scenario, it is also a very high-impact scenario and therefore it should be addressed in mitigation planning goals as a primary concern.

While the four pages of the "Long Term Hazards" section in Appendix A focuses on threats of climate change, the other chapters and sections of North Carolina's 2010 state hazard mitigation plan do not adequately integrate the potential effects of climate change into its risk assessment or mitigation goals. NRDC urges FEMA to only grant approval of NC's 2013 SHMP if it has expanded its incorporation of climate change compared to its 2010 plan. Instead of relying only on historical trends, state planners must now look to the growing body of climate change studies to understand, anticipate and mitigate future hazards.

Indeed, NRDC believes that all states must adequately address climate change considerations in hazard mitigation plans as a condition of receiving non-emergency disaster mitigation assistance under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S. C. §§ 5121-5207.[14] In FEMA's requirement for states to have a FEMA-approved plan before they are eligible for any hazard mitigation assistance grants, FEMA mandates an analysis of the probability of future hazard events.[15] FEMA should require that North Carolina's probability analysis take into account both the historical record of hazard events as well as the projected future impacts, because climate change has already moved the baseline hazard conditions to which mitigation planning must respond. If we do not apply all available resources, including climate models and impact projections, to predict to the best of our ability the full scope of extreme weather events that are now feasible, like Hurricane Sandy, the consequences could be catastrophic.

Climate change may affect coastal hazards such as tropical cyclones, surges, flooding, and erosion

Climate change may increase the risks of coastal hazards in a number of ways. While the 2010 NC SHMP makes a brief mention of climate change in its risk assessment as an "additional factor" involved in coastal erosion, the plan still only references historical data, without mentioning projections of climate change. [16] Additionally, the risk assessments of the other "greater hazards" listed in section 2 of Appendix A make no mention of climate change in their assessments of coastal hazards, including coastal flooding, hurricanes, and storm surge.

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[13] *Id.* at 3.2 (Appendix A "Long Term Hazards")

[14] Natural Resources Defense Council and National Wildlife Federation, *Petition Requesting That the Federal Emergency Management Agency Comply with the Stafford Act and Disaster Mitigation Act of 2000 By Approving Only State Hazard Mitigation Plans That Adequately Address Climate Change; Amend Its Regulations to Confirm that Climate Change Must Be Addressed in Hazard Mitigation Plans; and Provide Agency Guidance to States Regarding How to Address Climate Change in Hazard Mitigation Plans* (Oct. 2012), available at: http://switchboard.nrdc.org/blogs/rhammer/FEMA%20Petition%20-%20FINAL%20-%2010-2-12.pdf

[15] 44 C.F.R. §201.4(c)(2)(i) (2012)

[16] North Carolina 2010 SHMP, *supra* note 2 at 2.64 (Appendix A "Greater Hazards")

According to reports from UNC as well as North Carolina's Interagency Leadership Team, climate change in North Carolina is expected to lead to more intense hurricanes and other severe storms, rising sea levels, higher storm surges, more intense rainfall, and saltwater intrusion into aquifers.[17] Much of the North Carolina coastline is at "high" to "very-high" risk of physical changes occurring as sea level rises, with potentially limited ability to naturally adapt to those changes, leaving the coastline highly vulnerable to erosion and other destructive effects.[18] Recent studies suggest that sea level rise of between 2.5 to 6.2 feet is possible by 2100, with variation based on geographic location and the amount of future greenhouse gas emissions.[19] This rise in sea level along with the higher intensity of tropical cyclones may significantly exacerbate storm surges. A 2012 study found a "hot-spot" of sea level rise along the coastline from Cape Hatteras northward, with rates of sea level rise in the last 60 years 3-4 times higher than the global average.[20]

Additionally, saline intrusion into aquifers is problematic as sea levels rise, especially considering other potential stressors on water supply.[21] Climate change may contribute to longer dry periods and extreme heat in North Carolina, which is likely to increase water demands. Drought conditions exacerbated by climate change may also worsen saline intrusion into aquifers as groundwater recharge rates decrease and water tables decline, or as groundwater withdrawals increase to compensate for decreased surface water supplies.[22]

To receive FEMA approval, the 2013 State Hazard Mitigation Plan should improve on the last version of North Carolina's SHMP by addressing the potential impacts of climate change in its risk assessment of "greater hazards." Taking climate change and increased tropical cyclone intensity into account may change the State's analysis of areas that are vulnerable to inundation. Facilities and properties could be affected by storm surges at a much lower level of sea level rise, with potential for higher damages and economic losses. FEMA needs to require that the State considers how climate change is projected to affect the future intensity of tropical storms and hurricanes beyond the observations in the historical record.[23]

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[17] North Carolina Interagency Leadership Team, *supra* note 1, at 27; Institute for the Environment at University of North Carolina, Chapel Hill, *The University of North Carolina at Chapel Hill Climate Change Committee Report* (2009) at 13, *available at* www.ie.unc.edu/PDF/Climate_Change_Report.pdf

[18] Hammar-Klose E, Thieler E. 2001. National Assessment of Coastal Vulnerability to Future Sea-Level Rise: Preliminary Results for US Atlantic, Pacific and Gulf of Mexico Coasts. US Report 99-593, 00-178, and 00-179. *Available at* http://woodshole.er.usgs.gov/project-pages/cvi/

[19] Martin Vermeer & Stefan Rahmstorf, "Global Sea Level Linked to Global Temperature," 106 *Proc. of the Nat'l Acad. of Sci.* 21527 (2009), *available at* http://www.pnas.org/content/106/51/21527.full.pdf+html.

[20] Sallenger AH, Doran KS, Howd PA. 2012. Hotspot of accelerated sea-level rise on the Atlantic coast of North America. Nature Climate Change 2:884-888. doi:10.1038/nclimate1597.

[21] Ferguson G, Gleeson T. 2012. Vulnerability of coastal aquifers to groundwater use and climate change. Nature Climate Change 2:342-345.

[22] USGCRP, *supra* note 1, at 113.

[23] Intergovernmental Panel on Climate Change (IPCC), *Special Report: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* 16 (2012), *available at* http://www.ipcc-wg2.gov/SREX/.

Extreme heat, drought and wildfires may intensify due to increasing temperatures and longer dry periods from climate change

In North America, there has been an increasing trend in precipitation extremes over the last half century. Rainfall events are expected to become more concentrated, with longer and hotter dry periods in between.[24] Rising temperatures, particularly more frequent and intense heat waves, are directly linked to increased morbidity (illnesses) and mortality (premature deaths) due to extreme heat. Increased heat extremes have already been documented in the U.S., with 2012 being the warmest year experienced since recordkeeping began in 1895.[25] A recent study published in the *Proceedings of the National Academy of Sciences* concludes that climate change strongly contributed to the recent heat waves and extreme summer temperatures.[26] These heat extremes are projected to become even more frequent, with "summertime mean temperatures that occurred historically only 5% of the time are projected to occur at least 70% of the time everywhere in the 48-state region" of the continental U.S.[27]

North Carolina's 2010 SHMP does not specifically reference the impact of climate change on increasing temperatures and extreme heat. The plan does mention "the increased frequency of heat waves may raise the number of heat-related deaths…These past trends may or may not continue into the future."[28] The plan defines heat waves as a lesser hazard of secondary concern, although a full acknowledgment and analysis of climate change impacts may increase North Carolina's level of concern, as vulnerability increases with frequency, intensity and scope of extreme heat events. The 2010 Plan itself states that "In Greensboro, a warming of 3 degrees F during a typical summer is estimated to increase heat-related deaths by nearly 70 percent."[29]

The scientific community has identified several public health risks from climate change that are highly likely, including heat-related illnesses and premature mortality due to increased extreme heat events, greater air pollution and associated health effects, as well as proliferating pollen and associated allergies.[30] Extreme heat can lead to illness due to dehydration or heat stroke, and it can also contribute to a range of cardiovascular, respiratory and cerebrovascular illnesses.[31] Many of these illnesses can lead to premature death. For example, during a 1995 heat wave in Chicago, over 700 deaths were

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[24] *Id.* at 44.
[25] National Oceanic and Atmospheric Administration, National Climatic Data Center, "State of the Climate National Overview – Annual 2012," http://www.ncdc.noaa.gov/sotc/national/2012/13 (last visited Mar. 14, 2013).
[26] James Hansen et al., "Perception of Climate Change," *Proc. of the Nat'l Acad. of Sci.* (Aug. 6, 2012), *available at* http://www.pnas.org/content/early/2012/07/30/1205276109.full.pdf+html.
[27] P.B. Duffy & C. Tebaldi, "Increasing Prevalence of Extreme Summer Temperatures in the U.S.," 111 *Climatic Change* 487, 491 (2012).
[28] North Carolina 2010 SHMP, *supra* note 2 at 3.14 ("Lesser Hazards")
[29] *Id.*
[30] Mark E. Keim, "Building Human Resilience: The Role of Public Health Preparedness and Response as an Adaptation to Climate Change," 35 *Am. J. of Preventive Med.* 508 (2008), *available at* http://trig.squarespace.com/storage/Keim.pdf; Darrow LA, Hess J, Rogers CA, Tolbert PE, Klein M, Sarnat SE. 2012. Ambient pollen concentrations and emergency department visits for asthma and wheeze. J Allergy Clin Immunol 130(3):630-638.
[31] Environmental Protection Agency, *Excessive Heat Events Guidebook* (2006), *available at* http://www.epa.gov/hiri/about/pdf/EHEguide_final.pdf (developed collaboratively with NOAA, CDC, and FEMA).

attributable to extreme heat.[32] In addition to heat illnesses, warmer temperatures and longer, more intense heat waves are also associated with increased stagnant air and increased concentrations of air pollutants, such as ground-level ozone. Three North Carolina cities – Asheville, Charlotte and Raleigh – could see the numbers of unhealthy smog days double by the 2050s from the projected effects of climate change.[33] Poor air quality, especially exposure to ozone, has been shown to be accompanied by increases in allergies, hospital admissions for asthma and other respiratory diseases, and ultimately, mortality.[34] Warmer temperatures from climate change are also likely to increase the prevalence of infectious diseases in North Carolina, such as West Nile virus and Lyme disease.[35]

The health-related costs of just a few types of climate-sensitive events can run into the billions. One US study that looked at case studies of actual 2002-2009 events estimated $6.9 billion in total health-related costs and $452 million in direct medical costs from hurricanes, heat waves, and West Nile virus outbreaks.[36] The State can reduce these harmful impacts of extreme heat on human health through effective hazard mitigation and preparedness.

Along with increasing temperatures, changes in precipitation patterns and evaporation may also increase the incidence of drought. Extended dry periods have already become more frequent in parts of the United States. These dry periods, combined with higher air temperatures, lead to higher incidence of drought due to decreased soil moisture and increased evapotranspiration.[37] Severe droughts can have a hugely negative effect not only on water availability but also on the state economy. After the record drought in 2007, North Carolina's Department of Agriculture and Consumer Services estimated the state's losses between $300 million and $500 million.[38]

Climate change may also cause longer, more frequent and more intense wildfires in some U.S. regions due to increasing temperatures and more dry periods. The Southeast region leads the U.S. with 45,000 wildfires annually.[39] In 2012, the average size of wildfires by late November (165 acres per fire) was the largest on record for any January through November period, nearly doubling the previous 2001-2010

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[32] Steven Whitman et al., "Mortality in Chicago Attributed to the July 1995 Heat Wave," 87 *Am. J. of Pub. Health* 1,515, 1,515 (1997), *available at* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1380980/pdf/amjph00508-0117.pdf.

[33] Natural Resources Defense Council. 2007. Heat Advisory: How Global Warming Causes More Bad Air Days. Available online: http://www.nrdc.org/globalwarming/heatadvisory/contents.asp/.

[34] Kent E. Pinkerton et al., on behalf of the American Thoracic Society Environmental Health Policy Committee, "An Official American Thoracic Society Workshop Report: Climate Change and Human Health," 9 *Proc. Am. Thorac. Soc.* 3, 4-5 (2012), *available at* http://ehs.sph.berkeley.edu/krsmith/publications/2012/2012_PATS.pdf; Michelle L. Bell et al., "Climate Change, Ambient Ozone, and Health in 50 US Cities," 82 *Climatic Change* 61-76 (2007), *available at* http://sage.wisc.edu/pubs/articles/M-Z/Patz/BelletalCC2007.pdf.

[35] Institute for the Environment, *supra* note 13, at 13

[36] Kim Knowlton et al., "Six Climate Change-Related Events in the United States Accounted for about $14 Billion in Lost Lives and Health Costs," 30(11) *Health Affairs* 2167-2177 (2011).

[37] USGCRP, *supra* note 1, at 41 - 44.

[38] Matthew Eisley and Jay Price, *Drought is ravaging the fields, and some worry that 2008 could be worse*, Charlotte News & Observer, Dec. 18, 2007, *available at*: http://www.newsobserver.com/2007/12/18/92209/nc-crop-losses-this-year-573-million.html

[39] Gramley M. 2005. Fire in the South: A report by the Southern Group of State Foresters. Winder GA: Southern Group of State Foresters [Available online at http://216.226.177.78/PDFs/fire_in_the_south.pdf] Note that this region includes Oklahoma to Texas, Florida to North Carolina.

decadal average of approximately 89 acres/fire. Wildfire smoke poses health hazards that include increases in respiratory and cardiovascular hospitalizations, emergency department visits for asthma, bronchitis, and chest pain, as well as direct injury and death from fires and smoke inhalation.[40] Considering North Carolina has defined wildfires as a greater hazard of primary concern,[41] adequately addressing the impact of climate change on fires will be extremely important in the 2013 SHMP update. The U.S. Forest Service finds that annual area burned and length of the fire season will likely increase throughout the U.S. due to climate change, and that increased fire in the wildland-urban interface will likely create higher fire-suppression costs as well as other social and economic challenges. The Forest Service also estimates that future increases in annual area burned range from less than 100 percent to greater than 500 percent, depending on the region, timeframe, methods, and future emissions and climatic scenario. While land use activities also affect incidence of forest fires, including timber harvest, forest clearing, fire suppression, and grazing, the Forest Service states that weather is the best predictor of how much area will burn during a fire. Increased temperature and altered precipitation affect moisture and the length of the annual fire season.[42]

Climate change may increase heavy rainfall, inland flooding, and waterborne illness

Climate change affects water availability in terms of timing, quantity and location for water users, leading to too much water in some places, too little in others, and degraded water quality in many. Both the IPCC and USGCRP identify water management as a sector with a high risk of severe impacts of extreme events, with large implications for water infrastructure.[43] This precipitation trend is evident in U.S. weather patterns already. According to USGCRP, "in the past century, averaged over the United States, total precipitation has increased by about 7 percent, while the heaviest 1 percent of rain events increased by nearly 20 percent."[44] Over the last 60 years in North Carolina, there has been a 20 percent increase in the frequency of extreme precipitation; and the 24-hour total precipitation from the largest annual rainstorm or snowfall at each weather station increased an average of 12 percent across the state.[45] Increased storm intensity and inland flooding are expected to affect North Carolina,[46] but the 2010 NC SHMP does not acknowledge the increased risk of heavy precipitation events or floods due to climate change. FEMA should not approve North Carolina's 2013 plan unless it includes adequate consideration of this projected impact of climate change in the state.

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[40] Delfino RJ, Brummel S, Wu J, Stren H, Ostro B, Lipsett M, Winer A, Street DH, Zhang L, Tjoa T. 2009. The relationship of respiratory and cardiovascular hospital admissions to the southern California wildfires of 2003. Occupational and Environmental Medicine 66:189-197; and Dennekamp M, Abramson MJ. 2011. The effects of bushfire smoke on respiratory health. Respirology 16:198-209.

[41] North Carolina 2010 SHMP, *supra* note 2 at 2.98 ("Greater Hazards")

[42] US Forest Service, *Effects of Climatic Variability and Change on Forest Ecosystems: A Comprehensive Science Synthesis for the U.S. Forest Sector* 15-17 (Dec 2012), *available at* http://www.fs.fed.us/pnw/pubs/pnw_gtr870/pnw_gtr870.pdf

[43] USGCRP, *supra* note 1, at 41-44; Intergovernmental Panel on Climate Change (IPCC), *Special Report: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* 16 (2012), *available at* http://www.ipcc-wg2.gov/SREX/.

[44] USGCRP *supra* note 1, at 44.

[45] Madsen T, Willcox N. When It Rains, It Pours: Global Warming and the Increase in Extreme Precipitation from 1948 to 2011. Environment America. Available online at: www.environmentamericacenter.org.

[46] Institute for the Environment, *supra* note 13, at 29.

Extreme precipitation events and floods can cause water quality and public health problems, providing opportunities for waterborne pathogens to proliferate.[47] Cities with combined sewer systems are particularly vulnerable, as sewage may intermix with stormwater during heavy rains. Pathogenic parasites such as cryptosporidium and giardia, bacteria such as E. coli and salmonella, and viruses such as hepatitis A can all be found in contaminated waters.[48] Millions of cases of waterborne gastrointestinal illnesses occur annually in the United States.[49] An estimated two-thirds of those cases are associated with extreme rainfall events that can wash pathogens into drinking water supply sources and simultaneously compromise treatment capacity with high water volumes.[50] Since climate change is likely to increase the frequency and intensity of these extreme precipitation events, they could compound both direct flooding and indirect public health consequences and associated costs. However, these health-related costs are not as yet included in the estimates in the draft SHMP. The State would be able to more effectively mitigate flood hazards if the draft SHMP considers the full range of effects of climate change in addition to historical events data.

Integration of climate change into the State Hazard Mitigation Plan

Many of the risks associated with climate change can be mitigated by forward-looking hazard mitigation planning at the state level. The IPCC's recent report on managing the risks of extreme events and disasters highlights that "local response to climate extremes will require disaster risk management which acknowledges the role of climate variability and change and the associated uncertainties and that will contribute to long-term adaptation."[51] At a minimum, FEMA should require that the State addresses climate change in its SHMP through its risk assessment, mitigation goals, and capability assessment.

- *North Carolina's hazard risk assessment*

  In North Carolina's 2010 SHMP, it appears that the State only references historical data in its hazard risk assessments. In the 2013 update, the State should clearly indicate that it is considering climate change impacts and projections in these assessments. Climate change now means that past events are no longer accurate indicators of future risk. When considering climate impacts, the severity, frequency, and affected areas of hazards may change. Climate change projections have significant implications for North Carolina's vulnerability assessment, hazard profiling, and analysis of potential losses. A state vulnerability assessment that relies on

[47] Keim *supra* note 22, at 512.
[48] Natural Resources Defense Council, *Rising Tide of Illness: How Global Warming Could Increase the Threat of Waterborne Diseases* (July 2010), *available at* http://www.nrdc.org/health/files/GWillness4pgr_08.pdf; Jonathan Yoder et al., "Surveillance for Waterborne Disease and Outbreaks Associated with Drinking Water Not Intended for Drinking – United States, 2005-2006," *MMWR Surveillance Summaries* 57(SS09) 39 (2008), *available at* http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5709a4.htm.
[49] J.M. Colford Jr. et al., "A Review of Household Drinking Water Intervention Trials and an Approach to the Estimation of Endemic Waterborne Gastroenteritis in the United States," 4 (Suppl. 2) *J. of Water and Health* 71-88 (2006); M. Messner et al., "An Approach for Developing a National Estimate of Waterborne Disease due to Drinking Water and a National Estimate Model Application," 4 (Suppl. 2) *Journal of Water and Health* 201-240 (2006).
[50] F.C. Curriero et al., "The Association Between Extreme Precipitation and Waterborne Disease Outbreaks in the United States, 1948-1994," 91(8) *American Journal of Public Health* 1194-1199 (2001) (68% percent of waterborne disease outbreaks were associated with extreme rainfall events above the 80th percentile).
[51] IPCC SREX, *supra* note 32, at 300.

both historical event data and climate change projections will lead to more accurate predictions and effective hazard mitigation.

- *Hazard mitigation strategy (Section III)*

  In the upcoming 2013 SHMP, climate change should be more fully integrated into the hazard mitigation objectives and strategies than in the 2010 plan. For example, under Objective 3, to "improve communication, collaboration and integration among stakeholders" and the associated strategies of "outreach to less traditional stakeholders" and "data coordination," the intention to work specifically with climate change experts and climate-related groups should be stated clearly. FEMA can suggest that North Carolina improve its collaboration with stakeholders by making draft plans available for public review and commenting before submitting to FEMA, instead of directing stakeholders to give input based only the previous plan.

  In reference to Objective 4 to "increase public awareness and understanding of risks and mitigation opportunities," the 2013 plan should include a strategy to educate the public about possible changes in frequency, intensity, location, and vulnerability due to climate change. North Carolina residents need to understand that they may begin to experience hazards in a way that does not match the historical record, in order to prepare accordingly.
  Under Objective 5, to "identify and explore feasibility and effectiveness of all-hazard and hazard-specific mitigation measures," the supporting strategy to "identify development trends: address potential for increased exposure to and impact of hazards" should incorporate language specific to climate change. Development trends can be interpreted narrowly as changes in population, but trends in hazard frequency and intensity from climate change must also be addressed specifically.

  Lastly, a new objective should be included in the 2013 SHMP regarding the State's participation in the advancement of climate change science and planning. In the "Long-Term Hazards" section of Appendix A, the plan asserts that the North Carolina Hazard Mitigation Plan will serve as a framework for a statewide adaptation strategy. It also commits the NC Division of Emergency Management (NCEM) to "advancing climate change science, considering the probable impacts, and identifying planning parameters necessary for successful adaptation to climate change and its associated hazards."[52] These commitments should not simply appear in the Appendix – instead they must be fully integrated into North Carolina's hazard mitigation goals, objectives and strategies.

- *Capability assessment (Appendix B)*

  Regarding the capability assessment, FEMA should encourage NCEM to take a leadership role among state agencies to ensure that climate change is properly integrated into hazard mitigation planning. This may include coordinating new or supporting existing interagency groups to establish statewide climate change vulnerability assessments and to recommend new best practices for hazard mitigation. The State should also provide technical assistance to help local governments include climate change in local vulnerability assessments and identify mitigation opportunities. Through the allocation of non-disaster grants, the State can further encourage local governments to consider climate impacts in local hazard mitigation activities.

[52] North Carolina 2010 SHMP, *supra* note 2 at 3.4 ("Long-term Hazards")

In addition, NCEM should also initiate coordination within the state government to implement greenhouse gas emission reduction measures. In the 2010 SHMP, human-caused climate change is recognized as a problem, and the plan emphasizes that "to effectively minimize risks associated with long-term hazards, North Carolina must pursue an integrated approach that includes both mitigation and adaptation. Mitigation refers to efforts to reduce greenhouse gas emissions, while adaptation involves managing impending climate risks."[53] In the upcoming 2013 plan, FEMA should require that NCEM clearly identify partners for collaboration and describe how NCEM plans to engage with these partners to encourage emission reductions.

As the State's hazard mitigation planning efforts move forward, it will be crucial to ensure that risk assessments for hazards are not only based on historical data alone, but also incorporate the latest climate projections. It is critical that the State articulates concrete and measureable goals and actions to ensure that climate change is adequately integrated into state hazard mitigation planning. By establishing a clear understanding of necessary actions and responsibilities to address climate change impacts, the State will be more successful in building resiliency and ensuring public health and safety. We appreciate your consideration of our comments.

Sincerely,

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[53] *Id.*at 3.3