Public Hearing to Examine the Effectiveness of Current Flooding Emergency and Mitigation Efforts; Need for Future Assistance Due to Increase in Extreme Weather Events

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Written Testimony from

CLARKSON UNIVERSITY – SUNY ESF CENTER OF EXCELLENCE IN HEALTHY WATER SOLUTIONS

(CoE HWS)

Stefan J. Grimberg, **PhD**, **P.E.** Clarkson Professor of Civil & Environmental Engineering
Co-Director of the Center of Excellence in Healthy Water Solutions

Stephen B. Shaw, **PhD**, SUNY ESF Associate Professor of Environmental Resources Engineering | Co-Director of the Center of Excellence in Healthy Water Solutions

Lt. Col. Erik Backus, **P.E.**,Clarkson University Lechler Professor of Practice in Civil & Environmental Engineering | Director of Construction Engineering Management

Ian M. Knack, **PhD**, Clarkson University Assistant Professor of Civil & Environmental Engineering

Charles N. Kroll, **PhD**, SUNY ESF Professor of Environmental Resources Engineering

Shane Rogers, **PhD**, Clarkson University Associate Professor Civil & Environmental Engineering

Tyler Smith, **PhD**, Clarkson University Associate Professor of Civil & Environmental Engineering

Michael R. Twiss, **PhD**, Clarkson University Professor & Chair of Biology

Dr. Kelly O. Chezum, MBA, DLP | Clarkson University Vice President for External Relations
Please direct Center visit and media inquiries to: 315-268-4483 | kchezum@clarkson.edu

SUMMARY

Thank you Hon. Senator Rachel May and Hon. Assembly Member Angelo Santabarbara, and members of both chambers on the Commission for Rural Resources for calling this hearing and accepting written testimony to examine the effectiveness of current flooding and mitigation efforts and to discuss the need for future assistance due to the increase in extreme weather conditions.

In March 2019, New York State designated Clarkson University and SUNY College of Environmental Science & Forestry (ESF) to co-lead a new Center of Excellence (CoE) in Healthy Water Solutions to deliver synergistic problem-solving on the wide-range of water issues impacting the Empire State. Clarkson's world-class technical and engineering innovation

expertise in water systems and ESF's renowned expertise in monitoring, watershed ecosystem management and solution development uniquely position the CoE to create and leverage partnerships across the public-private sectors.

New York State's water assets are a source of international identity, points of pride for State and the country, and of strategic importance to the State's global economic position, now and into the future. New York is rich and uniquely diverse in rivers and streams, lakes and ponds, estuaries, the Erie Canal waterways and major coastlines along the Great Lakes and the Atlantic Ocean. Imminent and serious threats to these assets from multiple sources – including flooding -- call for integrated and coordinated efforts to preserve and improve the quality and quantity of clean and healthy water resources and innovations to ensure their protection.

Flooding, one of the most common natural disasters, can occur during any time of the year and occurs due to interactions of precipitation, snowmelt, soils, and land cover / land use. The average annual loss due to flood damage in the United States for the 20-year period from 1981 to 2000 was estimated at $4.3 billion by the U.S. Army Corps of Engineers. However, the economic impact of floods is ultimately linked to the presence of humans and infrastructure. As population and related infrastructure continues to expand along waterways, the economic impact of floods is expected to increase in the future.

In New York, many population centers and their associated infrastructure are concentrated along rivers and their valleys, reflecting the value of water as a resource and the importance of strategies to mitigate risks due to floods. Further, many roadways in New York are located within the Federal Emergency Management Agency's (FEMA) 100-year floodplain.

Climatic change / variability poses a significant challenge in forecasting future floods and has been linked to an increase in the occurrence of historically low frequency (large magnitude) events. However, while it is typical to focus on how precipitation intensity may increase in the future, it is also critical to understand how precipitation may change in conjunction with other factors. Across New York, these causative flood mechanisms can vary even across relatively short distances.

In the following testimony, we present examples of how faculty affiliated with the Clarkson – SUNY ESF Center of Excellence in Healthy Water Solutions are currently actively engaged in filling the knowledge gaps to develop improved tools to determine the flooding impact on New York State infrastructure, the environment and the economy.

The Center of Excellence in Healthy Water Solutions received an initial funding allocation of $125,000 in last year's budget. In the first 10 months, the CoE HWS has made significant outreach to public-private stakeholders in healthy water solutions across the state. Based on early input and resources, the Center has ignited new provisional patents addressing Harmful Algae Blooms and field tested new innovative technologies to treat PFAS/PFOS. Responses to requests for support to better manage landscapes to reduce loading of stressors to and from water bodies, including flood prediction and mitigation are also in progress. **Full funding for the Center of Excellence in Healthy Water Solutions and all CoEs to $1,000,000 per year**

would significantly increase the Center's contributions towards preparing NY State to an ever changing environment in protecting public health from flooding and landscape management challenges.

RISK ANALYSIS/ FORECASTING

Flooding is often due to the interaction of precipitation with other causative factors such as snowmelt or wet soils. Traditional approaches to flood frequency analysis do little to consider possible changes in future flood causation. An analysis of historical climate and hydrologic records can identify how this interaction of causative factors is changing in time in order to help inform the risk of future floods. For instance, recent work by Dr. Stephen Shaw (SUNY ESF) indicates that spring flood peaks are generally occurring earlier in the year in the western and central part of the state while occurring later in the Hudson Valley. This has been linked to an increase in magnitude of spring flood peaks in the Hudson Valley but no change in western and central New York. This work was recently presented in an invited talk at the American Meteorological Society annual conference. Gaining new knowledge of flood causation is essential for correctly understanding changes in future flood risk in New York in a changing climate.

The National Water Model is a recently developed modeling framework that complements existing National Weather Service flood forecast models while also providing potential flood forecast information at other locations that do not have traditional model forecasts. In New York, about 100 locations on large rivers and waterways have traditional flood forecasts, but the vast majority of streams and rivers in more remote locations (including rural areas), do not have flood forecasts. Dr. Charles Kroll (SUNY ESF) is currently comparing the National Water Model to observations of low stream flows during droughts as part of a NOAA funded project. However, future work could include the assessment of the National Water Model against high stream flows to assess the potential for making flood predictions for numerous inland waterbodies across the state, not just large rivers.

Forecasting flooding in northern climates where rivers and streams are susceptible to ice jams is complicated and confronted with significant uncertainties. In the U.S., ice jams cause an estimated loss of $120 million annually (White et al. 2007). In New Brunswick, Canada, ice jams account for 2/3 of the total damage from flooding although they account for only 1/3 of total flood events (Humes and Dublin, 1988). Ice-related flooding events are extremely variable and difficult to evaluate in terms of typical flood analyses (e.g., frequency / recurrence) and commonly result in more severe impacts (higher water levels, greater damage) than similar magnitude events occurring under open water conditions. Dr. Ian Knack (Clarkson) has worked with a number of industrial partners (HATCH, ltd, New Brunswick Power) and government agencies (New Brunswick Department of Transportation and Infrastructure as well as the New York Power Authority) to conduct studies using numerical models to understand and evaluate flood risk, potential flood levels under extreme events, and the development of operational and forecast tools to assist city planners and emergency response personnel. In the North Country, on the St. Regis Mohawk Reservation (SRMR) located at the downstream end of the St. Regis River Drs. Hung Tao Shen (Clarkson) and Fengbin Huang (Clarkson) with support by SRMR analyzed historical data and conducted numerical models to evaluate the impact of the

Hogansburg Dam removal on the ice transport, jamming process as well as possible flooding mitigation.

Hydrologic prediction, as a fundamental tool for water resource management and decision-making and an integral part of the economy, affect all of society (e.g., health and safety, agriculture, hydropower, insurance, recreation and tourism, etc.). Yet, there remains significant progress to be made in deploying best practices from research to industry, particularly with respect to developing an understanding of how to verify forecasts and how to use this information to manage risk and inform the public.

INTEGRATION OF USER-INSPIRED R&D IN COMMUNITIES

Because of this, communicating the importance and limitations of hydrologic forecasts for water resources management under uncertainty and change is paramount. However, a large majority of the public only actively thinks about hydrology under failure-driven scenarios; even fewer about how forecasts are produced and why they might fail. Dr. Tyler Smith (Clarkson) is working to address these gaps through targeted activities, supported by the Beacon Institute for Rivers and Estuaries, to engage school children in Beacon, NY, to become stewards of their water resources and to learn about the importance of forecasting through participatory modeling activities. These models are transferrable across the State and ignite career interests in the next generation of climate change problem solvers.

With community needs identified by Assemblymember Santabarbara, faculty from the CoE in Healthy Water Solutions and K-12 groups have been in discussions with the NYS Department of Transportation and its Human Resources Office, as well as miSci, the museum of Science and Innovation in Schenectady, to initiate the pilot of a “Statewide Ice Jam Challenge” designed to ignite citizen science through groups of high school students teamed with university researchers and students to both expand the current knowledge base and find new transferable solutions. As currently framed, the Ice Jam Challenge will be designed as a hands-on practical research and engagement experience that ignites new ways of thinking and creating solutions, mirroring the complex challenges and problem solving processes that field experts and agencies like the DOT face everyday. The inclusion of the CoE for Healthy Water Solutions will provide a pathway for solution ideas that emerge from this project to be further reviewed and tested to benefit NYS and the municipalities impacted by ice jams.

LIMITING THE MOBILIZATION OF CONTAMINANTS

Flooding poses unique risks to rural communities and agricultural operations that are amplified by their increased economic vulnerability and relatively limited services for recovery efforts. For example, recurrent flooding in rural North Carolina in response to the increasing intensity and frequency of hurricanes evidence the economic, environmental, and catastrophic water quality damage that can be caused at the interface of flooding and industrial livestock agriculture. Even as recent as Hurricane Florence (2018), several open-air anaerobic lagoons in the state were damaged or toppled, leading to the discharge of millions of gallons of livestock manure directly into the waterways of the state. Dr. Shane Rogers (Clarkson and formerly U.S.

EPA) provided key expert testimony in the U.S. District Court in North Carolina regarding environmental pollution and risks associated with open-air manure storage structures at large concentrated animal feeding operations that led to five successful trial outcomes and a pledge by the corporate hog producer to change its waste handling practices to reduce risks and improve quality of life for its neighbors.

Tangents can be drawn to New York State, which has also seen an increase in storm intensity and frequency, including damaging hurricanes that affect rural communities and urban centers alike. However, there has been increased interest in the State of New York to implement anaerobic digestion, and other technologies, for recycling livestock wastes and resource recovery at large dairy operations. Drs. Rogers and Stefan Grimberg (Clarkson) have worked with local dairy producers to promote anaerobic digestion technology and implement improvements to existing systems such as co-digestion of food wastes from regional industries. Benefits of the technology are several, and include lower odor production, waste stabilization and pollution prevention, covers over the waste treatment system that make them more resilient to rainfall and flooding, production of natural gas and electricity from wastes, solids recycling for safe, sustainable, and low-cost bedding of dairy cows, and improved nutrients recovery and efficiency of anaerobic digesters that reduce the environmental risks of farming. Through a series of successful grants funded through the U.S. EPA and USDA, they have also designed, implemented, and extend with the assistance of Cornell Cooperative Extension Services unique small farm anaerobic digestion technologies that provide similar benefits to producers with lower numbers of dairy animals seeking to take advantage of the technology.

Beyond impacts directly associated with flood damage, an additional consequence of flooding is the mobilization of contaminants into waterways as a result of runoff, erosion and/or changes in microbial communities due to inundation. Runoff of pollutants such as fertilizer nutrients and fecal bacteria from rural landscapes and agricultural operations driven by storm water threaten the quality of water resources in New York State, and of the shared resources of the Great Lakes. Indeed, the releases of manure to waterways of the state of North Carolina during Hurricane Florence that occurred from runoff from farm fields following the massive drain-down of open manure storage structures state-wide just prior to the hurricane (an attempt to prevent them from over-toppling) almost certainly outweighed that directly discharged in lagoon breaches. Prior work of Dr. Rogers with the U.S.EPA has demonstrated the efficacy of several different landscape management practices for reducing nutrients and pathogens in runoff from agricultural fields in Iowa, North Carolina, Indiana, Ohio, and New York. In New York, winter conditions can amplify problems of runoff when manure is applied to frozen or snow-covered ground, but the risks can be reduced with well-designed landscape interventions as evidenced by prior work of Dr. Rogers in Ohio, and by recent work of Dr. Rogers and Dr. Grimberg in Northern New York, in conjunction with researchers at the Miner Institute. Recent work by Dr. Michael Twiss (Clarkson) has identified the mobilization of mercury into the water column due to water level fluctuations in the Upper St. Lawrence River, a phenomenon that has also been identified in the Great Lakes region in general.

The relevancy of water resources to society cannot be overstated. Understanding the mechanisms that result in floods and developing strategies to accurately and efficiently

forecast floods under a non-stationary climate is paramount to the implementation of effective mitigation strategies. The current state of flooding emergency and mitigation across NYS is not sufficient to the anticipated future flooding scenarios in various ways.

RESILIENCE PLANNING

Specific to emergency planning and operations in a flooding event, there are several areas for improvement that interface of Clarkson's construction engineering program with the CoE, in particular, is poised to address. One area of struggle is in the area of resilience planning and asset management. Most communities continue to struggle to develop robust capacity to build resilience for most hazards, especially flooding. This kind of capacity building is something Clarkson exemplifies through such efforts as the partnership with the Ogdensburg Bridge and Port Authority (OBPA) and with local municipalities from the Town of Sherburne to the Town of Halfmoon to the Village of Lake Placid to the City of Schenectady. When speaking about Clarkson's efforts to better manage their assets, former OBPA Executive Director Wade Davis repeatedly has asserted, "The Clarkson Partnership is the most exciting thing we are doing, from my viewpoint." Chase Winton, Highway Superintendent for the Town of Sherburne, credits the work done by Clarkson to help map his culverts and watersheds, as greatly reducing road failures from flooding in his community. Such resilient capacity building is critical in light of worsening flood events across NYS.

During such events, temporary construction and the skills to rapidly assess the causes and degree of damage occurring in flood events is another skill set that Clarkson has great depth in. From open channel hydraulic modelling of the events, to rapid assessment and repair technical skills. Specific to the later, Erik Backus, Executive Officer of Clarkson's Civil and Environmental Engineering Department, served for 20 plus years as an officer in the US Army Corps of Engineers, with specific experience in riverine damage repair and construction. Further, through Clarkson's wide-ranging network, including senior leadership in marine construction and design firms, enables it to leverage technical and managerial capacity for flood damage mitigation and repairs.

CONCLUSION

Thank you again to the Hon. Rachel May and the Hon. Assemblymember Angelo Santabarbara and other Commission members and staff for the opportunity to present testimony at this hearing. As researchers who collaborate with public-private sector leaders and as educators of the next generation of technology leaders, we take seriously the public trust from the investments we receive. As emerging problems and projects are identified, we welcome full funding in the FY 2020-21 budget of the Center of Excellence in Healthy Water Solutions to provide additional support and expertise to align with the State's and people's priorities.

We believe that together we must show the world what New Yorkers can do in this important work to protect and preserve healthy waters – it's the work the rest of the world is depending upon New Yorkers to lead.