THE Water Research FOUNDATION

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REQUEST FOR PROPOSALS (RFP)

Holistic and Innovative Approaches for Flood Mitigation Planning and Modeling under Extreme Wet Weather Events and Climate Impacts (RFP 5084)

Due Date: Proposals must be received by 2:00 pm Mountain Time on
Thursday, October 29, 2020
WRF Project Contact: Harry Zhang, PhD, PE, hzhang@waterrf.org

Project Sponsors
This project is funded by The Water Research Foundation (WRF) as part of WRF's Research Priority Program.

Project Objectives
- Develop a synthesis document and guidebook for utilities and municipalities on holistic approaches to flood mitigation planning and modeling under extreme wet weather events and climate impacts.
- Demonstrate the use of an integrated planning framework in support of holistic flood management and mitigation planning with case studies at the community level.
- Synthesize the state-of-the-practice and provide guiding principles for integrated hydrologic and hydraulic (H&H) modeling systems that can be used for flood scenario modeling and mitigation planning to support decision making by utilities and municipalities.

Budget
Applicants may request up to $100,000 in WRF funds for this project. WRF funds requested and total project value are evaluation criteria considered in the proposal selection process.

Background and Project Rationale
An urban stormwater and wastewater planning workshop, including a broad spectrum of participants from utilities and municipalities, entitled "Climate-Resilient Planning for Urban Stormwater and Wastewater Utilities" was held on July 16-17, 2019. Principle among the workshop's conclusions was the recognition that "*intense precipitation events are occurring more frequently in many parts of the United States … and the frequency of such events is expected to increase as average global temperatures continue to rise. Even in regions where the frequency and intensity are not increasing, damaging and disruptive flooding, reduced drinking water and receiving water quality, and wastewater overflows put lives, property, and environmental assets at risk. In coastal regions, storm surge and sea level are compounding risks that can both cause and exacerbate serious flooding. These extreme events also have exposed important gaps in planning when it comes to effective urban stormwater and wastewater management in a changing climate.*"

Cities and utilities are beginning to do more to plan for extreme precipitation, but these efforts have been uneven at best and do not yet reflect a technical consensus on best practices for holistic analysis or planning. Additionally, it is difficult to find examples of integrated planning frameworks that consider flooding. Even in cases where utilities considered flooding as part of their integrated planning frameworks (e.g., City of Burlington, VT; City of Santa Maria, CA; and Onondaga County, NY), there was no flood scenario analyses performed in their case studies. Thus, the flood impacts were not quantified to support holistic flood management. Indeed, many cities are struggling to bridge the gap for connecting integrated planning frameworks with urban flood impact and mitigation planning. Furthermore, cities and utilities are often operating with inadequate data and information when analyzing and managing stormwater flows during intense precipitation events. Urban flooding is difficult to estimate and manage in the absence of practical modeling systems for decision-making support along with information on observed and projected extreme precipitation, streamflow, and system flows on an appropriate time scale.

In general, modeling issues and a lack of practical guiding principles place serious limitations on cities and utilities seeking to perform holistic flood management and integrated planning that incorporate climate projections. Neither statistical nor dynamic downscaling of global climate model (GCM) outputs can as yet provide actionable projections of extreme precipitation at the required spatial or time scales for municipalities to perform stormwater and flood mitigation planning. These limitations also challenge their ability to estimate the potential benefits of stormwater projects intended to mitigate flood impacts.

There is a strong need for cities and utilities to collaborate on developing holistic approaches to flood management and mitigation planning that account for the compounded uncertainties associated with climate impacts, future population growth (or decline), land use changes, and economic development.

Five knowledge gaps were identified where further research is needed:

- Integrating the governance of stormwater management, drainage system design, and flood risk assessment and mitigation with existing regulatory frameworks and requirements, particularly in the face of competing objectives.
- Developing approaches and analytical methods that transcend traditional “design storm” approaches that assume a stationary climate, and instead focus on approaches that minimize overall vulnerabilities.
- Improving integrated models for characterizing current and future flooding risks and evaluating strategies to enhance flood mitigation.
- Estimating benefits, co-benefits, and return on investment for both overall integrated flood management strategies and individual stormwater projects.
- Communicating uncertainty, risks, benefits, and trade-offs to regulators, stakeholders, and investors.

Research Approach

Task 1: Perform Research on State-of-the-Practice and Innovative Approaches for Holistic Flood Management and Flood Scenario Modeling

The research team will conduct a comprehensive literature review on holistic approaches to flood management, including flood scenario modeling and climate projection, across different climate regions at a national scale in the United States. Case studies from other countries (e.g., Canada, UK/European countries, and Australia) will be reviewed as well.

In addition, the research team will evaluate innovative approaches for holistic flood management under the U.S. Environmental Protection Agency's Integrated Municipal Stormwater and Wastewater Planning Approach Framework, and international frameworks and best practices.

Building on the outcomes of the July 2019 workshop and other ongoing studies, the research team will conduct more in-depth phone conversations/interviews with selected utilities/municipalities across geographic regions globally.

Topics and research questions to be considered in this study should include:

- How can an integrated planning framework be applied in proactive flood management? What are the barriers (e.g., regulatory, financial) to integration, and what strategies and support systems are available to address and overcome them?
- What are the advantages and limitations of hydrologic and hydraulic (H&H) modeling and planning tools for flood management, ranging from traditional engineering approaches to more sophisticated simulation models? What existing inputs and approaches have been used or are available for projecting future rainfall patterns, including extreme events, and land use changes? What scales and time sensitivities are required for these inputs to provide robust and accurate information for planning purposes? How should utilities consider and resolve the tradeoffs between model resolution and cost/computational intensity? In addition, consideration should be given to how fast an answer is needed for supporting decision making, and how accurate the modeling result needs to be.
- What precipitation, climate-informed, and sea level rise scenarios should be considered for flood modeling and mitigation planning?
- How should both direct economic impacts and co-benefits of stormwater projects be assessed, and what tools are available to support an integrated planning process (such as the one incorporated into the Water Infrastructure Improvement Act amendments to the Clean Water Act signed into law in January 2019)?
- How can cities and utilities effectively communicate the risks and uncertainty surrounding extreme weather events, and the costs, direct benefits, and co-benefits of both overall integrated flood management strategies and individual stormwater projects, to regulators, customers, and investors to garner support for implementing both?

Task 2: Conduct an Invitation-Only Interactive Virtual Workshop

The research team will host an invitation-only virtual workshop, which will include the Project Advisory Committee (PAC), representatives from participating utilities, WRF's collaborators and partners, and other invitees recommended by WRF. This interactive workshop is anticipated to be approximately one half-day (e.g., four hours), including possible use of a virtual breakout session, panel discussion, real-time polling, or other creative ways to facilitate the discussion among workshop participants.

The research team will prepare the workshop agenda, facilitate the virtual discussion, and prepare a document containing a summary of the workshop discussions. In addition, the research team will gather information on real-world case studies and best practices on holistic flood management and flood scenario modeling to be included in a "state-of-the-practice" synthesis, and preliminary project concepts based on knowledge gaps identified during Task 3.

Task 3: Prepare a Guidance Document with a "State-of-the-Practice" Synthesis

The research team will develop an interactive guidance document for holistic approaches to climate-informed flood management, flood scenario modeling, and cost-effective flood mitigation strategies,

including regulatory drivers and modeling tools, inputs for extreme wet weather events and climate impacts, and infrastructure-based (green and gray) solutions for flood mitigation under observed and future conditions.

A user-friendly guidance document with a state-of-the-practice synthesis will include the following:

- Flood mitigation planning and modeling tools for holistic flood management, including guiding principles on flood scenario modeling, with example case studies across climate and geographic regions in the U.S., and a summary of best practices from other countries.
- Flood modeling methodologies and climate-informed inputs (including a recommended list of storm scenarios and sea level rise scenarios for coastal communities) that can be developed and applied cost-effectively to evaluate various mitigation alternatives.
- Strategies for engaging stakeholders, regulators, and investors, along with strategies for public dissemination of critical technical information (e.g., which storm scenarios and associated flood risk analyses can be distributed publicly without burdening utilities?).
- User-friendly communication product (e.g., short video) on holistic flood management and flood scenario modeling.
- Emerging research needs for future consideration, along with recommendations for preliminary research project concepts that can help address these future research needs.
- All supporting documents (e.g., papers, reports, other types of publications and summary notes from phone conversations with selected utilities and municipalities).

Task 4: Community Outreach

For broader community outreach, the research team will conduct two webcasts hosted by WRF and collaborating organizations on the overall findings of this project.

The research team is encouraged to present the project findings at conferences whenever possible (without support from the project funding).

Expected Deliverables

- A stand-alone, comprehensive literature review summary document with annotations for the list of publications and resources used for the evaluation of the state-of-the-practice and innovative case studies.
- An invitation-only virtual workshop, along with logistics planning and all supporting materials (e.g., agenda, presentations, meeting notes, synthesis document).
- A user-friendly guidance document with a state-of-the-practice synthesis, which will be based on a combination of the literature review, web search, virtual workshop, and phone interviews with selected utilities, for holistic flood management with guiding principles on flood scenario modeling, along with real-world case studies on successful utilization of modeling tools to support decision making.
- A stand-alone document that summarizes the knowledge gaps, research needs, and preliminary project concepts for recommended research projects.
- Webcasts and conference presentation materials.
- Two short online videos on the project that can facilitate public communications.

Communication Plan

Please review WRF's *Project Deliverable Guidelines* for information on preparing a communication plan. The guidelines are available at https://www.waterrf.org/project-report-guidelines. Conference

presentations, webcasts, peer review publication submissions, and other forms of project information dissemination are typically encouraged.

Project Duration
The anticipated period of performance for this project is 24 months from the project start date.

References and Resources
The following list includes examples of research reports, tools, and other resources that may be helpful to proposers. It is not intended to be comprehensive, nor is it a required list for consideration.

Lampe, L., H. Andrews, M. Barrett, B. Woods-Ballard, P. Martin, C. Glass, N. Weinstein, and C. Jefferies. (2004). *Post-Project Monitoring of BMPs/SUDS to Determine Performance and Whole Life Costs.* Project 01-CTS-21T. Alexandria, VA: Water Environment Research Foundation; and London: IWA Publishing. https://www.waterrf.org/research/projects/post-project-monitoring-bmpssuds-determine-performance-and-whole-life-costs.

Marlow, D., D. Beale, and S. Gould. 2014. *Practitioner's Guide for Economic Decision Making in Asset Management: Part 1: Background*. Alexandria, VA: Water Environment Research Foundation; and London: IWA Publishing. Project SAM1R06b1. https://www.waterrf.org/research/projects/practitioners-guide-economic-decision-making-asset-management-part-i-background.

Marlow, D., D. Beale, and S. Gould. 2014a. *Practitioner's Guide for Economic Decision Making in Asset Management: Part II: Guidance*. Project SAM1R0b2. https://www.waterrf.org/research/projects/practitioners-guide-economic-decision-making-asset-management-part-ii-guidance.

National Academy of Sciences. 2019. *Framing the Challenge of Urban Flooding in the United States*. Washington, DC: The National Academies Press. http://www.nap.edu/catalog/25381/framing-the-challenge-of-urban-flooding-in-the-united-states.

National Academy of Sciences. 2020. *Incorporating the Costs and Benefits of Adaptation Measures in Preparation for Extreme Weather Events and Climate Change Guidebook*. Washington, DC: The National Academies Press. https://www.nap.edu/catalog/25744/incorporating-the-costs-and-benefits-of-adaptation-measures-in-preparation-for-extreme-weather-events-and-climate-change-guidebook.

NYCDEP (New York City Department of Environmental Protection). 2019. *Innovative and Integrated Stormwater Management*. NYCDEP. https://www.waterrf.org/resource/innovative-and-integrated-stormwater-management.

NOAA (National Oceanic and Atmospheric Administration). 2020. "Water Resources Dashboard." https://toolkit.climate.gov/topics/water/water-resources-dashboard.

NOAA (National Oceanic and Atmospheric Administration). 2020a. "U.S. Climate Resilience Toolkit - Case Studies." https://toolkit.climate.gov/case-studies.

NOAA (National Oceanic and Atmospheric Administration). 2020b. Digital Coast – Tools. "Coastal Flood Exposure Mapper." https://coast.noaa.gov/digitalcoast/tools/flood-exposure.html. and "Sea Level Rise Viewer." https://coast.noaa.gov/digitalcoast/tools/slr.html.

NOAA (National Oceanic and Atmospheric Administration). 2020c. "The Climate Explorer." https://crt-climate-explorer.nemac.org/.

U.S. EPA (U.S. Environmental Protection Agency). 2012. *Integrated Municipal Stormwater and Wastewater Planning Approach Framework*. https://www.epa.gov/npdes/integrated-municipal-stormwater-and-wastewater-planning-approach-framework.

U.S. EPA (U.S. Environmental Protection Agency). 2014. *Greening CSO Plans: Planning and Modeling Green Infrastructure for Combined Sewer Overflow (CSO) Control*. EPA Report 832-R-14-001. https://www.epa.gov/sites/production/files/2015-10/documents/greening_cso_plans_0.pdf.

U.S. EPA (U.S. Environmental Protection Agency). 2017. *Prioritizing Wastewater and Stormwater Projects Using Stakeholder Input*. Report Number EPA 830-R-17-002. https://www.epa.gov/npdes/prioritizing-wastewater-and-stormwater-projects-using-stakeholder-input.

WRF (The Water Research Foundation). 2020. *Climate-Resilient Planning for Urban Stormwater and Wastewater Utilities: Workshop Proceedings* and *An Action Agenda for the Water Sector to Advance Methods for Achieving Integrated Climate Resilience: Supplement to the Workshop Proceedings*. https://www.waterrf.org/research/projects/climate-resilient-planning-urban-stormwater-and-wastewater-utilities-workshop.

WRF (The Water Research Foundation). 2020a. "Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC)." Project 4978. https://www.waterrf.org/clasic.

WRF (The Water Research Foundation). 2020b. *User's Guide for Integrated Wastewater and Stormwater Planning*. Project 4854/SIWM9R14. Alexandria, VA: WRF. https://www.waterrf.org/research/projects/toolbox-completing-alternatives-analysis-part-integrated-planning-approach-water.

WRF (The Water Research Foundation). Forthcoming. *Enhancement of Resilience to Extreme Weather and Climate Events: Proactive Flood Management.* Project 4842/SIWM-17-15. https://www.waterrf.org/research/projects/enhancement-resilience-extreme-weather-and-climate-events-proactive-flood.

Proposal Evaluation Criteria

The following criteria will be used to evaluate proposals:

- Understanding the Problem and Responsiveness to RFP (maximum 20 points)
- Technical and Scientific Merit (maximum 30 points)
- Qualifications, Capabilities, and Management (maximum 20 points)
- Communication Plan, Deliverables, and Applicability (maximum 15 points)
- Budget and Schedule (maximum 15 points)

Proposal Preparation Instructions

Proposals submitted in response to this RFP must be prepared in accordance with the WRF document *Guidelines for Research Priority Program Proposals*. The current version of these guidelines is available

at https://www.waterrf.org/proposal-guidelines, along with *Instructions for Budget Preparation*. The guidelines contain instructions for the technical aspects, financial statements, indirect costs, and administrative requirements that the applicant must follow when preparing a proposal.

Eligibility to Submit Proposals
Proposals will be accepted from domestic or international entities, including educational institutions, research organizations, governmental agencies, and consultants or other for-profit entities.

WRF's Board of Directors has established a Timeliness Policy that addresses researcher adherence to the project schedule. The policy can be reviewed at https://www.waterrf.org/policies. Researchers who are late on any ongoing WRF-sponsored studies without approved no-cost extensions are not eligible to be named participants in any proposals. Direct any questions about eligibility to the WRF project contact listed at the top of this RFP.

Administrative, Cost, and Audit Standards
WRF's research program standards for administrative, cost, and audit compliance are based upon, and comply with, Office of Management and Budget (OMB) Uniform Grants Guidance (UGG), 2 CFR Part 200 Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, and 48 CFR 31.2 Contracts with Commercial Organizations. These standards are referenced in WRF's *Guidelines for Research Priority Program Proposals*, and include specific guidelines outlining the requirements for indirect cost negotiation agreements, financial statements, and the Statement of Direct Labor, Fringe Benefits, and General Overhead. Inclusion of indirect costs must be substantiated by a negotiated agreement or appropriate Statement of Direct Labor, Fringe Benefits, and General Overhead. Well in advance of preparing the proposal, your research and financial staff should review the detailed instructions included in WRF's *Guidelines for Research Priority Program Proposals* and consult the *Instructions for Budget Preparation*, both available at https://www.waterrf.org/proposal-guidelines.

Budget and Funding Information
The maximum funding available from WRF for this project is $100,000. The applicant must contribute additional resources equivalent to at least 33 percent of the project award. For example, if an applicant requests $100,000 from WRF, an additional $33,000 or more must be contributed by the applicant. Acceptable forms of applicant contribution include cost-share, applicant in-kind, or third-party in-kind that comply with 2 CFR Part 200.306 cost sharing or matching. The applicant may elect to contribute more than 33 percent to the project, but the maximum WRF funding available remains fixed at $100,000. **Proposals that do not meet the minimum 33 percent of the project award will not be accepted.** Consult the *Instructions for Budget Preparation* available at https://www.waterrf.org/proposal-guidelines for more information and definitions of terms.

Period of Performance
It is WRF's policy to negotiate a reasonable schedule for each research project. Once this schedule is established, WRF and its sub-recipients have a contractual obligation to adhere to the agreed-upon schedule. Under WRF's No-Cost Extension Policy, a project schedule cannot be extended more than nine months beyond the original contracted schedule, regardless of the number of extensions granted. The policy can be reviewed at https://www.waterrf.org/policies.

Utility and Organization Participation
WRF encourages participation from water utilities and other organizations in WRF research. Participation can occur in a variety of ways, including direct participation, in-kind contributions, or in-

kind services. To facilitate their participation, WRF has provided contact information, on the last page of this RFP, of utilities and other organizations that have indicated an interest in this research. Proposers are responsible for negotiating utility and organization participation in their particular proposals. The listed utilities and organizations are under no obligation to participate, and the proposer is not obligated to include them in their particular proposal.

Application Procedure and Deadline

Proposals are accepted exclusively online in PDF format, and they must be fully submitted before 2:00 pm Mountain Time on Thursday, October 29, 2020. All proposal documents must be compiled into two PDF files consisting of your technical review documents and your financial review documents. All forms and components of the proposal are available in the *Proposal Component Packet* zip file on the proposal website at https://proposals.waterrf.org/Pages/RFPs.aspx. An FAQ and a tutorial are also available. A login is required to access the proposal website and download the packet. Proposers are encouraged to create logins and verify the validity and compatibility of the system well in advance in order to avoid last-minute errors or delays.

The online proposal system allows submission of your documents until the date and time stated in this RFP. To avoid the risk of the system closing before you press the submit button, do not wait until the last minute to complete your submission.

Questions to clarify the intent of this RFP and WRF's administrative, cost, and financial requirements may be addressed to the WRF project contact, Harry Zhang, PhD, PE, at (571) 384-2098 or hzhang@waterrf.org. Questions related to proposal submittal through the online system may be addressed to Caroline Bruck at (303) 347-6118 or cbruck@waterrf.org**.**

5084 Utility and Organization Participants

The following utilities have indicated interest in possible participation in this research. This information is updated within 24 business hours after a utility or an interested organization submits a volunteer form, and this RFP will be re-posted with the new information. **(Depending upon your settings, you may need to click refresh on your browser to load the latest file.)**

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