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## GULF STATES POLICY INSTITUTE

February 17, 2020

Patti Wallace  
Purchasing Director, Sewerage and Water Board of New Orleans  
625 St. Joseph Street, Room 131  
New Orleans, LA 70165

Subject: Written Response and Firm Profile for Integrated Master Planning RFI

Dear Ms. Wallace,

Please find attached a response to the Sewerage and Water Board's request for information about Integrated Master Planning, dated January 31, 2020.

RAND is a nonprofit, nonpartisan, independent policy research organization that uses rigorous, evidence-based research and analysis to help communities throughout the world become safer, more secure, healthier and more prosperous. For more than 50 years, we have worked with cities to enhance public health, strengthen emergency services, improve safety and justice, and solve pressing infrastructure challenges, such as those facing the SWBNO.

The RAND Corporation, through our Gulf States Policy Institute here in New Orleans, is very interested in participating in this RFI process and any future workshops. We would be honored to bring our experience and commitment to the city to bear on the needs of the SWBNO.

Sincerely,

Gary Cecchine  
Director of Research, RAND Gulf States Policy Institute

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# **Written Response and Firm Profile for Integrated Master Planning, Sewerage and Water Board of New Orleans**

## **RAND Corporation, Gulf States Policy Institute**

February 17, 2020

### **Key Points**

In this response, we wish to establish two points. First, the challenges facing the Sewerage and Water Board of New Orleans (SWBNO), while daunting, can be approached transparently, systematically, and productively using an innovative, adaptive planning method capable of yielding an actionable plan. Second, we wish to establish that RAND and our Gulf States Policy Institute in New Orleans is well-positioned to assist SWBNO in each of the three phases of its integrated master planning process. Since the early 2000s, RAND analysts have been facilitating broad, participatory decision-making and implementation through a process that builds legitimacy, trust, and cooperation on a foundation of state-of-the-art analytics –features sorely lacking in much of the nation’s planning for major public investments. RAND is known for its objectivity, quality, and analytical rigor. It also is free of financial conflicts of interest, particularly important for such a wide-ranging integrated planning effort as envisioned by the SWBNO.

RAND can help guide SWBNO in implementing a well-tested planning approach known as Robust Decision Making (RDM). RDM emphasizes early and frequent engagement with stakeholders and decision-makers and makes use of advanced analytical tools to facilitate discussions of alternatives under a range of future scenarios. Rather than planning and designing to a specific realization of the future, an RDM-guided planning effort instead helps stakeholders and decisionmakers to build pragmatic plans that will be robust across a wide range of possible futures, avoiding the common shortcoming of many plans optimized for a single projection of the future.

RDM can be particularly helpful in navigating decision-making logjams when problems and solutions cross jurisdictional and bureaucratic boundaries. Using unique, state-of-the-art analytics in a proven process of stakeholder engagement, RDM can help create and build consensus around farsighted plans that can be adopted, implemented, and sustained. RDM “stress-tests” how well proposed infrastructure would perform across many future scenarios (including changes in governance, finance, policy, and extreme weather patterns). This process helps to build shared understanding of how plans meet and miss goals and generate consensus on potential responses to any vulnerabilities. RDM puts information and thus power in the hands of stakeholders by making data, simulations, and visualizations accessible in a comprehensive, easy-to-use on-line application. RDM also relies on stakeholder deliberations intended to build trust in the analysis and the process; and paves the way for decisionmakers to propose, defend, and implement their decisions.

## RAND's Experience in Long-term Water Planning<sup>1</sup>

Over the last 15 years, RAND has honed RDM and other decision support methods on numerous applications of long-term water planning in the United States and abroad. Supported by a 2004 grant from the National Science Foundation, RAND worked with a water agency in southern California to help its managers and political leadership to grasp the [implications of a changing climate on reliability of their water supply for a growing population and economy](#). The research showed that when confronted not only with a problem but with potential solutions, water managers were more likely to view adaptation to a changing climate - however uncertain and daunting - as manageable.

This work led to a series of innovative RAND studies on [long-term water resources planning for the state of California](#), the [Colorado River Basin](#); [New York City](#) and Jamaica Bay; the [San Francisco Bay-Delta](#); southeast Florida; [Lima, Peru](#); [Africa](#); [Jinan, China](#); and [Ho Chi Minh City](#). Some of this international work was funded by the World Bank. All projects were driven by near- and long-term concerns about coastal flooding and other impacts against the backdrop of climate change and rising seas. In each case, RAND's recommendations and decision support tools shaped major strategic planning and implementation pathways. References describing some of these engagements are provided at the end of this response.

RAND has been a key partner in helping the Louisiana Coastal Protection and Restoration Authority (CPRA) develop its long-term [Coastal Master Plan for a Sustainable Coast](#). Updated every five years at the direction of the state legislature, the state's master plan provides a 50-year blueprint for coastal restoration and flood risk reduction projects coastwide. RAND supported the development of the 2012 and 2017 Coastal Master Plans and is actively supporting the 2023 Plan. This has been done through two separate, but related efforts:

- Development of a decision framework and [Planning Tool](#) used to compare projects and formulate the specific plan; and
- Development and application of the [Coastal Louisiana Risk Assessment \(CLARA\)](#) model to evaluate flood risk across the coast under future without action conditions and with different structural and nonstructural projects in place.

Louisiana's Coastal Master Plan provides a successful example of how integrated, objective, analytic-based planning can address difficult multi-dimensional water planning challenges. The analytic infrastructure that RAND contributed, including the Planning Tool and the CLARA model, has helped CPRA take steps to secure long-term funding, refine its near-term implementation strategy, and adapt the Master Plan over time as assumptions change. The 2014 report [Strengthening Coastal Planning](#) summarizes RAND's contributions for the 2012 Coastal Master Plan and discusses potential applications in other regions of the world.

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<sup>1</sup> Please note there are hyperlinks embedded in this text for more information. An annotated list of selected references is provided at the end of this response document.

In our work for CPRA and in the previous engagements cited above, planners were faced with multiple and often competing public goals. Our experience has shown that a technically sound, credible, and durable planning process is built on a foundation of explicit goal-making and metrics associated with goals. A range of options can then be rigorously analyzed on the same level playing field of technical feasibility and assumptions regarding governance, finances, and regulatory policy.

## **RAND's Proposed Approach to SWBNO's Integrated Planning Process**

The RFI sets forth three phases of planning: pre-planning, vision and strategy, and system planning. Phase 1 consists of information gathering, the RFI process itself, and subsequent workshops. The emphasis in Phase 2 is on community visioning, outreach, and the development of the Utility Strategic Plan. Finally, Phase 3 will bring the work of the earlier phases together in an integrated plan for drinking water, wastewater, stormwater, and power systems. RAND has the experience and expertise to assist in each phase.

The RFI also requests responses to any combination of three questions related to New Orleans' biggest challenges in the coming 50 years and the best approaches to integrated, long-term planning to address those challenges in stormwater/drainage, wastewater/sewerage, and drinking water. Neither we nor anyone else has a crystal ball, but RAND does have 70 years of experience in developing and applying methods of long-range planning under deep uncertainty (the kind of uncertainty for which probability distributions are unknown or contested) that have enabled public agencies, including our nation's military services, to move forward with robust and adaptive plans for investments and operations. RAND has been applying this expertise to water resources planning for almost 40 years. In the 1970s, RAND helped the Dutch with early master planning to address catastrophic flood risk. That work helped pave the way for the Netherlands to become an international model of successful flood risk management.

Some of the integrated water management challenges facing SWBNO are not unique to New Orleans. Rather, they affect many areas, particularly older cities around the United States. As noted in a forthcoming publication of the Water Research Foundation<sup>2</sup>:

“Intense precipitation events are occurring more frequently in many parts of the United States, according to the Fourth National Climate Assessment, 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

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<sup>2</sup> Fischbach, Jordan, Alan Cohn, Debra Knopman, Krista Romita Grocholski, John Brock, and Valerie Washington, *Climate-Resilient Planning for Urban Stormwater and Wastewater Utilities: Workshop Proceedings*, The Water Research Foundation, publication forthcoming in spring 2020; pre-publication version available on request.

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 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 analysis or planning.”

In addition to the challenges associated with extreme weather events and climate change, cities have to contend with a range of common issues such as aging infrastructure, changes in population size and land use, emerging technologies, and the significant costs associated with infrastructure investments. This complexity necessitates decision-making processes that can carefully weigh a broad range of alternatives and identify synergies and trade-offs associated with different choices.

Such decision-making must, however, also account for those conditions that are unique to SWBNO and New Orleans. Any integrated planning process needs to be tailored to the special attributes of New Orleans and its institutions, including not only SWBNO but also the management and oversight of the power utility and the Department of Public Works. SWBNO has three separately funded divisions that must work together – and do so within an administrative arrangement that divides utilities by the size of pipes, infrastructure, and policy generation. These complicated management and administrative arrangements exist within the governance structure of a city council. The council may be supportive of SWBNO management initiatives, but also needs to reconcile the concerns of a range of constituencies that may or may not align with a unified SWBNO strategy. And of course, the damage wrought by Hurricane Katrina and other recent extreme precipitation events exacerbated the weaknesses of the city’s water infrastructure that has long been in need of major rehabilitation and improvements.

An integrated planning process of the kind envisioned by SWBNO will need to blend a bottom-up, participatory process with top-down analytical and communications strategies that will provide the common ground for the public outreach and engagement to be productive and forward-looking. SWBNO would be well-served by a team of partners in New Orleans (for example, decision support experts, engineers with in-depth knowledge of the existing system, communications experts, and community groups) and led by a “systems integrator” who could help coordinate the many moving parts of a serious master planning process. RAND envisions its role as a lead partner in the integration effort, bringing its expertise and on-the-ground experience in Louisiana and elsewhere in strategic planning and decision support.

A successful planning effort would draw on examples of integrated water planning elsewhere, while acknowledging and accommodating some of the unique features of SWBNO and governance, from New Orleans and other influencing bodies. Such an effort would need to strike a balance between preserving selected features of the status quo arrangements with new features that could be shown through analysis to be likely to produce demonstrably better outcomes for the City of New Orleans in an equitable, efficient, and affordable manner. This is why it is so important that the initial outreach with residents, other stakeholders, and

decisionmakers is done in a way that solicits a wide range of views but also helps to drive toward a common understanding of public goals. For example, these goals could include: customer-oriented, reliable provision of water services under a range of future conditions; efficiency and best practice in all aspects of operations; affordability of services for all of the city's residents; and equity in investment throughout the city.

There is no need to prematurely press for consensus around solutions in Phases 1 and 2. Indeed, that would be counterproductive. There is, however, considerable value in getting public buy-in on goals, metrics that represent progress toward goals, and the technical approach that will be employed by SWBNO to evaluate alternatives to the status quo. This is the essence of the approach employed in the CPRA master planning process and the one embodied in an RDM approach to "deliberation with analysis." Such an approach can help to establish a strong foundation for moving into Phase 3 identification of options and objective and rigorous analysis of those options in terms meaningful to decisionmakers and stakeholders.

To be in a position of dispassionately evaluating alternative courses of action to achieve integrated water management in New Orleans, SWBNO will need to invest in the development of a modeling framework that will be capable of assessing the performance of all facets of its system (e.g. water supply, wastewater, stormwater, and power) – and do so under a range of possible future conditions. The model or suite of models will need to embed not only hydrologic, hydraulic, and other technical features of the existing system but also the revenue structure, cost basis, policy assumptions, regulatory constraints, and other public purposes. This analytical capability will enable stakeholders and decisionmakers to understand the implications and trade-offs of maintaining the status quo compared to making changes that could advance their goals.

## **RAND's Capabilities to Support Each Phase of the Planning Process**

In this section, we highlight selected RAND's capabilities relevant to addressing each of the three phases of work.

### **Robust Decision Making**

Robust Decision Making (RDM) is a structured decision analysis framework that can be used to evaluate risk and alternative management and policy options over a range of assumptions, thereby facilitating deliberation among stakeholders that may have differing values and

expectations about the future.<sup>3,4,5</sup> An overview and listing of RAND’s robust decision-making work can be found at [www.rand.org/topics/rdm.html](http://www.rand.org/topics/rdm.html).

RDM has been used by RAND to help decisionmakers in areas such as water resources planning, energy, and coastal resilience—areas often plagued with “deep uncertainty,” in which stakeholders do not know or agree on the relationships among actions, consequences, and probabilities. The approach can be used to develop a portfolio of management options that mitigate the risk to an acceptable level.

The process involves iterative steps including stakeholder interactions, modeling, and statistical analysis that facilitate interactions and shape decisionmaker discussions around which factors lead to plan success or failure and the identification of robust solutions—those that perform well under a range of futures—rather than a single “best” solution(Figure 1).<sup>6</sup> Analysts then use visualization and statistical analysis of large sets of simulations to help decision-makers distinguish future conditions in which their plans will perform well from those in which they will perform poorly.<sup>7</sup> (Bryant and Lempert, 2010).

This information provides the foundation for identifying tipping points and triggers for additional investments and a robust strategy. Moreover, RAND researchers often integrate other futures methods, such as scenario discovery and analysis, into RDM approaches as a means helping organizations design, evaluate, and implement robust strategic plans.

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<sup>3</sup> Groves, David G., and Robert J. Lempert, “A New Analytic Method for Finding Policy-Relevant Scenarios,” *Global Environmental Change*, Vol. 17, No. 1, 2007, pp. 73–85.

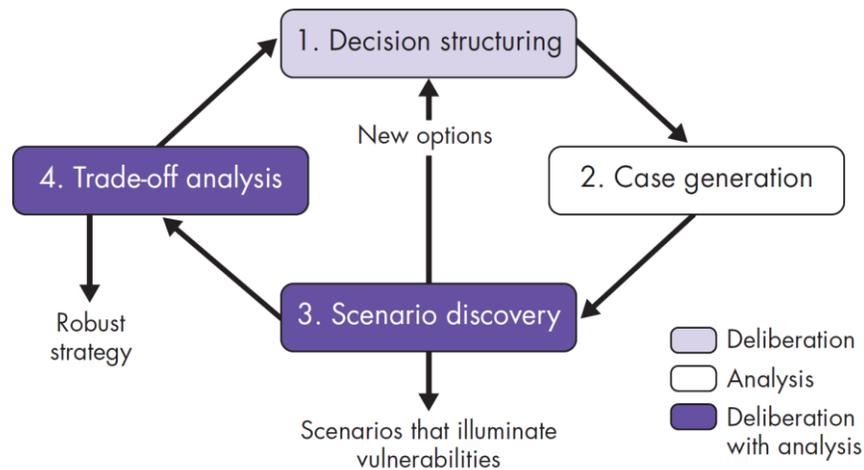
<sup>4</sup> Lempert, Robert J., David G. Groves, Steven W. Popper, and Steven C. Banks, “A General, Analytic Method for Generating Robust Strategies and Narrative Scenarios,” *Management Science*, Vol. 52, No. 4, April 2006, pp. 514–528.

<sup>5</sup> Lempert, Robert J., Steven W. Popper, and Steven C. Banks, *Shaping the Next One Hundred Years: New Methods for Quantitative Long-Term Policy Analysis*, Santa Monica, Calif.: RAND Corporation, MR-1626-RPC, 2003, [http://www.rand.org/pubs/monograph\\_reports/MR1626.html](http://www.rand.org/pubs/monograph_reports/MR1626.html).

<sup>6</sup> Hallegatte, S., Shah, A., Brown, C., Lempert, R., and Gill, S. *Investment Decision Making under Deep Uncertainty-Application to Climate change*. World Bank Policy Research Working Paper, 2012, p. 6193

<sup>7</sup> Bryant, Benjamin P., and Robert J. Lempert “Thinking inside the box: a participatory, computer-assisted approach to scenario discovery”. *Technological Forecasting and Social Change*, 77, No. 1, 2010, pp. 34-49.

Figure 1. Iterative, Participatory Steps of an RDM Analysis



## Decisionmaker and Stakeholder Engagement

Long-term strategic planning is only successful if decisionmakers and stakeholders are involved early and often, to understand potential future scenarios, risks, decisions and investments to be made. This is why RAND developed the *Planning Tool* for CPRA and related decision-based methods, to compare projects and formulate long term, adaptive plans.<sup>8</sup> RAND has also worked extensively on methods to enhance community resilience, as described in the bibliography at the end of this document.

## Other Approaches to Scenario Analysis and Strategic Planning

For decades, RAND has pioneered a wide variety of scenario analysis and strategic planning methods and applied them to pressing national as well as regional and urban problems.<sup>9</sup> In addition to RDM, there are four other strategic planning approaches that illustrate the range of RAND’s contributions to the field of strategic planning to advance public objectives. These methodologies are listed below with links embedded to provide further information:<sup>10</sup>

<sup>8</sup> For examples, see [https://www.rand.org/pubs/research\\_reports/RR437.html](https://www.rand.org/pubs/research_reports/RR437.html)

<sup>9</sup> For more on scenario analysis, see Robert J. Lempert, Robert J., Steven W. Popper, and Steven C. Bankes, *Shaping the Next One Hundred Years: New Methods for Quantitative, Long-Term Policy Analysis*, Santa Monica, CA: RAND Corporation, MR-1626-RPC, 2003 (<http://www.rand.org/t/MR1626>); and Paul K. Davis, *Lessons from RAND’s Work on Planning Under Uncertainty for National Security*, Santa Monica, CA: RAND Corporation, TR-1249-OSD, 2012 (<http://www.rand.org/t/TR1249>).

<sup>10</sup> More information about each of these methodologies can be found at [https://www.rand.org/pardee/pubs/strategic\\_planning.html](https://www.rand.org/pardee/pubs/strategic_planning.html).

1. Assumption-Based Planning
2. Capabilities-based Planning
3. "The Day After..." Methodology
4. Strategies-To-Tasks

## **Survey Research**

RAND's world-class Survey Research Group (SRG) has long experience with survey and other outreach protocols. The SRG conducts multi-lingual and cross-cultural surveys and specializes in difficult or hard-to-reach populations of all types. It employs expert statisticians to objectively analyze the results and draw meaningful – actionable – conclusions.<sup>11</sup> The SRG is particularly useful for rapidly collecting expert judgment or public opinion in a systematic way from a large number of individuals.

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<sup>11</sup> For more information, please see <https://www.rand.org/srg.html>

## **RAND Corporation and The RAND Gulf States Policy Institute**

RAND is an independent, not-for-profit organization based in Santa Monica, guided by a commitment to use objective analysis to make a positive difference in the way the world works. For seventy years, through its dedication to rigorous and objective research and its development of sophisticated analytic tools, RAND has been a defining force in the field of policy research and analysis. As an objective, nonpartisan nonprofit, RAND is uniquely positioned to bridge opposing sides of contentious debates and facilitate rational discourse through the presentation and timely provision of data-driven findings to diverse audiences – local to global. RAND clients include local and state governments, U.S. government agencies, foreign governments, international organizations, private foundations, and private-sector firms.

Our engagement with SWBNO would be situated within RAND’s Social and Economic Well-Being Division. The Division seeks to improve the health, social, and economic well-being of people in the U.S. and around the world with actionable solutions.

A hallmark of RAND’s work is attention to the “systems” nature of policy problems, with focus on the interactions among sectors (e.g., technology, public safety, transportation, education, workforce, and healthcare) and between organizational and technical systems. Developing an economic sustainability strategy will involve cross-cutting systems thinking and the convening multiple stakeholders. RAND’s experience will be very useful in this regard, as will RAND’s reputation and track record on working on complex policy issues that affect multiple stakeholders with objectivity and rigor.

RAND staff represent diversity in work experience; political and ideological outlook; race, gender, and ethnicity; and academic training. Our staff of nearly 2,000 come to RAND from over 50 countries, to work on topics as multifaceted, complex, and practical as economic sustainability.<sup>12</sup> This integrative and team science approach combined with real experience in working with local governments and nongovernmental stakeholders makes RAND unparalleled in its ability to deliver practical policy insights.

The majority of RAND’s research staff has advanced degrees in social sciences, political science, policy analysis, behavioral science, business and law, or economics, and over a quarter of RAND’s research staff has degrees in science, engineering, and mathematics, operations research or statistics. In addition to its full-time staff, RAND has access to a large number of adjunct staff. These are typically researchers working for other institutions (e.g., universities) that are drawn upon to provide unique or specialized expertise for RAND projects. RAND has a dense network of key contacts throughout the public and private sectors in California, the United States, and globally. We will draw on this network as needed to conduct the proposed work.

The RAND Corporation is a global organization, offering insights from work with other countries on economic strategies and informing our work in the U.S. as well. U.S. locations include our headquarters in Santa Monica, California, Arlington, Virginia; Pittsburgh,

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<sup>12</sup> <http://www.rand.org/about/glance.html>.

Pennsylvania; Boston, Massachusetts; and New Orleans, Louisiana. Our newest office is in the San Francisco Bay Area. RAND Europe is located in Cambridge, UK, and Brussels, Belgium. RAND Australia is located in Canberra.

RAND is unique among think tanks in having its own graduate school. The Pardee RAND Graduate School was founded in 1970 as one of the original eight graduate programs in public policy, and the only program specializing in the Ph.D. The multidisciplinary curriculum emphasizes research methods drawn from mathematics, economics and the behavioral and social sciences. Most of the Pardee RAND faculty members are also full-time policy analysts at RAND, and as such they bring the perspective of practitioners into the classroom. The graduate school's Ph.D. students are required to work on RAND projects and are a unique and valuable resource, who would be available for the proposed work. Since Hurricane Katrina, the Pardee RAND Graduate School has brought faculty and students from Louisiana and other Gulf states to RAND for training courses on policy analysis.

### **The RAND Gulf States Policy Institute**

The RAND Gulf States Policy Institute was created in 2005, with an internal investment by RAND Corporation, to support hurricane recovery and long-term development in Louisiana, Mississippi, and Alabama. The Institute brings extensive experience in developing and applying methods to improve both short- and long-term planning efforts under conditions of deep uncertainty. The RAND Gulf States team has extensive experience in measuring and evaluating policy challenges that affect our neighboring communities, in sectors such as water resources, energy, health, workforce development, and education. The Institute has been a leader in flood risk evaluation and management in coastal Louisiana, using state of the art modeling and decision support to combine high-resolution simulations of alternative futures in order to provide adaptive strategic solutions.

As part of the Gulf States community, we pride ourselves on building partnerships and bringing objective, data-based research solutions to help our communities be healthy, to thrive, and to be prepared for whatever the future might bring to our shores and neighborhoods.

### **A Selected List of RAND Research Leaders with Experience Relevant to SWBNO**

#### **Gary Cecchine**

Gary Cecchine, Ph.D. is an environmental biologist, with a focus on water quality and resources. He is a senior policy researcher who joined RAND in 1999. He is the Director of Research at the RAND Gulf States Policy Institute and leads RAND's office in New Orleans. He conducts technical and policy research in a range of areas, including water resources, community resilience, environmental health, emergency preparedness and response, and he advises policy makers from the local to national level about policies that affect all communities and their environments. As Director, he also develops and coordinates research in health, education, economics, labor, public safety, and regional and strategic planning. His current research activities aim to promote resilience in the U.S. Gulf Coast by developing and evaluating economically, socially, and ecologically sound strategies. Gary's Ph.D. in biology and public

policy is from the Georgia Institute of Technology, and he served as a commissioned officer in the U.S. Army Medical Service Corps, with a focus on disaster response, preventive medicine, and public health.

### **Debra Knopman**

Debra Knopman, Ph.D., is a principal researcher at the RAND Corporation and a professor at the Pardee RAND Graduate School. She served as vice president and director of RAND Infrastructure, Safety, and Environment, later called Justice, Infrastructure, and Environment, from 2004 to 2014. Knopman's expertise is in hydrology, environmental and natural resources policy, systems analysis and operations research, and public administration. Her project work spans a range of topics including adaptation of urban regions to a changing climate, integrated long-term water management, policy options for disposition of nuclear waste, governance and funding for U.S. Gulf Coast recovery, and the design of a National Research Fund for Qatar. She served for six years (1997–2003) as a member of the Nuclear Waste Technical Review Board and chaired the board's Site Characterization Panel. She was the director of the Progressive Policy Institute's Center for Innovation and the Environment from 1995 to 2000. From 1993 to 1995, Knopman was the Deputy Assistant Secretary for Water and Science, U.S. Department of the Interior. She had previously been a research hydrologist at the U.S. Geological Survey (USGS) and later chief of the Branch of Systems Analysis in the USGS's Water Resources Division. From 1979 to 1983, she served first as legislative assistant for energy and environmental issues to Senator Daniel P. Moynihan and then as professional staff member of the U.S. Senate Committee on Environment and Public Works. Knopman earned her B.A. from Wellesley College, M.S.C.E. from MIT, and Ph.D. in geography and environmental engineering from the Johns Hopkins University.

### **Ben Preston**

Benjamin Preston, Ph.D., is a Senior Policy Researcher at the RAND Corporation and Director of RAND's Community Health and Environmental Policy Program. His recent research efforts include understanding the development of knowledge systems for climate risk management, scenario analysis for a low-carbon future, and planning for disaster recovery and resilience. Previously, he held research positions with the Climate Change Science Institute at Oak Ridge National Laboratory, the CSIRO's Division of Marine and Atmospheric Research, and the Pew Center on Global Climate Change. He received a B.S. in biology from the College of William & Mary and a Ph.D. in environmental biology from the Georgia Institute of Technology.

In 2015, Ben received the American Geophysical Union's Falkenberg Award, and from 2016 to 2017 he was one of the American Association for the Advancement of Science's inaugural Leshner Leadership Fellows. Dr. Preston has contributed to national and international scientific assessments including the *U.S. National Climate Assessment*, the Intergovernmental Panel on Climate Change's *Fifth and Sixth Assessment Reports*, the *U.S. Global Change Research Program's second State of the Carbon Cycle Report*, and the *Arctic Monitoring and Assessment Program's Adaptation Actions for a Changing Arctic*. He currently serves as co-editor-in-chief for the Elsevier journal *Climate Risk Management* and was recently appointed to the Climate Adaptation Task Team for the Global Climate Observing System.

## **Jordan Fischbach**

Jordan R. Fischbach, Ph.D., is a Senior Policy Researcher at the RAND Corporation, Co-Director of RAND's Climate Resilience Center, Quality Assurance Manager for the Homeland Security Operational Analysis Center (HSOAC), and an affiliate faculty member at the Pardee RAND Graduate School. He leads RAND research focused on climate adaptation, urban resilience, water resources management, coastal planning, and post-disaster recovery. Dr. Fischbach is currently a Co-Investigator for the NOAA Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA) center. Since 2010, he has been the principal investigator for flood risk and damage assessment using the Coastal Louisiana Risk Assessment (CLARA) model in support of Louisiana's Coastal Protection and Restoration Authority, he currently leads several projects supporting resilience planning and improved stormwater management in Pittsburgh, and recently led an assessment of damage and needs to support the development of Puerto Rico's recovery plan after Hurricane Maria. From 2017-2018 he also served on a National Academy of Sciences panel investigating long-term coastal zone dynamics on the U.S. Gulf Coast. Dr. Fischbach earned a B.A. with Honors in History from Columbia University in 2001 and a Ph.D. in Policy Analysis from the Pardee RAND Graduate School in 2010.

## **David Groves**

David Groves, Ph.D., is Co-Director of the RAND Center on Decision Making Under Uncertainty, Co-Director of the RAND Climate Resilience Center, and Professor at the Pardee RAND Graduate School. He is a key developer of new methods for decision-making under deep uncertainty, and he works directly with organizations worldwide to improve their planning for the uncertain future. He focuses on climate adaptation issues facing water resources and coastal planning agencies. He is also working with development banks to ensure that decarbonization plans in developing countries account for critical uncertainties. Groves has worked with major water agencies throughout the United States, including the U.S. Bureau of Reclamation, California Department of Water Resources, Metropolitan Water District of Southern California, and Denver Water, helping them to address climate variability and change in their planning. He works domestically and internationally, most recently in Argentina, Peru, Mexico, and China. He also works on coastal sustainability issues, most notably in the San Francisco Bay Delta, South Florida, and Coastal Louisiana. For example, he led the RAND team that developed the planning framework and decision support tool used to formulate Louisiana's 50-year, \$50 billion Coastal Master Plan.

## **Bibliography of Selected RAND References Relevant to SWBNO's Integrated Master Planning Process**

RAND's stakeholder engagement projects with advanced analytics include our work on the Louisiana 2012 Coastal Master Plan (<http://www.rand.org/gulf-states/policy-spotlights/coastal-management.html>) and the 2017 Coastal Master Plan (<https://www.rand.org/well-being/community-health-and-environmental-policy/centers/climate-resilience/projects/louisiana-coastal-plan.html>)

Fischbach, Jordan R., David R. Johnson, David S. Ortiz, Benjamin P. Bryant, Matthew Hoover, and Jordan Ostwald, Coastal Louisiana Risk Assessment Model: Technical Description and 2012 Coastal Master Plan Analysis Results. Santa Monica, CA: RAND Corporation, 2012. [https://www.rand.org/pubs/technical\\_reports/TR1259.html](https://www.rand.org/pubs/technical_reports/TR1259.html).

Groves, David G., Jordan R. Fischbach, Debra Knopman, David R. Johnson, and Katheryn Giglio, Strengthening Coastal Planning: How Coastal Regions Could Benefit from Louisiana's Planning and Analysis Framework. Santa Monica, CA: RAND Corporation, 2014. [https://www.rand.org/pubs/research\\_reports/RR437.html](https://www.rand.org/pubs/research_reports/RR437.html). Also available in print form.

RAND conducted three pilot studies on urban adaptation to a changing climate, two of which related to integrated water management. The first pilot was in the Pittsburgh region on stormwater management and investment strategies. For more information on our work in Pittsburgh, see <http://www.rand.org/jie/infrastructure-resilience-environment/centers/water-climate-resilience/projects/resilient-stormwater-management-in-allegheny-county.html>.

Fischbach, Jordan R., Kyle Siler-Evans, Devin Tierney, Michael Wilson, Lauren M. Cook, and Linnea Warren May, Robust Stormwater Management in the Pittsburgh Region: A Pilot Study. Santa Monica, CA: RAND Corporation, 2017. [https://www.rand.org/pubs/research\\_reports/RR1673.html](https://www.rand.org/pubs/research_reports/RR1673.html). Also available in print form.

The second pilot project funded by MacArthur was in cooperation with Miami-Dade and Broward Counties in Florida. See:

Groves, David G., Debra Knopman, Neil Berg, Craig A. Bond, James Syme, and Robert J. Lempert, Adapting Land Use and Water Management Plans to a Changing Climate in Miami-Dade and Broward Counties, Florida. Santa Monica, CA: RAND Corporation, 2018. [https://www.rand.org/pubs/research\\_reports/RR1932.html](https://www.rand.org/pubs/research_reports/RR1932.html). Also available in print form.

As preparation for pilot studies in three urban areas, funded by the MacArthur Foundation, RAND first developed an evaluation framework and indicators to guide implementation.

Knopman, Debra and Robert J. Lempert, *Urban Responses to Climate Change: Framework for Decision-making and Supporting Indicators*. Santa Monica, CA: RAND Corporation, 2016. [https://www.rand.org/pubs/research\\_reports/RR1144.html](https://www.rand.org/pubs/research_reports/RR1144.html). Also available in print form.

Following Hurricane Sandy, RAND was asked by the Rockefeller Foundation to bring our methods developed in Louisiana for CPRA to the New York City region:

Fischbach, Jordan R., Debra Knopman, Heather Smith, Philip Orton, Eric W. Sanderson, Kim Fisher, Nerissa Moray, Adam Friedberg, and Adam Parris, *Building Resilience in an Urban Coastal Environment: Integrated, Science-Based Planning in Jamaica Bay, New York*. Santa Monica, CA: RAND Corporation, 2018. [https://www.rand.org/pubs/research\\_reports/RR2193.html](https://www.rand.org/pubs/research_reports/RR2193.html). Also available in print form.

For information on RAND's work in support of the California Bay Delta Stewardship Council's Delta Levee Investment Strategy, see the online project overview (<http://deltacouncil.ca.gov/delta-levees-investment-strategy>) and Decision Support Tool (<http://deltacouncil.ca.gov/dlis-decision-support-tool>).

RAND also applied RDM to a process of stakeholder engagement regarding supply and demand in the Colorado River (<http://www.rand.org/jie/infrastructure-resilience-environment/projects/colorado-river-basin.html>).

Groves, David G., Jordan R. Fischbach, Evan Bloom, Debra Knopman, and Ryan Keefe, *Adapting to a Changing Colorado River: Making Future Water Deliveries More Reliable Through Robust Management Strategies*. Santa Monica, CA: RAND Corporation, 2013. [https://www.rand.org/pubs/research\\_reports/RR242.html](https://www.rand.org/pubs/research_reports/RR242.html). Also available in print form.

We also have conducted extensive collaborative community resilience work; see [www.rand.org/resilience-in-action.html](http://www.rand.org/resilience-in-action.html) and [www.laresilience.org](http://www.laresilience.org). For examples of bringing diverse stakeholders into decision-making, see:

Anita Chandra et al., *Building a National Culture of Health: Background, Action Framework, Measures, and Next Steps*, Santa Monica, Calif.: RAND Corporation, RR-1199-RWJ, 2016 (<http://www.rand.org/t/RR1199>).

For descriptions of our interactive stakeholder processes, see <http://wellbeing.smgov.net> and <http://www.rand.org/jie/infrastructure-resilience-environment/projects/grasp.html>.

Chandra, Anita, Joie D. Acosta, Stefanie Howard, Lori Uscher-Pines, Malcolm V. Williams, Douglas Yeung, Jeffrey Garnett, and Lisa S. Meredith, *Building Community Resilience to Disasters: A Way Forward to Enhance National Health Security*. Santa Monica, CA: RAND Corporation, 2011. [https://www.rand.org/pubs/technical\\_reports/TR915.html](https://www.rand.org/pubs/technical_reports/TR915.html). Also available in print form.