

## Research Article

# Opinion: Differentiating Natural Threats and Hazards for Water and Wastewater Structures and Operations - Energetic Threats and Hazards for the Water Industry

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## Abstract

A novel approach is presented to view, discern, and to redefine dangerous threats and hazards from natural events that can impact water and wastewater systems. The intent of this approach is to minimize ambiguity while enhancing preparedness and operational awareness of water and wastewater facilities, each vital for sustainable public health. This new approach recognizes potential and kinetic energy sources to differentiate between the threats and hazards generated by natural events, such as hurricanes, tornadoes or landslides, which can impact the steady-state operations of essential water and wastewater recovery facilities, associated infrastructure, plus endanger workers and exposed personnel. To support this rethinking, absent in current literature searches, “energetic models” for anticipating latent, partial or total disruption of water and wastewater facilities and related management operations from naturally occurring events, such as a hurricane, tornado, or landslide, are presented. The proposed “energetic models” are atypical, yet they have practical value and encourage the rethinking and reimagining of threats and hazards used by water professionals and related fields and professions. The proposed models can be applied clearly to multiple and complex natural, human-caused, technological and equally disruptive events for water enterprises, expanding to similar challenges in public health responses to disease outbreaks.

## Keywords

Potential Threats, Kinetic Hazards, Disaster Management, Emergency Preparedness, Water and Wastewater Utilities, Energetic Impacts, THIRA

## 1. Introduction: Background

The field of emergency management has blossomed and is expanding with momentum to adjacent domains, including the response and recovery of public and private water and wastewater utilities [1]. In parallel, certificate and degree programs added by higher education institutions and profes-

sional organizations are mushrooming, offering expanded subfields with diversity of subject matter, each with unique or expanded career opportunities [2]. Growth and new players, however, are driving the challenge for a consistent definition and equal application of two essential operational terms in the

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arenas of emergency and disaster management: *Threats and Hazards* [3, 4].

In this Opinion, the Authors submit that the prevailing and undiscussed latent challenge is the multiple [5] operational meaning and use of threats and hazards. Operationally, they are not equivalent, but are treated and often conveniently viewed to be interchangeable [6]. Unintentional multiplicity clouds and endangers timely, critical decisions for timely preparedness, response and recovery [6], plus related disaster and management decision making, often generating an increase in the nature and scope of damages, extending disruptions, and raising harm to unsuspecting water personnel [7]. Using a new approach, this Opinion proposes a redescription of operational threats and hazards [8] as presented graphically in Figure 1.

Threats – are distinguished as a source of potential energy.  
Hazards – are distinguished as a source of kinetic energy.

**Figure 1.** Redescription of Threats and Hazards.

## 2. Reimaging: Threats and Hazards

Threats and Hazards are ubiquitous terms, and they are deeply rooted in the expanding field of emergency management [8]. Both are also ever-present in the allied fields of disaster, humanitarian, and public health management [9]. Also, the communications sector uses threats and hazards freely. This Opinion-proposes a new way to envision, discern, and apply threats and hazards – minus ambiguity [10].

The approach recognizes potential and kinetic energy sources to differentiate between threats and hazards that impact or upset steady-state operating conditions and can damage facilities and their related equipment, machinery and IT systems. A new operational view [6] of threats and hazards is given in Figure 2 as follows:

Threats are distinguished by their source of potential energy  
Hazards are distinguished by their source of kinetic energy.

**Figure 2.** Operational View of Threats and Hazards.

To support this energetic approach, a redefining of threats and hazards is offered, focusing on their potential and kinetic energy behavior to yield different operational views of threats and hazards, as presented graphically in Figure 3. Threats and hazards are presented and viewed as distinct [11] energetic and disruptive sources, especially for water, wastewater and resource recovery operations.

*Threats are amorphous potential energy sources that can coalesce quickly to generate havoc for emergency, disaster, and humanitarian operations.*

*Hazards are distinct kinetic energy sources with accelerating momentum and lethal force, impacting timely and orderly execution of operations.*

**Figure 3.** Proposed Energetic Models.

## 3. Conclusion: Discussion and Applications

Application of an energetic model for threats and hazards generated by naturally occurring events is presented in Table 1 for hurricanes, earthquakes, tsunamis, tornadoes and landslides [12]. Each natural event is a source of potential energy, ready for release to generate hazards, which are sources of kinetic energy. Typical hazards with kinetic energy are wind, seismic waves, tidal waves, hail, and flowing debris, each arising from the potential energy of the corresponding threats. This view is summarized in Table 1 for typical natural events [12] that are a concern for the water industry and extend to related enterprises, such as public health and medical care [13].

The proposed “energetic models” are uncommon in everyday thought [14]. They can, however, add clarity, operational value, and new insight for understanding and rethinking about natural threats and hazards commonly faced by water and related professionals [9].

**Table 1.** Application of Energetic Models for Threats and Hazards.

THREATS with POTENTIAL ENERGY	HAZARDS with KINETIC ENERGY
Hurricane	Intense Winds
	Excessive Rain
	Loose Lightning
	Severe Flooding
	Seismic Waves
Earthquake	Ground Shaking
	Mechanical Stress
	Pressure Waves
	Mass Flooding
Tsunami	Seismic Waves
	Ocean Currents
	Tidal Wave
Tornado	Thunderstorms
	Destructive Hail

THREATS with POTENTIAL ENERGY	HAZARDS with KINETIC ENERGY
	Lightning Strikes
	Flying Objects
	Surface Shock
	Flowing Debris
Landslide	Runoff Water
	Flying Objects

Overall, any hazard—resulting from a single threat can then transfer its kinetic energy into additional hazards such as fires, dam failures, explosions, and infrastructure collapse. This can occur because energy is neither created nor destroyed; it simply changes form. This sequence or chain of resulting hazards is referred to as a Cascading Event [15].

## Abbreviations

UNC University of North Carolina at Chapel Hill

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## Author Contributions

**Lee Presley Gary Jr:** Conceptualization, writing – original draft, supervision.

**Scott Richmond:** Formal analysis, writing – review & editing.

**Daryl Spiewak:** Formal analysis, writing – review & editing

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## Conflicts of Interest

The authors declare no conflicts of interest.

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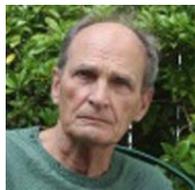
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## Biography



**Lee Presley Gary Jr** is an adjunct faculty member at Tulane University in New Orleans, and owner/CEO of Strategic Management Services – USA, a global consultancy specializing in mitigating the threats and hazards associated with dirty water and human waste. He has been named Fulbright Specialist and will be teaching in 2024 at the University of Makeni, located in the City of Makeni in Sierra Leone. He is an active member of the Water Environment Federation, an adjunct instructor for the FMEA/ Emergency Management Institute, and a graduate of the Tulane School of Public Health & Tropical Medicine.



**Scott Richmond** is an independent emergency manager. He holds a Masters of Urban Planning and a Masters of Public Administration from institutions in New York. His humble roots begin in the Australian coal mines and as a firefighter. He has worked in disaster situations across the United States for ten years and at various government and educational institutions. His introduction to emergency management came during nasty Hurricane Sandy while he was a student and quickly developed a deep appreciation of the critical role that emergency managers play in response to and recovery from disasters. During several disasters Scott has had the honor of leading large teams of fellow emergency managers. He has published several articles on emergency management.



**Daryl Lee Spiewak**, CEM, MEP is an independent Homeland Security consultant. He holds a Masters of Arts in Management from Webster University and he is a graduate of the US Army Command and General Staff College in Military Science. He is an Certified Emergency Manager from the International Association of Emergency Managers and a Master Exercise Practitioner from FEMA. In addition, he is a Past President of the American Society of Professional Emergency Planners, a Past President and Certification Commissioner of the International Association of Emergency Managers, and a Past Vice President of the Emergency Management Association of Texas. He is an author of numerous articles on emergency management and a co-author on a book published in Japanese on the Incident Command System. He also served many years on the Editorial Board of the American Society of Professional Emergency Planners Journal.

## Research Fields

**Lee Presley Gary Jr:** Emergency management, disaster management, waterborne diseases, treatment of dirty water and human waste, and mitigation of public health threats and hazards

**Scott Richmond:** Emergency and, disaster management, fire prevention, project management

**Daryl Spiewak:** Emergency and disaster management; active shooter, professional training