“Critical Infrastructure – Preparing for the “Long Haul”

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"It is change, continuing change, inevitable change, that is the dominant factor in society today. No sensible decision can be made any longer without taking into account not only the world as it is, but the world as it will be."

- Sir Isaac Asimov, 1981

Recent Events

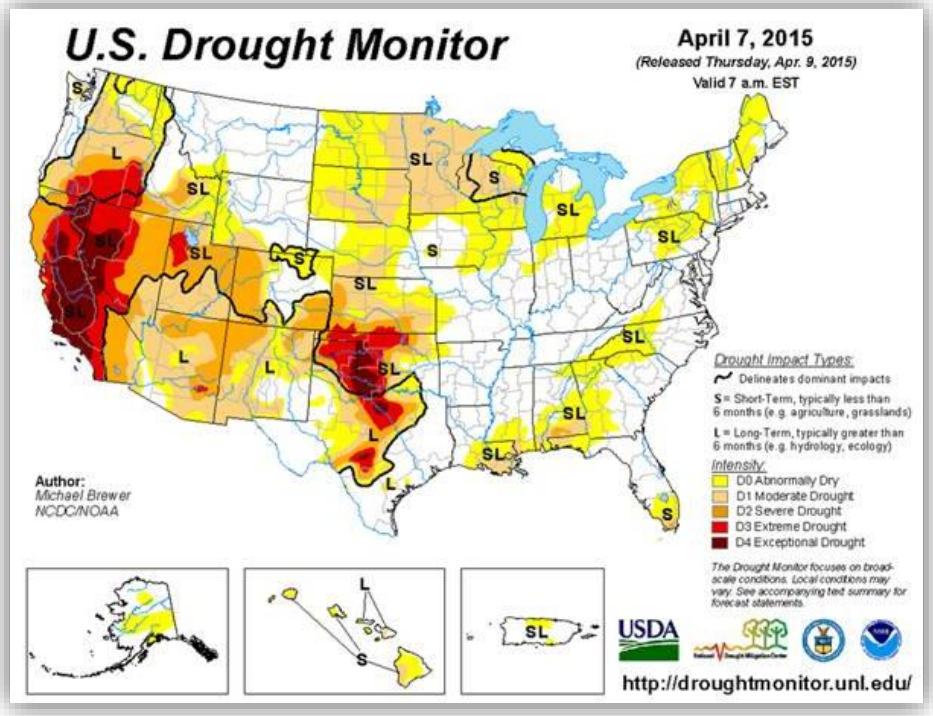
- **1993 – New York City: bomb exploded in basement garage of World Trade Center, killing 6 and injuring at least 1,040 others**
- **1993 – Midwest: largest flood of record (up to that time) on Mississippi River, est $12B to $16B in damages**
- **1995 – Oklahoma City: car bomb exploded outside federal office building, killing 168**
- **2001 – New York City, Arlington, Va., and Shanksville, Pa.: hijackers crashed commercial jets into the World Trade Center, Pentagon, and rural field. Total dead and missing 2,992**
- **2005 – Coastal AL, LA, TX: Hurricanes Katrina and Rita struck the Gulf coast killing 1,833, dislocating > 10,000, and caused $108B in damages**

Recent Events (cont)

- **2011 – Midwest: flooding along the Mississippi and Missouri Rivers killing ~20 and caused >$2B in damages**

- **2012 – Northeast Coast: Superstorm Sandy caused flooding and wind damage killing 149, >20B in damages**

- **2013-2015 – Drought: extended drought conditions in western states are leading to significant impacts. In Feb 2015, US Drought Monitor listed ~ 32% of contiguous US as experiencing moderate to exceptional drought**



Who is Involved

- Infrastructure design – civil engineers, water resources professionals, land use planners, geographers, etc
- First responders – law enforcement, fire fighting, emergency medical
- Intelligence community
- Health care professionals – community and public health
- Private industry
  - Design, Engineering, Construction
  - Private industry impacted
- Legal profession
- Science and technology fields
  - Climate and metrology
  - Basic and applied research and development
  - IT for communications and information gathering
- Elected Officials
- Individual citizen – stakeholder, taxpayer, and electorate

Challenges

- **Crisis provides an impetus for change**
  - **Willingness to compromise**
  - **Availability of resources (people and funding)**
- **Differing opinions on "roles" and "responsibilities"**
- **Memory of crisis soon fades**
  - **What is the "half-life" of a flood?**
- **Stovepipes**
- **Insufficient Resources**
  - **Challenge to prioritize**
  - **Desire to "do more with less" or "leverage resources"**

What About the Future

- **Most interest is the near term**
  - More easily visualized by many
  - Provides a tangible result within the tenure of most a job assignments
  - Uncertainly over the long term can be unsettling
  - Public, and therefore elected officials, are impatient
  - ‘Long term activities or changes will happen without me’
  - Funding is available for short term results
- **Long term**
  - Some processes, such as coordination, take time
  - Public and disciplinary cultures change slowly – but they do change
  - Changes of ‘substance’ take time

Academia

Hypothesis – The development and education of the next generation of professionals working on critical infrastructure, resilience, sustainability is the critical path for meeting the needs for a robust society.

- **Education is a long term process**
  - **Smart people are working these issues, so may get there by chance**
- **Stovepipes have been created – not all bad as long as stovepipes "leak into" each other (do they?)**
- **Lack of "general" consensus on nomenclature, language, and thought processes**
- **In all fairness – a new and emerging discipline(s)**

Case History

Evolution of Environmental Science Programs

- **Generally expanded in 1980's in concert with environmental movement and passage of environmental legislation**
  - **Yes, programs existed before this time**
- **A 2003 review for the purpose of benchmarking (King, 2003) indicated great disparity in environmental science programs**
  - **Reflected university specific interests**
  - **Program focuses included microbiology, biology, ecology, geography, water resources, resource management, and law**
- **As a result, it proved difficult to generically describe the skill sets of an environmental science graduate**
  - **Programs were clearly rigorous and graduates able to find jobs**

Case History (cont)

- **Observations**
  - **A variety of program models seems to work fine for students and universities involved with environmental science programs**
  - **Results produced great graduates, but has not, and did not seek, to develop commonalities of thinking**
  - **Without a concerted effort or "forcing function", new academic disciplines will not necessarily find convergence – at least not in the short term**

Sample - Where Are We Today

University	College or Department	Program
Carleton University	Department of Civil and Environmental Engineering	B.Eng. in Architectural Conservation and Sustainability Engineering Master of Infrastructure Protection and International Security
George Mason University	School of Law	Center for Infrastructure Protection and Homeland Security
George Mason University	Department of Civil and Infrastructure Engineering	BS, MS, PhD in Civil and Infrastructure Engineering
James Madison University	Institute for Infrastructure and Information Assurance	Critical Infrastructure Protection Program Institute for National Security Analysis

Sample - Where Are We Today

University	College or Department	Program
Michigan Technological University	Department of Civil and Environmental Engineering	Focus study areas in 'Infrastructure Systems Engineering' and 'Sustainability'
New Jersey Institute of Technology	Department of Civil and Environmental Engineering	MS in Critical Infrastructure Systems
Texas A&M University	Bush School of Government and Public Service	Integrative Center For Homeland Security (ICHS)
Towson University	Department of Interprofessional Health Studies	MS in Integrated Homeland Security Management
University of Southern California	Marshall School of Business USC School of Policy, Planning, and Development	Keston Institute for Public Finance and Infrastructure Policy

Sample - Where Are We Today

University	College or Department	Program
Virginia Commonwealth University	School of Government and Public Affairs	BA and MA in Homeland Security and Emergency Preparedness
University of Illinois at Champaign-Urbana	Department of Civil and Environmental Engineering	MS and PhD in Energy-Water-Environment Sustainability (interdisciplinary); Societal Risk Management; Sustainable and Resilient Infrastructure Systems (interdisciplinary) (On-line) MS with an Infrastructure specialization

Future

- **Initiatives have begun**
  - **US Government's National Response Framework (FEMA 2015)**
  - **The Infrastructure Security Partnership (TISP, 2015)**
  - **Institute for Sustainable Infrastructure (ISI, 2015)**
  - **American Society of Civil Engineers sustainability initiatives (ASCE, 2015)**
  - **Building Climate Resilience in the Health Sector (NIH, 2015)**
  - **… and many others**
- **Efforts are independent and do not have consistency in direction**
- **There is a need for national-level leadership – concerning disciplines not just operations**
  - **Without such leadership, the direction forward in developing professional workforces is not clear**
  - **Increased and better aligned efforts by practitioners, academicians, and professional organizations will be required**

Future

- **Is there a need for an overarching Body of Knowledge or similar treatise?**
  - **Reference NSPE BoK for "all" professional engineers**

In Review

If the development and education of the next generation of professionals working on critical infrastructure, resilience, sustainability is the critical path for meeting the needs for a robust society

– that path begins with the efforts by professionals such as you and I

– and our collaboration with those in fields with overlap in interests


Questions