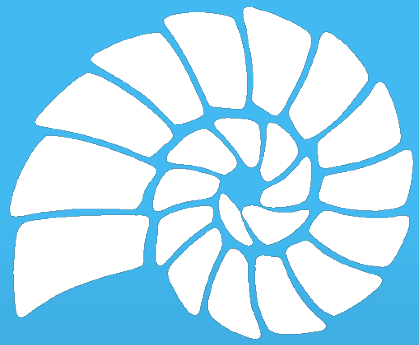

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Comparison of Risk Assessment Tools

for the Water Sector

Kate Novick, P.E., C.S.P.

AWWA Management Standards

- “G Standards”
- AWWA management standards “describe consensus requirements for utility management practices”
- Their use is “voluntary,” not a regulatory requirement
- “Intended to serve the water sector and improve overall operations and service”
- Establishes “formal management and operations guidelines”

Risk Assessments are Standard Practice in the Water Sector

- AWWA G430-14 Security Practices for Operation and Management
  - 4.4.1 The utility shall perform a risk assessment…
  - 4.4.2 The utility shall review and update its risk assessment as new hazards and threats emerge…
  - 4.4.3 The [review] schedule shall not exceed five years…
- AWWA G440-11 Emergency Preparedness Practices
  - Same as above
- Both standards "define the minimum emergency preparedness requirements for water, wastewater, or reuse facilities to respond to emergencies and restore normal operations, minimizing the disruption of critical services while sustaining public health, protecting property, and maintaining consumer confidence."

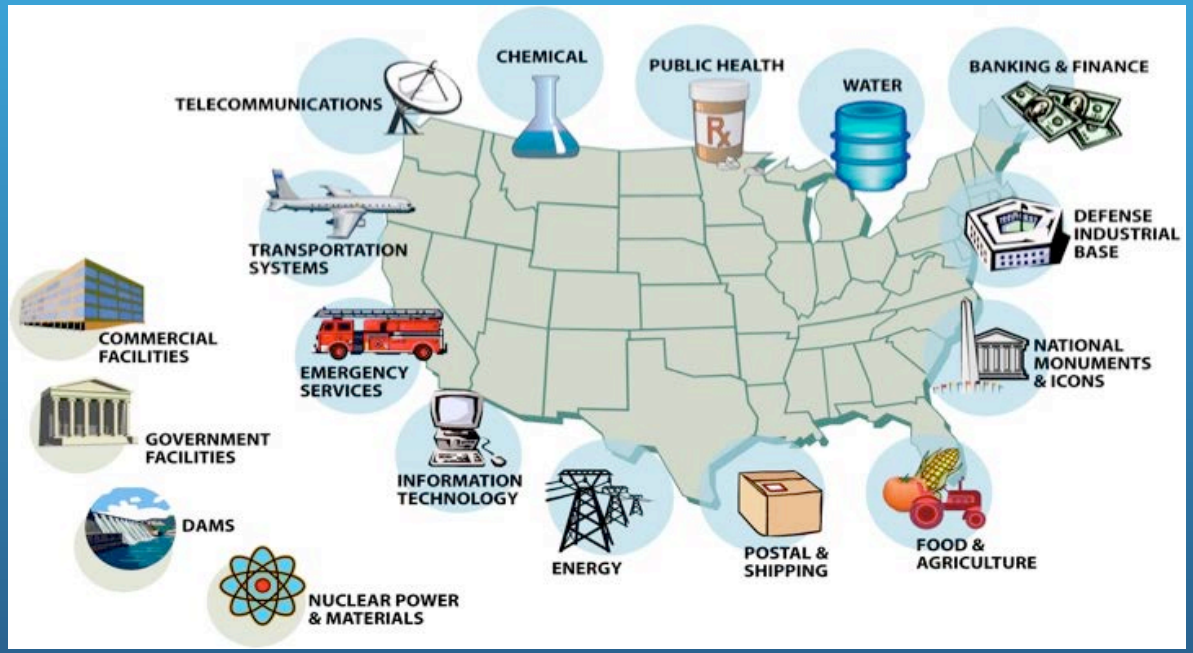
HOW DID WE GET HERE?

Public Health Security and Bioterrorism Preparedness and Response Act of 2002

- All water utilities servicing more than 3,300 people required to:
  - Perform Vulnerability Assessments (VA)
  - Update Emergency Response Plans to include the results of the VA

By December 2003…

- Homeland Security Presidential Directive (HSPD)-7*:
  - Identifies 18 critical infrastructure and key resources (CIKR) sectors
  - Assigned EPA as the Sector-Specific Agency for the water and wastewater sector

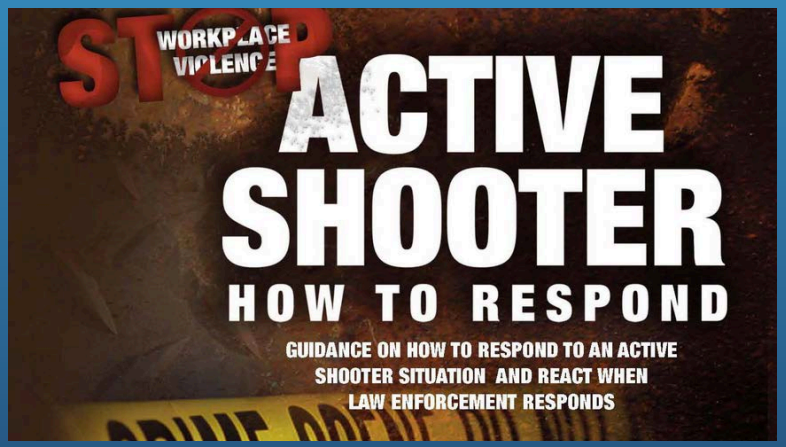


*Homeland Security Presidential Directive 7 (HSPD-7) from 2006 to 2009 and the Presidential Policy Directive 21 (PPD-21) after 2009

Since 2003, a Lot Has Changed

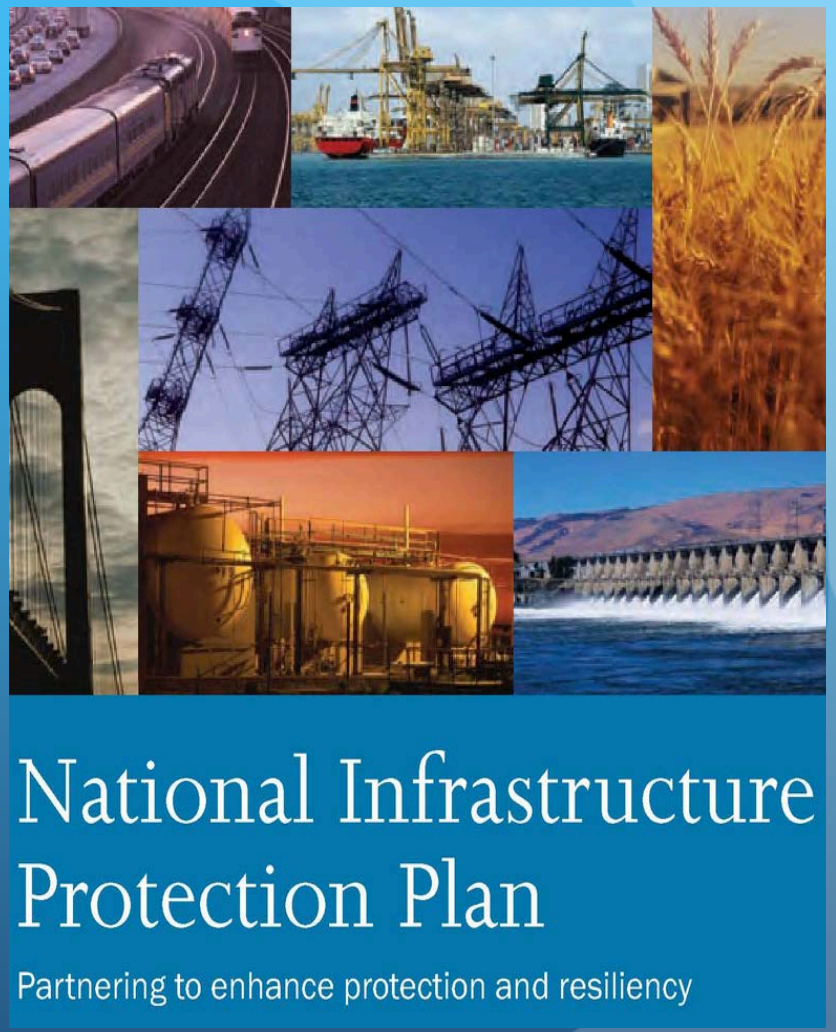
WARN℠
WATER /WASTEWATER AGENCY RESPONSE NETWORK

Since 2003, a Lot Has Changed



Common risk management framework for all critical sectors

PPD-21 set forth a comprehensive risk management framework and clearly defines critical infrastructure protection roles and responsibilities.



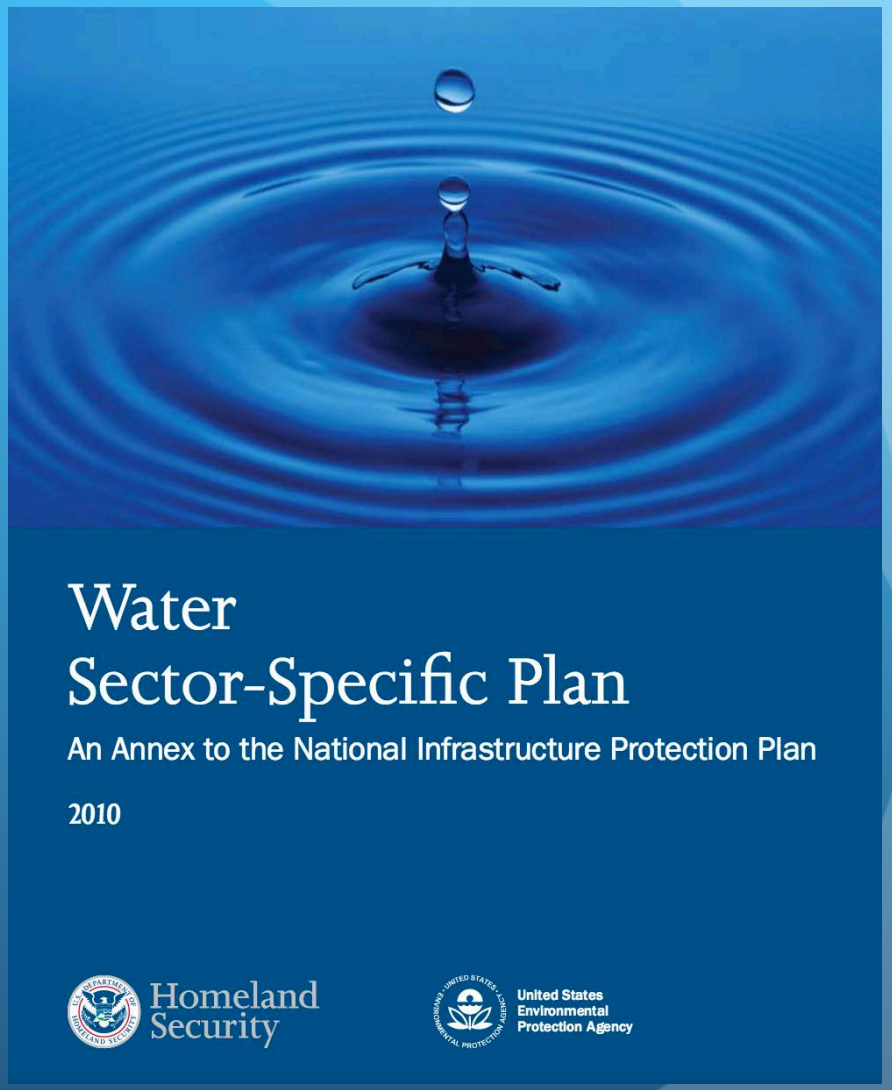
Managing Risk is a Utility Responsibility

(supported by public partnership)

PPD-21 states, “Critical infrastructure owners and operators are uniquely positioned to manage risks … and to determine effective strategies to make them more secure and resilient.”

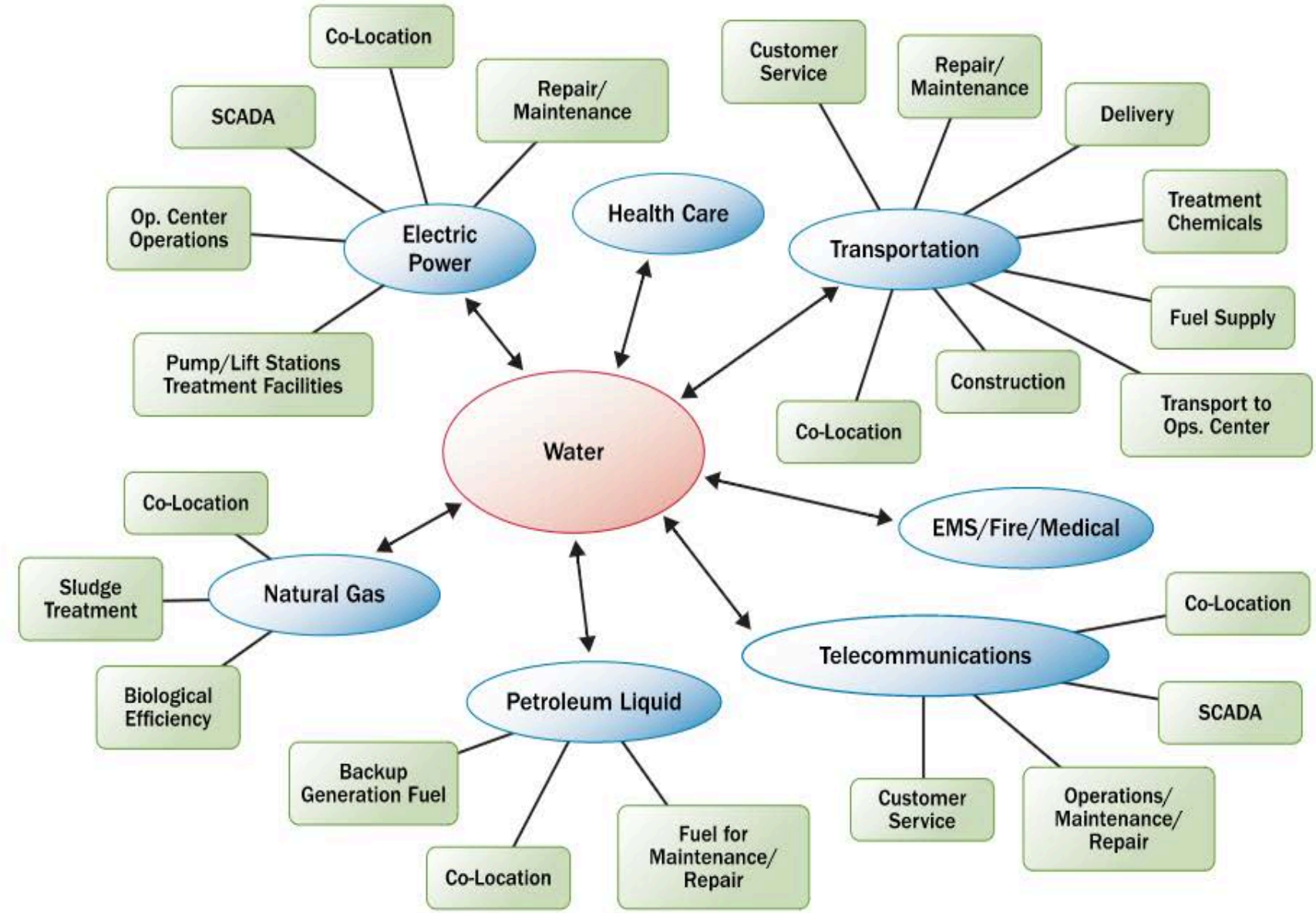
Utility risk assessments are one of the main topics of this plan:

"Utilities risk assessments prioritize security and emergency preparedness improvements by incorporating prevention, detection, response, and recovery concepts into their overall risk management strategy."



(from Water Sector Specific Plan)

Figure 3-2: Interdependencies with the Water Sector

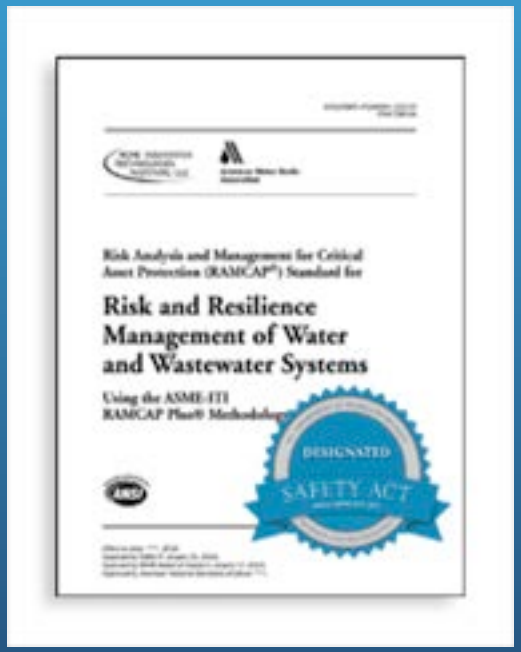


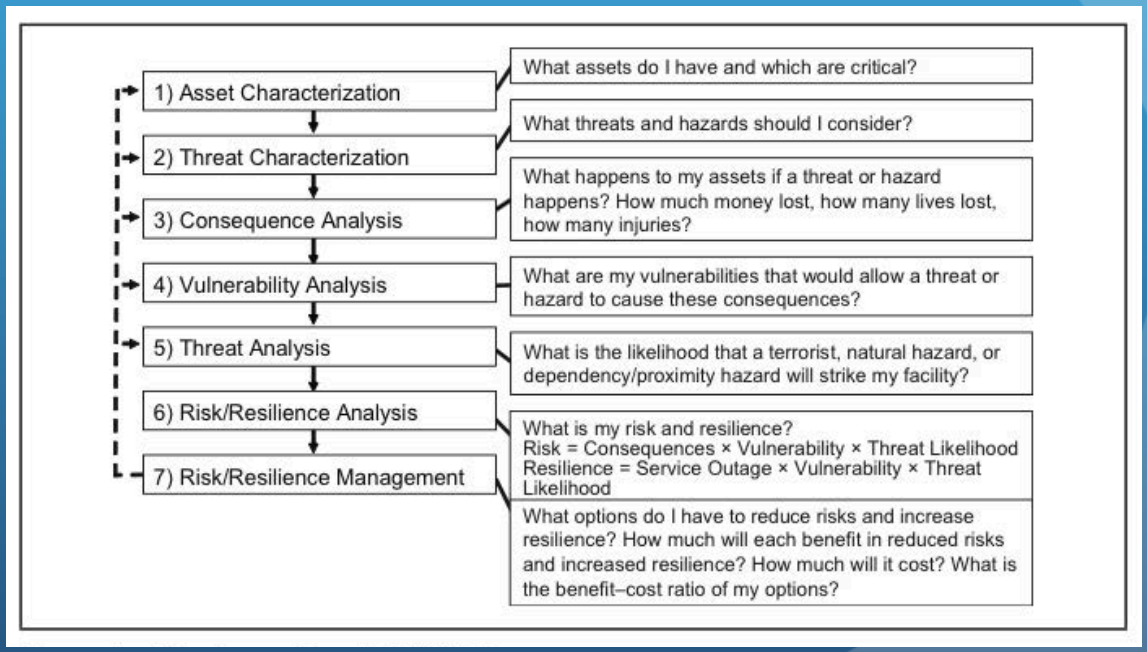
What is RAMCAP?

- Risk Analysis and Management for Critical Asset Protection (RAMCAP®) Standard
- “ANSI/ASME-ITI/AWWA J100-10”

By 2010, the VA process was retooled to respond to the needs of the nation to protect the water and wastewater infrastructure

~~Vulnerability Assessment~~ → Risk Assessment





Risk Analysis

- RAMCAP® is a process for analyzing and managing the risks associated with malevolent attacks and naturally occurring hazards against critical infrastructure

CONSEQUENCE ×

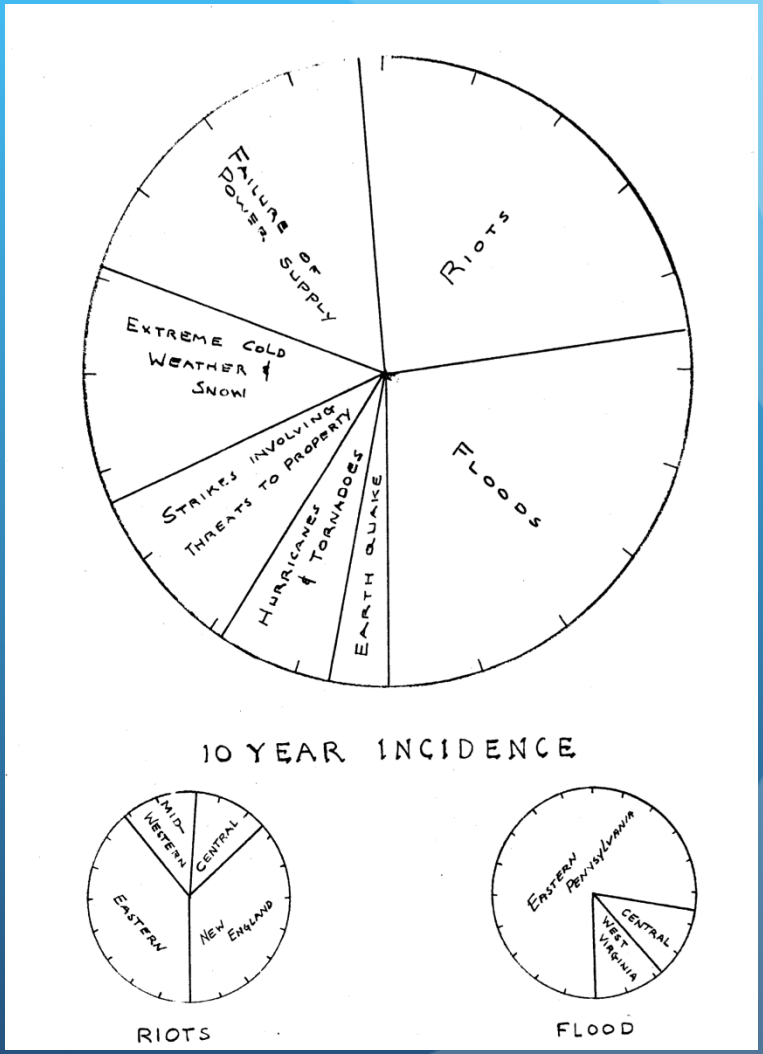
THREAT LIKELIHOOD ×

VULNERABILITY =

RISK

Risk assessments in the water sector were performed long before 2001. They are useful for planning.

Page from a 1973 Risk Assessment Report for a Water System in Pennsylvania



Benefits of Performing a Risk Assessment

- Standard practice across critical key infrastructure sectors
- Provide insights about water and wastewater system vulnerabilities, consequences and risks as support for internal decisions.
- Lower risks, increase resilience to attacks and natural hazards.
- Improve reliability of service.
- Improve ability to communicate risk.
- Assist in rate and fee setting to pay for reliability.
- May reduce insurance costs and/or improve credit ratings, etc.

Threats and Hazards in RAMCAP

- Specific reference threat scenarios are included in the Standard
  - Natural events
    - Flood, hurricane, tornado, wildfire, ice storm, earthquake
  - Man-made events
    - Contamination of product, process sabotage, diversion or theft, boat as weapon, plane as weapon, vehicle as weapon, assault teams
  - Dependency and proximity hazards
    - Other utilities, service interruptions of key suppliers, proximity to others' assets that carry significant risk)

RAMCAP Risk Assessment Tools

PARRE™

- Owned by AEM Corporation
- Buy annual license
- Web-based
- More user-friendly
- 1-hour of free technical support
- Been available for 2 years
- Been consistent with RAMCAP since its inception
- Good for any-size system

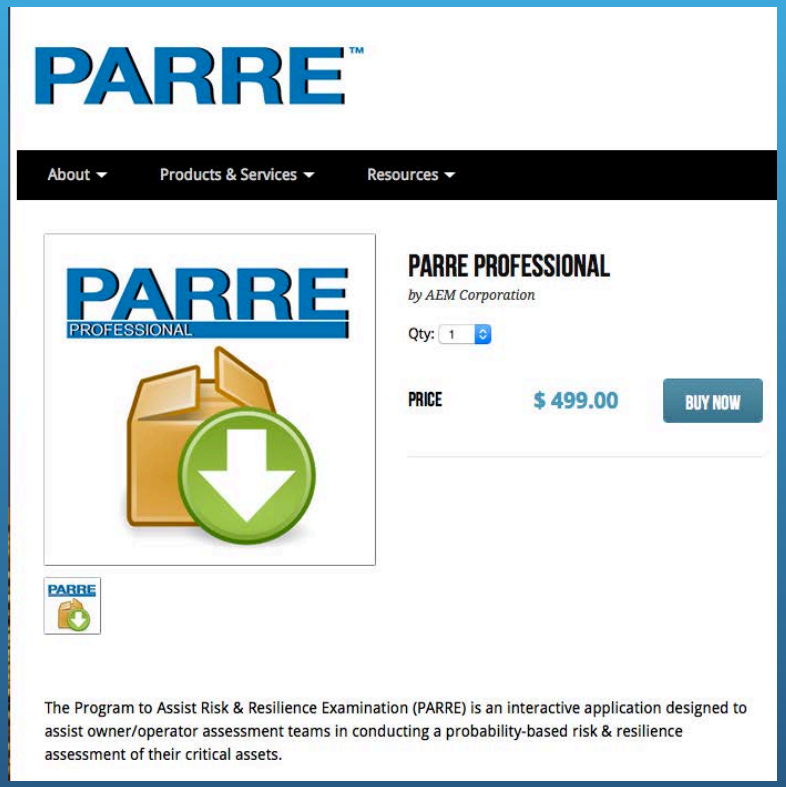
VSAT

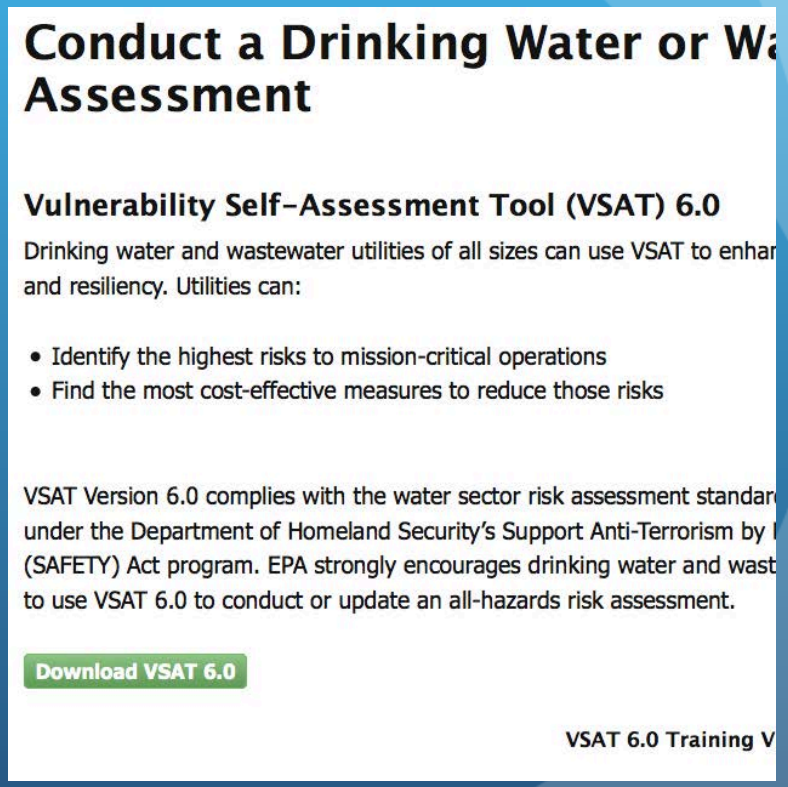
- Owned by EPA
- Free
- Not web-based
- Online tutorial videos
- Used more often than PARRE
- No technical support
- Latest version (6.02) is consistent with RAMCAP
- Good for small and some medium-sized systems

Getting the Tools

PARRE™

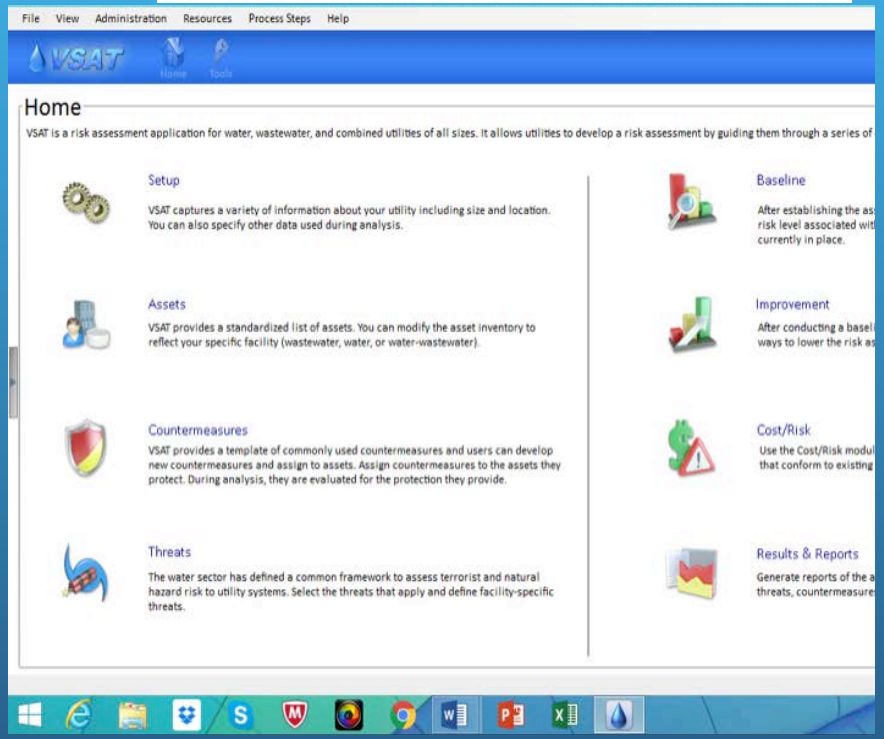
VSAT



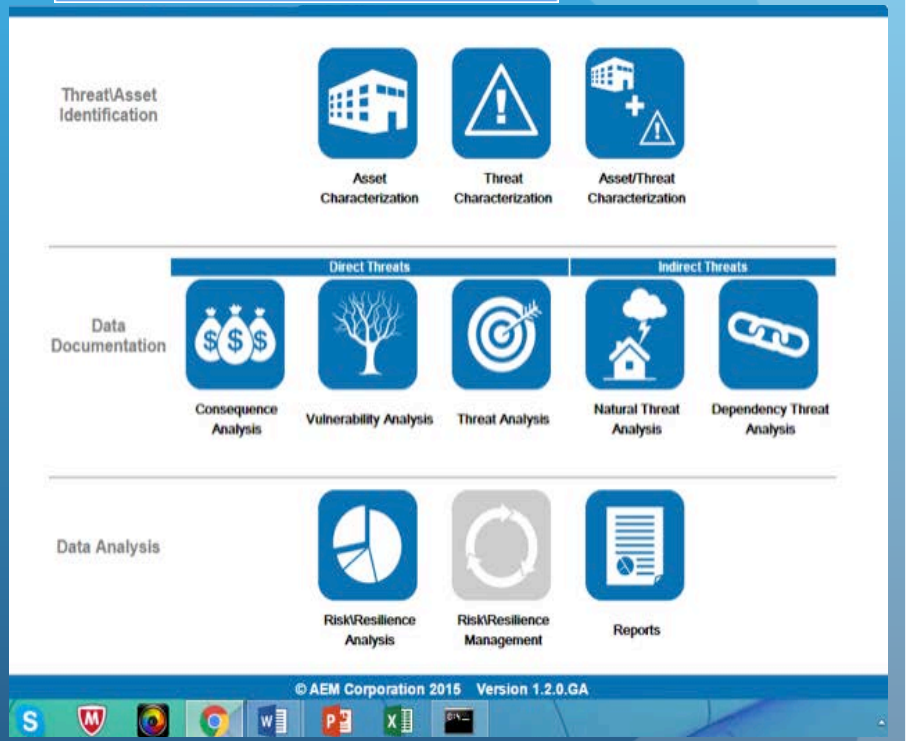


Home Screens

PARRE™



VSAT

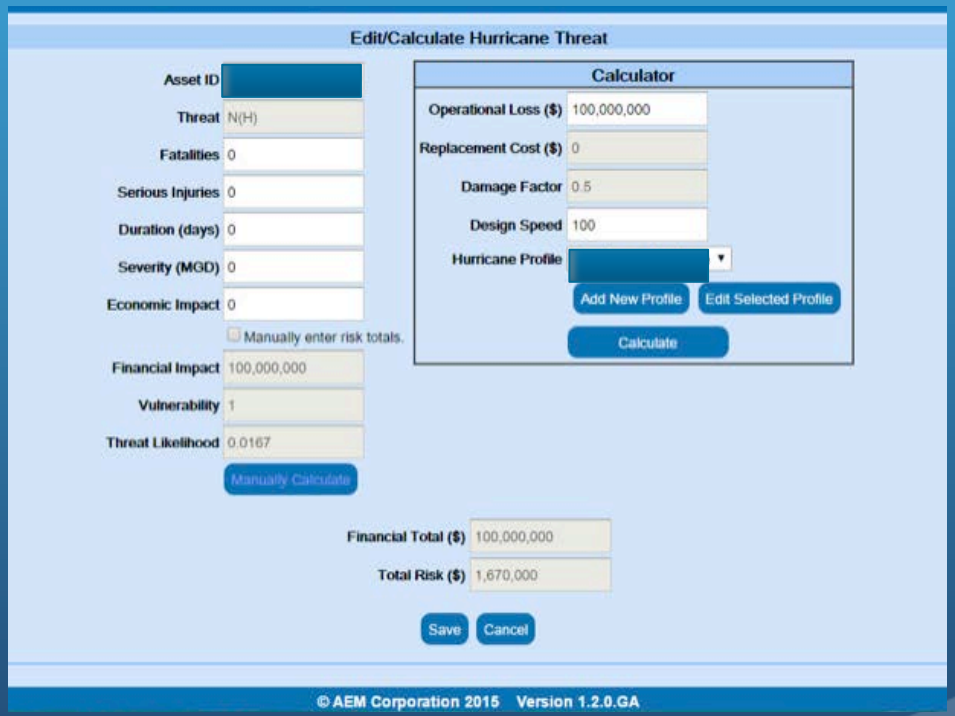


Additional Features of PARRE

- Two levels of prioritization and screening to refine scope of assessment
  - One at asset level and one at asset-threat pair level
- Vulnerability Analysis of Malevolent Threats has 4 built-in methods to choose:
  1. Direct expert elicitation
  2. Path analysis
  3. Vulnerability logic diagram
  4. Event tree
- Threat Analysis of Malevolent Threats has 3 built-in methods to choose:
  1. Conditional probability
  2. Best estimate
  3. Proxy indicator

Additional Features of PARRE

- Natural Threat Analysis has built-in calculators for hurricane, earthquake, tornado, floods, and ice storms to evaluate natural threats or you can manually input values



Baseline Results for Both

Asset	Threat	Number of Fatalities	Number of Injuries	Fatalities ($)	Injuries ($)	Utility Financial Impact	Regional Economic Impact
Treatment Facility	S(PI) - Process Sabotage-Physical Insider	50	2000	$390,000,000	$156,000,000	$100,000,000	$1,000,000,000
Treatment Facility	AT1 - Assault Team 1	50	2000	$390,000,000	$156,000,000	$100,000,000	$1,000,000,000
Treatment Facility	V1 - Car Bomb	50	2000	$390,000,000	$156,000,000	$10,000,000	$100,000,000
------ Lake	C(C) – Contamination	50	2000	$390,000,000	$156,000,000	$11,000,000	$110,000,000
------- Street Offices	Active Shooter	8	20	$62,400,000	$1,560,000	$1,000,000	$10,000,000
Treatment Facility	Active Shooter	4	10	$31,200,000	$780,000	$1,000,000	$10,000,000
------Storage	C(C) – Contamination	4	8	$31,200,000	$624,000	$2,000,000	$20,000,000
----- Street Offices	H1 - Category 1	2	2	$15,600,000	$156,000	$10,000,000	$0
Transmission Mains	F2 - 500-year flood	2	2	$15,600,000	$156,000	$5,000,000	$2,000,000
Distribution Mains	F2 - 500-year flood	2	2	$15,600,000	$156,000	$500,000	$100,000
-------Storage	T1 - Fujita 1	2	4	$15,600,000	$312,000	$2,000,000	$0
-------Storage	C(C) – Contamination	2	4	$15,600,000	$312,000	$4,000,000	$40,000,000
------ Storage	C(C) – Contamination	2	4	$15,600,000	$312,000	$3,000,000	$30,000,000
------Storage	C(C) – Contamination	2	4	$15,600,000	$312,000	$2,000,000	$20,000,000
------Storage	C(C) – Contamination	2	4	$15,600,000	$312,000	$2,000,000	$20,000,000
------ Storage	C(C) – Contamination	2	4	$15,600,000	$312,000	$5,000,000	$50,000,000
Continued…							

Baseline Results for Both

Asset	Threat	Likelihood of Damage	Likelihood of Threat	Total Monetized Risk
Treatment Facility	S(PI) - Process Sabotage-Physical Insider	0.3	0.0001	$49,380
Treatment Facility	AT1 - Assault Team 1	0.3	0.000000001	$0
Treatment Facility	V1 - Car Bomb	0.3	0.000000001	$0
------ Lake	C(C) – Contamination	0.15	1E-10	$0
------- Street Offices	Active Shooter	0.03	0.0001	$225
Treatment Facility	Active Shooter	0.3	0.00001	$129
------Storage	C(C) – Contamination	0.05	1E-10	$0
----- Street Offices	H1 - Category 1	0.03	0.0233	$18,003
Transmission Mains	F2 - 500-year flood	0.25	0.002	$11,378
Distribution Mains	F2 - 500-year flood	0.25	0.002	$8,178
-------Storage	T1 - Fujita 1	0.2	0.0001412	$506
-------Storage	C(C) – Contamination	0.1	1E-10	$0
------ Storage	C(C) – Contamination	0.1	1E-10	$0
------Storage	C(C) – Contamination	0.1	1E-10	$0
------Storage	C(C) – Contamination	0.1	1E-10	$0
------ Storage	C(C) – Contamination	0.05	1E-10	$0
Continued…				

RAMCAP Risk Assessment Report

- Top threats
- Asset-threat pair risks prioritized
- Risk reduction options prioritized
- And more…

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