Compounding & Cascading Events

Mitigating Impacts: Developing Solutions and Avoiding Unintended Consequences

May 2022

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Our Facilities

Aviation
- John F. Kennedy International Airport
- LaGuardia Airport
- Newark Liberty International Airport
- Stewart International Airport
- Teterboro Airport

Bridges, Tunnels & Terminals
- Bayonne Bridge
- George Washington Bridge
- Goethals Bridge
- Outerbridge Crossing
- Holland Tunnel
- Lincoln Tunnel
- Port Authority Bus Terminal
- George Washington Bridge Bus Terminal
- Journal Square Transportation Center

Port Commerce
- Port Jersey-Port Authority Marine Terminal
- Brooklyn-Port Authority Marine Terminal
- Elizabeth-Port Authority Marine Terminal
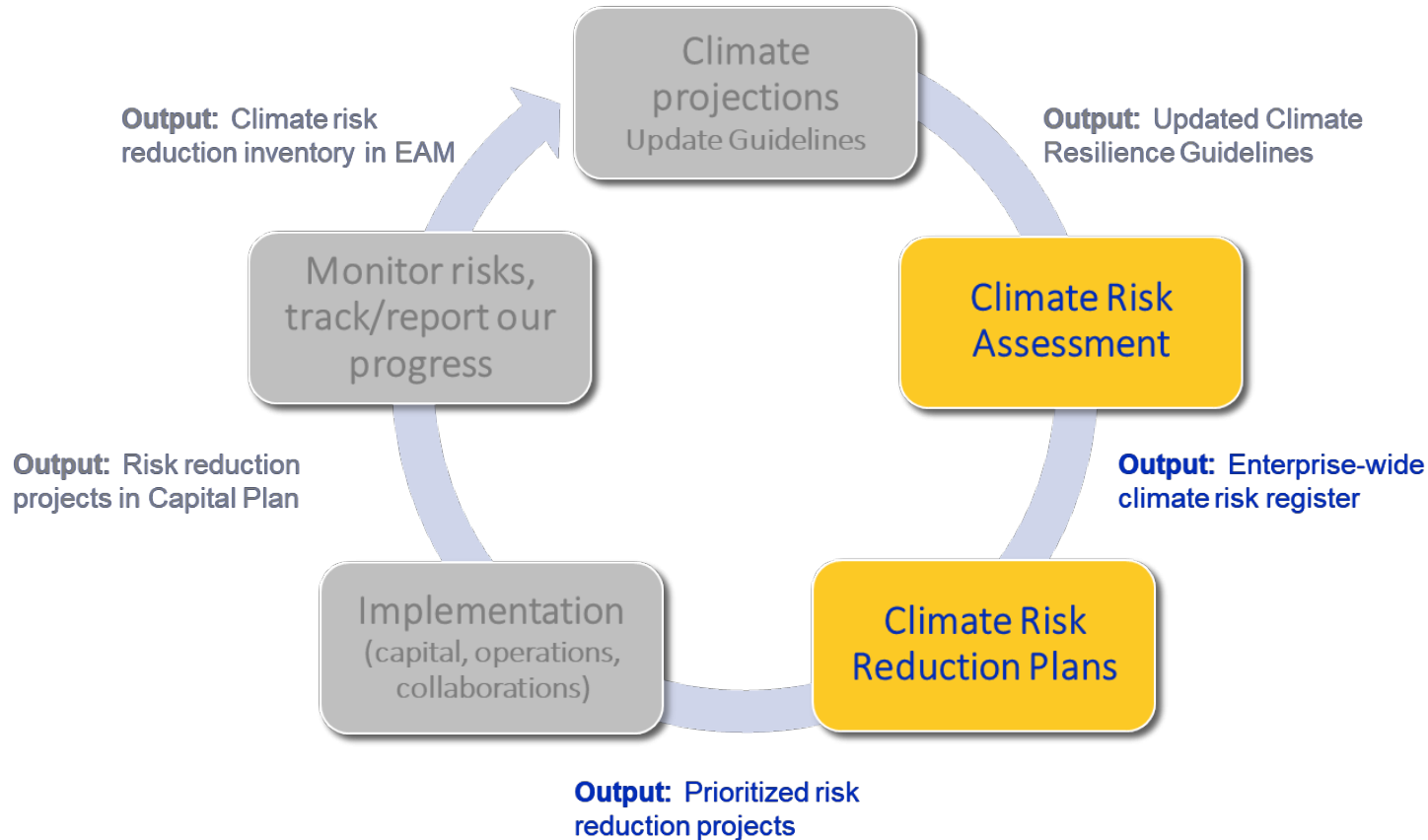- Howland Hook Marine Terminal
- Port Newark

Port Authority Trans-Hudson
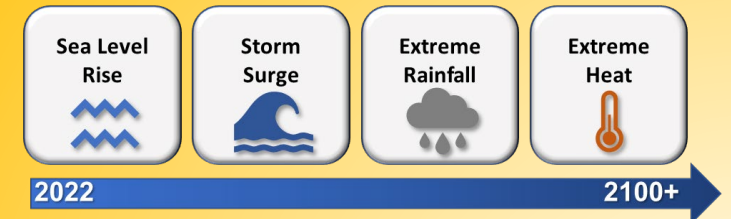- PATH Rail Transit System
- Journal Square Transportation Center

The World Trade Center

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Resilience Cycle

An Iterative Approach to Building Resilience at PANYNJ

Output: Climate risk reduction inventory in EAM

Climate projections
Update Guidelines

Output: Updated Climate Resilience Guidelines

Monitor risks, track/report our progress

Climate Risk Assessment

Output: Risk reduction projects in Capital Plan

Output: Enterprise-wide climate risk register

Implementation (capital, operations, collaborations)

Climate Risk Reduction Plans

Output: Prioritized risk reduction projects

Port Authority Climate Risk Assessment (CRA)

Sea Level Rise | Storm Surge | Extreme Rainfall | Extreme Heat

2022   2100+

Purpose: Cost-effectively mitigate the PA's highest priority climate risks.

Expected Outcome: Optimized climate risk reduction plans for Capital Plan integration.

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CRA Workflow

Digital Assessment Platform (DAP)

DRAFT

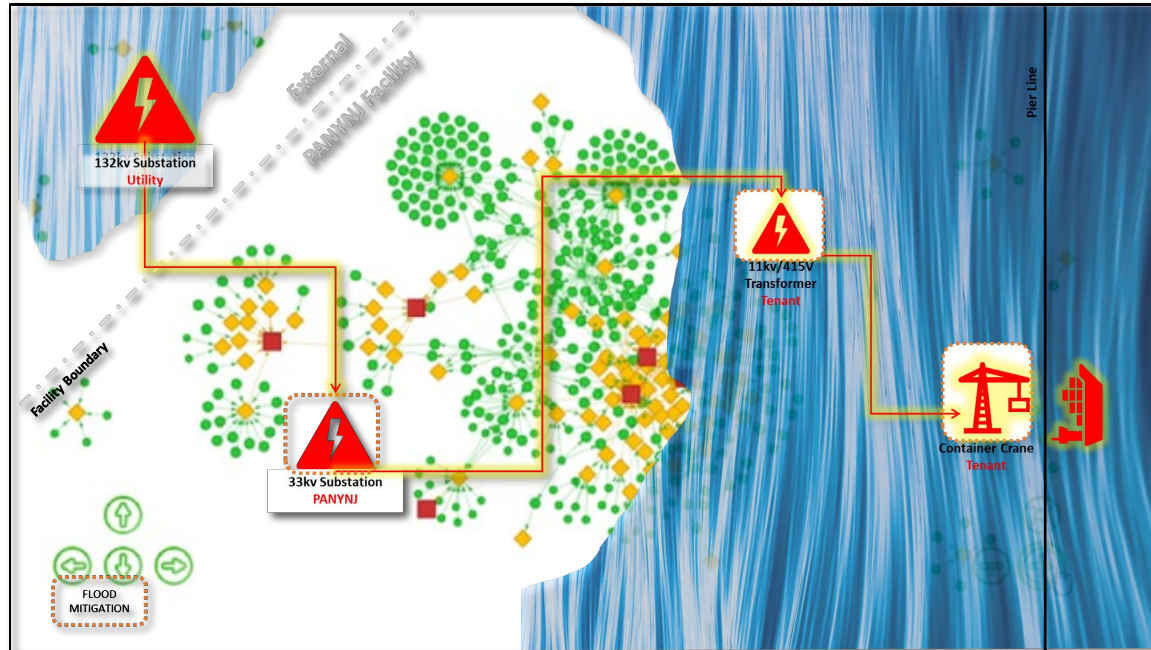PORT AUTHORITY NY NJ
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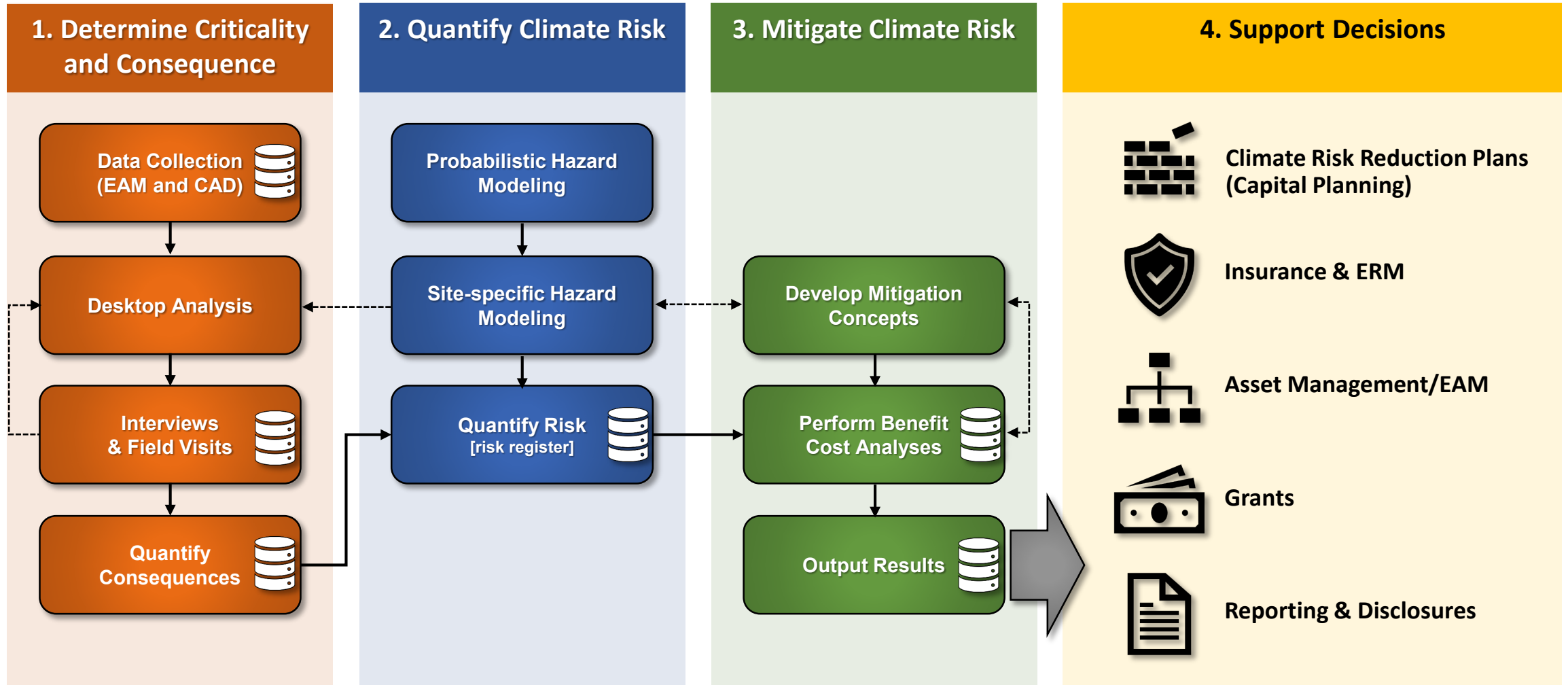
Digital Assessment Platform (DAP)

The "DAP" is the CRA's primary decision-support tool. It leverages engineering/scientific data to establish complex systems relationships, quantify risks, analyze mitigation alternatives, and develop optimized climate risk reduction plans.

Assets

Inputs

- Enterprise Asset Management (EAM) data
- Field data
- "Outside-the-gates" data
- Replacement costs
- Facility-scale revenue loss; regional economic loss

Functions & Outputs

- System hierarchies
- Asset interconnectivity/ interdependencies
- Consequence assignments (to assets/subsystems)

Hazards

Inputs

- Probabilistic hazard data and models (including coastal, wave, stormwater), present - 2100

Functions & Outputs

- Asset-level risk analysis (probability * consequence)
- Asset-scale risk register

Mitigations

Inputs

- Mitigation concepts (pre-engineering level)

Functions & Outputs

- Mitigation alternatives analysis ("Mitigation Explorer" module)
- Mitigation benefit-cost ratios

Climate Risk Reduction Plans

Functions & Outputs

- Optimized mitigation program(s)
- User-defined parameters, including:
  - **Cost:** Fiscally constrained/unconstrained
  - **Discount rate:** Standard, ESG, custom
  - **Scale:** Enterprise/Department/Facility
  - **Hazard:** All hazards or single hazard
  - **Consequence:** All or single consequence
  - **Risk Tolerance:** Worst-case, model average
  - **Timeframe:** Defined time range(s)
  - **Jurisdiction:** State/locality

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Cascading Impacts

Challenge: Quantifying Upstream/Downstream Consequences



CRA APPROACH TO CASCADING IMPACTS

- Using Enterprise Asset data, DAP algorithm develops operational interdependencies between systems/assets

- DAP computes the estimated operational impacts of hazard scenarios, assigns consequences by asset/subsystem:
  - Regional economic loss
  - Revenue loss
  - Replacement cost

- Informs mitigation priorities

Research Needs:

- Integrate interdependency mapping into standard Enterprise Asset Management practice
- Create inter-agency "collaboration platforms" to explore interdependencies and shared mitigations

Compound Events

Challenge: Integrating Compound Events into Risk Modelling
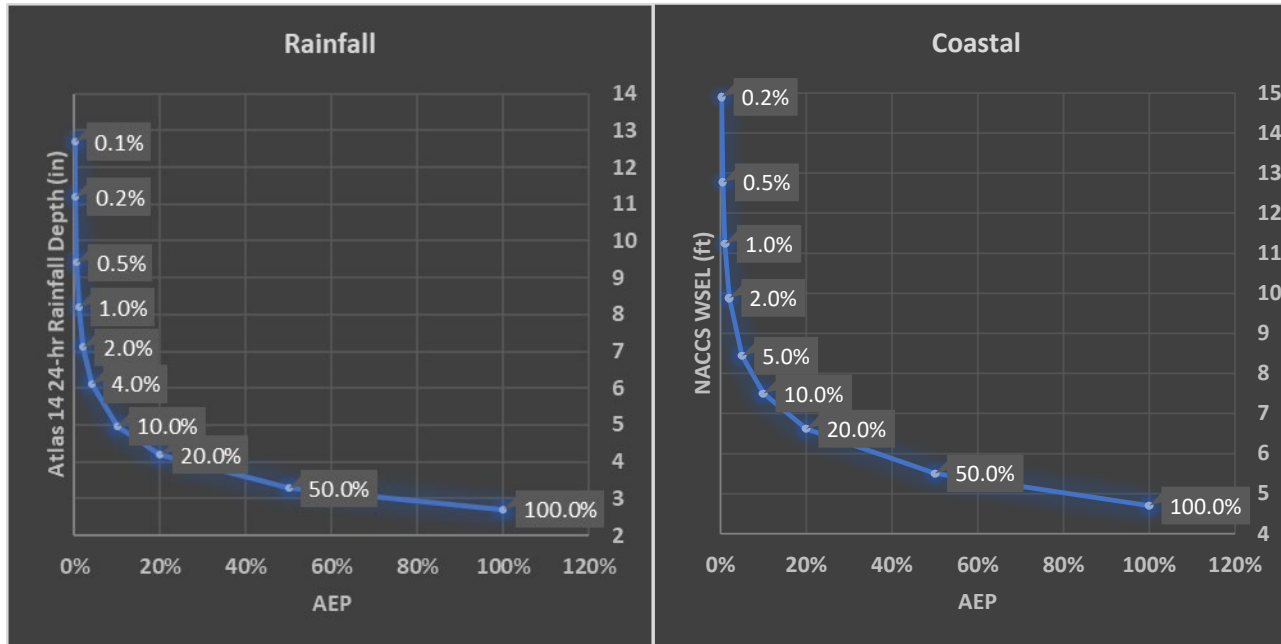
CRA APPROACH TO COMPOUND EVENTS

- Keep storm surge and rainfall Annual Exceedance Probabilities <u>separate</u> for risk quantification purposes (i.e., no compound probabilities).
- Conduct compound event scenario analysis, focused on higher AEP events (e.g., 2-year surge; 10-year rainfall), <u>without</u> consideration of probability.
- Engage Scientific Advisory Group for future direction.

Research Needs:

- More "ready-for-practice" scientific guidance on compound probabilities to establish credible methods
- Inclusion of rainfall in coastal storm modeling to derive compound probabilities from simulated datasets

Thank You!

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