Making Dollars and Sense of Growing Risk

Showcasing a New Digital Tool to Understand Flood Risk, Obtain Funding, and Build Resilience

NEWEA Annual Conference
January 25, 2023

Agenda

1 **Background**

Risk Quantification, the Flood Risk Calculator, and Benefit-Cost Analysis

2 **Case Study 1**

Nantucket Coastal Resilience Plan

3 **Case Study 2**

Coastal Resilience Solutions for East Boston and Charlestown (Phase II)

4 **Case Study 3**

Use in Federal Funding Applications

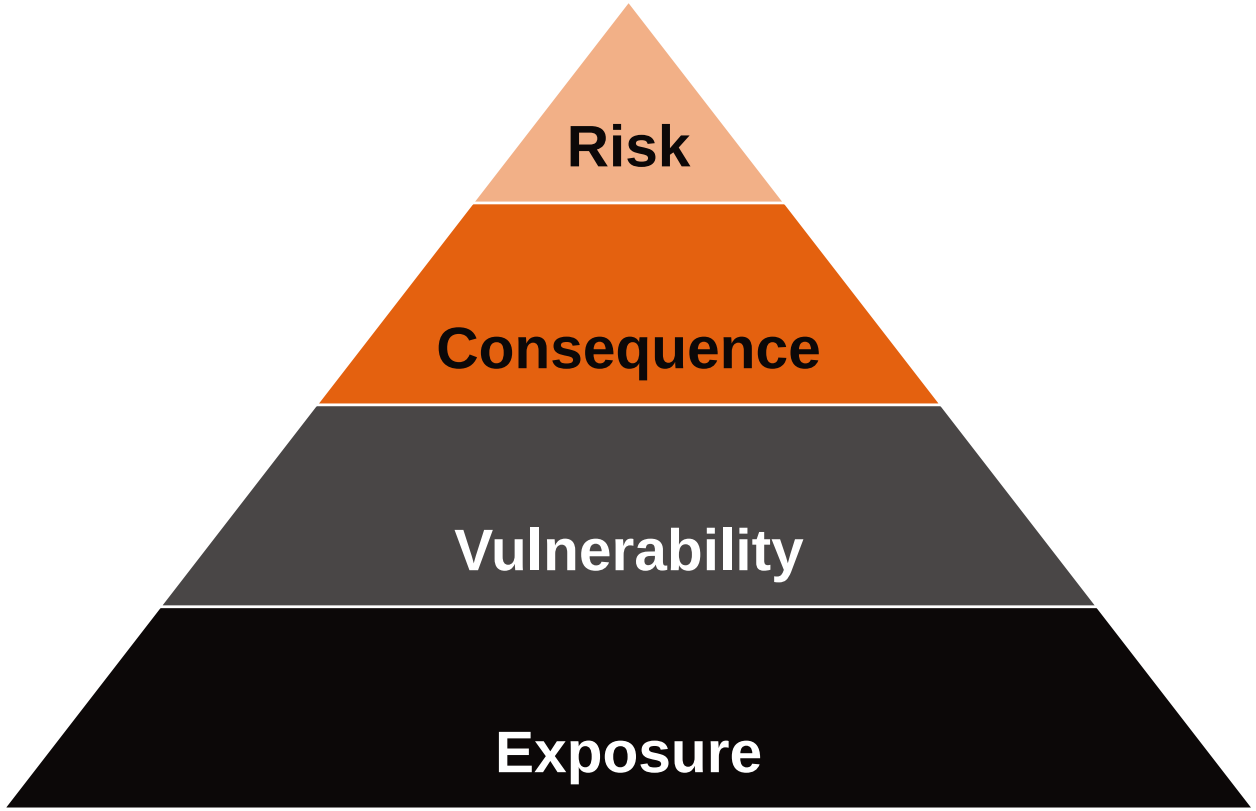
5 **Case Study 4**

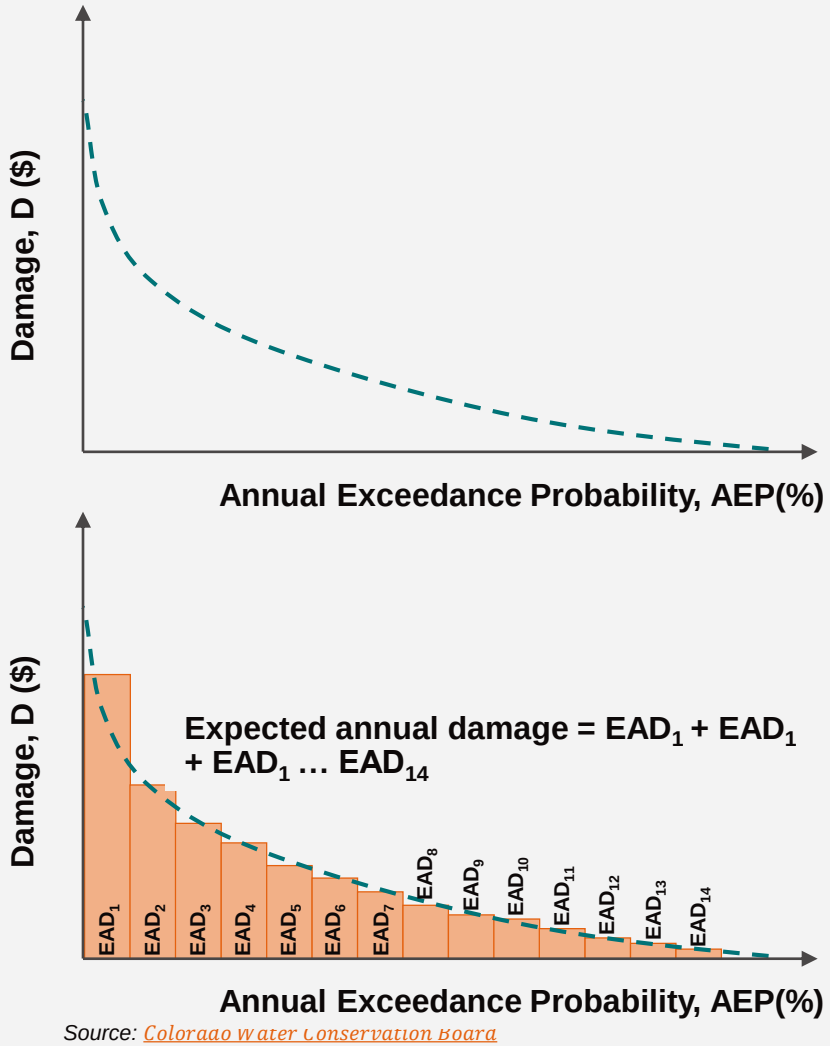
Incorporating Social Equity

6 **Conclusion/Q&A**

… But why?

Background: Flood Risk Quantification

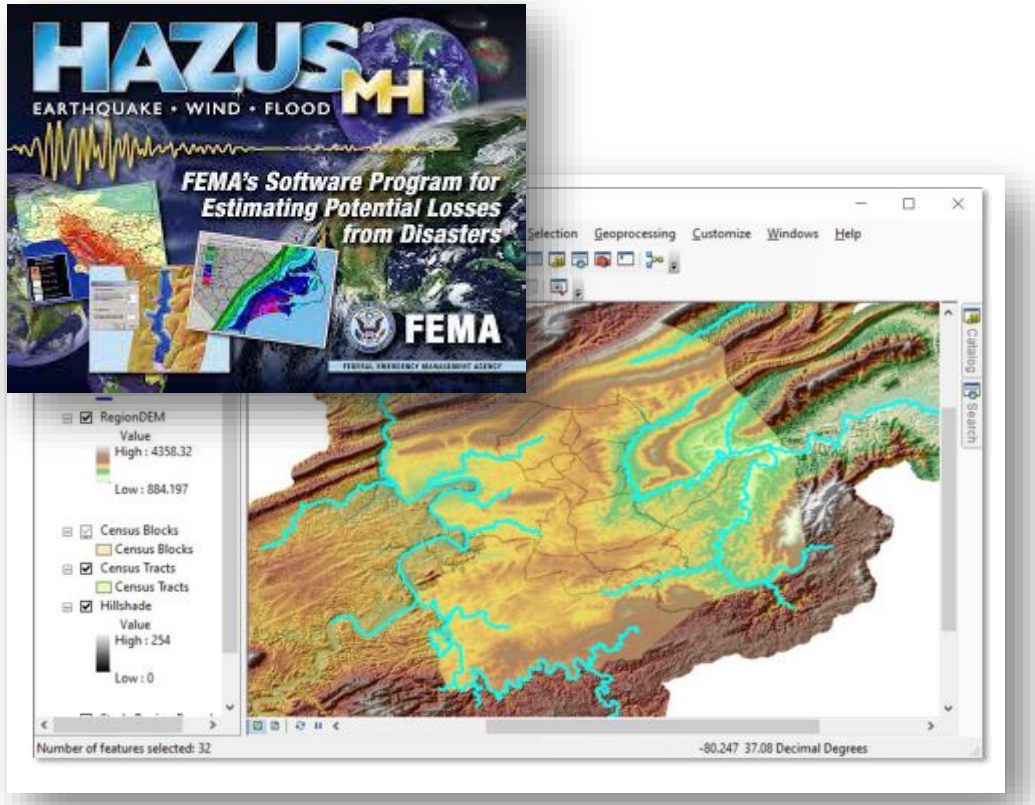


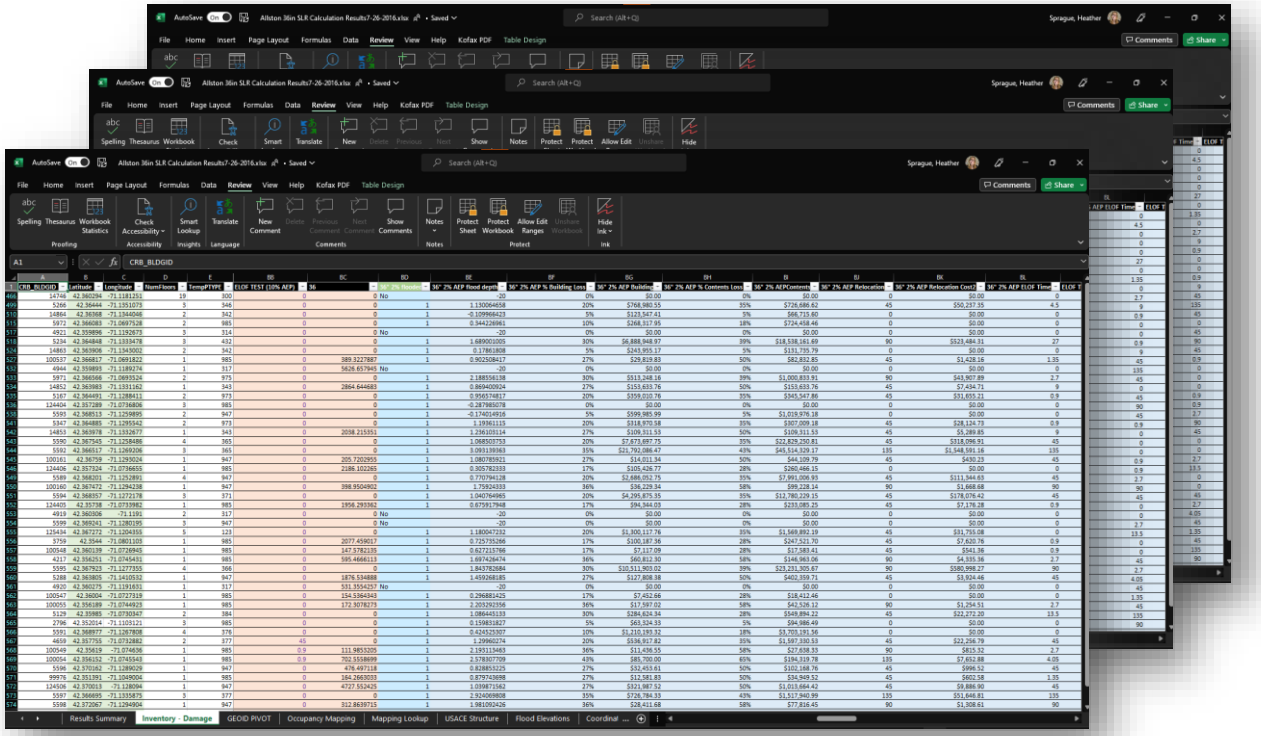


Source: Colorado Water Conservation Board

Background: Flood Risk Calculator

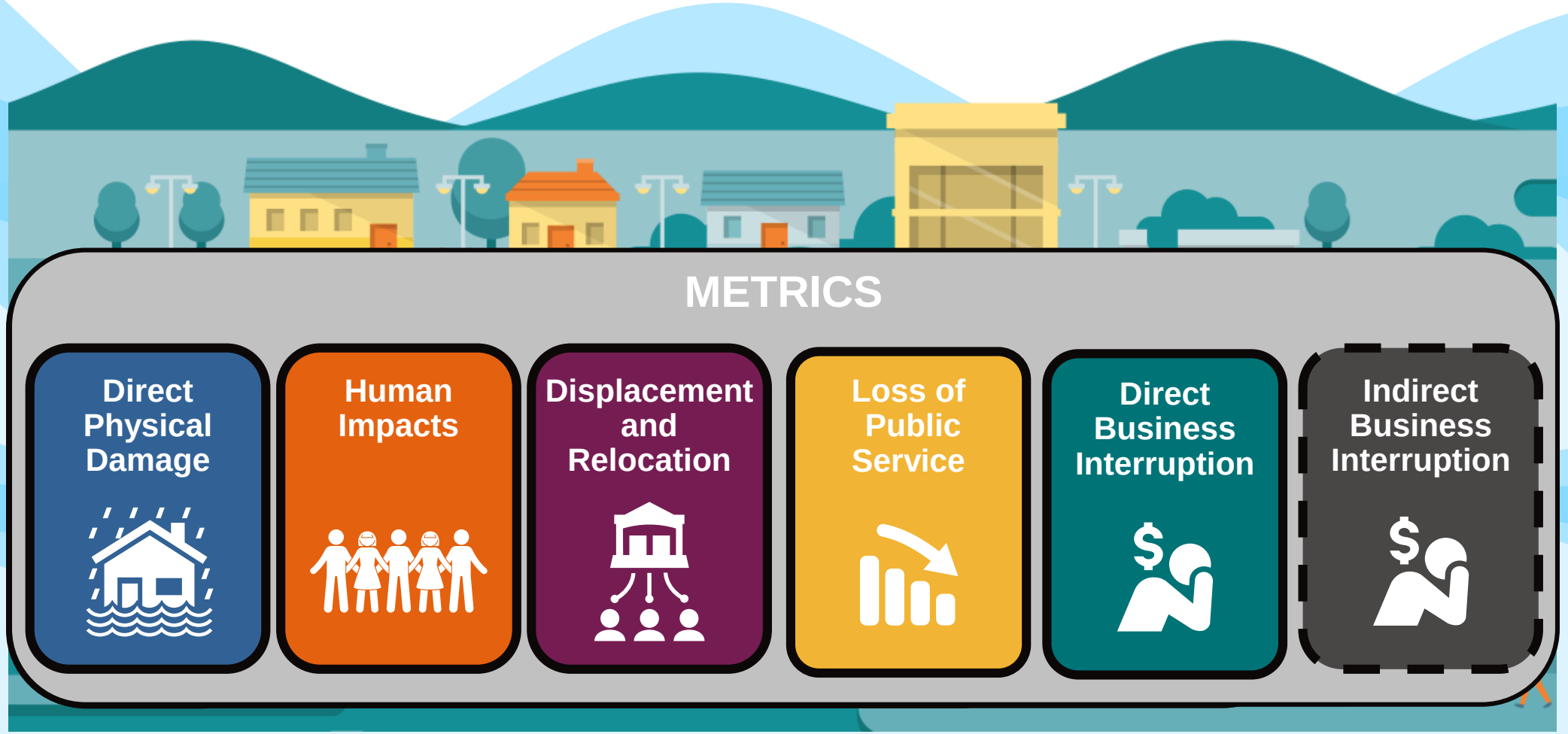
- 40+ years of experience in risk estimation on our team
- Customized spreadsheet model built to replicate Hazus, BCA Toolkit, and integrate additional methodologies
- Flood Risk Calculator built to standardize and automate spreadsheet model





Flood Risk Calculator

An Arcadis Product



Background: Benefit Cost Analyses

Components

Benefits

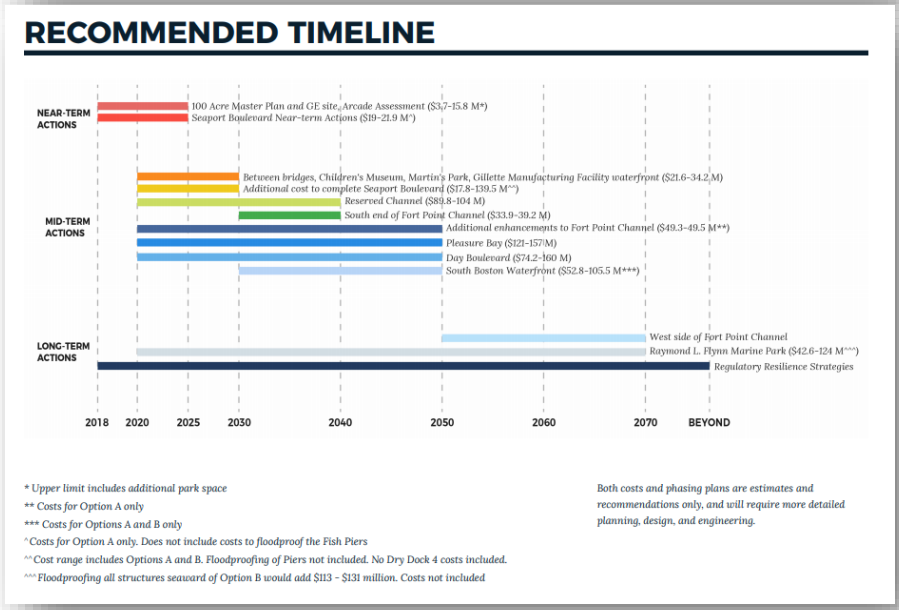
- Losses avoided
- Value added
  - Social
  - Environmental
  - Economic
- Policies that reduce risk

Costs

- Estimates for flood resilience investments

Uses

- Baseline risk and vulnerability assessments
- Loss avoidance assessments
- Alternatives evaluation
- Consensus building for project implementation
- Justification of public or private expenditure
- Funding applications
- Life cycle analyses



Case Studies

Nantucket: Informing risk-based planning at community scale

Boston: Detailed Benefit-Cost Analysis for neighborhood-level flood mitigation design and implementation planning

Funding: Use in grant application development for federal funding

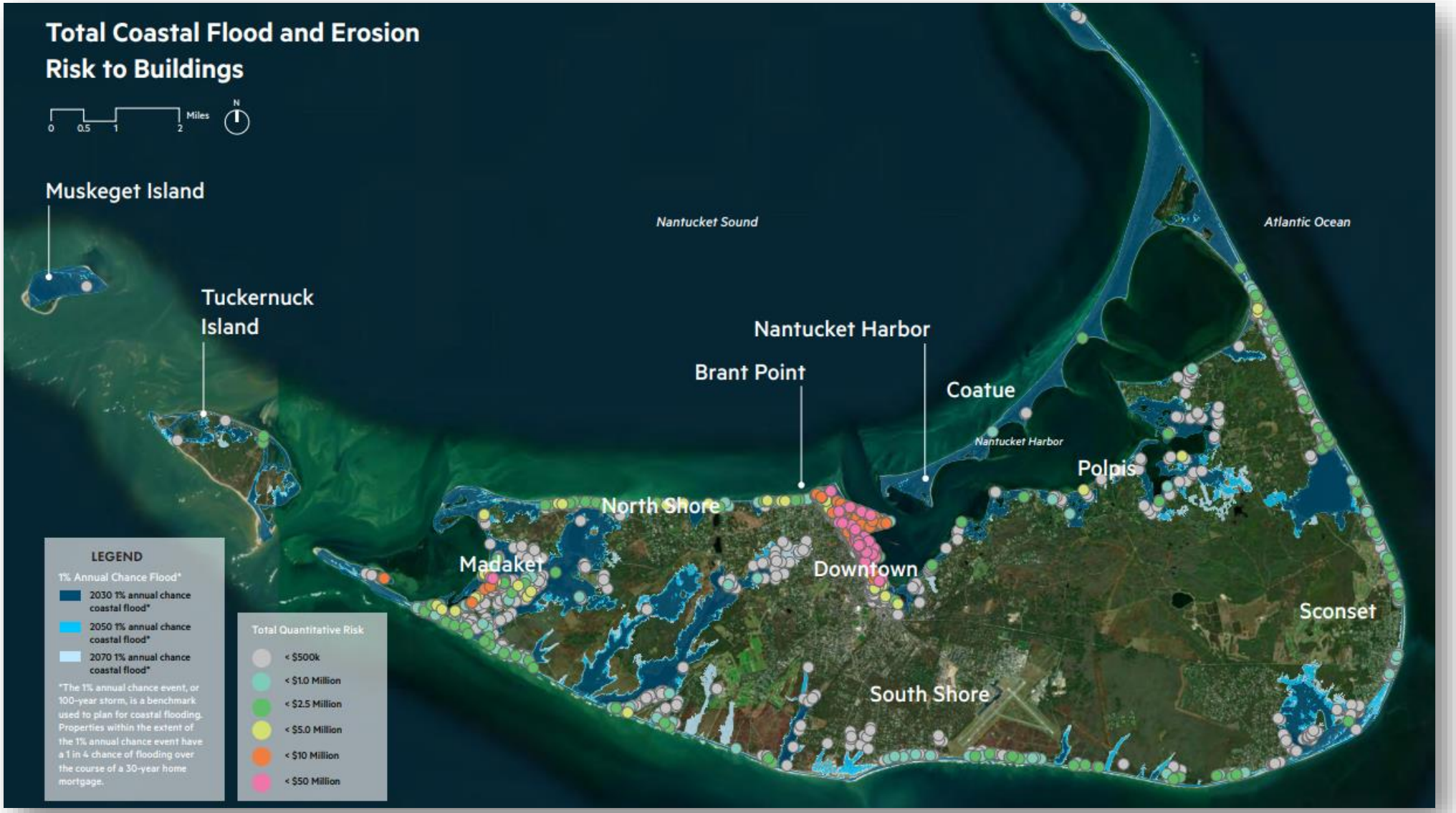
Equity: Incorporating social equity weights

Nantucket Coastal Resilience Plan

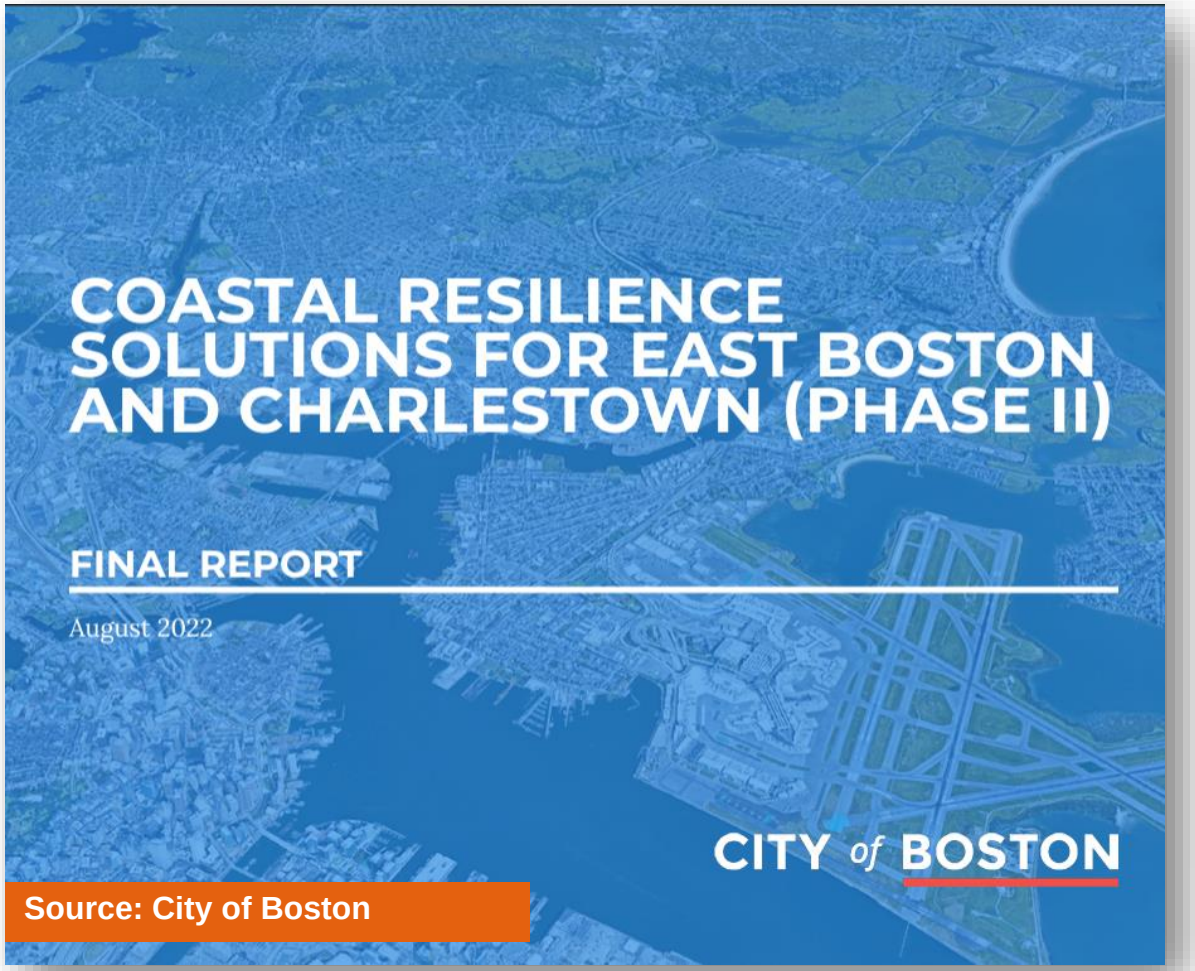
An island-wide adaptation plan that used risk quantification to drive decisions about how and where to adapt to erosion and flooding

Source: Town of Nantucket

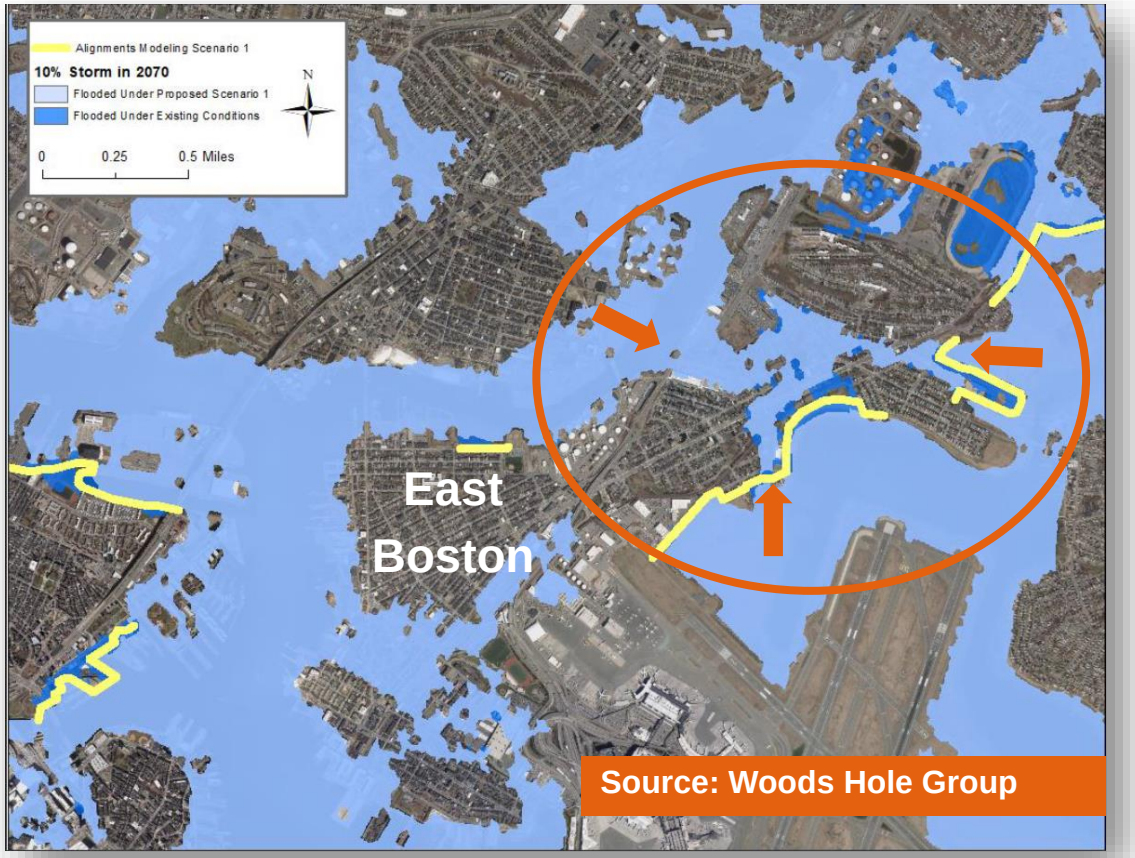
Nantucket Coastal Resilience Plan



Coastal Resilience Solutions for East Boston and Charlestown (Phase II)



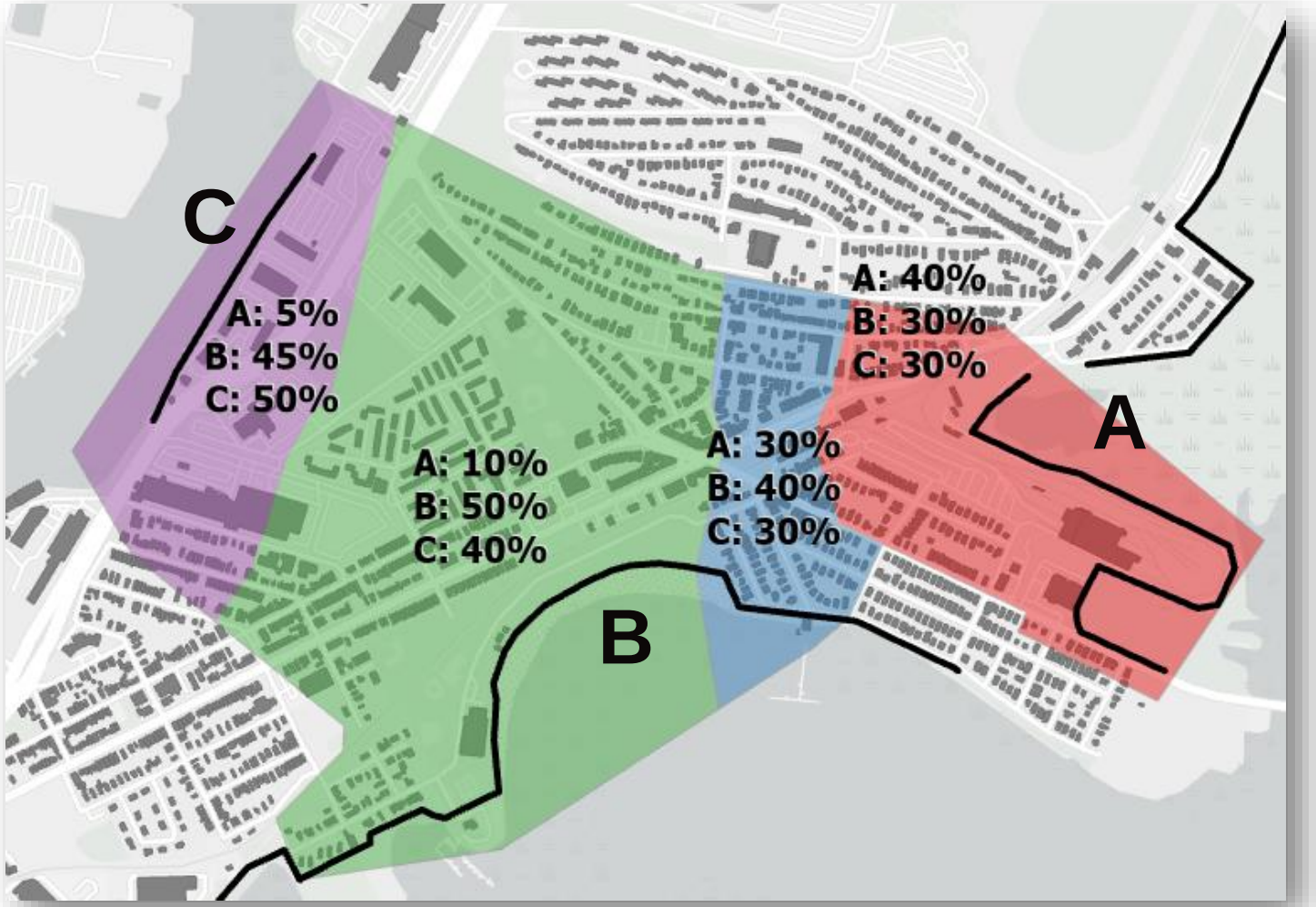
Source: City of Boston

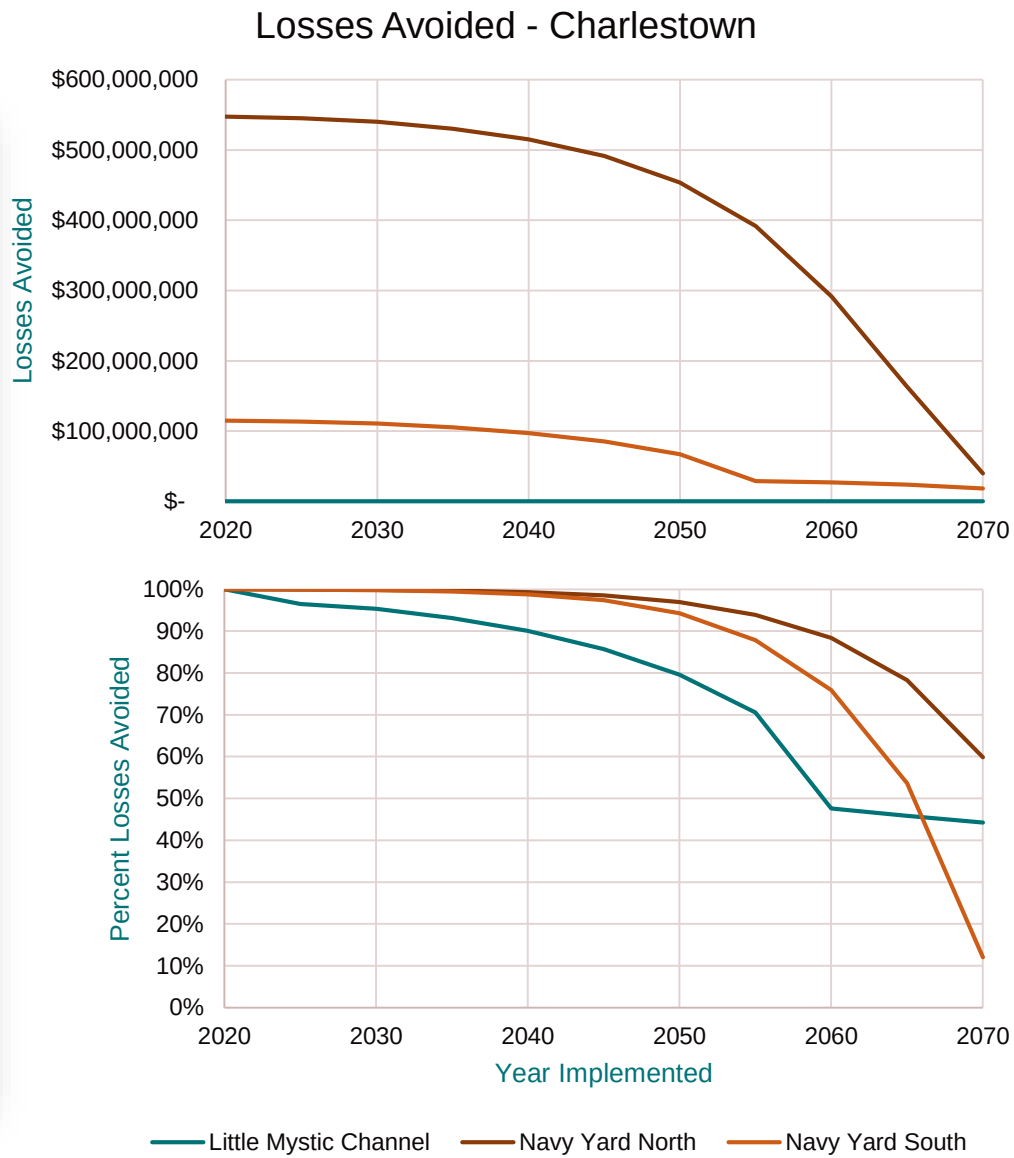


Source: Woods Hole Group

Coastal modeling performed by Woods Hole Group to inform project sequencing and distribute loss avoidance under different adaptation scenarios

Coastal Resilience Solutions for East Boston and Charlestown (Phase II)





Urban Water Department
Stormwater Flood Mitigation Project

Standard output from FRC (below) is directly entered into FEMA BCA Toolkit (right)

	A	B	C	D	E	F
1	Category	Return Period	Building Damage	Contents Damage	Relocation Cost	Total Damages
2	Pre-Mitigation	5	1,084,750	3,011,030	-	4,095,780
3	Pre-Mitigation	10	2,590,044	6,756,147	714,403	10,060,594
4	Pre-Mitigation	25	5,219,886	12,367,283	835,975	18,423,143
5	Pre-Mitigation	50	7,221,296	17,063,852	2,189,034	26,474,182
6	Pre-Mitigation	100	8,228,954	19,326,571	2,432,322	29,987,847
7	Post-Mitigation	25	1,536,618	3,148,926	-	4,685,544
8	Post-Mitigation	50	2,817,161	6,108,187	-	8,925,348
9	Post-Mitigation	100	4,468,145	9,358,106	1,307,552	15,133,803
10						

Professional Expected Damages Before Mitigation

Damages Before Mitigation

Add Row | Delete Row(s)

SELECT	RECURRENCE INTERVAL (YEARS)	OTHER DAMAGES ($)	OPTIONAL DAMAGES Contents Damages ...	OPTIONAL DAMAGES Displacement Costs...
☐	5	1,084,749.79	3,011,030.33	0
☐	10	2,590,044.26	6,756,147.08	714,403
☐	25	5,219,885.67	12,367,282.62	835,975
☐	50	7,221,295.97	17,063,852.33	2,189,034
☐	100	8,228,954.33	19,326,570.77	2,432,322

View Annualized Results

Professional Expected Damages After Mitigation

Damages After Mitigation

Add Row | Delete Row(s)

SELECT	RECURRENCE INTERVAL (YEARS)	OTHER DAMAGES ($)	OPTIONAL DAMAGES Contents Damages ...	OPTIONAL DAMAGES Displacement Costs...
☐	25	1,536,617.62	3,148,925.94	0
☐	50	2,817,161.43	6,108,187.04	0
☐	100	4,468,144.96	9,358,106	1,307,552

View Annualized Results

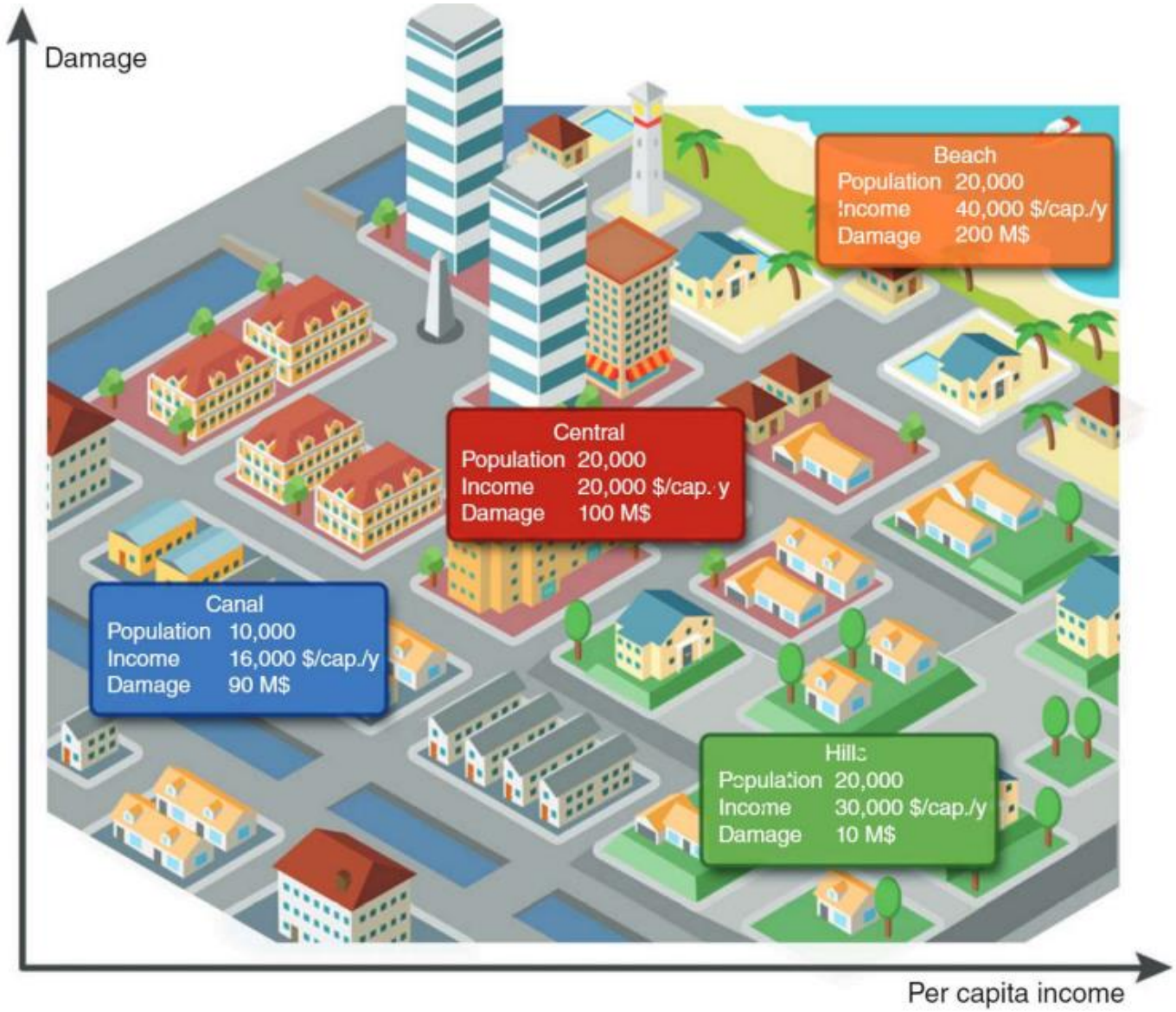
Social Equity Weighting

Advanced Review

Accounting for risk aversion, income distribution and social welfare in cost-benefit analysis for flood risk management

Jarl Kind,[1]* W.J. Wouter Botzen[2,3] and Jeroen C.J.H. Aerts[2]

Published: 2017



$$Equity\ Weight(EW) = \left(\frac{Block\ Group\ Median\ Income\ (\$)}{Regional\ Median\ Income\ (\$)}\right)^{-\gamma}$$

TABLE 5 | Flood Risk According to Four Different Metrics

District	Population No.	Income US$ per cap/year	Total Income Million US$/year	Flood Probability 1/year	Flood Damage Million US$	Expected Annual Damage (EAD) Million US$/year	Social Vulnerability (z) (damage as fraction of income)	Certainty Equivalent Annual Damage (CEAD) Million US$/year	Certainty Equivalent Annual Damage (CEAD) As % of EAD	Equity weight	Equity Weighted Expected Annual Damage (EWEAD) Million US$/year	Equity Weighted Expected Annual Damage (EWEAD) As % of EAD	Equity Weighted Certainty Equivalent Annual Damage (EWCEAD) Million US$/year	Equity Weighted Certainty Equivalent Annual Damage (EWCEAD) As % of EAD
Beach	20,000	40,000	800	1/100	200	**2.00**	0.25	**2.36**	118	0.65	1.30	65	1.54	77
Central	20,000	20,000	400	1/100	100	**1.00**	0.25	1.18	118	1.50	**1.50**	150	**1.77**	177
Canal	10,000	16,000	160	1/100	90	0.90	0.56	**1.43**	162	1.96	**1.76**	196	**2.80**	311
Hills	20,000	30,000	600	1/100	10	0.10	0.02	0.10	100	0.92	0.09	92	0.09	93
Total	70,000	28,000	1960			4.00		5.08	127		4.65	116	6.20	155

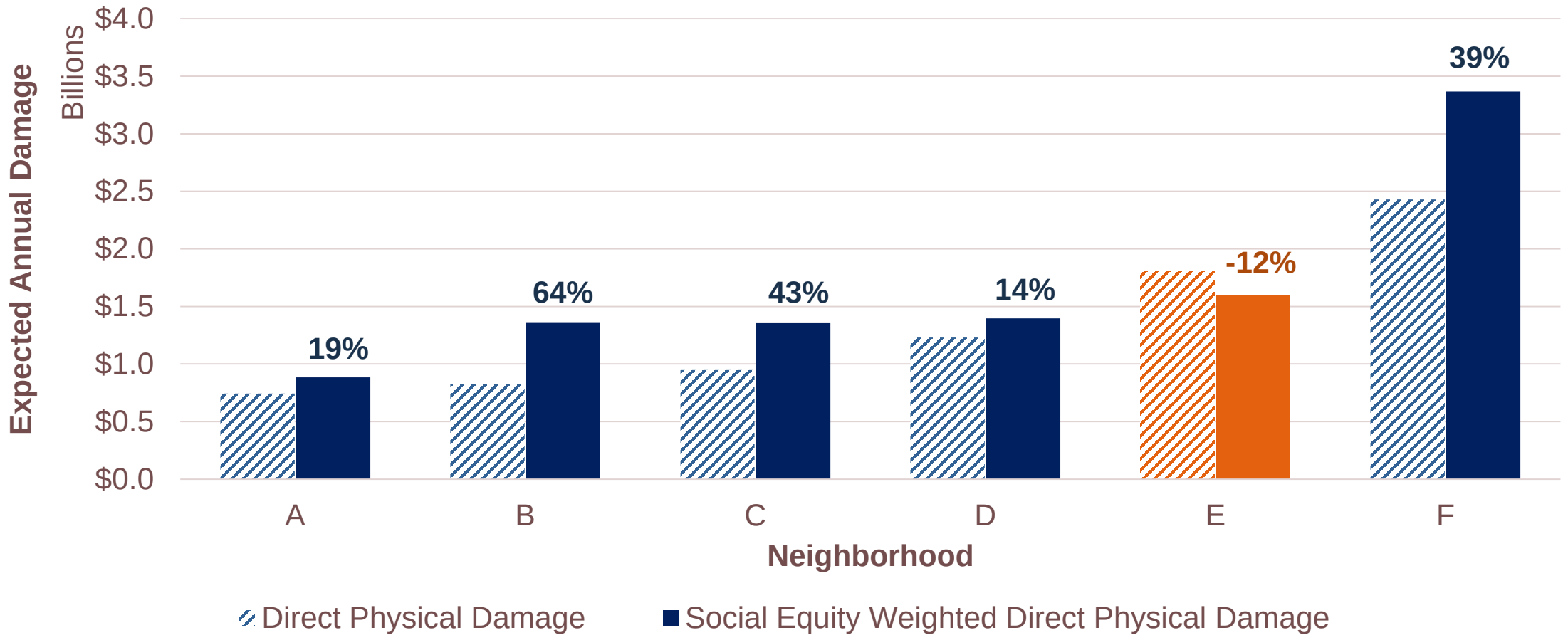
Expected Damage

Risk Premium Adjusted

Equity Weight Adjusted

Social Welfare Adjusted

Application in Risk-Based Flood Resilience Strategy



…. But why?

- Risk quantification helps inform decision-making
- Improved internal workflows allows us to do MORE for climate adaptation
- Need to increase digital capacity in our industry

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