

QUANTIFYING COSTS AND BENEFITS OF MANAGED RETREAT: INSIGHTS FROM VALMEYER AND GREATER OLIVE BRANCH, ILLINOIS

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INTRODUCTION

- Flooding is the most frequent and costly natural hazard in the United States, and aging levees, especially along the Mississippi River, create a false sense of security, exacerbating risk and impact through the **levee effect**¹.
- As **climate-driven flood risk** escalates, **managed retreat** - the planned, strategic movement of people, infrastructure, and development away from high-risk areas is gaining attention as a long-term adaptation strategy^{2,3}. Yet, its **cost-effectiveness** and **social outcomes** remain underexamined.
- Despite the increased focus on managed retreat, there is **limited empirical evidence** assessing its long-term cost-effectiveness and socio-economic impacts, especially in levee-protected communities.
- This study evaluates the outcomes of managed retreat in two Illinois communities: **Valmeyer**, which successfully relocated after the 1993 flood⁴, and **Greater Olive Branch (GOB)**, which faced funding limitations and implemented voluntary buyouts after the 2011 flood to assess the cost-effectiveness and social consequences using **flood loss modeling, benefit-cost analysis, and longitudinal socioeconomic analysis**.

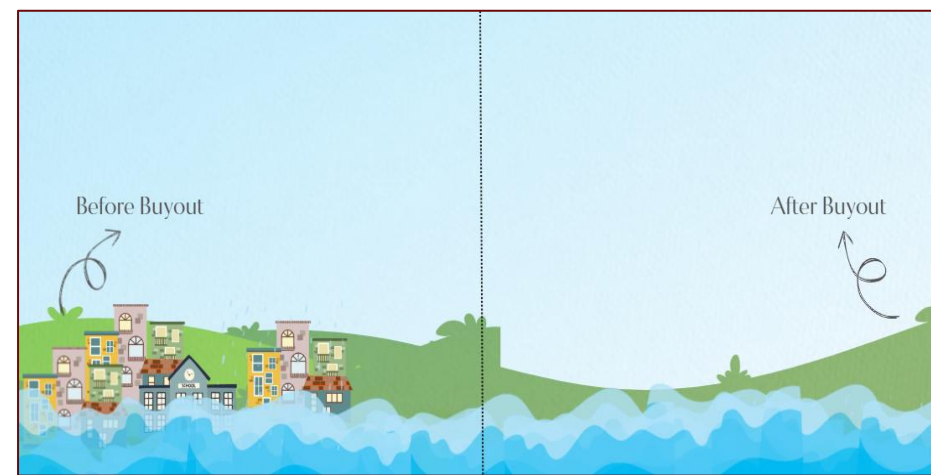


Figure 1: Concept of Voluntary Buyouts

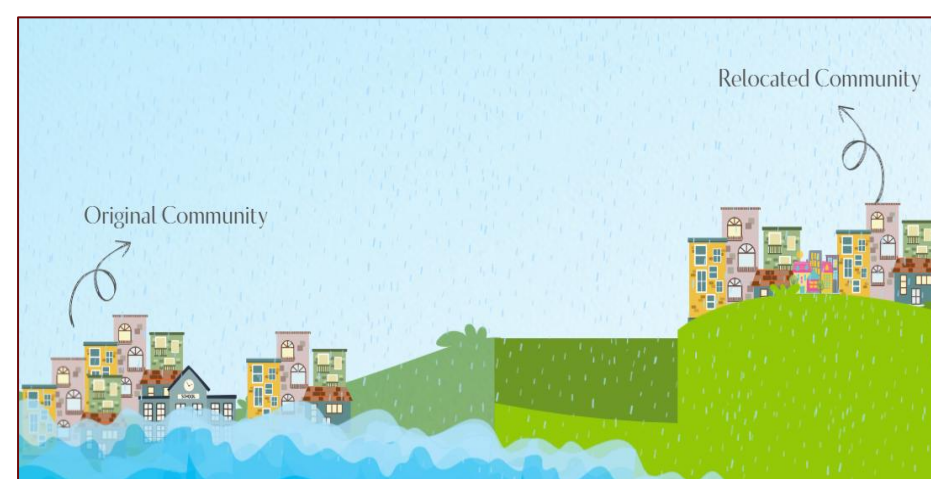


Figure 2: Concept of Community Relocation

STUDY AREA

	Old and New Valmeyer, IL	Greater Olive Branch, IL
County	Monroe County	Alexander County
Community Type	Incorporated community	Dispersed, unincorporated area (Unity, Willard, Miller City, Olive Branch)
Levee Type	Harrisonville-Stringtown Levee System (Federal)	Len Small Levee System (Non-Federal)
Major Flood Event	1993 Mississippi River Flood	1993, 2011, 2016, 2019 Mississippi River Floods
Structure Inundated	~90% of buildings inundated	~50% of buildings inundated
Community Relocation	Entire town relocated to higher ground ⁴ (3 miles east and 400 feet higher in elevation)	No community-wide relocation: Voluntary Buyouts

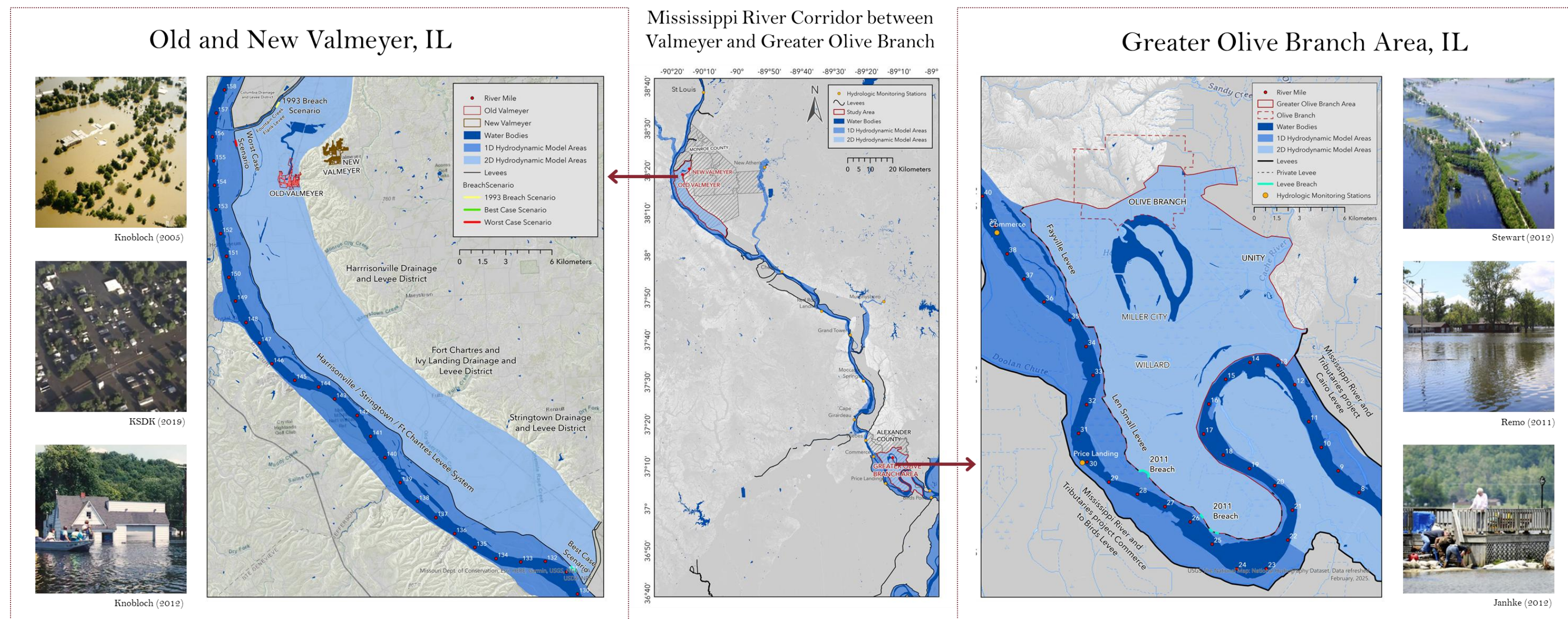


Figure 3 : Study area maps of Old and New Valmeyer, Illinois (left), and the Greater Olive Branch (GOB) Area, Illinois (right), with a central locator map showing their positions along the Mississippi River floodplain.

MATERIALS AND METHODS

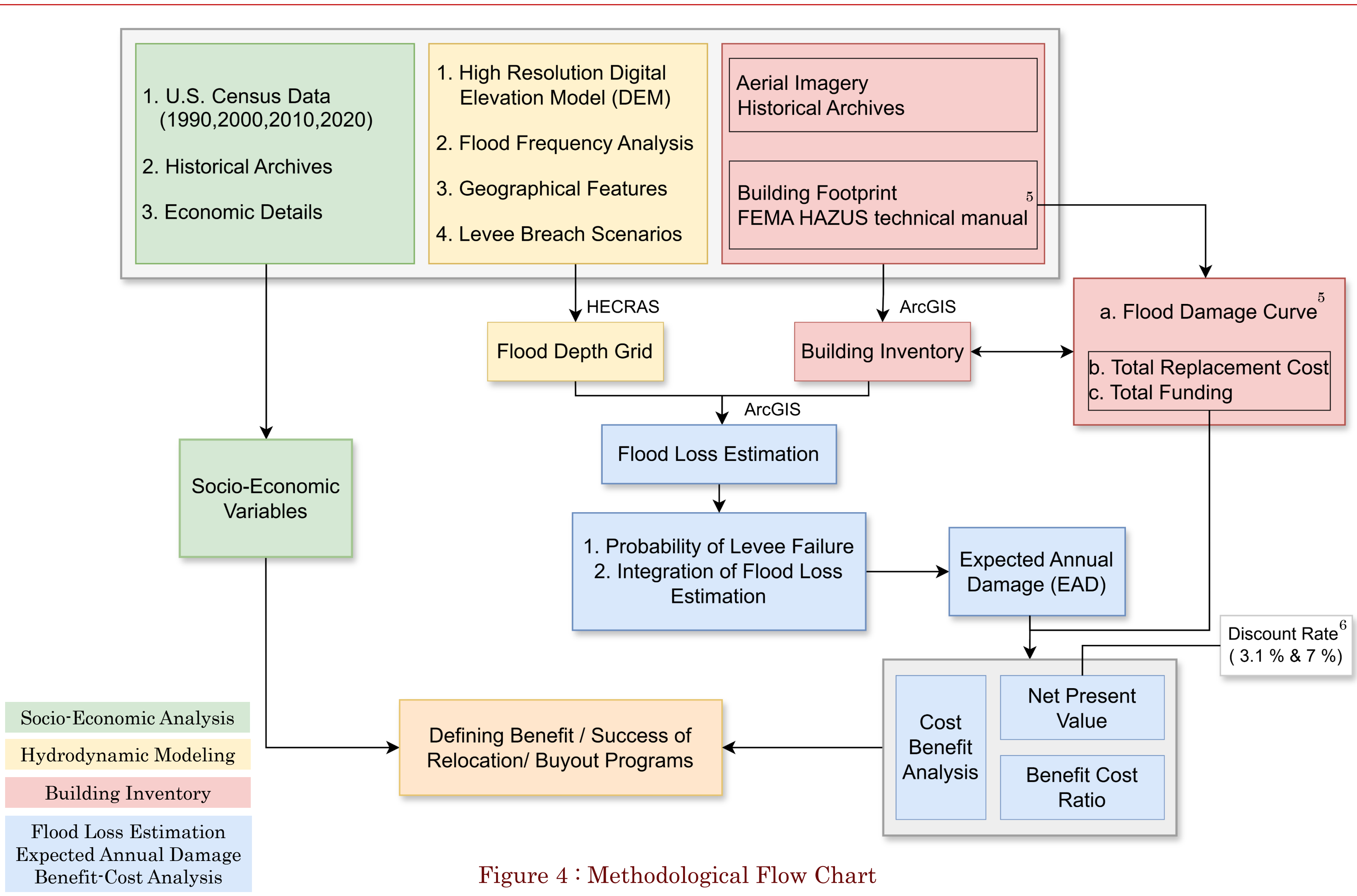


Figure 4 : Methodological Flow Chart

Calculation of Expected Annual Damages (EADs)

Levee failure probabilities using the methods developed by Dierauer et al. (2012)⁷

$$P_f = 0.36 \times \tan^{-1} \left(10.3 \times \left(\frac{(WSEL - h_{min})}{(h_{max} - h_{min})} - 7.2 \right) + 0.52 \right)$$

Where,

WSEL - Water surface elevation for each AEP.

h_{min} - Levee toe elevation.

h_{max} - Levee crest elevation.

Damage Probability Curves Function⁸

$$EAD = \sum D_i \Delta p$$

Where,

Δp is the exceedance-probability increment,

D_i is the midpoint damage for the increment.

- EADs** form the basis for **benefit cost ratios (BCR)** for both relocation and buyouts, using actual and hypothetical relocation and buyout costs.
- Benefit Cost Ratio Threshold:** A BCR ≥ 1.0 indicates cost-effectiveness^{9,10}

Table 3: Analysis periods and variables used for evaluating long-term socioeconomic changes in Valmeyer and Greater Olive Branch (GOB), Illinois

Category	Variables	Analysis Periods	Valmeyer	GOB
Demographics	Population ¹⁴ , Age Distribution ¹³ , Minority Status ¹⁴	Baseline Status	Before 1993 Relocation	Before 2011 Buyouts
Socioeconomic	Education ¹⁵ , Unemployment ¹⁶ , Poverty ^{14,17} , Income ¹⁴	Long Term Analysis	After 1993 Relocation and before 1993 Flood	After 2011 Buyouts and before 2010 Flood
Housing	Total Units ¹⁸ , Occupied Units ^{18,19} , Tenure Status ^{2,19} , Vacant Units ¹⁸ , Median Home Value ¹⁸			

RESULTS

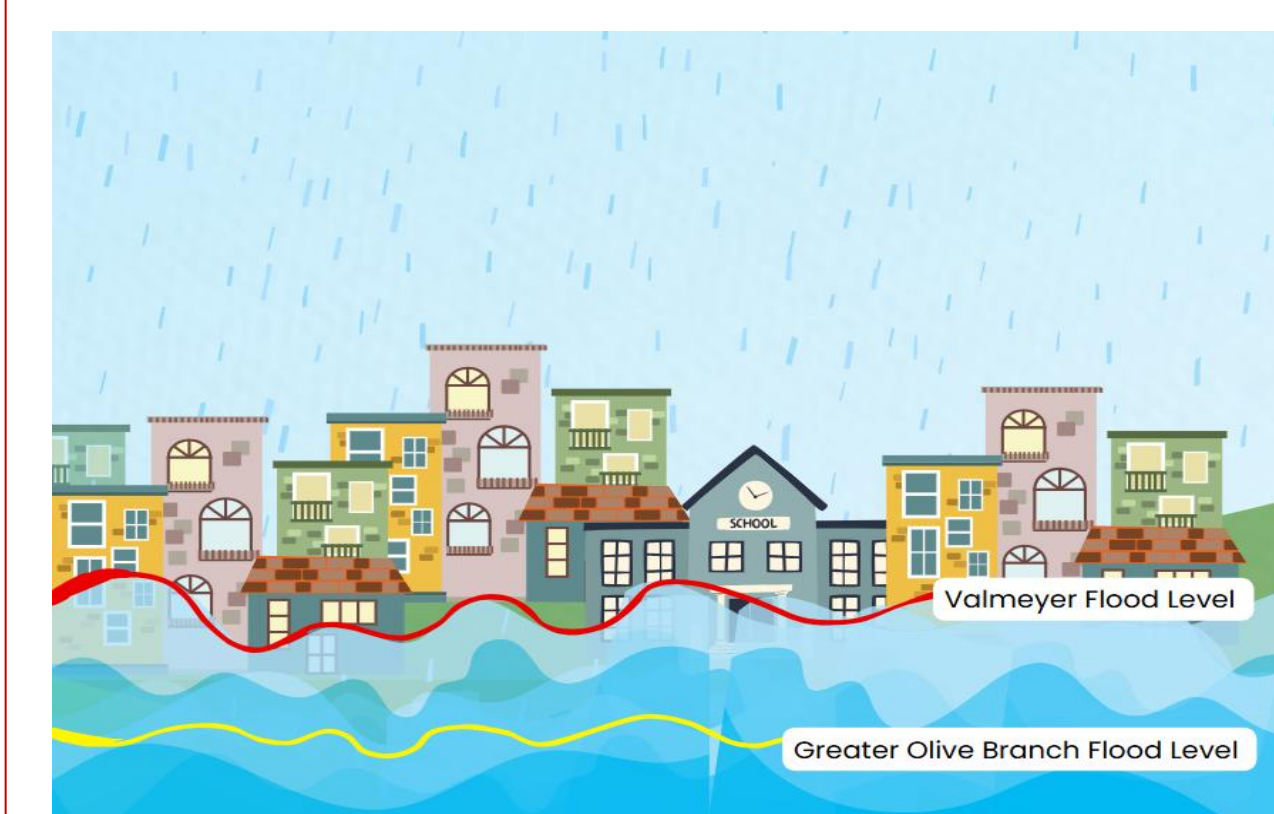


Figure 5 : Flood Depth difference at Valmeyer and GOB

Study Area	Number of Buildings	Scenarios	EAD (\$)
Valmeyer	323	Best Case Scenario	\$398,000
		Worst Case Scenario	\$3,935,000
		1993 Scenario	\$3,058,000
GOB	165	Pre Breach	\$766,000
		2011 Flood	\$548,000
		Pre Breach	\$591,000
	83	2011 Flood	\$493,000

Table 4 : Estimated Annual Damages (EAD) under Different Scenarios for Valmeyer and GOB

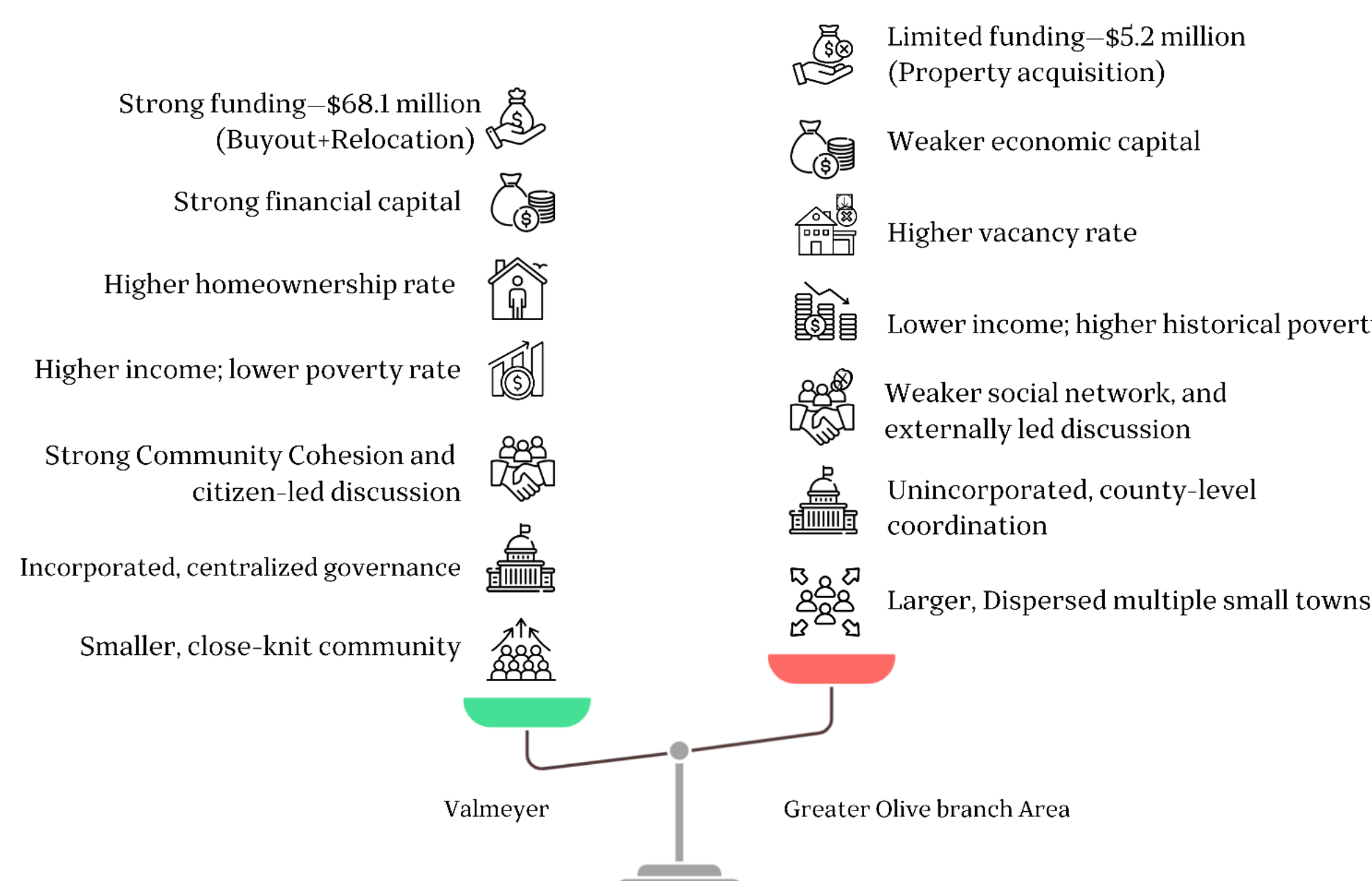


Figure 6: Baseline conditions at the onset of Relocation and Buyout planning in Valmeyer and GOB

Indicator	Valmeyer	GOB
Population	↑ Rebounded by 2010	↓ Continued decline
Median Income	↑ Gradual increase post-relocation	↓ Stagnant or declined
Poverty Rate	↓ Decreased over time	↑ Declined then increased
Age Distribution	➡ Younger families moved in post-relocation: stable aging population	➡ Decrease working age population: outmigration
Employment Trend	↓ Unemployment rate	↑ Unemployment rate
Education Attainment	↑ Increase educated Population	↓ Decline in educated population
Housing Quality	↑ Improved housing stock (new development)	↓ Vacant or deteriorating homes
Housing Trend	↑ Increase in Housing Units	↓ Decrease in Housing Units
Homeownership Rate	↑ Strong homeownership retention	↓ Shift towards Higher Vacancy Rates
Tenure	↑ Increase in renter-occupied units	↓ Increase, then decrease
Median Home Value	↑ Increased significantly	↓ Consistently lower than in Valmeyer

↑ Increase ↓ Decrease ➡ In Migration ➡ Out Migration — Stable

Indicator	Valmeyer	GOB
Implementation Timeline	3-year relocation process: complete ⁴	5 + year buyout process: Incomplete
Funding Delays & Availability	Maintained multi-source funding stability	Delayed (2015 Illinois state budget crisis) ²¹
Community & Infrastructure Retention	Key Infrastructure retention post relocation (School, Church, Local government offices)	..

Table 5: Comparative summary of demographic, housing, and institutional outcomes between Valmeyer and GOB

Table 2: Actual and Hypothetical Relocation and Buyout Costs

Scenario	Buildings	Costs (\$2024)	Building Inventory Scenario
Valmeyer - Total Funds*	324	\$68,136,912	Full Relocation post 1993 flood ^{11,12}
GOB - Upper Bound**	165	\$48,192,546	Hypothetical full-community relocation
GOB - Lower Bound (2011 Flood scenario)**	83	\$22,382,601	Hypothetical relocation of the 83 highest flood depth buildings
GOB - Lower Bound (Pre-breach Scenario)**	83	\$22,906,150	
GOB- Actual Buyout Funds*	83	\$5,123,625	Buyout Acquisition post 2011 flood ¹²

*Actual Funding amount extracted from FEMA

** Estimates developed for the study

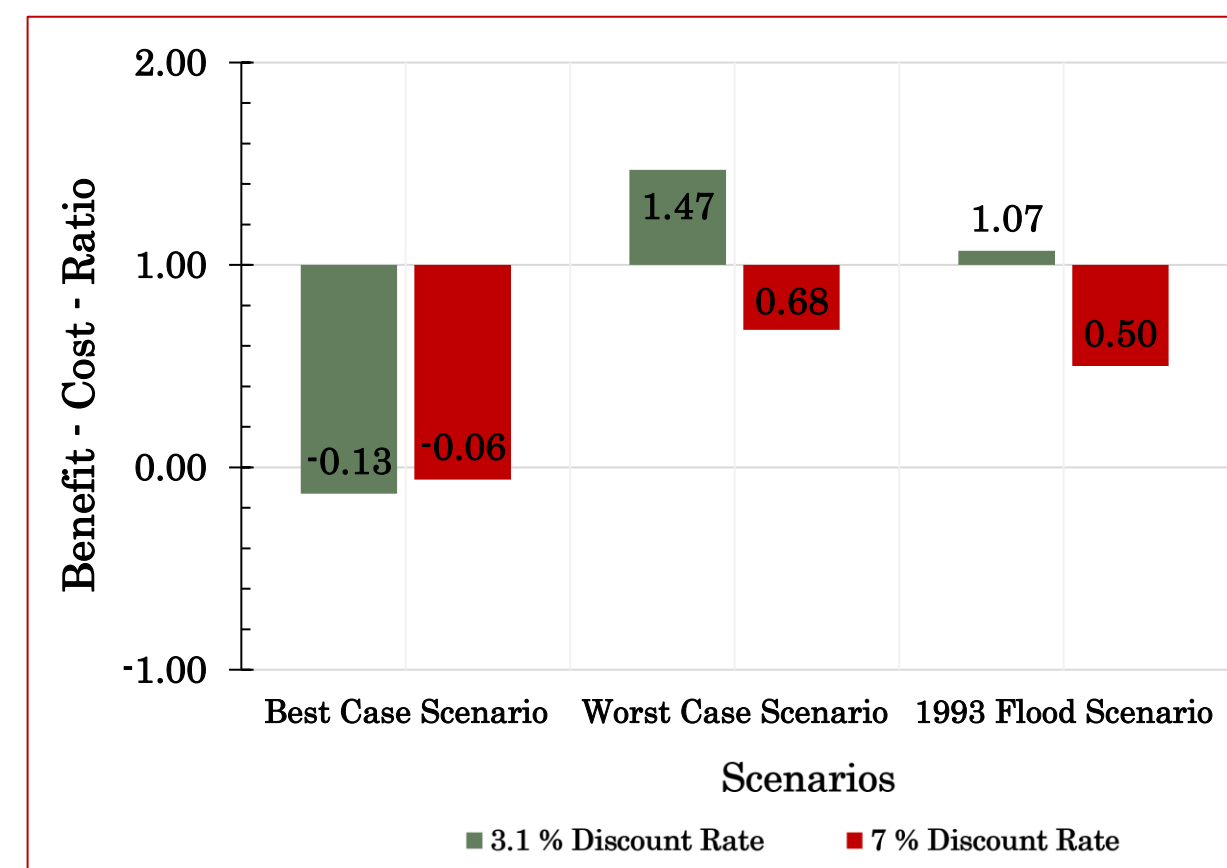


Figure 7 : Benefit-Cost Ratio for relocation of Valmeyer

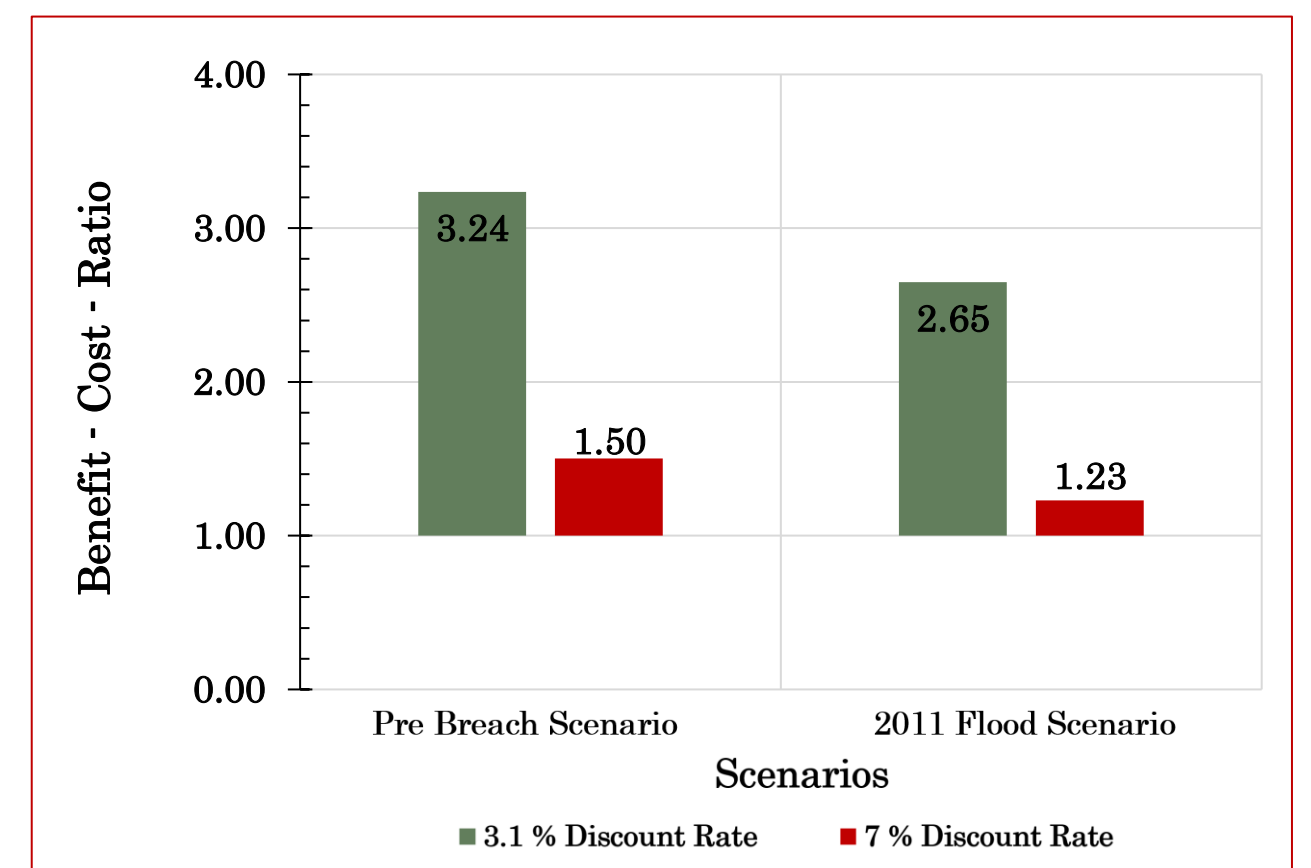


Figure 8: Benefit-Cost Ratio for the buyout under the pre-breach and 2011 flood scenarios for GOB

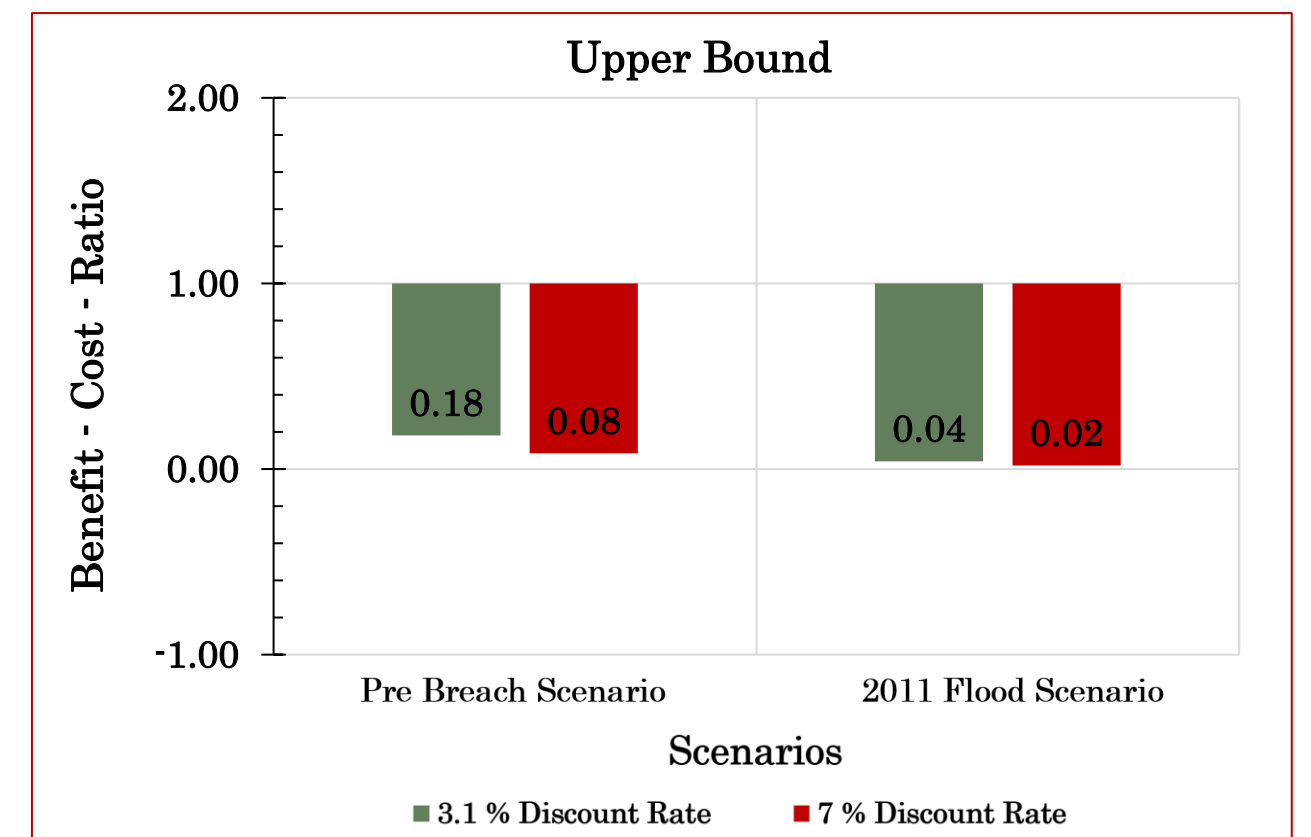
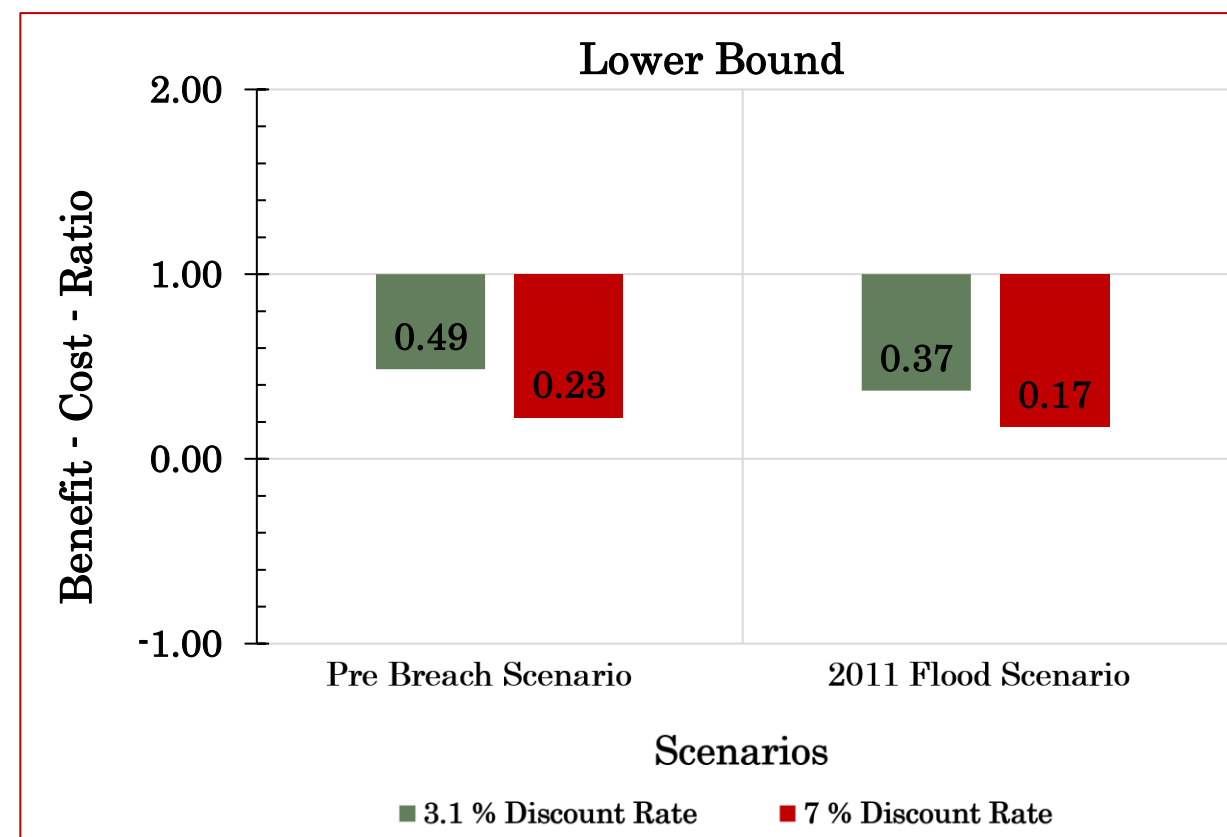


Figure 9: Benefit-Cost Ratio for the upper and lower-bound relocation scenarios in GOB

CONCLUSION

Key findings include:

- BCA revealed **Valmeyer's relocation has a BCR >1** for flood scenarios where flood damages in the community are large
- BCRs were <1 for the Greater Olive Branch (GOB) relocation scenarios**, as flood damage was not large enough to justify the potential relocation costs. However, **GOB's Buyout had a BCR >1** for the pre-breach and 2011 flood scenarios.
- Pre-existing social vulnerability, governance fragmentation, and limited institutional capacity shaped post-flood paths and influenced each community's recovery trajectory.
- Findings suggest that the applicability and success of managed retreat cannot be solely addressed through flood risk or benefit-cost analysis but also **depend on the underlying social, economic, and institutional capacities** of the community.
- Relocation is more viable in areas with large flood damage, stronger financial capacity, and strong social capital and community cohesion, while targeted buyouts may be more appropriate for dispersed, socioeconomically vulnerable communities.
- Managed retreat is not a one-size-fits-all solution** and is context sensitive.

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References

