Bernardi Environmental Risk Index

Our Methodology and Positioning for Natural Disaster Resiliency within Municipal Bond Portfolios

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OUTLINE

I. Overview

Our firm has developed a proprietary Environmental Risk Index ("ERI" or the "Index") to both measure and mitigate relative environmental risk within municipal bond portfolios. The Index assesses a county's exposure to natural disasters and aspects of its financial resiliency – factoring in insurance non-renewal risk. We believe that a municipality's overall resilience to natural disasters is a function of both this Index and its underlying fiscal health. **ERI scores do not independently determine municipal credit risk and are complementary to our internal, single security credit analysis process.**

We believe incorporating the Index into our credit analysis process is of growing importance as the cost of natural disasters continues to increase; in 2024, the US incurred approximately $182.7 billion in damages from 27 separate billion-dollar weather related disasters.[1] While the cost of disasters declined in 2025, damages still totaled approximately $115 billion across 23 billion-dollar events.[2] Based on these figures, the average annual cost of natural disasters has increased by approximately 3.60%-6.10% per year[3] – outpacing the 2.40% rate of inflation since 2005.

Stress in the insurance market in particular regions poses a growing risk to municipal credit quality. Constrained coverage availability, rising premiums, and higher deductibles can pressure household and business balance sheets, weakening the local tax base and slowing post-disaster economic recovery. Non-renewal rates are especially alarming and deteriorating insurance conditions often signal increasing levels of underinsurance. This can materially impede rebuilding efforts and prolong fiscal strain on state and local governments following a disaster.

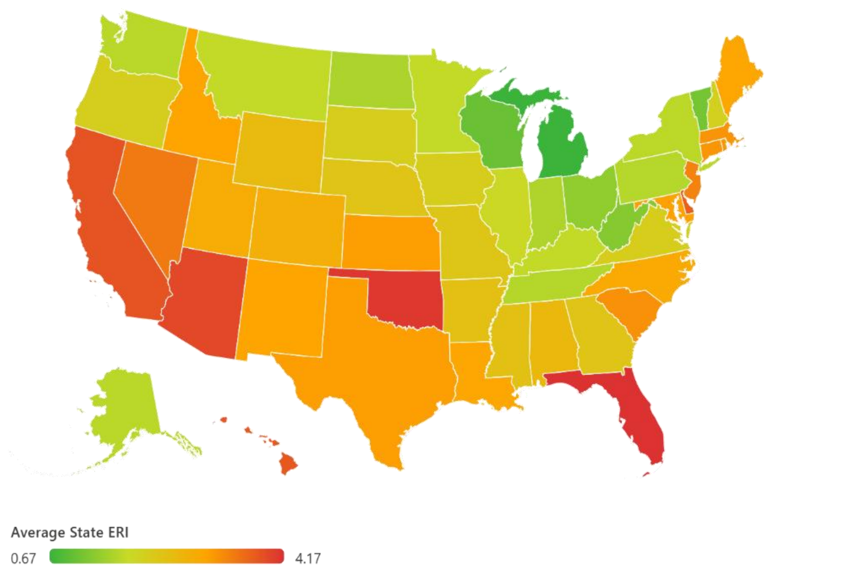


Figure 1: In the chart above, we have provided a heat map of each state's average county-based ERI score. The higher the score, the more risk. The scale runs from red-orange-yellow-green with the former indicating higher risk vs. the latter.

[1] https://coast.noaa.gov/states/stories/

[2] https://www.climatecentral.org/climate-matters/2025-in-review/

[3] This data is sourced from the National Oceanic and Atmospheric Administration (NOAA), which only covers events with at least $1 billion in damages. The annual growth rate is based on their average data from 2005-2015 vs. the 2024 and 2025 figures. This data can be found here: https://www.ncei.noaa.gov/access/billions/summary-stats/US/2000-2010. These calculations deserve a caveat, in that though the growth of the cost of natural disasters has outpaced inflation, this NOAA-based data could be biased towards a higher relative growth rate. Given the price level has increased drastically due to inflation, it is more likely a billion dollar event will occur today than ten, let alone, twenty years ago. As the value of property increases, so does the probability of billion dollar events used in NOAA's data.

Lastly, the importance of measuring natural disaster risk and resiliency is further intensified by the potential for waning federal support for disaster recovery and a ballooning federal debt load. These factors could place significant fiscal pressure on state and local governments during future rebuilding efforts. A lack of federal support may also temper the pace of post-disaster economic recovery, straining tax revenues.

It is important to note that the Index is a backward looking tool based on historical data, not a predictor of future events. Our primary data sources are FEMA's National Risk Index[4] and a Senate Budget Committee report[5] on insurance non-renewal rates. The ERI score ranges from 0 (lowest risk) to 10 (highest risk).

II. Bernardi Environmental Risk Index Findings

ERI National Average of States: 2.48

Below is the average ERI score, by state, calculated by averaging the scores of all counties within the given state. According to the Index, Florida leads the nation in environmental risk followed by Oklahoma, Arizona, California, and Hawaii. These five states represent the highest risk levels according to our blended Index of environmental risk and insurance non-renewal rates.

Notably, Midwestern states - led by Michigan, Wisconsin, Ohio, Indiana - generally have lower Index scores (less risk), averaging a score of 1.82.[6]

Rank	State	Average ERI
1	FL	4.17
2	OK	4.11
3	AZ	3.93
4	CA	3.82
5	HI	3.77
6	DE	3.68
7	NV	3.42
8	NJ	3.33
9	SC	3.19
10	MA	3.16
11	CT	3.13
12	RI	3.13
13	TX	3.04
14	KS	3.04
15	MD	3.02
16	ID	2.98

4 https://www.fema.gov/sites/default/files/documents/fema_national-risk-index_technical-documentation.pdf
5 https://www.budget.senate.gov/imo/media/doc/next_to_fall_the_climate-driven_insurance_crisis_is_here__and_getting_worse.pdf
6 Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin

Rank	State	Average ERI
17	NM	2.97
18	ME	2.96
19	LA	2.95
20	NC	2.89
21	UT	2.81
22	CO	2.74
23	AL	2.57
24	WY	2.52
25	AR	2.41
26	MS	2.39
27	NE	2.33
28	GA	2.33
29	MO	2.29
30	IA	2.15
31	SD	2.15
32	VA	2.15
33	OR	2.12
34	NH	2.07
35	IL	1.89
36	MT	1.78
37	MN	1.78
38	KY	1.78
39	NY	1.73
40	WA	1.70
41	AK	1.70
42	PA	1.68
43	TN	1.67
44	IN	1.62
45	ND	1.59
46	OH	1.38
47	WV	1.28
48	VT	1.15
49	WI	1.05
50	MI	0.67

Source: Bernardi ERI scores derived from FEMA National Risk Index and county-level property insurance non-renewal data (U.S. Senate Budget Committee, 'Next to Fall,' 2024). Data as of time of analysis.

Coastal and Gulf states consistently show elevated ERI values, primarily driven by hurricanes, coastal flooding, and riverine flooding. These regions not only face frequent hazards but are susceptible to compounding risks from sea level rise and increasing storm severity. In the interior western states and Pacific region, wildfire, drought conditions, and seismic activity drive higher ERI scores, where destructive storm potential is most prevalent. Counties with the highest ERI scores are concentrated in Southern California, the interior western states, and Oklahoma, with additional hot spots along the coastlines of North Carolina, Louisiana, and Florida.

The western United States exhibits a distinct risk profile, with elevated ERI scores largely driven by wildfires, earthquakes, and drought conditions. Counties in California, Oregon, and Washington face the highest exposure to earthquake and wildfire hazards, while mountain and arid regions are more susceptible to drought and fire frequency. Northern states deal primarily with winter storms and cold waves, though these events typically carry lower destructive potential than high-consequence hazards such as wildfires, tornadoes, and hurricanes.

States with Highest ERI Score			
Rank	**State**	**Average ERI**	**Key Considerations**
1	FL	4.17	• High hurricane frequencies in coastal counties • Highest insurance non-renewal rate
2	OK	4.11	• Multiple hazards: tornado, hail, drought, and flooding • Ranked 5th in insurance non-renewals
3	AZ	3.93	• Multiple hazards with elevated frequency including wildfire, drought, heat wave, riverine flooding
4	CA	3.82	• Ranked 3rd in insurance non-renewals • Prevalence of hazards including wildfire, drought, heat wave, earthquake, flooding
5	HI	3.77	• Multiple hazards with elevated frequency including volcanic and tsunami activity, as well as earthquake and flooding. • Ranked 14th in insurance non-renewals

States with Lowest ERI Score			
Rank	**State**	**Average ERI**	**Key Considerations**
46	OH	1.38	• Ranked 23rd in insurance non-renewal • Less frequent severe hazards
47	WV	1.28	• Ranked 47th in insurance non-renewals • Less frequent severe hazards
48	VT	1.15	• Ranked 36th in insurance non-renewals • Less frequent severe hazards
49	WI	1.05	• Ranked 40th in insurance non-renewals • Less frequent severe hazards
50	MI	0.67	• Ranked 41st in insurance non-renewals • Less frequent severe hazards

ERI National Average of all Counties: 2.34

Our analysis attributed an ERI score to 3,147 counties in the United States, with a national county-level average score of 2.34. The charts below show the twenty-five highest and lowest rankings by county. The higher the number, the more risk the county has within the ERI Index.

It is important these values are interpreted correctly. ERI scores are min-max normalized, and nonlinear. This means the scale is ordinal rather than ratio-based. For example, a score of 6.0 does not represent twice the risk as a score of 3.0. Instead, a higher score indicates higher rates of insurance non-renewals, more potential hazards, more frequency, or both. Furthermore, these scores are not probabilistic and should not be used to calculate the likelihood of a specific event in a given year.

Highest ERI Scores		
State	**County**	**ERI**
CA	San Bernardino	10.00
CA	San Diego	10.00
CA	Riverside	10.00
ID	Twin Falls	8.37
ID	Elmore	7.82
CO	Weld	7.82
OK	Pittsburg	7.12
NC	Carteret	6.90
AK	Aleutians West	6.81
FL	Collier	6.53
UT	Washington	6.51
CA	Los Angeles	6.49
CO	Washington	6.47
NV	Elko	6.47
LA	St. Bernard	6.43
OK	Haskell	6.38
FL	Palm Beach	6.37
OK	Latimer	6.37
OK	Osage	6.31
SC	Charleston	6.28
OK	LeFlore	6.27
FL	Hendry	6.25
AZ	Mohave	6.20
CA	Ventura	6.14
NV	Humboldt	6.14

Lowest ERI Scores		
State	**County**	**ERI**
MI	Schoolcraft	0.12
MI	Presque Isle	0.14
AK	North Slope	0.16
MI	Alpena	0.19
MI	Luce	0.19
MI	Mackinac	0.23
MI	Emmet	0.24
MI	Montmorency	0.25
MI	Cheboygan	0.26
MI	Alcona	0.26
MI	Benzie	0.27
WI	Florence	0.28
AK	Dillingham	0.30
MI	Menominee	0.31
WI	Menominee	0.32
MI	Dickinson	0.33
MI	Chippewa	0.34
MI	Manistee	0.36
MI	Lake	0.36
MI	Iosco	0.37
MI	Delta	0.37
MI	Otsego	0.37
MI	Missaukee	0.37
MI	Ogemaw	0.37
MI	Oscoda	0.37

Source: Bernardi ERI scores derived from FEMA National Risk Index and county-level property insurance non-renewal data (U.S. Senate Budget Committee, 'Next to Fall,' 2024). Data as of time of analysis.

III. <u>Property Insurance Non-Renewal Rates Across the Country</u>

Not surprisingly, insurance market stress is emerging in regions with the highest environmental risk. In 2023, county-level non-renewal rates spiked in parts of Florida and North Carolina, led by Glades County, FL (16.2%), aptly named Dare County, NC (12.9%), and Washington County, NC (12.2%). As shown in the tables below, several additional coastal counties in North Carolina and Florida recorded non-renewal rates in the 9–11% range. Smaller, yet significant, clusters also appeared in pockets in Massachusetts and California. The correlation between high ERI scores and elevated non-renewal rates underscores the compounding challenge: the dual pressure of rising hazard severity and declining insurance availability (or surging premiums making insurance cost prohibitive) in the most exposed counties.

Our ERI takes this into account if the insurance non-renewal for a specific county is higher than the national average. As a result, the ERI score is assigned a 10% penalty.

Average National Insurance Non-Renewal Rate: 1.17%

Rank	State[7]	Average Non-Renewal	Rank	State	Average Non-Renewal
1	FL	3.24%	26	GA	0.96%
2	NC	2.81%	27	IN	0.96%
3	CA	2.65%	28	AR	0.95%
4	MA	2.61%	29	MT	0.94%
5	OK	2.40%	30	VA	0.94%
6	NM	1.57%	31	KY	0.93%
7	LA	1.55%	32	AL	0.92%
8	SD	1.47%	33	AZ	0.89%
9	RI	1.47%	34	WA	0.89%
10	MS	1.37%	35	OR	0.88%
11	NE	1.35%	36	VT	0.87%
12	CO	1.24%	37	WY	0.86%
13	CT	1.22%	38	IL	0.83%
14	HI	1.20%	39	NJ	0.81%
15	KS	1.17%	40	WI	0.78%
16	ID	1.17%	41	MI	0.75%
17	SC	1.16%	42	WV	0.74%
18	IA	1.16%	43	DE	0.73%
19	UT	1.14%	44	NH	0.67%
20	ND	1.12%	45	MD	0.66%
21	MO	1.09%	46	ME	0.63%
22	TX	1.02%	47	NY	0.50%
23	OH	0.97%	48	AK	0.47%
24	TN	0.97%	49	PA	0.44%
25	NV	0.96%	50	MN	0.41%

Source: U.S. Senate Budget Committee, 'Next to Fall: How the Climate-Driven Insurance Crisis Threatens Housing and Economic Stability in America' (2024). Available at: budget.senate.gov. National average based on 2023 county-level data.

[7] In lieu of counties, Alaska uses "Boroughs" and Louisiana uses "Parishes"

Rising non-renewal rates indicate insurers' growing reluctance to underwrite natural disaster risk, reflecting their internal assessments of heightened disaster frequency and severity. This has also led to a surge in insurance premiums which creates a challenging environment where even if coverage is available, it has become increasingly cost prohibitive.

Declining insurance coverage increases the potential for financial stress following a disaster and likely indicates constituents are underinsured on a broader scale. Declining insurance availability and affordability materially reduce the attractiveness of these locations for both existing residents and prospective taxpayers.

Highest 25 Non-renewal		
State	**County**	**Non-Renewal Rate**
FL	Glades	16.2%
NC	Dare	12.9%
NC	Washington	12.2%
MA	Dukes	11.6%
NC	Greene	11.3%
FL	Dixie	9.6%
FL	Franklin	9.5%
NC	Hyde	9.3%
NC	Chowan	9.2%
NC	Tyrrell	9.1%
FL	Highlands	8.6%
OK	Harmon	8.4%
NC	Perquimans	8.3%
FL	Okeechobee	8.2%
NC	Bladen	8.0%
NC	Jones	7.8%
OK	Jefferson	7.7%
OK	Kiowa	7.6%
NC	Camden	7.6%
CA	Lake	7.5%
NC	Currituck	7.4%
NC	Wayne	7.3%
MA	Nantucket	7.3%
CA	Trinity	7.3%
NC	Pasquotank	7.1%

Lowest 25 Non-renewal		
State	**County**	**Non-Renewal Rate**
WV	Clay	0.0%
NE	Pierce	0.0%
MT	Fallon	0.0%
AK	Nome	0.0%
NE	Stanton	0.0%
AK	Yakutat-Skagway	0.0%
MT	Wheatland	0.0%
TX	Armstrong	0.0%
GA	Taliaferro	0.0%
ND	Kidder	0.0%
ND	Wells	0.0%
TX	Yoakum	0.0%
ND	Ransom	0.0%
TX	Lipscomb	0.0%
NE	Greeley	0.0%
ND	Grant	0.0%
ND	Renville	0.0%
KS	Stanton	0.0%
KY	Owsley	0.0%
MT	Powder River	0.0%
ND	Pierce	0.0%
ND	Foster	0.0%
TX	Collingsworth	0.0%
MT	Golden Valley	0.0%
KS	Hamilton	0.0%

Source: U.S. Senate Budget Committee, 'Next to Fall: How the Climate-Driven Insurance Crisis Threatens Housing and Economic Stability in America' (2024). Available at: budget.senate.gov. National average based on 2023 county-level data.

IV. FEMA Risk Index Shortfalls in Measuring Disaster Risk & Resiliency

FEMA provides highly granular, county-level data on natural disaster risk, which serves as the foundational input to our Index. This data plays a critical role in enhancing the public's understanding of disaster exposure across the United States. We hope FEMA continues to measure and maintain this data over long time horizons, as it will enable deeper analysis and more informed risk assessments of environment and financial risk over time.

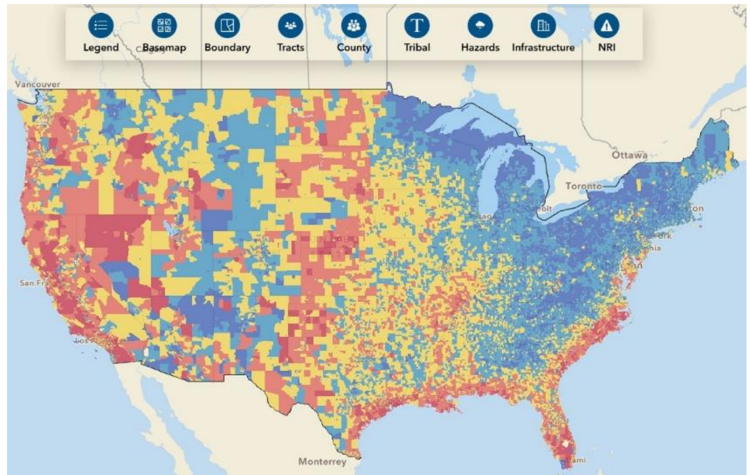


Figure 2 FEMA National Risk Index dataset provides information for communities most at risk to 18 different natural hazards.

From a municipal credit perspective, however, the FEMA framework requires refinement. The FEMA National Risk Index incorporates an economic value component that systematically assigns higher risk scores to larger and more economically valuable counties. While this construction is intuitive from a damage-estimation standpoint – higher concentrations of economic assets imply greater absolute potential losses – it can be misleading when applied to municipal credit analysis, in our opinion.

In our view, retaining the economic value input misrepresents credit risk and distorts relative risk rankings among municipal obligors.

When evaluated through the lens of municipal credit risk, this approach conflates exposure with credit vulnerability. Higher economic value is frequently associated with larger, more diversified, and economically dynamic jurisdictions. These characteristics are not weaknesses from a credit standpoint; rather, they are key drivers of fiscal resilience. In addition, larger counties tend to have broader geographic footprints, allowing disaster impacts to be absorbed across a wider economic base. These characteristics enhance resilience and support a municipality's ability to recover from the damage of a natural disaster.

To better align the Index with municipal credit fundamentals, we removed the economic value component of FEMA's National Risk Index and rely exclusively on FEMA's natural disaster probability variable. In our view, retaining the economic value input misrepresents credit risk and distorts relative risk rankings among municipal obligors.

In the context of municipal credit analysis, higher underlying economic value is more appropriately interpreted as an indicator of resilience, for several reasons:

- Greater aggregate wealth enhances a jurisdiction's capacity to levy taxes or fees to finance disaster recovery and maintain essential operations

- Wealthier jurisdictions typically exhibit broader economic and revenue diversification, reducing reliance on any single industry or taxpayer, which improves shock absorption.
- Larger, economically significant regions carry heightened national and regional importance, increasing the likelihood of federal or state assistance after a major disaster.
- Higher economic value often reflects entrenched commercial activity, strategic location, or natural advantages that support faster and more durable post-disaster recovery.

Conversely, smaller and less wealthy obligors generally operate with narrower and more concentrated economic footprints. In these cases, disaster damage is more likely to impair a materially larger share of the tax base, resulting in disproportionate fiscal stress, weaker recovery capacity, and elevated credit risk.

This distinction is illustrated by recent California wildfire events. The 2025 Los Angeles–area wildfires were geographically extensive and economically destructive, with estimated losses in the tens to hundreds of billions of dollars. While these events created near-term fiscal pressure on the City of Los Angeles and surrounding jurisdictions, the region's scale, wealth, and highly diversified revenue base materially enhanced its capacity to absorb losses and fund recovery costs over time.

By contrast, the 2018 Camp Fire in Paradise, California destroyed approximately 95% of the town's structures, effectively eliminating most of its economic base. Although the absolute dollar losses were significantly lower than those incurred in Los Angeles, the proportional economic and fiscal impact on Paradise was far more severe, resulting in substantially higher credit impairment.

This comparison underscores why absolute economic damage is an insufficient proxy for municipal credit risk, and why isolating disaster probability—rather than asset value— provides a more analytically sound framework for evaluating long-term municipal resilience and creditworthiness. Any environmental score, however, must be paired with a fiscally oriented credit assessment to fully evaluate an obligor's overall credit quality and financial resilience.

Removing the wealth variable in FEMA's risk framework materially alters the relative risk ranking. For example, this change moves Los Angeles down from the riskiest county in the FEMA National Risk Index to the ERI's 12th riskiest. Of the top ten riskiest ERI scored counties, the average population[8] is 883,861 with a median of 209,514 vs. FEMA's average population of 3,213,614 and median of 2,299,920. These differences illustrate how the ERI partly mitigates the size and wealth bias embedded in FEMA's index, resulting in a more appropriate assessment of natural disaster risk for municipal credit analysis.

[8] 2020 Census figures

ERI					FEMA Risk Index			
Rank	State	County	Score		Rank	State	County	Score
1	CA	San Bernardino	10.00		1	CA	Los Angeles	100.00
2	CA	San Diego	10.00		2	TX	Harris	99.97
3	CA	Riverside	10.00		3	CA	Riverside	99.94
4	ID	Twin Falls	8.37		4	CA	San Bernardino	99.90
5	ID	Elmore	7.82		5	CA	Alameda	99.87
6	CO	Weld	7.82		6	CA	Santa Clara	99.84
7	OK	Pittsburg	7.12		7	FL	Miami-Dade	99.81
8	NC	Carteret	6.90		8	CA	Orange	99.78
9	AK	Aleutians West	6.81		9	FL	Broward	99.75
10	FL	Collier	6.53		10	FL	Palm Beach	99.71
11	UT	Washington	6.51		11	CA	San Diego	99.68
12	CA	Los Angeles	6.49		12	WA	King	99.65
13	CO	Washington	6.47		13	IL	Cook	99.62
14	NV	Elko	6.47		14	CA	Contra Costa	99.59
15	LA	St. Bernard	6.43		15	FL	Hillsborough	99.55
16	OK	Haskell	6.38		16	TX	Galveston	99.52
17	FL	Palm Beach	6.37		17	FL	Lee	99.49
18	OK	Latimer	6.37		18	SC	Charleston	99.46
19	OK	Osage	6.31		19	CA	Ventura	99.43
20	SC	Charleston	6.28		20	CA	Santa Barbara	99.40
21	OK	Le Flore	6.27		21	FL	Brevard	99.36
22	FL	Hendry	6.25		22	CA	San Mateo	99.33
23	AZ	Mohave	6.20		23	NV	Clark	99.30
24	CA	Ventura	6.14		24	TX	Collin	99.27
25	NV	Humboldt	6.14		25	TN	Shelby	99.24

Each scoring framework will inherently attribute more risk to larger counties given the increased chance of a natural disaster due to their larger size. Furthermore, there is an increased risk multiple disasters could occur in a larger land mass vs. smaller.

Los Angeles County, CA is nearly 2.5x larger than Butte County, CA (location of the Camp Fire) and geographically more exposed to more risks. It has more coastal flooding, drought, earthquake, heatwave, landslide, riverine flooding, wind, tornado, tsunami, and wildfire risk due to its location and size. Therefore, before any weights are ascribed to disaster risk, Los Angeles County is going to have a higher risk score.

Cook County presents another great example of a county that is unfairly penalized by FEMA for its wealth and size. It is ranked as the 13th riskiest county overall within the FEMA risk framework. Within the Bernardi ERI, Cook is only ranked the 4th riskiest among all State of Illinois counties, and 704th nationwide. Within Illinois, the counties of Alexander, Jackson, and White all rank higher (riskier) within our ERI framework.

The table below presents the twenty-five counties with the highest risk according to the ERI and FEMA Index. For each county, the table also shows its ranking under the other index and the difference between the two rankings. This difference is reported in the fifth column of each section. A higher ranking indicates greater assessed risk under the respective index.

You will see significant risk ranking differences between the two indexes. This is primarily due to the ERI removing the size/wealth factor which FEMA incorporates. Generally, larger counties score higher (riskier) within the FEMA rankings vs. the ERI. Twelve different states are represented in the ERI's top twenty-five riskiest counties, while FEMA has only eight. The median population of the ERI top twenty-five riskiest counties is 70,400 vs. 1,080,000 for FEMA's top twenty-five.

ERI's 25 Riskiest Counties vs. FEMA Rank

State	COUNTY	ERI Rank	FEMA Rank	FEMA Difference
CA	San Bernardino	1	4	3
CA	San Diego	2	11	9
CA	Riverside	3	3	0
ID	Twin Falls	4	1,530	1526
ID	Elmore	5	650	645
CO	Weld	6	339	333
OK	Pittsburg	7	791	784
NC	Carteret	8	92	84
AK	Aleutians West	9	2,037	2028
FL	Collier	10	37	27
UT	Washington	11	136	125
CA	Los Angeles	12	1	-11
CO	Washington	13	2,865	2852
NV	Elko	14	226	212
LA	St. Bernard	15	422	407
OK	Haskell	16	1,432	1416
FL	Palm Beach	17	10	-7
OK	Latimer	18	1,654	1636
OK	Osage	19	826	807
SC	Charleston	20	18	-2
OK	Le Flore	21	591	570
FL	Hendry	22	279	257
AZ	Mohave	23	365	342
CA	Ventura	24	19	-5
NV	Humboldt	25	536	511

FEMA's 25 Riskiest Counties vs. ERI Rank

State	COUNTY	FEMA Rank	ERI Rank	ERI Difference
CA	Los Angeles	1	12	11
TX	Harris	2	40	38
CA	Riverside	3	3	0
CA	San Bernardino	4	1	-3
CA	Alameda	5	586	581
CA	Santa Clara	6	410	404
FL	Miami-Dade	7	28	21
CA	Orange	8	38	30
FL	Broward	9	31	22
FL	Palm Beach	10	17	7
CA	San Diego	11	2	-9
WA	King	12	2,101	2089
IL	Cook	13	704	691
CA	Contra Costa	14	590	576
FL	Hillsborough	15	61	46
TX	Galveston	16	94	78
FL	Lee	17	83	66
SC	Charleston	18	20	2
CA	Ventura	19	24	5
CA	Santa Barbara	20	189	169
FL	Brevard	21	65	44
CA	San Mateo	22	1,494	1472
NV	Clark	23	195	172
TX	Collin	24	587	563
TN	Shelby	25	725	700

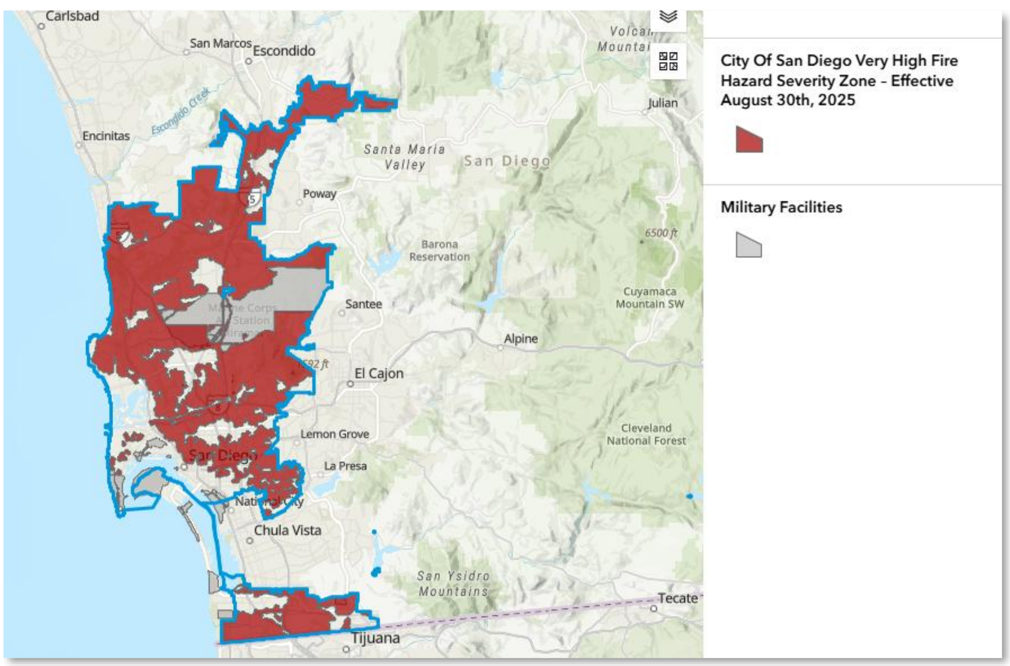
Evaluating an obligor's exposure to natural disaster risk requires analysis beyond the headline ERI score. This is particularly important for large counties, where a single county-level score may mask meaningful variation among the dozens—or even hundreds—of underlying municipal obligors within its boundaries. In addition to assessing an issuer's distinct financial and management profile, investors should incorporate more granular hazard indicators - such as wildfire risk maps and floodplain data - to form a more complete view of natural disaster risk

San Diego County's wildfire risk is one example of why any headline score requires closer examination. San Diego County scores the highest risk (10) within our framework. But given the multitude of municipalities located within the county and disparate risk, a deeper analysis is required.

Fire hazard maps help narrow down intra-county risk. We primarily utilize the CAL FIRE –

Fire Hazard Severity Zone maps to address fire risk. The Fire Hazard Severity Zone classifies area as moderate, high, and very high fire risk. See below from CAL FIRE:

> PUBLIC RESOURCE CODE 4202; THE STATE FIRE MARSHAL SHALL CLASSIFY LANDS WITHIN STATE RESPONSIBILITY AREAS INTO FIRE HAZARD SEVERITY ZONES. EACH ZONE SHALL EMBRACE RELATIVELY HOMOGENEOUS LANDS AND SHALL BE BASED ON FUEL LOADING, SLOPE, FIRE WEATHER, AND OTHER RELEVANT FACTORS PRESENT, INCLUDING AREAS WHERE WINDS HAVE BEEN IDENTIFIED BY THE DEPARTMENT AS A MAJOR CAUSE OF WILDFIRE SPREAD. GOVERNMENT CODE 51178; THE STATE FIRE MARSHAL SHALL IDENTIFY AREAS IN THE STATE AS MODERATE, HIGH, AND VERY HIGH FIRE HAZARD SEVERITY ZONES BASED ON CONSISTENT STATEWIDE CRITERIA AND BASED ON THE SEVERITY OF FIRE HAZARD THAT IS EXPECTED TO PREVAIL IN THOSE AREAS. MODERATE, HIGH, AND VERY HIGH FIRE HAZARD SEVERITY ZONES SHALL BE BASED ON FUEL LOADING, SLOPE, FIRE WEATHER, AND OTHER RELEVANT FACTORS INCLUDING AREAS WHERE WINDS HAVE BEEN IDENTIFIED BY THE OFFICE OF THE STATE FIRE MARSHAL AS A MAJOR CAUSE OF WILDFIRE SPREAD.9



Source: https://experience.arcgis.com/experience/5738ea10437f49f39c3e6406deb8f74f

[9] Source: https://osfm.fire.ca.gov/what-we-do/community-wildfire-preparedness-and-mitigation/fire-hazard-severity-zones

Top Natural Disaster Risk Per County				
#	FEMA National Risk	FEMA Top Risk	Bernardi ERI	Bernardi ERI Top Risk
1	Los Angeles County, CA	*Wildfire*	San Bernardino, CA	*Riverine Flooding*
2	Harris County, TX	*Riverine Flooding*	San Diego, CA	*Wildfire*
3	Riverside County, CA	*Wildfire*	Riverside, CA	*Wildfire*
4	San Bernardino County, CA	*Riverine Flooding*	Twin Falls, ID	*Wildfire*
5	Alameda County, CA	*Earthquake*	Elmore, ID	*Wildfire*
6	Santa Clara County, CA	*Wildfire*	Weld, CO	*Tornado*
7	Miami-Dade County, FL	*Hurricane*	Pittsburg, OK	*Wildfire*
8	Orange County, CA	*Wildfire*	Carteret, NC	*Hurricane*
9	Broward County, FL	*Wildfire*	Aleutians West, AK	*Earthquake*
10	Palm Beach County, FL	*Hurricane*	Collier, FL	*Hurricane*
11	San Diego County, CA	*Wildfire*	Washington, UT	*Wildfire*
12	King County, WA	*Coastal Flooding*	Los Angeles, CA	*Wildfire*
13	Cook County, IL	*Riverine Flooding*	Washington, CO	*Tornado*
14	Contra Costa County, CA	*Earthquake*	Elko, NV	*Wildfire*
15	Hillsborough County, FL	*Hurricane*	St. Bernard, LA	*Hurricane*
16	Galveston County, TX	*Hurricane*	Haskell, OK	*Wildfire*
17	Lee County, FL	*Hurricane*	Palm Beach, FL	*Hurricane*
18	Charleston County, SC	*Hurricane*	Latimer, OK	*Wildfire*
19	Ventura County, CA	*Wildfire*	Osage, OK	*Tornado*
20	Santa Barbara County, CA	*Wildfire*	Charleston, SC	*Hurricane*

V. Geographic Portfolio Construction Insights

Today, positioning a municipal portfolio based on geography is driven by tax status and benchmark weightings. We argue that natural disaster probability and resilience should also be a major factor. **For actively managed portfolios with no state of residence tax incentives, portfolios should be allocated to obligors with relatively lower natural disaster risk and higher resilience.**

If the cost of recovering from natural disasters continues to rise and outpace inflation, and if the federal government's role in post-disaster assistance becomes less certain, **measuring relative natural disaster risk will become increasingly critical to municipal credit research.**

We use the ERI to guide geographic portfolio construction on a relative risk basis, both across states and within them. The index indicates that the Midwest offers the most favorable natural disaster risk profile within the municipal bond market. Importantly, we do not believe this view is broadly reflected in current market consensus, nor is it embedded in valuations, as many Midwest issuers continue to offer attractive spread.

Several structural factors help explain why Midwest municipal issuers often trade at wider spreads. The largest issuers – those most heavily weighted in major benchmarks and therefore attracting the greatest index-driven demand – are largely located outside the Midwest, frequently in regions with higher natural disaster exposure. These issuers also tend to be based in high–income-tax states where in-state residents benefit from double tax-exempt income. Because a significant amount of investable wealth is concentrated in New York and California, this plays a major role in capital flows and pricing. Strong demand from benchmark-oriented strategies and local investors seeking state tax exemption tends to compress yields on these securities, effectively muting any yield premium that might otherwise arise from elevated natural disaster risk.

Barring tax status, this calls for a strong overweight of portfolios to Midwestern locations.

Additionally, the average Midwestern town is smaller than coastal cities.[10] This reduces the likelihood that Midwest-based municipalities are included in benchmarks given their smaller size. Therefore, the large fund complexes and passive strategies that mimic the benchmarks have a relatively lower weighting to these geographies.

Midwestern states benefit from lower ERI scores due to lower annual frequencies of highly destructive hazards. Primarily, the lack of hurricanes, earthquakes, and wildfire hazards. Our model weights those hazards heavily so the lack of annualized frequency brings the ERI score down relative to areas where those hazards are prevalent. Additionally, the lack of these hazards within the Midwest leads to lower insurance non-renewal rates so the ERI scores are not penalized like western and coastal states.

These variables are correlated, but if one believes the trends will continue, the Midwest will become an even more relatively attractive place to safely defend against natural disaster risk. Barring tax status, this calls for a strong overweight of portfolios to Midwestern locations.

[10] According to the U.S. Census Bureau's 2024 Annual Estimates of the Resident Population for Incorporated Places (SUB-IP-EST2024-POP), the median incorporated place in the Midwest has a population of approximately 700 — the lowest of the four official Census regions — compared to approximately 1,400 nationally, 2,400 in the Northeast, 1,400 in the South, and 2,700 in the West, across 19,479 total incorporated places nationwide. Source: U.S. Census Bureau, Population Division, May 2025.

VI. Methodology & Sources for Bernardi Environmental Risk Index

Assessing environmental risk and relating it more directly to municipal credit quality, we use two components that combine: first, an assessment of the destructive capacity of natural disasters; and second, the relative insurance vulnerability of properties that support both tax and enterprise revenues of any given municipality. To capture the natural disasters component, we use a comprehensive dataset assembled by FEMA – it's National Risk Index. To gauge the vulnerability of a municipality's revenue base (distinct from its size), we apply a penalty factor for counties with abnormally high average property insurance non-renewal rates – the more insurers refuse to guarantee property values in a county, the greater the permanent damage a natural disaster could wreak to the tax base. For the insurance non-renewal component, we use county-level data that property insurers provided to the U.S. Senate.

FEMA's National Risk Index is a dataset and online tool that helps illustrate the communities most at risk for eighteen natural hazards across the United States and territories. These eighteen hazards are listed below:

Avalanche	Heat Wave	Strong Wind
Coastal Flooding	Hurricane	Tornado
Cold Wave	Ice Storm	Tsunami
Drought	Landslide	Volcanic Activity
Earthquake	Lightning	Wildfire
Hail	Riverine Flooding	Winter Weather

FEMA's National Risk Index is based on three components: Social Vulnerability, Community Resilience, and Expected Annual Loss. Expected Annual Loss is comprised of Exposure (representative value of an area), Natural Hazards Annualized Frequency (how often a hazard occurs), and Historic Loss Ratio (historical loss in value corresponding to loss-causing hazard). Our methodology only uses the annualized frequency for a standalone metric that captures the likelihood of hazards. We then estimate each hazard's destructive potential and apply a relative weighting to that annualized frequency; this is a subjective judgement about the severity of future hazards, apart from historical precedent. See the Appendix for additional details.

A full description of the FEMA Index can be found here:
https://www.fema.gov/sites/default/files/documents/fema_national-risk-index_technical-documentation.pdf

Importantly, FEMA caveats the Risk Index dataset:

- are intended for use as a tool for broad, nationwide comparisons. Nationwide datasets used as inputs are in many cases not as accurate as locally available data.
- Modeling natural hazard risk for the entire country has inherent uncertainty and inaccuracy.

While FEMA's comprehensive data provides useful granularity for comparing the prevalence of natural disasters, we simplify key figures to enhance the comparability of the data. To do so, we take the annualized frequency for each county, then normalize the data using minimum-maximum scaling to generate a sub score for each hazard on a 0-100 scale adjusting for negative values.

$$x' = \frac{x - \min(x)}{\max(x) - \min(x)}$$

This generates a simple scale. A higher score (closer to 100) means the county has more frequent hazard occurrences. A lower score (closer to 0) means the county has fewer hazard occurrences. Because this score does not take into account economic exposure (value of buildings, infrastructure, agriculture, or population density), we isolate FEMA's insight on natural disaster probability. It purely reflects how often hazards are likely to occur in the county.

Next, we estimate the destructive potential of each hazard and weight each individual hazard by a factor accordingly. See tables below for weights and rationale.

We then sum the weighted scores to give us a raw County Environmental Risk Index Score and normalize that data on a 0-10 point scale. Note a 0 value here doesn't mean there are 0 environmental risks, just that it is the lowest value in the data set.

Hazard Type	Weight	Rationale
Avalanche	0.50%	Confined to mountainous regions with low population density.
Coastal Flooding	5.95%	Increasing due to sea-level rise; concentrated along East and Gulf Coasts.
Cold Wave	0.50%	Infrastructure risk in southern states, and health risk in the north.
Drought	5.00%	Slow-moving but widespread; impacts agriculture, water supply, and fire risk.
Earthquake	16.00%	High consequence but geographically limited (West Coast, Alaska).
Hail	3.90%	Common in central U.S.; among the costliest insured losses for property and agriculture.
Heat Wave	0.50%	Growing health threat, especially in urban areas.
Hurricane	20.00%	Still one of the costliest and most damaging in U.S. history (e.g., Katrina, Harvey, Ian).
Ice Storm	0.50%	Disruptive in the South and Northeast; critical for power and travel.
Landslide	2.00%	Limited to hilly/mountainous terrain; locally severe.
Lightning	0.00%	Frequent but typically low impact unless tied to wildfires or outdoor exposure.
Riverine Flooding	9.75%	Midwest and Southeast are flood-prone; high frequency and economic impact.
Strong Wind	0.50%	Widespread but lower intensity; can still damage trees, power lines, and light structures.
Tornado	15.00%	Much more prevalent in the U.S. than globally; highly destructive in Tornado Alley.
Tsunami	1.40%	Risk is mostly coastal Alaska, Hawaii, and Pacific Northwest low frequency.

Volcanic Activity	0.50%	Mostly a concern in Hawaii and Pacific Northwest; rare but potentially high impact regionally.
Wildfire	16.00%	Western U.S. increasingly affected by megafires; impacts growing due to drought and WUI expansion.
Winter Weather	2.00%	Frequent and disruptive across much of the country; impacts transportation and infrastructure.

Next, to capture the vulnerability of a municipality's capacity to support tax or enterprise revenues, we review where property insurers are pulling back from areas county-by-county versus the national average. If the insurance non-renewal for a specific county is higher than the national average, the ERI score is assigned a 10% penalty – increasing the score for the county by 1.1x to reflect the higher likelihood of lower recovery resiliency.

Bernardi ERI Master Formula:

Step 1 — Normalize Hazard Frequencies (per hazard *h*, per county *c*)

$$S_{c,h} = \max\left(0,\, 100 \cdot \frac{x_{c,h} - m_h}{M_h - m_h}\right)$$

Blank values of $x_{c,h}$ treated as zero. Output range: [0, 100].

Step 2 — Weighted Sum → Raw Score (per county *c*)

$$R_c = \sum_{h=1}^{H} w_h \cdot S_{c,h}$$

w_h = destructive potential weight for hazard h (weights undisclosed).

Step 3 — Rescale Raw Score to 0–10 (per county *c*)

$$E_c = \frac{1}{10} \cdot \max\left(0,\, 10 \cdot \frac{R_c - m_R}{M_R - m_R}\right)$$

Equivalent to: $\max(0, (R_c - m_R) / (M_R - m_R))$. Output range: [0, 10].

Step 4 — Insurance Nonrenewal Adjustment & Cap

$$\text{FinalERI}_c = \min\left(10,\, k_c \cdot E_c\right)$$

where

$$k_c = \begin{cases} 1.10 & \text{if } r_c > \bar{r} \\ 1.00 & \text{otherwise} \end{cases}$$

Variable Definitions

- c = county index
- h = hazard index; H = total number of hazards
- $x_{c,h}$ = annualized frequency (AFREQ) of hazard h in county c (blank = 0)
- w_h = destructive potential weight for hazard h (undisclosed)
- $m_h = \min_c x_{c,h}$ | $M_h = \max_c x_{c,h}$ — national min/max AFREQ for hazard h
- $S_{c,h}$ = normalized hazard score [0, 100]
- R_c = raw weighted hazard score
- $m_R = \min_c R_c$ | $M_R = \max_c R_c$ — national min/max raw score
- E_c = rescaled ERI score [0, 10], pre-adjustment
- r_c = county insurance nonrenewal rate
- $\bar{r}$ = national average insurance nonrenewal rate (vintage-specific)
- k_c = nonrenewal adjustment factor (1.10 or 1.00)

Bernardi ERI Methodology Recap:

Below is a quick breakdown of our process.

- Uses county-level annualized frequency of eighteen different hazards that are then weighted by a destructive potential factor and aggregated to determine an all-encompassing metric.
- That metric is then multiplied by a penalty factor (elevated non-renewal factor for the county).
- The scores range from 0-10, with 10 being the most at risk.
- This approach eliminates the bias in other environmental models by only considering likelihood of a high destructive event and insurability of the area.

VII. Conclusion

Defaults in the municipal bond market are exceptionally rare. To date, **we do not know of any natural disaster–driven defaults among general obligation bonds or essential-service revenue bonds**. Where disasters have contributed to payment failures, those cases have been confined to smaller, non-essential or commercially oriented revenue issuers with highly concentrated economic bases.

That said, natural disaster risk is becoming an increasingly material variable in municipal credit analysis. Greater storm severity, wildfire exposure, floodplain expansion, insurance market retrenchment, and demographic shifts are all altering the risk profile of certain issuers. As a result, portfolio construction should account for geographic risk.

Complete avoidance of disaster exposure is not practical in a diversified municipal strategy. However, risk can be meaningfully mitigated through disciplined security selection and the use of indexes such as the ERI to maintain exposure levels below the national average. Practically, this implies an overweight to Midwest issuers and a relative underweight to coastal credits where natural disaster frequency and insurance market stress are higher.

In the near term, municipal yields are predominantly influenced by technical factors—supply/demand imbalances, fund flows, and issuance calendars. Over the medium to long term, relative value is more closely anchored to tax policy, Treasury rate movements, and macroeconomic conditions. An open question is whether geographic risk differentials—particularly exposure to disaster risk—will increasingly command a pricing premium or discount at the state and local level, thereby becoming a more explicit component of spread differentiation across obligors. We believe it should and utilizing indexes such as the ERI are a starting point to provide guidance.

VIII. <u>Appendix & Resources</u>

FEMA Risk Index Detail:

The FEMA Score is made up of expected annual loss times a community risk factor. Expected annual loss is made up of annualized frequency, exposure, and historic loss ratio. The community risk factor is a function of social vulnerability and community resilience. Values are calculated at the Census tract level, with county values calculated by summing the values from their tracts.

Equation 2: Generalized National Risk Index Risk Equation

$$Risk = Expected\ Annual\ Loss \times Community\ Risk\ Factor$$

$$where\ Community\ Risk\ Factor = f\left(\frac{Social\ Vulnerability}{Community\ Resilience}\right)$$

The Community Risk Factor scales the value such that counties with higher relative Social Vulnerability and/or lower Community Resilience will have higher index values.

Resources:

FEMA Risk Index: https://www.fema.gov/flood-maps/products-tools/national-risk-index

Senate Budget Committee Report on Insurance Non-renewal rates:
https://www.budget.senate.gov/imo/media/doc/next_to_fall_the_climate-driven_insurance_crisis_is_here__and_getting_worse.pdf

IMPORTANT DISCLOSURES

General — Not Investment Advice

This white paper is published by Bernardi Securities, Inc. ("BSI"), a registered broker-dealer and member of FINRA and MSRB. This white paper is provided for informational and educational purposes only and does not constitute investment advice, a solicitation, or an offer to buy or sell any security or financial instrument. Nothing in this white paper should be construed as a recommendation to purchase or sell any specific security or to adopt any particular investment strategy. Past performance and historical data referenced herein are not indicative of future results. All investments involve risk, including the possible loss of principal.

Proprietary Model — Bernardi Environmental Risk Index (ERI)

The Bernardi Environmental Risk Index ("ERI" or "Index") is a proprietary analytical tool developed by BSI. The ERI is based on BSI's internal methodology and reflects BSI's assumptions, judgments, weightings, and data inputs as of the date indicated herein. The ERI is one of several factors considered in BSI's investment and credit analysis process and does not represent the sole basis for any investment decision. The ERI is subject to periodic revision, and scores may change as underlying data is updated. Prior ERI scores may not be directly comparable to current scores following any methodology revision.

Data Sources

ERI scores are derived primarily from two data sources: (1) the FEMA National Risk Index (NRI), a county-level dataset published by the Federal Emergency Management Agency measuring annualized frequency of eighteen natural hazards, available at fema.gov/flood-maps/products-tools/national-risk-index; and (2) county-level property insurance non-renewal rate data sourced from the U.S. Senate Budget Committee report on insurance non-renewal rates ("Next to Fall," 2024), available at budget.senate.gov. Data is utilized as of the most recent available vintage at the time of index construction. BSI does not independently verify third-party data and makes no representation as to its accuracy, completeness, or fitness for any particular purpose. FEMA has noted that its National Risk Index data is "intended for use as a tool for broad, nationwide comparisons" and that "modeling natural hazard risk for the entire country has inherent uncertainty and inaccuracy." BSI adopts this same caveat with respect to ERI scores derived therefrom.

Model Risk and Limitations

The ERI is a quantitative scoring model based on historical hazard frequency data and BSI's analytical framework. Like all models, the ERI is subject to inherent limitations, including: reliance on historical patterns that may not predict the frequency, severity, or geographic distribution of future natural disaster events; data gaps or inconsistencies at the county or regional level in the underlying FEMA and insurance datasets; potential misclassification of risk due to intra-county geographic variation not captured at the county level; and the possibility that factors not captured in the model — including climate change trajectory, land use changes, infrastructure investment, and policy changes — may materially affect natural disaster risk or municipal bond credit quality. The ERI should not be relied upon as a complete or definitive assessment of natural disaster risk, municipal credit quality, or investment suitability.

Forward-Looking Statements and Historical Resilience

Certain statements in this white paper regarding expected trends, future conditions, and the potential impact of natural disasters on municipal bond markets are forward-looking in nature and subject to significant uncertainty. Actual outcomes may differ materially from those anticipated. Historical resilience of the municipal bond market to natural disaster events does not guarantee that such resilience will continue in future events. The increasing frequency and severity of natural disasters, rising insurance non-renewal rates, and climate-related financial risks may affect municipal bond issuers in ways not fully captured by historical data. BSI undertakes no obligation to update this white paper to reflect subsequent developments.

Publication Date

This white paper reflects BSI's research, analysis, and views as of May 2026 and is subject to change without notice. The ERI scores and insurance non-renewal data presented herein reflect data available as of the time of analysis. BSI undertakes no obligation to update this white paper following its initial publication.