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TEXAS WINDSTORM  
INSURANCE ASSOCIATION

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**Texas Windstorm Insurance Association**

**Estimated Aggregate Annual Losses**

**Based on Hurricane and Severe Thunderstorm Catastrophe Models:**

**RMS RiskLink**

**AIR Touchstone**

**Impact Forecasting ELEMENTS**

**CoreLogic Solutions**

**Exposures In-Force as of  
11/30/2021 and 11/30/2022**



## Cautionary Language Regarding Catastrophe Model Loss Estimates

The following tables present hurricane and severe thunderstorm loss estimates prepared for the Association based on four leading industry models: RMS RiskLink, AIR Touchstone, Impact Forecasting, and CoreLogic. Developing models to estimate losses resulting from catastrophes or other large-scale events is an inherently subjective and imprecise process, involving judgment about a variety of environmental, demographic, and regulatory factors. Such factors are inherently uncertain, and the Association does not model all the types of perils that may result in losses to the Association.

The assumptions and/or methodologies used in connection with the preparation of estimated losses derived by the Association may not constitute the exclusive set of reasonable assumptions, and the use of alternative assumptions and/or methodologies could yield results materially different from those generated or relied upon by the Association. Each model run is based on exposure information that will differ from the Association's actual exposure in the future based on future action the Association may take, including changes to existing policies and the writing of new business. Loss distribution models are not facts and should not be relied upon as such. Actual loss experience can materially differ from the modeled loss estimates used by the Association.

The Board of Directors considers the results of the models and other factors in connection with its decisions with respect to the purchase of reinsurance, including the amount of total limit sought. The Board also considers the results of the models in considering to its obligations under Chapter 2210.453 which require that the Association maintain total available loss funding in an amount not less than the probable maximum loss for the association for a catastrophe year with a probability of one in 100.

These models simulate thousands of hurricane and severe thunderstorm scenarios and apply the simulated hurricanes and severe thunderstorms to the Association's insured business to calculate the probability of aggregate losses for the entire year. The results below were generated using Association exposures as of November 30, 2021 and November 30, 2022. The loss estimates are used by the Association in the course of its business operations. The data and analysis provided by TWIA herein are provided "as is", without warranty of any kind whether express or implied.

This report includes information that is output from catastrophe models of AIR Worldwide Corporation (AIR), Risk Management Solutions, Inc. (RMS), Impact Forecasting, LLC (IF) and CoreLogic Solutions (CoreLogic). The information from the models is provided by Aon Benfield Inc. (Aon) under the terms of its license agreements with AIR, RMS, IF, and CoreLogic. The results in this report from AIR, RMS, IF, and CoreLogic are the products of the exposures modeled, the financial assumptions made concerning insurance terms such as deductibles and limits, and the risk models that project the dollars of damage that may be caused by defined catastrophe perils. Aon recommends that the results from these models in this report not be relied upon in isolation when making decisions that may affect the underwriting appetite, rate adequacy, or solvency of the company. The AIR, RMS, IF, and CoreLogic models are based on scientific data, mathematical and empirical models, and the experience of engineering, geological, meteorological, and terrorism experts. Calibration of the models using actual loss experience is based on very sparse data, and material inaccuracies in these models are possible. The loss probabilities generated by the models are not predictive of future hurricanes, other windstorms, or earthquakes or other natural or man-made catastrophes, but provide estimates of the magnitude of losses that may occur in the event of such catastrophes. Aon makes no warranty about the accuracy of the AIR, RMS, IF, and CoreLogic models and has made no attempt to independently verify them. Aon will not be liable for any loss or damage arising from or related to any use of, or decisions based upon, data developed using the models of AIR, RMS, IF, and CoreLogic, including without limitation special, indirect, or consequential damages.



## Definitions

**Aggregate Loss Estimate:** The most basic output of a catastrophe model is the estimate of losses for every simulated event. Losses presented on an aggregate basis include estimated total losses from all events in any given year. In contrast, an “occurrence basis” reflects the losses from the largest single event in any given year. The aggregate loss estimates do not include a provision for loss adjustment expenses. TWIA staff would recommend adding an amount equal to 15% of the estimated aggregate losses to represent the estimated loss adjustment expenses. Loss adjustment expenses represent costs associated with investigating and settling claims.

**Aggregate Exceedance Probability:** Aggregate exceedance probability represents the probability of the total losses from all events in any given year meeting or exceeding a given threshold.

**Average Annual Loss (AAL):** The AAL is the expected value of losses to be experienced in any given year. It is equal to the sum of all simulated event losses multiplied by the probability of each of those events. Average annual losses are also calculated by dividing the total losses for all simulated storms by the number of simulated years in the computer simulation.

**Demand Surge:** Demand surge estimates the degree to which losses are escalated by a combination of economic, social, and operational conditions that follow a given event. Demand surge accounts for three separate mechanisms of escalation arising from (1) increase in the costs of building materials and labor costs as demand exceeds supply, (2) cost inflation due to the difficulties in fully adjusting claims following a catastrophic event, and (3) under certain extreme scenarios, coverage and loss expansion due to a complex collection of factors such as containment failures, evacuation effects, and systemic economic downturns in selected urban areas.

**Gross Basis:** Gross basis refers to the total losses before any recoveries from reinsurance or other funding mechanisms.

**Near Term vs. Long Term (Historical) Event Set:** Hurricanes in the Atlantic basin are known to follow multidecadal periods of heightened or diminished activity in terms of frequency of events, intensity, and landfall frequency. To account for these frequency changes, catastrophe model vendors provide alternative event catalogs or rates set alongside the long-term mean. Near-term or medium-term rates represent the five-year, medium-term outlook of North Atlantic hurricane activity. Long-term rates represent the event rates that are consistent with the long-term historical average.

**Return Period:** The return period is simply the inverse of the exceedance probability. For example, a 1% exceedance probability is equal to a 100-year return period. The return period term can be misleading by implying a period of time that would be expected to pass between events of that magnitude, when in reality they are representative of the probability of meeting or exceeding that level of loss in any given year.

**Risk Count:** Risk count refers to the number of individual structures insured. Some policies may cover more than one structure.

**Storm Surge:** Storm surge refers to the damage caused by rising ocean water levels along coastlines affected by a hurricane that can cause widespread flooding. Losses from storm surge and other forms of flooding are not covered by TWIA policies.

**Texas Windstorm Insurance Association**  
**Catastrophe Model Output Summary**  
**Model Versions and Exposure Summary**  
 Exposures In-Force as of 11/30/2021 and 11/30/2022



<b>Model</b>	<b>Data as of:</b>	<b>Portfolio</b>
RMS RiskLink v21.0 WS/CS	11/30/2021	HUR & SCS
	11/30/2022	HUR & SCS

Verisk Touchstone 9.0 TC/Sev Thun	11/30/2021	HUR & SevThun
	11/30/2022	HUR & SevThun

Impact Forecasting v15.0 TC/SCS	11/30/2021	HUR & SCS
	11/30/2022	HUR & SCS

CoreLogic RQE v21.0 HU/SCS	11/30/2021	HUR & SCS
	11/30/2022	HUR & SCS

<b>TWIA Exposures as of:</b>	<b>11/30/2021</b>	<b>11/30/2022</b>	<b>Percent Change</b>
Total Insured Values (000s)	\$70,833,471	\$89,935,082	27.0%
Total Insured Limits (000s)	\$65,223,102	\$82,865,490	27.0%
Risk Count (#)	202,136	231,121	14.3%

**Texas Windstorm Insurance Association**

**Catastrophe Model Output Summary**

**All Perils (Hurricane and Severe Convective Storm) Gross Loss Estimates**

RMS RiskLink, Verisk Touchstone, Impact Forecasting ELEMENTS, and CoreLogic RQE

Exposures In-Force as of 11/30/2022



		VaR (PML) - All Peril Near-Term (Stochastic)			
Return Period	Annual Exceedence Probability (AEP)	RMS RiskLink v21.0 WS/CS (1)	Verisk Touchstone 9.0 TC/Sev Thun (2)	Impact Forecasting v15.0 TC/SCS (3)	CoreLogic RQE v21.0 HU/SCS (4)
1,000	0.10%	12,813,682,470	13,905,877,832	9,605,169,617	10,305,639,424
500	0.20%	9,480,519,490	12,293,941,408	8,249,969,367	8,286,888,960
250	0.40%	6,519,244,900	8,859,243,149	6,599,340,758	6,427,227,648
100	1.00%	3,944,438,166	5,614,995,609	4,318,721,108	4,102,111,488
50	2.00%	2,447,703,737	3,248,243,821	2,808,672,089	2,470,216,960
25	4.00%	1,376,792,507	1,691,358,898	1,683,770,183	1,285,246,976
20	5.00%	1,118,655,863	1,377,498,694	1,345,386,422	1,006,832,832
Annual avg (AAL)		241,056,627	290,123,439	263,124,582	216,629,360
Std dev		958,128,615	1,123,210,761	866,473,415	821,560,896

		VaR (PML) - All Peril Long-Term (Historical)			
Return Period	Annual Exceedence Probability (AEP)	RMS RiskLink v21.0 WS/CS (1)	Verisk Touchstone 9.0 TC/Sev Thun (2)	Impact Forecasting v15.0 TC/SCS (3)	CoreLogic RQE v21.0 HU/SCS (4)
1,000	0.10%	12,774,698,163	13,905,877,832	9,453,539,887	9,605,532,672
500	0.20%	9,436,184,161	12,010,763,032	7,935,044,262	7,751,426,560
250	0.40%	6,478,745,993	8,196,615,316	6,391,889,201	5,926,180,864
100	1.00%	3,920,262,070	5,199,959,981	4,170,936,990	3,619,483,392
50	2.00%	2,423,213,213	3,062,974,078	2,669,934,577	2,182,423,552
25	4.00%	1,350,106,649	1,605,215,705	1,546,638,386	1,128,550,784
20	5.00%	1,091,320,901	1,260,308,230	1,223,104,899	877,177,088
Annual avg (AAL)		234,273,833	272,370,329	242,019,897	192,861,360
Std dev		952,147,185	1,081,553,325	835,627,138	754,420,416

Aggregate annual expected loss by return period based on TWIA exposure data as of 11/30/2022 and

- (1) the indicated RMS windstorm and convective storm model version with loss amplification impact, excluding storm surge;
- (2) the indicated Verisk tropical cyclone and severe thunderstorm model version with demand surge impact, excluding storm surge
- (3) the indicated IF tropical cyclone and convective storm model version with demand surge impact, excluding storm surge; or
- (4) the indicated RQE hurricane and convective storm model version with demand surge impact, excluding storm surge

**Texas Windstorm Insurance Association**  
**Catastrophe Model Output Summary**  
**All Perils (Hurricane and Severe Convective Storm) Gross Loss Estimates**  
RMS RiskLink  
Exposures In-Force as of 11/30/2021 and 11/30/2022



Return Period	AEP - All Perils Near-Term (Stochastic)		
	<b>A</b>	<b>B</b>	<b>B vs A</b>
	11/30/21 Exposures RMS v21	11/30/22 Exposures RMS v21	11/30/21 v21 to 11/30/22 v21 Exposure Change
1,000	9,953,453,207	12,813,682,470	28.7%
500	7,373,971,209	9,480,519,490	28.6%
250	5,095,188,786	6,519,244,900	27.9%
100	3,091,511,058	3,944,438,166	27.6%
50	1,932,223,534	2,447,703,737	26.7%
25	1,093,592,882	1,376,792,507	25.9%
20	891,317,364	1,118,655,863	25.5%
Annual avg (AAL)	191,164,925	241,056,627	26.1%
Std dev	748,456,209	958,128,615	28.0%

Return Period	AEP - All Perils Long-Term (Historical)		
	<b>A</b>	<b>B</b>	<b>B vs A</b>
	11/30/21 Exposures RMS v21	11/30/22 Exposures RMS v21	11/30/21 v21 to 11/30/22 v21 Exposure Change
1,000	9,921,846,103	12,774,698,163	28.8%
500	7,341,018,680	9,436,184,161	28.5%
250	5,062,190,120	6,478,745,993	28.0%
100	3,071,456,117	3,920,262,070	27.6%
50	1,912,083,710	2,423,213,213	26.7%
25	1,071,835,150	1,350,106,649	26.0%
20	869,195,657	1,091,320,901	25.6%
Annual avg (AAL)	185,688,426	234,273,833	26.2%
Std dev	743,772,134	952,147,185	28.0%

Aggregate annual expected loss by return period based on indicated RMS windstorm and convective storm model version and exposure data (as of 11/30/2021 or 11/30/2022), with loss amplification impact, excluding storm surge impact, using either near term (stochastic) or long term (historical) event frequency as noted

**A** RMS Risklink v21 model output using 11/30/2021 exposure data

**B** RMS Risklink v21 model output using 11/30/2022 exposure data

This model output was used by the TWIA Board in the determination of the 1:100 PML for the 2023 hurricane season

**Texas Windstorm Insurance Association**  
**Catastrophe Model Output Summary**  
**All Perils (Hurricane and Severe Convective Storm) Gross Loss Estimates**  
 Verisk Touchstone  
 Exposures In-Force as of 11/30/2021 and 11/30/2022



Return Period	AEP - All Perils (Warm Sea Surface Temperature)		
	<b>A</b>	<b>B</b>	<b>B vs A</b>
	11/30/21 Exposures Verisk v9	11/30/22 Exposures Verisk v9	11/30/21 v9 to 11/30/22 v9 Exposure Change
1,000	11,392,502,864	13,905,877,832	22.1%
500	9,900,713,925	12,293,941,408	24.2%
250	7,106,758,172	8,859,243,149	24.7%
100	4,540,357,178	5,614,995,609	23.7%
50	2,612,537,980	3,248,243,821	24.3%
25	1,342,319,706	1,691,358,898	26.0%
20	1,076,982,762	1,377,498,694	27.9%
Annual avg (AAL)	230,179,142	290,123,439	26.0%
Std dev	908,601,137	1,123,210,761	23.6%

Return Period	AEP - All Perils (Standard)		
	<b>A</b>	<b>B</b>	<b>B vs A</b>
	11/30/21 Exposures Verisk v9	11/30/22 Exposures Verisk v9	11/30/21 v9 to 11/30/22 v9 Exposure Change
1,000	11,392,502,864	13,905,877,832	22.1%
500	9,701,719,232	12,010,763,032	23.8%
250	6,760,599,015	8,196,615,316	21.2%
100	4,218,061,860	5,199,959,981	23.3%
50	2,476,805,827	3,062,974,078	23.7%
25	1,267,728,817	1,605,215,705	26.6%
20	974,337,155	1,260,308,230	29.4%
Annual avg (AAL)	215,922,636	272,370,329	26.1%
Std dev	874,245,959	1,081,553,325	23.7%

Aggregate annual expected loss by return period based on indicated AIR tropical cyclone and severe thunderstorm model version and exposure data (as of 11/30/2021 or 11/30/2022), with demand surge impact, excluding storm surge impact, using either warm sea surface temperature (near term) or standard (long term) event frequency as noted

**A** AIR Touchstone v9 model output using 11/30/2021 exposure data

**B** AIR Touchstone v9 model output using 11/30/2022 exposure data

This model output was not used by the TWIA Board in the determination of the 1:100 PML for the 2023 hurricane season

**Texas Windstorm Insurance Association**  
**Catastrophe Model Output Summary**  
**All Perils (Hurricane and Severe Convective Storm) Gross Loss Estimates**  
Impact Forecasting ELEMENTS  
Exposures In-Force as of 11/30/2021 and 11/30/2022



Return Period	AEP - All Perils Near-Term (Stochastic)		
	<b>A</b>	<b>B</b>	<b>B vs A</b>
	11/30/21 Exposures IF v15	11/30/22 Exposures IF v15	11/30/21 v15 to 11/30/22 v15 Exposure Change
1,000	8,009,175,776	9,605,169,617	19.9%
500	6,927,277,047	8,249,969,367	19.1%
250	5,511,968,054	6,599,340,758	19.7%
100	3,600,975,648	4,318,721,108	19.9%
50	2,353,044,356	2,808,672,089	19.4%
25	1,406,008,325	1,683,770,183	19.8%
20	1,121,452,051	1,345,386,422	20.0%
Annual avg (AAL)	220,163,589	263,124,582	19.5%
Std dev	725,479,778	866,473,415	19.4%

Return Period	AEP - All Perils Long-Term (Historical)		
	<b>A</b>	<b>B</b>	<b>B vs A</b>
	11/30/21 Exposures IF v15	11/30/22 Exposures IF v15	11/30/21 v15 to 11/30/22 v15 Exposure Change
1,000	7,931,102,072	9,453,539,887	19.2%
500	6,725,327,556	7,935,044,262	18.0%
250	5,348,913,758	6,391,889,201	19.5%
100	3,504,494,110	4,170,936,990	19.0%
50	2,221,176,872	2,669,934,577	20.2%
25	1,292,720,701	1,546,638,386	19.6%
20	1,016,272,828	1,223,104,899	20.4%
Annual avg (AAL)	202,458,916	242,019,897	19.5%
Std dev	699,526,218	835,627,138	19.5%

Aggregate annual expected loss by return period based on indicated Impact Forecasting windstorm and convective storm model version and exposure data (as of 11/30/2021 or 11/30/2022), with loss amplification impact, excluding storm surge impact, using either near term (stochastic) or long term (historical) event frequency as noted

**A** Impact Forecasting ELEMENTS v15 model output using 11/30/2021 exposure data

**B** Impact Forecasting ELEMENTS v15 model output using 11/30/2022 exposure data

This model output was not used by the TWIA Board in the determination of the 1:100 PML for the 2023 hurricane season



**Texas Windstorm Insurance Association**  
**Catastrophe Model Output Summary**  
**All Perils (Hurricane and Severe Convective Storm) Gross Loss Estimates**  
CoreLogic RQE  
Exposures In-Force as of 11/30/2021 and 11/30/2022



Return Period	AEP - All Perils Near-Term (Stochastic)		
	<b>A</b>	<b>B</b>	<b>B vs A</b>
	11/30/21 Exposures RQE v21	11/30/22 Exposures RQE v21	11/30/21 v21 to 11/30/22 v21 Exposure Change
1,000	8,980,694,016	10,305,639,424	14.8%
500	7,201,098,752	8,286,888,960	15.1%
250	5,557,921,280	6,427,227,648	15.6%
100	3,502,033,152	4,102,111,488	17.1%
50	2,124,728,576	2,470,216,960	16.3%
25	1,089,906,560	1,285,246,976	17.9%
20	853,711,680	1,006,832,832	17.9%
Annual avg (AAL)	182,402,400	216,629,360	18.8%
Std dev	709,454,144	821,560,896	15.8%

Return Period	AEP - All Perils Long-Term (Historical)		
	<b>A</b>	<b>B</b>	<b>B vs A</b>
	11/30/21 Exposures RQE v21	11/30/22 Exposures RQE v21	11/30/21 v21 to 11/30/22 v21 Exposure Change
1,000	8,285,607,424	9,605,532,672	15.9%
500	6,738,680,320	7,751,426,560	15.0%
250	5,088,745,984	5,926,180,864	16.5%
100	3,121,842,688	3,619,483,392	15.9%
50	1,867,077,888	2,182,423,552	16.9%
25	961,538,752	1,128,550,784	17.4%
20	744,038,144	877,177,088	17.9%
Annual avg (AAL)	162,196,416	192,861,360	18.9%
Std dev	653,291,392	754,420,416	15.5%

Aggregate annual expected loss by return period based on indicated RQE windstorm and convective storm model version and exposure data (as of 11/30/2021 or 11/30/2022), with loss amplification impact, excluding storm surge impact, using either near term (stochastic) or long term (historical) event frequency as noted

**A** CoreLogic RQE v21 model output using 11/30/2021 exposure data

**B** CoreLogic RQE v21 model output using 11/30/2022 exposure data

This model output was not used by the TWIA Board in the determination of the 1:100 PML for the 2023 hurricane season