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"Asset-Level Risk Assessments – The Key to Resilient Decision-Making"

In order to make informed decisions about specific corporate assets, hazard and climate risk assessments must be downscaled to the property level.

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Over the past century, average global temperatures have risen by 1.8°F (1°C). The consequences of this increase, and projected future temperature increases, are that damaging weather events will intensify and may occur more frequently. The U.S. has sustained 355 weather and climate disasters since 1980 where overall damages/costs reached or exceeded $1 billion (including CPI adjustment to 2023). The total cost of these 355 events exceeds $2.540 trillion. The annual average of these events over the last five years is more than double the average since 1980, clearly indicating intensification. Compounding extreme event intensity and frequency changes are increasing the exposure and vulnerability of communities, which are a result of population and associated infrastructure development.

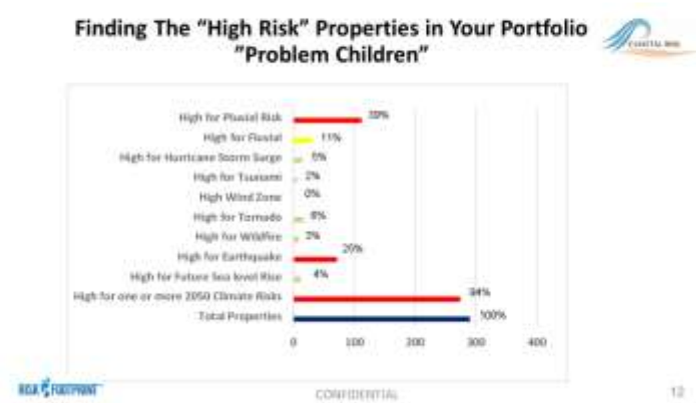
Calls for hard and soft climate adaptations are increasing rapidly, particularly in coastal communities that face increasing seasonal threats from tropical storms. However, publicly-available vulnerability and risk assessments are mostly limited to large spatial scales, such as national, state or county/city levels. In order to make informed decisions about specific corporate assets, however, such assessments must be downscaled to the property level. To fill this need for more granular and actionable risk assessments, the RiskFootprint™ hazard and climate assessment (www.riskfootprint.com) was developed by top scientists in the world, including a Nobel Prize winner. RiskFootprint™ helps decision-makers calculate and visualize asset-level risks, now, and in the future. RiskFootprint™ accomplishes this by downscaling the available data and information on current and future extreme events to the asset level.

By quantifying asset-level impacts of floods, natural hazards and climate change, asset owners can work from the bottom-up to more accurately determine portfolio-level risks. Identification of hazards, vulnerability and risk at the asset level helps corporate leaders better plan, prepare, and adapt to current and future climate events. For most businesses, a large percentage of their assets will perform well within tolerances of normal weather and environmental conditions. When extreme events occur, however, some buildings will suffer more damage and loss than others. Sometimes, such damage/loss may be catastrophic. In many cases, ownership may not be fully informed of which buildings are most vulnerable to which type of hazards and what the potential damage/loss could be as a percentage of replacement costs (structure and contents). Additionally, some buildings have greater economic value than others, are more sensitive to such hazards, and are more critical to the company's bottom line or brand. Without determining each facility's hazards, vulnerabilities, and value-at-risk, it is difficult to make informed decisions on whether to keep the asset or sell it, protect it with feasible resilience measures, increase insurance coverages, or take other business-prudent measures (e.g., sale/leaseback, etc.). At some point, where a building is shown to be vulnerable to extreme events and has significant value, ownership will need to determine its "risk tolerance" for that asset, its predicted "hold time" and use such factors in choosing whether to invest in risk mitigation, when to invest, and how much. The actionable information provided by RiskFootprint™ is fundamental to quality capital planning by large companies with significant real assets.

RiskFootprint™ technology also offers "top down" portfolio risk screening using its unique hazard scoring model (see example below). Using an Excel spreadsheet of asset addresses, RiskFootprint™ identifies the company's most vulnerable assets. The RiskFootprint™ scored Excel spreadsheet identifies 16 different risks as low, medium, or high and allows clients to quickly explore which assets pose the greatest risks to the company.

RiskFootprint™ Scored Excel Spreadsheet

Using Excel spreadsheet tools, bar charts (see below) can be developed that reveal the percentages of portfolios that are subject to specific hazards. Looking at these percentages by hazard and by relevant hazard combinations (e.g., flood, storm surge and sea level rise), corporate risk managers can easily focus on the highest risk properties and, if warranted, determine their vulnerability and value-at-risk.



The Property Resilience Assessment (PRA)

For many years, commercial, industrial, and multi-family property transfer due diligence has included four major assessments: (1) the Environmental Site Assessment (ESA) Phase 1 and 2; (2) the Property Condition Assessment (PCA); (3) the Appraisal; and (4) the Title Report. Consultancies with significant expertise in property transfer due diligence may not have on-staff the expertise required to: 1) identify and downscale climate projections and future extreme weather threats to the asset and infrastructure level; 2) translate threats of exposure to vulnerability and risk; and 3) develop practical adaption pathways from risk profiles. Many engineers, architects and planners can produce climate-minded designs; however, without fully understanding asset-level climate vulnerability and risk, climate resilience may not be optimized. RiskFootprint™ SaaS technology and its B-Resilient™ Advisory Services Team fill this gap.

An ASTM International Work Group was also formed to identify a proposed approach that would bring commercial property due diligence into better alignment with the rapidly increasing availability of open source hazard datasets and new SaaS assessment technologies improved by artificial intelligence (AI) and machine learning. This new approach, in the form of a guide, is called the Property Resilience Assessment or PRA. According to the ASTM: "This guide provides an overview of a generalized, systematic approach for conducting a Property Resilience Assessment (PRA) consisting of first, identifying the natural hazards likely to affect a property; next, evaluating the risks posed by those hazards along with the capacity of the property to prepare for, adapt to, withstand and recover from those hazards; and then finally, identifying conceptual resilience measures to enhance property-level performance and recovery."

The PRA draft guide, which is still in balloting and subject to change, breaks down the approach into three, interconnected stages: (1) Hazard Assessment; (2) Vulnerability and Risk Assessment; and (3) Identification of Feasible Resilience Measures and Rough Order of Magnitude (ROM) costs. See image, below.

NEW ASTM Standard: o erty Resilience Assessment

*Hazards include those caused by climate change, those made more extreme by climate change, and other natural hazards.

Assessing hazards, vulnerability and risk at the asset-level enables decision-makers and planners to scale the measured exposure levels of extreme weather events down to actionable levels for cost-effective, resilience decision-making. To estimate vulnerability and values-at-risk, RiskFootprint™ uses HAZUS-MH, a damage/loss software, open source model from FEMA to estimate damage and loss during a specified event, whether that be flood, hurricane, wind, or earthquake. For flooding, RiskFootprint™ has also developed a new screening tool, the automated "**Max Flood % Damage/Loss Estimate"**. See example below. With the User only providing a postal address of a commercial, industrial, or multi-family building, the RiskFootprint™ Max Flood % Damage/Loss Estimate provides the probable maximum loss from a flood event, whether that be heavy rainfall, riverine, or hurricane storm surge. The Max Flood % Damage/Loss tool uses an artificial intelligence (AI) estimate of the finished floor height (FFH) of the subject building based on Google Street View.

RiskFootprint™ Max Flood Damage/Loss %*

Google Street View

#1 Building Type	#2 Square Footage	#3 No. Stories	#4 Finished Floor Height (AGL in Feet)	#5 Max Flood Depth (AGL in Feet)	#6 Max Flood Source	#7 Max Flood % Loss
Commercial Office Space	170,390	3	0.5	16.5	Storm Surge Cat 3	23%

If the Max Flood Estimate shows a percentage loss to the replacement cost of the building that is material to the owner, operator, or lender, then they may require a more detailed and in-depth flood vulnerability and damage/loss estimate. RiskFootprint™ can provide this, where the client supplies building diagrams, Elevation Certificates, COPE data, and other pertinent information (e.g., any existing hazard protection systems). COPE stands for construction, occupancy, protection, exposure. These are the main areas that an insurance underwriter must evaluate when writing an insurance policy for a property. Below is an example of the output of a more in-depth, vulnerability and value-at-risk assessment that was done for a non-bank lender as a part of loan underwriting for an apartment building in Houston, post-Hurricane Harvey.

Stage 2 - Vulnerability and Materiality Assessment – Value-at-Risk

Flood Type	Depth	Damage	Restoration (Days)
Fluvial 100-year	3.7'	6.7%	480
Fluvial 500-year	8.5'	19.0%	720
Fluvial 1000-year	12.0'	35.0%	900
Pluvial 100-year	0.0'	0%	0
Pluvial 500-year	3.7'	6.7%	480
Pluvial 1000-year	4.3'	7.3%	630
FEMA 100-year	11.3'	31.5%	720

The final step in the Property Resilience Assessment is to bring in experts in hazard-specific, resilience measures to identify what investments might be feasible in this particular situation and estimate the rough order of magnitude (ROM) costs. These could be experts in flood, wind, hurricane, or seismic risk mitigation. Below is a slide showing some feasible resilience measures identified in advance of an upgrade and retrofit project to mitigate flooding at a South Florida, oceanside hotel.

Stage 3 –Resilience Measures
Removable Barriers, Wet Flood-Proofing, Raise MEP Equipment and More

Once feasible resilience measures have been identified, these risk mitigation experts can prepare rough order of magnitude costs (ROM). An example of such an effort is shown below. You can see that feasible resilience measures vary by the type/severity of the event and the costs, based on the level of protection ("risk tolerance") chosen by the client. Here ROM costs are broken down by the severity of a hurricane event that could impact the property in any year.

Feasible Resilience Measures and ROM Costs

	ROM Capital Costs				
	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Cat. 5
Deployable Barrier - Tiger Dam	$35,000.00	$100,000.00	$350,000.00	$225,000.00	$300,000.00
Permanent Sea Wall - 900 LF	$0.00	$0.00	$0.00	$6,000,000.00	$6,000,000.00
Relocate/Elevate Utilities	$0.00	$0.00	$0.00	$250,000.00	$250,000.00
Elevator Pit Flood Proofing	$200,000.00	$200,000.00	$300,000.00	$100,000.00	$100,000.00
Replace Elevator w/ Pitless Model	$0.00	$0.00	$1,000,000.00	$1,000,000.00	$1,000,000.00
Interior Flood Barrier Renovations	$0.00	$0.00	$0.00	$500,000.00	$500,000.00
Flood Doors/Gates	$0.00	$0.00	$100,000.00	$200,000.00	$200,000.00
Wet Floodproof Lobby - 8000 SF	$0.00	$100,000.00	$0.00	$0.00	$0.00
Wet Floodproof 1st Floor - 75000 SF	$0.00	$0.00	$300,000.00	$0.00	$0.00
Dry Floodproof Lobby - 8000 SF	$0.00	$0.00	$200,000.00	$200,000.00	$200,000.00
Dry Floodproof 1st Floor - 75000 SF	$0.00	$0.00	$0.00	$1,800,000.00	$1,800,000.00
Total	**$235,000.00**	**$400,000.00**	**$2,250,000.00**	**$10,275,000.00**	**$10,350,000.00**
Design - 12%	$28,200.00	$48,000.00	$270,000.00	$1,233,000.00	$1,242,000.00

CONCLUSION

By quantifying asset-level potential impacts of floods, natural hazards and climate change, asset owners can work from the bottom-up to determine portfolio-level risks and impacts more accurately and better quantify current and future revenues, asset valuations, and capital expenditures. Identification of hazards, vulnerability and risk at the asset level helps corporate leaders plan, prepare, and adapt to current and future climate events. The RiskFootprint™ hazard and climate impact assessment technology and the RiskFootprint™ process, based on the ASTM's draft Property Resilience Assessment (PRA), are currently available to help asset ownership quantify risks and make more informed decisions supported by sound science and best practices in damage/loss quantification.

For further information or sales, please contact: CustomerService@RiskFootprint.com.

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