MarshMcLennan

Preparing for a wetter world: Strategies for corporate flood resilience

Marsh GuyCarpenter Mercer OliverWyman

Five strategies for a wetter world

1

Take a 360-degree view of flood risk

Climate change and the growing complexity of events require firms to understand direct and indirect sources of flood risk. Risk assessment must span direct operations, the entire value chain, and the wider business environment.

2

Reimagine operational flood resilience

Traditional resilience measures like flood defenses can be complemented by investments in green infrastructure. Collaboration with stakeholders along the value chain is essential to mitigate cascading impacts.

3

Prepare for changes in access to capital and insurance

As climate change gathers pace, concerns are growing among regulators and financial institutions about flood risk exposures. Businesses should prepare for greater demands for information on climate and flood risks, and changes in the cost and availability of insurance as new risks are priced in.

4

Harness innovations in data and risk transfer

Technologies to quantify and transfer evolving flood risks are advancing rapidly. New data and techniques can anticipate how flooding will develop under climate change, allowing firms to preemptively reduce risk and maintain access to affordable capital. Innovations in parametric insurance provide new opportunities to transfer flood risk and supplement traditional insurance.

5

Develop a multi-stakeholder agenda

Flooding often affects a firm's stakeholders — customers, suppliers, employees, capital providers, and local communities. Liability, reputational, and financial consequences may follow. Stakeholder management strategies can be critically important.

An increasingly complex threat

Climate change, growing concentrations of infrastructure and business activity in flood-prone areas, and the increasing connectivity of global supply chains are making flood risks harder to identify and manage.

These three trends are causing business exposure to grow (see Exhibit 1), and 2021 has provided stark reminders of the threats posed by flooding. In March, floods in eastern Australia disrupted supply chains and impacted multiple industries including coal and agriculture, pushing coal prices in the country to a two-year high.[1] In July, extreme rainfall in Germany and Belgium crippled critical infrastructure and disrupted industry, shipping, and rail logistics. The deluge — made more likely by climate change — caused more than $53 billion in damage.[2, 3] At the same time, mass flooding in China engulfed major regional manufacturing and transportation hubs and led to economic losses exceeding $24 billion.[4] In September, Hurricane Ida caused more than $65 billion in damage in the United States, disrupted crude oil and natural gas production, and caused a 0.6% decline in the country's industrial output.[5] In November, heavy rainfall in Vancouver impacted key national supply chains and cut off the city by road, rail, and sea.[6] Flooding forced the temporary closure of the city's port, the busiest in the country with over $440 million dollar worth of cargo moved every day.[7]

Firms are often underprepared for the impacts and consequences of flooding. As the third installment in the *Rethinking Flood* series — after *Sunk Costs: The Socioeconomic Impacts of Flooding* and the *Marsh McLennan Flood Risk Index* — this report presents five novel strategies for companies to reimagine their approach to flood risk management in a warmer and wetter world.

Exhibit 1: Three trends shaping flood risk today

Climate change is increasing the frequency and severity of flooding across large parts of the world

181% increase in global number of flood events in 2010-19 compared to 1980-89[8]

A growing amount of business activity and critical infrastructure are located in areas at risk of flooding

100% increase in global GDP exposed to floods in 2000-09 compared to 1980-89[9]

Supply chains have been growing in complexity, and companies are increasingly exposed to flood risk overseas

76% of all trade occurs through global supply chains[10]

Source: Marsh McLennan Advantage

1 Take a 360-degree view of flood risk

Firms need to rethink and expand their approach to flood risk management. A thorough assessment of flood risk should strive to uncover hidden vulnerabilities in a company's value chain and business environment.

Flooding can affect firms through multiple channels, and assessing the risks of a company's property and direct operations provides only a partial picture. Businesses need to understand how flood risk threatens their value chains from suppliers to customers, as well as the critical infrastructure on which they depend.

Firms must also appreciate how climate change is causing investors, banks, and insurers to re-evaluate their own flood risk exposures, with long-term repercussions on the cost and availability of finance and insurance. Finally, businesses should evaluate how their flood risks may interact with stakeholders such as local communities and regulators. As an example, there are increasing expectations for climate-related disclosures that include information on physical risks.

Assembling a 360-degree perspective of flood risk can help to prevent lock-ins, where poor decisions made today force firms into future situations of higher risk that are difficult and costly to manage.[11] A first step for businesses involved in complex global supply chains should entail the identification of potential hotspots of risk. Exhibit 2 (on the next page) shows the global distribution of areas exposed to riverine and coastal flooding as reported in the *Marsh McLennan Flood Risk Index* and highlights some countries that are flood risk hotspots due to their production and logistics exposures.

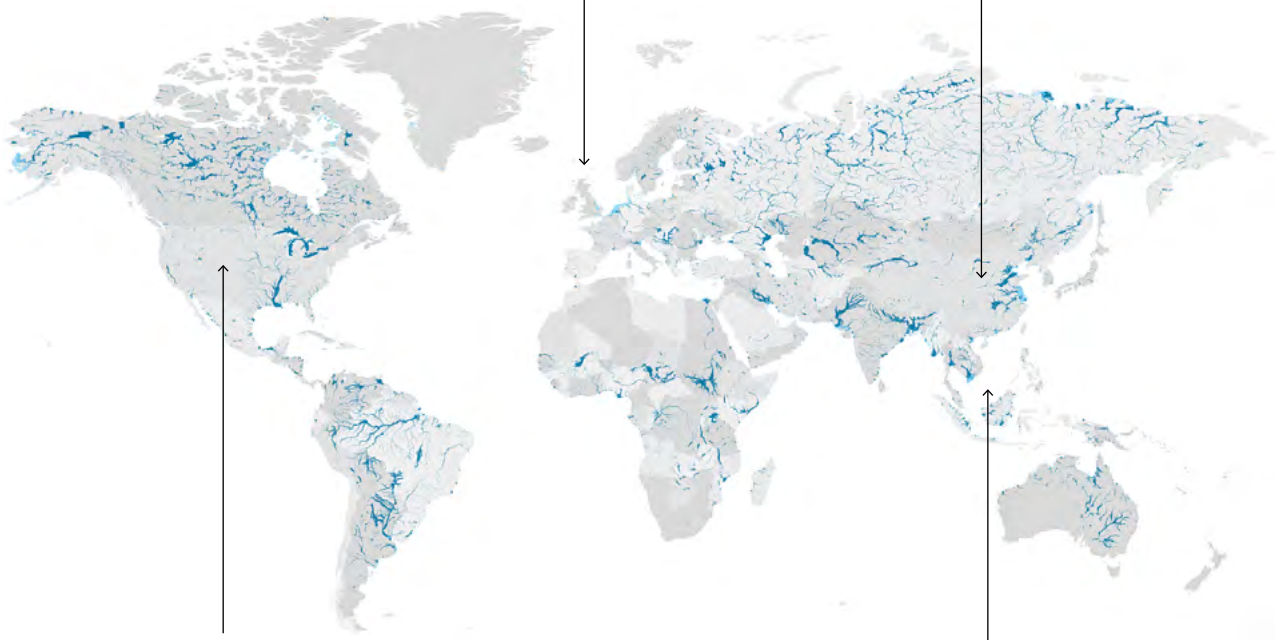
Given the complexity of flood risk, more granular tools may be needed to assess how the threat can propagate through different channels (see Exhibit 3 on page 6). Flood models, for example, can provide critical insight into present-day and future levels of physical risk under multiple climate change scenarios at higher geographical resolutions, helping to inform risk transfer strategies and support capital expenditure, asset siting, and long-term investment decisions.

42% of organizations experienced weather-related supply chain disruptions in 2020.[12]

Exhibit 2: Areas exposed to riverine and coastal flooding

The **United Kingdom** has made substantial investments to reduce vulnerability to flooding, but still faces high economic exposure. One in three commercial properties is at risk, and three out of four firms don't have a business continuity plan for floods.[13]

China is the world's largest manufacturer, and regularly experiences high flood damage. Over 350 cities in the country were affected by flooding in the last 10 years,[14] leaving global industry value chains vulnerable.



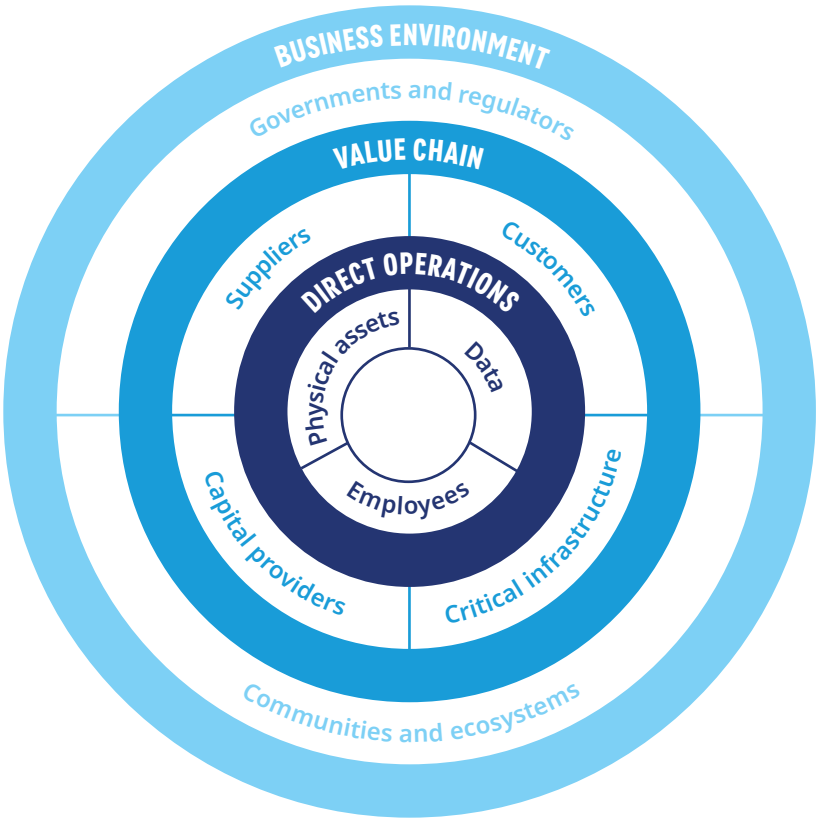
The **United States** has over a quarter of its critical infrastructure at risk of flooding.[15] Firms situated in coastal areas are especially vulnerable to hurricane-induced storm surges and extreme rainfall.

Thailand and **Vietnam** are leading electronics manufacturing centers, with a high concentration of assets and activities in river basins. Large-scale flooding has disrupted global electronics supply chains on multiple occasions.[16]

Note: The exhibit shows areas prone to riverine[17] and coastal[18] flooding as represented by the undefended 100-year return period hazard maps accessible through the *Marsh McLennan Flood Risk Index*.

Source: Marsh McLennan Advantage

Exhibit 3: Sources of flood risk in a firm's direct operations, value chain and business environment



Direct operations

Physical assets such as facilities, equipment, and inventory can be damaged in ways that leave premises inaccessible, interrupt production processes, and amplify losses. Following Hurricane Irma in 2017, insured losses to commercial properties alone were estimated to be between $4 billion and $8 billion.[19]

Data loss can cripple operations. IT systems are particularly vulnerable to flooding, and firms can face significant costs to recover data and replace IT infrastructure. A 2015 survey found that only 40% of IT professionals in the UK believed their data center facilities were flood resistant.[20]

Employees may be directly affected by flooding. Physical or psychological harm may translate into both liability risks and decreased productivity.[21]

Value chain

Suppliers can indirectly cause damage to a firm whenever they are impacted by flooding. Floods in China in 2021 threatened global supply chains and led to the closure of major ports, delaying shipments of key commodities.[22]

Customers may look for alternatives as product supply is disrupted, putting further pressure on businesses. Sectors such as tourism and hospitality are particularly vulnerable to flood risk. Hurricane Maria severely impacted Puerto Rico's tourism sector — an industry that accounts for 6.5% of the island's GDP.[23]

Capital providers incorporate information on a firm's flood exposure in their decision-making processes. Financial institutions, for example, are wary of increasing loss rates for commercial mortgage-backed securities (CMBS). CMBS pool loans are among the most exposed US securities to flood risk, with more than $56 billion in value threatened by coastal flooding.[24, 25]

Critical infrastructure failures such as power outages and disruption to transport can impact operations and cause business interruption. Over 250 airports, accounting for 8.5% of all flight routes, are at risk of coastal flooding.[26]

Business environment

Governments and regulators around the world are stepping up expectations for businesses to build resilience to climate change physical and transition risks. A multinational bank was recently fined $18 million after failing to buy flood insurance for clients as required by the US Flood Disaster Protection Act.[27]

Communities and ecosystems can be harmed after incidents caused by flooding at business facilities, with potentially costly reputational and liability consequences for businesses. A chemical manufacturing company faced lawsuits for fires and contamination induced by flooding caused by Hurricane Harvey in 2017.[28]

Source: Marsh McLennan Advantage

2 Reimagine operational flood resilience

Investments in flood resilience are critical to minimize damage and disruption. Protecting business premises is essential but may not be enough. Companies need to reassess resilience strategies at all levels of operations.

According to estimates from the National Institute of Building Sciences, each dollar spent in the US on flood mitigation results in a seven-fold amount in avoided costs.[29] Beyond preparing a Flood Emergency Response Plan (FERP) to protect employees, facilities, and activities in their immediate surroundings, companies should explore innovative solutions such as green infrastructure. This provides nature-based, cost-effective solutions to contain risk while restoring ecosystems and oftentimes sequestering carbon, thus reducing the overall greenhouse gas footprint of a business.[30, 31]

Working with suppliers and business customers is critical for firms to strengthen their value chain. Contingency planning is also important for core business functions, especially when considering the long-term impacts often caused by increasingly severe flooding. Exhibit 4 lists essential actions that can be taken to bolster resilience.

>$65 billion/year in coastal flood damage averted thanks to mangroves.[32]

Exhibit 4: Steps to enhance operational flood resilience

	ADAPT BUSINESS PREMISES	DEVELOP VALUE CHAIN RESILIENCE	PREPARE ROBUST CONTINGENCY PLANS
Traditional	Protect physical assets through on-site risk reduction measures such as flood defenses and floodproofing[33]	Segment supply chain operations and prioritize essential processes to limit disruption[34]	Identify back-up sites and operating models to ensure the safety of staff, limit productivity loss, and reduce downtime
	Retrofit existing facilities and build new ones with resilience in mind[35]	Diversify suppliers and logistics strategies	Develop joint contingency plans and establish new standby relationships with third parties with uncorrelated flood risk
	Invest in green infrastructure such as wetlands, mangroves, and green roofs	Incorporate information on stakeholder exposure to flooding when deciding on external partnerships	Establish processes to assess developments in post-disaster recovery, and update contingency strategies accordingly
Innovative		Co-invest in flood risk management measures with stakeholders	

Source: Marsh McLennan Advantage

3 Prepare for changes in access to capital and insurance

Climate change means flood risk will become increasingly important in financial institutions' strategic decisions, affecting the cost of capital and access to insurance.

Three related trends are causing investors, banks, and insurers to pay increasing attention to the implications of climate change for flood risk concentrations on their balance sheets:

- As more companies and financial institutions implement the recommendations of the Taskforce on Climate-related Financial Disclosures (TCFD),[36] awareness of climate risks is growing.
- Due to heightened scrutiny by regulators, financial institutions in an increasing number of jurisdictions face requirements to quantify their exposures to physical climate risks.
- Advances in data and analytical tools are making it easier for financial institutions to model how flood risk concentrations on their balance sheets are likely to evolve under climate change.

As climate change accelerates, financial institutions are likely to steer their balance sheets away from unattractive flood risks. Lenders harbor growing concerns about the implications of flooding on loan performance, and flood trends are leading to insurers adopting more restrictive underwriting practices.[37]

Businesses at high risk or those with a deteriorating risk outlook may face increases in cost of capital and difficulty securing affordable insurance or sufficient limits of coverage. Those unable to provide financial institutions with comprehensive exposure data and information on how they manage evolving flood risks will be the most impacted.

>1,300 among the largest UK companies and financial institutions will be required to disclose climate-related financial information in line with TCFD.[38]

4 Harness innovations in data and risk transfer

New analytical tools can anticipate how flood risk will evolve under climate change and inform adaptation strategies. Innovations in parametric insurance provide new opportunities to transfer flood risk and supplement traditional insurance solutions.

Many of the same advances in physical risk modelling and data being used by financial institutions are also available to corporates. Tools exist for evaluating expected changes in the frequency and severity of climate-related perils — such as flood — for different climate scenarios and over different timeframes. These solutions can help meet the expectations of governments, regulators, and financial markets for climate-related disclosures, and can provide the analytical foundation for strategies to address increasing flood risk and maintain access to capital.

Parametric insurance — where payout is indexed to a verifiable parameter such as rainfall or river level — allows businesses to transfer flood risk and has some important advantages (see Exhibit 5).

As climate change exacerbates flood risk, parametric insurance will become increasingly valuable as a supplement to traditional indemnity insurance and to limit business interruption losses (see next page). *Community-based catastrophe insurance (CBCI)* is another innovative solution to transfer flood risk. CBCI can be arranged by governmental or quasi-governmental entities to provide coverage to multiple properties, and can be a cost-effective tool to increase community and business resilience.[39]

Exhibit 5: Advantages of parametric insurance

Speed

Payouts are fast, streamlined, and simple to settle, as they reply on a trigger without the need for a loss adjustment process. This can accelerate recovery and enhance resilience.

Costs

Administrative costs are low. Event data are verified through indices (e.g., derived from remote sensing technologies) without the need for loss adjustment.

Flexibility

There are no restrictions on use of the payout, which are linked to an event and do not directly indemnify property owners for damage. This ensures greater cashflow flexibility and can provide resources to be invested in resilience or to offset revenue impacts.

Complementarity

Parametric solutions can be used to supplement conventional insurance in circumstances where the latter may be unavailable, or prohibitively expensive, at the desired level of cover.

Source: Marsh McLennan Advantage

Parametric insurance and flood protection

As climate change leads to more frequent and severe flooding, companies are likely to face a more challenging insurance environment. Insurers are often reluctant to offer coverage to businesses with a history of flood losses. The UK, for example, has experienced more severe flooding in recent years and impacted firms have had to deal with withdrawals of cover, significant premium hikes, and excess levels rising by as much as 10 times. In such cases, parametric solutions can be used to transfer some of the risks that conventional indemnity insurance is unable to cover.

The speed and flexibility of parametric insurance also makes it a suitable risk management solution for flood-related business interruption and contingent business interruption risks. Marsh designed and negotiated a parametric product that helped an international commodities trader minimize its transport revenue losses caused by flooding on the Mississippi River. By modelling the relationship between historical water levels along the Mississippi and client revenues, a parametric cover was structured to pay out for each day the river exceeds flood levels as measured by a set of gauges distributed along the river.

5 Develop a multi-stakeholder agenda

Companies need to assess the different ways in which stakeholder decisions and actions may influence their flood risks, and how stakeholders may be affected in the event of a flood.

A company's flood risk can be significantly shaped by its stakeholders. Government decisions about flood defenses and climate change adaptation may have obvious consequences. Urban planning in the vicinity of a company's operations may affect local hydrology, as can farming and land management practices within a watershed. Commercial strategies can often align with government ambitions to build resilience, and firms can take a leading role in engaging with public agencies and communities. Synergies between the public and private sectors can provide the technical capabilities and the financial resources to mitigate flood risk,[40] reduce the risk of maladaptive practices,[41] and avoid lock-ins.

Employees, customers, suppliers, capital providers, local communities, and other stakeholders may be exposed to the risks from a business being flooded. Firms not taking action to mitigate cascading impacts may face indirect consequences such as reputational damage, loss of market share, and litigation.

Appropriate strategies should be developed for the most material stakeholders, recognizing that responsibility for these may rest with different parts of the business (government relations, finance and risk, procurement, etc.). Exhibit 6 lists the key elements of a comprehensive flood risk stakeholder management strategy.

Exhibit 6: Actions for effective stakeholder management

Action	Stakeholders
Disclose information on flood risks and how these are managed	Regulators, capital providers
Lead and co-invest in flood resilience measures and develop joint contingency plans	Local authorities, communities, business partners along the value chain
Prepare communications plans	Employees, customers, business partners along the value chain, government agencies, communities, media
Develop post-disaster programs to address mental, social, housing, and financial needs of affected staff	Employees, government agencies
Engage in policymaking processes, e.g., on national adaptation and investment in flood defenses	Government agencies, communities

Source: Marsh McLennan Advantage

Getting ready

Firms should take a strategic approach to flood resilience and ensure it becomes an integral part of their enterprise risk management (ERM) practices.

The costs of flooding are scaling up with the complexity of the business environment and as a consequence of climate change. Controlling the cascading effects of flood risk, ranging from impacts on access to capital to legal liabilities, requires interacting with a growing number of stakeholders.

Most large organizations have well-established ERM frameworks and clearly defined responsibilities for risk management that can be leveraged to design effective flood resilience strategies and disclose risk. Firms need insights from across functions to ensure they have a comprehensive view of their exposure and value at risk. Strengthening resilience to flooding requires a cross-cutting agenda relying on collaboration among senior business executives, and bringing together capabilities from risk managers, procurement and supply chain officers, sustainability practitioners, and human resources and public affairs leaders.

"Businesses are facing increasing challenges from the rise in extreme weather events — such as droughts, heat waves and floods. In this changing environment, companies that move first to address the risks and develop innovative strategies to adapt to climate change are likely to be the winners and gain a competitive advantage moving forward."

Manish Bapna, former Managing Director at the World Resources Institute

References

1 The Business Times. (2021, March 23). *Australia's worsening floods crisis impacting coal, agriculture.* Retrieved November 23, 2021.

2 World Weather Attribution. (2021, August 23). *Heavy rainfall which led to severe flooding in Western Europe made more likely by climate change.* Retrieved November 23, 2021.

3 Insurance Journal. (2021, October 18). *Munich Re, Hannover Re Expect Rising Prices After Floods in Germany.* Retrieved November 23, 2021.

4 ABC News. (2021, August 2). *Death toll from floods in Zhengzhou, China more than triples, says provincial governments.* Retrieved November 23, 2021.

5 Ott, M. (2021, October 18). *Industrial production falls 1.3% as effects from Ida linger.* AP News. Retrieved November 23, 2021.

6 Cecco, L. (2021, November 17). *British Columbia and Pacific north-west storm wreaks havoc.* The Guardian. Retrieved November 23, 2021.

7 Aljazeera. (2021, November 16). *At least one dead, Vancouver port closed in Canada floods.* Retrieved November 23, 2021.

8 Marsh McLennan. (2021). *Sunk costs: The socioeconomic impacts of flooding*.

9 United Nations. (2011). *Global Assessment Report on Disaster Risk Reduction*.

10 International Trade Administration, United States Department of Commerce. (n.d.). *Supply Chain Services*. Retrieved November 23, 2021.

11 Mathews, S., Roezer, V., & Surminski, S. (2021). *The risk of corporate lock-in to future physical climate risks: The case of flood risk in England and Wales*. Centre for Climate Change Economics and Policy Working Paper No. 399.

12 Business Continuity Institute. (2021). *Supply Chain Resilience Report 2021*.

13 Aviva. (2021). *Building Future Communities: Creating resilient homes and businesses in a changing climate*.

14 Chan, F., Thadani, D., & Li, L. (2021, September 24). *Sponge City Is Transforming Urban Flood Management.* China Water Risk. Retrieved November 23, 2021.

15 First Street Foundation. (2021). *The 3rd National Risk Assessment Infrastructure on the Brink*.

16 Nikkei Asia. (2021, October 13). *Global companies must learn from Thai floods that upended supply chains.* Retrieved November 23, 2021.

17 Dottori, F., Salamon, P., Bianchi, A., Alfieri, L., Hirpa, F. A., & Feyen, L. (2016). *Development and evaluation of a framework for global flood hazard mapping.* Advances in Water Resources, 94, 87-102.

18 Muis, S., Verlaan, M., Winsemius, H. C., Aerts, J. C. J. H., & Ward, P. J. (2016). *A global reanalysis of storm surges and extreme sea levels.* Nature Communications, 7(1), 11969.

19 Reuters. (2017, September 20). *Corelogic estimates Hurricane Irma property damage at $42.5-$65 billion.* Retrieved November 23, 2021.

20 Zenium Data Centers. (2015). *Managing Growth, Risk and the Cloud.*

21 Smith, S. (2020, November 6). *Seasonal Safety: Protecting Employees from the Hazards of Flooding.* EHS Today. Retrieved November 23, 2021.

22 Lim, C. (2021, July 27). *Typhoon In-Fa Shuts Down Ports, Destroys Farmlands Already Damaged By Floods.* Business Times. Retrieved November 23, 2021.

23 Warren, K. (2020, July 1). *American Resilience: How Puerto Rico rebuilt its tourism industry after Hurricane Maria, from revitalizing its hotel scene to bringing hit musical 'Hamilton' to the island.* Business Insider. Retrieved November 23, 2021.

24 BlackRock. (2019). *Getting physical: Scenario analysis for assessing climate-related risks*.

25 Powell, J. (2019, October 28). *Climate change: The CMBS angle.* Financial Times. Retrieved November 23, 2021.

26 Yesudian, A.N., & Dawson, R.J. (2021). *Global analysis of sea level rise risk to airports*. Climate Risk Management; 31: 100266. DOI: 10.1016/j.crm.2020.100266.

27 Pederson, B. (2020, January 21). *Citibank fined nearly $18 million for flood insurance violations.* American Banker. Retrieved November 23, 2021.

28 Platoff, E. (2018, March 30). *As lawsuits over Texas chemical disaster add up, advocates blame Arkema and rules regulating it.* The Texas Tribune. Retrieved November 23, 2021.

29 National Institute of Building Sciences. (2019). *Natural Hazard Mitigation Saves: 2019 Report.*

30 US Environmental Protection Agency. (n.d.). *What is Green Infrastructure?*. Retrieved November 23, 2021.

31 The Nature Conservancy. (2020, April 6). *Natural Infrastructure.* Retrieved November 23, 2021.

32 Menéndez, P., Losada, I. J., Torres-Ortega, S., Narayan, S., & Beck, M. W. (2020). *The Global Flood Protection Benefits of Mangroves.* Scientific Reports, 10(1), 4404.

33 Marsh. (2020). *Flood resilience 10 top tips*.

34 Sodhi, M. S., & Chopra, S. (2014, March 18). *Reducing the Risk of Supply Chain Disruptions.* MIT Sloan Management Review. Retrieved November 23, 2021.

35 Adams, B. (2020, June 22). *Climate Change Is Now Driving Investments in Flood Resilience.* BRINK News. Retrieved November 23, 2021.

36 TCFD. (n.d.). *Task Force on Climate-Related Financial Disclosures.* Retrieved November 30, 2021.

37 Bernstein, A., Gustafson, M., & Lewis, R. (2018). *Disaster on the Horizon: The Price Effect of Sea Level Rise.* Journal of Financial Economics (JFE).

38 Gov.uk. (2021, October 29). *UK to enshrine mandatory climate disclosures for largest companies in law.* Retrieved November 23, 2021.

39 Bernhardt, A., Kousky., C., Read, A., & Sykes, C. (2021). *Community-Based Catastrophe Insurance: A model for closing the disaster protection gap.* Marsh McLennan.

40 Smith-Bingham, R., Wittenberg, A., & Kaniewski, D. (2020). *Building national resilience.* Marsh McLennan.

41 Carbon Brief. (2021, February 10). *Why avoiding climate change 'maladaptation' is vital.* Retrieved November 30, 2021.

Acknowledgements

Authors

Claudio Saffioti

Research Manager, Marsh McLennan Advantage
claudio.saffioti@oliverwyman.com

Sumer Drall

Research Analyst, Marsh McLennan Advantage
sumer.drall@oliverwyman.com

Rob Bailey

Partner, Insurance & Asset Management, Oliver Wyman
rob.bailey@oliverwyman.com

Contributors

Marsh

Beverley Adams, Nick Faull, Melissa Leuck, Tom Marković

Guy Carpenter

Ruth Lux

Oliver Wyman

Jessica Koh

Marsh McLennan Advantage

Richard Smith-Bingham, Lucy Nottingham, Daniel Kaniewski, Sydney Hedberg

Designed by

Tezel Lim

Marsh McLennan (NYSE: MMC) is the world's leading professional services firm in the areas of risk, strategy and people. The Company's 78,000 colleagues advise clients in 130 countries. With annual revenue over $18 billion, Marsh McLennan helps clients navigate an increasingly dynamic and complex environment through four market-leading businesses. *Marsh* provides data-driven risk advisory services and insurance solutions to commercial and consumer clients. *Guy Carpenter* develops advanced risk, reinsurance and capital strategies that help clients grow profitably and pursue emerging opportunities. *Mercer* delivers advice and technology-driven solutions that help organizations redefine the world of work, reshape retirement and investment outcomes, and unlock health and well being for a changing workforce. *Oliver Wyman* serves as a critical strategic, economic and brand advisor to private sector and governmental clients.

For more information, visit *mmc.com*, follow us on *LinkedIn* and *Twitter* or subscribe to *BRINK*.