Destination Water Risk Index

2nd edition, March 2023

The *Destination Water Risk Index* (DWRI) is a joint initiative of Greenview, the Sustainable Hospitality Alliance, STR, a CoStar Group Company and Ecolab.

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1.0 Executive summary

Water scarcity is a pressing issue that has consistently ranked among the top ten global risks. Hospitality businesses should take this into account in their business strategies and operations as they're in a high-use industry and the potential for lack of water to impact negatively on them is high.

The *Destination Water Risk Index* was created to:

- help the hotel industry **understand the water-related risks** where they are located
- **incorporate water-related risks into their strategies** to grow sustainably, responsibly and intelligently.

Four locations

have very high water-related risks

13%

of all destinations assessed have very high / high water risk

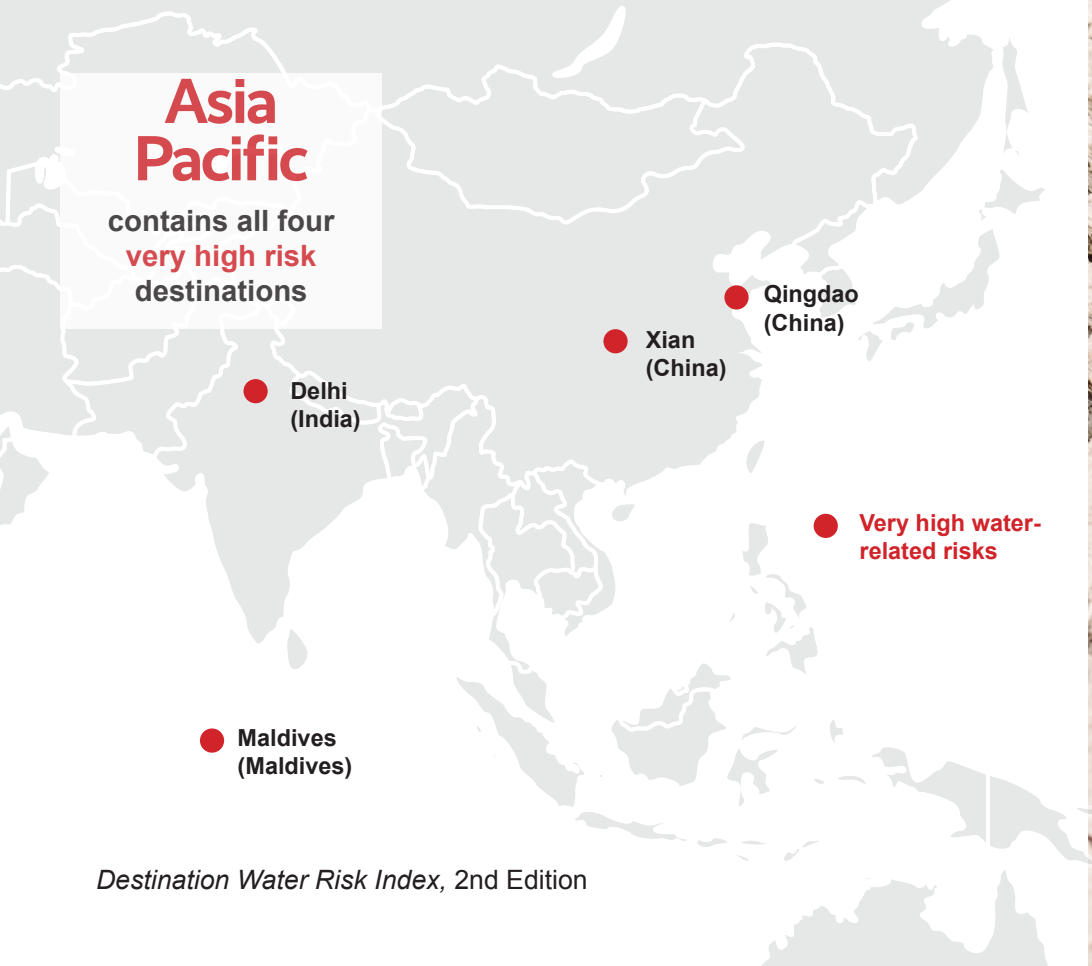
The *Destination Water Risk Index* (2nd edition) has highlighted:

90%
Middle East and Africa destinations assessed have very high / high risk

33%
Asia Pacific destinations assessed have very high / high risk

4%
Europe destinations assessed have very high / high risk

2%
Americas destinations assessed have very high / high risk



Full results can be found in the Key Findings section.

2.0 Introduction

2.1 The importance of water risks

Water scarcity is a pressing issue that has consistently ranked among the top ten global risks[1]. A quarter of the world's population already face "extremely high" levels of water stress, and this leaves them highly vulnerable to the impact of drought or increases in water use[2]. Lack of water may severely affect businesses and local communities in a variety of ways, including increased costs of water and food, political and economic instability, reputational loss, and a reduction in revenue[3].

While global water consumption by the tourism industry may be lower than other water-intensive sectors, consumption in particular tourism destinations is substantial in comparison to the usage of the local population. In some locations, tourism uses over eight times more water per person than the local population[4].

As well as being a high-use industry, the potential for lack of water to impact negatively on hospitality businesses is high. Water is often undervalued in its utility pricing in comparison to its relative availability[5]. This presents the risk of future cost rises, which could be even more pressing for hotels as destinations seek controls and pricing based on sectoral consumption. Likewise, the growth in hotel supply in a destination may further press the water resources and result in regulation. The industry is already seeing water scarcity impact revenues, for instance, the 2018 crisis in Cape Town led to a $65 million loss in tourism revenue[6].

A quarter of the world's population face "extremely high" levels of water stress

The hotel industry has an opportunity to respond to this by showing that it can grow sustainably, responsibly, and intelligently. By planning smart and inclusive growth, safeguarding freshwater resources in the communities where they operate, and contributing to their long-term availability, hotel companies can use tourism growth to bring positive change for their guests, staff and local stakeholders.

1. World Economic Forum (2023), *Global Risks Report 2023*, www.weforum.org/globalrisks
2. World Resources Institute (2019), *17 Countries, Home to One-Quarter of the World's Population, Face Extremely High Water Stress*, www.wri.org
3. WWF (2009), *Understanding Water Risk*, https://assets.wwf.org.uk/
4. Sustainable Hospitality Alliance (2018), *Water Stewardship for Hotel Companies*, www.sustainablehospitalityalliance.org
5. Ecolab Smart Water Navigator (2023), https://smartwaternavigator.com
6. IOL (2018), *Water crisis leaves R1bn hole in tourism coffers*, www.iol.co.za

2.2 About the *Destination Water Risk Index*

Objectives

The *Destination Water Risk Index* (DWRI) was created to provide an insight on the importance of water risk management and identify high risk destinations, thereby helping to navigate the hotel industry in managing its water consumption and conservation.

It consolidates water and associated risk data from various primary sources, to enable the hotel industry to understand how water risks relate in practical terms, and to proactively address them.

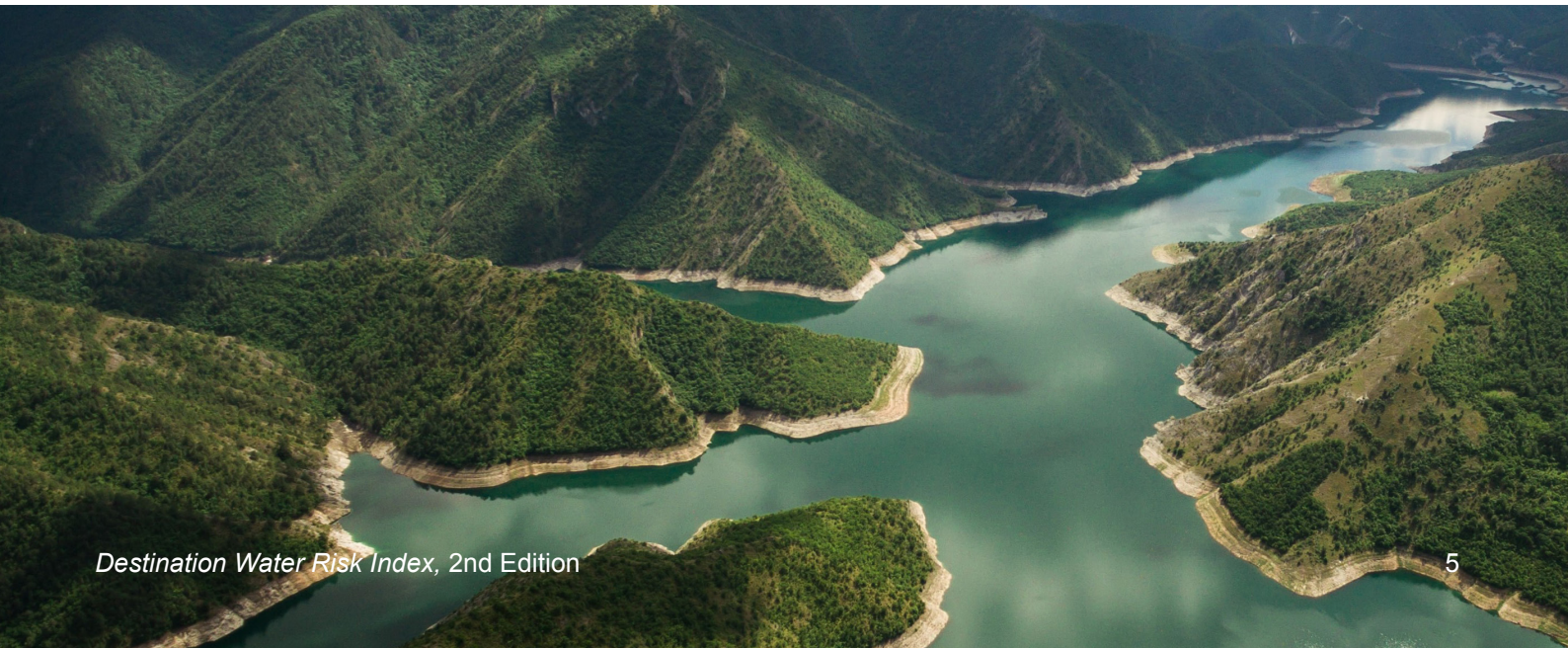
The DWRI has three key objectives:

- **To help hotel companies prioritise action on water scarcity** in risk destinations and implement water stewardship strategies in their hotel developments and operation.
- **To encourage the industry to take collective action** in high-risk destinations, to address current and future local water scarcity in their properties and within the communities in which they operate.
- **To call the attention of the wider tourism industry** and its stakeholders including the national and local governments to water scarcity in these destinations and the need to take proactive and collective action to avoid many more water crisis situations.

Who is it for?

The DWRI seeks to help hotel owners, operators, and their stakeholders to better understand and evaluate water risks and their implications. It is designed to provide evidence and rationale to prioritise water conservation in capital allocation, development and renovation decisions, and operational focus in high-risk destinations.

It can be used by hotel companies to set context-based targets and build the business case for making investments in solutions, including those which go beyond site-based efficiency towards community-based developments, to ensure truly sustainable water management.



3.0 Key findings

The *Destination Water Risk Index* incorporates nine risk metrics categorised by three types of risk: **physical**, **financial** and **market**. (See Methodology for full details.)

- **Physical risk**
  Physical risk accounts for the quantity of available water, whether too little or too much water.
- **Financial risk**
  Financial risk assesses the potential impact of water risks on revenue and operating costs.
- **Market risk**
  Market risk accounts for the impact of tourism market conditions on water risks.

Summarised findings are included in this report for the highest risk categories and destinations. The full data set of each destination are freely available for public use. To receive the data set, please email support@greenviewportal.com with the request.

3.1 Risk by destination

Very high risk destinations

Destination	Country	Region	Physical risk	Financial risk	Market risk
Delhi	India	Asia Pacific	Very high	Very high	Very high
Maldives	Maldives	Asia Pacific	Very high	Very high	Moderate
Qingdao	China	Asia Pacific	High	Very high	High
Xian	China	Asia Pacific	High	Very high	Very high

Table 1: Destinations with very high risk

- Delhi has a very high risk in the baseline water stress and seasonal variability (Physical risk) as well as risk of revenue loss (Financial risk) in a very highly populated location (Market risk).
- The Maldives has a very high risk for all metrics under the Physical and Financial risks, and significant dependency of tourism industry to the country's GDP (Market risk).
- Qingdao and Xian, China, are both facing a very high risk of the baseline water stress (Physical risk), risk of revenue loss and very high water intensity (Financial risk) in a very highly populated location (Market risk).
- All these very high risk destinations are located in the Asia Pacific region.

High risk destinations

Destination	Country	Physical risk	Financial risk	Market risk
Americas				
Honolulu, HI	United States	Very high	Very high	Moderate
Los Angeles, CA	United States	High	High	Moderate
Monterrey	Mexico	High	High	High
Phoenix, AZ	United States	Moderate	Very high	High
Santiago	Chile	High	High	Moderate
Asia Pacific				
Adelaide	Australia	High	High	High
Ahmedabad	India	Very high	Very high	High
Bangkok	Thailand	Moderate	High	Very high
Beijing	China	High	Very high	High
Bengaluru	India	Moderate	High	High
Chennai	India	High	Very high	Moderate
Dalian	China	Moderate	Very high	High
Goa	India	Moderate	Very high	Moderate
Greater Zhengzhou	China	High	Very high	Very high
Hangzhou	China	Moderate	Very high	Very high
Hyderabad	India	Moderate	Very high	Moderate
Jinan	China	High	High	Very high
Manila	Philippines	Moderate	High	Very high
Melbourne	Australia	Moderate	Very high	Very high
Mumbai	India	Moderate	Very high	High
Shanghai	China	Moderate	Very high	High
Shenyang	China	Moderate	Very high	High
Shenzhen	China	Very Low	Very high	Very high
Suzhou-Wuxi-Changzhou	China	Moderate	Very high	Very high
Tianjin	China	Moderate	Very high	Very high
Yinchuan	China	High	Very high	High
Europe				
Athens	Greece	Moderate	Very high	High
Tbilisi	Georgia	High	High	Very high

Table 2: Destinations with high risk (continues overleaf)

High risk destinations, continued

Destination	Country	Physical risk	Financial risk	Market risk
Middle East & Africa				
Abu Dhabi	United Arab Emirates	High	Very high	Moderate
Algiers	Algeria	High	Very high	Moderate
Al Khobar	Saudi Arabia	Moderate	Very high	Moderate
Amman	Jordan	High	Very high	Moderate
Ankara	Turkey	High	Very high	Very high
Cape Town	South Africa	Moderate	Very high	Moderate
Casablanca	Morocco	High	Very high	High
Doha	Qatar	Moderate	Very high	High
Dubai-Sharjah-Ajman	United Arab Emirates	High	Very high	High
Istanbul	Turkey	High	Very high	Very high
Jeddah	Saudi Arabia	Low	Very high	Very high
Kuwait	Kuwait	Moderate	Very high	Moderate
Makkah	Saudi Arabia	Low	Very high	Very high
Marrakech	Morocco	High	Very high	Moderate
Muscat	Oman	Moderate	Very high	Moderate
Riyadh	Saudi Arabia	Moderate	Very high	Very high
Tunis	Tunisia	High	Very high	High

Table 2 (continued): Destinations with high risk

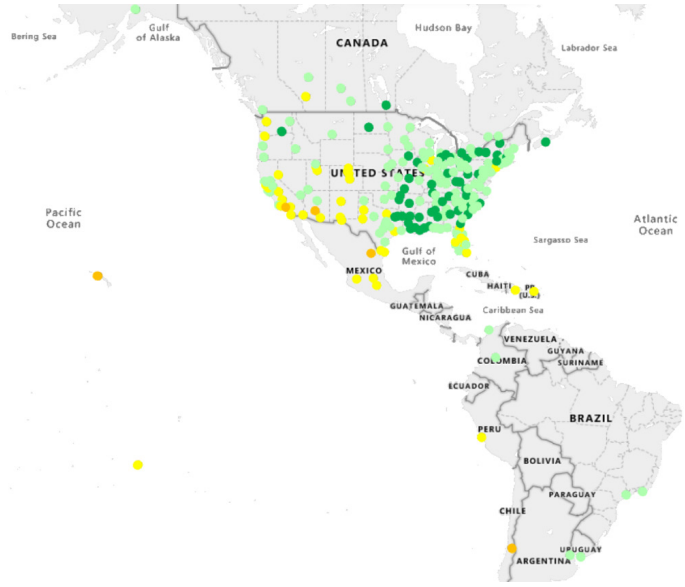
- Financial risk is very high or high for almost all destinations in the above list.
- Physical risk is predominantly within the range of moderate and high. Only two destinations, Hawaii and Ahmedabad have very high physical risk.
- Market risk for the above destinations range from moderate to very high, with the highest risk seen in Bangkok, Manila, Melbourne, a significant number of destinations in China, Tbilisi in Georgia, Ankara and Istanbul in Turkey and Jeddah, Makkah and Riyadh in Saudi Arabia.
- The majority of high-risk destinations are found in Asia Pacific (21) and Middle East & Africa (17) with relatively few in Europe (2) and the Americas (5).

Further analysis by the individual metric of the respective risk types is provided under the Risk Types section.

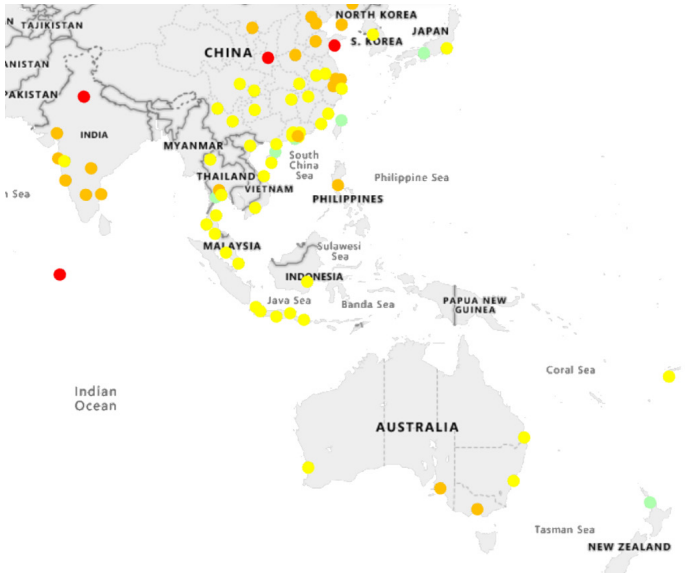
3.2 Risk by region

The heat maps below show the total risk score (index) by region for all destinations in the data set.

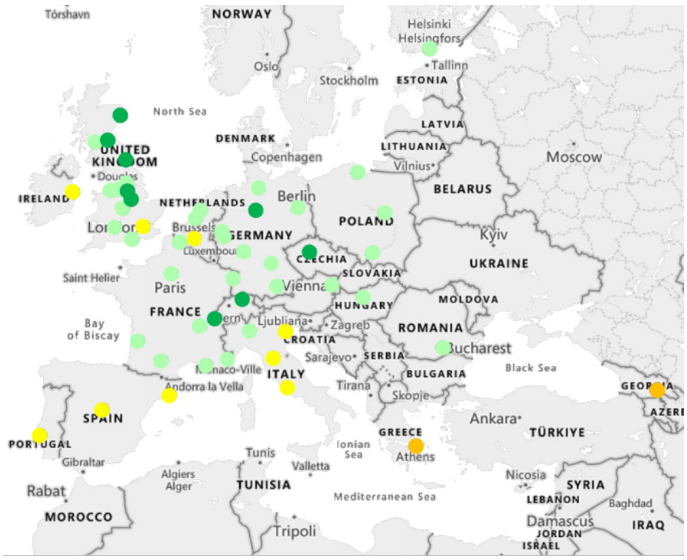
Americas (233 destinations)



Asia Pacific (75 destinations)



Europe (52 destinations)



Middle East & Africa (19 destinations)

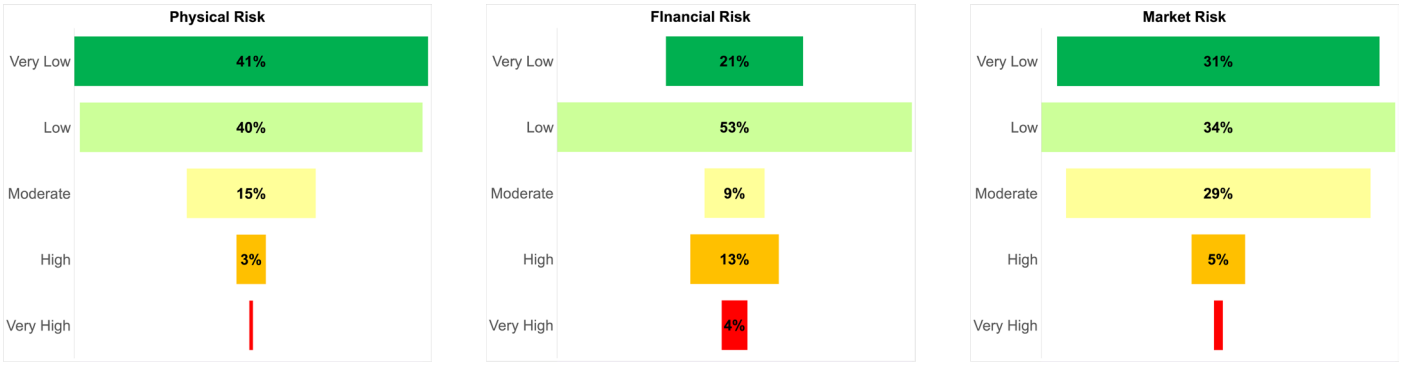
Colour code	Risk index	DWRI score threshold
	1 – Very low	<16.8
	2 – Low	>16.8 and <23.6
	3 – Moderate	>23.6 and <30.4
	4 – High	>30.4 and <37.2
	5 – Very high	>37.2

Graph 1: Heat map of risk by region

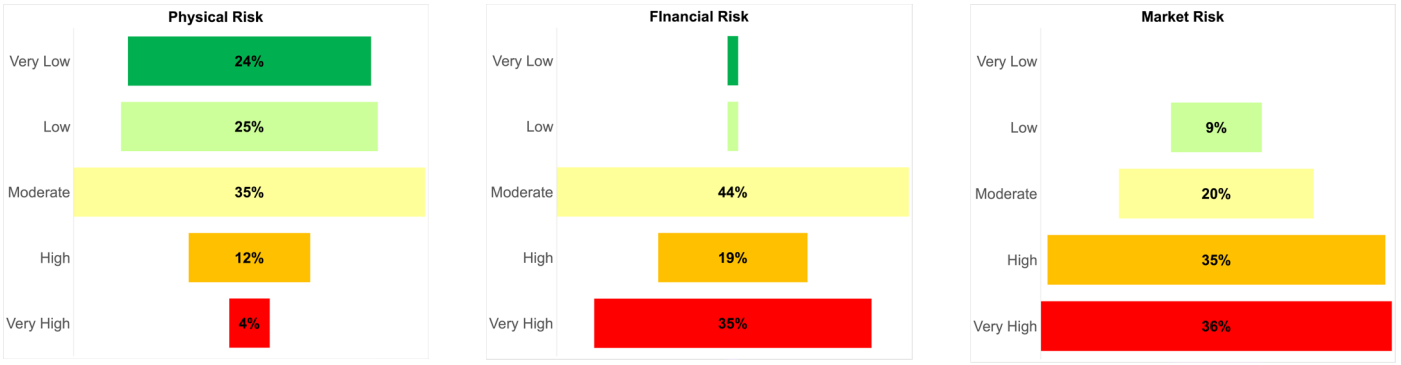
3.3 Risk by region and risk type

The following graphs show the distribution of the risk index from for each risk type within the respective regions.

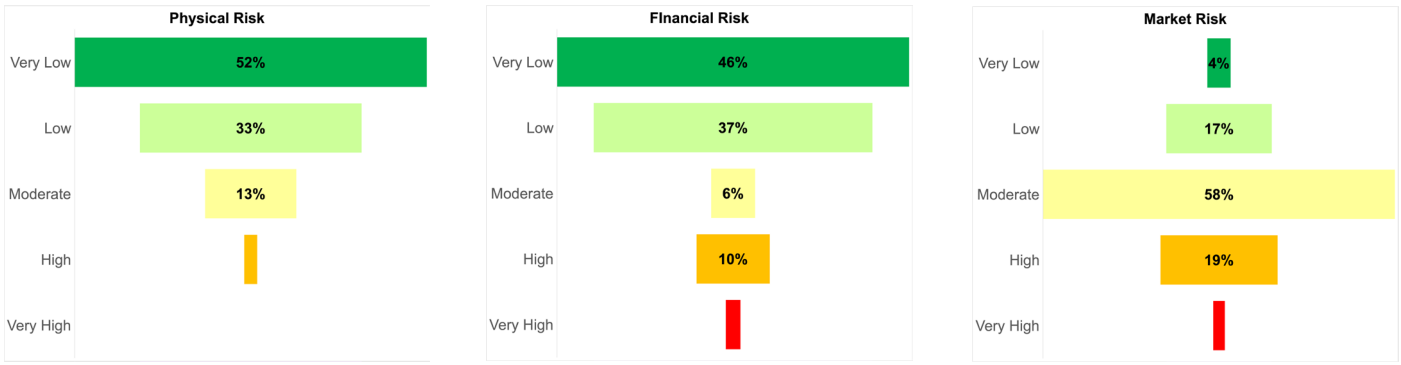
Americas (233 destinations)



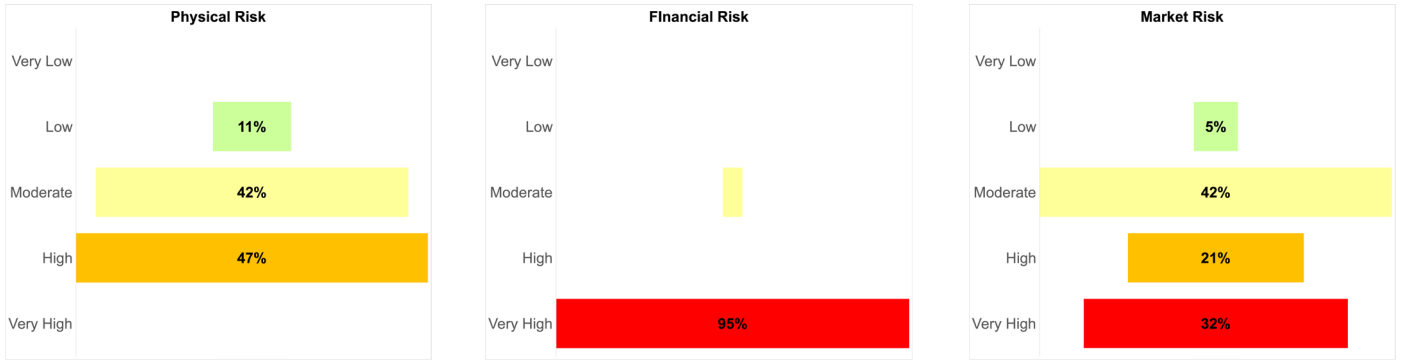
Asia Pacific (75 destinations)



Europe (52 destinations)



Middle East & Africa (19 destinations)



Graph 2: Risk by region and type

Physical risk: quantity of available water, whether too little or too much.

Financial risk: potential impact of water risk on revenue and operating costs.

Market risk: impact of tourism market conditions on water risks.

- All destinations in the Americas were seen to have very low to moderate risks, with the majority classified as low or very low.
- Most Asia Pacific destinations have moderate to high risks. Overall, the region presents significant percentages of very high level in both Financial and Market risks.
- In Europe, the majority of destinations were found to have very low or low risks. However, it is worth noting that nine destinations present a moderate risk (Barcelona, Brussels, Dublin, Lisbon, London, Madrid, Rome, Venice, and Florence).
- The Middle East and Africa region showed a high portion of destinations with high/very high risk in both Physical and Market risks and severely high in Financial risk. This is likely due to the typically arid conditions with low rainfall. Based on the total score, all destinations in the region are high risk except for Cairo, Egypt and Manama, Bahrain which have a moderate risk.

3.4 Destinations per risk type

Physical risk

The quantity of available water, whether too little or too much water

Destinations listed in Table 3 were identified to have a very high Physical risk. They are destinations which are expected to experience a significant water stress now and in the future periods, arising from the competing demand in water usage and natural and seasonal variations in supply.

Destination	Country	Region
Ahmedabad	India	Asia Pacific
Delhi	India	Asia Pacific
Honolulu, HI	United States	Americas
Maldives	Maldives	Asia Pacific

Table 3: Destinations with very high Physical risk

Financial risk

The potential impact of water risks on revenue and operating costs

Destinations listed in Table 4 below were determined to have very high level of the Financial risk. They are destinations with a higher likelihood of increased costs based on the current water consumption trends and the effect of future physical water stress, as well as potential loss to revenue due to inability to meet quantity and quality water demand in operation.

These destinations are primarily located in the Asia Pacific and Middle East & Africa regions with multiple locations in the Americas and one in the Europe.

Destination	Country	Region
Abu Dhabi	United Arab Emirates	Middle East & Africa
Ahmedabad	India	Asia Pacific
Al Khobar	Saudi Arabia	Middle East & Africa
Algiers	Algeria	Middle East & Africa
Amman	Jordan	Middle East & Africa
Ankara	Turkey	Middle East & Africa
Athens	Greece	Europe

Table 4: Destinations with very high Financial risk (continues overleaf)

Destination	Country	Region
Bakersfield, CA	United States	Americas
Beijing	China	Asia Pacific
Cape Town	South Africa	Middle East & Africa
Casablanca	Morocco	Middle East & Africa
Chennai	India	Asia Pacific
Dalian	China	Asia Pacific
Delhi	India	Asia Pacific
Doha	Qatar	Middle East & Africa
Dubai-Sharjah-Ajman	United Arab Emirates	Middle East & Africa
Fiji	Fiji	Asia Pacific
Fort Collins, CO	United States	Americas
French Polynesia	French Polynesia	Europe
Goa	India	Asia Pacific
Greater Zhengzhou	China	Asia Pacific
Hangzhou	China	Asia Pacific
Hong Kong, China	China	Asia Pacific
Honolulu, HI	United States	Americas
Hyderabad	India	Asia Pacific
Istanbul	Turkey	Middle East & Africa
Jeddah	Saudi Arabia	Middle East & Africa
Kuwait	Kuwait	Middle East & Africa
Las Cruces, NM	United States	Americas
Makkah	Saudi Arabia	Middle East & Africa
Maldives	Maldives	Asia Pacific
Manama	Bahrain	Middle East & Africa
Marrakech	Morocco	Middle East & Africa
Melbourne	Australia	Asia Pacific
Mumbai	India	Asia Pacific
Muscat	Oman	Middle East & Africa
Ningbo	China	Asia Pacific
Phoenix, AZ	United States	Americas
Qingdao	China	Asia Pacific
Riyadh	Saudi Arabia	Middle East & Africa
San Diego, CA	United States	Americas
San Juan–Caguas–Guaynabo	Puerto Rico, USA	Americas
Shanghai	China	Asia Pacific
Shenyang	China	Asia Pacific
Shenzhen	China	Asia Pacific
Singapore	Singapore	Asia Pacific
Suzhou-Wuxi-Changzhou	China	Asia Pacific
Taipei	Taiwan	Asia Pacific
Tianjin	China	Asia Pacific
Tokyo	Japan	Asia Pacific
Tucson, AZ	United States	Americas
Tunis	Tunisia	Middle East & Africa
Xian	China	Asia Pacific
Yinchuan	China	Asia Pacific

Table 4 (continued): Destinations with very high Financial risk

Market risk

The impact of tourism market conditions on water risks

These destinations are foreseen to have a very high Market risk.

They are predominantly in the Asia Pacific, with a few in the Middle East & Africa and the Americas and one in Europe.

Destination	Country	Region
Ankara	Turkey	Middle East & Africa
Bangkok	Thailand	Asia Pacific
Cairo	Egypt	Middle East & Africa
Changsha	China	Asia Pacific
Danang	Vietnam	Asia Pacific
Delhi	India	Asia Pacific
Foshan	China	Asia Pacific
Fuzhou	China	Asia Pacific
Greater Zhengzhou	China	Asia Pacific
Guiyang	China	Asia Pacific
Hangzhou	China	Asia Pacific
Hanoi	Vietnam	Asia Pacific
Hefei	China	Asia Pacific
Ho Chi Minh City	Vietnam	Asia Pacific
Huizhou	China	Asia Pacific
Istanbul	Turkey	Middle East & Africa
Jeddah	Saudi Arabia	Middle East & Africa
Jinan	China	Asia Pacific
Kunming	China	Asia Pacific
Lima	Peru	Americas
Makkah	Saudi Arabia	Middle East & Africa
Manila	Philippines	Asia Pacific
Melbourne	Australia	Asia Pacific
Miami, FL	United States	Americas
Nanchang	China	Asia Pacific
Nanjing	China	Asia Pacific
Ningbo	China	Asia Pacific
Riyadh	Saudi Arabia	Middle East & Africa
Shenzhen	China	Asia Pacific
Suzhou-Wuxi-Changzhou	China	Asia Pacific
Tbilisi	Georgia	Europe
Tianjin	China	Asia Pacific
Wuhan	China	Asia Pacific
Xian	China	Asia Pacific
Zhanjiang-Maoming-Yangjiang	China	Asia Pacific
Zhuhai-Zhongshan- Jiangmen	China	Asia Pacific

Table 5: Destinations with very high Market risk

4.0 Taking action

The *Destination Water Risk Index* provides a unique analysis on water risk in key markets, by factoring multiple datasets (see Methodology).

Risk type	Metric
Physical risk	Baseline water stress
	Seasonal variability
	Future water stress
Financial risk	Incoming risk likelihood
	Revenue at risk
	Water intensity litres per occupied room (OCRM)
Market risk	Hotel pipeline % of supply
	Population
	Tourism contribution as a % of GDP

The results can therefore be used to inform a water stewardship strategy and complement any existing water risk assessment, using sector-specific information.

The following provides insights from the different perspectives of hotel owners and operators, respectively. Ultimately, collective participation and collaboration is important to achieve better results.

4.1 Owner – development, governance and reporting teams

When determining locations for hotel development, the following metrics should be considered to understand the potential risks of planned future hotel growth:

- hotel pipeline % of supply
- future water stress
- revenue at risk, and
- population

This will be of particular importance in water stressed areas where management of demand and supply is critical. Destinations with moderate and higher risk level for the above metrics have a high tendency of being impacted by future cost increases. Additional properties built in these markets may face increased local water stress in the future. Their operational costs will likely increase with potential loss in revenue due to future water shortages, national or local regulatory and reputational risk, and changes in national or local water tariffs. These destinations include:

- Ahmedabad, Delhi, Goa, and Mumbai in India
- Adelaide, Melbourne, and Sydney in Australia
- Greater Zhengzhou, Hangzhou, Jinan, Suzhou-Wuxi-Changzhou, Xian, and Yinchuan in China
- Denver, Phoenix, and Salt Lake City, United States
- Algiers, Ankara, Casablanca, Doha, Dubai-Sharjah-Ajman, Jeddah, Istanbul, Makkah, Muscat, and Tunis in the Middle East & Africa region
- Others – Jakarta, Indonesia, Monterrey, Mexico and Tbilisi, Georgia

Development teams should also make water stress a key factor in their planning and development process for destinations with a lower predicted growth (based on hotel pipeline % of supply) but a moderate to very high-risk levels for the other factors. This includes Abu Dhabi, Amman, Athens, Chennai, Dalian, Marrakech, Qingdao, Santiago, Shanghai, Singapore and Tucson, Arizona.

Building design should incorporate high-efficiency water systems (such as low-flow showers, toilets, taps, etc.) and water-saving features (such as an automatic rigid pool cover, automatic sprinklers etc.). Continuous monitoring of risk exposure from consumption, as well as planning for diversification in destinations within the portfolio to minimise the risk exposure, can be considered. The latter may not address the water risk specifically, but it may help in managing the overall business risk.

4.2 Operator – General managers, engineering and operations teams

Regular monitoring of water consumption and an action plan for improvement is essential, particularly in destinations with high and very high risks in the following metrics:

- baseline water stress
- incoming risk
- water intensity litres per OCRM, and
- population

This applies worldwide, however results indicate that the practice can still be improved, particularly for hotels in these destinations:

- Multiple locations in China namely Beijing, Greater Zhengzhou, Hangzhou, Jinan, Qingdao, Shanghai, Shenyang, Suzhou-Wuxi-Changzhou, Xian, and Yinchuan
- Ahmedabad, Bengaluru, Chennai, Delhi, Hyderabad, and Pune in India
- Abu Dhabi, Algiers, Amman, Cape Town, Riyadh, Kuwait, and Tunis in the Middle East & Africa region

Advanced water management best practices are recommended in all destinations to manage water usage efficiently and avoid being impacted by future water related costs. These include rainwater capture, grey water reuse, native or drought tolerant landscaping, leak detecting for water piping or toilet tanks and water sub-metering practice.

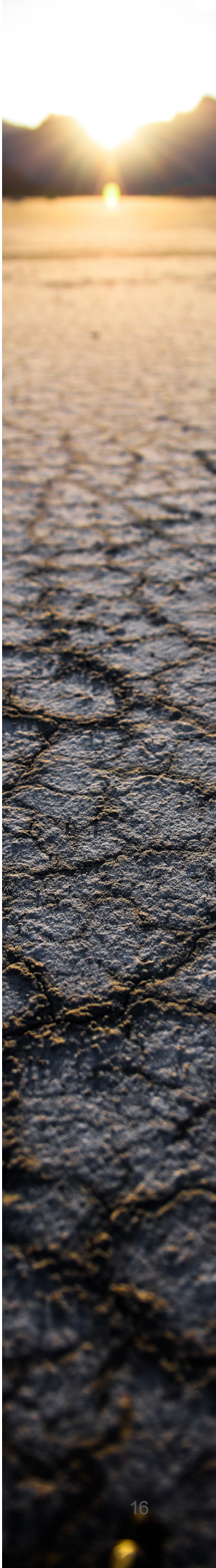
5.0 Resources for sustainable water management

The *Pathway to Net Positive Hospitality*[7] is a live resource and guidance launched by the Sustainable Hospitality Alliance to enable every hotel to advance its positive impact, regardless of size, starting point, or location.

The Pathway sets out the key ambitions and milestones for various sustainability issues, including water-related ones, and provides guidance for owners, operators and brands to understand and manage their impacts in a more sustainable manner.

Here is a section of tools and resources for hotels to support the implementation towards Net Positive Hospitality.

- *Environmental Action Planner* (download) – serves as an action plan tool that contains various initiatives that can be implemented to improve the water stewardship of hotel properties and can be used to track progress on actions.
- *Resources Map* (download) – brings together various resources and tools which can support hotels in their efforts to manage their impacts more sustainable and work towards becoming net positive. Water-related resources include the following:
    - *Green Lodging Trends Report* – a global benchmarking study on sustainability best practices in hotels. The *Green Lodging Trends Report* (GLTR) assesses and benchmarks sustainable best practices and highlights green initiatives across properties worldwide. The results allow a more practical understanding of current water management practices in the destinations identified in this report and can help identify how current gaps between risks and practices can be closed.
    - *Hotel Water Measurement Initiative* (HWMI) – a methodology and tool to calculate the water use in hotels.
    - *Water Risk Assessment* – a report which provides an overview of the possible impacts the industry could suffer due to shifts in the availability of quality water sources and recommends key action areas for the hotel industry to preserve freshwater resources.
    - *Water Stewardship Factsheet* – a factsheet which explores the issues of water risk and provides recommendations on how to reduce impacts on hotel operations and local supply.
    - *Water Stewardship for Hotel Companies* – a report which recommends six steps every hotel should take to better manage their impact on water, with guidance on setting targets, managing water use, working with supply chain, and collaborating for maximum impact.



7. Sustainable Hospitality Alliance (2023), *Pathway to Net Positive Hospitality v.2.0*, www.sustainablehospitalityalliance.org

6.0 Annex

6.1 Methodology

2023 data set and updates

The *Destination Water Risk Index* was initially created in 2018. The following updates have been included in this second edition:

- Addition of new metrics to the composite index – population and tourism contribution as a % of GDP.
- Inclusion of more robust hotel supply and pipeline data across hundreds of destinations globally (provided by STR, a CoStar Group Company) resulting in a five-fold increase in available destinations to index, with 379 total (up from 68 in the first edition).
- Categorisation of risks into three types – physical, financial and market – to ease understanding, application, and assessment.
- Updates to the water usage intensity data with the latest available Cornell Hotel Sustainability Benchmarking Index (CHSB) based on 2021 calendar year data set.
- Modification of the financial risk metrics provided by Ecolab's Smart Water Navigator.
- Updates to the water risk metrics from the WRI's Aqueduct Water Risk Atlas tool based on version 3.0, released by WRI in 2019, which provides more granular spatial data results.

Summarised findings are included in this report for the highest risk categories and destinations. The full data set of each destination's composite score and the three tiers of sub-categories are freely available for public use. To receive the data set, please email support@greenviewportal.com with the request.

Data set

Destinations for inclusion in the *Destination Water Risk Index* were selected based on availability of data for all metrics. A total of 379 destinations across 63 countries are included in this edition.

Americas		Asia Pacific		Europe		Middle East & Africa	
Country	Destinations	Country	Destinations	Country	Destinations	Country	Destinations
Argentina	1	Australia	5	Austria	1	Algeria	1
Brazil	2	China	33	Belgium	1	Bahrain	1
Canada	11	Fiji	1	Czech Republic	1	Egypt	1
Chile	1	Hong Kong China	1	Finland	1	Jordan	1
Colombia	2	India	8	France	8	Kuwait	1
Costa Rica	1	Indonesia	5	Hungary	1	Morocco	2
Dominican Republic	1	Japan	2	Georgia	1	Oman	1
French Polynesia	1	Kazakh-stan	1	Germany	8	Qatar	1
Mexico	4	Macau, China	1	Greece	1	Saudi Arabia	4

Table 6: Destinations included in the Destination Water Risk Index (continues overleaf)

Americas		Asia Pacific		Europe		Middle East & Africa	
Country	Destinations	Country	Destinations	Country	Destinations	Country	Destinations
Panama	1	Maldives	1	Ireland	1	South Africa	1
Peru	1	Malaysia	2	Italy	4	Tunisia	1
Puerto Rico	1	New Zealand	1	Nether-lands	2	Turkey	2
Uruguay	1	Philippines	1	Poland	3	United Arab Emirates	2
United States	205	South Korea	1	Portugal	1		
		Singapore	1	Romania	1		
		Taiwan	1	Spain	2		
		Thailand	7	Switzerland	2		
		Vietnam	3	United Kingdom	13		

Table 6 (continued): Destinations included in the Destination Water Risk Index

Data sources

The *Destination Water Risk Index* incorporates nine risk metrics categorised by three types of risk: physical, financial and market. Data was collected from the following primary sources:

Risk type	Metric	Primary data source
Physical risk	Baseline water stress	World Resources Institute's Aqueduct Water Risk Atlas 3.0, 2019
	Seasonal variability	
	Future water stress	
Financial risk	Incoming risk likelihood	Ecolab's Smart Water Navigator, September 2022
	Revenue at risk	
	Water intensity litres per occupied room (OCRM)	Cornell Hotel Sustainability Benchmarking Index (CHSB) 2023
Market risk	Hotel pipeline % of supply	STR, a CoStar Group Company, 2021
	Population	Tourism Economics, April 2022
	Tourism contribution as a % of GDP	World Travel & Tourism Council (WTTC), 2019

Table 7.1: Risk metrics and data sources

Metrics, definitions, and sources

Metric	Definition	Primary data source
Baseline water stress	Measures the ratio of total annual water withdrawal to mean of available blue water. Baseline water stress measures the level of competition for available water and estimates the degree to which freshwater availability is an ongoing concern.	World Resources Institute's Aqueduct Water Risk Atlas
Seasonal variability	Estimates the coefficient of variation between the mean total blue water for each of the 12 months of the year. Seasonal variability represents a measure of the unpredictability of supply, by providing information on water supply variability within a year.	
Future water stress	An indicator of competition for water resources and is defined as the ratio of demand (withdrawal) for water divided by available water (supply). It is also commonly known as the withdrawals-to-availability ratio or relative water demand—for future periods.	
Incoming risk likelihood	The likelihood that a business will realize increased operating costs due to incoming water risk based on baseline water stress, future water stress, inter-annual variability, seasonal variability, national or local regulatory and reputational risk, and historical changes in national or local water tariffs.	Ecolab's Smart Water Navigator
Revenue at risk	Estimates value of the revenue that could potentially be loss due to the impact of water scarcity on operations, forecasted over five years' time horizon.	
Water intensity litres per OCRM	Measures the actual median water usage per occupied room (in litres), comprised of over 20,000 hotels worldwide.	Cornell Hotel Sustainability Benchmarking Index (CHSB)
Hotel pipeline % of supply	Evaluates the estimated future growth (pipeline) in form of number of rooms under the three stages: construction, final planning, and planning stages over the total current number of hotel rooms (supply).	STR, a CoStar Group Company, Hotel Supply and Development
Population	Total population by destination.	Tourism Economics
Tourism contribution as a % of GDP	Measures economic contribution of tourism industry to a city or country's GDP.	World Travel & Tourism Council (WTTC)

Table 7.2: Metrics, definitions and data sources

Risk index

Each of the nine metrics was given a score in the range of 1 (very low risk) to 5 (very high risk). These were then combined, with equal weighting, to create the risk index for each destination.

The following outlines the risk types, the metrics they are comprised of, and the thresholds/ classifications used to derive the risk scores.

Physical risk

Physical risk accounts for the quantity of available water, whether too little or too much water.

- *Baseline water stress* compares annual water withdrawal to mean available blue water. It measures the level of competition for available water and estimates the degree to which freshwater availability is an ongoing concern.
- *Seasonal variability* estimates the coefficient of variation between the mean total blue water for each of the 12 months of the year. It represents a measure of the unpredictability of supply within a year.
- *Future water stress* is an indicator of competition for water resources and is defined as the ratio of demand (withdrawal) for water divided by available water (supply) for future periods.

DWRI score	Baseline water stress classification	Seasonal variability classification	Future water stress classification
1 – Very Low	Low (<10%)	Low (<0.33)	1.4x decrease
2 – Low	Low – Medium (10-20%)	Low – Medium (0.33-0.66)	Near normal
3 – Moderate	Medium – High (20-40%)	Medium – High (0.66-1.00)	1.4x increase
4 – High	High (40-80%)	High (1.00-1.33)	2x increase
5 – Very High	Extremely High (>80%) and Arid and Low Water Use	Extremely High (>1.33)	2.8x or greater increase

Table 8: Physical risk classifications

This edition was prepared using Aqueduct 3.0 which had updated calculation models and data, including increased granularity for water stress metrics from the previous release. As a result, the DWRI risk ratings for several of the original 68 destinations are significantly different from the first edition.

Financial risk

Financial risk assesses the potential impact of water risks on revenue and operating costs.

- *Incoming risk likelihood* is the probability that operating costs will increase due to projected water risks including baseline water stress, future water stress, inter-annual and seasonal variability, national or local regulatory and reputational risk, and historical changes in national or local water tariffs.
- *Revenue at risk* estimates value of revenue that could potentially be lost due hotels' inability to ensure required quantity and quality water supply to meet demand in the operations and is forecast over a five-year time horizon. This metric replaces the water risk premium metric used in the first edition.
- *Water intensity* measures the actual median water usage (litres per occupied room), and is based on CHSB 2023, which contains data from 2021 for more than 20,000 hotels.

DWRI score	Incoming risk likelihood classification	Revenue at risk threshold	Water intensity threshold
1 – Very Low	-	<5%	<350
2 – Low	Low (<30%)	>5% and <15%	>350 and <500
3 – Moderate	Medium (30% - 60%)	>15% and <30%	>500 and <700
4 – High	High (>60%)	>30% and <50%	>700 and <1000
5 – Very High	-	>50%	>1000

Table 9: Financial risk classifications

Market risk

Market risk accounts for the impact of tourism market conditions on water risks.

- *Hotel pipeline % of supply* compares the estimated future growth ("Pipeline" – number of rooms under construction, in final planning, and in planning stages) to the current total number of rooms within the market ("Supply").
- *Population threshold* determines the potential relative impact of current and future hotel supply on the local community. Water demand generally rises as population grows, putting additional pressure on sustainable water management.
- *Tourism contribution as a % of GDP* connects the importance of water management to the economic contribution of the tourism industry. An economy or destination that is more reliant on the tourism industry is more vulnerable to water scarcity.

DWRI score	Hotel pipeline % of supply threshold	Population threshold ('000)	Tourism contribution as a % of GDP
1 – Very Low	<5%	<250	<2.0%
2 – Low	>5% and <10%	>250 and <1000	>2.0% and <2.5%
3 – Moderate	>10% and <20%	>1000 and <2500	>2.5% and <3.5%
4 – High	>20% and <30%	>2500 and <5000	>3.5% and <4.5%
5 – Very High	>30%	>5000	>4.5%

Table 10: Market risk classifications

Limitations and future improvement

Despite an increase of 5.5x (>400%) in destinations since the first edition, these may only be a handful of destinations where tourism is the primary driver of economic activity. It is desirable to continue expanding the number of destinations covered.

The existing assessment of the physical risk is based on the three fundamental metrics of the quantity aspect: baseline water risk, seasonal variability, and future water risk. Additional metrics could be introduced in the future for measuring the quality aspect of physical water risk, subject to the availability of data and while striking a balance with managerial application and summarized outputs that will be used in practice by hotel professionals.

Data sets were drawn from the primary sources, subject to their latest availability, and where necessary, secondary sources might be used. There might be instances where a proxy destination is applied, based on either proximity or country due to limitations in data.

Future outlook

As additional metrics and analyses evolve, the data set and composite index will also be modified to ensure it is aligned with the best available data and approaches to water risk for the tourism sector.

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