ECOLAB
WATER RISK
MONETIZER
POWERED BY **MICROSOFT AND TRUCOST**

SMART WATER MANAGEMENT FOR BUSINESS GROWTH:

Integrating water risk into business decision making

DECEMBER 2019

WHITE PAPER

Acknowledgments

This paper has been prepared by a project team comprising Libby Bernick (Trucost), Steven Bullock (Trucost), Beth Burks (Trucost), Eliza Chlebeck (Ecolab), David Hobson (Trucost) and Emilio Tenuta (Ecolab).

We would like to thank the businesses and expert advisory group members who have dedicated time and resources to this project by pilot testing the Water Risk Monetizer and providing invaluable advice to inform the development of the tool.

While Ecolab and Trucost alone take full responsibility for the content and calculations of the Water Risk Monetizer, the support of these expert advisory group members has helped ensure that our approach to valuing water risk can be integrated into business decision making.

EXPERT ADVISORY GROUP MEMBERS

- **Marianne Balfe,** Director of Energy and Environmental Sustainability, The Americas, Marriott International
- **Dr. Andrew A. Boyd,** Director Environment & Sustainability — Global Engineering & Integrated Supply Chain, Mondelez International
- **Andrew Collins,** Technical Director, Sustainability Accounting Standards Board (SASB)
- **Lindy Farrar,** Research Analyst, Greenview
- **Monika Freyman,** Director, Investor Initiative, Water Program, Ceres
- **Bill Gaines,** Principal Engineer, Ford Motor Company
- **Mark Giordano,** Director of the Program in Science, Technology and International Affairs, Georgetown University
- **Mark Gough,** Executive Director, Natural Capital Coalition
- **Jim Hanna,** Director of Datacenter Sustainability, Microsoft
- **Yvette Harding Griffin,** Sustainability Reporting and Program Manager, Mondelez International
- **Josh Henretig,** Senior Director, Environmental Sustainability, Microsoft
- **Piet Klop,** Senior Advisor Responsible Investment, PGGM
- **Heidi McKenzie,** Manager, Environmental Strategies and NBS, Ford Motor Company
- **Neil Parke,** Senior Consultant Engineer – HSE, Eli Lilly and Company
- **Himani Phadke,** Sustainable Finance Research Director, Sustainability Accounting Standards Board (SASB)
- **Paul Reig,** Senior Associate – Corporate Water Stewardship, World Resources Institute (WRI)
- **Susan Rokosz,** Senior Environmental Engineer, Ford Motor Company
- **Joe Rozza,** Global Manager, Water Sustainability and Natural Capital, The Coca-Cola Company
- **Jim Smith,** Manager, Environmental Programs, Saint-Gobain
- **Hubert Thieriot,** Project Leader – Water Risk Valuation, China Water Risk
- **Katarina Veem,** Director Swedish Water House, Stockholm International Water Institute
- **John Viera,** Global Director, Sustainability and Vehicle Environmental Matters, Ford Motor Company
- **Kari Vigerstol,** Director of Conservation, Water Funds, The Nature Conservancy
- **Charlene Wall-Warren,** Director, Sustainability, BASF
- **Dennis Wilson,** Director, Product Stewardship and Sustainability, Saint-Gobain

ECOLAB
WATER RISK
MONETIZER
POWERED BY MICROSOFT AND TRUCOST

Contents

Executive summary

Water is essential to the production and delivery of nearly all goods and services. Many businesses are reliant on a sufficient flow of clean water to operate and realize their growth ambitions. Over-consumption of water, water pollution, environmental degradation and changing climatic conditions are making clean water an increasingly scarce resource (GIZ, NCD and VfU,[1] 2016). This paper describes the framework behind the Water Risk Monetizer tool and how to use its outputs to address business-critical water risks.

One of the challenges businesses face while considering water risk in growth plans is the current value placed on water, as reflected in market water pricing. In most geographies, there is little correlation between the price paid for water and its availability — in some cases, water is cheapest where it is most scarce. The failure to factor scarcity into water pricing encourages unsustainable water use in locations most at risk. Traditional financial accounting based solely on the market price paid for water provides incomplete information on the value of water to business and underestimates business value at risk from water-related issues (Morgan and Orr, 2015).

To enable continuity and growth, businesses need better information to quantify water-related business value at risk in ways that can be incorporated into existing decision-making frameworks and factored alongside operational costs and revenue forecasts. Several good water frameworks and tools, such as the World Resources Institute (WRI) Aqueduct Tool and the World Wildlife Fund (WWF) Water Risk Filter, provide a good starting point for quantitative and systematic assessments of water risk. However, without monetizing these water risks, it is often difficult for businesses to plan which mitigation projects are most valuable for growth.

The Water Risk Monetizer is a publicly available global water risk assessment tool that uses best-in-class local water basin datasets and scientific methodologies to monetize water-specific business risks. It provides a comprehensive series of metrics to help businesses understand water-related risks by using economic techniques to quantify the risks in financial terms. The Water Risk Monetizer is globally relevant, simple to use and applicable across a wide range of businesses and industries. The output of the tool is credible, actionable information that can be used to help businesses make more informed decisions to protect against water quantity and water quality constraints to growth.

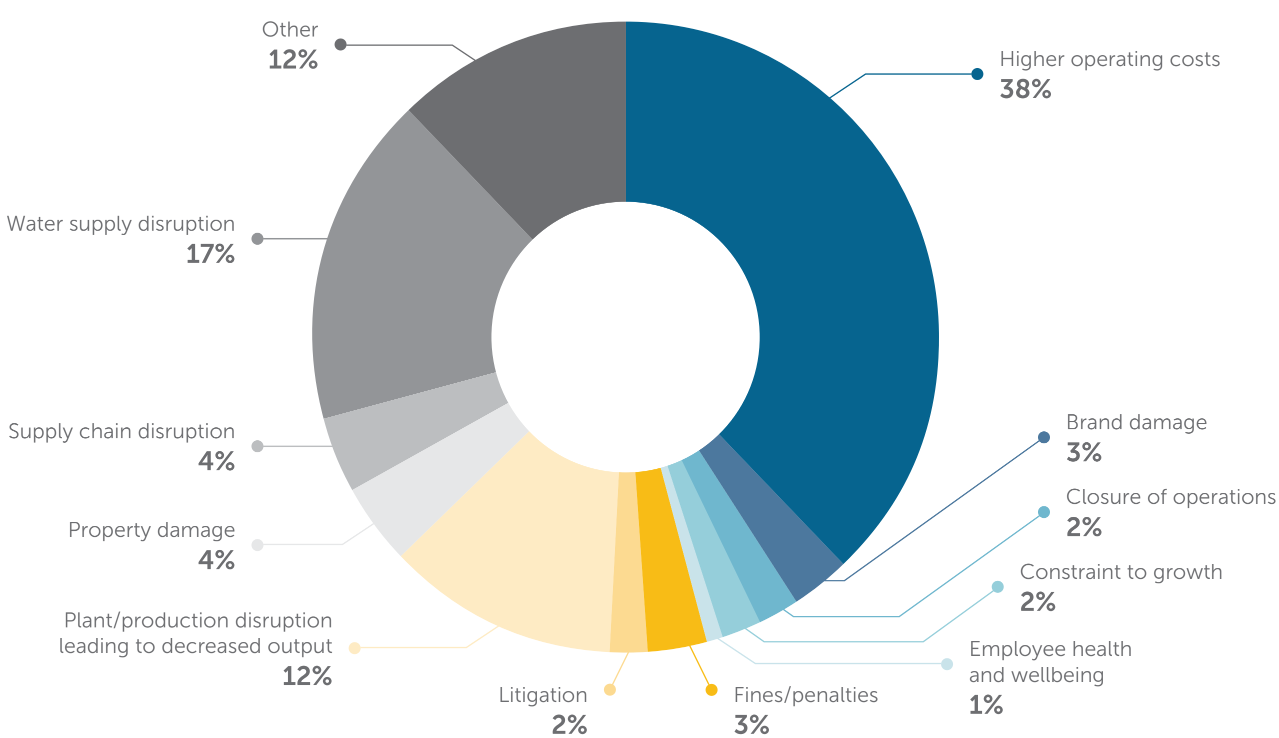
[1] Natural Capital Declaration (NCD), Deutsche Gesellschaft für Internationale Zusammenarbeitand (GIZ) and German Association for Environmental Management and Sustainability in Financial Institutions (VfU).

Why water is a material business issue

As our global population grows and competition for water resources between water-dependent sectors intensifies, we are set to experience a 40 percent shortfall in water by 2030 (UN, 2015). As these demands for clean water increase, water-related expenditure by businesses is rising. In 2016, for example, 607 of the world's largest businesses responding to the CDP's Global Water Program questionnaire reported exposure to water risks totaling more than US$14 billion (CDP, 2016). Most listed companies do not disclose water-related financial risks, and the total unpriced risk is estimated to be US$439 billion (Trucost, 2017). Figure 1 outlines the types of financial impacts relating to water quality within the CDP 2016 survey.

The level of global water scarcity expected in coming years is a function of the compounding impacts of decreasing availability and declining quality, and both factors are now incorporated into the Water Risk Monetizer risk assessment. In order to adapt operations to respond to increasing scarcity, businesses need to rethink the water cycle by shifting our understanding and practices away from water as an inexpensive consumable good toward water as a valuable recyclable asset.

FIGURE 1: Financial impacts of declining water quality and increasing regulatory costs



Source: CDP (2016b)

A 2014 survey of US Fortune 500 corporations indicated that nearly 60 percent of respondents believed water is poised to negatively affect business growth and profitability within five years, and more than 80 percent claimed it would affect their decision on where to locate facilities. This is a stark increase from 2008, when water issues were seen to impact business growth and profitability for less than a fifth of responding businesses (VOX Global/Pacific Institute, 2014).

Mismanagement of water resources can also affect a business's license to operate, increasing its risk profile and ultimately its cost of capital (SASB, 2014). Credit rating agencies and bond investors are duly paying closer attention to corporate water risk disclosures — with S&P Global Ratings (S&P), the world's leading provider of credit ratings, already using environmental, social and governance (ESG) metrics to measure the performance of businesses that have demonstrated superiority across a wide range of ESG factors, including water (S&P, 2016).

FIGURE 2: Water-related risks facing businesses

Risk	How are risks impacting businesses?	Examples
Operational	• Business disruptions due to lack of water • Higher production costs due to decreased availability of clean water	• California's historic drought will cost the state US$2.74 billion and result in the loss of more than 21,000 jobs (US Davis Center for Watershed Sciences, 2015) • Global brewing company SABMiller reported that it may need to relocate its brewing facility in water-stressed Lukasa, Zambia, because of increased competition for water in the area (FT, 2015a)
Legal and regulatory	• More stringent legislation or reduced allocations as regulators anticipate decreasing water quantity and decreasing water quality in local water basins • Fines for water pollution incidents	• UK-based water utilities company Yorkshire Water received a record US$1.5 million (£1.1 million) fine for illegal sewage discharge into a local river (The Guardian, 2016) • Water price increases in Mexico were as high as 300 percent in 2015, and new regulations and fees for allotted water volumes at food manufacturing plants, including those of Kellogg, led to higher operating costs (Ceres, 2015)
Reputational and marketing	• Loss in market share • Inability to access new markets as customers become increasingly concerned with water management issues • Loss of social license to operate due to competition for shared water resources or local water pollution incidents	• Coca-Cola was forced to abandon plans for a US$81 million bottling plant in India's southern state of Tamil Nadu after fierce resistance from local farmers, who feared that the US-based beverage company would use groundwater and cause a precipitous fall in the water table (FT, 2015b) • Nestlé, the world's biggest bottler of water, faced renewed criticism over their groundwater bottling operations in British Colombia, Canada, as wildfires and droughts prompted water bans on residential use in the region (Huffington Post, 2015)
Financial	• Increased financing costs and reduced financing options as market participants demand more transparency on corporate water risk	• Three US municipalities announced issues of green bonds totaling almost US$800 million to finance projects to deliver clean drinking water or treat wastewater (Environmental Finance, 2016) • Morgan Stanley Capital Index Research points out the total value of sales or reserves at risk from water scarcity amount to US$221 billion for All Country World Index (ACWI) goldminers, US$20.7 billion for MSCI US Investable Market Index (IMI) electric utilities and US$17.2 billion for MSCI ACWI steel producers (SIWI, 2014)

Water is undervalued in most regions of the world. The disconnect between market price and water scarcity makes it difficult for businesses to understand the full value of water to their operations. This also makes it challenging to internalize water-related risks in business planning.

Table 1 shows the potential impact of water risks on businesses' profits at a macro-sector level. If the full costs of water availability and water quality impairment had to be absorbed by companies, this would equate to a decline in average profits of 18 percent for the chemical sector, 44 percent for utilities and 116 percent for food and beverage companies (Trucost, 2017).

Table 1: Average company profit margins and external costs of water

Business-as-usual sector performance				Monetized water risk		Risk adjusted sector performance	
Sector	Average revenue, US$ million	Profit, US$ million	Profit margin, %	Monetized water risk, US$ million	Monetized water risk as a % of profit	Risk adjusted profit, US$ million	Profit margin, %
Automobiles & Parts	19,273	1,514	8%	122	8%	1,392	7%
Chemicals	7,393	829	11%	150	18%	679	9%
Construction & Materials	6,922	473	7%	60	13%	413	6%
Food & Beverage	5,760	596	10%	691	116%	-95	-2%
Oil & Gas	16,870	1,330	8%	90	7%	1,240	7%
Personal & Household Goods	6,431	804	13%	85	11%	719	11%
Utilities	7,513	834	11%	370	44%	464	6%

Source: Trucost (2017)

This disconnect between the value and price of water means that it is difficult for businesses to substantiate the business case for investment in strategies that address water risks, set meaningful, context-based targets for water reduction and communicate effectively to customers, investors and other important stakeholders.

Businesses need better information to quantify and monetize water-related business value at risk in order to incorporate water into existing decision-making frameworks and factor water-related risk value alongside operational costs and revenue forecasts.

What is the Water Risk Monetizer?

The Water Risk Monetizer is a publicly available global water risk tool that uses best-in-class local water basin datasets and scientific methodologies to monetize business water risks. Businesses can face incoming water risks if the resource is insufficient in quantity or quality to meet business needs.[2] Businesses can also face quality risks relating to outgoing or discharged water.

The Water Risk Monetizer provides a comprehensive series of risk metrics, as summarized in Table 2, to help businesses understand incoming (quantity and quality) risks and outgoing (quality) risks by using economic techniques to quantify the risks in financial terms. The Water Risk Monetizer is globally relevant, simple to use and applicable across a wide range of businesses and industries. The output of the tool is credible, actionable information that can be used to help businesses make more informed decisions to protect against water quantity and quality constraints to growth. The tool can help businesses select locations for facilities, identify and prioritize water-related projects or investments that deliver the greatest value to the business and make the business case for projects to reduce their reliance on fresh water.

Table 2: The Water Risk Monetizer's metrics on water risk

Financial implication	Type of risk	Metric	Description	To what type of water-related projects does each metric apply?
Increased operating costs	Incoming water risk	Incoming quantity risk premium	Monetary estimate of the potential increased operating costs resulting from incoming water quantity risk per cubic meter of incoming water	Projects focused on reducing incoming water use
		Incoming quality risk premium	Monetary estimate of the potential increased operating costs resulting from incoming water quality risk per cubic meter of incoming water	Projects focused on improving incoming water quality
		Combined incoming risk-adjusted price	Monetary estimate of the potential increased operating costs resulting from incoming water quantity and quality risks combined with the incoming water bill per cubic meter of incoming water	Projects focused on reducing water use, reuse, recycling and improving incoming water quality
		Incoming risk likelihood score	The likelihood of the combined incoming risk-adjusted price (quantity and quality) being realized	Projects focused on reducing incoming water use, water reuse, recycling and/or improving incoming water quality

[2]Please note that other organizations may define water scarcity differently. The Water Risk Monetizer defines scarcity based on both water quantity and quality aspects. In the Water Risk Monetizer, the quantity-related aspect is the Baseline Water Stress metric from the WRI's Aqueduct Tool (WRI, 2019).

Table 2: The Water Risk Monetizer's metrics on water risk (continued)

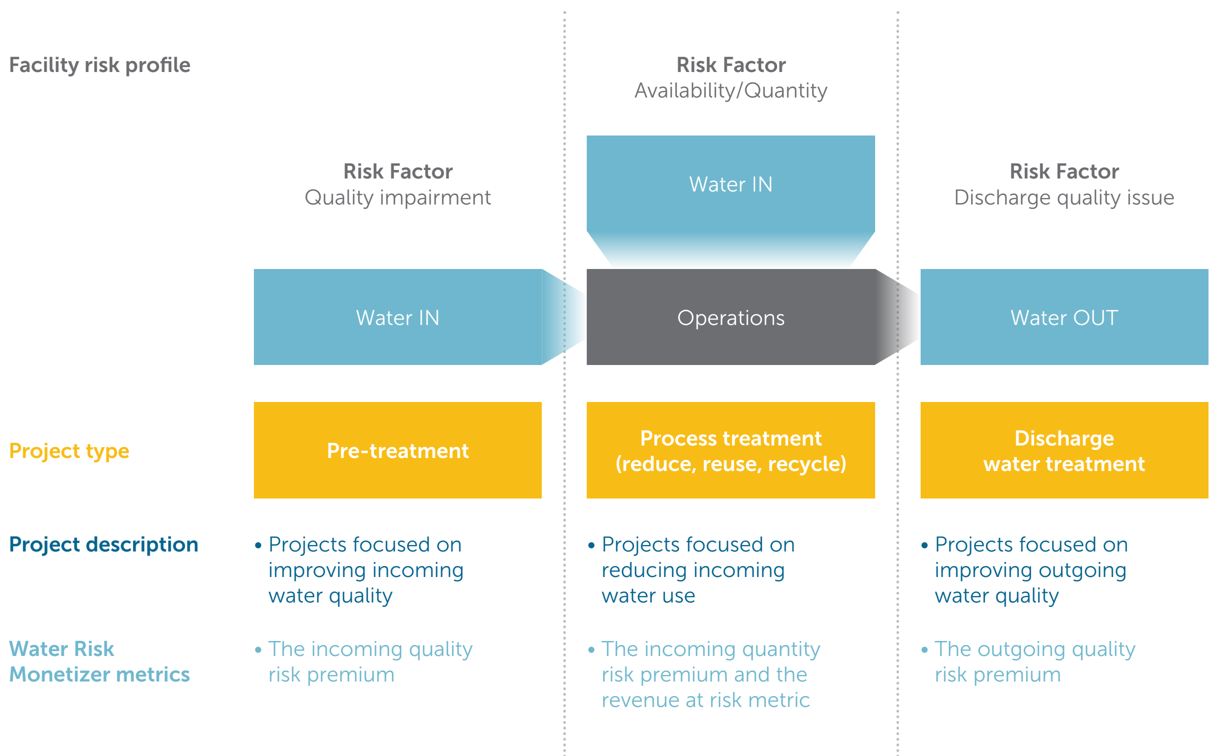
Financial implication	Type of risk	Metric	Description	What type of water-related projects does each metric apply?
Increased operating costs	Outgoing water risk	Outgoing quality risk premium	Monetary estimate of the potential increased operating costs resulting from outgoing water quality risk per cubic meter of outgoing water	Projects focused on improving outgoing water quality
		Combined outgoing risk-adjusted price	Monetary estimate of the potential increased operating costs resulting from outgoing water quality risks combined with the outgoing water bill per cubic meter of outgoing water	
		Outgoing risk likelihood score	The likelihood of the outgoing risk-adjusted price being realized	
Loss of revenue	Incoming water risk	Revenue at risk	Monetary estimate of the potential revenue loss resulting from incoming water quantity risk	Projects focused on reducing incoming water use
		Revenue at risk likelihood score	The likelihood of revenue loss being realized	

Any assessment of water risk needs to consider its magnitude and likelihood. Not all risks are realized by a business, and those that are will be realized in different ways and over different time horizons. For example, operational and regulatory risks may be realized as increased water costs. Other risks, such as reputational and marketing risks, may be realized as a loss in business value or market capitalization. Risks such as a business disruption due to drought may be realized by an immediate loss in revenue. All of these different types of risk, when monetized and added to current costs, are a proxy for the full value of water to a business.

The Water Risk Monetizer takes user-provided business information on water use, water prices and production data and calculates incoming and outgoing water risk, which may result in increased operating costs. The monetary value assigned to this risk considers water availability, water quality and competing uses of water within local water basins across a three-, five- and 10-year time horizon. The Water Risk Monetizer also calculates the potential loss in revenue from incoming water quantity risk across the same time horizons. Alongside each monetary value, the tool also calculates the likelihood of these costs being realized through a number of risk triggers including future water stress and regulatory and reputational risk factors. The magnitudes and likelihoods are combined into an overall water risk rank so businesses can prioritize facilities for further assessment and start identifying appropriate risk mitigation strategies for each location in order to reduce the company's overall risk profile.

Figure 3, for example, considers a simple business risk scenario, where a single facility is facing three different but overlapping water-related risks. The first risk factor is a local quality impairment that is impacting incoming water to the facility. The second risk factor relates to the availability or quantity of incoming water, and the third risk factor relates to a discharge quality issue. The business can mitigate these risks by investing in different types of water projects at different stages in production. For example, the business could invest in pre-treatment projects that improve the quality of incoming water. It could invest in process treatment projects that aim to reduce, reuse and recycle. Finally, the business could decide to invest in discharge treatment projects that aim to improve the quality of outgoing water. However, knowing where and when to invest, and understanding which projects would deliver the greatest value to the business, can be challenging. The Water Risk Monetizer helps businesses overcome this challenge by providing risk metrics that can be used to screen water-related risks and allow business leaders to make informed decisions about when, where and how to act.

Figure 3: Linking water risk metrics to business decision making



How can the Water Risk Monetizer be used by businesses to manage water risk?

The Water Risk Monetizer allows businesses to screen facilities for overall water risk in order to prioritize water-related projects and investments that enable growth. The Water Risk Monetizer has a built-in enterprise risk analysis that assesses each facility's risk based on growth projections over three years and location-specific water risks. The tool displays facilities in water risk "quadrants" for efficient prioritization. Facilities are categorized by high or low growth and high or low water scarcity. This provides a way for business leaders to understand water risks within their business context.

Businesses can use the Water Risk Monetizer to start developing a successful corporate water strategy that may involve the following steps:

- Establishing a water management plan and goals that are aligned with overarching business and sustainability strategies
- Assessing and monetizing business risks based on a holistic understanding of what water means to your business
- Prioritizing actions based on site-specific risk
- Identifying opportunities to minimize water risk, maximize performance results and optimize costs (reduce, reuse and recycle)
- Executing a water management plan using a "plan-do-check-adjust" cycle

To support some of these steps, the Water Risk Monetizer also includes a built-in investment calculator, recommendations on useful external risk data providers and downloadable reporting outputs that can support CDP, SASB and GRI water risk disclosures.

Figure 4 summarizes some of the ways that the Water Risk Monetizer and its outputs can help businesses address business-critical water risks.

Figure 4: How the Water Risk Monetizer can help businesses manage water risk

Risk	How are risks impacting businesses?	How can the Water Risk Monetizer help businesses plan and take action?
Operational	• Business disruptions due to lack of water • Higher production costs due to decreased availability of clean water	• **Plan:** Prioritize locations for targeted action plans based on site-specific risk (locations where water risk is most material) using the "High Growth — High Water Scarcity" quadrant of the dashboard risk matrix • **Invest:** Use the Water Risk Monetizer investment calculator to model project investment outcomes
Legal and regulatory	• More stringent legislation or reduced allocations as regulators anticipate decreasing water quantity and decreasing water quality in local water basins • Fines for water pollution incidents	• **Plan:** Water dependency is known but business risk is low because sufficient water is available at facilities with "High Growth — Low Water Scarcity" in current conditions • **Monitor:** Update your Water Risk Monetizer risk assessment annually using updated growth projections and consider the five-year and 10-year projections
Reputational and marketing	• Loss in market share • Inability to access new markets as customers become increasingly concerned with water management issues • Loss of social license to operate due to competition for shared water resources or local water pollution incidents	• **Plan:** Prioritize water stewardship at facilities with "Low Growth — High Water Scarcity." Water is a shared resource and therefore requires a stewardship approach to ensure sustainable outcomes for all stakeholders • **Engage:** Understand your industry- and location-specific reputational risks to protect license to grow
Financial	• Increased financing costs and reduced financing options as investors demand more transparency on corporate water risk	• **Plan:** The tool ranks facilities for overall water risk. Use the enterprise risk analysis to identify the facilities with material water risks in the business context • **Report:** Use the tool's reporting outputs for CDP questionnaire, SASB accounting or GRI principles

The evolution of water risk analysis

Water risk analysis is a fast-evolving space, and in recent years there has been significant growth in the number of water risk tools and frameworks available to businesses. The WRI Aqueduct Tool and the WWF Water Risk Filter, for example, have led the way in providing publicly available, quantitative data and spatial mappings of global water availability and quality risk. Veolia has developed the "True Cost of Water," a tool that combines traditional CAPEX and OPEX calculations with analysis of water risks and their financial implications. In 2016, the Natural Capital Coalition (NCC) developed the Natural Capital Protocol, a standardized framework to help businesses measure and value their impacts and dependencies on natural capital (which included water as an important input), and CDP, GRI and SASB have continued to develop guidance to help businesses disclose information on their material water risks. There are also tools specifically for investors, such as the Water Risk Valuation Tool developed by Bloomberg and the Corporate Bond Water Credit Risk Tool developed by GIZ, the Natural Capital Declaration (NCD) and VfU. A useful appraisal of water risk analysis for investors is provided by China Water Risk (2016).

The Water Risk Monetizer has responded to this changing landscape by ensuring that it constantly evolves in line with the availability of best-in-class data and scientific methodologies. Rather than re-create existing assessment frameworks that address quantitative water risk, the Water Risk Monetizer utilizes leading, publicly available datasets such as those developed by the WRI (2019) and WWF (2016a). The Water Risk Monetizer has also kept pace with the development in corporate water risk measurement and valuation techniques through close association with the Natural Capital Coalition and the development of the Natural Capital Protocol (NCC, 2016). This flexibility in a changing market has also been enhanced through collaboration with corporations and other water risk experts to ensure that the outputs of the Water Risk Monetizer tool continue to meet the needs of business.

The result of this flexible and collaborative approach to development is a tool that proactively builds upon existing best-in-class water risk frameworks and adds new and insightful water risk metrics that translate water availability and water quality risks into financial terms. Version 1, launched in 2014, helped businesses understand the potential increase in operating costs as a result of incoming water quantity risk. Version 2, launched in 2015, incorporated revenue at risk, and Version 3, released in the spring of 2017, addresses incoming and outgoing water quality risk and its potential impact on operating costs and provides a deeper level of business insight and action planning. As water risk analysis evolves in the future, so too will the capabilities of the Water Risk Monetizer.

Figure 5: Timeline of the Water Risk Monetizer

2014	2015	2017
Monetizing incoming quantity-related water risks • The Water Risk Monetizer was introduced to help businesses quantify the risk of increased operating costs from insufficient quantity of incoming water	**Monetizing revenue at risk and updating underlying water risk datasets** • Added new functionality to help businesses quantify the risk of revenue loss from incoming water quantity risk • Incorporated the latest WRI data on basin-level water stress	**Monetizing quality-related water risks and launching a new user interface** • Added new functionality to help businesses quantify the risk of increased operating costs from incoming and outgoing water quality risk • Deployed a new user interface, transforming the user experience of the tool and adding more reporting and water risk management outputs

The Water Risk Monetizer's water risk framework: Quantifying the full value of water to businesses

As water scarcity intensifies and the financial implications of this issue are realized by more and more businesses across the world, there is growing global awareness for the need to value water in a different way. Traditional financial accounting only values the market price for water use, its treatment and the revenue generated by businesses themselves. It does not account for the full value of water to businesses, and this disconnect means that business value at risk from water-related issues is significantly underestimated (NCC, 2016; GIZ, NCD and VfU, 2016; Morgan and Orr, 2016). Moreover, traditional approaches do not consider other stakeholders who may be competing for the same water resources in the same water basin.

In the absence of market prices that reflect water risk, businesses need new ways to better understand and account for water risks and the value of water to their operations. Aligning with global best practices, the Water Risk Monetizer uses concepts taken from environmental economics to calculate water risk premiums that consider costs and/or benefits that are not currently included in the market price paid for water. The water risk premiums are proxies for the magnitude of exposure to water risk and consider the non-market, intangible costs and/or benefits to business and society that water provides. These non-market values include, for example, human-health impacts, environmental impacts and the future costs associated with water treatment. The Water Risk Monetizer incorporates the risk premium alongside the market price[3] of incoming and outgoing water to produce risk-adjusted prices that reflect the true value of water to business.

Water risk premiums are proxies for the magnitude of exposure to water risk

Incoming quantity and quality risk premiums — place a monetary value on the local environmental, human-health and domestic supply impacts of water depletion and the future costs of incoming water treatment. Local water availability, local water quality and local population density are all variables that impact the size of the risk premium. Locations that have high levels of water stress (due to quantity- or quality-related impacts) and high population densities will usually have a higher risk premium.

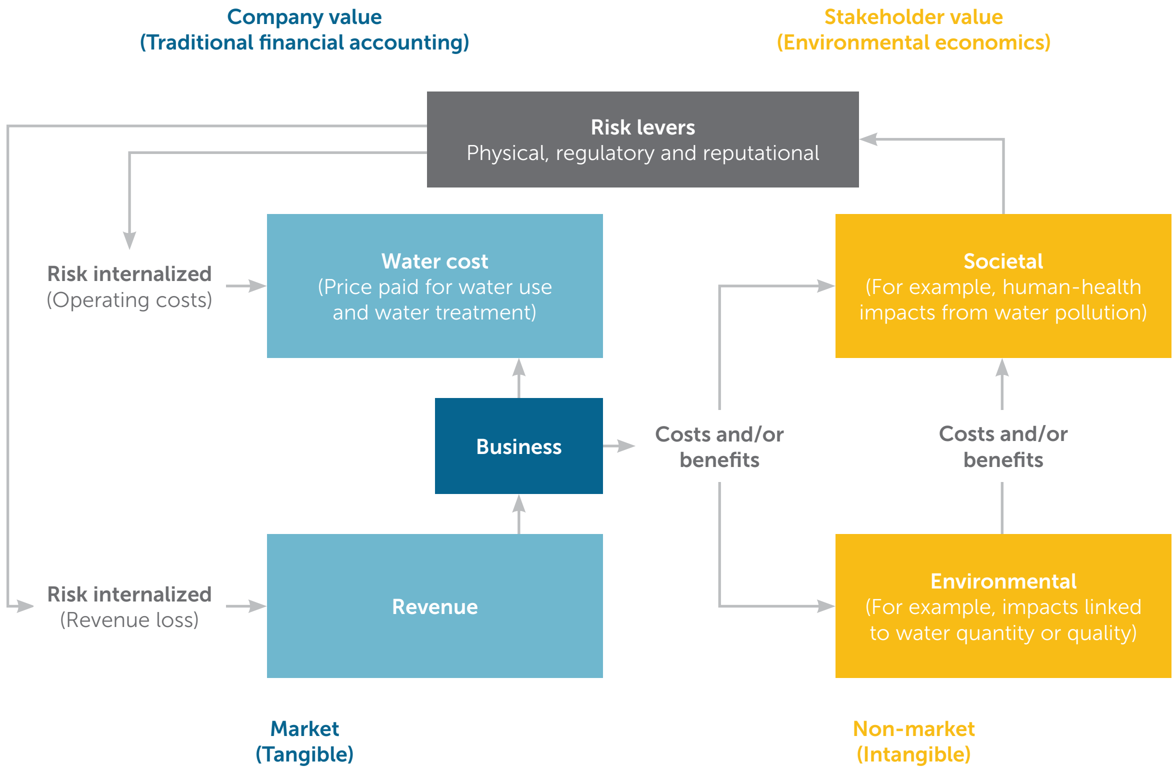
Outgoing quality risk premium — places a monetary value on the local environmental and human-health impacts of water pollution and the future costs of water treatment. Local water stress, local water quality and local population density are all variables that impact the size of the risk premium. Locations that have high levels of water stress and high population densities will usually have a higher risk premium; however, the type of water pollutant and its treatment method will also influence the value.

A full explanation of water risk premiums can be found in the Methodology (Appendix 1).

[3]The market price in the Water Risk Monetizer can include all costs paid by businesses relating to water provision and treatment including costs of sourcing, treating, permits, licenses and other aspects.

Figure 6: The water risk framework: The full value of water

Full value of water = Market value + non-market values



The concept of water as a shared resource used by many stakeholders in local water basins is an important part of the approach to quantify revenue at risk. The Water Risk Monetizer estimates the basin share of water available within a water basin for business use according to the amount of economic activity within the same water basin. The Water Risk Monetizer then calculates how much water is required by a business to generate revenue, and whenever the amount of water required outstrips the basin share of water available, revenue is potentially at risk. This risk can intensify as water stress increases over time or there is growth in demand or competition for water resources in the water basin. Context-based risk appraisals that compare the amount of water needed by businesses with the water that is actually available in a specific location are an important stepping-stone for businesses that wish to set context-based targets for water reductions that are meaningful, defensible and relevant (WWF, 2016b).

Revenue at risk is a context-based appraisal of water constraints to growth

Revenue at risk — compares the estimated amount of water a business requires to generate revenue (m^3 per USD of revenue) to the business's share of water available in the water basin if water were allocated among water users based on economic activity (contribution to basin-level GDP). If more water is required than the basin share of water allocated, then a proportion of the business's revenue is potentially at risk. Industry type, local water stress and competition (basin-level economic activity) are all variables that impact the amount of revenue at risk. Water-intensive industries that are located in areas with high levels of water stress and competition for water resources will usually have a higher amount of revenue at risk.

A full explanation of revenue at risk can be found in the Methodology (Appendix 1).

APPENDIX 1

Methodology

1. USER INPUTS

1.1 Requisite inputs

Table M1: Summary of requisite user inputs

User input	Description	Scale	Unit	Data source
Facility information				
Facility name	The name of the facility to identify it from other facilities	Facility level	Text	User input
Reporting year	The reporting year of the facility level data		Numerical	User selection
Country, State/ Province, City	The location of the facility		Text	User selection
Industry classification	The primary industry classification or activity of the facility		Text	User selection
Incoming water time period	The incoming water quantity can be entered on a weekly, monthly, quarterly or annual basis		Text	User selection
Incoming water quantity	The total amount of incoming water into the facility excluding any recycled water		m^3 or gallons	User input
Incoming water price	The price paid for incoming water to the facility — excluding any fees paid for wastewater treatment or other charges		Local currency per m^3 or 1,000 gallons	User input
Where are you sourcing water from?	The source of incoming water (groundwater, surface water, municipal, rain capture, other)		Text	User selection
Outgoing water time period	The outgoing water quantity can be entered on a weekly, monthly, quarterly or annual basis		Text	User selection
Outgoing water quantity	The total amount of outgoing water from the facility		m^3 or gallons	User input

Table M1: Summary of requisite user inputs (continued)

User input	Description	Scale	Unit	Data source
Facility information				
Outgoing water price	The price paid for wastewater treatment at the facility — including operating expenses for on-site water treatment and fees paid to a third party	Facility level	Local currency per m^3 or 1,000 gallons	User input
Where is your outgoing water treated?	The wastewater treatment location (on-site, sent to a third party, not treated)		Text	User selection
Total facility output per year	The total number of units of output from the facility per year		Numerical	User input
Facility output (units of measure)	The units of output or throughput from the facility		Text	User input

1.2 Optional inputs

Table M2: Summary of optional user inputs

User input	Description	Scale	Unit	Data source
Business information				
Drought scenario	Simulates drought conditions in the underlying water availability data	Facility level	Check box	User selection
Projected incoming water price over three years (%)	Overrides incoming water price forecast in year three		%	User input
Projected incoming water quantity over three years (%)	Overrides incoming water quantity in year three		%	User input
Projected outgoing water price over three years (%)	Overrides outgoing water price forecast in year three		%	User input
Projected outgoing water quantity over three years (%)	Overrides outgoing water quantity in year three		%	User input
Total facility revenue per year	Overrides estimated facility revenue in year one		Local currency	User input
Projected revenue increase over three years (%)	Overrides incoming facility revenue forecast in year three		%	User input
Has your business lost revenue due to water scarcity in the last year?	Increases revenue at risk likelihood score		Text	User selection
Projected facility output over three years (%)	Overrides facility output in year three		%	User input

Table M2: Summary of optional user inputs (continued)

User input	Description	Scale	Unit	Data source
Regulation and reputation				
How would you rate the regulation of water in your local community compared to the country as a whole?	If it is worse than the country as a whole, then the regulatory risk score will be lower, which impacts the incoming, outgoing and revenue at risk likelihood scores	Facility level	Text	User selection
Has there been environmental issues at your facility that have affected your company's reputation?	If there have been environmental issues at your facility that have affected your company's reputation, the reputational risk score will be higher, which impacts the incoming and outgoing risk likelihood scores		Text	User selection
Is your facility aware of the stakeholders depending on the same water resources?	If you do not know what other businesses or organizations depend on the same water resources as your facility, the reputational risk score will be higher, which impacts the incoming and outgoing risk likelihood scores		Text	User selection
Is your facility's industry exempt from potential water restrictions imposed by local regulators?	If your facility's industry is exempt from potential water restrictions, the revenue at risk likelihood score will be lower		Text	User selection
Has there been any local pressure from non-governmental organizations (NGOs) or the public relating to water quality issues that have led to a change in water management practices at your facility?	If there has been a change in water management practices because of local stakeholder pressure, the outgoing risk likelihood score will be higher		Text	User selection

Table M2: Summary of optional user inputs (continued)

User input	Description	Scale	Unit	Data source
Water quality				
How would you rate the quality of incoming water for this year compared to previous years?	If the quality is the same or getting better, this will remove the incoming quality risk premium	Facility level	Text	User selection
What type of impairment, if any, is there for incoming water?	If local water quality is getting worse, the user can specify the type of local water impairment by checking all boxes that apply. This will influence the incoming quality risk premium calculation		Text	User selection
Are there alternative sources of water available for this facility?	The user can indicate whether there are alternative sources of water available for the facility. This will influence the incoming quality risk premium calculation		Text	User selection
If treating outgoing water on-site, is your water treatment facility close to capacity?	On-site treatment facilities that are close to capacity will have an outgoing risk premium even if local water quality thresholds are not currently being breached. The facility will also be more likely to realize increased operating costs in the future		Text	User selection
If sending outgoing water to a third party for treatment, is the third party close to capacity?	Third-party treatment facilities that are close to capacity will have an outgoing risk premium even if local water quality thresholds are not currently being breached. The facility will also be more likely to realize increased operating costs in the future		Text	User selection
Pollutants				
Pollutant thresholds	The user can override local water quality thresholds for each pollutant	Facility level	mg/L	User input
Pollutant concentrations	The user can override the concentration of each pollutant		mg/L	User input
Dilution factor	Values below 1 will reduce the concentration of pollutants. For example, a value of 0.5 will reduce pollutant concentrations by 50%		Numerical value between 0 and 1	User input

2. INCOMING RISK

Water can become a scarce resource if it is insufficient in quantity or quality to meet business needs. As such, the Water Risk Monetizer considers both quantity- and quality-related risk in its incoming risk assessment. The Water Risk Monetizer uses the Baseline Water Stress metric from the WRI's Aqueduct Tool (WRI, 2019) to assess quantity risk and user inputs to assess quality risk.

2.1 Incoming water bill

The incoming water bill is calculated by multiplying the incoming water quantity (m^3) by the incoming water price (USD per m^3). The incoming water bill is forecast over a three-, five- and 10-year time horizon using historical changes in country-level incoming water tariffs (GWI, 2019). The user can choose to override the year three forecast to make it more specific to site location based on an optional user input.

2.2 Incoming risk premium (quantity and quality)

The incoming risk premium is the monetary estimate of the increased price of incoming water, which may be realized by a business as an increase in its operating costs. The incoming risk premium is calculated based on the full value of water, as estimated by local water availability and its quality. The incoming risk premium is made up of two components which address two different types of incoming risk. The first component is the incoming quantity risk premium and the second component is the incoming quality risk premium. To quantify these two components, the Water Risk Monetizer looks at the amount and quality of water available at a specific location, the amount of water used by a facility, additional demands on the supply of water and the impact of a facility's water use on the local water basin. The resulting water risk premium is a financial metric that businesses can use to make better decisions to address water-related constraints to growth.

2.3 Valuation approach

The incoming risk premium valuation approach estimates the monetary value of the costs and/or benefits that are not currently included in the market price paid for water. The risk premium is a proxy for the magnitude of exposure to water risk and considers the non-market, intangible costs and/or benefits to business and society that water provides. The Water Risk Monetizer uses the Total Economic Value Framework (TEV), adapted in Figure M1, a concept drawn from environmental economics that provides a structured approach to estimate the total economic value of the costs and/or benefits that environmental assets provide to society. The TEV is an approach used throughout the environmental economics literature and supported by organizations such as the World Business

Council for Sustainable Development (WBCSD) and the Natural Capital Coalition (NCC) who developed the Natural Capital Protocol released in July 2016. The Water Risk Monetizer focuses on non-consumptive use values of water within the TEV framework. Other values such as the non-use value and the future option value of water are excluded because scientific consensus on how to monetize these components is less advanced.

Figure M1: The total economic value framework — incoming risk premium

FULL VALUE OF WATER	Non-market (Intangible)	**Human-health impacts:** The value of human-health impacts due to the reduction in water available for agriculture and increased incidence of water-borne diseases	Incoming quantity risk premium
		Environmental impacts: The value of environmental impacts on local ecosystems as a result of water depletion	
		Domestic value: The value of water supply to the domestic population	
		Future treatment costs: To improve the quality of incoming water in line with business requirements or the cost of sourcing water from an alternative location	Incoming quality risk premium
	Market (Tangible)	**Administration**	Incoming water price
		Operations and maintenance	
		Capital	

2.3.1 Human-health impacts

The quantification of the human-health impacts due to the reduction in the availability of water for agriculture and increased incidence of water-borne diseases was developed using an estimate of the disability adjusted life years (DALYs) lost per unit of water consumed. For agriculture, the Water Risk Monetizer uses a methodology developed by Pfister (2011) which provides country-level estimates of the DALYs lost per cubic meter of water due to malnutrition. For increased incidence of water-borne diseases, the Water Risk Monetizer uses country-level DALY estimates sourced from Motoshita et al. (2010). DALYs are monetized using the value of a statistical life year (VOLY), which encompasses most aspects relating to illness and expresses the value of a year of life to the wider population. The Water Risk Monetizer uses VOLY estimates from a stated preference study conducted in the context of the New Energy

Externalities Development for Sustainability (NEEDS) project (Desaigues et al., 2006; 2011). The value of DALYs is a function of basin-level water stress (WRI, 2019), with higher values in locations with higher water stress. Water stress is the ratio of current demand to long-term average supply of surface water in a basin. In basins where demand exceeds surface water availability, baseline water stress will be more than 100 percent.

The human-health impact valuation is a peer-reviewed methodology. For more information on the methodology, including sensitivity analysis for selected parameters, please contact info@trucost.com.

2.3.2 Environmental impacts

Impacts of water depletion on ecosystems are measured based on the reduction in net primary productivity (NPP) caused by limited water availability. NPP is a proxy of how well an ecosystem is functioning. For each country, the Water Risk Monetizer calculates the average NPP per ecosystem type using datasets from Costanza et al. (2007) and Olson et al. (2004). Once the average NPP value is known, the Water Risk Monetizer calculates the change in NPP per cubic meter of water depleted. This change is then monetized by applying ecosystem service valuations to the proportion of ecosystem services lost from a reduction in NPP based on the analysis of De Groot et al. (2012). The value of ecosystem services lost is also a function of basin-level water stress (WRI, 2019), with higher values in locations with higher water scarcity.

The environmental impact valuation is a peer-reviewed methodology. For more information on the methodology, including sensitivity analysis for selected parameters, please contact info@trucost.com.

2.3.3 Domestic value

The value of water supply to the domestic population is estimated using country-level domestic water tariff data (GWI, 2019). The domestic value of water is a proxy for the benefit of having safe and secure access to water in domestic households.

2.3.4 Future treatment costs

Future water treatment costs are calculated using appropriate water treatment cost curves from Guo (2014) for salinity, organics, suspended solids, taste and odor. The user is able to select the water impairment that is specific to a facility's water basin. The water treatment costs are adjusted for purchasing power parity between countries using country-level wastewater treatment cost information from GWI (2019). The Water Risk Monetizer also estimates the cost of sourcing local municipal water using national or regional average water tariff data from GWI (2019) and the cost of sourcing water from another location by combining the same national or regional average water tariff data with a global average water transportation cost (Zhou and Tol, 2005).

Table M3: Summary of incoming risk premium components

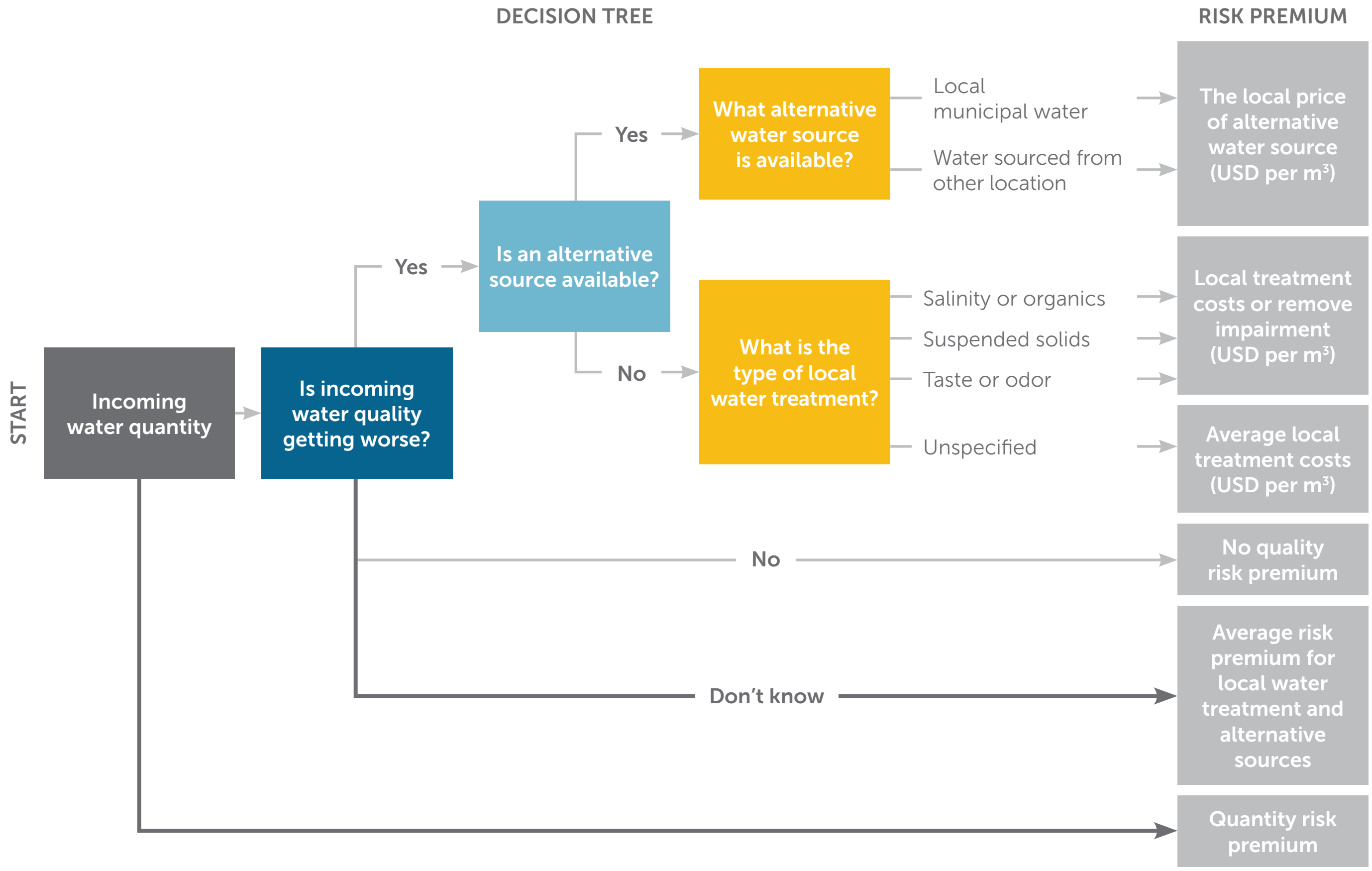
Dependent variable	Description	Data source	Independent variable	Data source
Human-health impacts	Country-level valuation of DALYs	Pfister (2011); Motoshita et al. (2010); Desaigues et al. (2006; 2011)	Water stress and quantity of incoming water	WRI (2019) and user input
Environmental impacts	Country-level valuation of reduction in ecosystem services	Costanza et al. (2007); Olson et al. (2004); De Groot et al. (2012)		
Domestic value	Country-level value of water to the local population	GWI (2019)		
Future costs of water treatment	Country-level cost estimate of water treatment	Guo (2014)	Purchasing power parity and quantity of incoming water	GWI (2019) and user input
Cost to source water from alternative location	National or regional estimate of costs to source from local municipal provider or another location	GWI (2019); Zhou and Tol (2005)	Quantity of incoming water	User input

If the user applies the Drought Scenario, the Water Risk Monetizer estimates water availability in a simulated drought condition, where there is less water available. The tool uses the inter-annual variability of water, as provided by the WRI (2019), to simulate the scenario where there is a 10 percent chance that less water will be available. The tenth percentile of water available was selected using sensitivity analysis as it has the highest correlation with the drought severity metric, also provided by the WRI (2019). The basin water stress is adjusted by this drop in water availability or increased to 100 percent stress, whichever is higher, to simulate a drought valuation.

2.4 Incoming water risk decision tree

The incoming risk premium is calculated based on the responses provided by the user to questions contained in the facility form. Figure M2 details what is included in the risk premium calculation for each combination of responses.

Figure M2: Decision tree and default values (dark gray)



2.5 Incoming risk premium forecast

The incoming risk premium is forecasted over a three-, five- and 10-year time horizon using a number of location-specific variables as listed in Table M4.

Table M4: Incoming risk premium forecast

Component	Forecast variable	Description	Influence	Data source
Incoming quantity risk premium	Future water stress	Estimate of basin-level water stress in three, five and 10 years' time	Higher future water stress, higher future risk premium	WRI (2019)
Incoming quality risk premium	Change in country-level incoming and outgoing water tariffs	Estimate of the change in country-level water tariffs in three, five and 10 years' time. The user can choose to override the year three forecast to make it more specific to site location based on an optional user input	Higher future treatment cost, higher future risk premium	GWI (2019)

2.6 Combined incoming risk-adjusted price

The combined incoming risk-adjusted price is calculated by adding the incoming water bill unit price (USD per m^3) to the incoming risk premium (USD per m^3). The combined incoming risk-adjusted price is the price that would be paid per m^3 of water if it included all the currently unpriced benefits that water provides and the future costs of water treatment at a local basin level, taking into account baseline water stress, as defined by the WRI (2019), and local water quality.

2.7 Incoming risk likelihood score

The likelihood that a business will realize increased operating costs as a result of incoming water risk is scored as high, medium or low by the tool, based on seven variables, as listed in Table M5. Each variable is assigned a value between zero and one, and each variable is weighted according to its importance to the likelihood score. Current and future water stress is weighted the highest because this quantity risk is more likely to lead to an increase in operating costs. Each variable had an existing high, medium and low boundary, and those boundaries were also mapped to a value between zero and one to create new risk thresholds. The high-, medium- and low-risk thresholds for the incoming risk likelihood score are listed in Table M6.

Table M5: Incoming risk likelihood score

Variable	Description	Influence	Weighting	Data source
Baseline water stress	Identifies if the facility is located in a water basin with reduced water availability. If drought scenario is selected by the user, the stress score is increased to high risk	Higher stress, higher likelihood	25%	WRI (2019)
Future water stress	Identifies if a facility will be located in a water basin with reduced water availability in the future. If drought scenario is selected by the user, the future stress score is increased to high risk	Higher future stress, higher likelihood	25%	WRI (2019)
Inter-annual variability	Identifies if a facility is located in a water basin with high inter-annual variability. High inter-annual variability means there is a larger variation in water supply between years and as such, the water basin could be prone to more severe droughts and floods	High inter-annual variability, higher likelihood	6.25%	WRI (2019)

Table M5: Incoming risk likelihood score (continued)

Variable	Description	Influence	Weighting	Data source
Seasonal variability	Identifies if a facility is located in a water basin with high seasonal variability. High seasonal variability means there is a larger variation in water supply between months of the year and as such, the water basin could be prone to more severe droughts and floods	High seasonal variability, higher likelihood	6.25%	WRI (2019)
National or local regulatory risk	Demonstrates the level of governance of water regulation and the level of enforcement in each country. The user can choose to override this to make it more specific to site location based on an optional user input	Higher quality and level of enforcement, higher likelihood	12.5%	WWF Water Risk Filter (2016); user input
National or local reputational risk	Demonstrates the level of reputational risk in each country. The user can choose to override this to make it more specific to site location based on an optional user input	Higher reputational risk, higher likelihood	12.5%	WWF Water Risk Filter (2016); user input
Historical changes in national or local water tariffs	Identifies if the facility is located in a country where water tariffs have increased in recent years. The user can choose to override this to make it more specific to site location based on an optional user input	Rising water tariffs, higher likelihood	12.5%	GWI (2019); user input

Table M6: Risk threshold for the incoming risk likelihood score

Score	Risk threshold
High	Above 60%
Medium	Between 30% and 60%
Low	Below 30%

3. OUTGOING RISK

3.1 Outgoing water bill

The outgoing water bill is calculated by multiplying the outgoing water quantity (m^3) by the outgoing water price (USD per m^3). The outgoing water bill is forecasted over a three-, five- and 10-year time horizon using historical changes in country-level outgoing water tariffs (GWI, 2019). The user can choose to override the year three forecast to make it more specific to site location based on an optional user input.

3.2 Outgoing risk premium (quality)

The outgoing risk premium is the monetary estimate of the increased price of outgoing water, which may be realized by a business as an increase in its operating costs. The outgoing risk premium is calculated based on the full value of water, as estimated by the quality of water discharged from the facility. The outgoing risk premium is made up of one component relating to water quality since the impact of water quality on the availability of water is addressed in the incoming risk premium. To quantify the outgoing quality risk premium, the Water Risk Monetizer looks at the amount and quality of water being discharged by a facility, local water quality thresholds and the impact of water pollution on the local water basin.

3.3 Valuation approach

The outgoing risk premium valuation approach estimates the monetary value of the costs and/or benefits that are not currently included in the market price paid for water. The outgoing risk premium is a proxy for the magnitude of exposure to water risk and considers the non-market, intangible costs and/or benefits to business and society that water provides. Similar to the incoming risk premium, the Water Risk Monetizer uses the Total Economic Value Framework (TEV), adapted in Figure M3, a concept drawn from environmental economics that provides a structured approach to estimate the total economic value of the costs and/or benefits that environmental assets provide to society. The TEV is an approach used throughout the environmental economics literature and supported by organizations such as the World Business Council for Sustainable Development (WBCSD) and the Natural Capital Coalition (NCC), who developed the Natural Capital Protocol released in July 2016. The Water Risk Monetizer focuses on non-consumptive use values of water within the TEV framework. Other values, such as the non-use value and the future option value of water, are excluded because scientific consensus on how to monetize these components is less advanced.

Figure M3: The total economic value framework — outgoing risk premium

FULL VALUE OF WATER	Non-market (Intangible)	**Human-health impacts:** The value of human-health impacts due to exposure and bioaccumulation of harmful pollutants as a result of water pollution	Outgoing quality risk premium
		Environmental impacts: The value of environmental impacts on local ecosystems as a result of water pollution	
		Future treatment costs: To improve the quality of outgoing water in line with local water quality thresholds	
	Market (Tangible)	**Administration**	Outgoing water price
		Operations and maintenance	
		Capital	

The Water Risk Monetizer considers the total quantity (load) of pollutants released in outgoing water by the facility. This load is calculated by multiplying a user input concentration (in mg per liter) by the total quantity of outgoing water (in liters) and applying a dilution factor. In the absence of user input concentrations, the quantity is based on the facility's industry classification using data modeled by Trucost (2015). Four standard pollutants (biological oxygen demand (BOD), chemical oxygen demand (COD), suspended solids (SS) and dissolved solids (DS)) are included for every facility. Other non-standard pollutants are determined based on their materiality to the facility's industry classification using data modeled by Trucost (2015). Costs associated with human-health and environmental impacts are calculated for all non-standard pollutants, whereas future treatment costs are applied to all pollutants when their concentrations are in breach of local water quality thresholds. Local water quality thresholds are based on drinking water standards as determined by the US EPA (2016) or provided as a user input.

Table M7: Pollutants, concentrations and thresholds

<table>
<tr><th>Pollutant type</th><th>Pollutant name</th><th>Concentration</th><th>Threshold</th><th>Costs associated with human-health and environmental impacts</th><th>Future treatment costs</th></tr>
<tr><td rowspan="4">Standard pollutants</td><td>BOD</td><td rowspan="21">User input or Trucost (2015)</td><td rowspan="21">User input or US EPA (2016)</td><td rowspan="4">Not applied</td><td rowspan="21">Applied when concentration is in breach of threshold</td></tr>
<tr><td>COD</td></tr>
<tr><td>SS</td></tr>
<tr><td>DS</td></tr>
<tr><td rowspan="17">Non-standard pollutants</td><td>Antimony</td><td rowspan="17">Applied on annual load of pollutant</td></tr>
<tr><td>Arsenic</td></tr>
<tr><td>Barium</td></tr>
<tr><td>Cadmium</td></tr>
<tr><td>Chromium</td></tr>
<tr><td>Cobalt</td></tr>
<tr><td>Copper</td></tr>
<tr><td>Cyanide compounds</td></tr>
<tr><td>Lead</td></tr>
<tr><td>Manganese</td></tr>
<tr><td>Mercury</td></tr>
<tr><td>Nickel</td></tr>
<tr><td>Nitrate</td></tr>
<tr><td>Phosphate</td></tr>
<tr><td>Selenium</td></tr>
<tr><td>Vanadium</td></tr>
<tr><td>Zinc</td></tr>
</table>

3.3.1 Human-health impacts

The quantification of the human-health impacts due to the exposure and bioaccumulation of harmful pollutants in local water bodies is based on an estimate of the disability adjusted life years (DALYs) lost per unit of pollutant released into the environment. DALYs for each pollutant are sourced from USES-LCA 2.0 (EC, 2004; National Institute of Public Health and the Environment, 2004) and vary depending on the geographical location where they are released. USES-LCA 2.0 takes into account the impact of cancer and non-cancer diseases caused by the ingestion of food and water and the inhalation of chemicals and converts these into DALYs. The DALYs are monetized using the value of a statistical life year (VOLY), which encompasses most aspects relating to illness and expresses the value of a year of life to the wider population. The Water Risk Monetizer uses VOLY estimates from a stated preference study conducted in the context of the New Energy Externalities Development for Sustainability (NEEDS) project (Desaigues et al., 2006; 2011). The value of DALYs is a function of the load of pollutants discharged by a facility in a specific location.

The human-health impact valuation is a peer-reviewed methodology. For more information on the methodology, including sensitivity analysis for selected parameters, please contact info@trucost.com.

3.3.2 Environmental impacts

Impacts of water pollutants on ecosystems are measured based on the reduction in species number caused by one unit of each pollutant being released into the environment. Estimates of the impact of each pollutant on the number of species in an ecosystem are sourced from USES-LCA 2.0 (EC, 2004; National Institute of Public Health and the Environment, 2004) and vary depending on the geographical location where they are released. Once the reduction in species number for each pollutant is known, the Water Risk Monetizer calculates the change in NPP caused by each pollutant. This change is then monetized by applying ecosystem service valuations to the proportion of ecosystem services lost from a reduction in NPP based on the analysis of De Groot et al. (2012). The value of ecosystem services lost is also a function of the load of pollutants discharged by a facility in a specific location.

The environmental impact valuation is a peer-reviewed methodology. For more information on the methodology, including sensitivity analysis for selected parameters, please contact info@trucost.com.

3.3.3 Future treatment costs

Future water treatment costs are calculated using appropriate water treatment cost curves from Guo (2014) for standard and non-standard pollutants when their concentrations are in breach of local water quality thresholds. The user is able to specify the concentrations and thresholds of all water pollutants relevant to a facility. In the absence of any user input, the Water Risk Monetizer assumes that concentrations are in breach of thresholds for standard pollutants, whereas for non-standard pollutants, concentrations are based on the facility's industry classification using data modeled by Trucost (2015). The water treatment costs are adjusted for purchasing power parity between countries using country-level wastewater treatment cost information from GWI (2019).

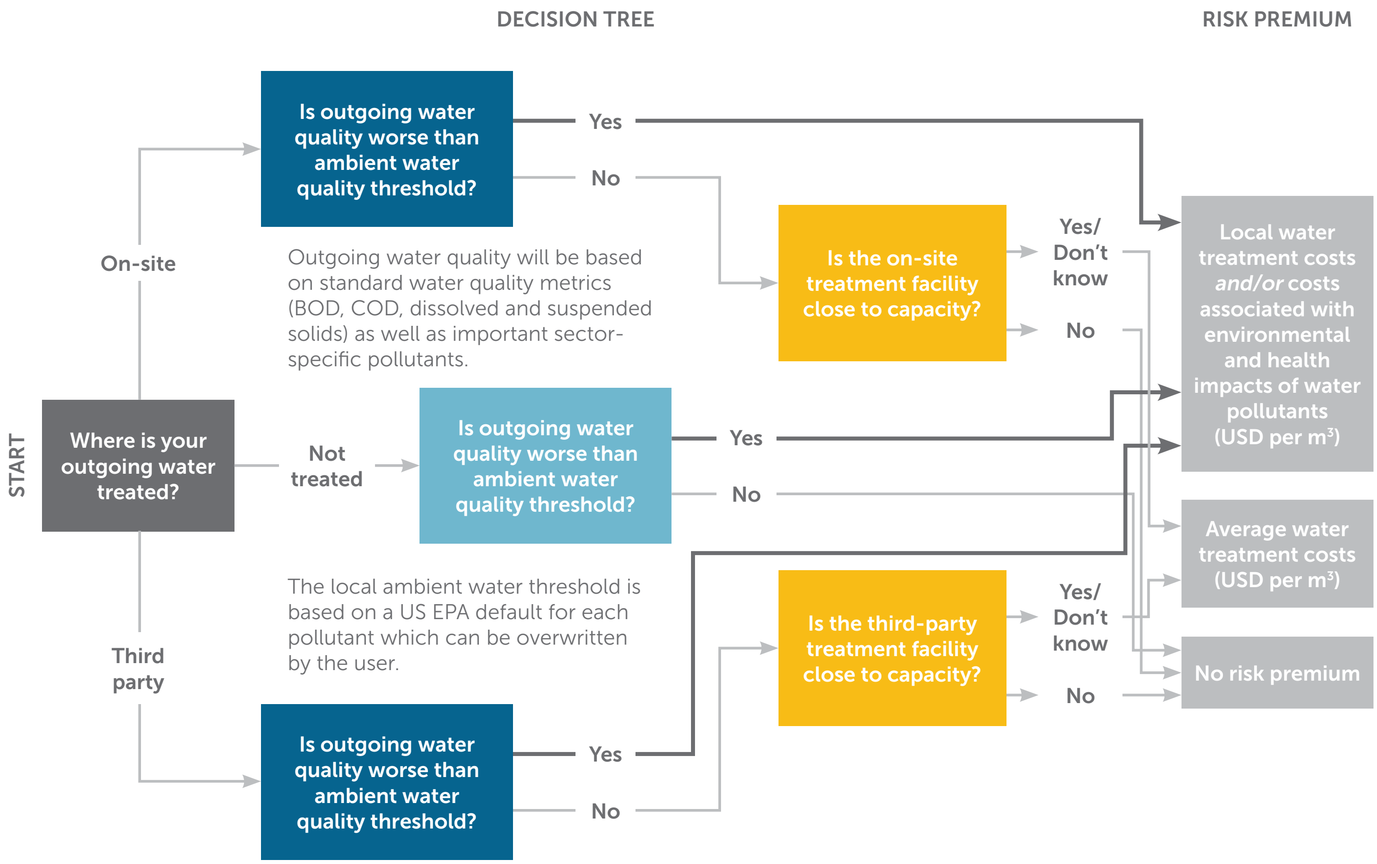
Table M8: Summary of outgoing risk premium components

Dependent variable	Description	Data source	Independent variable	Data source
Human-health impacts	Country-level valuation of DALYs	EC (2004); National Institute of Public Health and the Environment (2004); Desaigues et al. (2006; 2011).	Load of pollutants discharged by a facility	User input or Trucost (2015)
Environmental impacts	Country-level valuation of reduction in ecosystem services	EC (2004); National Institute of Public Health and the Environment (2004); Costanza et al. (2007); Olson et al. (2004); De Groot et al. (2012)		
Future costs of water treatment	Country-level cost estimate of water treatment	Guo (2014)	Purchasing power parity and quantity of outgoing water	GWI (2019) and user input

3.4 Outgoing water risk decision tree

The outgoing risk premium is calculated based on the responses provided by the user to questions contained in the facility form. Figure M4 details what is included in the risk premium calculation for each combination of responses.

Figure M4: Decision tree and default values (dark gray)



3.5 Outgoing risk premium forecast

The outgoing risk premium is forecasted over a three-, five- and 10-year time horizon using the change in country-level outgoing water tariffs (GWI, 2019). The user can choose to override the year three forecast to make it more specific to the site location based on an optional user input. Higher future treatment costs result in a future risk premium.

3.6 Combined outgoing risk-adjusted price

The combined outgoing risk-adjusted price is calculated by adding the outgoing water bill unit price (USD per m^3) to the outgoing risk premium (USD per m^3). The combined outgoing risk-adjusted price is the price that would be paid per m^3 of water if it included the future costs of water treatment and the currently unpriced human-health and environmental impacts of water pollution at a local basin level.

3.7 Outgoing risk likelihood score

The likelihood that a business will realize increased operating costs as a result of outgoing water risk is scored as high, medium or low by the tool, based on five variables, as listed in Table M9. Each variable is assigned a value between zero and one, and each variable is weighted according to its importance to the likelihood score. Current and future water stress is weighted the highest because this physical risk is more likely to lead to an increase in operating costs. The outgoing risk likelihood score is amplified if the on-site or third-party treatment facility is close to capacity. Each variable had an existing high, medium and low boundary, and those boundaries were also mapped to a value between zero and one to create new risk thresholds. The high-, medium- and low-risk thresholds for the outgoing risk likelihood score are listed in Table M10.

Table M9: Outgoing risk likelihood score

Variable	Description	Influence	Weighting	Data source
Baseline water stress	Identifies if the facility is located in a water basin with reduced water availability	Higher stress, higher likelihood	29%	WRI (2019)
Future water stress	Identifies if a facility will be located in a water basin with reduced water availability in the future	Higher future stress, higher likelihood	29%	WRI (2019)
National or local regulatory risk	Demonstrates the level of governance of water regulation and the level of enforcement in each country. The user can choose to override this to make it more specific to site location based on an optional user input	Higher quality and level of enforcement, higher likelihood	14%	WWF Water Risk Filter (2016); user input

Table M9: Outgoing risk likelihood score (continued)

Variable	Description	Influence	Weighting	Data source
National or local reputational risk	Demonstrates the level of reputational risk in each country. The user can choose to override this to make it more specific to site location based on an optional user input	Higher reputational risk, higher likelihood	14%	WWF Water Risk Filter (2016); user input
Population density	Identifies if the facility is located in a water basin with high population density. The user can choose to override this to make it more specific to site location based on an optional user input	Higher population density, higher likelihood	14%	CI ESEN (2016)
Amplifier	**Description**	**Influence**	**Factor**	**Data source**
Capacity of on-site or third-party treatment facility	The user can indicate whether the on-site or third-party treatment facility is close to capacity or not	Facility close to capacity, higher likelihood	x2	User input

Table M10: Risk thresholds for the outgoing risk likelihood score

Score	Risk threshold
High	Above 50%
Medium	Between 25% and 50%
Low	Below 25%

4. REVENUE AT RISK

4.1 Revenue at risk

Revenue at risk is the estimated value of the revenue that could potentially be lost at a facility due to the impact of water scarcity on operations. The Water Risk Monetizer uses a revenue at risk model to estimate the amount of water that should be available to the facility — its "share" of total water available to industry water users in the basin based on the facility's contribution to the local economy.

4.2 Valuation approach

The model estimates the amount of water a facility requires to generate revenue and estimates the amount of water available to the facility if water were allocated among users in the local basin based on economic activity. If more water is required than the basin share of water available in the river basin (as determined by the model), then the facility's revenue is potentially at risk.

The model estimates the amount of water required based on the annual amount of water used by the facility and the facility revenue. The facility revenue can be entered by the user but is an optional input. If the user does not enter facility revenue, the model estimates this value using data modeled by Trucost (2015), based on industry average data and the facility's industry classification. The facility's industry classification is a user-entered value.

Because water is a shared resource, the share of water available to a facility is estimated by the model, taking into account local water stress and economic activity. The estimated basin share of water available within a water basin for domestic, agricultural, industrial and institutional users is based on basin-level water withdrawals and the location's Gross Domestic Product (GDP), which provides an estimate of the demand for water in the basin from all the different users of the water.

In any given location, the model assumes there are specific volumes of water for agricultural use, or for industrial and institutional use. The facility's industry classification determines which volume of water the model will allocate to the facility. However, water withdrawals are not allowed to exceed 20 percent water stress in any water basin, which is medium risk determined by the WRI (2019). This ensures that the basin can continue to provide water in the future.

The model uses GDP to account for different users within the water basin that are competing for a finite amount of water. As GDP increases, the competition for water also increases (assuming the amount of water stays the same). The Water Risk Monetizer uses the most site-specific GDP data. It draws first from megacity GDP but, if unavailable, it selects state GDP and finally, if unavailable, it selects national GDP to estimate the basin share of water available for the facility's industry. The correlation between GDP and population is also taken into account for estimating the basin share.

If the user applies the Drought Scenario, the Water Risk Monetizer estimates water availability in a simulated drought condition, where there is less water available. The tool uses the inter-annual variability of water, as provided by the WRI (2019), to simulate the scenario where there is a 10 percent chance that less water will be available. The tenth percentile of water available was selected using sensitivity analysis as it has the highest correlation with the drought severity metric, also provided by the WRI (2019).

The model estimates the facility's revenue per unit of water by dividing the total facility revenue by the amount of water used by the facility (user input value).

Table M11: Summary of revenue at risk components

Variables	Description	Data source
GDP	National, state or megacity GDP data is used to calculate the competition for water in the basin	IMF (2019); China Statistic Press (2018); BEA (2018); Insee (2018); Parilla et al. (2014)
Population	Alongside GDP, the tool uses estimates of basin population and population density to calculate the competition for water in the basin	CIESEN (2016)
Water withdrawals	Basin-level estimates of water withdrawals by domestic, agriculture, industry and institutional users	WRI (2019); Dieter (2018); FAO (2016)
Basin-level water stress	This is used to ensure that withdrawals do not exceed the threshold of medium risk, defined by WRI (2019) as 20% stress. This is a conservative estimate for the risk threshold	WRI (2019)

4.3 Revenue at risk forecast

The revenue at risk metric is forecasted over a three-, five- and 10-year time horizon using a number of location-specific variables as listed in Table M12.

Table M12: Revenue at risk forecast

Component	Forecast variable	Description	Influence	Data source
Revenue at risk	Future water stress	Estimate of basin-level water stress in three, five and 10 years' time	Higher future water stress, higher future revenue at risk	WRI (2019)
	Basin-level GDP	Estimate of the change in basin-level GDP in three, five and 10 years' time	Higher future GDP indicates increased competition and higher future revenue at risk	IMF (2019); China Statistic Press (2018); BEA (2018); Insee (2018)
	Basin population	Estimate of the change in basin population GDP in three, five and 10 years' time	Higher future basin population indicates increased competition and higher future revenue at risk	CIESEN (2016)

4.4 Revenue at risk likelihood score

The likelihood that a business will realize revenue loss is scored as high, medium or low by the tool, based on six variables, as listed in Table M13. Each variable is assigned a value between zero and one, and each variable is weighted according to its importance to the likelihood score. Current and future water stress is weighted the highest because this physical risk is more likely to lead to a loss in revenue than the other variables. The revenue at risk likelihood score is amplified if the facility has experienced a loss of revenue due to water stress in the last year. Each variable had an existing high, medium and low boundary, and those boundaries were also mapped to a value between zero and one to create new risk thresholds. The high-, medium- and low-risk thresholds for the revenue at risk likelihood score are listed in Table M14.

Table M13: Revenue at risk likelihood score

Variable	Description	Influence	Weighting	Data source
Baseline water stress	Identifies if the facility is located in a water basin with reduced water availability	Higher stress, higher likelihood	25%	WRI (2019)
Future water stress	Identifies if a facility will be located in a water basin with reduced water availability in the future	Higher future stress, higher likelihood	25%	WRI (2019)
Water requirement of industry per unit of revenue	Demonstrates how critical water is to an industry's revenue. Seven high-level industries are considered including Agriculture, Mining, Utilities, Manufacturing and Construction	Higher requirement, higher likelihood	12.5%	Trucost (2015)
Water requirement of specific industry per unit of revenue	Demonstrates how critical water is to each industry within its sector. The seven high-level sectors are divided into more than 450 industry sectors	Higher requirement, higher likelihood	12.5%	Trucost (2015)
National or local regulatory risk	Demonstrates the level of governance of water regulation and the level of enforcement in each country. The user can choose to override this to make it more specific to site location based on an optional user input	Higher quality and level of enforcement, higher likelihood	12.5%	WWF Water Risk Filter (2016); user input
Importance of the industry to the national or local economy	Identifies the importance of each industry to the national economy (GDP), which aids regulatory restriction decisions. The user can choose to override this to make it more specific to site location based on an optional user input	Lower importance, higher likelihood	12.5%	UN Stat (2016)
Amplifier	**Description**	**Influence**	**Factor**	**Data source**
Historical revenue loss	The user can indicate whether the facility has lost revenue due to water stress in the last year	Historical revenue loss, higher likelihood	x2	User input

Table M14: Risk thresholds for the revenue at risk likelihood score

Score	Risk threshold
High	Above 55%
Medium	Between 25% and 55%
Low	Below 25%

5. FACILITY DASHBOARD

There are additional outputs in the facility dashboard that allow the user to screen facilities for incoming and outgoing water risk. The additional outputs combine metrics described above as outlined in Table M15 below.

Table M15: Description of facility dashboard metrics

Output	Description
Risk premium relative to price for incoming and outgoing water	This metric compares the year one incoming and outgoing risk premium against the year one incoming and outgoing water bill unit price. This metric allows the user to understand the discrepancy between the current price paid for water and the risk premium at each facility
Potential revenue at risk due to water quantity risk	This metric is the year one revenue at risk for the facility displayed as a percentage
Rank based on water quantities, monetized risk and likelihood	This metric combines the year one incoming and outgoing water quantities, year one incoming and outgoing risk premiums, year one revenue at risk value and the incoming, outgoing and revenue at risk likelihood scores into a single ranked metric. This metric can be used to compare the relative water risk across a group of different facilities

6. RISK ANALYSIS

6.1 Reputational risk

In the risk analysis section of the tool, the Water Risk Monetizer uses data provided by RepRisk to calculate the facility's industry and country RepRisk Risk Exposure scores. The RepRisk Risk Exposure scores are based on RepRisk's business intelligence on environmental, social and governance (ESG) risks related to companies, projects, countries and sectors. The score denotes high-, medium- or low-risk exposure and is related to reputational risks associated with local pollution and water scarcity in a specific location or industry. The exposure refers to a weighted reputational risk value based on the number and severity of risk incidents captured by RepRisk in the last two years.

For more information on RepRisk's methodology, please visit www.reprisk.com. If you are interested in an in-depth look at the ESG risk exposure of your company including all 28 ESG Issues and 45 Topic Tags covered by RepRisk, please visit https://www.reprisk.com/report.

Limitations

The Water Risk Monetizer was designed to provide a fast, easy-to-use water risk assessment in monetary terms at a facility level, taking into account local conditions. The output is intended to inform business decision-making and action on water-related risks. The tool does not provide a holistic, detailed, facility-specific water risk assessment.

At present, the tool's scope includes only risk assessments associated with a facility's incoming water quantity and quality risks and outgoing water quality risks related to surface water use. We acknowledge there are other water-related risks, and the tool will be updated over time to incorporate modules that assess these other risks.

Developing a globally relevant tool that is able to address local conditions is challenging, and comes with limitations. Gaps in local-level data often exist, and the uncertainty in making estimates and assumptions has been mitigated through extensive consultation with subject-matter experts and other important stakeholders. Wherever possible, local-level data has been included in the tool or alternatively, the user is provided with the option to provide local insights to increase the accuracy of the results. Some of the limitations and the mitigation strategies deployed by the Water Risk Monetizer are discussed in Table L1.

Table L1: Limitations

Limitation	Mitigation strategy
The Water Risk Monetizer's scope is limited to incoming water quantity and quality risks and outgoing water quality risks	The Water Risk Monetizer is a fast, easy-to-use and educational screening tool to understand a facility's exposure to water risks in monetary terms. It is not intended to be a detailed risk assessment tool that takes into account all business risks. These other water-related risks may be significant, and will be addressed in future version of the tool
Only surface water is considered not groundwater	The Water Risk Monetizer uses the WRI's Aqueduct Tool as its source of basin-level water statistics. To date, this has allowed for surface water assessment only. However, should basin-level groundwater metrics become available in the future, the Water Risk Monetizer will incorporate this into its risk assessment
Aging infrastructure is not included in water risk premiums	Aging water infrastructure presents a material financial risk in some basins for business and domestic users of water. The tool does not cover this at present in its water risk premium calculations

Limitation	Mitigation strategy
Data gaps and coverage	In recognizing the limitations inherent in global datasets, the Water Risk Monetizer uses local data wherever possible or provides for local data input by the user. For example, with GDP this is done at a megacity, state or national level depending on the availability and reliability of the data source
Uncertainty in forecasting data	Forecasting has limitations including reliance on historical data, assumptions about variables and other factors. Wherever possible, the Water Risk Monetizer sources forecast models from internationally recognized data providers and advice from subject matter experts
Default values for facility revenue and the concentrations of specific water pollutants are estimated using secondary data modeled by Trucost (2015)	The tool provides an input override option to allow the user to specify facility revenue and pollutant concentration data
GDP is not calculated at a water basin level	GDP is calculated at a national level for most countries. Wherever possible, state-level GDP is used (for the United States and for China). Further granularity has also been achieved by incorporating GDP per capita of megacities (Parilla et al, 2014)
Basin water allocation may not consider economic output	The revenue at risk metric uses economic allocation for determining a business's fair share of water available for businesses. Water allocation is a debated subject and many basins do not consider economic output for allocating resources between business users
Water risk premium calculations are based on secondary data sources	The development of valuation coefficients for all water basins and water pollutants across the globe leverages existing academic studies that have been conducted in different locations. This means there are uncertainties and sensitivities in the original academic studies that carry over into the Water Risk Monetizer. To mitigate against this risk, Trucost has used valuation techniques in line with the Total Economic Value (TEV) framework and Natural Capital Protocol, supported by the World Business Council for Sustainable Development (WBCSD) and the Natural Capital Coalition (NCC). Furthermore, third-party experts are consulted during the development process

APPENDIX 3

More information

For more information about the methodology used in the Water Risk Monetizer, valuing water or valuing water-related business risks across business operations and supply chains, please contact Trucost at info@trucost.com or northamerica@trucost.com.

If you would like more information about managing water risks with water efficiency or technology solutions or you have questions about water stewardship, please visit www.ecolab.com or contact waterriskmonetizer@ecolab.com.

References

1. Aon Benfield, (2017), 2016 Annual Global Climate and Catastrophe Report. Available from: http://thoughtleadership.aonbenfield.com/Documents/20170117-ab-if-annual-climate-catastrophe-report.pdf [Accessed: January 2017].
2. Bureau of Economic Analysis (BEA), (2018), GDP by State. Available from: http://www.bea.gov/data/gdp/gdp-state [Accessed: October 2019].
3. CDP, (2015), *Accelerating action: CDP Global Water Report 2015*. Available from: https://www.cdp.net/en/research/global-reports/global-water-report-2015 [Accessed: September 2016].
4. CDP, (2016), *Thirsty business: Why water is vital to climate action: CDP Global Water Report 2016*. Available from: https://www.cdp.net/en/research/global-reports/global-water-report-2016 [Accessed: January 2017].
5. CPD, (2016b), *Data Catalog: Climate Change 2016*. Available from: https://data.cdp.net [Accessed: January 2017].
6. Center for International Earth Science Information Network — CIESIN — Columbia University, (2016), Gridded Population of the World, Version 4 (GPWv4): Population Density Adjusted to Match 2015 Revision UN WPP Country Totals. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H4HX19NJ [Accessed: June 3, 2016].
7. Ceres, (2015), *Feeding ourselves thirsty: How the food sector us managing global water risks*. Available from: https://www.ceres.org/resources/reports/feeding-ourselves-thirsty-how-the-food-sector-is-managing-global-water-risks [Accessed: September 2016].

8. Ceres, (2016), *Value every drop*. Available from: https://www.ceres.org/issues/water/valuing-every-drop-flyer/at_download/file [Accessed: September 2016].

9. China Statistics Press, (2018), China Statistical Yearbook. Available from: http://www.stats.gov.cn/tjsj/ndsj/2018/indexeh.htm [Accessed: October 2019].

10. China Water Risk, (2016), *Toward water risk valuation*. Available from: http://chinawaterrisk.org/wp-content/uploads/2016/08/China-Water-Risk-Report-2016-Toward-Water-Risk-Valuation-WebM.pdf [Accessed: September 2016].

11. Costanza, R., Fisher, B., Mulder, K., Liu, S., Christopher, T., (2007), Biodiversity and ecosystem services: A multi-scale empirical study of the relationship between species richness and net primary production. *Ecological Economics*. Vol. 61, pp. 478–491.

12. De Groot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L. C., ten Brink, P., van Beukering, P., (2012), Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*. 1, pp. 50–61.

13. Desaigues, B., Ami, D., Hutchison, M., (2006), *Final report on the monetary valuation of mortality and morbidity risks from air pollution*. Paris: NEEDS.

14. Desaigues, B., Ami, D., Bartczak, A., Braun-Kohlová, M., Chilton, S., Czajkowski, M., Farreras, V., Hunt, A., Hutchison, M., Jeanrenaud, C., Kaderjak, P., Máca, V., Markiewicz, O., Markowska, A., Metcalf, H., Navrud, S., Nielsen, J. S., Ortiz, R., Pellegrini, S., Rabl, A., Riera, R., Scasny, M., Stoeckel, M., Szántó, R., Urban, J., 2011. *Economic valuation of air pollution mortality: A nine-country contingent valuation survey of value of a life year (VOLY)*. Ecological Indicators. 11 (3), pp.902–910.

15. Dieter, C.A., Linsey, K.S., Caldwell, R.R., Harris, M.A., Ivahnenko T.I., Lovelace, J.K., Maupin, M.A., and Barber, N.L., 2018, *Estimated Use of Water in the United States Country-Level Data for 2015* (ver. 2.0, June 2018): U.S. Geological Survey data release. Available from: https://doi.org/10.5066/F7TB15V5.

16. EC, (2004), *European Union System for the Evaluation of Substances 2.0 (USES 2.0). Prepared for the European Chemicals Bureau by the National Institute of Public Health and the Environment (RIVM)*. Bilthoven, The Netherlands (RIVM Report no. 601900005). Available via the European Chemicals Bureau, http://ecb.jrc.it.

17. Environmental Finance, (2016), *US municipalities launch $800m of green bonds for water projects*. Available from: https://www.environmental-finance.com/content/news/us-municipalities-launch-800m-of-green-bonds-for-water-projects.html [Accessed: September 2016].

18. FAO, (2016), AQUASTAT Main Database, Food and Agriculture Organization of the United Nations (FAO). Available from: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en [Accessed: November 2019].

19. GIZ, NCD and VfU, (2015), Integrating water stress into corporate bond credit analysis. Available from: http://naturalcapitaldeclaration.org/documents/wgi/INTEGRATING%20WATER%20STRESS%20REPORT_FINAL.pdf [Accessed: September 2016].

20. Global Water Intelligence (GWI), (2019), *2019 Water Tariff Survey*. Available from: https://www.globalwaterintel.com/tariff-survey/ [Accessed: November 2019].

21. Goedkoop, M. Spriensma, R., (2000), *The Ecoindicator 99 — A Damage Oriented Method for Life Cycle Impact Assessment.* Netherlands. Product Ecology Consultants.

22. Guo, T., Englehardt, J., Wu, T., (2014), Review of cost versus scale: water and wastewater treatment and reuse processes. *Water Sci. Technol*. 69 (2), 223–234.

23. Huffington Post, (2015), *Nestle water use in B.C. under fire again amid drought, wildfires*. Available from: http://www.huffingtonpost.ca/2015/07/10/nestle-water-bc-petition_n_7771404.html [Accessed: September 2016].

24. Institut national de la statistique et des études économiques (INSEE), (2018), *Produits intérieurs bruts régionaux et valeurs ajoutées régionales de 1990 à 2015*. Available from: http://www.insee.fr/fr/themes/detail.asp?reg_id=99&ref_id=pib-va-reg-base-2010 [Accessed: October 2019].

25. International Finance Corporation (IFC) (2007). General Environmental, Health, and Safety (EHS) Guidelines: Environmental wastewater and ambient water quality. Available from: http://www.ifc.org/ehsguidelines [Accessed: June 2016].

26. International Monetary Fund (IMF), (2019), *IMF Data and Statistics*. Available from: http://www.imf.org/external/data.htm [Accessed: October 2019].

27. Morgan, A. and Orr, S., (2015), *The value of water: A framework for understanding water valuation, risk and stewardship*. Available from: https://d2ouvy59p0dg6k.cloudfront.net/downloads/the_value_of_water_discussion_draft_final_august_2015.pdf [Accessed: September 2016].

28. Motoshita, M., Itsubo, N., Inaba, A., (2010), Development of impact factors on damage to health by infectious diseases caused by domestic water scarcity. *International Journal of Life Cycle Assessment*. Vol. 16, pp. 65–73.

29. National Institute of Public Health and the Environment, (2004), *European Union System for the Evaluation of Substances 2.0 (USES 2.0)*. Bilthoven.

30. Parilla, J., Leal Trujillo, J., Berube, A. and Ran, T., (2014), *Global Metro Monitor An Uncertain Recovery*. Available from: http://www.brookings.edu/research/reports2/2015/01/22-global-metro-monitor [Accessed: June 2015].

31. Pfister, S., (2011), *Environmental evaluation of freshwater consumption within the framework of life cycle assessment.* DISS. ETH NO. 19490. ETH ZURICH.

32. Olson, D. M., Dinerstein, E., Wikramanayake, E. D., Burgess, N. D., Powell, G. V. N., Underwood, E. C., D'Amico, J. A., Itoua, I., Strand, H. E., Morrison, J. C., Loucks, C. J., Allnutt, T. F., Ricketts, T. H., Kura, Y., Lamoreux, J. F., Wettengel, W. W., Hedao, P., Kassem K. R., (2004), *Terrestrial Ecoregions of the World: A New Map of Life on Earth. BioScience.* Vol. 51, no. 11, pp. 933–938.

33. SASB, (2014), *Metals & Mining: Research Brief*. Available from: http://www.sasb.org/wp-content/uploads/2014/06/NR0302_MetalsMining_2014_06_24_Industry_Brief.pdf [Accessed: September 2016].

34. Standard and Poor's (S&P), (2016), *Sustainability: ESG*. Available from: http://us.spindices.com/index-family/sustainability/esg [Accessed: September 2016].

35. Stockholm International Water House (2014) Water Risks for Swedish Businesses. Available from: http://www.siwi.org/wp-content/uploads/2014/07/Scoping-study-water-risk_webb_30-june.pdf [Accessed: February 2017].

36. The Financial Times (FT), (2015a), *Water supply threatens the flow of SABMiller's Zambian expansion*. Available from: http://www.ft.com/cms/s/0/359801aa-2403-11e5-bd83-71cb60e8f08c.html#axzz4LXiv7Ney [Accessed: September 2016].

37. The Financial Times (FT), (2015b), *Coca-Cola forced to abandon India bottling plant plans*. Available from: http://www.ft.com/cms/s/0/9e7d36da-e8e5-11e4-87fe-00144feab7de.html?siteedition=uk#axzz4LXiv7Ney [Accessed: September 2016].

38. The Guardian, (2016), *UK water companies receive record sewage leak fines*. Available from: https://www.theguardian.com/environment/2016/may/12/uk-water-companies-receive-record-sewage-leak-fines [Accessed: September 2016].

39. The Natural Capital Coalition (NCC), (2016), *The Natural Capital Protocol,* http://naturalcapitalcoalition.org/protocol/ [Accessed: September 2016].

40. Trucost, (2015), *Environmentally Extended Input-Output Model*. Trucost, London.

41. Trucost, (2017), *Maintained universe of corporate environmental disclosures*. Trucost, London.

42. United Nations (UN), (2015), *The United Nations World Development Report: Water for a sustainable world*. Available from: http://unesdoc.unesco.org/images/0023/002318/231823E.pdf [Accessed: September 2016].

43. Unstats.un.org, (2016), *National Accounts Main Aggregates Database*. Available from: http://unstats.un.org/unsd/snaama/introduction.asp [Accessed: June 2016].

44. US Davis Center for Watershed Sciences, (2015), *Economic analysis of the 2015 drought for California agriculture*. Available from: https://watershed.ucdavis.edu/files/biblio/Final_Drought%20Report_08182015_Full_Report_WithAppendices.pdf [Accessed: September 2016].

45. US Environmental Protection Agency (US EPA), (2012), *2012 Edition of the Drinking Water Standards and Health Advisories*. Available from: https://www.epa.gov/sites/production/files/2015-09/documents/dwstandards2012.pdf [Accessed: July 2016].

46. US Environmental Protection Agency (US EPA), (2016b) Table of Regulated Drinking Water Contaminants. Available from: https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants [Accessed: July 2016].

47. Veolia, (2017), The True Cost of Water. Available from: http://www.veoliawatertechnologies.com/en/sustainability/true-cost-water [Accessed: September 2016].

48. VOX Global/Pacific Institute, (2014), Bridging Concern with Action: Are US Companies Prepared for Looming Water Challenges? Available from: http://voxglobal.com/wp-content/uploads/Bridging-Concern-with-Action-Are-US-Companies-Prepared-For-Looming-Water-Challenges_2014-04-01PM.pdf [Accessed: February 2017].

49. World Economic Forum (WEF), (2015), *China has a water crisis — how can it be solved?* Available from: https://www.weforum.org/agenda/2016/04/china-has-a-water-crisis-how-can-it-be-solved/ [Accessed: September 2016].

50. World Resources Institute (WRI), (2019), *Aqueduct Water Risk Atlas*. Available from: http://www.wri.org/applications/maps/aqueduct-atlas/ [Accessed: November 2019].

51. World Wildlife Fund (WWF), (2016a), *Water Risk Filter*. Available from: http://waterriskfilter.panda.org/ [Accessed: September 2016].

52. World Wildlife Fund (WWF), (2016b), *When water efficiency increases water risk: the need for context-based water targets*. Available from: http://ecological.panda.org/2016/08/26/water-efficiency-increases-water-risk-need-context-based- water-targets/ [Accessed: September 2016].

53. Zhou, Y., Tol, R.S.J., 2005. Evaluating the costs of desalination and water transport. *Water Resources Research*, 41 (3), W03003.